



THE MADURA COLLEGE (AUTONOMOUS)

(Affiliated to Madurai Kamaraj University, Reaccredited (4th cycle) with “A” Grade by NAAC)

TPK Road, Madurai – 625 011, Tamil Nadu

www.maduracollege.edu.in

ACADEMIC COUNCIL

15.04.2025



ESTD : 1889

Learning Shines with Righteousness

BOOK 2 of 3
(Corrected Copy)

(Syllabi Pages: 932-1798)



THE MADURA COLLEGE (AUTONOMOUS)

(Affiliated to Madurai Kamaraj University, Reaccredited (4th Cycle) with "A" Grade by NAAC)

Ordinary Meeting of the Academic Council

Venue : Seminar Hall

Date : 15.04.2025

Time : 10.30 a.m.

Members are requested to bring with them this copy as well as the copy of the appendices.

R.Eswaran
Member Secretary

Dr. J. Suresh
Principal & Chairman



THE MADURA COLLEGE (AUTONOMOUS)

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ACADEMIC COUNCIL

Date: 20.03.2025

NOTICE

An ordinary meeting of the Academic Council will be held on **15th April 2025** at **10:30 a.m.** at Seminar hall. Resolutions from Board of Studies and Private resolutions may be submitted to the Member Secretary, Academic Council (eswaran@maduracollege.edu.in) on or before 25.03.2025. The deadline for withdrawal of resolutions will be 28.03.2025 up to 3:00 p.m.

The agenda and resolutions to be discussed will be made available to the members sufficiently in advance.

Dr.R.Eswaran
Member Secretary

Dr.J.Suresh
Principal & Chairman



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ACADEMIC COUNCIL

MEMBERS IN THE ACADEMIC COUNCIL

Dr.J.Suresh

The Principal & Chairman

Dr.R.Eswaran

Member Secretary

EXTERNAL MEMBERS

Sri.S.Seetharaman,

President,

Madura College Board,

Madurai.

C.A.S.Natanagopal,

Secretary,

Madura College Board,

Madurai.

Sri.N.Anand Srinivasan,

Treasurer,

Madura College Board,

Madurai.

Dr.K.Perumal

Professor

Department of Computer Applications

School of Information Technology

Madurai Kamaraj University

Madurai – 625 021.

Dr.V.Ramarajapandian

Professor

Department of Modern Literature

School of Tamil Studies

Madurai Kamaraj University

Madurai – 625 021.

Dr.S.Saleema Rabiyyath.

Assistant Professor

Department of Journalism and Mass Communication

Directorate of Distance Education

Madurai Kamaraj University

Madurai – 625 021.

Dr.S.Vaidhya Subramanian,

Dean, (Member representing Education)

SASTRA University,

Tirumalai Samudiram,

Thanjavur – 613 401.

Sri.S.Sankaran,

(Member representing Profession)

Vice president – Madura College Board,

Madurai.

Sri.R.Sridharan,

(Member representing Profession)

Director – Madura College Board,

Madurai.

Sri.K.K.Raman,

(Member representing Industry)

President,

Sundaram Industries (TVS Rubber)

Madurai.

INTERNAL MEMBERS

Boards of Studies Chairmen	- All Heads/Coordinators of the Department
Members of Academic Council	- All Permanent Faculty Members
Special invitees	- Nominated by Chairman
(Teachers on probation/Senior Faculties of SF stream)	



THE MADURA COLLEGE (AUTONOMOUS) **(Reaccredited with “A” Grade by NAAC)**

ACADEMIC COUNCIL

AGENDA FOR THE MEETING ON 15.04.2025

1. Prayer
2. Welcome Address : The Chairman, Academic Council
3. Confirmation of the Minutes of the previous Academic Council Meeting held on 03.04.2024
4. Business brought forward by the Chairman
5. Resolutions of Boards of Studies from various Departments
6. Any other subjects brought forward by the Chairman
7. Observation & Remarks by the External Members
8. Vote of Thanks : Member Secretary
9. National Anthem

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**I. CONFORMATION OF MINUTES OF THE PREVIOUS ACADEMIC COUNCIL
MEETING HELD ON 03.04.2024.**



THE MADURA COLLEGE

(Autonomous, Affiliated to Madurai Kamaraj University, Re-accredited (4th Cycle) with 'A' Grade by NAAC)

MADURAI -625 011

MEETING OF THE ACADEMIC COUNCIL

Date : 03.04.2024 (Wednesday)

Venue: Seminar Hall

Time : 10.30a.m.

MINUTES OF THE ACADEMIC COUNCIL MEETING

The ordinary meeting of the Academic Council was held in the Seminar Hall on Wednesday, 03rd April 2024 at 10.30 am.

Members Present

1) Dr. J. Suresh (Chairman, Academic Council)	35) Dr. K. HemaMalini
2) Dr. R. Eswaran (Member Secretary, Academic Council).	36) Dr. Y. Natarajan
3) Sri. S. Seetharaman (President, MCB)	37) Dr. S. Chandrasekar
4) CA.S. Natanagopal (Secretary, MCB)	38) Dr. R. Vennila
5) Sri. N. Anand Srinivasan (Treasurer, MCB)	39) Dr. A. Karuppusamy
6) Dr. K. Perumal (University Nominee)	40) Dr. S. Ramachandran
7) Dr. V. Ramarajapandian (University Nominee)	41) Prof. S. Krithika
8) Dr. S. SaleemaRabiyath (University Nominee)	42) Prof. P. Jayalakshmi
9) Sri. S. Sankaran (Member representing Industry & Vice President, MCB)	43) Dr. S. Muthukumar
10) Dr. S. Dhanasamy	44) Dr. C. Thangapandi
11) Dr. A. Atheeswari	45) Dr. R. Pandiselvi
12) Dr. G. Karunakaran	46) Dr. K.M. Dharmalingam
13) Dr. N. Rathinakumar	47) Dr. V. Ananthaswamy
14) Dr. V. Usha	48) Dr. I. Sahul Hamid
15) Dr. M. Kannan	49) Dr. U. Karthick Raja
16) Dr. D. Gandhimathi	50) Dr. I. Padmavathi
17) Dr. S. Kannadasan	51) Dr. S. Usha
18) Dr. Sheela P. Karthick	52) Dr. V. Sangeethasubha
19) Dr. G. Sivasubramanian	53) Dr. P. Vetriselvi
20) Dr. A. Chandrabose	54) Dr. R. Madhanagopal
21) Dr. S. Sudha	55) Dr. M. Venkateswaran
22) Dr. A. Vigneshkumar	56) Dr. M. Rabert
23) Dr. S. Venkatesh	57) Dr. M. Premarani
24) Prof. B. Tamilselvi	58) Prof. V. Meenakshisundaram
25) Prof. S. Murali	59) Prof. T. Vivekanandan
26) Prof. P. Manikandan	60) Prof. S. Sivaramakrishnan
27) Dr. S. Theenathalayan	61) Dr. M. Kavitha
28) Dr. P. Kannan	62) Dr. G. Gowri
29) Dr. R. Gopi	63) Dr. K. Neyvasagam
30) Dr. V. Sriman Narayanan	64) Dr. R. Vishnu Priya
31) Dr. S. Karthikeyan	65) Dr. J. Sivasubramanian
32) Dr. S. Meenakshi	66) Dr. A. Xavier
33) Dr. A. Mayilmurugan	67) Dr. P.S. Harikrishnan
34) Dr. S. Selvakumar	68) Dr. M. Karpagavalli

69) Dr. M. Malarvizhi
 70) Dr. S.V. Karthikeyan
 71) Prof. S. Vidhyasankar
 72) Dr. R. Ramachandran
 73) Dr. S. Selvakumar
 74) Dr. P. Prasanna
 75) Dr. M. Boominathan
 76) Dr. M. Hasmath Farzana
 77) Dr. J. Shanmugapriya
 78) Prof. S. ChellaPandian
 79) Dr. P. Kannan
 80) Dr. S. Karuppusamay
 81) Dr. S. Gnaana Saraswathi
 82) Prof. V. Meenakshi Sundaram
 83) Dr. N. Janakiraman
 84) Dr. M. Karpagajothi
 85) Dr. P. Jansi Rani
 86) Dr. S. Saravanan
 87) Dr. S. Dinakaran

88) Dr. L.D. Devasree
 89) Dr. B. Latha
 90) Dr. C. Selvakumar
 91) Dr. P. Sivakumar
 92) Er. J. Rajendran
 93) Prof. R. Umasankari
 94) Dr. T. SreeRamkumar
 95) Dr. K. Kathirvel Pandian
 96) Dr. N. Paneerselvam
 97) Dr. S. Vimal
 98) Dr. K. Vidhya
 99) Dr. S. Suresh Kannan
 100) Prof. G. Sreedevi
 101) Dr. M. Revathi
 102) Dr. S. Angayarkanni
 103) Prof. K. Rajasaravanakumar
 104) Prof. R. Suguna
 105) Dr. K. Rajeswari
 106) Mr. M. Venkatraman

1. The meeting was called to order by Dr.J.Suresh, Principal and The Chairman of the Academic Council (*hereafter mentioned as The Chairman*). The meeting started with the college prayer. The Chairman welcomed Sri.S.Seetharaman, President, Madura College Board (MCB), Sri.S.Sankaran, Vice-president, MCB, CA.S.Natanagopal, Secretary, MCB, Sri.N.Anand Srinivasan, Treasurer, MCB, University nominees: Dr.K.Perumal, Dr.V.Ramaraipandian and Dr.S.SaleemaRabiyath, all Heads of the Departments (HoDs), Deans, Dr.N.Paneerselvam, Chief Coordinator (Self-Financing Stream), Controller of Examinations (CoE), Deputy Controller of Examinations, Assistant Controller of Examinations, Co-ordinators (SF stream) and all other members of the Academic Council.

2. The Chairman, during welcome address, emphasized the importance of curriculum design and development in the current scenario of higher education system in India. He also narrated the phases on successful implementation of Outcome Based Education (OBE) and Tamil Nadu State Council for Higher Education (TANSCH) model curriculum in the college. The chairman also elucidated the dynamic nature of curriculum development and implementation. He stressed the point that curriculum should progress the student(s) to take up their role in the academic cum industrial arena. He added that the concept of curriculum should be adaptable and protean nature, which should cater the diverse requirements of the society. And with delight, he announced that NAAC assessment has given high score (3.8 out of 4) for the Criterion-I (Curricular aspects) covering curriculum design and implementation. The

chairman profusely thanked the Madura College Board for their support and encouragement. The chairman concluded by appreciating the support rendered by the faculty for the accomplishment.

3. The Minutes of the previous Academic Council meeting held on 12.10.2023 was confirmed and passed. The Chairman invited the Heads and Chairman, Board of Studies (BoS) of all the Departments to present their resolutions one by one.

4. Resolutions No. **1.1. to 1.8.** were moved by **Dr.S.Dhanasamy**, Chairman, BoS of Tamil department and seconded by **Dr.A.Atheeswari**. Dr.S.Muthukumar suggested to mention III and IV semester in the resolution 1.1. The chairman (BoS, Tamil) agreed for the correction suggested. CA S. Natanagopal, The Secretary, MCB, queried about the total lecture hours for Add on course and Prof.S.Sivaramakrishnan replied that 30 hours per semester for Add on course. While presenting resolution 1.6, Dr.S.Dinakaran suggested to write the resolutions in Tamil instead of English. The chairman replied that the suggestions are well taken. While presenting resolution 1.7., Dr.S.Muthukumar queried about the need of resolution to be passed by Tamil department. Dr.Sheela P.Karthich explained that the course is a multi-disciplinary course to be offered by English Department and a part of the course (an unit) would be handled by the Tamil Department. After a long discussion among the members, Chairman (BoS, Tamil) agreed to **withdraw resolution 1.7.**

While presenting resolution 1.8, about certificate courses, Prof.S.Sivaramakrishnan pointed out that the course contents was already passed in the previous meetings of Academic council and therefore, he suggested to pass the ratification instead of a resolution. Dr.S.Dhanasamy replied that the department didn't make any changes in the syllabi contents. Hence, He agreed to **withdraw resolution 1.8.** Then, the motion was put to vote and CARRIED.

5. Resolution No. **2.1.** was moved by **Prof.S.Murali**, Chairman, BoS of Hindi department and seconded by **Dr.S.Dinakaran**. Members unanimously agreed the resolution. Then, the motion was put to vote and CARRIED.

6. Resolutions No. **3.1.** was moved by **Prof.P.Manikandan**, Chairman, BoS of Sanskrit department and seconded by **Prof.S.Murali**. Members unanimously agreed the resolution. Then, the motion was put to vote and CARRIED.

7. Resolutions No. **4.1. to 4.7.** were moved by **Dr.Sheela P.Karthick**, Chairperson, BoS of English department and seconded by **Dr.G.Sivasubramanian**. Prof.S.Sivaramakrishnan suggested to remove the word “on” in front of course title in resolution 4.3. Dr.S.Muthukumar inquired about the contribution of participating departments for Multi-disciplinary course (MDC). Dr.Sheela P.Karthick clarified that Departments of English, Tamil and Botany contributes in the ratio of 3:1;1. In response to resolution 4.4, Dr.S.Muthukumar questioned about the Generic elective courses, Dr.Sheela P.Karthick requested the members to consider the course as Elective. Dr.A.Xavier, CoE, argued that it could be discipline specific elective. The Chairman requested the English department to mention the programme (UG/PG) when presenting resolution 4.5, Dr.A.Xavier, CoE, requested to remove the word ‘Generic or discipline specific’ in the resolution. Prof. S. Sivaramakrishnan replied that Elective courses would have options. In response to resolution 4.7., Prof. S. Sivaramakrishnan suggested to mention NME in the resolution. Dr.A.Xavier clarified that PGNME is to be offered during 2nd and 4th semesters of PG programmes. The chairman advised the department to revise resolutions and suggested to include one more resolution for NME. Dr.Sheela P.Karthick agreed for the changes suggested by the The chairman and members of Academic Council.

Then, the motion was put to vote and CARRIED.

8. Resolutions No. **5.1. to 5.9.** were moved by **Dr.S.Theenathayalan**, Chairman, BoS of Economics department, and seconded by **Dr.P.Kannan**.

While presenting resolution 5.2., Dr.S.Theenathayalan, reiterated that Department of Economics will handle 2 hours in the multidisciplinary course. In response to resolution 5.8, regarding certificate courses, Dr.A.Xavier reminded that the list of certificate courses offered by the department has not been received by the CoE office. Dr.S.Theenathayalan assured to send it soon.

Then, the motion was put to vote and CARRIED.

9. Resolution No. **6.1. to 6.9.** were moved by **Dr.A.Mayil Murugan**, Chairman, BoS of Commerce department, and seconded by **Dr.S.Selvakumar**.

While reading resolution 6.6., Dr.A.Mayilmurugan requested the members to read the page numbers as 635-670. He read the resolutions by including ‘and onwards’ at the end of the resolutions. While reading resolution 6.9, Dr.S.Theenathayalan opined that if we mention from the year 2023-24, we don’t need to include ‘and onwards’ in the resolution.

Then, the motion was put to vote and CARRIED.

9. Resolutions No. **7.1. to 7.9.** were moved by **Dr.S.Muthukumar**, Chairman, BoS of Mathematics department and seconded by **Dr.C.Thangapandi**. While presenting resolution 7.3, Dr.S.Muthukumar clarified that the resolution is for UG students. While presenting resolution 7.7., Dr.S.Theenathayalan questioned that whether any changes made in the syllabi. Dr.S.Muthukumar clarified that the courses are optional/choices for the respective elective courses. Prof.S.Sivaramakrishnan opined that the core elective should be mentioned as Elective. Added to that Dr.A.Xavier, CoE, suggested to mention as course code instead of subject code. Dr.S.Muthukumar agreed for the changes suggested in the resolutions. Then, the motion was put to vote and CARRIED.

10. Resolutions No. **8.1 to 8.6.** were moved **Dr.P.Vetriselvi**, Chairperson, BoS of Statistics department and seconded by **Dr.P.Madhanagopal**. While presenting resolution 8.3, Dr.S.Muthukumar questioned the suitability of the resolution as the resolution is about the Generic Elective courses. Chairman (BoS, Statistics) agreed to **withdraw resolution 8.3**. While presenting resolution 8.5., Dr.S.Muthukumar suggested to paraphrase the resolution by adding page numbers in the respective courses of UG and PG. Dr.P.Vetriselvi agreed to recast the resolution. While presenting resolution 8.6., Dr.P.Vetriselvi clarified that the course will be offered from 2024-25. Dr.Sheela P.Karthick pointed out a typographical error in the resolution as “entitles” instead of “entitled”. Dr.S.Theenathayalan questioned about the need of passing the resolution in the current Academic council meeting. There was a lot of discussion among members on the resolution. The chairman intervened and explained that the concerned BoS discussed and approved the syllabi for the course, and he suggested to pass the resolution in the current meeting. A few members gainsaid and opined as a wrong precedence. The chairman clarified and confirmed the statutory requirements and compliance of academic process i.e., deliberated and approved in the BoS. Hence, he supported the stand of Statistics department in passing the resolution in the today’s meeting. Members unanimously agreed in passing the resolution. Then, the motion was put to vote and CARRIED.

11. Resolutions No. **9.1. to 9.6.** were moved **Dr.M.Prema Rani**, Chairperson, BoS of Physics department, and seconded by **Prof.V.Meenakshi Sundaram**. While presenting resolution 9.3, Dr.S.Muthukumar questioned about the options offered by the department for the elective courses. Dr.M.Prema Rani replied that there are 2 options offered for each elective course. Dr.S.Muthukumar also suggested to mention the semester in the resolution 9.4. and 9.5. The chairman intervened and explained that the semester mentioned in the programme skeleton and passed in the BoS. He questioned the need of

mentioning the semester in the resolution. Also, He suggested that the resolution(s) could be of more general with clarity. He also reiterated that the general nature of resolution would have the space for the department for replacing the course content or taught, semester etc. in the forthcoming years. At the end, He justified that the query made by the member could be considered as suggestion and not as a correction. Then the motion was put to vote and CARRIED.

12. Resolutions No. **10.1. to 10.6.** were moved by **Dr.A.Xavier**, Chairman, BoS of Chemistry department and seconded by **Dr.M.Karpagavalli**. While presenting resolution 10.3., The chairman clarified that Generic Elective courses are to be considered as such for the B.A. Tamil and English programme and for all others it means allied, He said. While presenting resolution 10.4., Dr. Theenathayalan questioned the equal usage of the term “Skill Enhancement course” and “Non-Major Elective course” He also questioned how come NME comes under SEC. The chairman summarised the history of the move. He further explained that NME was not included first in the list of courses given by TANSCHER for various programmes, and later university suggested that NME can be included in place of SEC. As per the direction, we have decided in the council meeting and subsequent meetings on curriculum framework. We have also decided that in the UG courses it can be considered as SEC and for the PG courses as NME. He also profounded that honestly speaking no difference between SEC and NME. Dr.P.Harikrishnan also expressed that same opinion. Dr.K.Perumal, University nominee opined that usage of SEC or NME doesn’t more important than the content offered. He also supported for the decision by the college on SEC on UG courses and NME on PG courses. Then all the members unanimously agreed for the usage of SEC and NME. While presenting resolution 10.6. about the change of title of Foundation course offered during I semester of the B.Sc. Chemistry Programme, Dr.S.Theenathayalan queried Whether the change of title reflected in the mark statement. Dr.A.Xavier assured that the title change will be reflected in the mark statement.

Then, the motion was put to vote and CARRIED.

13. Resolutions Nos.**11.1. to 11.6.** were moved by **Prof.S.Chellapandian**, Chairman, BoS of Botany department and seconded by **Dr.P.Kannan**. Before presenting the resolutions, Prof.S.Chellapandian proposed that the resolution should start with “It has been resolved”. He also reviewed the history of Academic council from since receipt of Autonomous status by the college. He also pleaded the members to focus the discussion on issue based not a person based. While

reading the resolutions, he clarified that a few common corrections in the resolutions from various departments could be due to the template provided by the college. The Chairman replied that the template could be considered as a 'tool fix' and it was given to ensure the basic interests of the resolutions. He reiterated that 'we didn't impose and absolutely no issues if the department(s) make necessary changes of their interests'. Prof.S.Chellapandian thanked the Chairman for the clarification. While presenting resolution 11.5., He requested the members to read the resolution with correction inside the bracket "(as NME course)".

Then, the motion was put to vote and CARRIED.

14. Resolutions No.12.1. to 12.6. were moved by **Dr.S.Dinakaran**, Chairman, BoS of Zoology department and seconded by **Dr.L.D.Devasree**. While reading resolution 12.4, He requested the members to read as "Programme" instead of "Programmes". While presenting resolutions 12.5. and 12.6., about adopting existing syllabi of add on course and Generic Elective courses, members queried about the need of resolutions. Chairman (BoS, Zoology) also agreed to **withdraw resolutions 12.5. and 12.6.**

Then the motion was put to vote and CARRIED.

15. Resolutions No.13.1 to 13.3. were moved by **Er.J.Rajendran**, Chairman, BoS of Computer Science department and seconded by **Prof.R.Umasankari**. Members unanimously agreed the resolutions.

Then, the motion was put to vote and CARRIED.

16. Resolutions No.14.1. to 14.10. were moved by **Prof.K.Rajasaravanakumar**, Chairman, BoS of Information Technology department and seconded by **Dr.K.Rajeswari**. The motion was then thrown open for discussion. While presenting resolution 14.8 on Add-on course on "Values and Ethics", Dr.S.Theenathayalan questioned about having Add-on course in PG. Prof.S.Sivaramakrishnan replied that the department didn't have a course on research methods, hence, they have decided to give as add on course and that could validate the project in PG curriculum. The chairman queried whether it is a compulsory course and will it not affect the minimum credits since it offered out of curriculum hours. Dr.Theenathayalan opined that it is an extra course and compulsory. Dr.K.Perumal, University nominee suggested to keep Add on course and make it non-mandatory. Dr.S.Saleema Rabiya opined that the content is more important for the students of the programme. Hence keep an Add-on and not as a Mandatory course. After a long discussion among members, it was unanimously accepted to keep the

course with non-mandatory option. While reading resolution 14.9 regarding certificate course., Prof.K.Rajasaravankumar, clarified that the course is for UG students only. Then, the motion was put to vote and CARRIED.

17. Resolutions No.**15.1. to 15.7.** were moved by **Dr.K.Rajeswari**, Chairperson, BoS of Microbiology department and seconded by **Prof.R.Suguna**. While presenting resolution 15.4., Dr.S.Dinakaran questioned the competency of the staff to handle the programme on medical coding. The chairman overviewed about the examination and valuation pattern of add-on course and he explained that the pattern could ease the passing of students in the Add-on course. While presenting resolution 15.7., The chairman opined that serious discussion on evaluation pattern and pass minimum in Add-on is needed. He pleaded that whenever we conduct exam we should fix pass minimum and we need to refine it in the coming years after a healthy deliberations. The members questioned the need of resolution 15.7. Chairman (BoS, Microbiology) also agreed to **withdraw resolution 15.7.**

Then, the motion was put to vote and CARRIED.

18. Resolutions No.**16.1. to 16.6.** were moved by **Prof.R.Suguna**, Chairperson, BoS of Biotechnology department and seconded by **Dr.K.Rajeswari**. Members requested to rephrase the resolution 16.1. Prof.R.Suguna agreed for changing the resolution.

Then the motion was put to vote and CARRIED.

19. Resolutions No.**17.1. to 17.2.** were moved by **Dr.S.V.Karthikeyan**, Chairman, BoS in National Cadet Corps (NCC) and seconded by **Dr.K.Kathirvelpandian**. Members unanimously agreed the resolutions.

Then the motion was put to vote and CARRIED.

20. Resolutions No.**18.1. to 18.2.** were moved by **Dr.Y.Natarajan**, Chairman, BoS in National Service Scheme (NSS) and seconded by **Dr.M.Kannan**. Members unanimously agreed the resolutions.

Then the motion was put to vote and CARRIED.

21. Resolutions No. **19.1. to 19.2.** were moved by **Dr.S.Selvakumar**, Chairman, BoS in Youth Red Cross (YRC) and seconded by **Dr.S.Krithika**. Members unanimously agreed the resolutions. Then the motion was put to vote and CARRIED.

22. Resolutions No. **20.1. to 20.2.** were moved by **Dr.K.Kathirvelpandian**, Chairman, BoS in Physical Education (PEd) and seconded by **Dr.S.V.Karthikeyan**. Members unanimously agreed the resolutions. Then the motion was put to vote and CARRIED.

23. Resolution No. **21.1.** was moved by **Prof.S.Sivaramakrishnan**, Dean (Academics) and seconded by **Dr.I.Sahul Hamid**, Dean (Planning and Development). Dr.S.Theenathayalan queried that if it is extra credit and not mandatory why to run the course?. Dr.SheelaPKarthick opined that exceptions may be given to departments. The chairman explained that if it is given option many departments wont offer. Prof.V. Meenakshisundaram questioned the mode of conduct of self study courses. The chairman clarified the need of Add on courses and self study courses for the NAAC assessment to cater the need of above average students. Dr.Saleema Rabiya opined that the Add on and self study courses may be continued as in the present system. Members agreed the resolution to keep the Add on courses and self study courses. Then, the motion was put to vote and CARRIED.

24. The private Resolution No. **22.1.** was moved by **Prof.S.Chellapandian**, Head, Department of Botany and seconded by **Dr.S.Dinakaran**, Head, Department of Zoology, Members unanimously agreed the resolution. Then, the motion was put to vote and CARRIED.

25. The private Resolution No. **22.2.** was moved by **Dr.S.V.Karthikeyan**, NCC officer, and seconded by **Dr.K.Kathirvelpandian**. The chairman explained that the existing On-duty (OD) for students is for 15 days and the students may be permitted to write the exam with prescribed fine if he/she acquired 50-75% attendance. He requested the members to present their opinions. Dr.S.Dinakaran and Dr.S.Theenathayalan opined that The principal can be authorized to finalize the decision on OD for students. After a lengthy discussion, it was decided to give a maximum of 35

days OD for the students and the forum authorize the principal to consider the genuine request from the NCC cadets.

Then the motion was put to vote and CARRIED.

In any other matters, Dr.R.Gopi remembered his participation along with NSS volunteers in Republic Day celebrations at New Delhi, with special permission along with OD from the University and The College. He suggested to consider the OD for the genuine request from students.

The Chairman requested the University nominees to give their observations and remarks. Dr.K.Perumal expressed his views about the deliberations of the academic council as follows:

1. He congratulated all the members for the fruitful deliberations.
2. He also suggested to focus more on How to develop skills among students? and he opined that the inclusion of skill content in curriculum is the need of the hour.
3. He felt such skill development help the students to face the competitive world.

Dr.S.Saleema Rabiya expressed her views as follows:

1. She cherished the tradition of The Madura College and felt happy to attend the meeting.
2. She highlighted the need of NSS and other Part-V to create social awareness and responsibility in the era of Media, piracy, fake news etc.
3. She also felt happy about inclusion of practical experience, field visits in the curriculum of many departments.
4. She also suggested to include the content that focus more on plagiarism, reference, ethics of reference in the PG curriculum.

26. The Member secretary, Dr.R.Eswaran proposed vote of thanks .

22. The Chairman adjourned the Academic Council meeting followed by the National Anthem.



Dr.R.Eswaran

Member Secretary



Dr.J.Suresh

Principal & Chairman

II. BUSINESS BROUGHT FORWARD BY THE CHAIRMAN

III. RESOLUTIONS BROUGHT FORWARD BY HEADS OF VARIOUS DEPARTMENTS

1) FROM THE BOARD OF STUDIES OF TAMIL DEPARTMENT

Dr.S.Dhanasamy, Chairman, Board of Studies in Tamil, shall move and **Dr.A.Atheeswari** shall second the following resolutions, passed in the Board of Studies meeting held on 22.01.2025.

- 1.1. Resolved to introduce the revised curriculum, programme structure, syllabi for III year B.A. Tamil for students who have joined the programme from the academic year 2023-24 and onwards. The Curriculum includes an Inter-disciplinary course titled OPPILAKKIYAM offered jointly with the department of English and the Curriculum includes Internship in the V semester and the Project in the VI semester (**pp 1-79, 37-43**).
- 1.2. Resolved to adopt the existing Part I syllabi (Regulation 2023) for the programmes (B.Sc. B.Sc. (CS with AI) and B.Com (CA) to be introduced from the academic year 2025-26 (*Subject to the approval of Madurai Kamaraj University*).
- 1.3. Resolved to introduce the revised curriculum, programme structure, syllabi for I year M.A. Tamil for students who will join the programme from the academic year 2025-26. The Curriculum includes the Non Major Elective (NME) for the first (போட்டித் தேர்வுகளுக்குரிய தமிழ் இலக்கிய வரலாறு) and second (பணிவாய்ப்புத் தமிழ்) semesters (**pp 80-168, 123-127, 163-168**).

2) FROM THE BOARD OF STUDIES OF ENGLISH DEPARTMENT

Dr.Sheela P.Karthick, Chairman, Board of Studies in English, shall move and **Dr.G.Sivasubramanian** shall second the following resolutions, passed in the Board of Studies meeting held on 22.01.2025.

- 2.1. Resolved to pass the revised curriculum, programme structure and syllabi based on TANSCHÉ model curriculum under Choice Based Credit System with Outcome Based Education for the third year (Semesters V and VI) B.A. English programme for the students who have joined the programme from the Academic year 2023-24 and onwards. The curriculum includes an Inter-Disciplinary Course on “Cultural Studies in Feminism” offered jointly with the department of Tamil (**pp 169-244, 197-202**).
- 2.2. Resolved to pass the revised curriculum, programme structure and syllabi based on TANSCHÉ model curriculum under Choice Based Credit System with Outcome Based Education for the First year (Semesters I and II) M.A. English programme for the students who will join the programme from the Academic year 2025-26 (**pp 245-369**).

- 2.3. Resolved to pass the syllabi for the Discipline Centric Elective Courses (DEC) to be offered to the third year B.A. English programme who have joined the programme from the Academic year 2023-24 and onwards (**pp 192-196, 229-234**).
- 2.4. Resolved to pass the syllabi for the Discipline Centric Elective Courses (DEC) to be offered to the first year M.A. English programme who will join the programme from the Academic year 2025-26 (**pp 272-295, 319-342**).
- 2.5. Resolved to pass the syllabi for Non-Major Elective courses (NME) to be offered to the students of all PG programmes other than their programme of study and who will join their respective programmes from the Academic Year 2025-26 (**pp 296-300, 343-347**).
- 2.6. Resolved to pass the syllabus for Skill Enhancement Course (SEC) to be offered to the third year students of B.A English programme who have joined the programme from the Academic Year 2023-24 and onwards (**pp 235-240**).
- 2.7. Resolved to pass the syllabi for Value Education, Industrial Visit and Project and Viva courses to be offered to the third-year students of B.A. English who have joined the programme from the Academic Year 2023-24 and onwards (**pp 203-204, 241-242**).
- 2.8. Resolved to pass the syllabi for Enrichment Courses (EC) as extra optional credit courses to be offered to the students of M.A. English programme who will join the programme from the Academic year 2025-26 (**pp 348-367**).
- 2.9. Resolved to implement the existing syllabi of Part - II English Courses for the first two semesters namely General English-I 2023U1NENG1 and General English - II 2023U2NENG2 for the students who are going to be admitted in the UG Programmes namely B.Com. with Computer Applications & B.Sc. Computer Science with Artificial Intelligence [*both the programmes are subject to the approval of Madurai Kamaraj University*] from the academic year 2025-26.
- 2.10. Resolved to pass the components of assessment and the associated rubrics of assessment for the first year students of M.A. English programme who will join the programme from the Academic year and 2025-26 (**pp 248-252**).

3) **FROM THE BOARD OF STUDIES OF ECONOMICS DEPARTMENT**

Dr.S.Theenathayalan, Chairman, Board of Studies in Economics, shall move and **Dr.P.Kannan** shall second the following resolutions, passed in the Board of Studies meeting held on 22.01.2025.

- 3.1. Resolved to introduce the restructured syllabi for the First Year M.A. Economics students to be admitted from the academic year 2025-26 and to introduce the restructured syllabi for the Third Year B.A. Economics students who have admitted during the academic year 2023-24 and onwards as per TANSCHÉ guidelines (**pp 370-449, 450-540**).
- 3.2. Resolved to introduce the new courses for the Third Year B.Sc. Statistics students who have been admitted during the academic year 2023-24 and onwards as elective courses in the Fifth and Sixth semester.
 - i) **Indian Economy (pp 541-546).**
 - ii) **Budget and Banking (pp 547-551).**
- 3.3. Resolved to introduce a new elective course entitled **Computer Applications in Economics** for the First Year M.A. Economics students (First Semester) in the place of Regional Economics course (**pp 481-487**).
- 3.4. Resolved to introduce a course entitled **Economics of Health Care** for the Third Year UG (Fifth Semester) under the nomenclature as Inter-Disciplinary Course for the students who have admitted during the academic year 2023-24 and onwards (**pp 404-408**).
- 3.5. Resolved to introduce a new course entitled **Economic Thinkers** for the UG Economics students (Sixth Semester) as one of the elective courses for the students who have admitted during the academic year 2023-24 and onwards (**pp 431-435**).

4) FROM THE BOARD OF STUDIES OF COMMERCE DEPARTMENT

Dr.A.Mayilmurugan, Chairman, Board of Studies in Commerce, shall move and **Dr.S.Selvakumar** shall second the following resolutions, passed in the Board of studies meeting held on 22.01.2025.

- 4.1. Resolved to pass the revised curriculum and syllabi based on TANSCHÉ model for the third year **B.Com (General)** Programme for students who have joined the programme from the Academic year 2023-24 and onwards (**pp 552-554, 564-566, 571-739**).
- 4.2. Resolved to pass the revised curriculum and syllabi based on TANSCHÉ model for the third year **B.Com. (Professional Accounting)** Programme for students who have joined the programme from the Academic year 2023-24 and onwards (**pp 555-556, 566-567, 571-739**).
- 4.3. Resolved to pass the revised curriculum and syllabi based on TANSCHÉ model for the third year **B.Com. (Banking and Insurance)** Programme for students who have joined the programme from the Academic year 2023-24 and onwards (**pp 557-558, 567-568, 571-739**).

- 4.4. Resolved to pass the revised curriculum and syllabi based on TANSCHÉ model for the third year **B.Com. (Financial Marketing Analytics)** Programme for students who have joined the programme from the Academic year 2023-24 and onwards (**pp 559-560, 568-570, 571-739**).
- 4.5. Resolved to pass the modified curriculum and syllabi based on TANSCHÉ model for the first year **M.Com.** programme for Students who will join the programme from the Academic year 2025-26 (**pp 562-563, 740-848**).
- 4.6. Resolved to pass the curriculum and syllabi based on TANSCHÉ model for the first year **B.Com. (Computer Applications)** Programme for students who will join the programme from the Academic year 2025-26 (*Subject to approval from Madurai Kamaraj University*) (**pp 561, 849-931**).

5) FROM THE BOARD OF STUDIES OF MATHEMATICS DEPARTMENT

Dr.C.Thangapandi, Chairman, Board of Studies in Mathematics, shall move and **Dr.R.Pandiselvi** shall second the following resolutions, passed in the Board of studies meeting held on 22.01.2025.

- 5.1. Resolved to approve the curriculum and syllabi based on TANSCHÉ model curriculum for III B.Sc. Mathematics students who have joined the programme from the Academic year 2023-24 and onwards (**pp 932-1011**).
- 5.2. Resolved to approve the curriculum and syllabi based on TANSCHÉ model curriculum for I M.Sc. Mathematics Students who will join the programme from the Academic Year 2025-26 (**pp 1022-1110**).
- 5.3. Resolved to approve the curriculum for Allied Course to be offered for B.Sc. Computer Science with Artificial Intelligence (*Subject to approval from Madurai Kamaraj University*) from the Academic year 2025-26 (**pp 1012-1021**).
- 5.4. Resolved to approve the syllabi for Skill Enhancement Courses offered to the students of III B.Sc. Mathematics students who have joined their respective programmes from the Academic year 2023-24 and onwards. The curriculum includes a Multi-disciplinary course titled “Operations Research and Web Technology” jointly offered by the department of Mathematics, Commerce and Computer Science (**pp 969-974, 1005-1009**).
- 5.5. Resolved to approve the syllabi for Generic Elective courses and NME Course in the first and second semester respectively offered to the students who will join from the Academic Year 2025-26. The curriculum includes a Multi-disciplinary course titled “Stochastic processes, Statistical Mechanics and Point groups of Molecules” jointly offered by the department of Mathematics, Physics and Chemistry (**pp 1025, 1065-1069, 1106-1110**).

- 5.6. Resolved to ratify the change of 'Book for study' for the course "Probability Theory - 23P3MCCT8" as "**Introduction to Mathematical Statistics by Robert V.Hogg and Allen T.Craig**" IV Edition instead of the book "**Probability theory and Mathematical Statistics by M.Fisz**" without changing the content of the TANSCHÉ syllabus from the academic year 2024-2025 onwards. [Reference: The academic council book-2 (corrected Copy), 2024, Page no. 794] **(pp 1111-1116)**.

**Resolution 5.6. given in the addendum during the Academic council meeting held on 15th April 2025*

6) FROM THE BOARD OF STUDIES OF STATISTICS DEPARTMENT

Dr.P.Vetriselvi, Chairman, Board of Studies in Statistics, shall move and **Dr.R.Madhanagopal** shall second the following resolutions, passed in the Board of studies meeting held on 22.01.2025.

- 6.1. Resolved to pass the revised curriculum and syllabi based on TANSCHÉ model curriculum for third year B.Sc. Statistics programme for students who have joined the programme from the Academic year 2023-24 and onwards **(pp 1117-1188)**.
- 6.2. Resolved to pass the revised curriculum and syllabi based on TANSCHÉ model curriculum for first year M.Sc. Statistics programme for Students who will join the programme from the Academic Year 2025-26 **(pp 1189-1279)**.
- 6.3. Resolved to ratify the shifting of the course entitled "Research Publication and Ethics" from Semester IV to Semester III for M.Sc. Statistics students have admitted from the Academic Year and 2023-24 onwards.

7) FROM THE BOARD OF STUDIES OF PHYSICS DEPARTMENT

Dr.J.Suresh, Chairman, Board of Studies in Physics, shall move and **Prof.S.Sivaramakrishnan** shall second the following resolutions, passed in the Board of studies meeting held on 22.01.2025.

- 7.1. Resolved to pass the revised curriculum and syllabi based on TANSCHÉ model curriculum for third year B.Sc. Physics programme for students who have joined the programme from the academic year 2023-24 and onwards. The curriculum includes an interdisciplinary course "Nanoscience" offered jointly with the department of Chemistry **(pp 1280-1366, 1317-1322)**.
- 7.2. Resolved to pass the revised curriculum and syllabi based on TANSCHÉ model curriculum for first year M.Sc. Physics programme for Students who will join the programme from the academic year 2025-26 **(pp 1367-1461)**.

- 7.3. Resolved to pass the revised assessment schema for continuous assessment for students who will join the M.Sc. Physics programme from the academic year 2025-26. The components of assessment include gamified challenges (5), test (5), assignment (5), seminar / presentation (5) and quiz (5).
- 7.4. Resolved to pass the syllabus for Skill Enhancement Courses (NME) to be offered to the students of PG programmes from other departments and who will join their respective programmes from the Academic Year 2025-26 (**pp 1409-1413, 1453-1457**).
- 7.5. Resolved to pass the list of MOOC courses offered in Swayam / NPTEL platform as equivalent courses for credit transfer against elective courses for M.Sc. Physics programme for students from the academic year 2025-26 (**P 1458**).

8) FROM THE BOARD OF STUDIES OF CHEMISTRY DEPARTMENT

Dr.A.Xavier, Chairman, Board of Studies in Chemistry, shall move and **Dr.P.S.Harikrishnan** shall second the following resolutions, passed in the Board of studies meeting held on 22.01.2025.

- 8.1. Resolved to pass the curriculum and syllabi based on TANSCHÉ model curriculum for Third year B.Sc., (Chemistry) students who have joined the programme from the Academic year 2023-24 and onwards (**pp 1462-1554**).
- 8.2. Resolved to pass revised curriculum and syllabi based on TANSCHÉ for First year M.Sc., (Chemistry) Students who will join the programme from the Academic Year 2025-26 (**pp 1555-1649**).
- 8.3. Resolved to pass the syllabi for Skill Enhancement Courses - (NME) to be offered to the PG First year students (I and II semester) who will join their respective programmes from the Academic Year 2025-26 (**pp 1602-1606, 1650-1655**).
- 8.4. Resolved to pass the scheme for Skill Enhancement Course (SEC) to be offered in Fifth semester of III – year B.Sc., Chemistry students who have joined the programme from the Academic year and 2023-2024 and onwards.
- 8.5. Resolved to pass the pattern for Project and Viva Voce Examination (PROV) 23U6C PROV to be offered with (VI- semester) for III year students who have joined their respective programmes from the Academic Year 2023-24 and onwards (**pp 1552-1553**).
- 8.6. Resolved to pass the scheme for Skill Enhancement - Professional Competency Skill (SEC) to be offered to the III B.Sc. (VI- semester) students who have joined their respective programmes from the Academic Year 2023-24 and onwards (**pp 1547-1551**).

- 8.7. Resolved to pass the syllabus for value education to be offered to the UG students III B.A./B.Sc./B.Com. (V- semester) (**pp 1510-1515**).
- 8.8. Resolved to pass the syllabus for IDC (23U5CIDT1) to be offered to the III B.Sc. students (V- semester) who have joined from the Academic Year 2023-24 and onwards (**pp 1504-1509**).

9) FROM THE BOARD OF STUDIES OF BOTANY DEPARTMENT

Dr.P.Kannan, Chairman, Board of Studies in Botany, shall move and **Dr.S.Karuppusamy** shall second the following resolutions, passed in the Board of studies meeting held on 22.01.2025.

- 9.1. Resolved to pass the revised curriculum and syllabi based on TANSCHÉ model curriculum for third year B.Sc., Botany programme for students who have joined the programme from the Academic year 2023-24 and onwards (**pp 1656-1735**).
- 9.2. Resolved to pass the revised curriculum and syllabi based on TANSCHÉ model curriculum for the first year M.Sc., Botany programme for students who will join the programme from the Academic year 2025-26 (**pp 1736-1798**).
- 9.3. Resolved to pass the syllabus for the inter-disciplinary course to be offered to the third year Zoology major students who have joined from the Academic year 2023-24 and onwards (**pp 1690-1699**).
- 9.4. Resolved to pass the syllabus for skill enhancement course to be offered to the students of third year B.Sc., Botany who have joined the programme from the Academic year 2023-24 and onwards (**pp 1728-1732**).
- 9.5. Resolved to pass the syllabus for skill enhancement course (NME) to be offered to the PG students who will join their respective programme from the Academic year 2025-26 (**pp 1764-1767, 1792-1796**).

10) FROM THE BOARD OF STUDIES OF ZOOLOGY DEPARTMENT

Dr.L.D.Devasree, Chairman, Board of Studies in Zoology, shall move and **Dr.R.Eswaran** shall second the following resolutions, passed in the Board of studies meeting held on 22.01.2025.

- 10.1. Resolved to pass the revised curriculum and syllabi based on TANSCHÉ model curriculum for third year B.Sc. Zoology programme for students who have joined the programme from the academic year 2023-24 and onwards. The curriculum includes an interdisciplinary course “Wildlife Conservation & Management” offered jointly with the department of Botany (**pp 1799-1875, 1832-1838**).

- 10.2. Resolved to pass the syllabus for Skill Enhancement - Professional Competency Skill (SED) to be offered to III B.Sc. Zoology (VI- semester) students who have joined from the academic year 2023-24 and onwards (**pp 1869-1873**).
- 10.3. Resolved to pass the Assessment schema for Project and Viva Voce Examination (PROV) 23U6ZPROV offered to III B.Sc. Zoology students who have joined from the academic year 2023-24 and onwards (**pp 1874-1875**).
- 10.4. Resolved to ratify the syllabi for Certificate course titled 'Fish Breeding Technology' offered to all UG students who have joined their respective programme from the Academic year 2023-24 and onwards (**P 1876**).

11) FROM THE BOARD OF STUDIES OF COMPUTER SCIENCE DEPARTMENT
Er.J.Rajendran, Chairman, Board of Studies in Computer Science, shall move and **Prof.R.Uma Sankari** shall second the following resolutions, passed in the Board of studies meeting held on 22.01.2025.

- 11.1. Resolved to pass the Revised curriculum and syllabi based on the TANSCHÉ model curriculum in V and VI semesters of the third-year B.Sc. computer Science Programme for students who have joined the programme from the academic year 2023-24 and onwards (**pp 1877-1965**).
- 11.2. Resolved to pass the revised syllabus for the Generic / Discipline-specific elective courses based on the TANSCHÉ model curriculum in V and VI semesters of the third-year B.Sc. computer science programme for students who have joined the programme from the academic year 2023-24 and onwards (**pp 1910-1920, 1947-1959**).
- 11.3. Resolved to pass the syllabus for the Multidisciplinary Course / Skill-based Elective Course in V and VI semesters respectively for the students of Third-year B.Sc. Computer Science Programme who have joined from the academic year 2023-24 and onwards (**pp 1921-1926, 1960-1965**).
- 11.4. Resolved to pass the revised curriculum and syllabus based on the TANSCHÉ model curriculum for the Skill-based Elective courses in V and VI semesters of the B.Com. (Financial Marketing Analysis) Programme for students who have joined from the academic year 2023-24 and onwards (**pp 1966-1973**).
- 11.5. Resolved to pass the revised Curriculum and syllabus based on the TANSCHÉ model curriculum for the Generic Elective courses to be offered in the I and II semesters of the B.Com (Computer Applications) Programme for students who will join from from the academic year 2025-26. (*Subject to the course approval from Madurai Kamaraj University*) (**pp 1974-1989**)

12) FROM THE BOARD OF STUDIES OF INFORMATION TECHNOLOGY DEPARTMENT

Prof.K.RajaSaravanaKumar, Chairman, Board of Studies in Information Technology, shall move and **Dr.N.Paneerselvam** shall second the following resolutions, passed in the Board of Studies meeting held on 22.01.2025.

- 12.1. Resolved to pass the revised Curriculum and Syllabi based on TANSCHÉ Model Curriculum for the students of Third Year B.Sc. Information Technology programme, who have joined the programme from the Academic year 2023-24 and onwards (**pp 1990-2069**).
- 12.2. Resolved to pass the Programme Structure and Syllabi based on TANSCHÉ Model Curriculum for the students of First Year M.Sc. Computer Science programme who will join the programme from the Academic Year 2025-26 (**pp 2070-2157**).
- 12.3. Resolved to pass the Programme Structure and Syllabi based on TANSCHÉ Model Curriculum for the students of First Year B.Sc. Computer Science with Artificial Intelligence programme who will join the programme from the Academic Year 2025-26. (Subject to approval from Madurai Kamaraj University) (**pp 2158-2207**).
- 12.4. Resolved to pass the Syllabus for Inter-Disciplinary Course titled “Biometrics” to be offered to the students during the Fifth Semester of B.Sc. Information Technology programme, who have joined the programme from the Academic Year 2023-24 and onwards. This Course is offered jointly with the Department of Biotechnology (**pp 2023-2027**).
- 12.5. Resolved to pass the Syllabus for Professional Competency Skill Course to be offered to the students during the Sixth Semester of B.Sc. Information Technology programme, who have joined the Programme from the Academic Year 2023-24 and onwards (**pp 2062-2066**).
- 12.6. Resolved to pass the Syllabi for Non-Major Elective Courses to be offered to the students during the First and Second Semester of the PG programme, other than their PG programme of study and who will join their respective PG programme from the Academic Year 2025-26 (**pp 2113-2117, 2152-2156**).
- 12.7. Resolved to pass the Syllabi for Foundation Course and Skill Enhancement Courses to be offered to the students during the First and Second Semester of B.Sc. Computer Science with Artificial Intelligence programme, who will join the Programme from the Academic Year 2025-26. (Subject to approval from Madurai Kamaraj University) (**pp 2177-2181, 2182-2186, 2196-2206**).

13) FROM THE BOARD OF STUDIES OF MICROBIOLOGY DEPARTMENT

Dr.N.Paneerselvam, Chairman, Board of Studies in Microbiology, shall move and **Prof.K.RajaSaravanaKumar** shall second the following resolutions, passed in the Board of studies meeting held on 22.01.2025.

- 13.1. Resolved to pass the revised syllabi based on TANSCHÉ model curriculum for third year (V & VI semester) B.Sc. Microbiology Programme for students who have joined the programme from the Academic year 2023-24 and onwards (**pp 2208-2296**).
- 13.2. Resolved to pass the revised syllabus for Inter Disciplinary Courses (IDC) titled, “Bio Economics” to be offered in the V semester for B.Sc Microbiology Programme for students who have joined the programme from the Academic year 2023-24 and onwards. This course is offered jointly with the department of Economics (**pp 2249-2254**).
- 13.3. Resolved to pass the revised programme structure and syllabi based on TANSCHÉ model curriculum for first year (I & II semester) M.Sc Microbiology programme for students who will join the programme from the Academic year 2025-26 (**pp 2297-2427**).
- 13.4 Resolved to pass the syllabi for Non Major Elective Courses (NME) titled “Microbial World”(NME I) and “Microbes in Human Welfare” (NME II) to be offered to the first year PG students of other PG programmes who will join their respective programmes from the Academic year 2025-26 (**pp 2357-2361, 2422-2427**).

**Resolutions 13.5, 13.6, 13.7, 13.8 & 13.9 - Withdrawn*

14) FROM THE BOARD OF STUDIES OF BIOTECHNOLOGY DEPARTMENT

Dr.N.Paneerselvam, Chairman, Board of Studies of Biotechnology shall move and **Prof.K.RajaSaravanaKumar** shall second the following resolutions passed in the Board of Studies of Biotechnology held on 22.01.2025.

- 14.1. Resolved to introduce the revised curriculum and syllabi based on TANSCHÉ model for Third year B.Sc. Biotechnology Program for students who have joined the programme from the Academic year 2023-24 and onwards (**pp 2428-2518, 2521-2523**).
- 14.2. Resolved to pass the syllabi for Inter-Disciplinary Course titled ‘Computer Aided Drug Design’ for Third year B.Sc. Biotechnology Program for students who have joined the programme from the Academic year 2023-24 and onwards (**pp 2468-2473**).
- 14.3. Resolved to pass the syllabi for Skill Enhancement Course- Professional Competency Skill course titled ‘Biotechnology for Competitive Exam’ for Third year B.Sc Biotechnology Program for students who have joined the programme from the Academic year 2023-24 and onwards (**pp 2512-2516**).
- 14.4. Resolved to pass the syllabi for Certificate course titled ‘Organic Farming and Health Management’ offered to all UG and PG students of all programs from the Academic year 2025-26 onwards (**pp 2519-2520**).

15) FROM THE MEMBER – PRIVATE RESOLUTION

Dr.P.S.Harikrishnan, IQAC Coordinator, shall move and **Prof.S.Sivaramakrishnan**, Dean (Academics) shall second the following resolution:

15.1. Resolved to introduce the add-on course titled “Health & Wellness” for the students of all UG programmes from the academic year 2025-26 as per the directions of the Government of Tamil Nadu (**pp 2524-2526**).

15.2. Resolved to offer the existing add-on course in the fourth semester instead of third semester for all UG programmes from the Academic year 2025-26.

**Resolution 15.1. & 15.2. given in the addendum during the Academic council meeting held on 15th April 2025*

IV. Any Other Subject



Dr. R. Eswaran
Member Secretary



Dr. J. Suresh
Principal & Chairman



DEPARTMENT OF MATHEMATICS

Revised Curriculum

Based on the model curriculum of

TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION (TANSCH)

With elements from

Learning Outcome Based Education framework (LOBE) of UGC
(Choice Based Credit system with Outcome Based Education)

Academic Year 2023-2024 onwards

V and VI semesters (B.Sc. Mathematics) – Regulation 2023

I and II semesters (M.Sc. Mathematics) – Regulation 2025

THE MADURA COLLEGE (AUTONOMOUS)
(Re- accredited (4th cycle) with ‘A’ grade by NAAC)
MADURAI-11

Department of Mathematics

VISION

To train the students so that they are strong in logic, which enables them to approach, analyze and solve any problem, both scientific and sociological, in an unbiased manner and to enhance the quantitative and analytical skill.

MISSION

- ❖ To provide an environment where students can learn and become an efficient and accurate problem solver of Mathematics and Mathematical applications.
- ❖ To make the students as Mathematical thinkers and enable them to become a long time learners of Mathematics.
- ❖ To make the students to have core knowledge and able to correlate this core mathematical knowledge with other disciplines

Programme Outcomes:

At the end of the program the graduates will be able to

PO1: Disciplinary Knowledge: Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate programme of study.

PO2: Critical Thinking: Capability to apply analytic thought to a body of knowledge; analyze and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development.

PO3: Problem Solving: Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real-life situations.

PO4: Analytical Reasoning: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples and addressing opposing viewpoints.

PO5: Scientific Reasoning: Ability to analyse, interpret and draw conclusions from quantitative / qualitative data; and critically evaluate ideas, evidence, and experiences from an open-minded and reasoned perspective.

PO6: Self-directed & Lifelong Learning: Ability to work independently, identify and manage a project. Ability to acquire knowledge and skills, including "learning how to learn", through self-placed and self-directed learning aimed at personal development, meeting economic, social and cultural objectives.

Programme Specific Outcomes:

PSO1: Acquire good knowledge and understanding, to solve specific theoretical & applied problems in different area of mathematics & statistics.

PSO2: Understand, formulate, develop mathematical arguments, logically and use quantitative models to address issues arising in social sciences, business and other context /fields.

PSO3: To prepare the students who will demonstrate respectful engagement with other's ideas, behaviors, and beliefs and apply diverse frames of references to decisions and actions. To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organization



The Madura College (Autonomous), Madurai – 625 011
Department of Mathematics

PROGRAMME STRUCTURE - B.Sc., Mathematics

Semester	Course Category	Course Code	Title of the Course	Hours	Credits
I	Language - I	23U1TLAN1/ 23U1HLAN1/ 23U1SLAN1	TAMIL / HINDI / SANSKRIT	6	3
	Language - II	23U1NENG1	ENGLISH	6	3
	Core	23U1MCCT1	ALGEBRA & TRIGONOMETRY	4	4
	Core	23U1MCCT2	DIFFERENTIAL CALCULUS	4	4
	Allied / GEC	23U1CGET1	CHEMISTRY FOR PHYSICAL SCIENCE-I	4	4
	Allied / GEC - Practical	23U1CGEP1	CHEMISTRY PRACTICAL FOR PHYSICAL SCIENCE-I	2	1
	SEC	23U1MSD1	FOURIER SERIES	2	2
	Foundation Course	23U1MFCT1	BRIDGE MATHEMATICS	2	2
	Total Number of Credits			30	23
II	Language - I	23U2TLAN2/ 23U2HLAN2/ 23U2SLAN2	TAMIL / HINDI / SANSKRIT	6	3
	Language - II	23U2NENG2	ENGLISH	6	3
	Core	23U2MCCT3	ANALYTICAL GEOMETRY	4	4
	Core	23U2MCCT4	INTEGRAL CALCULUS	4	4
	Allied / GEC	23U2CGET2	CHEMISTRY FOR PHYSICAL SCIENCE- II	4	4
	Allied / GEC - Practical	23U1CGEP2	CHEMISTRY PRACTICAL FOR PHYSICAL SCIENCE- II	2	1
	SEC	23U2MSD2	TRANSFORM TECHNIQUES	2	2
	SEC	23U2MSD3	COMPUTATIONAL MATHEMATICS	2	2
	Part V	23U4YRC1/ 23U4NSS1/ 23U4NCC1	YRC/NSS/NCC	-	-
	Total Number of Credits			30	23

Semester	Course Category	Course Code	Title of the Course	Hours	Credits
III	Language - I	23U3TLAN3/ 23U3HLAN3/ 23U3SLAN3	TAMIL / HINDI / SANSKRIT	6	3
	Language - II	23U3NENG3	ENGLISH	6	3
	Core	23U3MCCT5	VECTOR CALCULUS AND APPLICATIONS	4	4
	Core	23U3MCCT6	DIFFERENTIAL EQUATIONS AND APPLICATIONS	3	3
	Allied / GEC	23U3PGET1	ALLIED PHYSICS – I	4	4
	Allied / GEC - Practical	23U3PGEP1	ALLIED PHYSICS PRACTICAL – I	2	1
	SEC	23U3MSED4	DISCRETE MATHEMATICS	2	2
	SEC	23U3MSED5	MATHEMATICS FOR COMPETITIVE EXAMINATIONS	2	2
	EVS	-	EVS	1	-
	Total Number of Credits			30	22
IV	Language - I	23U4TLAN4/ 23U4HLAN4/ 23U4SLAN4	TAMIL / HINDI / SANSKRIT	6	3
	Language - II	23U4NENG4	ENGLISH	6	3
	Core	23U4MCCT7	ELEMENTS OF MATHEMATICAL ANALYSIS	4	4
	Core	23U4MCCT8	INDUSTRIAL STATISTICS	3	3
	Allied / GEC	23U4PGET2	ALLIED PHYSICS – II	4	4
	Allied / GEC - Practical	23U4PGEP2	ALLIED PHYSICS PRACTICAL – II	2	1
	SEC	23U4MSED6	COMBINATORICS	2	2
	SEC	23U4MSED7	REASONING AND APTITUDE	2	2
	EVS	23U4EVST1	EVS	1	2
	Part V	23U4YRC2/ 23U4NSS2/ 23U4NCC2	YRC/NSS/NCC	-	1
	Total Number of Credits			30	25

Semester	Course Category	Course Code	Title of the Course	Hours	Credits
V	Core	23U5MCCT9	ABSTRACT ALGEBRA	5	4
	Core	23U5MCCT10	REAL ANALYSIS	5	4
	Core	23U5MCCT11	MATHEMATICAL MODELLING	5	4
	Core - Practical	23U5MCCP1	PRACTICAL IN DOCUMENTATION USING LATEX	3	3
	Discipline Elective	23U5MDET1 (A)	OPTIMIZATION TECHNIQUES	5	4
		23U5MDET1 (B)	BIO-STATISTICS		
	MDC	23U5MMDCT	OPERATIONS RESEARCH AND WEB TECHNOLOGY	5	4
	Value Education	23U5VENT1	VALUE EDUCATION	2	2
	Industrial Visit/ Internship Field Visit	23U5MINTR	INDUSTRIAL VISIT/ INTERNSHIP FIELD VISIT	-	2
Total Number of Credits				30	27
VI	Core	23U6MCCT12	LINEAR ALGEBRA	6	4
	Core	23U6MCCT13	COMPLEX ANALYSIS	6	4
	Core	23U6MCCT14	MECHANICS	6	4
	Core - Practical	23U6MCCP2	PRACTICAL IN C++	3	3
	Discipline Elective	23U6MDET2 (A)	GRAPH THEORY AND APPLICATIONS	4	2
		23U6MDET2 (B)	LOGISTICS AND SUPPLY CHAIN MANAGEMENT		
	SEC-PC	23U6MSED8	ACTUARIAL SCIENCE	2	2
	Project	23U6MPROV	PROJECT AND VIVA-VOCE	3	2
Total Number of Credits				30	21
Grand Total Number of Credits				180	141

Language I – Tamil / Hindi / Sanskrit

Language II – English

SEC – Skill Enhancement Course

GEC – Generic Elective Course

SEC-PC – Professional Competency Skill Enhancement Course

MDC – Multidisciplinary Course



The Madura College (Autonomous), Madurai – 625 011
Department of Mathematics

COURSE DESCRIPTION WITH DESCRIPTOR ELEMENTS AND PERCENTAGE OF REVISION

Semester	Course Code	Title of the Course	Hours	Credits	Nature of Course (Employability/ Entrepreneurship/ Skill Development)			Scope of Focus (Local / National / Global developmental needs)			Percentage of Syllabus Revision/ New
					Empl	Ent.	Skill	Local	National	Global	
I	23U1MCCT1	Algebra & Trigonometry	4	4			Yes		Yes		20.45%
	23U1MCCT2	Differential Calculus	4	4			Yes			Yes	60%
	23U1MGET1 (P)	Allied Mathematics - I (Physics)	6	5	Yes		Yes		Yes		17%
	23U1MGET1 (D)	Numerical Methods (Computer Science)					Yes			Yes	No change
	23U1MSED1	Fourier Series	2	2			Yes			Yes	No change
	23U1MFCT1	Bridge Mathematics	2	2	Yes		Yes		Yes		100% / New
II	23U2MCCT3	Analytical Geometry	4	4	Yes		Yes		Yes		65%
	23U2MCCT4	Integral Calculus	4	4			Yes			Yes	12%
	23U2MGET2(P)	Allied Mathematics – II (Physics)	6	5	Yes		Yes		Yes		15%
	23U2MGET2(D)	Graph Theory and Applications (Computer Science)			Yes		Yes			Yes	85.17%
	23U2MSED2	Transform Techniques	2	2			Yes			Yes	41.66%
	23U2MSED3	Computational Mathematics	2	2	Yes		Yes			Yes	100% / New

III	23U3MCCT5	Vector Calculus and Applications	4	4			Yes			Yes	17%
	23U3MCCT6	Differential Equations and Applications	3	3			Yes			Yes	No change
	23U3MGET1(C)	Allied Mathematics – I (Chemistry)	6	5			Yes		Yes		No change
	23U3MGET1(S)	Numerical Methods (Statistics)					Yes			Yes	100% / New
	23U3MSED4	Discrete Mathematics	2	2			Yes			Yes	65%
	23U3MSED5	Mathematics for Competitive Examinations	2	2	Yes				Yes		60%
IV	23U4MCCT7	Elements of Mathematical Analysis	4	4			Yes			Yes	No change
	23U4MCCT8	Industrial Statistics	3	3			Yes			Yes	40%
	23U4MGET2(C)	Allied Mathematics – II (Chemistry)	6	5			Yes		Yes		No change
	23U4MGET2(S)	Real Analysis (Statistics)					Yes			Yes	100% / New
	23U4MSED6	Combinatorics	2	2			Yes			Yes	100% / New
	23U4MSED7	Reasoning and Aptitude	2	2	Yes					Yes	100% / New
V	23U5MCCT9	Abstract Algebra	5	4			Yes			Yes	No change
	23U5MCCT10	Real Analysis	5	4			Yes			Yes	No change
	23U5MCCT11	Mathematical Modelling	5	4	Yes		Yes			Yes	100% / New

	23U5MCCP1	Practical In Documentation Using Latex	3	3	Yes		Yes			Yes	100% / New
	23U5MDET1 (A)	Optimization Techniques	5	4			Yes			Yes	No change
	23U5MDET1 (B)	Bio-Statistics			Yes		Yes			Yes	100% / New
	23U5MMDCT	Operations Research and Web Technology	5	4	Yes		Yes			Yes	No change
	23U5MINTR	Industrial Visit/ Internship Field Visit	-	2	Yes	Yes	Yes		Yes		100% / New
VI	23U6MCCT12	Linear Algebra	6	4			Yes			Yes	20%
	23U6MCCT13	Complex Analysis	6	4			Yes			Yes	No change
	23U6MCCT14	Mechanics	6	4			Yes			Yes	45%
	23U6MCCP2	Practical In C++	3	3	Yes		Yes		Yes		13.33%
	23U6MDET2 (A)	Graph Theory and Applications	4	2	Yes		Yes			Yes	100% / New
	23U6MDET2 (B)	Logistics and Supply Chain Management			Yes		Yes			Yes	No change
	23U6MSED8	Actuarial Science	2	2	Yes		Yes	Yes			100% / New
	23U6MPROV	Project And Viva	3	2	Yes		Yes			Yes	100% / New
I	23U1MGET1(D)	Numerical Methods (Computer Science With Artificial Intelligence)	6	5			Yes			Yes	No change
II	23U2MGET2(D)	Graph Theory and Applications (Computer Science With Artificial Intelligence)	6	5	Yes		Yes			Yes	No change

Emp.: Employability; Ent. : Entrepreneurship; Skill: Skill Development

DEPARTMENT OF MATHEMATICS				CLASS: III B.Sc., MATHEMATICS				
Semester	Course Type	Course Code	Course Title	Credits	Contact hours/Week	CIA	Ext.	Total
V	Core IX	23U5MCCT9	ABSTRACT ALGEBRA	4	5	25	75	100

Nature of Course	Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objectives:

- To acquaint the students with basic concepts of fundamental algebraic structures
- Acquiring the basic knowledge and the structure of Group, Subgroup and Cyclic Groups
- Analysing and demonstrate examples of subgroups, normal subgroups and quotient groups
- Able to construct and analyse mathematical proofs in algebra
- Applying the concepts of homomorphism and isomorphism for groups and rings
- Describing the characteristics of a ring, quotient rings and Ideals.

Unit	Description	Hours	K-level	CLO
I	Groups – Definition and Examples – Elementary Properties of Groups – Permutation Groups.	15	Upto K2	1
II	Subgroups – Definition and Examples – Cyclic Groups and Properties of Cyclic Groups– Order of an Element– Cosets and Lagrange’s Theorem – Euler’s Theorem – Fermat’s Theorem.	15	Upto K3	2
III	Normal Subgroups and Quotient groups –Definition and Examples – Isomorphism – Cayley’s Theorem – Automorphism – Inner Automorphism–Group Homomorphisms – Fundamental Theorem of a Homomorphism.	15	Upto K4	3
IV	Rings – Definition and Examples– Elementary Properties of Rings – Ring Isomorphism–Types of Rings–Subrings – Ideals.	15	Upto K3	4
V	Quotient Rings –Maximal and Prime Ideals– Homomorphism of Rings – Field of Quotients of an Integral Domain – Euclidean Rings – Examples.	15	Upto K4	5

Books for Study:

1. Modern Algebra - S. Arumugam, Issac, 2014 Scitech Publications (India) Pvt. Ltd.
UNIT-I: Chapter 3 (3.1, 3.2, 3.4)
UNIT-II: Chapter 3 (3.5 - 3.8)
UNIT-III: Chapter 3 (3.9-3.11)
UNIT-IV: Chapter 4 (4.1 – 4.4, 4.6 - 4.7)
UNIT-V: Chapter 4 (4.8 – 4.11, 4.14)

Books for References:

1. Topics in Algebra, I.N.Herstein, Wiley Eastern Ltd. Second Edition (1st January 2006).
2. A First Course in Abstract Algebra, John B. Fraleigh, 7th Ed., Pearson, 2002.
3. Abstract Algebra, M. Artin, 2nd Ed., Pearson, 2011.
4. Contemporary Abstract Algebra, Joseph A Gallian, 4th Ed., Narosa, 1999.

Web Resources:

1. <https://people.maths.ox.ac.uk/flynn/genus2/sheets0405/grfnotes1011>
2. <https://archive.nptel.ac.in/courses/111/106/111106131/>
3. https://www.cse.iitk.ac.in/users/rmittal/prev_course/s15/notes/complete_notes.pdf
4. http://www.supermath.info/AlgebraNotes_2016.pdf
5. <http://www.uop.edu.pk/ocontents/Topics%20in%20Algebra%20by%20I.%20N.%20Herstein.pdf>

Rationale for Nature of the course

Abstract algebra is used in many fields of Mathematics and science. It is practically important for Physics students that groups are used to represent symmetry operations, and the usage of group theory could simplify differential equations. The groups that describe those symmetries are Lie groups, and the study of Lie groups and Lie algebras reveals much about the physical system.

Activities having direct bearing on Skill development / Employability /Entrepreneurship

Seminar, Assignment preparation, Group discussion, Quiz

Pedagogy

Lecture, Seminar, Quiz, Problem Solving, Tutorial Sessions, Group Discussions, PPT

Course Designer(s):

1. **Dr. V. ANANTHASAMY**, Associate Professor, Research Centre and PG Department of Mathematics.
2. **Dr. B.SEETHALAKSHMI**, Assistant Professor, Research Centre and PG Department of Mathematics.

Lecture Schedule

Units	Description	Hours	Pedagogy
I	Definition and Examples of Groups	5	Lecture, Quiz
	Elementary Properties of a Groups	5	Lecture, Quiz & Group Discussion
	Permutation Groups	5	Lecture, Quiz & PPT
II	Definition and Examples of Subgroups	3	Lecture, Quiz & Seminar
	Cyclic Groups and Properties of Cyclic Groups	5	Lecture, Quiz
	Order of an Element	2	Lecture, Quiz
	Cosets and Lagrange's Theorem – Euler's Theorem – Fermat's Theorem.	5	Lecture, Quiz, Group Discussion & PPT
III	Definition and Examples of Normal Subgroups and Quotient groups.	3	Lecture, Quiz
	Group Isomorphism.	3	Lecture, Quiz & PPT
	Cayley's Theorem – Automorphism – Inner Automorphism.	3	Lecture, Quiz
	Group Homomorphisms.	3	Lecture, Quiz & Seminar
	Fundamental Theorem of a Homomorphism.	3	Lecture, Quiz & Group Discussion
IV	Definition and Examples of Rings.	2	Lecture, Quiz
	Elementary Properties of Rings.	2	Lecture, Quiz
	Ring Isomorphism.	3	Lecture, Quiz & Seminar
	Types of Rings – Subrings.	5	Lecture, Quiz & PPT
	Ideals.	3	Lecture, Quiz & Seminar
V	Quotient Rings – Maximal and Prime Ideals.	5	Lecture, PPT, Seminar & Assignment
	Homomorphism of Rings – Field of Quotients of an Integral Domain.	5	Lecture, Quiz, Problem Solving, Seminar & Assignment
	Euclidean Rings – Examples.	5	Lecture, Quiz, Seminar, Assignment
Total		75	

COURSE OUTCOMES:

At the end of the course, the student will be able to:

Number	Course Learning Outcome	Knowledge level
CLO1	Learn about Groups, Subgroups with examples, Properties of groups and subgroups.	Up to K2
CLO2	Demonstrate knowledge and understanding of the concept of cosets of a subgroup of a group, Quotient group and normal subgroups.	Up to K3
CLO3	Analyse the Homomorphism, Isomorphism and Automorphism of groups	Up to K4
CLO4	Demonstrate knowledge and understanding of rings, fields and their properties.	Up to K3
CLO5	Understand and prove fundamental results and solve algebraic problems using appropriate techniques to improve skill development.	Up to K4

Mapping of CLOs with PSOs

CLO	PSO-1	PSO-2	PSO-3
CLO-1	2	1	2
CLO-2	2	1	2
CLO-3	1	1	2
CLO-4	1	1	2
CLO-5	1	1	2

Mapping of CLOs with POs

CLO	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	-	2	2	2
CLO2	3	3	-	2	2	2
CLO3	3	2	-	2	2	2
CLO4	2	2	2	2	1	2
CLO5	2	2	2	2	1	2

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model

Units	CLO s	K Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K Level	No. of Questions	K Level		
1	CLO 1	Up to K2	2	K1& K2	1	K1	2(K1& K1)	1(K2)
2	CLO 2	Up to K3	2	K1& K2	1	K1	2(K3& K3)	1(K3)
3	CLO 3	Up to K4	2	K1& K2	1	K2	2(K4& K4)	1(K3)
4	CLO 4	Up to K3	2	K1& K2	1	K2	2(K2& K2)	1(K3)
5	CLO 5	Up to K4	2	K1& K2	1	K2	2(K3& K3)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total Marks	% of marks with choice	Consolidated
K1	5	4	10	-	19	15.83	41.66%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	41.67%
K4	-	-	10	10	20	16.67	16.67%
Total Marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS					CLASS: III B.Sc., MATHEMATICS			
Semester	Course Type	Course Code	Course Title	Credits	Contact Hours/Week	CIA	Ext.	Total
V	Core X	23U5MCCT10	REAL ANALYSIS	4	5	25	75	100

Nature of Course	Skill Oriented	✓	Employability Oriented		Entrepreneurship Oriented	

Objectives:

The objectives of the course is

- To understand the concepts of Real Numbers and the properties of Real-valued functions.
- To analyze and demonstrate the metric spaces and completeness of metric spaces.
- To explain and illustrate the concepts of continuity, connectedness and compactness.

Unit	Description	Hours	K-Level	CLO
I	Metric Spaces: Introduction – Definition and examples of metric space – Bounded sets in a metric space – Open ball in a metric space – Open sets.	15	K2	CLO 1
II	Metric Spaces (Continued): Subspace of a metric space – Interior of a set – Closed sets – Closure – Limit point – Dense sets.	15	K3	CLO 2
III	Complete Metric Space: Introduction – Completeness – Baire's Category theorem.	15	K3	CLO 3
IV	Continuity: Introduction – Continuity – Homeomorphism – Uniform continuity – Discontinuous functions on $\mathbb{R}$.	15	K3	CLO 4
V	Connectedness and Compactness: Connectedness: Introduction – Definition and examples – Connected subsets of $\mathbb{R}$ – Connectedness and Continuity. Compactness: Introduction – Compact metric spaces – Compact subsets of $\mathbb{R}$ – Compactness and Continuity.	15	K4	CLO 5

Book for Study:

1. Modern Analysis by S.Arumugam, A.Thangapandi Issac, and A.Somasundaram, Yes Dee Publishing Pvt. Ltd., (2019).

Unit I: Chapter: 2, Section: 2.1 – 2.5

Unit II: Chapter: 2, Section: 2.6 – 2.11

Unit III: Chapter: 3, Section: 3.1 – 3.3

Unit IV: Chapter: 4, Section: 4.1 – 4.5

Unit V: Chapters: 5 and 6, Section: 5.1 – 5.4, 6.1 – 6.3 and 6.5

Books for Reference:

1. Methods of Real Analysis by Richard R. Goldberg, Oxford and IBH Publishing Co. New Delhi, (2020).
2. Mathematical Analysis by Tom M. Apostol, Narosa Publishing House, New Delhi, (2002).
3. Mathematical Analysis by S.C. Malik and Savitha Arora, Wiley Eastern Limited, New Delhi, (1991).

Web Resource

<https://nptel.ac.in>

Rationale for nature of course

Real Analysis, a branch of mathematical analysis, focuses on the behaviour of real numbers, real-valued functions, and series. It explores the fundamental properties of real numbers, forming the basis for the formal development of Real Analysis and the study of limits in metric spaces. The goal is to introduce the number systems underlying Real Analysis and provide a deeper understanding of various physical phenomena.

Activities having direct bearing on Skill Development / Employability / Entrepreneurship

The course imparts theoretical knowledge and problem solving skills to the students and is crafted to help the students to knowing the best techniques in a given theory. Theoretical learning gives the guidance. Theoretical knowledge explains the why factor at the back of any situation and technique of working.

Pedagogy

Lecture, Seminar, Quiz, Problem Solving, PPT, Group Discussion

Course Designer(s):

1. **Dr. K. M. DHARMALINGAM**, Associate Professor, PG and Research Department of Mathematics.
2. **Dr. M. RAJARAM**, Assistant Professor, Department of Mathematics.

Course Schedule

Unit	Description	Hours	Mode
I	Definition and examples of metric space.	4	Chalk and Talk
	Bounded sets in a metric space with examples.	3	Lecture
	Definition of Open ball in a metric space, Open sets with examples and some related problems.	4	Lecture, Quiz, Problem Solving
II	Concept of Subspace of a metric space some related theorems.	4	Lecture, Group Discussion
	Interior of a set, Closed sets some related theorems and problems.	5	Chalk and Talk
	Closure, Limit point, Dense sets some related theorems.	5	Lecture, Group Discussion
III	Definition of Completeness and related theorems.	6	Lecture, Quiz, Problem Solving
	Baire's Category theorem and solving problems.	5	Lecture
IV	Introduction of Continuity and their properties and problems.	6	Chalk and Talk
	Homeomorphism of some related theorems.	5	Lecture, Quiz, Problem Solving
	Definition of Uniform continuity and some problems.	5	Lecture, Seminar
	Introduction of Discontinuous functions on $\mathbb{R}$.	4	Lecture, PPT
V	Definition and examples of Connected subsets of $\mathbb{R}$ and some related theorems.	6	Lecture, Quiz, Problem Solving
	Definition and example of Connectedness and some related theorems.	5	Lecture, Assignment
	Compact metric spaces with examples and some related theorems.	4	Lecture, Seminar
	Compact subsets of $\mathbb{R}$, Compactness and Continuity of standard theorems.	4	Lecture, Quiz, Assignment
Total		75	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CLO	Course Learning Outcomes	K – Level
CLO 1	Describe the concepts of metric space, bounded sets and open sets.	K2
CLO 2	Elaborate the concepts of interior of a set, closed sets, limit point and dense sets.	K3
CLO 3	Define the completeness and explain Baire's category theorem.	K3
CLO 4	Explain the concept of continuity, uniform continuity and discontinuous functions.	K3
CLO 5	Elucidate the connected subsets, compact subsets and continuity	K4

Mapping of CLOs with PSOs

CLO	PSO1	PSO2	PSO3
CLO1	3	1	1
CLO2	3	1	1
CLO3	3	1	1
CLO4	3	1	1
CLO5	3	1	1

Mapping of CLOs with POs

CLO	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	1	3	1	-
CLO2	3	3	1	3	1	-
CLO3	3	3	1	3	1	-
CLO4	3	3	1	3	1	-
CLO5	3	3	1	3	1	-

Advance applications – 3;**Intermediate level – 2;****Basic level – 1**

Blueprint for Semester Examination

S. No.	CLOs	K Level	Section A		Section B		Section C	Section D
			MCQs		Short Answers		(Either /or Choice)	(Open Choice)
			No. of questions	K Level	No. of questions	K Level		
1	CLO1	K2	2	(K1&K2)	1	K2	2 (K1&K1)	1(K2)
2	CLO2	K3	2	(K1&K2)	1	K1	2 (K2&K2)	1(K3)
3	CLO3	K3	2	(K1&K2)	1	K1	2 (K3&K3)	1(K3)
4	CLO4	K3	2	(K1&K2)	1	K2	2 (K3&K3)	1(K3)
5	CLO5	K4	2	(K1&K2)	1	K2	2 (K4&K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented-solving problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of section wise marks with K levels

K Level	Section A (No Choice)	Section B (No Choice)	Section C (Either /or Choice)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	4	10	-	19	15.83	41.66%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	41.67%
K4	-	-	10	10	20	16.67	16.67%
Total Marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS				CLASS: III B.Sc., MATHEMATICS				
Semester	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext.	Total
V	Core XI	23U5MCCT11	MATHEMATICAL MODELLING	4	5	25	75	100

Nature of Course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship oriented	

COURSE OBJECTIVES:

- Construction and Analysis of Mathematical models found in real life problems.
- Modelling through differential and difference equations.

Unit	Description	Hours	K-level	CLO(s)
I	Mathematical Modelling: Simple situations requiring mathematical modelling, characteristics of mathematical models.	15	K3	1
II	Mathematical Modelling through differential equations: Linear Growth and Decay Models. Non-Linear growth and decay models, Compartment models.	15	K2	2
III	Mathematical Modelling, through system of Ordinary differential equations of first order: Prey-predator models, Competition models, Model with removal and model with immigrations. Epidemics: simple epidemic model, Susceptible-infected- susceptible (SIS) model, SIS model with constant number of carriers. Medicine: Model for Diabetes Mellitus.	15	K3	3
IV	Introduction to difference equations.	15	K4	4
V	Mathematical Modelling through difference equations: Harrod Model, cob web model application to Actuarial Science	15	K3	5

Book for Study:

1. J N Kapur, Mathematical Modelling, New Age International publishers (2009).

Unit I: Chapter 1: Sections 1.1 to 1.4

Unit II: Chapter 2: Sections 2.1 to 2.4

Unit III: Chapter 3: Sections 3.1, 3.2, 3.5-3.5.1 only

Unit IV: Chapter: 5: Section-5.1, 5.2

Unit V: Chapter: 5: Section-5.3-5.3.1, 5.3.2 & 5.3.4

Books for References:

1. Mathematical Modelling by Bimalk. Mishra and Dipak K.Satpathi. Ane Books Pvt. Ltd (1 January 2009)
2. Mathematical Modelling Models, Analysis and Applications, by Sandip Banerjee, CRC Press, Taylor & Francis group, 2014
3. Mathematical Modelling applications with Geogebra by Jonas Hall & Thomas Ligefjard, John Wiley & Sons, 2017
4. Mark M. Meerschaert: Mathematical Modelling, Elsevier Publ., 2007.
5. Edward A. Bender: An introduction to mathematical Modelling, CRC Press, 2002
6. Walter J. Meyer, Concepts of Mathematical Modelling, Dover Publ., 2000

Web Resources:

<https://nptel.ac.in>

Rationale for Nature of the course

An important feature of mathematical modelling is its interdisciplinary nature. It involves applied mathematics, computer sciences, physics, chemistry, engineering, biology and other disciplines such as economics, depending on the problem of interest.

Activities having direct bearing on Skill development/ Employability/ Entrepreneurship

Case study, Formulation and Analysis plan and problem solving

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Course Designer:

1. **Dr.K.LAKSHMI**, Assistant professor, PG and Research Department of Mathematics.

Course Schedule

Unit	Description	Hours	Mode
I	Mathematical Modelling: Simple situations requiring mathematical modelling, characteristics of mathematical models.	15	Lecture, Quiz, Tutorial
II	Mathematical Modelling through differential equations: Linear Growth and Decay Models. Non-Linear growth and decay models, Compartment models.	15	Lecture, Quiz
III	Mathematical Modelling, through system of Ordinary differential equations of first order: Prey-predator models, Competition models, Model with removal and model with immigrations. Epidemics: simple epidemic model, Susceptible-infected-susceptible (SIS) model, SIS model with constant number of carriers. Medicine: Model for Diabetes Mellitus.	20	PPT, Lecture, Quiz
IV	Introduction to difference equations.	10	Lecture, Tutorial
V	Mathematical Modelling through difference equations: Harrod Model, cob web model application to Actuarial Science	15	Lecture, Quiz
Total Hours		75	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CLO	Course Learning Outcomes	K-level
CLO1	Explain simple situations requiring Mathematical Modelling and to determine the characteristics of such models	Up to K2
CLO2	Interpret mathematical modelling through differential equations of linear growth and decay models.	Up to K3
CLO3	Model using systems of ordinary differential equations of first order, to discuss about various models under the categories 'Epidemics' and 'Medicine'	Up to K4
CLO4	Explain about the difference equations.	Up to K4
CLO5	Model using difference equations in Harrod Model, Cobweb model and apply in actuarial science.	Up to K5

Mapping of CLOs with PSOs

CLO	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	2	3	2	3
CLO2	3	1	-	2	3
CLO3	3	1	-	2	3
CLO4	2	2	-	2	3
CLO5	2	2	1	2	3

Mapping with CLOs with POs

CLO	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	2	1	1	-
CLO2	3	3	1	1	1	-
CLO3	3	3	-	1	1	1
CLO4	2	2	-	1	1	2
CLO5	2	2	2	1	1	2

3-AdvanceApplication

2-IntermediateLevel

1-BasicLevel

SUMMATIVE ASSESSMENT – BLUE PRINT

S. No.	CLOs	K Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K Level	No. of questions	K level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K1	2(K2 & K2)	1(K3)
3	CLO 3	Up to K4	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2(K4 & K4)	1(K4)
5	CLO 5	Up to K5	2	K3 & K4	1	K3	2(K4 & K4)	1(K4/K5)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - Solving Problems

K4 - Examining, analyzing, presentation and make inferences with evidences

K5 - Evaluate the mistakes in answers

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30	30%
K4	2	-	20	10	32	26.67	27%
K5			-	10	10	8.33	8%
Total Marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS					CLASS: III B.Sc., MATHEMATICS			
Semester	Course Type	Course Code	Course Title	Credits	Contact hours/Week	CIA	Ext.	Total
V	Core Practical	23U5MCCP1	PRACTICAL IN DOCUMENTATION USING LATEX	3	3	25	75	100

Nature of Course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

COURSE OBJECTIVES:

On completion of this course, the learner will

- To enable the students to understand Latex a document preparation system.
- To learn the complicated Mathematical typesetting with Latex.
- To create and insert tables, figures, diagrams using graphical packages
- To build bibliographic, cross reference to citations and presentation.

S. No.	List of Programs	Hours	K-Levels	CLO
1	Create a simple latex document using article class.	9	Upto K2	CLO1
2	Create a text file by using mathematical symbols and equations.			
3	Create a text file by using array and matrix environment.			
4	Create a text file by using list making environment.	9	Upto K3	CLO2
5	Create a latex document to format tabular and table.			
6	Create a latex document to import an image and make figures.			
7	Create a latex document for bio-data.	9	Upto K3	CLO3
8	Create a text file with sections and subsections			
9	Create a text file by using bibliography environment.			
10	Create a text file by importing another text file.	9	Upto K4	CLO4
11	Create an article with abstract, introduction, sections and bibliography.			
12	Create a two columns journal article.			
13	Create a latex document using report document class.	9	Upto K4	CLO5
14	Create a latex document to format a question paper.			
15	Create a latex presentation using beamer document class.			

Books for Study:

1. Learning LATEX by David F. Griffiths and Desmond J. Higgham, SIAM.

Books for Reference:

1. A Document Preparation System LATEX by Leslie Lamport, Addison-Wesley, 2nd Edition, 2009.
2. LATEX Tutorials - A PRIMER, Indian TEX Users Group, Trivandrum, India, 2003

Web Resources:

1. <https://www.overleaf.com/learn>
2. <http://mathforum.org>
3. <http://ocw.mit.edu/ocwwweb/Mathematics>,
4. <http://www.opensource.org>

Rationale for nature of the Course

This course provides an introduction to the typesetting and preparing a document using latex coding. Ability to develop a document which includes mathematical formulae, tables, figures, bibliographic and cross reference using LATEX. Ability to prepare an article, thesis and beamer presentation.

Pedagogy

Demonstration of Latex code, Quiz, Group-Discussion, Practical Session.

Course Designer:

1. **Dr. I. Padmavathi**, Assistant Professor, PG and Research Department of Mathematics.

Course Learning Outcomes (CLO)

At the end of the course, the student will be able to:

CLO	Description	K-level
CLO1	Learn to create a document using environment in mathematical equations, array and matrices.	UptoK2
CLO2	Understand the Environment in listing, tabular, table and figures.	UptoK3
CLO3	Import chapters, sections, subsections and bibliography in a document.	UptoK3
CLO4	Learn to import other text file and different style of articles.	UptoK4
CLO5	Create a text file using report, question and beamer document class.	UptoK4

Mapping of CLOs with PSOs

CLOs	PSO -1	PSO -2	PSO -3
CLO -1	3	2	1
CLO -2	2	2	1
CLO -3	1	1	1
CLO -4	2	1	1
CLO -5	2	3	1

Mapping of CLOs with POs

CLOs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO1	3	3	2	1	1	-
CLO2	3	3	1	1	1	-
CLO3	3	3	-	1	1	1
CLO4	2	2	-	1	1	2
CLO5	2	2	2	1	1	2

Advance application– 3

Intermediate level–2

Basic level–1

DEPARTMENT OF MATHEMATICS					CLASS: III B.Sc., MATHEMATICS			
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours /week	CIA	Ext.	Total
V	Discipline Elective	23U5MDET1 (A)	OPTIMIZATION TECHNIQUES	4	5	25	75	100

Nature of Course	Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objectives:

- To explain concepts in linear programming and queuing models and solve the programming models of real life situations.
- To understand the replacement policy for goods whose cost of maintenance increases with time and the value of money also changes at a constant rate at that time.
- To apply the fundamental concept of inventory control.
- To construct networks for a given plan and schedule them by PERT / CPM

Unit	Description	Hours	K-level	CLO
I	Linear Programming Problem: Mathematical formulation of LPP – Graphical solution method – Some exceptional cases- General Linear programming problem-Canonical and standard forms of LPP-The computational procedure-Simplex method-Problems only.	15	Up to K2	1
II	Linear Programming Problem (Continued): Uses of Artificial variables: The two phase method and Big M – Method- Duality in Linear programming-General Primal-Dual Pair-Formulating a dual problem-Primal-Dual pair in matrix form- Problems only.	15	Up to K3	2
III	Inventory Control: Introduction-types of inventories- Reason for carrying inventories-Inventory decisions-Objectives of scientific inventory control- Cost associated with inventories-Factors affecting inventory control- An inventory control problem-The concept of EOQ- Deterministic inventory problems with no shortages- Deterministic inventory problems with shortages- Problems only.	15	Up to K3	3
IV	Replacement Models: Introduction- Replacement of equipment/Asset that deteriorates gradually- Replacement of equipment that fails suddenly-Problems only.	15	Up to K3	4

V	Network Scheduling : (PERT / CPM) Introduction-Network-Logical sequencing- Rules of Network construction- Concurrent activities- Critical path analysis- Probability considerations in PERT- Problems only.	15	Up to K4	5

Books for Study:

1. Operations Research by Kanti Swarup, P.K.Gupta and Manmohan, Sultan Chand & Sons, 2017, (19th Ed.), (Reprint 2019).

Unit I: Chapter-2, Chapter 3 and Chapter 4:4.3 only

Unit II: Chapter 4: 4.4 only, Chapter 5: 5.1- 5.4

Unit III: Chapter 19: 19.1-19.8

Unit IV: Chapter 18: 18.1-18.3

Unit V: Chapter 25: 25.1-25.7

Books for References:

1. Operations Research, by R.K.Gupta , Krishna Prakashan India (p),Meerut Publications.
2. Introduction to Operations Research - Hillier, F.S. and G.J. Lieberman, 9th Ed., Tata McGrawHill, Singapore, 2009.
3. Operations Research, An Introduction -Hamdy A. Taha, 8th Ed., Prentice Hall India, 2006.
4. Linear Programming - Hadley, G. Narosa Publishing House, New Delhi, 2002.
5. Gupta P.K. and Hira D.S., Problems in Operations Research, S.Chand & Co.

Web Resources

1. <http://ebooks.lpude.in.operationsresearch>
2. <https://ocw.mit.edu>.
3. <https://nptel.ac.in>

4. Rationale for Nature of the course

Operations research helps in solving problems in different environments that needs decisions. This module aims to introduce students to use quantitative methods and techniques for effective decisions–making model formulation and applications that are used in solving business decision problems.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Course Designer(s):

1. **Dr. K.LAKSHMI**, Assistant Professor, Department of Mathematics.

Lecture Schedule

Unit	Topics	Hours	Mode
I	Mathematical formulation of LPP – Graphical solution method– Some exceptional cases	5	PPT, Chalk and Talk ,Test
	General Linear programming problem-Canonical and standard forms of LPP-The computational procedure	5	
	Simplex method	5	
II	Uses of Artificial variables: The two phase method and Big M – Method	5	PPT, Chalk and Talk, Test
	Duality in Linear programming- General Primal-Dual Pair	5	
	Formulating a dual problem- Primal-Dual pair in matrix form	5	
III	Introduction-types of inventories- Reason for carrying inventories-Inventory decisions-Objectives of scientific inventory control- Cost associated with inventories	5	PPT, Chalk and Talk, Test
	Factors affecting inventory control- An inventory control problem-The concept of EOQ- Deterministic inventory problems with no shortages-	5	
	Deterministic inventory problems with shortages	5	
IV	Introduction- Replacement of equipment that deteriorates gradually	5	PPT, Chalk and Talk, Test
	Replacement of Asset that deteriorates gradually	5	
	Replacement of equipment that fails suddenly	5	
V	Introduction-Network-Logical sequencing	5	Assignments and Seminar
	Rules of Network construction- Concurrent activities- Critical path analysis	5	
	Probability considerations in PERT	5	
Total		75	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CO	Course Learning Outcome	K-level
CLO 1	Understand the theoretical workings of canonical and standard form and simplex method for linear programming and demonstrate their iterations.	Up to K2
CLO 2	Formulate the specialized linear programming problems like the transportation and Assignment problems, Dual problems using appropriate method.	Up to K3
CLO 3	Explain the various costs related to inventory system and understand the various selective inventory control techniques and its applications.	Up to K3
CLO 4	Decide an optimal replacement period/policy for a given item/equipment/machine.	Up to K3
CLO 5	Find the constructions of networks of a project and optimal scheduling using CPM and PERT.	Up to K4

Mapping of CLOs with PSOs

CLO	PSO-1	PSO-2	PSO-3
CLO-1	3	2	1
CLO-2	2	2	1
CLO-3	1	1	1
CLO-4	2	1	1
CLO-5	2	2	1

Mapping of CLOs with POs

CLO	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	-	-	2	1
CLO2	3	3	-	-	2	1
CLO3	3	2	-	-	2	1
CLO4	2	2	-	-	1	1
CLO5	2	2	-	-	1	1

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model

S. No.	CLOs	K–Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K-Level	No. of questions	K-Level		
1	CLO1	UptoK2	2	K1&K2	1	K1	2(K1& K1)	1(K2)
2	CLO2	UptoK3	2	K1&K2	1	K1	2(K2&K2)	1(K3)
3	CLO3	UptoK3	2	K1&K2	1	K2	2(K3& K3)	1(K3)
4	CLO4	UptoK3	2	K1&K2	1	K2	2(K3& K3)	1(K3)
5	CLO5	UptoK4	2	K1&K2	1	K2	2(K4& K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Level	Section A (No Choice)	Section B (No Choice)	Section C (Either /or Choice)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	4	10	-	09	7.50	41.67%
K2	5	6	10	10	41	34.16	
K3	-	-	20	30	50	41.67	41.67%
K4	-		10	10	20	16.67	16.66%
Total Marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS					CLASS: III B.Sc., MATHEMATICS			
Semester	Course Type	Course Code	Course Title	Credits	Contact Hours/Week	CIA	Ext.	Total
V	Discipline Elective	23U5MDET1 (B)	BIO-STATISTICS	4	5	25	75	100

Nature of Course	Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	

Objectives:

The objectives of the course is

- To explain the important concepts of statistics and mathematical data concept.
- To formulate the visualization of frequency distribution.
- To describe the relationship between two different variables in terms of positive and negative correlation, describe how strongly correlated two different variables are based on the proximity to a line of best fit on a scatter graph or a scatter graph without a line of best fit.

Unit	Description	Hours	K-level	CLO
I	Correlation: Introduction – Definitions – Types of correlation – Karl Pearson's coefficient of correlation – Rank coefficient of correlation – Problems.	15	K2	CLO 1
II	Regression: Introduction – Definitions – Line of regression of x on y and y on x Difference between correlation and regression – Problems.	15	K2	CLO 2
III	Index Numbers: Introduction – Definitions – Types of index number – Laspeyre's method – Paasche's method, Drobish and Bowley's method – Fisher's ideal method – Marshall Edgeworth method – Problems.	15	K3	CLO 3
IV	Index Numbers (continued): Quantity index numbers – Value index numbers – Time reversal test – Factor reversal test – Consumer price index – Family Budget method – Problems.	15	K3	CLO 4
V	Time series: Introduction – Definitions – Measurements of secular trend – Semi average method – Moving average method – Method of Least squares – Measurement of Seasonal variation – Method of simple average - Problems.	15	K2	CLO 5

Book for Study:

1. Statistics Theory and Practice, R.S.N. Pillai and Bagavathi S. chand and company Reprint 2021.

Chapters 12, 13, 14, 15 (Relevant Topics only)**Books for Reference:**

1. Gupta S.C and Kapoor, V.K. (2002). Fundamentals of Mathematical Statistics, Sultan Chand & Sons Pvt. Ltd., New Delhi
2. Goon A.M. Gupta. A.K. and Das Gupta, B (1987). Fundamental of Statistics, vol.2 World Press Pvt. Ltd., Kolkatta
3. G.U.Yule and M.G. Kendall (1956). An introduction to the theory of Statistics, Charles Griffin.
4. M.R. Spiegel (1961). Theory and problems of Statistics, Schaum's outline series.
5. Anderson, T.W. and Sclove SL. (1978). An introduction to statistical analysis of data, Houghton Mifflin & co.

Web Resources

1. <https://geographyfieldwork.com/SpearmanRank.htm#:~:text=Spearman's%20Rank%20correlation%20coefficient%20is%20a%20technique%20which%20can%20be,between%201%20and%20minus%201.&text=Create%20a%20table%20from%20your,Rank%20the%20two%20data%20sets.>
2. <https://www.geeksforgeeks.org/laspeyres-paasches-and-fishers-methods-of-calculating-index-number/>
3. https://www.brainkart.com/article/Measurements-of-Trends--Methods-of-measuring-Seasonal-Variations-By-Simple-Averages_39019/

Rationale for nature of the course

Statistics is the part of mathematical science which pertains to the collection, classification, tabulation, analysis, interpretation and presentation of data. Some of the eminent researchers consider Statistics to be a separate mathematical science rather than a branch of mathematics.

Activities having direct bearing on Skill Development/Employability /Entrepreneurship

Students have the ability to work on challenging issues during class hours. The challenges can be discussed and further difficulties can be worked through in class.

Pedagogy

Lecture, Seminar, Quiz, Problem Solving, Tutorial, Group Discussion, PPT

Course Designer(s):

1. **Dr. C. THANGAPANDI**, Associate Professor, Department of Mathematics.
2. **Dr. M. RAJARAM**, Assistant Professor, Department of Mathematics.

Course Schedule

Unit	Topics	Hrs	Mode
I	Introduction – Definitions – Types of correlation.	5	Lecture, Tutorial, Quiz, Test.
	Karl Pearson's coefficient of correlation – Problems.	5	
	Rank coefficient of correlation – Problems.	5	
II	Introduction – Definitions and examples.	5	Lecture, PPT, Problem Solving.
	Line of regression of x on y and y on x and problems.	5	
	Difference between correlation and regression – problems.	5	
III	Introduction – Definitions – Types of index number and simple problems.	5	Lecture, Problem solving, Quiz, Test.
	Laspeyre's method – Paasche's method, Derbish and Bowley's method – Problems.	5	
	Fisher's ideal method – Marshall – Edge Worths method – Problems.	5	
IV	Quantity index numbers – Value index numbers — Problems.	5	Problem solving Lecture, Quiz Tutorial, Test.
	Time reversal test – Factor reversal test – simple problems.	5	
	Consumer price index – Family Budget method – Problems.	5	
V	Introduction – Definitions – Measurements of secular trend – Problems.	5	Seminar, Lecture, Quiz Lecture, Assignment.
	Semi-average method – Moving-average method – Simple problems.	5	
	Method of Least square – Measurement of Seasonal variation – Method of simple average problems.	5	
Total		75	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CLO	Course Learning Outcomes	Knowledge Level
CLO 1	Identify the types of correlation, Karl Pearson's coefficient of correlation, Rank coefficient of correlation and Problems.	K2
CLO 2	Find line of regression of x on y and y on x and difference between correlation and regression, problems.	K3
CLO 3	Understand index numbers, Laspeyre's method, Paasche's method, Dorbish and Bowley's method, Fisher's ideal method, Marshall, Edgeworth method and Problems.	K3
CLO 4	Understand value index numbers, Time reversal test, Factor reversal test, Consumer price index, Family Budget method and Problems.	K2
CLO 5	Solve problem by using moving average method, Method of Least squares, and Measurement of Seasonal variation, Method of simple average and Problems.	K2

Mapping of CLOs with PSOs

CLO	PSO1	PSO2	PSO3
CLO 1	3	3	2
CLO 2	3	3	2
CLO 3	3	3	2
CLO 4	3	3	2
CLO 5	3	3	2

Mapping of CLOs with POs

CLO	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	1	1	1	1
CLO2	3	2	1	1	1	1
CLO3	3	2	1	1	1	1
CLO4	3	2	1	1	1	1
CLO5	3	2	1	1	1	1

Advance application– 3;**Intermediate level–2;****Basic level–1**

Blueprint for Semester Examination

S. No.	CLOs	K Level	Section A		Section B		Section C	Section D
			MCQs		Short Answers		(Either /or Choice)	(Open Choice)
			No. of questions	K Level	No. of questions	K Level		
1	CLO1	K2	2	(K1&K2)	1	K2	2 (K1&K1)	1(K1)
2	CLO2	K3	2	(K1&K2)	1	K1	2 (K3&K3)	1(K3)
3	CLO3	K3	2	(K1&K2)	1	K2	2 (K3&K3)	1(K3)
4	CLO4	K2	2	(K1&K2)	1	K2	2 (K2&K2)	1(K2)
5	CLO5	K2	2	(K1&K2)	1	K1	2 (K2&K2)	1(K2)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented-Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of section wise marks with K levels

K Level	Section A (No Choice)	Section B (No Choice)	Section C (Either /or Choice)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	4	10	10	29	24.17	66.67%
K2	5	6	20	20	51	42.50	
K3	-	-	20	20	40	33.33	33.33%
K4	-	-	-	-	-	-	-
Total Marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS					CLASS: III B.Sc., MATHEMATICS			
Semester	Course Type	Course Code	Course Title	Credits	Contact hours/ Week	CIA	Ext.	Total
V	MDC	23U5MMDCT	OPERATIONS RESEARCH AND WEB TECHNOLOGY	4	5	25	75	100

Nature of Course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

Course Objectives:

- To explain about concept of Queuing system and elements of a Queuing system, Characteristic of Queuing system
- To understand the knowledge of Queuing model-Poisson Queuing system.
- To apply the fundamental concept of decision analysis and Expected Profit with perfect information.
- To Gain knowledge on application of Management concepts and its relevant in operational management issues.
- To Comprehend and elucidate the concept of web designing and technology.

Unit	Description	Hours	K-level	CLO
I	Queuing system-elements of a Queuing system-Characteristic of Queuing system-Classification of Queuing model-Poisson Queuing system-(M/M/1): (∞ /FIFO)-model-problems.	15	Up to K2	1
II	Poisson Queuing models-(M/M/1): (N/FIFO) model-(M/M/C): (∞ /FIFO) model-problems-(M/M/C): (N/FIFO) model-problems.	15	Up to K2	2
III	Decision Analysis-Decision making problems-Decision under uncertainty-Decisions under Risk-Expected Monetary Value Criterion-Expected Opportunity Loss-Expected Profit with perfect information-Expected value of perfect information.	15	Up to K2	3
IV	Commerce: Applications of Management Concepts in Operations Management: Management – Meaning - Definition – Features – Levels of Management – Principles of Management – Functions of Management. Planning – Steps in planning – MBO. Organization – Meaning – Types of Organization Structure – Centralization and Decentralization - Delegation of Authority. Staffing – Recruitment – Selection Process. Motivation – Maslow Theory. Leadership – Leadership Styles. Control – Meaning – Steps in control – Techniques – Budget.	15	Up to K2	4

V	Computer Science: Internet Technology: Introduction- Internet Access–Internet Basics–Internet Addressing- World Wide Web- Web pages & HTML – Web browsers – Searching the Web – Internet Chat –Electronic Mail- Introduction-working of E-mail- E-mail names & Address- Mailing Basics-E-mail Ethics-spamming-E-Mail advantages & Disadvantages – Tips for Effective E-Mail use -Smileys- Introduction to E-Commerce and E-Business- Technological Advancement- E- E-commerce – E-commerce and E-Business.	15	Up to K2	5

Books for study:

1. Operations Research by Kanti Swarup, P.K.Gupta, Manmohan, 19th edition, Reprint 2019, Sultan Chand & Son Publishers.
2. L.M. Prasad, Principles and Practice of Management, Sixth Edition, Sultan Chand & Sons, New Delhi.
3. Alexis Leon & Mathews Leon, “Fundamentals of Information Technology”, Second Edition, 2009, Leon Vikas, Chennai.

Book 1:

Unit I, II- Chapters: 21 (21.1-21.9) (Relevant Topics Only)

Unit III -Chapters: 16 (16.1-16.6)

Book 2:

Unit IV

Book 3:

Unit V: Chapters 24, 25, 27

Books for References:

1. Resource management techniques, Prof.V.Sundaresan, K.S. Ganapathy Subramanian, K.Ganesan-A.R.Publications-Revised edition June-2009.
2. Gupta.P.K.And D.S. Hira – Operations Research - S.Chand and Company.
3. Operations Research, Theory and Applications - J. K. Sharma, Third Edition (2007) MacmillanIndia Ltd.
4. N.P. Gopalan, J. Akilandeswari, “Web Technology “, 2016, PHI Learning private Limited, Delhi.
5. Ramesh Bangia, “Internet Technology & Web design “, 2003, Firewall Media, New Delhi.
6. N. Gupta, Principles of Management, S.Chand& Company Pvt. Ltd. New Delhi.
7. DinkarPagare, Business Management, Sultan Chand & Sons, New Delhi.

Web Resources:

1. https://hithaldia.in/faculty/sas_faculty/Dr_M_B_Bera/Lecture%20note_5_CE605A&CHE705B.pdf
2. https://www.mi.fu-berlin.de/inf/groups/ag-tech/intern/19540-V-Simulation/08_Queueing_Models.pdf
3. <https://egyankosh.ac.in/bitstream/123456789/35163/1/Unit-10.pdf>
4. <https://gurunanakcollege.edu.in/files/commerce-management/STATISTICS-UNIT-5.pdf>
5. <http://anucde.info/bba1a.pdf>
6. <http://www.nou.ac.in/Online%20Resourses/17-5/Internet%20and%20Web%20Technology.pdf>
7. <https://ncert.nic.in/textbook/pdf/kect107.pdf>

Rationale for Nature of the course

Understand basic concepts and aspects related queuing systems, queuing process and models. Thinking critically and Applying basic mathematics skills to interpret queuing models, and solve problems. Maslow hierarchy of need is a theory that can be used in commerce to understand and motivate employees, customers and entrepreneurs. Web Designing helps students to develop a combination of creative and technical skills that will be useful in many industries.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Exercise, Assignment and Quiz.

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Course Designer(s):

1. **Prof. S. KRISHNA JAYANTHI**, Assistant Professor, Department of Mathematics.

Lecture Schedule

Unit	Topics	Hours	Mode
I	Elements of a Queuing system-Characteristic of Queuing system	5	PPT, Chalk and Talk, Quiz.
	Classification of Queuing model	5	
	Poisson Queuing system-(M/M/1) : (∞ /FIFO)-model-problems.	5	
II	(M/M/1) : (N/FIFO) model. problems	5	PPT, Chalk and Talk, Quiz.
	(M/M/C) : (∞ /FIFO) model-problems	5	
	(M/M/C) : (N/FIFO) model-problems	5	
III	Decision making problems-Decision under uncertainty	5	PPT, Chalk and Talk, Quiz.
	-Decisions under Risk-Expected Monetary Value Criterion-Expected Opportunity Loss.	5	
	Expected Profit with perfect information-Expected value of perfect information.	5	
IV	Management – Meaning - Definition – Features – Levels of Management – Principles of Management – Functions of Management. Planning – Steps in planning – MBO.	5	PPT, Chalk and Talk, Test
	Organization – Meaning – Types of Organization Structure – Centralization and Decentralization - Delegation of Authority. Staffing – Recruitment – Selection Process. Motivation – Maslow Theory.	5	
	Leadership – Leadership Styles. Control – Meaning – Steps in control – Techniques – Budget.	5	
V	Introduction- Internet Access–Internet Basics-Internet Addressing- World Wide Web- Web pages & HTML – Web browsers – Searching the Web .	5	PPT, Chalk and Talk, Test
	Internet Chat –Electronic Mail- Introduction-working of E-mail- E-mail names & Address- Mailing Basics-E-mail Ethics-spamming-E-Mail advantages & Disadvantages – Tips for Effective E-Mail use -Smileys.	5	
	Introduction to E-Commerce and E-Business- Technological Advancement- E- E-commerce – E-commerce and E-Business.	5	
Total		75	

Course Learning Outcomes:

At the end of the course, students will be able to:

CLO	Course Learning Outcome	K-level
CLO 1	Understand the characteristics and classification of Queuing model.	Up to K2
CLO 2	Ascertain the behaviour of Poisson Queue and its relative model.	Up to K2
CLO 3	Formulate scientific and commercial problems to a mathematical model and analyse it to arrive at a solution.	Up to K2
CLO 4	Study the organizational structure, types of organization and the principles of management.	Up to K2
CLO 5	Get to know the basics of internet Access and web technology.	Up to K2

Mapping of CLOs with PSOs

CLO	PSO-1	PSO-2	PSO-3
CLO-1	3	2	3
CLO-2	3	3	3
CLO-3	3	3	3
CLO-4	-	1	-
CLO-5	-	1	-

Mapping of CLOs with POs

CLO	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	2	3	2	3
CLO2	3	3	2	3	2	3
CLO3	3	3	2	3	2	3
CLO4	3	3	2	3	2	2
CLO5	3	3	2	3	2	2

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model

S. No.	CLOs	K Level	Section A		Section B (Either /or Choice)	Section C (Open Choice)
			Short Answers			
			No. of questions	K Level		
1	CLO1	Up to K2	1	K1	2 (K2&K2)	1(K2)
2	CLO2	Up to K2	1	K1	2 (K2&K2)	1(K2)
3	CLO3	Up to K2	1	K1	2 (K2&K2)	1(K2)
4	CLO4	Up to K2	1	K1	2 (K2&K2)	1(K2)
5	CLO5	Up to K2	1	K1	2 (K2&K2)	1(K2)
No. of Questions to be asked			5		10	5
No. of Questions to be answered			5		5	3
Marks for each question			2		7	10
Total Marks for each Section			10		35	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K- Levels	Section A Short Answers	Section B (Either/or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	10	-	-	10	7.69	8
K2	-	70	50	120	92.31	92
Total marks	10	70	50	130	100	100%

DEPARTMENT OF MATHEMATICS				CLASS :III B.Sc MATHEMATICS				
Sem.	Course type	Course code	Course title	Credits	Contact hours/ week	CIA	Ext.	Total
V	Industrial Visit/ Internship Field Visit	23U5MINTR	INDUSTRIAL VISIT/ INTERNSHIP FIELD VISIT	2	-	-	-	-

Nature of the course	Skill oriented	✓	Employability	✓	Entrepreneurship oriented	✓

Course Objectives:

The objective of the course is:

- To motivate students to take up internship in research institutions / industry.
- To develop the employability of students.
- To promote entrepreneurial tendencies among students.

Course Learning Outcomes:

At the end of the internship, the students will be able to

CLO	Course Learning Outcomes	K level
CLO 1	Work independently and as a team in mission critical projects in real-time	K4
CLO 2	Develop into a critical thinker and solve every day problems in the industry.	K5
CLO 3	Learn and analyze problems faced by the industry and workforce at large.	K4
CLO 4	Survey the job market / understand entrepreneurial opportunities / research opportunities available to them.	K2
CLO 5	Communicate precisely and accurately with team members and supervisors.	K3

Mapping of CLOs with PSOs

CLO	PSO 1	PSO 2	PSO 3
CLO 1	3	3	3
CLO 2	3	3	3
CLO 3	3	3	3
CLO 4	3	3	3
CLO 5	3	3	3

Mapping of CLOs with POs

CLO	PO1	PO2	PO3	PO4	PO5	PO6
CLO 1	3	3	3	3	3	3
CLO 2	3	3	3	3	3	3
CLO 3	3	3	3	3	3	3
CLO 4	3	3	3	3	3	3
CLO 5	3	3	3	3	3	3

Advance application –3,**Intermediate level –2,****Basic level–1****Valuation Schema for Internship**

The student will be graded on a seven point scale with corresponding GPAs as mentioned below.

Grade	GPA
Outstanding	10
Excellent	9
Very Good	8
Good	7
Average	6
Below average	5
Reappearance	1-4

DEPARTMENT OF MATHEMATICS				CLASS: III B.Sc., MATHEMATICS				
Semester	Course Type	Course Code	Course Title	Credits	Contact hours/Week	CIA	Ext.	Total
VI	Core XII	23U6MCCT12	LINEAR ALGEBRA	4	6	25	75	100

Nature of Course	Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objectives:

- Provides a strong foundation in fundamental concepts of Linear Algebra culminating in abstract vector spaces and linear transformations
- To understand the use of basic concepts of vector algebra including linear dependence / independence, basis and dimension of a subspace
- Learning rank and nullity of a given Linear Transformation.
- Analyzing the relation between the Matrices of Linear Transformations with respect to two ordered bases for a given finite dimensional vector space.

Unit	Description	Hours	K-level	CLO
I	Vector Spaces – Definition and Examples – Subspaces – Properties of Subspaces – Quotient Spaces – Vector Space Homomorphisms – Fundamental Theorem of Homomorphism – Isomorphism Theorems.	18	Up to K2	1
II	Linear Span – Definition and Examples – Linear Independence and Dependence – Finite Dimensional Vector Space – Basis and Dimension.	18	Up to K3	2
III	Inner Product Spaces – Definition and Examples – Norm of a Vector – Orthogonality – Orthogonal Complement – Orthonormal set – Cauchy –Schwarz inequality – Bessel's inequality – Gram-Schmidt's Orthogonalization process.	18	Up to K4	3
IV	Linear Transformations – Definition and Examples of Linear Transformations – Algebra of Linear Transformations – Rank and Nullity of a Linear Transformation – Invertible Linear Transformations – Matrix of a Linear Transformation.	18	Up to K3	4
V	Dual Spaces – Eigen values –Eigen vectors, Diagonalizability – Simple problems.	18	Up to K4	5

Book for Study:

1. Vijay K. Khanna and S.K. Bhambri, A Course in Abstract Algebra, 2nd Revised Edition (Reprint 2004), Vikas Publishing House Pvt. Ltd.

UNIT-I: Chapter 9 (Pg. No: 350-365)

UNIT-II: Chapter 9 (Pg. No: 365-386)

UNIT-III: Chapter 9 (Pg. No: 386-398)

UNIT-IV: Chapter 10 (Pg. No: 399- 425)

UNIT-V: Chapter 10 (Pg. No: 425- 440) and Chapter 11(Pg. No.: 447-467)

Books for References:

1. Linear Algebra - Stephen H Friedberg, Arnold J Insel and Lawrence E Spence, 5th edition (2018) Pearson.
2. I.N.Herstein, Topics in Algebra, Wiley Eastern Ltd. Second Edition, 2006.
3. N.S.Gopalakrishnan, University Algebra, New Age International Publications, Wiley Eastern Ltd.
4. John B.Fraleigh, First course in Algebra, Addison Wesley.
5. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra, 4th Ed., Prentice Hall of India Pvt. Ltd., New Delhi, 2004.
6. David C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007.
7. S. Lang, Introduction to Linear Algebra, 2nd Ed., Springer, 2005.
8. Gilbert Strang, Linear Algebra and its Applications, Thomson, 2007.

Web Resources

1. <https://archive.nptel.ac.in/courses/111/106/111106051/>
2. <https://www.math.ucdavis.edu/~linear/linear.pdf>
3. <https://www.khanacademy.org/math/linear-algebra>
4. https://home.iitk.ac.in/~psraj/mth102/lecture_notes.html
5. <https://anandinstitute.org/pdf/lenearal.pdf>

Rationale for Nature of the course

Linear algebra is used in most sciences and fields of engineering, because it allows modeling many natural phenomena, and computing efficiently with such models. For nonlinear systems, which cannot be modeled with linear algebra, it is often used for dealing with first-order approximations, using the fact that the differential of a multivariate function at a point is the linear map that best approximates the function near that point.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Seminar, Assignment preparation, Group discussion, Quiz

Pedagogy

Lecture, Seminar, Quiz, Problem Solving, Tutorial Sessions, Group Discussions, PPT

Course Designer(s):

1. **Dr. V. ANANTHASAMY**, Associate Professor, Research Centre and PG Department of Mathematics.
2. **Dr. B.SEETHALAKSHMI**, Assistant Professor, Research Centre and PG Department of Mathematics.

Lecture Schedule

Units	Description	Hours	Pedagogy
I	Definition of Vector space with examples	3	Lecture, Quiz
	Subspaces and its properties	3	Lecture, Quiz
	Quotient spaces and examples	3	Lecture, Quiz& PPT
	Vector Space Homomorphism and examples	3	Lecture, Quiz
	Fundamental Theorem of Homomorphism	3	Lecture, Quiz
	Isomorphism theorems	3	Lecture, Quiz& Group Discussion
II	Definition and Examples of Linear Span	4	Lecture, Quiz& Seminar
	Linear Independence and Linear Dependence	5	Lecture, Quiz
	Finite Dimensional Vector spaces	3	Lecture, Quiz& Group Discussion
	Basis and Dimension of a Vector Spaces	6	Lecture, Quiz& PPT
III	Inner Product Space – Definition and Examples	3	Lecture, Quiz
	Norm of a vector	3	Lecture, Quiz& PPT
	Orthogonal and orthonormal set	3	Lecture, Quiz
	Orthogonal complement of a subspace	3	Lecture, Quiz& Seminar
	Gram-Schmidt's orthogonalization process	6	Lecture, Quiz& Group Discussion
IV	Linear Transformations: Definition and examples	2	Lecture, Quiz
	Kernel, Range, Rank and Nullity of a Linear Transformations	4	Lecture, Quiz
	Algebra of Linear Transformations	3	Lecture, Quiz& Seminar
	Invertible Linear Transformations	6	Lecture, Quiz& PPT
	Matrix of a Linear Transformations	3	Lecture, Quiz& Seminar
V	Dual Spaces	6	Lecture, PPT, Seminar& Assignment
	Finding of Eigen Values and Eigen Vectors	6	Lecture, Quiz, Problem Solving, Seminar & Assignment
	Diagonalizability	6	Lecture, Quiz, Seminar, Assignment
Total		90	

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CLO	Course Learning Outcome	Knowledge level
CLO1	Acquire a detailed knowledge about vector spaces and subspaces.	Up to K2
CLO2	Explain the concepts of Linear Dependence, Linear Independence, Bases and Dimension of basis	Up to K3
CLO3	Explain about Inner product and norms and to apply Gram Schmidt Orthogonalization Process to problems on inner product spaces.	Up to K4
CLO4	Explain the concept of Linear Transformations, their Matrix representations and invertible Linear Transformations.	Up to K3
CLO5	Find the Eigen values and Eigen vectors, to apply the concepts for diagonalisation.	Up to K4

Mapping of CLOs with PSOs

CLO	PSO-1	PSO-2	PSO-3
CLO-1	2	1	2
CLO-2	2	1	2
CLO-3	1	1	2
CLO-4	1	1	2
CLO-5	1	1	2

Mapping of CLOs with POs

CLO	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	-	2	2	2
CLO2	3	3	-	2	2	2
CLO3	3	2	-	2	2	2
CLO4	2	2	2	2	1	2
CLO5	2	2	2	2	1	2

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model

Units	CLO	K Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K Level	No. of Questions	K Level		
1	CLO 1	Up to K2	2	K1& K2	1	K1	2(K1& K1)	1(K2)
2	CLO 2	Up to K3	2	K1& K2	1	K1	2(K3& K3)	1(K3)
3	CLO 3	Up to K4	2	K1& K2	1	K2	2(K4& K4)	1(K3)
4	CLO 4	Up to K3	2	K1& K2	1	K2	2(K2& K2)	1(K3)
5	CLO 5	Up to K4	2	K1& K2	1	K2	2(K3& K3)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total Marks	% of marks with choice	Consolidated
K1	5	4	10	-	19	15.83	41.66%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	41.67%
K4	-	-	10	10	20	16.67	16.67%
Total Marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS					CLASS: III B.Sc., MATHEMATICS			
Semester	Course Type	Course Code	Course Title	Credits	Contact Hours/Week	CIA	Ext.	Total
VI	Core XIII	23U6MCCT13	COMPLEX ANALYSIS	4	6	25	75	100

Nature of Course	Skill Oriented	✓	Employability Oriented		Entrepreneurship Oriented	

Objectives:

The objectives of the course is

- To apply concept and consequences of analyticity and C-R equations.
- To understand the concept of mappings and transformations.
- To compute complex contour integrals and applying Cauchy's integral in various versions.
- To understand zeros and singularities of an analytic function, apply their properties in the evaluation of definite integral.

Unit	Description	Hours	K-Level	CLO
I	Analytic functions: Functions of a Complex variable – Limits – Theorem on limits – Continuous functions – Differentiability – The Cauchy - Riemann equations – Analytic functions – Harmonic functions.	18	K2	CLO 1
II	Conformal Mapping and Bilinear Transformations: Conformal mapping – Bilinear transformations: Elementary transformations – Bilinear transformations – Cross ratio – Fixed points of bilinear transformations.	18	K3	CLO 2
III	Complex Integration: Definite integral – Cauchy's theorem – Cauchy's integral formula – Higher derivatives.	18	K4	CLO 3
IV	Series Expansions: Taylor's series – Laurent's series – Zeros of an analytic function – Singularities.	18	K3	CLO 4
V	Calculus of Residues: Residues – Cauchy's residue theorem – Evaluation of definite integrals.	18	K4	CLO 5

Book for study:

1. Complex Analysis by S.Arumugam , A.Thangapandi Issac, and A.Somasundaram, SciTech Publications Pvt. Ltd., Reprint-(2010).

Unit I: Chapter: 2, Section: 2.1 – 2.8

Unit II: Chapters: 2 and 3, Section: 2.9, 3.1 – 3.4

Unit III: Chapter: 6, Section: 6.1 – 6.4

Unit IV: Chapter: 7, Section: 7.1 – 7.4

Unit V: Chapter: 8, Section: 8.1 – 8.3

Books for Reference:

1. Complex Analysis by T.K.Manickavasagam Pillay and S.Narayanan, S.V. Publishers, India, (2008).
2. Complex Variables and Application by James Ward Brown and Ruel V. Churchill, McGraw Hill Book Co., International Edition, (2009).
3. Complex Analysis by Lars V. Ahlfors, McGraw Hill International Edition, (2013).
4. Complex Variables with Applications by S. Ponnusamy and H. Silverman, Birkhauser, (2006).

Web Resource

<https://nptel.ac.in>

Rationale for nature of course

This course is designed to introduce the fundamental theories of functions of complex variables. It covers key concepts such as analyticity, Cauchy's theorems, and harmonic functions. The classification of isolated singularities is explored, along with the theory and practical applications of the calculus of residues for evaluating integrals.

Activities having direct bearing on Skill Development / Employability / Entrepreneurship

The essential ideas of complex analysis are covered in this course, along with their importance in contemporary mathematics, real-world situations, and the application of complex theory methods to the evaluation to the evaluation of definite integrals and infinite series.

Pedagogy

Lecture, Seminar, Quiz, Problem Solving, PPT, Group Discussion

Course Designer(s):

1. **Dr. K. M. DHARMALINGAM**, Associate Professor, PG and Research Department of Mathematics.
2. **Dr. M. RAJARAM**, Assistant Professor, Department of Mathematics.

Course Schedule

Unit	Description	Hours	Mode
I	Functions of a Complex variable, Limits and theorem on limits and some problems.	8	Lecture, Problem Solving
	Continuous functions, Differentiability and some theorems.	8	Lecture, PPT
	The Cauchy -Riemann equations and some related problems and theorems.	6	Lecture, Quiz, Group Discussion
	Analytic functions, Harmonic functions and some related problems.	7	Lecture, Quiz, Problem Solving
II	Concept of Conformal mapping and some problems.	6	Lecture
	Elementary transformations, Bilinear transformations, some theorems and problems.	8	Lecture, PPT
	Cross ratio, fixed points of bilinear transformations related problems.	6	Lecture, Group Discussion
III	Definite integral, Cauchy's theorem and some problems.	6	Lecture, Quiz, Problem Solving
	Cauchy's integral formula, Higher derivatives some theorems and simple problems.	8	Lecture, Seminar
IV	Taylor's series, Laurent's series and some problems.	8	Lecture, PPT
	Concept of Zeros of an analytic function, Singularities and some problems.	6	Lecture, Quiz, Problem Solving
V	Residues, Cauchy's residue theorem and some problems.	6	Lecture, Seminar
	Evaluation of definite integrals, some theorems and problems.	7	Lecture, Assignment
Total		90	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CLO	Course Learning Outcomes	K – Level
CLO 1	Elucidate analytic functions, their differentiation and continuity and to verify the Harmonic functions using analyticity conditions.	K2
CLO 2	Explain the concept of conformal mappings and mappings by bilinear transformations.	K3
CLO 3	Demonstrate the complex integrations of functions over simply and multiply connected domains and to derive the Cauchy integral formula and higher derivatives.	K4
CLO 4	Test the convergence of the series, to derive Taylor's and Laurent's series, and analyze the nature of singularities.	K3
CLO 5	Evaluate the residue of a given function at a given singular point. Develop the Cauchy's residue theorem and evaluation of definite integrals.	K4

Mapping of CLOs with POs

CLO	PO1	PO2	PO3
CLO1	3	3	2
CLO2	3	3	2
CLO3	3	3	2
CLO4	3	3	2
CLO5	3	3	2

Mapping of CLOs with POs

CLO	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	3	2	1	-
CLO2	3	3	3	2	1	-
CLO3	3	3	3	2	1	-
CLO4	3	3	3	2	1	-
CLO5	3	3	3	2	1	-

Advance applications – 3;

Intermediate level – 2;

Basic level – 1

Blueprint for Semester Examination

S. No.	CLOs	K Level	Section A		Section B		Section C	Section D
			MCQs		Short Answers		(Either /or Choice)	(Open Choice)
			No. of questions	K Level	No. of questions	K Level		
1	CLO1	K2	2	(K1&K1)	1	K1	2 (K2&K2)	1(K2)
2	CLO2	K3	2	(K2&K2)	1	K2	2 (K3&K3)	1(K3)
3	CLO3	K4	2	(K3&K3)	1	K3	2 (K4&K4)	1(K4)
4	CLO4	K3	2	(K1&K1)	1	K2	2 (K3&K3)	1(K3)
5	CLO5	K4	2	(K3&K3)	1	K4	2 (K4&K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented-solving problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of section wise marks with K levels

K Level	Section A (No Choice)	Section B (No Choice)	Section C (Either /or Choice)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	4	2	-	-	06	5.00	26.67%
K2	2	4	10	10	26	21.67	
K3	4	2	20	20	46	38.33	38.33%
K4	-	2	20	20	42	35.00	35.00%
K5	-	-	-	-	-	-	-
Total Marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS				CLASS: III B.Sc., MATHEMATICS				
Semester	Course Type	Course Code	Course Title	Credits	Contact Hours/ week	CIA	Ext.	Total
VI	Core XIV	23U6MCCT14	MECHANICS	4	6	25	75	100

Nature of Course	Skill oriented	✓	Employability oriented		Entrepreneurship oriented	

COURSE OBJECTIVES:

- To create a foundation for understanding Equilibrium of a particle under the action of given forces
- To learn Simple Harmonic Motion
- To learn the importance and consequences of Projectiles

Unit	Description	Hours	K-level	CLO(s)
I	Force: Resultant of two forces on a particle – Resolution of a force - Equilibrium of a Particle: Equilibrium of any number of forces acting upon a particle.	18	K2	1
II	Forces on a Rigid Body: Rigid body subjected to any three forces – Conditions of Equilibrium – Forces acting along a triangle - Problems.	18	K3	2
III	Projectiles: Forces on a projectile – Projectile projected on an inclined plane – Magnitude and velocity of a projectile – Range on an inclined plane – Motion on the surface of a smooth inclined plane	18	K3	3
IV	Simple Harmonic Motion: along a horizontal line – along a vertical line – Force necessary to produce Simple Harmonic Motion.	18	K4	4
V	Collision of Elastic Bodies: Laws of Impact – Impact of smooth Sphere on a smooth plane – Direct impact of two smooth spheres – Oblique impact of two smooth spheres.	18	K3	5

Book for Study:

1. Dr. M. K. Venkataraman, A text book of STATICS, Agasthiar Publications.

Unit I – Chapter 2

Unit II – Chapter 5

2. Dr. M. K. Venkataraman, A text book of DYNAMICS, Agasthiar Publications.

Unit III – Chapter 6.1 – 6.16

Unit IV – Chapter 10.1 – 10.13

Unit V – Chapter 8.1 – 8.8

Books for References:

1. A. Ruina and R. Pratap, Introduction to Statics and Dynamics, Oxford University Press, 2014.
2. S.L. Loney, The Elements of Statics and Dynamics, Cambridge University Press, 1904.

Web Resources:

<https://nptel.ac.in>

Rationale for Nature of the course

Knowledge of the motion of non-quantum mechanical, low-energy particles in weak gravitational fields and Hamilton-Jacobi in identifying conserved quantities for a mechanical system.

Activities having direct bearing on Skill development/Employability/ Entrepreneurship

Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Pedagogy

Lecture, Chalk and Talk, Quiz, PPT, Tutorial, Assignment

Course Designer:

1. **Dr. V. Sangeethasubha**, Assistant Professor, PG and Research Department of Mathematics.

Course Schedule

Unit	Description	Hours		Mode
I	Force: Resultant of two forces on a particle – Resolution of a force	9	18	Lecture, Chalk and Talk Problem Solving, Quiz, Test
	Equilibrium of a Particle: Equilibrium of any number of forces acting upon a particle.	9		
II	Forces on a Rigid Body: Rigid body subjected to any three forces – Conditions of Equilibrium	11	18	Lecture, Problem Solving, Chalk and Talk, Test
	Forces acting along a triangle - Problems.	7		
III	Projectiles: Forces on a projectile – Projectile projected on an inclined plane – Magnitude and velocity of a projectile	9	18	PPT, Lecture, Quiz, Tutorial Problem Solving, Test
	Range on an inclined plane – Motion on the surface of a smooth inclined plane	9		
IV	Simple Harmonic Motion: along a horizontal line – along a vertical line	11	18	Lecture, Tutorial, Problem Solving, Test
	Force necessary to produce Simple Harmonic Motion.	7		
V	Collision of Elastic Bodies: Laws of Impact – Impact of smooth Sphere on a smooth plane	9	18	Lecture, Chalk and Talk, PPT, Problem Solving, Assignment
	Direct impact of two smooth spheres – Oblique impact of two smooth spheres.	9		
Total		90		

Course Learning Outcomes:

At the end of the course, students will be able to:

CLO	Course Learning Outcomes	Knowledge Level
CLO 1	Understand the concept of Resultant, Component of a Force, Coplanar forces, like and unlike parallel forces, Equilibrium of a Particle, Limiting equilibrium of a particle on an inclined plane.	Up to K2
CLO 2	Use the concept of Moment of a force and Couple with examples, Parallel Forces and Forces acting along a Triangle, Solve problems on frictional forces	Up to K3
CLO 3	Evaluate work, energy, power, rectilinear motions under varying forces. Simple Harmonic Motion and find its Geometrical representation.	Up to K3
CLO 4	Acquire the knowledge about Projectile, impulse, impact and laws of impact. Prove that the path of a projectile is a parabola and Find the direct and oblique impact of smooth elastic spheres	Up to K4
CLO 5	Use central orbits, explain conic as centered orbits and solve problems related to central orbits	Up to K3

Mapping of CLOs with PSOs

CLO	PSO1	PSO2	PSO3
CLO1	3	2	1
CLO2	3	2	1
CLO3	3	2	1
CLO4	3	2	1
CLO5	3	2	1

Mapping with CLOs with POs

CLO	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	2	2	1	-
CLO2	3	2	2	2	1	-
CLO3	3	2	3	2	2	-
CLO4	3	2	3	2	2	-
CLO5	3	2	3	2	3	-

3-AdvanceApplication

2-IntermediateLevel

1-BasicLevel

SUMMATIVE ASSESSMENT-BLUEPRINT

S. No.	CLOs	K– Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K-Level	No. of questions	K-Level		
1	CLO1	K2	2	K1 & K1	1	K1	2 (K1 & K1)	1(K2)
2	CLO2	K3	2	K2 & K3	1	K1	2 (K2 & K2)	1(K3)
3	CLO3	K3	2	K2 & K3	1	K2	2 (K3 & K3)	1(K3)
4	CLO4	K4	2	K3 & K4	1	K3	2 (K4 & K4)	1(K4)
5	CLO5	K3	2	K3 & K3	1	K2	2 (K3& K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented-solving problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of section wise marks with K-levels

K- Levels	Section A (No choice)	Section B (No choice)	Section C (Either /or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	5	2	20	30	57	47.5	47.5%
K4	1	-	10	10	21	17.5	17.5%
Total Marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS					CLASS: III B.Sc., MATHEMATICS			
Semester	Course Type	Course Code	Course Title	Credits	Contact hours/ Week	CIA	Ext.	Total
VI	Core Practical	23U6MCCP2	PRACTICAL IN C++	3	3	25	75	100

Nature of Course	Skill oriented		Employability oriented	✓	Entrepreneurship Oriented	

Course Objectives:

On completion of this course, the learner will be able to

- Understand and apply various object-oriented features.
- Use appropriate data types to design C++ classes for code reuse.
- Understand dynamic memory management techniques using pointers, constructors and destructors.
- Know the concepts in operator overloading and function overloading.

S. No.	List of Programs	K-Levels	Hours
1	Write a C++ program to convert temperature in Fahrenheit to Celsius	Up to K3	9
2	Write a C++ program to calculate the variance and standard deviation of n numbers.		
3	Write a C++ program to find the factorial of a number.		
4	Develop a C++ program to add two integers using classes and objects.	Up to K3	9
5	Using the idea of friend function returning object technique to add two complex numbers.		
6	Develop a C++ program to implement banking operations.		
7	Write an object-oriented program to generate and display the Pascal triangle using constructors.	Up to K4	9
8	Adding two times using parameterized constructors.		
9	Develop a C++ Program using Copy Constructors		
10	Develop a C++ Program using Dynamic Constructors		
11	Write an object-oriented program with the help of unary operator overloading concept to check whether the given number is Armstrong or not.	Up to K3	9
12	Develop an OOP to implement binary operator overloading using friend function. (Add and Subtract Complex numbers)		
13	Develop an OOP to implement single inheritance to display student details.	Up to K4	9
14	Develop an OOP to implement Multilevel inheritance (Area of triangle and its internal angles provided the sides of triangles).		
15	Write an object-oriented program for multiplying two numbers by implementing multiple inheritances.		

Book for Study:

1. Object Oriented Programming with C++ by E. Balagurusamy, 8th Edition -2021, McGraw Hill Education (India), Private Limited, New Delhi.

Books for Reference:

1. C++ - The Complete Reference by Herbert Schildt, 1998, TMH
2. How to program by Paul Deitel, Harvey Deitel, Ninth edition (2014), PHI
3. Object Oriented Programming with ANSI & Turbo C++ by Ashok N. Kamthane, Pearson Education.
4. Object Oriented Programming with C++ by Poornachandra Sarang, second edition, PHI

Web Resources:

1. <https://www.learncpp.com/>
2. <https://hackr.io/tutorials/learn-c-plus-plus>
3. <https://www.programiz.com/cpp-programming/examples>

Rationale for the Nature of Course

Employability Oriented: Thinking in an object-oriented manner involves envisioning program components as objects that belong to classes and are similar to concrete objects in the real world; C++ is a general-purpose programming language and widely used nowadays for competitive programming. 1. Practice to implement programs 2. Bug fixing

Pedagogy

Demonstration of Programs, Quiz, Group-Discussion, Practical Session.

Course Designer:

1. **Dr.R.CHITRA**, Assistant Professor, Department of Mathematics & Statistics.

Course Learning Outcomes:

At the end of the course, the student will be able to:

Number	Course Learning outcome	Knowledge level
CLO1	Write code that includes the reuse of both existing code and calling functions in the C++ libraries	Up to K3
CLO2	Demonstrate an understanding of the overall syntax and semantics of C++ programs by writing small programs using classes and objects	Up to K3
CLO3	Use constructors to initialize the object with the default or initial state.	Up to K4
CLO4	Apply the overloading to provide a special meaning of an operator for a user-defined data type.	Up to K3
CLO5	Write code that includes the reuse of both existing code and calling functions in the C++ libraries by applying inheritance concept	Up to K4

Mapping of CLOs with PSOs

CLOs	PSO -1	PSO -2	PSO -3
CLO -1	3	2	1
CLO -2	2	2	1
CLO -3	1	1	1
CLO -4	2	1	1
CLO -5	2	2	1

Mapping of CLOs with POs

CLOs	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6
CLO -1	3	2	2	1	1	2
CLO -2	2	2	1	1	2	1
CLO -3	1	1	1	2	1	2
CLO -4	2	1	2	-	1	1
CLO -5	2	3	1	1	2	2

Advance application– 3

Intermediate level–2

Basic level–1

DEPARTMENT OF MATHEMATICS				CLASS: III B.Sc., MATHEMATICS				
Semester	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext.	Total
VI	Discipline Elective	23U6MDET2 (A)	GRAPH THEORY AND APPLICATIONS	2	4	25	75	100

Nature of Course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship oriented	

COURSE OBJECTIVES:

- To introduce the notion of graph theory and its applications.
- To introduce some of the most important notions of Graph Theory and develop their skills and solving basic exercises.

Unit	Description	Hours	K-level	CLO(s)
I	Introduction - The Konigsberg Bridge Problem - Graphs and subgraphs: Definition and Examples - Degrees – Subgraphs.	12	K3	1
II	Isomorphism – independent sets and coverings- Matrices - Operations on Graphs.	12	K2	2
III	Walks, Trails and Paths –Connectedness and Components - Eulerian Graphs - Hamiltonian Graphs (Omit Chavatal Theorem).	12	K3	3
IV	Introduction-Characterization of Trees - Centre of a Tree- Directed Graphs: Introduction - Definitions and Basic Properties	12	K4	4
V	Some Applications: Connector Problem - Kruskal's algorithm – Shortest Path Problem – Dijkstra's algorithm.	12	K3	5

Book for Study:

- S. Arumugam and S. Ramachandran, Invitation to Graph Theory, SciTech Publications (India) Pvt. Ltd., Chennai, 2013.

UNIT – I: Chapter-1 Sec 1.0, 1.1 and Chapter -2 Sec 2.0, 2.1, 2.2, 2.3

UNIT – II: Chapter-2 Sec 2.4.2.6 2.8, 2.9

UNIT – III: Chapter-4 Sec 4.1, 4.2 and Chapter-5 Sec 5.0, 5.1, 5.2

UNIT – IV: Chapter-6 Sec 6.0, 6.1, 6.2, Chapter-10 Sec 10.0, 10.1

UNIT – V: Chapter-11 Sec 11.0, 11.1, 11.2

Books for References:

- Narsingh Deo, Graph Theory with applications to Engineering and Computer Science, Prentice Hall of India, 2004.
- Choudum S A, A first Course in Graph Theory, Macmillan India Limited, Chennai, First Edition, 1987.

3. Harary, Graph Theory, Narosa Publishing House, 2001.
4. Gary Chartrand and Ping Zhang, Introduction to Graph Theory, Tata Mc Graw-Hill Edition, 2004.

Web Resources:

<https://nptel.ac.in>

Rationale for Nature of the course

In mathematics and computer science, a graph is a mathematical structure that consists of two main components: vertices (or nodes) and edges. The study of these graphs in various contexts is called graph theory. There are various applications of graph theory in real life such as in computer graphics and networks, biology, and many other fields as well.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Case study, Formulation and Analysis plan and problem solving

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Course Designer:

1. **Dr.K.LAKSHMI**, Assistant Professor, PG and Research Department of Mathematics

Course Schedule

Unit	Description	Hours	Mode
I	Introduction - The Konigsberg Bridge Problem -	4	Lecture, Quiz, Tutorial
	Graphs and subgraphs: Definition and Examples - Degrees – Subgraphs.	8	
II	Isomorphism – independent sets and coverings- Matrices - Operations on Graphs.	12	Lecture, Quiz
III	Walks, Trails and Paths –Connectedness and Components	6	PPT, Lecture, Quiz
	Eulerian Graphs - Hamiltonian Graphs (Omit Chavatal Theorem).	6	
IV	Introduction-Characterization of Trees - Centre of a Tree- Directed Graphs: Introduction - Definitions and Basic Properties	12	Lecture, Tutorial
V	Some Applications: Connector Problem - Kruskal's algorithm - Shortest Path Problem – Dijkstra's algorithm.	12	PPT, Lecture, Quiz
Total		60	

Course Learning Outcomes

At the end of the course, the student will be able to:

CLO	Course Learning Outcomes	K-level
CLO1	Understand and apply the fundamental concepts in graph theory.	Up to K2
CLO2	Apply graph theory - based tools in solving practical problems	Up to K3
CLO3	Understand walk, path, trials, Eularian graphs	Up to K4
CLO4	To understand the trees.	Up to K4
CLO5	To explain the Kruskal's algorithm and Dijkstra's algorithm.	Up to K5

Mapping of CLOs with PSOs

CLO	PSO1	PSO2	PSO3
CLO1	3	2	3
CLO2	3	1	-
CLO3	3	1	-
CLO4	2	2	-
CLO5	2	2	1

Mapping with CLOs with POs

CLO	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	2	1	1	-
CLO2	3	3	1	1	1	-
CLO3	3	3	-	1	1	1
CLO4	2	2	-	1	1	2
CLO5	2	2	2	1	1	2

3-AdvanceApplication

2-IntermediateLevel

1-BasicLevel

SUMMATIVE ASSESSMENT-BLUEPRINT

S. No.	CLOs	K Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K Level	No. of questions	K level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K1	2(K2 & K2)	1(K3)
3	CLO 3	Up to K4	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2(K4 & K4)	1(K4)
5	CLO 5	Up to K5	2	K3 & K4	1	K3	2(K4 & K4)	1(K4/K5)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - Solving Problems

K4 - Examining, analysing, presentation and make inferences with evidences

K5 - Evaluate the mistakes in answers

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30	30%
K4	2	-	20	10	32	26.67	27%
K5			-	10	10	8.33	8%
Total Marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS				CLASS: III B.Sc., MATHEMATICS				
Semester	Course Type	Course Code	Course Title	Credits	Contact Hours / week	CIA	Ext.	Total
VI	Discipline Elective	23U6MDET2 (B)	LOGISTICS AND SUPPLY CHAIN MANAGEMENT	2	4	25	75	100

Nature of Course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship oriented	

COURSE OBJECTIVES:

- To incorporate and learn the critical elements of logistics and supply-chain management processes based on the most relevant application in forward-thinking companies.
- To develop criteria and standards to achieve improved business performance by integrating and optimizing the total logistics and supply-chain process.
- To understand how Warehouse Management and, other functions in logistics fits into logistics & supply Chain Management.
- To understand how Managers, take decisions strategic, tactical and operations and how they are taken in Warehouse Management functional area.

Unit	Description	Hours	K-level	CLO
I	Introduction-Logistics and supply chain Management-Importance of Logistics and SCM-Objective of business logistics-Functions of Logistic management SCM process-Supply chain relationship-Channel structure-relationship management-channel relationship-Leadership-Logistical service alliances-approaches to study channels classification of middlemen-Graphic approach-channel arrangement classifications-conditions for successful SCM.	12	K3	CLO1
II	Transportation importance of transportation system-Model of transportation-Modelling-Mathematical Formulation of Transportation Problems – Initial basic solution by North-west Corner Rule, Row Minima Method, Column Minima Method-Least Cost Method – Vogel’s Approximation Method - Optimal solution by modified distribution (MODI) Method.	12	K2	CLO2
III	Mathematical Formulation of Assignment Problems – Solution to Assignment Problems –Hungarian method–minimization and maximization problem-Balanced and Unbalanced problems-Travelling Salesman Problem.	12	K3	CLO3
IV	Sequencing Problem – Introduction – Problem of Sequencing – Basic terms used in sequencing – No passing rule – Processing n jobs through two machines – Processing n jobs through three machines – Processing n jobs through K machines- -optimal sequence algorithm.	12	K4	CLO4

V	Games and Strategies –Introduction- Two –person zero-sum games- some basic terms- The maximin-minimax principle- Games without saddle points –mixed strategies- Graphic solution of 2xn and mx2 games- Dominance property	12	K3	CLO5

Books for Study:

1. Logistics and Supply chain management by Dr.L.Natarajan Margham publications.
2. Operations Research by Kanti Swarup, P.K. Gupta and Manmohan - Sultan Chand & Sons - 2006, 12th edition.

Text Book 1:

Unit I: Chapters 1, 3

Text Book 2:

Unit II: Chapter 10 (10.1-10.10, 10.13)

Unit III: Chapter 11 (11.1-11.5, 11.7)

Unit IV: Chapter 12 (12.1-12.5)

Unit V: Chapter 17 (17.1-17.7)

Books for Reference:

1. Logistics and Supply Chain Management Christopher, M (1992) Pitman Publishing, London.
2. Logistics and Supply Chain Management Cases and Concepts Raghuram, Rangaraj MccMillan
3. Gupta.P.K.and D.S. Hira – Operations Research - S.Chand and Company.
4. J. K. Sharma, Operations Research, Theory and Applications, Third Edition (2007) MacmillanIndia Ltd. Supply Chain Logistics Management-2nd Edition Bowersox, Closs, Cooper McGraw
5. Hillier, F.S. and G.J. Lieberman, *Introduction to Operations Research*, 9th Ed., Tata McGrawHill, Singapore, 2009.
6. Hamdy A. Taha, *Operations Research, An Introduction*, 8th Ed., Prentice Hall India, 2006.

Web Resources:

1. <https://www.economicdiscussion.net/supply-chain-management/supply-chain-management/32495>
2. <https://backup.pondiuni.edu.in/sites/default/files/Logistics%20Supply%20Chain%20Mgt200813.pdf>
3. <https://www.linearprogramming.info/northwest-corner-method-transportation-algorithm-in-linear-programming/>
4. <https://kanchiuniv.ac.in/coursematerials/OperationResearch.pdf>
5. <https://www.srividyaengg.ac.in/coursematerial/CSE/104745.pdf>

Rationale and activities having direct bearing on Nature of Course

This course is to develop the ability to evaluate any logistics operations to which they are exposed and determine if it is working effectively. Logistics & Supply Chain concerned with the efficient flow of materials, products, and information within and among organizations. Supply chain management involves the integration of business processes across organizations, from material sources and suppliers through manufacturing and processing to the final customer. The program provides students with the core knowledge related to a wide variety of supply chain activities, including demand planning, manufacturing planning and control, purchasing, transportation

management, warehouse management, inventory control, material handling, product and service support, information technology, and strategic supply chain management.

Activities having direct bearing on Skill Development /Employability/Entrepreneurship

This course imparts theoretical knowledge & Problem-Solving Skills to the students and is crafted to help the students to knowing the best techniques in a given theory. Theoretical learning gives the guidance. Theoretical knowledge explains the why factor at the back of any situation and technique of working.

Pedagogy

Lecture, Seminar, Quiz, Problem Solving, Tutorial, Group Discussion, PPT

Course Designer:

1. **Dr. M. REVATHI**, Coordinator, Department of Mathematics & Statistics.

Course Schedule

Units	Topic	Hours	Mode
I	Introduction of logistics and supply chain Management-Importance of Logistics and SCM	4	PPT, Chalk and Talk, Test, Quiz
	Objective of business logistics-Functions of Logistic management SCM process, Supply chain relationship-Channel structure-relationship management-channel relationship	4	
	Graphic approach-channel arrangement classifications-conditions for successful SCM and related problems.	4	
II	Introduction of the Transportation model– the Transportation Method- Linear Programming Formulation of the Transportation Problem and Methods of calculating IBFS	4	Chalk and Talk, Problem solving, Seminar & Quiz, Test
	Solution of North west corner rule, Least cost method and Vogel's approximation method	4	
	MODI Method of optimality and Solution of Problems on MODI Method of optimality.	4	
III	Introduction to Assignment Model with examples. Solution of Problems on Assignment Problem.	4	Chalk and Talk, Problem solving, PPT, Quiz, Test
	Hungarian method concept and minimization and maximization problem	4	
	Travelling Salesman Problem and Solution of Problems on Travelling Salesman Problem.	4	
IV	Introduction of Sequencing Problem – Problem of Sequencing – Basic terms used in sequencing – No passing rule.	4	Chalk and Talk, Seminar, GD, Test, Assignment, Quiz
	Explain about Processing n jobs through two machines – Processing n jobs through three machines.	4	
	Processing n jobs through K machines- -optimal sequence algorithm and related problems.	4	
V	Games and Strategies –Introduction- Two –person zero-sum games- some basic terms.	4	Chalk and Talk, Seminar, GD, Assignment, Quiz
	The maximin-minimax principle- Games without saddle points – mixed strategies	4	
	mixed strategies-Graphic solution of 2xn and mx2 games- Dominance property	4	
Total		60	

Course Learning Outcomes:

At the end of the course, students will be able to:

CLO	Course Learning outcome	Knowledge level
CLO1	Understand the logistical decisions (e.g., facilities, inventory, and transportation) impact the performance of the firm as well as the entire supply chain. Identify and Analyze Business Models, Business Strategies and, corresponding Competitive Advantage and to provide a brief overview of the set of activities that make up the logistics process.	Up to K3
CLO2	Analyze how supply chain decisions related to facility location can be applied to various industries and designing the supply chain and the relationship between Supply Chain Management and Integrated Logistics.	Up to K2
CLO3	Formulate and understand the importance of transportation in logistics management.	Up to K3
CLO4	Solve Transportation and Assignment Problems.	Up to K4
CLO5	Apply sequencing algorithm and find the solution of problem	Up to K3

Mapping of CLOs with PSOs

CLO	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	2	3	2	3
CLO2	3	3	3	3	3
CLO3	3	3	3	3	1
CLO4	3	2	3	2	3
CLO5	3	2	3	-	1

Mapping of CLOs with POs

CLO	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	2	3	2	-
CLO2	3	3	2	3	2	-
CLO3	3	3	2	3	3	1
CLO4	3	3	2	3	2	2
CLO5	3	3	2	3	2	2

3-AdvanceApplication

2-IntermediateLevel

1-BasicLevel

SUMMATIVE ASSESSMENT – BLUE PRINT

S. No.	CLOs	K–Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K-Level	No. of questions	K-Level		
1	CLO1	UptoK3	2	K1&K2	1	K1	2 (K2&K2)	1(K3)
2	CLO2	UptoK2	2	K1&K2	1	K1	2 (K2&K2)	1(K2)
3	CLO3	UptoK3	2	K1&K2	1	K2	2 (K3&K3)	1(K3)
4	CLO4	UptoK4	2	K1&K2	1	K2	2 (K4& K4)	1(K4)
5	CLO5	UptoK3	2	K1&K2	1	K2	2 (K3& K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of section wise marks with K-levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	5	4	10	-	09	7.50	41.67%
K2	5	6	10	10	41	34.16	
K3	-	-	20	30	50	41.67	41.67%
K4	-	-	10	10	20	16.67	16.66%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS				CLASS : III B.Sc. MATHEMATICS				
Semester	Course Type	Course Code	Course Title	Credits	Contact Hours/ week	CIA	Ext.	Total
VI	Prof. Compt. Skill	23U6MSED8	ACTUARIAL SCIENCE	2	2	25	75	100

Nature of Course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

Course Objectives:

The objectives of the course is

- Develop as greater understanding of statistical principles and their application in actuarial statistics.
- Describe the core areas of actuarial practice and relate to those areas actuarial principles, theories and models.
- It gives the understanding of the application knowledge of the life insurance environment.

Unit	Description	Hours	K-level	CLO(s)
I	Compound interest - Present value accumulated values of fixed rate, varying rate of interest.	6	K2	1
II	Mortality: Gompertz-Makeham laws of mortality-life tables. Annuities: Endowments, Annuities-Simple problems	6	K2	2
III	Policy Values: Surrender values and paid up policies, industrial assurances - Premiums-Simple problems.	6	K2	3
IV	Contingent Functions: Contingent probabilities, assurances. Decrement tables. Pension funds: Capital sum on retirement and death-simple problems	6	K2	4
V	Principles of insurance, pure endowment, whole life assurance, Net premium for assurance and annuity plans-level.	6	K2	5

Book for Study:

1. Mathematical Basis of Life Assurance (IC-81) (2000), published by insurance institute of India, Bombay.
2. S.C. Gupta and V. K. Kapoor, (2007) ,Fundamentals of Applied Statistics, sultan chand and sons, New Delhi.

Unit I - Text Book 1: Chapter 1(Page No: 1-6, 12-17)

Unit II - Text Book 1: Chapter 2(Page No: 27-50), Chapter 9(Page No: 248-263)

Text Book 2: Chapter 9(Page No: 9.15-9.18, 9.33)

Unit III - Text Book 1: Chapter 15(Page No: 349-366)

Unit IV - Text Book 1: Chapter 16(Page No: 369-375)

Unit V - Text Book 1: Chapter 11(Page No: 289-296),

Chapter 12(Page No: 317-321)

Books for References:

1. Actuarial Mathematics for life Contingent Risks by David Dickinson, Mary Hardy, and Howard waters.
2. Hosack, I.B., Pollard, J.H. and Zehnwrth, B. (1999): introductory statistics with applications in general insurance, Cambridge University.
3. An introduction to Actuarial Mathematics by Michiel Gerhard and Thomas Mikosch.

Web Resources:

1. <http://mshaocong.github.io/actuarial.pdf>
2. <https://www.investopedia.com/terms/c/cash-value-life-insurance.asp>
3. <http://www.atlas-mag.net/en/article/pension-fund-and-social-investment>

Rationale for Nature of the course

The strength of our Actuarial Statistics subjects is the emphasis on understanding statistical concepts and methods, and their practical application to actuarial problems. In both CS1 and CS2, emphasis is placed on being able to apply statistical methods to actuarial problems using real data sets and the open-source software environment R. In designing these new subjects will enhance Actuarial Science for our student members through the development of transferable skills and enhanced employability.

Activities having direct bearing on Skill development/ Employability /Entrepreneurship

Seminars, Assignments, Group Discussion, Quiz.

Pedagogy

Chalk and Talk, PPT, Quiz, Group discussion, Seminar, Interaction, Tutorial sessions

Course Designer:

1. **Prof.V.VIJAYALAKSHMI**, Assistant Professor, Department of Mathematics.

Course Schedule

Unit	Topics	Hours	Mode
I	Simple and compound interest, present value and accumulated values of fixed rate, varying rate of interest.	2	PPT, Chalk Test, Quiz and Talk.
	Present value and accumulated values of fixed rate.	3	
	Accumulated values of fixed rate, varying rate of interest.	3	
II	Mortality: Gompertz-Makeham laws of mortality-life tables	3	PPT, Chalk and Talk, Test
	Annuities: Endowments, Annuities,	3	
III	Policy Values: Surrender values and paid up policies,	2	PPT, Chalk and Talk, quiz,
	Industrial assurances.	2	
	Premiums-Simple problems.	2	
IV	Contingent Functions: Contingent probabilities, assurances.	2	PPT, Chalk and Talk, Quiz, Test
	Decrement tables. Pension funds: Capital sum son retirement	2	
	Capital sum son retirement death.	2	
V	Principles of insurance, pure endowment, whole life assurance, Net premium for assurance and annuity plans.	3	Assignments, Seminar and Quiz
	Level annual premium under temporary assurance.	3	
	Total	30	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CLO	Description	K- level
CLO 1	To explain the utility them or y and insurance terminologies.	Upto K3
CLO 2	To articulate the insurance and annuity benefits through multiple life functions evaluation for special mortality laws.	UptoK2
CLO 3	To describe the various types of premium and their numerical evaluations.	UptoK3
CLO 4	To describe Insurance payable at the moment of death and at the end of the year of death-level benefit insurance.	UptoK4
CLO 5	To explain implementation of the Life insurance policies. To understand real life problems related to insurance.	UptoK3

Mapping of CLOs with PSOs

CLO	PSO-1	PSO-2	PSO-3
CLO-1	1	3	1
CLO-2	2	1	2
CLO-3	2	2	2
CLO-4	2	3	1
CLO-5	1	1	3

Mapping of CLOs with Pos

CLO	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	2	2	2	1	2	1
CLO2	3	2	2	1	2	1
CLO3	2	2	2	1	2	1
CLO4	3	2	2	1	2	1
CLO5	2	2	2	1	2	1

Advance application-3

Inter mediate level-2

Basic level-1

SUMMATIVE ASSESSMENT-BLUEPRINT

S. No.	CLOs	K–Level	Section A		Section B		Section C (Either /or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. Of questions	K-Level	No. Of questions	K- Level		
1	CLO1	UptoK3	2	K1&K2	1	K1	2(K2& K2)	1(K3)
2	CLO2	UptoK2	2	K1&K2	1	K1	2(K2&K2)	1(K2)
3	CLO3	UptoK3	2	K1&K2	1	K2	2(K3& K3)	1(K3)
4	CLO4	UptoK4	2	K1&K2	1	K2	2(K4& K4)	1(K4)
5	CLO5	UptoK3	2	K1&K2	1	K2	2(K3& K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	5	4	-	-	09	7.50	41.67%
K2	5	6	20	10	41	34.16	
K3	-	-	20	30	50	41.67	41.67%
K4	-		10	10	20	16.67	16.66%
Total Marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS				CLASS : III B.Sc. MATHEMATICS				
Semester	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext.	Total
VI	Project	23U6MPROV	PROJECT AND VIVA-VOCE	2	3	25	75	100

Nature of Course	Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	

Objectives:

The objectives of the course is

- To make students to develop the research aspect perspectives in both pure and applied mathematics.
- To develop scientific, systematic approach to problem solving and research methodology.
- To recommend research writing aptitude among students.

During the sixth semester, students shall undertake a project work and submit the project report.

Course Learning Outcomes:

At the end of the course, the student will be able to:

CLO	Course Learning Outcomes	K – Level
CLO1	Survey scientific literature available and identify gaps in existing studies.	K2
CLO2	Design a scientific study taking practical constraints into account.	K3
CLO3	Perform the scientific study taking practical constraints into account.	K3
CLO4	Analyse the results.	K4
CLO5	Communicate the findings based on ethical standards of reporting.	K3

Mapping of CLOs with PSOs

CLO	PSO1	PSO2	PSO3
CLO1	3	2	3
CLO2	3	3	2
CLO3	3	3	2
CLO4	3	2	3
CLO5	3	3	3

Mapping of CLOs with POs

CLO	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	3	3	3	3
CLO2	2	2	2	2	2	2
CLO3	3	3	3	3	3	3
CLO4	3	3	3	3	3	3
CLO5	2	2	3	3	3	3

Advance application-3;

Intermediate level-2;

Basic level-1

Internal & External Valuation for Project

Internal 25 Marks	External 75 Marks
<u>Research Supervisor/ Guide Evaluation</u> • 10 marks for Students ability and interest. • 10 marks for Regularity and Punctuality. • 5 marks for Quality of the work and Presentation.	<u>External Evaluation</u> • 25 marks for Viva Voce • 50 marks for Report, Presentation and Quality of work (in the presence of HOD every guide jointly with external examiner.

DEPARTMENT OF MATHEMATICS				CLASS: I B.Sc., (COMPUTER SCIENCE WITH ARTIFICIAL INTELLIGENCE)				
Semester	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext.	Total
I	Allied-I	23U1MGET1 (D)	NUMERICAL METHODS	5	6	25	75	100

Nature of Course	Skill Oriented	✓	Employability Oriented		Entrepreneurship Oriented	

Objectives:

The objectives of the course is

1. To make understand the fundamentals of algebraic equations.
2. To solve problems using numerical differentiation and integration.
3. To solve linear systems, numerical solution of ordinary differential equations.

Unit	Description	Hours	K-Level	CLO
I	FUNDAMENTALS OF ALGEBRAIC EQUATION: Solution of algebraic and transcendental equations- Bisection method – Fixed point iteration method – Newton Raphson method – Linear system of equations – Gauss elimination method – Gauss Jordan method .	18	K2	CLO 1
II	ITERATIVE, INTERPOLATION AND APPROXIMATION: Iterative methods - Gauss Jacobi and Gauss Seidel – Eigen values of a matrix by Power method and Jacobi's method for symmetric matrices. Interpolation with unequal intervals – Lagrange's interpolation – Newton's divided difference interpolation.	18	K3	CLO 2
III	INTERPOLATION WITH EQUAL INTERVAL: Difference operators and relations. -Interpolation with equal intervals – Newton's forward and backward difference formulae.	18	K3	CLO 3
IV	NUMERICAL DIFFERENTIATION AND INTEGRATION: Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal, Simpson's 1/3 rule.	18	K4	CLO 4
V	INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS: Single step methods – Taylor's series method – Euler's method – Modified Euler's method - Runge Kutta method for solving(first, second , Third and 4th) order equations – Multi step methods	18	K3	CLO 5

Book for study:

1. P. Kandasamy , K. Thilagavathy and K. Gunavathy – “Numerical Methods”, S.Chand& Company Ltd., Reprint 2019.

Unit 1: Chapter - 3 : 3.1, 3.2, 3.4 & Chapter - 4 : 4.1 – 4.2

Unit 2: Chapter - 4 : 4.7– 4.9, Chapter - 13 : 13.1 – 13.2 & Chapter - 8

Unit 3 : Chapter - 9 : 9.1 – 9.3

Unit 4: Chapter - 9: 9.9 & 9.13

Unit 5: Chapter - 11 : 11.1 – 11.7, 11.9, 11.11 – 11.12, 11.16 – 11.17

Books for Reference:

1. S. Arumugam, A. Thangapandi Isaac, A. Somasundaram, Numerical Methods- 2022, (Reprint) Scitech, publications(India), Pvt.Ltd.
2. Balasubramaniam, Pand Venkatraman, M.K. (1972) Numerical Mathematics, Part I and II, Rochouse and Sons, New Delhi.
3. Saxena, H.C. (1972) Finite differences, S. Chand & Co, New Delhi.
4. Rajaraman, V. (1993) Computer Oriented Numerical Methods, PHI learning, New Delhi.
5. Sastry, S. S. (1993) Introductory Methods of Numerical Analysis, PHI learning, New Delhi.
6. Hutchison, I. H. (2015), A student guide to Numerical Methods, Cambridge University Press, Cambridge.

Web Resource

https://onlinecourses.swayam2.ac.in/cec22_cs20/preview

Rationale for nature of course

In this course, mathematical modelling methods for engineering systems are studied. It entails the creation of mathematical models and the use of computers to address engineering issues using the following computational methods: Taylor Series approximation, numerical differentiation, root-finding with bracketing and open methods, fitting linear and polynomial curves, resolving matrices, numerical integration, and solving differential equations. Numerical analysis is used during laboratory sessions.

Activities having direct bearing on Skill Development / Employability / Entrepreneurship

The course imparts theoretical knowledge and problem solving skills to the students and is crafted to help the students to knowing the best techniques in a given theory. Theoretical learning gives the guidance. Theoretical knowledge explains the why factor at the back of any situation and technique of working.

Pedagogy

Lecture, Seminar, Quiz, Problem Solving, PPT, Group Discussion

Course Designer(s):

1. **Dr. M. REVATHI**, Coordinator , Department of Mathematics & Statistics.
2. **Dr. M. RAJARAM**, Assistant Professor, Department of Mathematics.

Course Schedule

Unit	Description	Hours	Mode
I	Solution of algebraic and transcendental equations- Bisection method.	6	Chalk and Talk
	Fixed point iteration method – Newton Raphson method –linear system of equations.	6	Lecture, Group Discussion
	linear system of equations – Gauss elimination method – Gauss Jordan method .	6	Lecture, Quiz, Problem Solving
II	Iterative methods - Gauss Jacobi and Gauss Seidel	6	Lecture,
	Eigen values of a matrix by Power method and Jacobi's method for symmetric matrices.	6	Chalk and Talk
	Interpolation with unequal intervals – Lagrange's interpolation – Newton's divided difference interpolation.	6	Lecture, Problem Solving
III	Difference operators and relations.	6	Lecture, Quiz,
	Interpolation with equal intervals	6	Lecture
	Newton's forward and backward difference formulae.	6	Problem Solving
IV	Approximation of derivatives using interpolation polynomials.	6	Chalk and Talk
	Numerical integration using Trapezoidal	6	Lecture, Quiz, Problem Solving
	Numerical integration using Simpson's 1/3 rule	6	Lecture, Seminar
V	Single step methods – Taylor's series method	6	Lecture, Quiz, Problem Solving
	Euler's method – Modified Euler's method	6	Lecture, Assignment
	Runge Kutta method for solving(first, second , Third and 4th) order equations – Multi step methods	6	Lecture, Seminar
Total		90	

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO	Description	K-level
CO1	Know how to solve various problems on numerical methods	Up toK2
CO2	Use approximation to solve problems	Up toK3
CO3	Differentiation and integration concept are applied	Up toK3
CO4	Apply , direct methods for solving linear systems	Up toK4
CO5	Numerical solution of ordinary differential equations	Up toK3

Mapping of CLOs with PSOs

CLO	PSO1	PSO2	PSO3
CLO1	1	3	1
CLO2	1	3	1
CLO3	1	3	1
CLO4	1	3	1
CLO5	1	3	1

Mapping of CLOs with POs

CLO	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	2	3	3	1	-	-
CLO2	2	3	3	1	-	-
CLO3	2	3	3	1	-	-
CLO4	2	3	3	1	-	-
CLO5	2	3	3	1	-	-

Advance applications – 3;**Intermediate level – 2;****Basic level – 1**

Blueprint for Semester Examination

Units	CLO	K. Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K. Level	No. of questions	K. level		
1	CLO 1	Up to K2	2	K1&K2	1	K1	2(K1& K1)	1(K2)
2	CLO 2	Up to K3	2	K1&K2	1	K2	2(K2 & K2)	1(K3)
3	CLO 3	Up to K3	2	K1&K2	1	K2	2(K3& K3)	1(K3)
4	CLO 4	Up to K4	2	K1&K2	1	K1	2(K4& K4)	1(K4)
5	CLO 5	Up to K3	2	K1&K2	1	K2	2(K3 & K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented-solving problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	5	4	10	-	19	15.83	41.66%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	41.67%
K4	-	-	10	10	20	16.67	16.67%
Total Marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS					CLASS: I B.Sc., (COMPUTER SCIENCE WITH ARTIFICIAL INTELLIGENCE)			
Semester	Course Type	Course Code	Course Title	Credits	Contact Hours/ Week	CIA	Ext.	Total
II	Allied-II	23U2MGET2 (D)	GRAPH THEORY AND APPLICATIONS	5	6	25	75	100

Nature of Course	Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	

Objectives:

The objectives of the course is

1. To understand and apply the fundamental concepts in graph theory.
2. To apply graph theory based tools in solving practical problems.
3. Analyzing the Various Concepts of Representation of Graphs.

Unit	Description	Hours	K-Level	CLO
I	INTRODUCTION: Graph-mathematical definition- Introduction – sub graphs – Walks, paths, Circuits connectedness- Components- Euler Graphs- Hamiltonian paths and circuits-Trees-properties of Trees- Distance and centers in Tree- Rooted and Binary Trees.	18	K3	CLO 1
II	CONNECTIVITY AND PLANARITY: Introduction to circuits - cut set- properties of cut set- All cut sets –connectivity and separability – Network Flows - 1-Isomorphism - 2-Isomorphism- Combinatorial and Geometric graphs- Planar Graphs – Different representation of planar graph.	18	K2	CLO 2
III	COLORING AND DIRECTED GRAPH: Basics of Colouring & Chromatic number – Chromatic partitioning – Graph Colouring – four colour Problem Chromatic polynomial - Matching – Covering - Directed graphs - Types of Directed Graphs – Diagraphs and binary relations – Directed paths- Euler Graph.	18	K3	CLO 3
IV	MATRIX REPRESENTATION IN GRAPH: Introduction, Representing Graphs, Adjacency Matrices, Incidence Matrices, spanning Trees of Connected Relations, Prim's Algorithm to construct Spanning Trees, Weighted Graphs, Minimal, Spanning Trees by Prim's Algorithm & Kruskal's Algorithm.	18	K4	CLO 4

V	APPLICATIONS OF GRAPH: Traveling Sales Person Problem with Directed and Undirected Graph - Shortest path from one to many Cities with directed graph- Shortest Paths with Undirected Graphs - Connected Components.	18	K3	CLO 5

Book for Study:

1. Narsingh Deo, Graph Theory with Application to Engineering and Computer Science Prentice Hall of India 2010 (Reprint)
2. Kenneth H. Rosen “Discrete Mathematics and Its Application, Mc Graw Hill, 2021.

Unit I –T1: Chapter 1 (1.1, 1.3-1.5),

Chapter 2 (2.2, 2.4-2.6, 2.9), Chapter 3 (3.1, 3.2, 3.4, 3.5)

Unit II-T1: Chapter 4 (4.1-4.8), Chapter 5 (5.1, 5.2, 5.4)

Unit III-T1: Chapter 8 (8.1-8.6), Chapter 9 (9.1-9.5)

Unit IV-T1: Chapter 3 (3.10)

T2: Chapter 9 (9.3.1-9.3.4), Chapter 10 (10.4.1, 10.5)

Unit V- T1: Chapter 2 (2.10), Chapter 11 (11.4, 11.5) , T2: Chapter 9 (9.6.3)

Books for Reference:

1. Discrete Maths for Computer Scientists & Mathematicians by Mott, Kandel, Baker.
2. Clark J and Holton D A , First look at Graph Theory, Allied Publishers 1995.
3. Discrete Maths for Computer Scientists & Mathematicians by Mott, Kandel, Baker.

Web Resource

1. <https://d3gt.com/>
2. <https://www.coursera.org/courses?query=graph%20theory>

Rationale for nature of course

Graph Theory, has applications in various fields. Graph theory has been serving as an elegant tool to easily approach/solve several problems/concepts in other fields ranging from Science to Sociology. This course will enable the students to acquire skills by which they can model certain real-life problems as graph theoretical terms and can make inferences.

Activities having direct bearing on Skill Development / Employability / Entrepreneurship

A mathematical structure that consists of two main components: vertices (or nodes) and edges. There are various applications of graph theory in real life such as in computer graphics and networks, biology, and many other fields as well.

Pedagogy

Lecture, Seminar, Quiz, Problem Solving, PPT, Group Discussion

Course Designer(s):

1. **Dr. M. REVATHI** , Coordinator , Department of Mathematics & Statistics.
2. **Dr. S.VALLIRANI**, Assistant Professor, Department of Mathematics.

Course Schedule

Unit	Description	Hours	Mode
I	Graph-mathematical definition- Introduction – sub graphs –Walks, paths, Circuits.	6	Lecture, Problem Solving
	Connectedness - Components- Euler Graphs- Hamiltonian paths and circuits	6	Lecture, PPT
	Trees- properties of Trees- Distance and centers in Tree- Rooted and Binary Trees.	6	Lecture, Quiz, Group Discussion
II	Introduction to circuits - cut set- properties of cut set.	6	Lecture
	All cut sets –connectivity and separability – Network Flows - 1-Isomorphism - 2-Isomorphism	6	Lecture, PPT
	Combinatorial and Geometric graphs- Planar Graphs – Different representation of planar graph.	6	Lecture, Group Discussion
III	Basics of Colouring & Chromatic number – Chromatic partitioning.	6	Lecture, Quiz, Problem Solving
	Graph Colouring – four colour Problem Chromatic polynomial - Matching – Covering.	6	Lecture, Seminar
	Directed graphs - Types of Directed Graphs.	3	Chalk and Talk
	Diagraphs and binary relations – Directed paths- Euler Graph.	3	PPT, Chalk and Talk
IV	Matrix representation of graphs, Sub graphs & Quotient Graphs.	6	Lecture, PPT
	Transitive Closure digraph, Euler's Path & Circuit (only definitions and examples), spanning Trees of Connected Relations,	6	Chalk and Talk, Assignments
	Prim's Algorithm to construct Spanning Trees, Weighted Graphs, Minimal, Spanning Trees by Prim's Algorithm & Kruskal's Algorithm.	6	Lecture, Quiz, Problem Solving
V	Traveling Sales Person Problem with Directed and Un directed Graph.	6	Lecture, Seminar
	Graph with n vertices and k colours	6	Lecture, Assignment
	Shortest path from one to many Cities with directed graph -Shortest Paths with Un directed Graphs- Connected Components.	6	Lecture, Assignment, Seminar
Total		90	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CO	Course learning outcome	K-level
CO1	To Introduce the fundamental concepts in graph theory Graphs, sub-graphs, walks, Euler graphs, Hamiltonian Paths Tree Properties, Hamiltonian paths and circuits.	Upto K3
CO2	Understanding the concepts of Circuits, Cut set and its Properties, Network Flows, Isomorphism and Combinatorial and Planar Graphs.	Upto K2
CO3	Applying the concept of Colouring with Chromatic Number, Directed Graphs, Matching, Covering Pattern and Euler Graphs.	Upto K3
CO4	Analysing the Various Concepts of Representation of Graphs, Euler Paths Circuit, Kruskals and Prims Algorithms, Connected Components.	Upto K4
CO5	Implementation of an application using all types of graphs and evaluate the Applications with travelling sales person Problem, K colour Problem with n vertices in a Graph and Shortest Path finding Problem using Directed and Undirected Graphs.	Upto K3

Mapping of CLOs with PSOs

CLO	PSO1	PSO2	PSO3
CLO1	2	2	3
CLO2	2	2	3
CLO3	2	2	3
CLO4	2	2	3
CLO5	2	2	3

Mapping of CLOs with POs

CLO	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	3	3	3	2
CLO2	3	2	3	3	3	2
CLO3	3	2	3	3	3	2
CLO4	3	2	3	3	3	2
CLO5	3	2	3	3	3	2

Advance applications – 3;

Intermediate level – 2;

Basic level – 1

Blueprint for Semester Examination

S. No.	CLOs	K – Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K – Level	No. of questions	K - Level		
1	CLO 1	Up to K3	2	K1 & K2	1	K1	2(K2 & K2)	1(K3)
2	CLO 2	Up to K2	2	K1 & K2	1	K1	2(K2 & K2)	1(K2)
3	CLO 3	Up to K3	2	K1 & K2	1	K2	2(K3 & K3)	1(K3)
4	CLO 4	Up to K4	2	K1 & K2	1	K2	2(K4 & K4)	1(K4)
5	CLO 5	Up to K3	2	K1 & K2	1	K2	2(K3 & K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented-solving problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	5	4	-	-	09	7.50	41.67%
K2	5	6	20	10	41	34.16	
K3	-	-	20	30	50	41.67	41.67%
K4	-		10	10	20	16.67	16.66%
Total Marks	10	10	50	50	120	100	100%



DEPARTMENT OF MATHEMATICS

Revised Curriculum

**TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION
(TANSCHE)**

(Choice Based Credit system with Outcome Based Education)

Academic Year 2025 - 2026 onwards

I and II semesters (M.Sc. Mathematics)



THE MADURA COLLEGE (Autonomous)

DEPARTMENT OF MATHEMATICS

VISION

To train the students so that they are strong in logic, which enables them to approach, analyze and solve any problem, both scientific and sociological, in an unbiased manner and to enhance the quantitative and analytical skill.

MISSION

- ❖ To provide an environment where students can learn and become an efficient and accurate problem solver of Mathematics and Mathematical applications.
- ❖ To make the students as Mathematical thinkers and enable them to become a long time learners of Mathematics.
- ❖ To make the students to have core knowledge and able to correlate this core mathematical knowledge with other disciplines

PROGRAMME OUTCOMES FOR M.Sc. GRADUATES:

At the end of the program the graduates will be able to

PO1: Disciplinary Knowledge: Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate programme of study.

PO2: Critical Thinking: Capability to apply analytic thought to a body of knowledge; analyze and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development.

PO3: Problem Solving: Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real-life situations.

PO4: Analytical Reasoning: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples and addressing opposing viewpoints.

PO5: Scientific Reasoning: Ability to analyse, interpret and draw conclusions from quantitative / qualitative data; and critically evaluate ideas, evidence, and experiences from an open-minded and reasoned perspective.

PO6: Self-directed & Lifelong Learning: Ability to work independently, identify and manage a project. Ability to acquire knowledge and skills, including "learning how to learn", through self-

placed and self-directed learning aimed at personal development, meeting economic, social and cultural objectives.

PROGRAMME SPECIFIC OUTCOMES:

PSO1: Acquire good knowledge and understanding, to solve specific theoretical & applied problems in different area of mathematics & statistics.

PSO2: Understand, formulate, develop mathematical arguments, logically and use quantitative models to address issues arising in social sciences, business and other context /fields.

PSO3: To prepare the students who will demonstrate respectful engagement with other's ideas, behaviors, beliefs and apply diverse frames of references to decisions and actions.

PSO4: To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations.

PSO5: To encourage practices grounded in research that comply with employment laws, leading the organization towards growth and development.



The Madura College, Madurai – 625 011
Department of Mathematics
PROGRAMME STRUCTURE – M.Sc., Mathematics

Sem	Course category	Course code	Title of the Course	Hours	Credits
I	Core	25P1MCCT1	ALGEBRAIC STRUCTURES	6	5
	Core	25P1MCCT2	REAL ANALYSIS – I	6	5
	Core	25P1MCCT3	ORDINARY DIFFERENTIAL EQUATIONS	6	4
	Discipline Elective	25P1MECT1(A)	NUMBER THEORY AND CRYPTOGRAPHY	5	3
		25P1MECT1(B)	FUZZY SETS AND APPLICATIONS		
	Discipline Elective	25P1MECT2(A)	GRAPH THEORY AND APPLICATIONS	5	3
		25P1MECT2(B)	DISCRETE MATHEMATICS		
	NME – I	25P1MSEN1	FOUNDATIONAL MATHEMATICS	2	2
Total				30	22
II	Core	25P2MCCT4	ADVANCED ALGEBRA	6	5
	Core	25P2MCCT5	REAL ANALYSIS – II	6	5
	Core	25P2MCCT6	PARTIAL DIFFERENTIAL EQUATIONS	6	4
	Discipline Elective	25P2MECT3(A)	RESOURCE MANAGEMENT TECHNIQUES	5	3
		25P2MECT3(B)	FORMAL LANGUAGE AND AUTOMATA THEORY		
	Discipline Elective	25P2MECT4(A)	MECHANICS	5	3
		25P2MECT4(B)	MODELLING AND SIMULATION WITH EXCEL		
	NME – II	25P2MSEN2	BUSINESS STATISTICS	2	2
Total				30	22
III	Core	25P3MCCT7	COMPLEX ANALYSIS	6	5
	Core	25P3MCCT8	TOPOLOGY	6	5
	Core – Programming Theory	25P3MCCT9	PROGRAMMING IN PYTHON	6	4
	SEC	25P3MSED1	PROBABILITY THEORY	5	3
	MDC	25P3MMDC	STOCHASTIC PROCESSES, STATISTICAL MECHANICS AND POINT GROUPS OF MOLECULES	5	3
	IKS	25P3MIKS	INDIAN KNOWLEDGE SYSTEM	2	2
	Internship / Industrial Visit	25P3MINTR	INTERNSHIP – INDUSTRIAL VISIT	-	2
Total				30	24

IV	Core	25P4MCCT10	FUNCTIONAL ANALYSIS	6	5
	Core	25P4MCCT11	DIFFERENTIAL GEOMETRY	6	4
	Core	25P4MCCT12	RESEARCH METHODOLOGY AND RESEARCH ETHICS	4	2
	Core - Programming Practical	24P4MCCP1	PRACTICAL IN PYTHON	4	2
	Project with Viva Voce	25P4MPROV	PROJECT WITH VIVA VOCE	6	6
	Elective – Industry/ Entrepreneurship	25P4MECT5(A)	MATHEMATICS FOR CSIR-UGC NET /GATE/ SET COMPETITIVE EXAMINATIONS	4	3
		25P4MECT5(B)	MATHEMATICAL METHODS		
	Extension Activity	25P4MEXTN	EXTENSION ACTIVITY	-	1
	Total				30
Grand Total				120	91

SEC – Skill Enhancement Course
MDC – Multidisciplinary Course
IKS – Indian Knowledge System



The Madura College, Madurai – 625 011

Department of Mathematics

COURSE DESCRIPTION WITH DESCRIPTOR ELEMENTS AND PERCENTAGE OF REVISION

Sem	Course Code	Title of the Course	Hours	Credits	Nature of Course (Employability/ Entrepreneurship/ Skill Development)			Scope of Focus (Local / National / Global developmental needs)			Percentage of Syllabus Revision/ New
					Empl.	Ent.	Skill	Local	National	Global	
I	25P1MCCT1	ALGEBRAIC STRUCTURES	6	5			Yes			Yes	14%
	25P1MCCT2	REAL ANALYSIS - I	6	5			Yes			Yes	11%
	25P1MCCT3	ORDINARY DIFFERENTIAL EQUATIONS	6	4			Yes			Yes	No Change
	25P1MECT1(A)	NUMBER THEORY AND CRYPTOGRAPHY	5	3			Yes			Yes	25%
	25P1MECT1(B)	FUZZY SETS AND APPLICATIONS					Yes			Yes	5%
	25P1MECT2(A)	GRAPH THEORY AND APPLICATIONS	5	3			Yes			Yes	No Change
	25P1MECT2(B)	DISCRETE MATHEMATICS					Yes			Yes	New
	25P1MSEN1	FOUNDATIONAL MATHEMATICS	2	2			Yes			Yes	No Change

II	25P2MCCT4	ADVANCED ALGEBRA	6	5			Yes			Yes	9%
	25P2MCCT5	REAL ANALYSIS - II	6	5			Yes			Yes	11%
	25P2MCCT6	PARTIAL DIFFERENTIAL EQUATIONS	6	4			Yes			Yes	No Change
	25P2MECT3(A)	RESOURCE MANAGEMENT TECHNIQUES	5	3	Yes		Yes			Yes	No Change
	25P2MECT3(B)	FORMAL LANGUAGE AND AUTOMATA THEORY					Yes			Yes	New
	25P2MECT4(A)	MECHANICS	5	3			Yes			Yes	No Change
	25P2MECT4(B)	MODELLING AND SIMULATION WITH EXCEL					Yes			Yes	New
	25P2MSEN2	BUSINESS STATISTICS	2	12			Yes			Yes	No Change

Emp.: Employability; Ent. : Entrepreneurship; Skill: Skill Development

SEMESTER – I

DEPARTMENT OF MATHEMATICS				CLASS: I M.Sc., Mathematics				
Semester	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Core	25P1MCCT1	ALGEBRAIC STRUCTURES	5	6	25	75	100

Nature of Course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship oriented	

Objectives:

To introduce the concepts and to develop working knowledge on class equation, solvability of groups, finite abelian groups, linear transformations, real quadratic forms.

Unit	Description	Hours	K-level	CLO
I	Counting Principle - Class equation for finite groups and its applications - Sylow's theorems	18	K3	CLO1
II	Solvable groups - Direct products - Finite abelian groups	18	K2	CLO2
III	Linear Transformations: Canonical forms –Triangular form - Nilpotent transformations.	18	K3	CLO3
IV	Jordan form - rational canonical form.	18	K4	CLO4
V	Trace and transpose - Hermitian, unitary, normal transformations	18	K3	CLO5

Book for study:

I.N. Herstein. Topics in Algebra (II Edition) Wiley Eastern Limited, New Delhi, 1975.

Unit I: **Chapter 2: Sections 2.11 and 2.12 (Theorem 2.12.1 Only)**

(Omit Lemma 2.12.5)

Unit II: **Chapter 5 : Section 5.7 (Lemma 5.7.1, Lemma 5.7.2, Theorem 5.7.1)**

Chapter 2: Section 2.13 and 2.14 (Theorem 2.14.1 only)

Unit III: **Chapter 6: Sections 6.4 and 6.5**

Unit IV: **Chapter 6 : Sections 6.6 and 6.7**

Unit V: **Chapter 6: Sections 6.8 and 6.10.**

Books for References:

1. M.Artin, Algebra, Prentice Hall of India, 1991.
2. P.B.Bhattacharya, S.K.Jain, and S.R.Nagpaul, Basic Abstract Algebra (II Edition) Cambridge University Press, 1997. (Indian Edition)

3. I.S.Luther and I.B.S.Passi, Algebra, Vol. I –Groups(1996); Vol. II Rings, Narosa Publishing House , New Delhi, 1999
4. D.S.Malik, J.N. Mordeson and M.K.Sen, Fundamental of Abstract Algebra, McGraw Hill (International Edition), New York. 1997.
5. N.Jacobson, Basic Algebra, Vol. I & II W.H.Freeman (1980); also published by Hindustan Publishing Company, New Delhi.

Web Resources:

1. <http://mathforum.org>
2. <http://ocw.mit.edu/ocwweb/Mathematics>
3. <http://www.opensource.org>, www.algebra.com

Rationale for Nature of the course

An algebraic structure may be based on other algebraic structures with operations and axioms involving several structures. Algebra helps to develop your critical thinking, Knowledge to find number of Sylow subgroups, Algebraic structures with their associated transformations, form mathematical categories and given polynomial is solvable by radicals or not.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Case study, Formulation and Analysis plan and problem solving

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Course Designer:

Dr.S.USHA, Assistant professor, PG and Research Department of Mathematics

Lecture Schedule

Unit	Description	Hours	Mode
I	Counting Principle - Class equation for finite groups and its applications	9	Lecture, Quiz
	Sylow's theorems	9	Lecture, Tutorial
II	Solvable groups - Direct products	9	Lecture, Quiz
	Finite abelian groups.	9	Lecture, Quiz
III	Linear Transformations: Canonical forms	9	PPT, Lecture
	Triangular form - Nilpotent transformations	9	Lecture, Quiz
IV	Jordan form	9	Lecture, Tutorial
	Rational canonical form	9	Lecture, Tutorial
V	Trace and transpose - Hermitian, unitary	9	PPT, Lecture
	Normal transformations.	9	Lecture, Quiz
Total Hours		90	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CO	Course Outcome	K-level
CLO-1	Recall basic counting principle, define class equations to solve problems, explain Sylow's theorems and apply the theorem to find number of Sylow subgroups.	Upto K2
CLO-2	Define Solvable groups, define direct products, examine the properties of finite abelian groups.	Upto K3
CLO-3	Define similar Transformations, define invariant subspace, explore the properties of triangular matrix, to find the index of nilpotence to decompose a space into invariant subspaces, to find invariants of linear transformation, to explore the properties of nilpotent transformation relating nilpotence with invariants.	Upto K4
CLO-4	Define Jordan, canonical form, Jordan blocks, define rational canonical form, define companion matrix of polynomial, find the elementary devices of transformation, apply the concepts to find characteristic polynomial of linear transformation.	Upto K4
CLO-5	Define trace, define transpose of a matrix, explain the properties of trace and transpose, to find trace, to find transpose of matrix, to prove Jacobson lemma using the triangular form, define symmetric matrix, skew symmetric matrix, adjoint, to define Hermitian, unitary, normal transformations and to verify whether the transformation in Hermitian, unitary and normal.	Upto K5

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	2	1	3	1	2
CLO-2	2	1	3	1	2
CLO-3	2	1	3	1	2
CLO-4	2	1	3	1	2
CLO-5	2	1	3	1	2

Mapping of CLOs with Pos

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	1	3	2	3	3
CLO2	2	1	3	1	3	3
CLO3	3	2	3	1	3	3
CLO4	1	2	3	2	3	3
CLO5	3	1	2	3	3	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

S. No.	CLOs	K Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K Level	No. of questions	K level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2 (K1 & K1)	1(K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K1	2(K2 & K2)	1(K3)
3	CLO 3	Up to K4	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2(K4 & K4)	1(K4)
5	CLO 5	Up to K5	2	K3 & K4	1	K3	2(K4 & K4)	1(K4/ K5)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - Solving Problems

K4 - Examining, analyzing, presentation and make inferences with evidences

K5 - Evaluate the mistakes in answers

Distribution of section wise marks with K levels.

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30	30%
K4	2	-	20	10	32	26.67	27%
K5			-	10	10	8.33	8%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS				CLASS: I M.Sc., Mathematics				
Semester	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Core	25P1MCCT2	REAL ANALYSIS - I	5	6	25	75	100

Nature of Course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship oriented	

Objectives:

- To learn about advanced topics in Riemann's Stieltjes Integrals.
- To understand the concepts of infinite series and products.
- To impart the knowledge of sequence and series of functions

Unit	Description	Hours	K-level	CLO
I	Functions of bounded variation - Introduction - Properties of monotonic functions - Functions of bounded variation - Total variation - Additive property of total variation - Total variation on $[a, x]$ as a function of x - Functions of bounded variation expressed as the difference of two increasing functions - Continuous functions of bounded variation. Infinite Series: Absolute and conditional convergence - Dirichlet's test and Abel's test - Rearrangement of series - Riemann's theorem on conditionally convergent series.	18	K3	1
II	The Riemann - Stieltjes Integral - Introduction - Notation - The definition of the Riemann - Stieltjes integral - Linear Properties - Integration by parts- Change of variable in a Riemann - Stieltjes integral - Reduction to a Riemann Integral – Euler's summation formula - Monotonically increasing integrators, Upper and lower integrals - Additive and linearity properties of upper, lower integrals - Riemann's condition - Comparison theorems.	18	K2	2
III	The Riemann-Stieltjes Integral - Integrators of bounded variation-Sufficient conditions for the existence of Riemann-Stieltjes integrals-Necessary conditions for the existence of RS integrals- Mean value theorems -integrals as a function of the interval – Second fundamental theorem of integral calculus-Change of variable -Second Mean Value Theorem for Riemann integral- Riemann-Stieltjes integrals depending on a parameter-Differentiation under integral sign-Lebesgue criteriaon for existence of Riemann integrals.	18	K3	3

IV	Infinite Products: Cesaro summability - Infinite products. Power series - Multiplication of power series - The Taylor's series generated by a function - Bernstein's theorem - Abel's limit theorem - Tauber's theorem	18	K4	4
V	Sequences of Functions – Pointwise convergence of sequences of functions - Examples of sequences of real - valued functions - Uniform convergence and continuity - Cauchy condition for uniform convergence - Uniform convergence of infinite series of functions - Riemann - Stieltjes integration – Non-uniform Convergence and Term-by-term Integration - Sufficient condition for uniform convergence of a series.	18	K3	5

Book for study:

Tom M. Apostol : *Mathematical Analysis*, 2nd Edition, Addison-Wesley Publishing Company Inc. New York, 1974.

Unit – I: Chapter – 6: Sections 6.1 to 6.8, Chapter 8: Sections 8.8, 8.15, 8.17, 8.18

Unit – II: Chapter – 7: Sections 7.1 to 7.14

Unit – III: Chapter - 7: Sections 7.15 to 7.26

Unit – IV: Chapter 8: Sections: 8.25 & 8.26

Chapter - 9: Sections 9.14 ,9.15, 9.19 to 9.23

Unit – V: Chapter - 9: Sections 9.1 to 9.6, 9.8,9.9,9.11.

Books for References:

1. Bartle, R.G. *Real Analysis*, John Wiley and Sons Inc., 1976.
2. Rudin, W. *Principles of Mathematical Analysis*, 3rd Edition. McGraw Hill Company, New York, 1976.
3. Malik, S.C. and Savita Arora. *Mathematical Analysis*, Wiley Eastern Limited, New Delhi, 1991.
4. Sanjay Arora and Bansi Lal, *Introduction to Real Analysis*, Satya Prakashan, New Delhi, 1991.
5. Gelbaum, B.R. and J. Olmsted, *Counter Examples in Analysis*, Holden day, San Francisco, 1964.
6. A.L. Gupta and N.R. Gupta, *Principles of Real Analysis*, Pearson Education, (Indian print) 2003.

Web Resources:

1. <http://mathforum.org>
2. <http://ocw.mit.edu/ocwweb/Mathematics>,
3. <http://www.opensource.org>

Rationale for Nature of the course

Real analysis is an area of analysis that studies concepts such as sequences and their limits, continuity, differentiation, integration and sequences of functions. By definition, real analysis focuses on the real numbers, often including positive and negative infinity to form the extended real

line. Various ideas from real analysis can be generalized from the real line to broader or more abstract contexts.

This course imparts theoretical knowledge & Problem Solving Skills to the students and is crafted to help the students to knowing the best techniques in a given theory. Theoretical learning gives the guidance to the mind and mind guides our body to convert that theoretical learning into practical performance. Theoretical knowledge explains the why factor at the back of any situation and technique of working

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Case study, Formulation and Analysis plan and problem solving

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Course Designer:

Dr.K.LAKSHMI, Assistant professor, PG and Research Department of Mathematics

Lecture Schedule

Unit	Description	Hours	Mode
I	Functions of bounded variation - Introduction - Properties of monotonic functions - Functions of bounded variation - Total variation - Additive property of total variation - Total variation on $[a, x]$ as a function of x - Functions of bounded variation expressed as the difference of two increasing functions - Continuous functions of bounded variation.	12	Lecture, Quiz, Tutorial
	Infinite Series: Absolute and conditional convergence - Dirichlet's test and Abel's test - Rearrangement of series - Riemann's theorem on conditionally convergent series.	10	Lecture, Tutorial
II	The Riemann - Stieltjes Integral - Introduction - Notation - The definition of the Riemann - Stieltjes integral - Linear Properties - Integration by parts- Change of variable in a Riemann - Stieltjes integral - Reduction to a Riemann Integral – Euler's summation formula - Monotonically increasing integrators, Upper and lower integrals - Additive and linearity properties of upper, lower integrals - Riemann's condition - Comparison theorems.	19	Lecture, Quiz
III	The Riemann-Stieltjes Integral - Integrators of bounded variation-Sufficient conditions for the existence of Riemann-Stieltjes integrals-Necessary conditions for the existence of RS integrals- Mean value theorems -integrals as a function of the interval –	9	PPT, Lecture, Quiz
	Second fundamental theorem of integral calculus-Change of variable -Second Mean Value Theorem for Riemann integral- Riemann-Stieltjes integrals depending on a parameter- Differentiation under integral sign-Lebesgue criteriaon for existence of Riemann integrals.	10	Lecture, Tutorial
IV	Infinite Series and infinite Products - Cesaro summability - Infinite products. Power series - Multiplication of power series - The Taylor's series generated by a function - Bernstein's theorem - Abel's limit theorem - Tauber's theorem	16	Lecture, Tutorial
V	Sequences of Functions – Pointwise convergence of sequences of functions - Examples of sequences of real - valued functions - Uniform convergence and continuity - Cauchy condition for uniform convergence - Uniform convergence of infinite series of functions -	8	PPT, Lecture
	Riemann - Stieltjes integration – Non-uniform Convergence and Term-by-term Integration - Sufficient condition for uniform convergence of a series.	6	Lecture, Quiz
Total Hours		90	

Course Learning Outcomes:

At the end of the course, Students will be able to

CLOs	Course Learning outcome	Knowledge level
CLO1	Analyze and evaluate functions of bounded variation and functions	Upto K3
CLO2	Describe the concept of Riemann-Stieltjes integral and its properties.	Upto K3
CLO3	Demonstrate the concept of Riemann-Stieltjes integrand it conditions.	Upto K3
CLO4	Construct various mathematical proofs using the properties of infinite series and products	Upto K4
CLO5	Formulate the concept and properties of sequence of functions.	Upto K5

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	3	2	2	1	2
CLO-2	3	2	2	1	2
CLO-3	3	2	2	1	2
CLO-4	3	2	2	1	2
CLO-5	3	2	2	1	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	2	3	3	2	3	2
CLO2	2	3	3	2	3	2
CLO3	2	3	3	2	3	2
CLO4	2	3	3	2	3	2
CLO5	2	3	2	2	3	2

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K-level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K-Level	No. of Questions	K- Level		
1	CLO 1	Up to K3	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)
2	CLO 2	Up to K3	2	K2 & K2	1	K1	2(K2 & K2)	1(K3)
3	CLO 3	Up to K3	2	K3 & K3	1	K2	2(K3 & K3)	1(K3)
4	CLO 4	Up to K4	2	K3 & K3	1	K2	2(K4 & K4)	1(K4)
5	CLO 5	Up to K5	2	K4 & K4	1	K3	2(K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - Solving Problems

K4 - Examining, analysing, presentation and make inferences with evidences

K5 - Evaluate the mistakes in answers

Distribution of section wise marks with K levels.

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30	30%
K4	2	-	20	10	32	26.67	27%
K5			-	10	10	8.33	8%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS					CLASS: I M.Sc., MATHEMATICS			
Sem.	Course type	Course code	Course title	Credits	Contact hours / Week	CIA	Ext	Total
I	Core	25P1MCCT3	ORDINARY DIFFERENTIAL EQUATIONS	4	6	25	75	100
Nature of course		Skill oriented	✓	Employability oriented		Entrepreneurship Oriented		

Objectives:

1. Develop strong background on finding solutions to linear differential equations with constant and variable coefficients and also with singular points.
2. Study the existence and uniqueness of the solutions of first order differential equations.
3. To solve the second order and n -th order Initial value problems.
4. Introduce the students to the technique of solving various problems of engineering and science.
5. Study the concepts relating to the order and linearity of ODEs, analytic and computational solution methods for ODEs

Unit	Description	Hours	K-level	CLO
I	Linear equations with constant coefficients Second order homogeneous equations-Initial value problems-Linear dependence and independence-Wronskian and a formula for Wronskian-Non-homogeneous equation of order two.	18	K2	CLO1
II	Linear equations with constant coefficients Homogeneous and non-homogeneous equation of order n – Initial value problems- Annihilator method to solve non-homogeneous equation- Algebra of constant coefficient operators.	18	K3	CLO2
III	Linear equation with variable coefficients Initial value problems -Existence and uniqueness theorems – Solutions to solve a non-homogeneous equation – Wronskian and linear dependence – reduction of the order of a homogeneous equation – homogeneous equation with analytic coefficients-The Legendre equation.	18	K4	CLO3
IV	Linear equation with regular singular points Euler equation – Second order equations with regular singular points –Exceptional cases – Bessel Function.	18	K4	CLO4
V	Existence and uniqueness of solutions to first order equations: Equation with variable separated – Exact equation – method of successive approximations – the Lipschitz condition – convergence of the successive approximations and the existence theorem.	18	K5	CLO5

Book for study:

E.A.Coddington, *An introduction to ordinary differential equations* (3rd Printing) Prentice-Hall of India Ltd., New Delhi, 1987.

Unit-I: Chapter 2: Sections 1 to 6

Unit-II: Chapter 2: Sections 7 to 12

Unit-III: Chapter 3: Sections 1 to 8 (Omit section 9)

Unit-IV: Chapter 4: Sections 1 to 4 and 6 to 8 (Omit sections 5 and 9)

Unit-V: Chapter 5: Sections 1 to 6 (Omit Sections 7 to 9)

Books for References:

1. Williams E. Boyce and Richard C. Di Prima, *Elementary differential equations and boundary value problems*, John Wiley and sons, New York, 1967.
2. George F Simmons, *Differential equations with applications and historical notes*, Tata McGraw Hill, New Delhi, 1974.
3. N.N. Lebedev, *Special functions and their applications*, Prentice Hall of India, New Delhi, 1965.
4. W.T. Reid. *Ordinary Differential Equations*, John Wiley and Sons, New York, 1971
5. M.D.Raisinghania, *Advanced Differential Equations*, S.Chand & Company Ltd. New Delhi 2001
6. B.Rai, D.P.Choudary and H.I. Freedman, *A Course in Ordinary Differential Equations*, Narosa Publishing House, New Delhi, 2002.

Web Resources

1. <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=ZLCHeZEhCZ8yCri36nSF3A==>
2. <https://tutorial.math.lamar.edu/classes/de/wronskian.aspx>
3. <https://archive.nptel.ac.in/courses/111/104/111104031/>

Rationale for Nature of the course

Knowledge and Skill

Ordinary differential equations have wide applications in various science disciplines. It is practically important for science students able to model physical problems using mathematical equations, then solve these equations so that the behaviour of the systems concerned can be studied.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Quiz, Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved.

Pedagogy

Lecture with PPT, Seminar, Tutorial, Group Discussion, Assignments

Course Designer(s):

1. Dr. V. Ananthaswamy, Associate Professor, Research Centre & PG Department of Mathematics.
2. Prof.V.Vijayalakshmi, Assistant Professor

Lecture Schedule

Unit	Topics	Hrs	Mode
I	Introduction	2	Lecture
	Second order homogeneous equations	3	Lecture
	Initial value problem for second order equations	3	Lecture & PPT
	Linear dependence and independence	2	Lecture
	Problems on Linear dependence and independence	2	Lecture
	A formula for Wronskian	3	Lecture
	The Non-Homogeneous equations of order two	3	Lecture
II	Homogeneous equations of order n	3	Lecture& Seminar
	Non-Homogeneous equation of order n	3	Lecture
	Initial value problems for n -th order equations	3	Lecture & PPT
	Annihilator method	3	Lecture
	Annihilator method to solve Non-Homogeneous equations	3	Lecture& Seminar
	Algebra of constant coefficient operators.	3	Lecture& Seminar
III	Initial value problem	3	Lecture
	Existence and Uniqueness theorem and solutions to solve non-homogeneous equations.	3	Lecture & PPT
	The Wronskian and Linear independence	3	Lecture
	Reduction of the order of a Homogeneous equation	2	Lecture
	Reduction of the order of a Homogeneous equation	2	Lecture & Seminar
	Homogeneous equations with analytic coefficients	2	Group Discussion
	The Legendre equations.	3	Lecture & Seminar
IV	The Euler equations	3	Lecture
	Second order equations with Regular singular points	3	Lecture
	Exceptional cases	4	Lecture & Seminar
	The Bessel equation	4	Lecture
	The Bessel equation continued.	4	Lecture & PPT
V	Equations with variable separated	2	Lecture
	Exact equations	3	Lecture & Seminar
	The method of successive approximation	2	Lecture
	The Lipschitz condition	2	Lecture & PPT
	Convergence of successive approximation	2	Assignment
	Non-local existence of solutions.	2	Group Discussion
	Approximations to and uniqueness of solutions.	2	Lecture
Total		90	

Course Learning Outcomes:

At the end of the course, students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Establish the qualitative behavior of solutions of systems of differential equations.	K2
CLO2	Recognize the physical phenomena modeled by differential equations and dynamical systems.	K3
CLO3	Analyze solutions using appropriate methods and give examples.	K4
CLO4	Formulate Green's function for boundary value problems.	K4
CLO5	Understand and use various theoretical ideas and results that underlie the mathematics in this course.	K5

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	3	2	2	1	2
CLO-2	3	2	2	1	2
CLO-3	3	2	2	1	2
CLO-4	3	2	2	1	2
CLO-5	3	2	2	1	2

Mapping of CLOs with Pos

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	2	3	3	2	3	2
CLO2	2	3	3	2	3	2
CLO3	2	3	3	2	3	2
CLO4	2	3	3	2	3	2
CLO5	2	3	2	2	3	2

Advance application– 3;

ntermediate level–2;

Basic level–1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

SL.No	CLOs	K-level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Question s	K-Level	No. of Question s	K- Level		
1	CLO 1	Up to K 2	2	K1 & K1	1	K1	2(K1& K1)	1(K2)
2	CLO 2	Up to K 3	2	K2& K3	1	K1	2(K2 & K2)	1(K3)
3	CLO 3	Up to K 4	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)
4	CLO 4	Up to K 4	2	K3 & K4	1	K2	2(K4& K4)	1(K4)
5	CLO 5	Up to K5	2	K3& K4	1	K3	2(K4& K4)	1(K5)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers.

K3 - Application oriented - Solving Problems.

K4 - Examining, analyzing, presentation and make inferences with evidences.

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30	30%
K4	2	-	20	10	32	26.67	26.67%
K5	-	-	-	10	10	8.33	8.33%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS				CLASS: I M.Sc. Mathematics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Elective	25P1MECT1(A)	NUMBER THEORY AND CRYPTOGRAPHY	3	5	25	75	100

Nature of the Course	Skill Oriented	✓	Employability oriented		Entrepreneurship oriented	

Objectives:

1. To understand the fundamentals of number theoretical algorithms and techniques.
2. To learn the concepts of congruence, quadratic residues and quadratic reciprocity.
3. Able to identify arithmetic functions and study their properties.
4. To apply the number theoretic concepts in modern cryptography.

Unit	Description	Hours	K-level	CLO
I	Divisibility Divisible – Division algorithm – GCD – Euclidean algorithm – LCM – Primes – Unique factorization theorem – Euclid theorem.	15	Up to K3	CLO1
II	Congruences Congruence's – Euler's function - Euler's Theorem – Fermat's theorem – Wilson's theorem – Solutions of congruence's – The Chinese Remainder Theorem – its problem.	15	Up to K3	CLO2
III	Quadratic Reciprocity Quadratic residues – Lemma of Gauss – greatest integer function - Gaussian reciprocity law – Jacobi symbol.	15	Up to K4	CLO3
IV	The function of Number Theory Greatest Integer function – Arithmetic functions – The Moebius Inversion formula.	15	Up to K3	CLO4
V	Cryptography Principles of public key Cryptosystem – RSA algorithm – Elliptic curve Arithmetic - Elliptic curve cryptography.	15	Up to K4	CLO5

Book for Study:

1. **An introduction to the theory of numbers** by Ivan Niven and Herbert Zuckerman, 5th Edition 2008, Wiley Eastern Limited, New Delhi.
2. **Cryptography and Network Security Principles and Practice** by William Stallings, Fifth Edition, 2011, Prentice Hall, New Delhi.

UNIT-I: B1: Chapter 1: Sec 1.1 -1.3

UNIT-II: B1: Chapter 2: Sec 2.1 - 2.3

UNIT-III: B1: Chapter 3: Sec 3.1 - 3.3

UNIT-IV: B1: Chapter 4: Sec 4.1 - 4.3

UNIT-V: B2: Chapter 9: Sec 9.1 - 9.2, Chapter 10: sec 10.3 – 10.4

Book for reference:

1. Introduction to Analytic Number theory, Tom Apostol, Narosa Publications, New Delhi
2. A Course in Number Theory and Cryptography, Neal Koblitz, Springer-Verlag, New York, 1987.
3. Elementary Number Theory, David M. Burton, Wm.C. Brown Publishers, Dubuque, Iowa, 1989.

Web Resources:

1. <https://nptel.ac.in/courses/106/103/106103015/>
2. <http://mathforum.org>.
3. <http://ocw.mit.edu/ocwwweb/Mathematics>
4. <http://www.opensource.org>, https://onlinecourses.nptel.ac.in/noc20_ma42/preview
5. https://onlinecourses.nptel.ac.in/noc20_ma42/preview

Rationale for Nature of the course:

Number theory helps to discover interesting relationships between different sorts of numbers. It also helps to learn the unique properties of prime and rational numbers. Understanding of the course, helps to encrypt and decrypt using basic concept of number theory and to break the code using RSA carelessly.

Pedagogy: Chalk and Talk, Problem Solving, Tutorial, Group Discussion, Quiz, Seminar.

Course Designer: Dr. I. Padmavathi, Assistant Professor, PG and Research Department of Mathematics, The Madura College (Autonomous), Madurai.

Lecture Schedule

Unit	Topics	Hrs	Mode
I	Divisibility - Division algorithm	3	Chalk and Talk, Problem Solving, Tutorial, quiz and test
	GCD, Euclidean algorithm	4	
	LCM and Properties	3	
	Primes and unique factorization theorem	5	
II	Congruence's - Euler's Theorem Quadratic residues – Lemma of Gauss	5	Chalk and Talk, Problem Solving, e-quiz and test
	Fermat's theorem – Wilson's theorem	5	
	Solutions of congruence's – The Chinese Remainder Theorem	5	
III	Quadratic residues – Lemma of Gauss	5	Chalk and Talk, group discussion, quiz and test
	Gaussian reciprocity law – its problems	5	
	Jacobi symbol – properties – problems	5	
IV	Greatest integer function	5	Chalk and Talk, tutorial, quiz and test
	Arithmetic functions	5	
	The Moebius Inversion formula	5	
V	Principles of public key Cryptography	3	Chalk and Talk, seminar, Assignment and quiz
	RSA algorithm and its problem	4	
	Elliptic curve Arithmetic and its examples	3	
	Elliptic curve cryptography and its application	5	
Total		75	

Course Learning Outcomes:

At the end of the course, students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Understand the concept of divisible, GCD and LCM	K3
CLO2	Solve the congruence and find the solution to congruence	K3
CLO3	Learn the idea of Quadratic residues and reciprocity.	K4
CLO4	Identify and solve the number theoretical functions.	K3
CLO5	Implement number theoretical concepts to encrypt and decrypt the plain text	K4

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	1	3	2	3
CLO2	2	1	3	1	3
CLO3	3	2	3	1	3
CLO4	1	2	3	2	3
CLO5	3	1	2	3	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	1	3	2	3	-
CLO2	2	1	3	1	3	1
CLO3	3	2	3	1	3	1
CLO4	1	2	3	2	3	3
CLO5	3	1	2	3	3	3

3 – Advance Application

2 – Intermediate Level

1 – Basic Level

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K-level	Section A		Section B		Section C	SectionD
			MCQs		Short Answers			
			No. of Questions	K-Level	No. of Questions	K-Level	(Either/or Choice)	(Open Choice)
1	CLO 1	K3	2	K1& K2	1	K1	2(K1&K1)	1(K3)
2	CLO 2	K3	2	K2& K3	1	K2	2(K3& K3)	1(K3)
3	CLO 3	K4	2	K3& K4	1	K3	2(K4& K4)	1(K4)
4	CLO 4	K3	2	K1& K3	1	K1	2(K2& K2)	1(K3)
5	CLO 5	K4	2	K3& K4	1	K2	2(K4& K4)	1(K4)
No.of Questions to be Asked			10		5		10	5
No.of Questions to be Answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

Distribution of Section-wise Marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C(Either/or)	Section D(Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	27%
K2	2	4	10	-	16	13.33	
K3	4	2	10	30	46	38.33	38%
K4	2	-	20	20	42	35.00	35%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS				CLASS: I M.Sc., Mathematics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Elective	25P1MECT1(B)	FUZZY SETS AND APPLICATIONS	3	5	25	75	100

Nature of Course	Skill oriented	✓	Employability oriented		Entrepreneurship oriented	

OBJECTIVES:

To provide an understanding of the basic mathematical elements of the theory of fuzzy sets and crisp sets. Fuzzy environments Provide the sufficient real life application thus the students can face the competitive world.

Unit	Description	Hours	K-level	CLO
I	Crisp sets and fuzzy sets Overview of Classical Sets, Membership Function, Height of a fuzzy set – Normal and sub normal fuzzy sets – Support – Level sets, cuts – Decomposition Theorems, Extension Principle.	18	K3	CLO1
II	Operation on fuzzy sets Standard fuzzy operations – Union, intersection and complement – properties De. Morgan's laws - $\square$ – Cuts of fuzzy operations.	18	K2	CLO2
III	Fuzzy relations Cartesian Product, Crisp relations – cardinality – operations and properties of Crisp and Fuzzy relations. Image and inverse image of fuzzy sets - Various definitions of fuzzy operations – Generalizations – Non interacting fuzzy sets, Tolerance and equivalence relations.	18	K3	CLO3
IV	Decision making in Fuzzy environments General Discussion – Individual Decision making – multi person decision making – multi criteria decision making – multi stage decision making – fuzzy ranking methods – fuzzy linear programming.	18	K4	CLO4
V	Applications Medicine – Economics – Fuzzy Systems and Genetic Algorithms – Fuzzy Regression – Interpersonal Communication – Other Applications.	18	K3	CLO5

Book for study:

George J.Klir and Bo Yuan , Fuzzy sets and Fuzzy Logic Theory and Applications, PHI Learning Private Limited, New Delhi (2009).

Unit I : Chapters 1&2

Unit II : Chapter 3: 3.1-3.5

Unit III : Chapter 5: 5.1-5.6

Unit IV: Chapter 15

Unit V: Chapter 17

Books for References:

1. A. K. Bhargava; Fuzzy Set Theory, Fuzzy Logic and their Applications, S. Chand Pvt. Limited (2013).
2. K.Pundir and R.Pundir, Fuzzy sets and their application, Published by A Pragati edition (2012)
3. H.J. Zimmermann, Fuzzy set theory and its applications

Web Resources:

1. <https://www.sciencedirect.com/topics/engineering/fuzzy-settheory#:~:text=Fuzzy%20set%20theory%20%5B9%5D%20allows,respect%20to%20the%20test%20instances.>
2. <https://nitsri.ac.in/Department/Computer%20Science%20&%20Engineering/FuzzyLogic.pdf>
3. https://www.tutorialspoint.com/fuzzy_logic/fuzzy_logic_set_theory.htm
4. <https://www.iitk.ac.in/eeold/archive/courses/2013/intel-info/d1pdf3.pdf>

Rationale for Nature of the course

This course, namely Fuzzy sets and its Applications, has applications in various fields. It is designed to give a solid grounding of fundamental concepts of fuzzy logic and its applications. The level of the course is chosen to be such that all students aspiring to be a part of computational intelligence directly or indirectly in near future should get these concepts.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Case study, Formulation an Analysis plan and problem solving

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Course Designer:

Dr.S.USHA, Assistant professor, PG and Research Department of Mathematics

Lecture Schedule

Unit	Description	Hours	Mode
I	Overview of Classical Sets, Membership Function, Height of a fuzzy set – Normal and sub normal fuzzy sets	7	Lecture, Quiz
	Support – Level sets, α -cuts – Decomposition Theorems, Extension Principle.	8	Lecture, Tutorial
II	Standard fuzzy operations – Union, intersection and complement	8	Lecture, Quiz
	Properties De. Morgan's laws - α -Cuts of fuzzy operations.	7	Lecture, Quiz
III	Cartesian Product, Crisp relations – cardinality – operations and properties of Crisp and Fuzzy relations. Image and inverse image of fuzzy sets.	7	PPT, Lecture
	Various definitions of fuzzy operations – Generalizations – Non interacting fuzzy sets, Tolerance and equivalence relations.	8	Lecture, Quiz
IV	General Discussion – Individual Decision making – multi person decision making – multi criteria decision making – multi stage decision making	7	Lecture, Tutorial
	Fuzzy ranking methods – fuzzy linear programming.	8	Lecture, Tutorial
V	Medicine – Economics – Fuzzy Systems and Genetic Algorithms.	8	PPT, Lecture
	Fuzzy Regression – Interpersonal Communication – Other Applications.	7	Lecture, Quiz
Total Hours		75	

Course Learning Outcomes:

At the end of the course, Students will be able to

CLOs	Course Learning outcome	Knowledge level
CLO1	Illustrate the concepts of Classical Sets, fuzzy sets, fuzzy points and α -cuts.	Upto K3
CLO2	Analyze the axioms and build operations on fuzzy sets	Upto K4
CLO3	Able to know the concept of various relations of fuzzy sets. Using this to analyse the properties and operations of Crisp and Fuzzy relations.	Upto K4
CLO4	Apply and evaluate multistage decision making in dynamic systems.	Upto K4
CLO5	Enhance the knowledge in various branches like Fuzzy Systems, Genetic Algorithms, Medicine, Economics.	Upto K3

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	3	3	2	3
CLO2	3	3	3	3	3
CLO3	3	3	3	3	3
CLO4	3	3	3	3	3
CLO5	2	3	3	1	2

Mapping of CLOs with POs

CLOs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	3	2	1	3
CLO2	3	3	3	3	1	3
CLO3	3	3	2	2	1	1
CLO4	3	3	3	3	1	2
CLO5	3	2	3	2	2	2

Advance application– 3

Intermediate level–2

Basic level-1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

S. No.	CLOs	K Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K Level	No. of questions	K level		
1	CLO 1	Up to K 2	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)
2	CLO 2	Up to K3	2	K2& K3	1	K2	2(K3& K3)	1(K3)
3	CLO 3	Up to K3	2	K2& K3	1	K1	2(K2 & K2)	1(K3)
4	CLO 4	Up to K4	2	K3& K4	1	K3	2(K4& K4)	1(K4)
5	CLO 5	Up to K4	2	K3 & K4	1	K2	2(K4& K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – solving problems

K4- Examining, analyzing, presentation and make inference with evidences.

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30	30 %
K4	2	-	20	20	42	35	35 %
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS					CLASS: I M.Sc., MATHEMATICS			
Sem	Course type	Course code	Course title	Credits	Contact hours / Week	CIA	Ext	Total
I	Elective	25P1MECT2(A)	GRAPH THEORY AND APPLICATIONS	3	5	25	75	100

Nature of course	Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objectives:

- To determine whether or not a given graph is Eulerian /Hamiltonian/planar.
- To inculcate proof techniques available in the topics of graph theory such as connectedness, distance, algorithms, transversability, connectivity, independence, covering, matching, planarity and colorings.

Unit	Description	Hours	K-level	CLO
I	Trees, Cut Edges and Bonds, Cut Vertices, Cayley's Formula – Applications: The Connector Problem – Connectivity, Blocks – Applications: Construction of Reliable Communication Networks.	15	Upto K3	CLO1
II	Euler Tours, Hamiltonian Cycles –Applications: The Chinese Postman Problem, The Travelling Salesman Problem.	15	Upto K3	CLO2
III	Matchings and Coverings in Bipartite Graphs, Perfect Matching – Applications: The Personnel Assignment Problem.	15	Upto K3	CLO3
IV	Chromatic Number, Brook's Theorem, Chromatic Polynomials, Girth and Chromatic Number – Applications: A Storage Problem.	15	Upto K4	CLO4
V	Directed Graphs, Directed Paths, Directed Cycles – Applications: A Job Sequencing Problem, Designing as Efficient Computer Drum.	15	Upto K4	CLO5

Book for study:

J.A Bondy and U.S.R Murty, Graph Theory with Applications, North Holland, 1976.

Unit – I: Chapter 2 : Sections 2.1-2.5 and Chapter 3: Sections 3.1-3.3

Unit – II: Chapter 4: Sections 4.1-4.4

Unit – III: Chapter 5: Sections 5.1-5.4

Unit –IV: Chapter 8: Sections 8.1, 8.2, 8.4, 8.5, 8.6

Unit –V: Chapter 10: Sections 10.1-10.6

Books for References:

1. Frank Harray, Graph Theory, Addison - Wesley, Reading Mass, 1969.
2. R.Balakrishnan and K.Ranganathan, A Textbook of Graph Theory (second edition), Springer, New York, 2012.
3. J.A.Bondy and U.S.R.Murty, Graph Theory with Applications, Macmillan Co., London, 1976.
4. Robin J. Wilson, Introduction To Graph Theory (5th Edition), Pearson publications, 2010.
5. D.B.West, Introduction to Graph Theory, Prentice - Hall of India, 2001.

Web Resources

1. <https://d3gt.com/>
2. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-042j-mathematics-for-computer-science-fall-2010/video-lectures/lecture-6-graph-theory-and-coloring/>
3. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-042j-mathematics-for-computer-science-fall-2010/video-lectures/lecture-7-matching-problems/>
4. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-042j-mathematics-for-computer-science-fall-2010/video-lectures/lecture-8-graph-theory-ii-minimum-spanning-trees/>
5. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-042j-mathematics-for-computer-science-fall-2010/video-lectures/lecture-10-graph-theory-iii/>
6. <http://mit.usiu.ac.ke/high-school/courses/combinatorics-the-fine-art-of-counting/lecture-notes/>
7. https://www.brianheinold.net/graph_theory/graph_theory_book.html

Rationale for Nature of the course

This course, namely Graph Theory, has applications in various fields. Graph theory has been serving as an elegant tool to easily approach/solve several problems/concepts in other fields ranging from Science to Sociology. This course will enable the students to acquire skills by which they can model certain real-life problems as graph theoretical terms and can make inferences.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Modelling of certain real-life problems like Scheduling problem, Traffic signal problem, Marriage problem and so on as graph structure and solving them using graph theoretic tools.

Pedagogy

Chalk and Talk, PPT, Quiz, Group discussion, Seminar, Interaction, Tutorial sessions

Course Designer:

Dr.I.SAHUL HAMID, Associate Professor, Department of Mathematics

Lecture Schedule

UNIT	Topics to be covered	Hour(s)	Pedagogy
I	Trees, Cut Edges and Bonds	2	Chalk and talk, PPT, Interaction, e-Quiz and Group Discussion & Test
	Cut Vertices, Cayley's Formula	3	
	Applications: The Connector Problem	3	
	Connectivity, Blocks	3	
	Applications: Construction of Reliable Communication Networks	4	
II	Euler Tour	5	Chalk and talk, PPT, Interaction, quiz, Group Discussion and Test
	Hamiltonian Cycles	5	
	Applications: The Chinese Postman Problem, The Travelling Salesman Problem.	5	
III	Matchings and Coverings in Bipartite Graphs	5	Chalk and talk, PPT, Interaction, Seminar and Test
	Perfect Matching	5	
	Applications: The Personnel Assignment Problem.	5	
IV	Chromatic Number	4	Chalk and talk, PPT, Interaction, e-Quiz and test
	Brook's Theorem	3	
	Chromatic Polynomials	3	
	Girth and Chromatic Number	3	
	Applications: A Storage Problem	2	
V	Directed Graphs	4	Chalk and talk, Interaction, Quiz and Assignment
	Directed Paths	4	
	Directed Cycles	2	
	Applications: A Job Sequencing Problem	2	
	Designing as Efficient Computer Drum	3	
	Total Hours	75	

Course Learning Outcomes:

At the end of the course, student will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Recognize cut edges, Bonds, Cut vertices and some connector problems and blocks	Upto K3
CLO2	Identify Euler tours, Hamiltonian cycles and solve applications like Chinese postman problem, Travelling salesman problem.	Upto K3
CLO3	Find Matchings and coverings in Bipartite graphs and perfect matching and its applications	Upto K3
CLO4	Evaluate Chromatic number, Brook's theorem, chromatic polynomial and Brook's theorem	Upto K4
CLO5	Find directed graphs, directed paths, cycles and its applications: Job Sequencing Problem, Designing as Efficient Computer Drum	Upto K4

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	1	-	2	2	-
CLO-2	-	1	2	-	2
CLO-3	-	3	1	-	-
CLO-4	1	2		2	2
CLO-5	-	2	3	-	-

Mapping of CLOs with Pos

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	-	-	2	1	3	-
CLO2	-	1	2	2	3	-
CLO3	-	1	-	2	-	2
CLO4	-	2	3	2	3	2
CLO5	-	2	-	2	-	2

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

S. No.	CLOs	K Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K Level	No. of questions	K level		
1	CLO 1	Up to K3	2	K1& K1	1	K1	2(K3 & K3)	1(K3)
2	CLO 2	Up to K3	2	K2& K3	1	K2	2(K3& K3)	1(K3)
3	CLO 3	Up to K3	2	K2& K3	1	K1	2(K2 & K2)	1(K3)
4	CLO 4	Up to K4	2	K3& K4	1	K3	2(K4& K4)	1(K4)
5	CLO 5	Up to K4	2	K3 & K4	1	K2	2(K4& K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers.

K3 - Application oriented - Solving Problems.

K4 - Examining, analyzing, presentation and make inferences with evidences.

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	-	-	6	5	18%
K2	2	4	10	-	16	13.33	
K3	4	2	20	30	56	46.67	47%
K4	2	-	20	20	42	35.00	35%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS					CLASS: I M.Sc., MATHEMATICS			
Sem.	Course type	Course code	Course title	Credits	Contact hours / Week	CIA	Ext	Total
I	Elective	25P2MECT2(B)	DISCRETE MATHEMATICS	3	5	25	75	100

Nature of Course	Skill oriented	✓	Employability oriented		Entrepreneurship oriented	

Objectives:

- To create a foundation for Algebraic structures and Mathematical Induction
- To learn Lattices and its properties
- To learn Boolean algebra and polynomials and its applications

Unit	Description	Hours	K-level	CLO
I	UNIT-I: Algebraic Systems: Binary Operation – Algebraic Systems – Semigroups and Monoids – Homomorphism and Isomorphism of Semi groups and Monoids – Properties of Homomorphism – Sub semi Groups and Sub monoids.	15	K2	1
II	UNIT-II: Mathematical Induction: Techniques of Proof – Mathematical Induction – Recurrence Relations and Generating Functions – Recurrence – an Introduction – Polynomials and their Evaluations Recurrence Relations – Solution of Finite order Homogeneous (Linear) Relations.	15	K3	2
III	UNIT-III: Solution of Non-homogeneous Relations – Generations Functions – Some Common Recurrence Relations – Primitive Recursive Functions – Recursive and Partial Recursive Functions.	15	K3	3
IV	UNIT – IV: Lattices: Lattices – Some Properties of Lattices – New Lattices – Modular and Distributive Lattices.	15	K4	4
V	UNIT-V: Boolean Algebra: Boolean Algebras – Boolean Polynomials – Karnaugh Map – Switching Circuits.	15	K4	5

Book for Study:

Dr. M. K. Venkatraman, Dr. N. Sridharan and Dr. N. Chandra Sekaran, The National Publishing Company, Chennai.

Unit I: Chapter 7 (7.1-7.6)

Unit II: Chapter 4 and Chapter 5 (5.1-5.4)

Unit III: Chapter 5 (5.5-5.9)

Unit IV: Chapter 10 (10.1-10.4)

Unit V: Chapter 10 (10.5-10.8)

Books for References:

1. Kenneth H. Rosen, Discrete Mathematics and its Applications, Fourth edition, McGraw Hill Publications.
2. N. Chandrasekaran and M. Umaparvathi, Discrete Mathematics, PHI Learning Private Limited, New Delhi, 2010.

Web Resources:

<https://nptel.ac.in>

Rationale for Nature of the course

Knowledge of the Algebraic systems, Properties of homomorphism sub semi groups and sub monoids, Mathematical Induction, Recurrence relations, Lattices and Boolean Algebras.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional communication and Transferrable Skill.

Pedagogy

Lecture, Chalk and Talk, Quiz, PPT, Tutorial, Assignment

Course Designer: Dr. V. Sangeethasubha, Assistant Professor, PG and Research Department of Mathematics.

Lecture schedule

Unit	Description	Hours		Mode
I	Binary Operation – Algebraic Systems – Semigroups and Monoids – Homomorphism and Isomorphism of Semi groups and Monoids	8	15	Lecture, Chalk and Talk Problem Solving, Quiz, Test
	Properties of Homomorphism – Sub semi groups and Sub monoids.	7		
II	Techniques of Proof – Mathematical Induction – Recurrence Relations and Generating Functions – Recurrence – an Introduction	8	15	Lecture, Problem Solving, Chalk and Talk, Test
	Polynomials and their Evaluations Recurrence Relations – Solution of Finite order Homogeneous (Linear) Relations.	7		
III	Solution of Non-homogeneous Relations – Generations Functions – Some Common Recurrence Relations	8	15	PPT, Lecture, Quiz, Tutorial Problem Solving, Test
	Primitive Recursive Functions – Recursive and Partial Recursive Functions.	7		
IV	Lattices – Some Properties of Lattices	7	15	Lecture, Tutorial, Problem Solving, Test
	New Lattices – Modular and Distributive Lattices	8		
V	Boolean Algebras – Boolean Polynomials	7	15	Lecture, Chalk and Talk, PPT, Problem Solving, Assignment
	Karnaugh Map – Switching Circuits	8		
Total Hours		75		

Course Learning Outcomes:

At the end of the course, students will be able to:

CLO	Course Learning Outcomes	Knowledge Level
CLO 1	Understand the concept of Binary operation, Algebraic system semi group and Monoid, Homomorphism and Isomorphism of semi group and monoids and some properties.	Up to K2
CLO 2	Use the concept of Mathematical Induction, Proof techniques, Recurrence relations and some solution of finite order Homogeneous relations.	Up to K3
CLO 3	Evaluate Solution of Non-homogeneous Relations, Primitive recursive functions and Partial recursive functions	Up to K3
CLO 4	Acquire the knowledge about Lattices and some properties of lattices and modular and distributive lattices	Up to K4
CLO 5	Use Boolean Algebra, Boolean Polynomials, Karnaugh Map and Switching Circuits.	Up to K4

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	2	1	2	3
CLO2	3	2	1	2	3
CLO3	3	2	1	2	3
CLO4	3	2	1	2	3
CLO5	3	2	1	2	3

Mapping with CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	2	2	1	-
CLO2	3	2	2	-	1	-
CLO3	3	2	3	-	2	-
CLO4	3	2	-	2	2	-
CLO5	3	-	-	2	3	-

3- Advance Application

2- Intermediate Level

1- Basic Level

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

S. No.	CLOs	K – Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K - Level	No. of questions	K - Level		
1	CLO1	K2	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)
2	CLO2	K3	2	K2 & K3	1	K1	2(K2 & K2)	1(K3)
3	CLO3	K3	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)
4	CLO4	K4	2	K3 & K4	1	K2	2(K3 & K3)	1(K4)
5	CLO5	K4	2	K3 & K4	1	K3	2(K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1 - Remembering and recalling facts with specific answers.

K2 - Basic understanding of facts and stating main ideas with general answers.

K3 - Application oriented - Solving Problems.

K4 - Examining, analyzing, presentation and make inferences with evidences.

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	20	20	46	38.33	38.3%
K4	2	-	10	20	32	26.67	26.7%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS					CLASS: I M.Sc., MATHEMATICS			
Sem.	Course type	Course code	Course title	Credits	Contact hours / Week	CIA	Ext	Total
I	Non-Major Elective	25P1MSEN1	FOUNDATIONAL MATHEMATICS	2	2	25	75	100

Nature of course	Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objectives:

- To obtain the knowledge of indices and logarithms
- To acquire idea about various Progression
- To calculate the Annuities and True discount.

Unit	Description	Hours	K-level	CLO
I	Positive integral indices – Law of indices – Zero and negative indices – Fractional indices.	6	Upto K2	CLO1
II	Logarithm – Properties of Logarithms – Common Logarithm.	6	Upto K2	CLO2
III	Sequence of Numbers – Arithmetic Progression – Geometric Progression – Arithmetic and Geometric means.	6	Upto K2	CLO3
IV	Ratio – Compounding, Duplicate, Triplicate and Sub-duplicate of ratio's – Proportion – Rules of Proportion – Direct, Inverse, Compound and Continued proportion.	6	Upto K2	CLO4
V	Simple interest – Compound interest – Annuities – Percentage – Discount – True discount, Banker's discount and Banker's gain.	6	Upto K2	CLO5

Book for study:

G.K.Ranganath, C.S.Sampagiram and Y.Rajaram, "Business Mathematics", Third edition, 2019, Himalaya Publishing House, Mumbai.

Unit-I: Chapter 2 (2.1 – 2.5)

Unit-II: Chapter 3 (3.1 – 3.4)

Unit-III: Chapter 6 (6.1 – 6.4)

Unit-IV: Chapter 9 (9.1 - 9.7)

Unit-V: Chapter 12 (12.1 – 12.6)

Books for References:

1. M.Manokaran, C. Elango and K.L.Eswaran “Business Mathematics”, Paramount Publications, Palani.
2. Ghosh & Sinha (2018). Business Mathematics and Statistics. Oxford University Press.
3. S.K. Sharma and Kaur, G. (2019). Business Mathematics. New Delhi: Sultan Chand & Sons (P) Ltd.
4. Singh, J. K. (2017). Business Mathematics. New Delhi: Himalaya Publishing House.

Web Resources

1. <https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:logs/x2ec2f6f830c9fb89:log-intro/v/logarithms>
2. <https://archive.nptel.ac.in/courses/109/107/109107115/>
3. <https://www.nios.ac.in/media/documents/srsec311new/L.No.13.pdf>

Rationale for Nature of the course

Fundamentals of math are the basic building blocks that help students form a solid mathematical foundation. Math learning entirely relies on the understanding of these fundamental concepts. Logarithmic scales are used to reduce wide-ranging quantities to smaller scopes. For example, the pH scale is a logarithmic measure for the acidity of an aqueous solution. Arithmetic progressions are used in many fields, including finance, physics, and computer science, to model linear relationships, analyze growth patterns, calculate averages, and solve real-world problems.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Quiz, Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved.

Pedagogy

Lecture with PPT, Seminar, Tutorial, Group Discussion, Assignments

Course Designer(s): Dr. V. Sangeethasubha, Assistant Professor, PG and Research Department of Mathematics.

Lecture Schedule

Unit	Topics	Hrs		Mode
I	Positive integral indices	2	6	Lecture, Quiz
	Law of indices	1		Problem Solving
	Zero and negativeindices	1		Problem Solving
	Fractional indices.	2		Lecture, Group Discussion
II	Logarithm	2	6	Lecture, Quiz
	Properties of Logarithms	2		Lecture, Discussion
	Common Logarithm.	2		Lecture, Problem Solving
III	Sequence of Numbers	2	6	PPT, Lecture
	Arithmetic Progression	1		PPT, Tutorial
	GeometricProgression	1		Problem Solving
	Arithmetic and Geometric means	2		Problem Solving
IV	Ratio – Compounding, Duplicate, Triplicate	2	6	Lecture, Tutorial
	Sub-duplicateof ratio’s	1		Lecture, Tutorial
	Rules of Proportion	1		Tutorial
	Proportion — Direct, Inverse, Compound and Continued proportion.	2		Problem Solving
V	Simple interest, Compound interest	2	6	PPT, Lecture
	Annuities	1		Assignment
	Percentage	1		Tutorial, Seminar
	Discount –True discount, Banker’s discount and Banker’s gain.	2		Tutorial, Seminar
Total Hours		30		

Course Learning Outcomes:

At the end of the course, student will be able

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Understand the concepts of Law of indices and Fractional indices	Upto K2
CLO2	Recall the concept of Logarithm, Properties of Logarithms and learn Common Logarithm.	Upto K2
CLO3	Understand the concept of sequence of Numbers, Arithmetic Progression, Geometric Progression.	Upto K2
CLO4	Understand the concepts of Ratio, Compounding, Duplicate, Triplicate and Sub-duplicate of ratios and Proportion	Upto K2
CLO5	Understand the concept of Simple interest, Compound interest, Annuities, Percentage and Discount	Upto K2

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	3	2	2	2	1
CLO-2	3	2	2	1	1
CLO-3	3	2	2	1	1
CLO-4	3	2	2	1	1
CLO-5	3	2	2	1	1

Mapping of CLOs with Pos

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	2	1	2	1
CLO2	3	2	2	1	2	1
CLO3	3	2	2	1	2	1
CLO4	3	2	2	1	2	1
CLO5	3	2	2	1	2	1

Advance application– 3;

ntermediate level–2;

Basic level–1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

S. No.	CLO	K – Level	Section A	Section B	Section C
			Short Answers	(Either/OR Choice)	(Open Choice)
1	CLO1	K2	1(K1)	2(K2 &K2)	1(K1)
2	CLO2	K2	1(K1)	2(K2 &K2)	1(K1)
3	CLO3	K2	1(K1)	2(K2 &K2)	1(K1)
4	CLO4	K2	1(K1)	2(K2 &K2)	1(K1)
5	CLO5	K2	1(K1)	2(K2 &K2)	1(K1)
No. of Questions to be asked			5	10	5
No. of Questions to be answered			5	5	3
Marks for each question			2	7	10
Total Marks for each Section			10	35	30

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers.

K3 - Application oriented - Solving Problems.

K4 - Examining, analyzing, presentation and make inferences with evidences.

Distribution of section wise marks with K levels

K Level	Section A (Short Answers)	Section B (Either /or Choice)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	10	-	50	60	46.15	46%
K2	-	70	-	70	53.85	54%
Total Marks	10	70	50	130	100	100%

SEMESTER – II

DEPARTMENT OF MATHEMATICS				CLASS: I M.Sc., Mathematics				
Semester	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	Core	25P2MCCT4	ADVANCED ALGEBRA	5	6	25	75	100

Nature of Course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship oriented	

Objectives:

To study field extension, roots of polynomials, Galois Theory, finite fields, division rings, solvability by radicals and to develop computational skill in abstract algebra.

Unit	Description	Hours	K-level	CLO
I	Extension fields – Transcendence of e .	18	K2	CLO1
II	Roots of Polynomials - More about roots.	18	K3	CLO2
III	Elements of Galois theory.	18	K4	CLO3
IV	Finite fields - Wedderburn's theorem on finite division rings.	18	K4	CLO4
V	Solvability by radicals - Integral Quaternions and the Four - Square theorem.	18	K5	CLO5

Book for study:

I.N. Herstein. Topics in Algebra (II Edition) Wiley Eastern Limited, New Delhi, 1975.

Unit I: **Chapter 5: Section 5.1 and 5.2**

Unit II: **Chapter 5: Sections 5.3 and 5.5**

Unit III: **Chapter 5: Section 5.6**

Unit IV: **Chapter 7: Sections 7.1 and 7.2 (Theorem 7.2.1 only)**

Unit V: **Chapter 5: Section 5.7 (omit Lemma 5.7.1, Lemma 5.7.2 and Theorem 5.7.1)**

Chapter 7: Section 7.4 only.

Books for References:

1. M.Artin, Algebra, Prentice Hall of India, 1991.
2. P.B.Bhattacharya, S.K.Jain, and S.R.Nagpaul, Basic Abstract Algebra (II Edition) Cambridge University Press, 1997. (Indian Edition)
3. I.S.Luther and I.B.S.Passi, Algebra, Vol. I –Groups(1996); Vol. II Rings, Narosa Publishing House , New Delhi, 1999
4. D.S.Malik, J.N. Mordeson and M.K.Sen, Fundamental of Abstract Algebra, McGraw Hill (International Edition), New York. 1997.

5. N.Jacobson, Basic Algebra, Vol. I & II W.H.Freeman (1980); also published by Hindustan Publishing Company, New Delhi.

Web Resources:

<http://mathforum.org>,
<http://ocw.mit.edu/ocwweb/Mathematics>,
<http://www.opensource.org>, www.algebra.com

Rationale for Nature of the course

Advanced algebra is also used in most sciences and fields of engineering, because it allows modelling many natural phenomena, and computing efficiently with such models. This course imparts theoretical knowledge & problem solving skills to the students and is crafted to help the students to knowing the best techniques for a given theory. Theoretical learning gives the guidance to the mind and mind guides our body to convert that theoretical learning into practical performance. Theoretical knowledge explains the why factor at the back of any situation and technique of working.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Case study, Formulation and Analysis plan and problem solving

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Course Designer: Dr.S.USHA, Assistant professor, PG and Research Department of Mathematics

Lecture Schedule

Unit	Description	Hours	Mode
I	Extension fields	9	Lecture, Quiz
	Transcendence of e .	9	Lecture, Tutorial
II	Roots of Polynomials	9	Lecture, Quiz
	More about roots	9	Lecture, Quiz
III	Elements of Galois theory.	9	PPT, Lecture
		9	Lecture, Quiz
IV	Finite fields	9	Lecture, Tutorial
	Wedderburn's theorem on finite division rings.	9	Lecture, Tutorial
V	Solvability by radicals	7	PPT, Lecture
	Integral Quaternions and the Four - Square theorem.	11	Lecture, Quiz
Total Hours		90	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CO	Course Outcome	K-level
CLO1	Use the concept of extension fields and prove theorems applying algebraic ways of thinking.	Upto K2
CLO2	Examine splitting field in rational fields, extension fields, splitting fields and understand the idea of roots of polynomials.	Upto K3
CLO3	Compose clear and accurate proofs using the concepts of Galois Theory.	Upto K4
CLO4	Bring out insight into Abstract Algebra with focus on axiomatic theories.	Upto K4
CLO5	Demonstrate knowledge and understanding of fundamental concepts including extension fields, Algebraic extensions and Finite fields.	Upto K5

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	2	1	3	1	2
CLO-2	2	1	3	1	2
CLO-3	2	1	3	1	2
CLO-4	2	1	3	1	2
CLO-5	2	1	3	1	2

Mapping of CLOs with Pos

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	1	3	2	3	3
CLO2	2	1	3	1	3	3
CLO3	3	2	3	1	3	3
CLO4	1	2	3	2	3	3
CLO5	3	1	2	3	3	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

S. No.	CLOs	K Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K Level	No. of questions	K level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K1	2(K2 & K2)	1(K3)
3	CLO 3	Up to K4	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2(K4 & K4)	1(K4)
5	CLO 5	Up to K5	2	K3 & K4	1	K3	2(K4 & K4)	1(K4/K5)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - Solving Problems

K4 - Examining, analyzing, presentation and make inferences with evidences

K5 - Evaluate the mistakes in answers

Distribution of section wise marks with K levels.

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30	30%
K4	2	-	20	10	32	26.67	27%
K5			-	10	10	8.33	8%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS				CLASS: I M.Sc., Mathematics				
Semester	Course Type	Course Code	Course Title	Credits	Contact Hours/ week	CIA	Ext	Total
II	Core	25P2MCCT5	REAL ANALYSIS - II	5	6	25	75	100

Nature of Course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship oriented	

Objectives:

- To learn about advanced topics in Fourier series and Fourier Integrals.
- To acquire idea to know functions of several variables.
- To obtain the knowledge of the Lebesgue measure & integral.
- To provide students with fundamental concepts and techniques of multivariable calculus and to develop student understanding and skills for its applications to other areas.

Unit	Description	Hours	K-level	CLO
I	Measure on the Real line - Lebesgue Outer Measure - Measurable sets - Regularity - Measurable Functions - Borel and Lebesgue Measurability	18	K3	CLO1
II	Integration of Functions of a Real variable - Integration of Non-negative functions - The General Integral - Riemann and Lebesgue Integrals	18	K2	CLO2
III	Fourier Series and Fourier Integrals - Introduction - Orthogonal system of functions - The theorem on best approximation - The Fourier series of a function relative to an orthonormal system - Properties of Fourier Coefficients - The Riesz-Fischer Theorem - The convergence and representation problems in for trigonometric series - The Riemann - Lebesgue Lemma - The Dirichlet Integrals - An integral representation for the partial sums of Fourier series - Riemann's localization theorem - Sufficient conditions for convergence of a Fourier series at a particular point - Cesaro summability of Fourier series- Consequences of Fejes's theorem - The Weierstrass approximation theorem	22	K3	CLO3
IV	Multivariable Differential Calculus - Introduction - The Directional derivative - Directional derivative and continuity - The total derivative - The total derivative expressed in terms of partial derivatives - The matrix of linear function - The Jacobian matrix -	18	K4	CLO4

	The chain rule - Matrix form of chain rule - The mean - value theorem for differentiable functions - A sufficient condition for differentiability.			
V	Implicit Functions and Extremum Problems: Functions with non-zero Jacobian determinants – The inverse function theorem- The Implicit function theorem-Extrema of real valued functions of severable variables-Extremum problems with side conditions.	14	K3	CLO5

Book for study:

1. G. de Barra, *Measure Theory and Integration*, Wiley Eastern Ltd., New Delhi, 1981. (for Units I and II)
2. Tom M. Apostol : *Mathematical Analysis*, 2nd Edition, Addison- Wesley Publishing Company Inc. New York, 1974. (for Units III, IV and V)

Unit I – T1: Chapter - 2 Sec 2.1 to 2.5

Unit II – T1: Chapter - 3 Sec 3.1,3.2 and 3.4

Unit III – T2: Chapter - 11: Sections 11.1 to 11.15

Unit IV – T2: Chapter-12: Section 12.1 to 12.1 to 12.12

Unit V – T2: Chapter-13: Sections 13.1 to 13.4

Books for References:

1. Burkill, J.C. *The Lebesgue Integral*, Cambridge University Press, 1951.
2. Munroe, M.E. *Measure and Integration*. Addison-Wesley, Mass. 1971.
3. Roydon, H.L. *Real Analysis*, Macmillan Pub. Company, New York, 1988.
4. Rudin, W. *Principles of Mathematical Analysis*, McGraw Hill Company, New York, 1979.
5. Malik, S.C. and Savita Arora. *Mathematical Analysis*, Wiley Eastern Limited. New Delhi, 1991.
6. Sanjay Arora and Bansi Lal, *Introduction to Real Analysis*, Satya Prakashan, New Delhi, 1991

Web Resources:

<http://mathforum.org>, <http://ocw.mit.edu/ocwwweb/Mathematics>,
<http://www.opensource.org>

Rationale for Nature of the course

Real analysis is an area of analysis that studies concepts such as sequences and their limits, continuity, differentiation, integration and sequences of functions. By definition, real analysis focuses on the real numbers, often including positive and negative infinity to form the extended real line. Various ideas from real analysis can be generalized from the real line to broader or more abstract contexts.

This course imparts theoretical knowledge & Problem Solving Skills to the students and is crafted to help the students to knowing the best techniques in a given theory. Theoretical learning gives the guidance to the mind and mind guides our body to convert that theoretical learning into practical performance. Theoretical knowledge explains the why factor at the back of any situation and technique of working

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Case study, Formulation and Analysis plan and problem solving

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Course Designer: Dr.K.LAKSHMI, Assistant professor, PG and Research Department of Mathematics

Lecture Schedule

Unit	Description	Hours	Mode
I	Measure on the Real line - Lebesgue Outer Measure - Measurable sets - Regularity -	9	Lecture, Quiz, Tutorial
	Measurable Functions - Borel and Lebesgue Measurability	9	Lecture, Tutorial
II	Integration of Functions of a Real variable - Integration of Non- negative functions - The General Integral - Riemann and Lebesgue Integrals	18	Lecture, Quiz
III	Fourier Series and Fourier Integrals - Introduction - Orthogonal system of functions - The theorem on best approximation - The Fourier series of a function relative to an orthonormal system - Properties of Fourier Coefficients - The Riesz-Fischer Theorem - The convergence and representation problems in for trigonometric series - The Riemann - Lebesgue Lemma	11	PPT, Lecture, Quiz
	The Dirichlet Integrals - An integral representation for the partial sums of Fourier series - Riemann's localization theorem - Sufficient conditions for convergence of a Fourier series at a particular point – Cesaro summability of Fourier series- Consequences of Fejes's theorem - The Weierstrass approximation theorem.	11	Lecture, Tutorial
IV	Multivariable Differential Calculus - Introduction - The Directional derivative - Directional derivative and continuity - The total derivative - The total derivative expressed in terms of partial derivatives.	9	Lecture, Tutorial
	The matrix of linear function - The Jacobian matrix - The chain rule - Matrix form of chain rule - The mean - value theorem for differentiable functions - A sufficient condition for differentiability.	9	Lecture, Tutorial
V	Implicit Functions and Extremum Problems: Functions with non-zero Jacobian determinants – The inverse function theorem-	7	PPT, Lecture
	The Implicit function theorem-Extrema of real valued functions of severable variables-Extremum problems with side conditions.	7	Lecture, Quiz
Total Hours		90	

Course Learning outcomes

At the end of the course, Students will be able to

CLOs	Course Learning outcome	Knowledge level
CLO1	Identifying the concept of Lebesgue measure	Upto K3
CLO2	Analyzing the concept of Lebesgue integral	Upto K3
CLO3	Understand and describe the basic concepts of Fourier series and Fourier integrals with respect to orthogonal system. Analyze the representation and convergence problems of Fourier series.	Upto K3
CLO4	Understand the concept of Multivariable Differential Calculus	Upto K4
CLO5	Understand the concept of Implicit functions and Extremum problems.	Upto K5

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	3	2	2	1	2
CLO-2	3	2	2	1	2
CLO-3	3	2	2	1	2
CLO-4	3	2	2	1	2
CLO-5	3	2	2	1	2

Mapping of CLOs with Pos

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	2	3	3	2	3	2
CLO2	2	3	3	2	3	2
CLO3	2	3	3	2	3	2
CLO4	2	3	3	2	3	2
CLO5	2	3	2	2	3	2

Advance application- 3;

Intermediate level-2;

Basic level-1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K-level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K-Level	No. of Questions	K- Level		
1	CLO 1	Up to K3	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)
2	CLO 2	Up to K3	2	K2 & K2	1	K1	2(K2 & K2)	1(K3)
3	CLO 3	Up to K3	2	K3 & K3	1	K2	2(K3 & K3)	1(K3)
4	CLO 4	Up to K4	2	K3 & K3	1	K2	2(K4 & K4)	1(K4)
5	CLO 5	Up to K5	2	K4 & K4	1	K3	2(K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - Solving Problems

K4 - Examining, analysing, presentation and make inferences with evidences

K5 - Evaluate the mistakes in answers

Distribution of section wise marks with K levels.

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30	30%
K4	2	-	20	10	32	26.67	27%
K5			-	10	10	8.33	8%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS					CLASS: I M.Sc., MATHEMATICS			
Sem.	Course type	Course code	Course title	Credits	Contact Hours / Week	CIA	Ext	Total
II	Core	25P2MCCT6	PARTIAL DIFFERENTIAL EQUATIONS	4	6	25	75	100
Nature of course		Skill oriented	✓	Employability oriented		Entrepreneurship Oriented		

Objectives:

- Develop strong background on finding various solutions to first order linear and nonlinear Partial Differential Equations (PDE's).
- Solve the nonlinear PDE's by Charpit's method and Jacobi's method.
- Focus the formulation of first and second orders PDE's.
- Classify and solving for three basic types namely Hyperbolic, Parabolic and Elliptic PDE's.

Unit	Description	Hours	K-level	CLO
I	Mathematical Models and Classification of second order equation: Classical equations-Vibrating string – Vibrating membrane – waves in elastic medium – Conduction of heat in solids – Gravitational potential – Second order equations in two independent variables – canonical forms – equations with constant coefficients – general solution.	18	K2	CLO1
II	Cauchy Problem : The Cauchy problem – Cauchy-Kowalewsky theorem – Homogeneous wave equation – Initial Boundary value problem- Non-homogeneous boundary conditions – Finite string with fixed ends – Non-homogeneous wave equation – Riemann method – Goursat problem – spherical wave equation – cylindrical wave equation.	18	K3	CLO2
III	Method of separation of variables: Separation of variable- Vibrating string problem – Existence and uniqueness of solution of vibrating string problem - Heat conduction problem – Existence and uniqueness of solution of heat conduction problem – Laplace and beam equations	18	K4	CLO3
IV	Boundary Value Problems and Applications: Boundary value problems – Maximum and minimum principles – Uniqueness and continuity theorem – Dirichlet Problem for a circle , a circular annulus, a rectangle – Dirichlet problem involving Poisson equation – Neumann problem for a circle and a rectangle.	18	K4	CLO4

V	Green's Function: The Delta function – Properties of Green's function – Method of Green's function – Dirichlet Problem for the Laplace and Helmholtz operators – Method of images and eigen functions – Higher dimensional problem – Neumann Problem.	18	K5	CLO5

Book for study:

TynMyint-U and Lokenath Debnath, *Partial Differential Equations for Scientists and Engineers* (Fourth Edition), North Hollan, New York, 1987

Unit-I: Chapter 3 : Sections 3.1 to 3.6 Chapter 4 : Sections 4.1 to 4.4

Unit-II: Chapter 5 : Sections 5.1 to 5.11

Unit-III: Chapter 7 : Sections 7.1 to 7.7

Unit-IV: Chapter 9 : Sections 9.1 to 9.9

Unit-V: Chapter 11 : Section 11.1 to 11.10

Books for References:

1. M.M.Smirnov, *Second Order partial Differential Equations*, Leningrad, 1964.
2. I.N.Sneddon, *Elements of Partial Differential Equations*, McGraw Hill, New Delhi, 1983.
3. R. Dennemeyer, *Introduction to Partial Differential Equations and Boundary Value Problems*, McGraw Hill, New York, 1968.
4. M.D.Raisinghania, *Advanced Differential Equations*, S.Chand & Company Ltd., New Delhi, 2001.
5. S, Sankar Rao, *Partial Differential Equations*, 2nd Edition, Prentice Hall of India, New Delhi. 2004

Web Resources

1. https://aryabhatacollege.ac.in/samplepaper/637205741610058516Chap_5_PDE.pdf
2. <https://archive.nptel.ac.in/courses/111/101/111101153/>
3. <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=ZLCHeZEhCZ8yCri36nSF3A==>

Rationale for Nature of the course

Partial differential equations have wide applications in various science disciplines. It is practically important for science students able to model physical problems using mathematical equations, then solve these equations so that the behaviour of the systems concerned can be studied

Activities having direct bearing on Skill development / Employability Entrepreneurship

Quiz, Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved.

Pedagogy

Lecture with PPT, Seminar, Tutorial, Group Discussion, Assignments

Course Designer(s):

1. Dr. V. Ananthaswamy, Associate Professor, Research Centre & PG Department of Mathematics.
2. Prof. V.Vijayalakshmi, Assistant Professor

Lecture Schedule

Units	Description	Hours	Pedagogy
I	Classical equations - Introduction	3	Lecture
	Vibrating String and Vibrating String membrane	2	Lecture
	Waves in elastic medium	2	Lecture
	Conduction of heat in solids, Gravitational potential	3	Lecture
	Second order equations in two independent variables	3	Lecture & Group Discussion
	Canonical forms and equations with constant coefficients	3	Lecture
	General solution of equation with constant coefficients.	2	Lecture
II	The Cauchy problem	2	Lecture
	Cauchy -Kowalewsky theorem	2	Lecture & Seminar
	Homogeneous wave equation initial boundary value problem	2	Lecture
	Non homogeneous boundary conditions, finite string with fixed ends	2	Lecture & PPT
	Non homogeneous wave equation	2	Lecture
	Riemann method and Goursat problem	2	Lecture & Seminar
	Spherical wave equations	3	Lecture
	Cylindrical wave equations	3	Lecture
III	Separation of variables and vibrating string problem	4	Lecture
	Existence and uniqueness of solution of vibrating string problem	4	Lecture & PPT
	Heat conduction problem	4	Lecture
	Existence and uniqueness of solution of heat conduction problem,	3	Lecture
	Laplace and beam equations	3	Lecture & Seminar
IV	Boundary value problems	3	Lecture
	Maximum and minimum principles	3	Lecture
	Uniqueness and continuity theorem	2	Lecture & PPT
	Dirichlet problem for a circle and a circular annulus and a rectangle	4	Lecture
	Dirichlet problem involving poisson equation	4	Lecture
	Neumann problem for a circle and a rectangle	2	Lecture & Group Discussion
V	The Delta function and Green function	4	Lecture
	Method of Green's function	4	Lecture & Seminar
	Dirichlet Problem for the Laplace and Helmholtz operators	4	Lecture & PPT
	Method of images and eigen functions	3	Assignment
	Higher dimensional problem and Neumann problem	3	Lecture & Group Discussion
Total		90	

Course Learning Outcomes:

At the end of the course, students will be able to

CLOs	Course Learning outcome	Knowledge level
CLO1	Understand and classify second order equations and find general solutions.	K2
CLO2	Analyse and solve wave equations in different polar coordinates.	K3
CLO3	Solve Vibrating string problem, Heat conduction problem, to identify and solve Laplace and beam equations	K4
CLO4	Apply maximum and minimum principle's and solve Dirichlet, Neumann problems for various boundary conditions.	K4
CLO5	Apply Green's function and solve Dirichlet, Laplace problems, to apply Helmholtz operation and to solve Higher dimensional problem.	K5

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	3	2	2	2	1
CLO-2	3	2	2	1	1
CLO-3	3	2	2	1	1
CLO-4	3	2	2	1	1
CLO-5	3	2	2	1	1

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	1	3	3	3	3
CLO2	2	1	3	3	3	3
CLO3	3	2	3	3	3	3
CLO4	1	2	3	3	3	3
CLO5	2	2	2	3	2	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

SL.No	CLOs	K-level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)	Total
			MCQs		Short Answers				
			No. of Question s	K-Level	No. of Questions	K- Level			
1	CLO 1	Up to K2	2	K1& K1	1	K1	2(K1 & K1)	1(K2)	
2	CLO 2	Up to K3	2	K2 & K3	1	K1	2(K2 & K2)	1(K3)	
3	CLO 3	Up to K4	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)	
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2(K4 & K4)	1(K4)	
5	CLO 5	Up to K4/K5	2	K3 & K4	1	K3	2(K4 & K4)	1 (K4/K5)	
No. of Questions to be asked			10		5		10	5	30
No. of Questions to be answered			10		5		5	3	23
Marks for each question			1		2		5	10	
Total Marks for each Section			10		10		25	30	75

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers.

K3 - Application oriented - Solving Problems.

K4 - Examining, analyzing, presentation and make inferences with evidences.

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30	30%
K4	2	-	20	10	32	26.67	26.67%
K5	-	-	-	10	10	8.33	8.33%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS					CLASS: I M.Sc., MATHEMATICS			
Sem.	Course type	Course code	Course title	Credits	Contact hours / Week	CIA	Ext	Total
II	Elective	25P2MECT3(A)	RESOURCE MANAGEMENT TECHNIQUES	3	5	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

Objectives:

- To provide the depth knowledge about inventory control theory and make students to solve the inventory problems.
- To understand the application of queuing theory in real life situation and methods of solving related problems.
- To illustrate various dynamic programming models and their applications in solving a decision-problem.
- To introduce the concept of classical optimization techniques.
- To appreciate the use of some of the non-linear programming techniques such as quadratic and separable programming

Unit	Description	Hours	K-level	CLO
I	Deterministic Inventory Models: Introduction – General Inventory Model – Deterministic Inventory Problems with No Shortages – Deterministic inventory Models with shortages – Static EOQ Model – Classic EOQ Model – EOQ with price breaks – Multi-item EOQ with storage limitation	15	Upto K2	CLO1
II	Queuing Systems: Introduction – Queuing System – Elements of Queuing Model – Role and derivation of exponential distribution – Pure birth and death model – Generalized Poisson queuing model – Specialized Poisson queues – Steady-state measures of performance – Single-Server Models – Multiple-Server Models	15	Upto K3	CLO2
III	Dynamic Programming: Introduction – Application of Dynamic Programming: Recursive nature of computations in DP – Forward and backward Recursion – Selected DP Applications – Cargo Leading Problem – Problem of Dimensionality	15	Upto K3	CLO3

IV	Classical Optimization Theory: Unconstrained Problems – Necessary and Sufficient Conditions for an extreme point – The Newton-Raphson Method – Constrained Problems – Equality Constraints – Lagrangean method – Jacobi method – Inequality Constraints – Kuhn-tucker conditions.	15	Upto K4	CLO4
V	Nonlinear Programming Algorithms: Unconstrained Nonlinear Algorithms – Direct Search Method – Gradient Method – Constrained Algorithms – Quadratic Programming – Geometric Programming – Linear Combinations Method.	15	Upto K4	CLO5

Book for study:

Hamdy A. Taha, *Operations Research*, (Sixth edition) Pearson Prentice Hall of India Private Limited, New Delhi, 1997.

Unit-I: Chapter 11(11.1-11.3)

Unit-II: Chapter 17(17.1-17.5), 17.6 (17.6.1-17.6.3)

Unit-III: Chapter 10(10.1-10.3), 10.4(10.4.1), 10.5

Unit-IV: Chapter 20(20.1-20.4)

Unit-V: Chapter 21(21.1), 21.2(21.2.2, 21.2.3, 21.2.5)

Books for References:

1. Kanti Swarup, P.K. Gupta, Man Mohan, *Operations Research*, Sultan Chand & Sons, Educational Publishers, New Delhi.
2. Panneerselvam R, *Operations Research*, 2nd Edition, PHI Learning Private Limited, Delhi, 2015
3. Hiller.F.S & Lieberman.J, *Introduction to Operation Research*, 7th Edition, Tata– MC Graw Hill Publishing Company, New Delhi, 2001.
4. Prem Kumar Gupta.Er, Hira.D.S. *Operations Research*, 7th Edition, S.Chand & Company Pvt. Ltd.2014.

Web Resources

1. <https://archive.nptel.ac.in/courses/111/103/111103159/>
2. <https://archive.nptel.ac.in/courses/111/107/111107104/>
3. https://onlinecourses.nptel.ac.in/noc20_mg17/preview

Rationale for Nature of the course

Optimization is a process to search for solutions to reach the best objective under certain constraints. It is an important process in maintaining a business or trading system. By adjusting system parameters to reduce costs and maximize output, optimization allows businesses and traders to become more efficient and competitive.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Quiz, Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved.

Pedagogy

Lecture with PPT, Seminar, Tutorial, Group Discussion, Assignments

Course Designer(s):

Dr. C. THANGA PANDI, Associate Professor, PG and Research Department of Mathematics.

Dr. R. CHITRA, Assistant Professor, Department of Mathematics

Lecture Schedule

Unit	Topics	Hrs		Mode
I	Deterministic Inventory Models: Introduction – General Inventory Model	4	15	Lecture, Quiz
	Deterministic Inventory Problems with No Shortages – Deterministic inventory Models with shortages	4		Problem Solving
	Static EOQ Model – Classic EOQ Model – EOQ with price breaks	3		Problem Solving
	Multi-item EOQ with storage limitation	4		Lecture, Group Discussion
II	Queuing Systems: Introduction – Queuing System – Elements of Queuing Model	4	15	Lecture, Quiz
	Role and derivation of exponential distribution – Pure birth and death model – Generalized Poisson queuing model	4		Lecture, Discussion
	Specialized Poisson queues – Steady-state measures of performance	3		Lecture, Problem Solving
	Single-Server Models – Multiple-Server Models	4		Lecture, Group Discussion
III	Dynamic Programming: Introduction – Application of Dynamic Programming: Recursive nature of computations in DP	4	15	PPT, Lecture
	Forward and backward Recursion – Selected DP Applications	4		PPT, Tutorial
	Cargo Leading Problem	4		Problem Solving
	Problem of Dimensionality	3		Problem Solving
IV	Classical Optimization Theory: Unconstrained Problems – Necessary and Sufficient Conditions for an extreme point	3	15	Lecture, Tutorial
	The Newton-Raphson Method – Constrained Problems	4		Lecture, Tutorial
	Equality Constraints – Lagrangean method – Jacobi method	4		Tutorial
	Inequality Constraints – Kuhn-tucker conditions.	4		Problem Solving
V	Nonlinear Programming Algorithms: Unconstrained Nonlinear Algorithms – Direct Search Method	2	15	PPT, Lecture
	– Gradient Method – Constrained Algorithms	3		Lecture
	Quadratic Programming	3		Assignment
	Geometric Programming	5		Tutorial, Seminar
	Linear Combinations Method.	2		Tutorial, Seminar
Total Hours		75		

Course Learning Outcomes:

At the end of the course, students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Understand the fundamental concept of Inventory control price break models.	Upto K2
CLO2	Apply the concept of queuing system and analyze the problems in queuing models.	Upto K3
CLO3	Solve Linear Programming problems using dynamic programming approach.	Upto K3
CLO4	Obtain the optimal solution of problems that involve constrained and unconstrained optimization problems.	Upto K4
CLO5	Apply techniques such as quadratic programming, separable programming for solving non-linear programming problems.	Upto K4

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	3	2	2	2	1
CLO-2	3	2	2	1	1
CLO-3	3	2	2	1	1
CLO-4	3	2	2	1	1
CLO-5	3	2	2	1	1

Mapping of CLOs with Pos

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	2	1	2	1
CLO2	3	2	2	1	2	1
CLO3	3	2	2	1	2	1
CLO4	3	2	2	1	2	1
CLO5	3	2	2	1	2	1

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

S. No.	CLOs	K Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K Level	No. of questions	K level		
1	CLO 1	Up to K2	2	K1& K1	1	K1	2(K1 & K1)	1(K2)
2	CLO 2	Up to K3	2	K2& K3	1	K2	2(K3& K3)	1(K3)
3	CLO 3	Up to K3	2	K2& K3	1	K1	2(K2 & K2)	1(K3)
4	CLO 4	Up to K4	2	K3& K4	1	K3	2(K4& K4)	1(K4)
5	CLO 5	Up to K4	2	K3 & K4	1	K2	2(K4& K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers.

K3 - Application oriented - Solving Problems.

K4 - Examining, analyzing, presentation and make inferences with evidences.

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30.00	30%
K4	2	-	20	20	42	35.00	35%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS					CLASS: I M.Sc., MATHEMATICS			
Sem.	Course type	Course code	Course title	Credits	Contact hours / Week	CIA	Ext	Total
II	Elective	25P2MECT3(B)	FORMAL LANGUAGE AND AUTOMATA THEORY	3	5	25	75	100

Nature of the Course	Skill Oriented	✓	Employability oriented		Entrepreneurship oriented	

Course Objectives:

1. To introduce the fundamental concepts of automaton and its properties.
2. To design grammars to produce strings from a specific language.
3. Classify machines by their power to recognize languages.
4. Employ finite-state machines to solve problems in computing.

Unit	Description	Hours	K-level	CLO
I	The Theory of Automata Definition of an automata and finite automata – Transition systems and Transition functions – Acceptability of a string by a finite Automaton – Nondeterministic finite state machines – The Equivalence of DFA and NDFA.	15	Up to K3	CLO1
II	Formal Languages Basic Definitions and Examples – Definition of a Grammar – Chomsky classification of languages – Languages and their relation.	15	Up to K3	CLO2
III	Formal Languages(continues) Recursive and recursively Enumerable sets – Operations on Languages – Language and automata – Supplementary Examples.	15	Up to K3	CLO3
IV	Regular sets Regular Expressions – Finite Automata and regular expressions – Pumping lemma for regular sets – Application of pumping lemma – Closure properties of regular sets.	15	Up to K4	CLO4
V	Context-free Languages Context-free Languages and derivation trees – Ambiguity in context-free grammars – Simplification of Context-free Grammars.	15	Up to K4	CLO5

Book for Study:

Theory of Computer Science (Automata, Languages and Computation) by K.L.P. Mishra and N. Chandrasekar, 3rd Edition, 2016, Prentice Hall of India, New Delhi.

UNIT-I: Chapter 3: Sec 3.1 – 3.7

UNIT-II: Chapter 4: Sec 4.1 - 4.3

UNIT-III: Chapter 4: Sec 4.4 - 4.7

UNIT-IV: Chapter 5: Sec 5.1 – 5.5

UNIT-V: Chapter 6: Sec 6.1 - 6.3

Book for reference:

1. Introduction to Automata Theory, Languages, and Computation, John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, 3rd Edition, Pearson Addison Wesley.
2. Elements of the Theory of Computation, Harry R. Lewis and Christos H. Papadimitriou, 2nd edition, 1997, Prentice Hall.
3. An Introduction to Formal Languages and Automata, Peter Linz, 4th edition, 2006, Narosa Publishing House.

Web Resources:

1. <https://www.geeksforgeeks.org/theory-of-computation-automata-tutorials/>
2. <https://youtu.be/drIbsV-pTAw>
3. <https://youtu.be/WQ8bJooiEeQ>

Rationale for nature of the course:

Automata Theory possesses a high degree of permanence and stability, in contrast with the ever-changing paradigms of the technology, development, and management of computer systems. Further, parts of the Automata theory have direct bearing on practice, such as Automata on circuit design, compiler design, and search algorithms; Formal Languages and Grammars on compiler design; and Complexity on cryptography and optimization problems in manufacturing, business, and management.

Pedagogy:

Chalk and Talk, Problem Solving, Tutorial, Group Discussion, Quiz, Seminar.

Course Designer: Dr. I. Padmavathi, Assistant Professor, PG and Research Department of Mathematics, The Madura College (Autonomous), Madurai.

Lecture Schedule

Unit	Topics	Hrs	Mode
I	Definition of an automata and finite automata	3	Chalk and Talk, Problem Solving, Tutorial, quiz and test
	Transition systems and Transition functions	3	
	Acceptability of a string by a finite Automaton	3	
	Nondeterministic finite state machines	3	
	The Equivalence of DFA and NDFA.	3	
II	Basic Definitions and Examples	3	Chalk and Talk, Problem Solving, e-quiz and test
	Definition of a Grammar	4	
	Chomsky classification of languages	4	
	Languages and their relation.	4	
III	Recursive and recursively Enumerable sets	3	Chalk and Talk, group discussion, quiz and test
	Operations on Languages	4	
	Language and automata	4	
	Supplementary Examples.	4	
IV	Regular Expressions.	3	Chalk and Talk, tutorial, quiz and test
	Finite Automata and regular expressions,	3	
	Pumping lemma for regular sets.	3	
	Application of pumping lemma.	3	
	Closure properties of regular sets.	3	
V	Context-free Languages and derivation trees	5	Chalk and Talk, seminar, Assignment and quiz
	Ambiguity in context-free grammars	5	
	Simplification of Context-free Grammars.	5	
	Total	75	

Course Learning Outcomes:

At the end of the course, students will be able to

CLOs	Course Outcome	Knowledge level
CLO1	Employ the finite-state machines to solve problems in computing.	K3
CLO2	Understand the concept of grammar, language and its relation	K3
CLO3	Learn the idea of operations on language and automata	K3
CLO4	Understand the Pumping lemma for regular sets	K4
CLO5	Design context-free grammars for formal languages	K4

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	2	2	1	-	-
CLO2	2	3	2	1	1
CLO3	3	3	3	1	1
CLO4	3	3	2	2	1
CLO5	3	3	2	2	1

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	2	1	1	-
CLO2	2	3	-	1	1	-
CLO3	3	2	-	1	1	1
CLO4	2	2	1	1	1	2
CLO5	3	2	2	1	1	2

3 – Advance Application

2 – Intermediate Level

1 – Basic Level

Summative - Blue – Print – Model

(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K-level	Section A		Section B		Section C	SectionD
			MCQs		Short Answers			
			No. of Questions	K-Level	No. of Questions	K-Level	(Either/or Choice)	(Open Choice)
1	CLO 1	K3	2	K1& K2	1	K1	2(K1&K1)	1(K3)
2	CLO 2	K3	2	K2& K3	1	K2	2(K2& K2)	1(K3)
3	CLO 3	K3	2	K3& K3	1	K3	2(K3& K3)	1(K3)
4	CLO 4	K4	2	K1& K4	1	K1	2(K4& K4)	1(K4)
5	CLO 5	K4	2	K3& K4	1	K2	2(K4& K4)	1(K4)
No.of Questions to be Asked			10		5		10	5
No.of Questions to be Answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

Distribution of Section-wise Marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	27%
K2	2	4	10	-	16	13.33	
K3	4	2	10	30	46	38.33	38%
K4	2	-	20	20	42	35.00	35%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS					CLASS: I M.Sc., MATHEMATICS			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
II	Elective	25P2MECT4(A)	MECHANICS	3	5	25	75	100

Nature of the Course	Skill Oriented	✓	Employability oriented		Entrepreneurship oriented	

Objectives:

- To create a foundation for understanding basic principles of mechanics and some classical problems.
- To learn Lagrangian and Hamiltonian formulations of classical mechanics
- To learn the importance and consequences of canonical transformations

Unit	Description	Hours	K-level	CLO
I	UNIT I: Introductory concepts - Mechanical system – generalized coordinates – constraints – virtual work – d'Alembert's principle - energy and momentum – equilibrium and stability – kinetic energy – angular momentum.	15	K2	CLO1
II	UNIT II: Lagrange's equations - Derivation of Lagrange's equations for different conditions – Lagrange equations for some simple systems - integrals of motion – Routhian procedure – natural system – Liouville's system – small oscillations.	15	K3	CLO2
III	UNIT III: Hamilton's equations - Stationary values - Hamilton's principle under different conditions – Hamilton's equations – the Legendre transformation – modified Hamilton's principle – principle of least action.	15	K3	CLO3
IV	UNIT IV: Hamilton-Jacobi theory - Hamilton's principle function – canonical integral – Pfaffian differential form – Hamilton-Jacobi equation – Jacobi's theorem – modified Hamilton-Jacobi equation – separability – Liouville's system Stackel's theorem.	15	K4	CLO4
V	UNIT V: Canonical transformations - Differential forms and generating functions – some simple, point and momentum transformations - Lagrange and Poisson brackets.	15	K4	CLO5

Book for study:

D.T. Greenwood, Classical Dynamics, Prentice Hall of India Pvt. Ltd, New Delhi, 1979.

Unit I: Chapter 1(1.1-1.5)

Unit II: Chapter 2(2.1-2.4)

Unit III: Chapter 4(4.1-4.3)

Unit IV: Chapter 5(5.1-5.3)

Unit V: Chapter 6(6.1-6.3)

Books for References:

1. H. Goldstein, C. Poole & J. Safko, Classical Mechanics, Pearson Education, New Delhi, 2002.
2. N.C.Rane and P.S.C.Joag, Classical Mechanics, Tata McGraw Hill, 1991.
3. J.R. Taylor, Classical Mechanics, University Science Books, Sausalito 2005.

Web Resources:

1. <http://kestrel.nmt.edu/~raymond/classes/ph321/notes/lagrange/lagrange.pdf>
2. <https://www.physics.rutgers.edu/~shapiro/507/book3.pdf>
3. <http://complex.gmu.edu/www-phys/phys705/notes/015.5%20Hamilton-Jacobi%20Equation.pdf>
4. <http://complex.gmu.edu/www-phys/phys705/notes/014%20Canonical%20Transformation%20I.pdf>

Rationale for Nature of the course

Knowledge of the motion of non-quantum mechanical, low-energy particles in weak gravitational fields and Hamilton-Jacobi in identifying conserved quantities for a mechanical system.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill.

Pedagogy

Lecture, Chalk and Talk, Quiz, PPT, Tutorial, Assignment

Course Designer:

Dr. V. Sangeethasubha, Assistant Professor, PG and Research Department of Mathematics.

Lecture Schedule

Unit	Topics	Hours		Mode
I	Introductory concepts: mechanical system – generalized coordinates – constraints – virtual work	7	15	Lecture, Chalk and Talk Problem Solving, Quiz, Test
	d’Alembert’s principle - energy and momentum – equilibrium and stability – kinetic energy – angular momentum	8		
II	Lagrange’s equations: derivation of Lagrange’s equations for different conditions	5	15	Lecture, Problem Solving, Chalk and Talk, Test
	Lagrange equations for some simple systems - integrals of motion – Routhian procedure	5		
	Natural system – Liouville’s system – small oscillations.	5		
III	Hamilton’s equations: stationary values - Hamilton’s principle under different conditions	6	15	PPT, Lecture, Quiz, Tutorial Problem Solving, Test
	Hamilton’s equations – the Legendre transformation	5		
	modified Hamilton’s principle – principle of least action.	4		
IV	Hamilton-Jacobi theory: Hamilton’s principle function – canonical integral	5	15	Lecture, Tutorial, Problem Solving, Test
	Pfaffian differential form – Hamilton-Jacobi equation	5		
	separability – Liouville’s system Stackel’s theorem	5		
V	Canonical transformations: differential forms and generating functions	5	15	Lecture, Chalk and Talk, PPT, Problem Solving, Assignment
	some simple, point and momentum transformations	5		
	Lagrange and Poisson brackets	5		
Total Hours		75		

Course Learning Outcomes:

At the end of the course, students will be able to:

CLO	Course Learning Outcomes	Knowledge Level
CLO 1	Understand the concepts of mechanical system, energy, momentum and d'Alembert's principle	Up to K2
CLO 2	Use the concept of Lagrange's equations in simple systems and in Routhian procedure, Liouville's system.	Up to K3
CLO 3	Evaluate stationary values using Hamilton's equations and find about Liouville's system	Up to K3
CLO 4	Use Hamilton Jacobi theory and find pfaffin differential form, Liouville's system stackel's theorem	Up to K4
CLO 5	Acquire the knowledge about canonical transformations, momentum transformations and poisson brackets	Up to K4

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	2	1	2	3
CLO2	3	2	1	2	3
CLO3	3	2	1	2	3
CLO4	3	2	1	2	3
CLO5	3	2	1	2	3

Mapping with CLOs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	2	2	1	-
CLO2	3	2	2	-	1	-
CLO3	3	2	3	-	2	-
CLO4	3	2	-	-	2	-
CLO5	3	-	-	2	3	-

3- Advance Application

2- Intermediate Level

1- Basic Level

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

S. No.	CLOs	K – Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K - Level	No. of questions	K - Level		
1	CLO1	K2	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)
2	CLO2	K3	2	K2 & K3	1	K1	2(K2 & K2)	1(K3)
3	CLO3	K3	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)
4	CLO4	K4	2	K3 & K4	1	K2	2(K3 & K3)	1(K4)
5	CLO5	K4	2	K3 & K4	1	K3	2(K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1 - Remembering and recalling facts with specific answers.

K2 - Basic understanding of facts and stating main ideas with general answers.

K3 - Application oriented - Solving Problems.

K4 - Examining, analyzing, presentation and make inferences with evidences.

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	20	20	46	38.33	38.3%
K4	2	-	10	20	32	26.67	26.7%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS				CLASS: I M.Sc., Mathematics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/ week	CIA	Ext	Total
II	Elective	25P2MECT4(B)	MODELLING AND SIMULATION WITH EXCEL	3	5	25	75	100

Nature of Course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship oriented	

Objectives:

To apply and analyse qualitative and quantitative data in Excel.

Unit	Description	Hours	K-level	CLO
I	Presentation of Quantitative Data: Introduction-Data Classification-Data Context and Data Orientation-Types of Charts and Graphs-An Example of Graphical Data Analysis and Presentation.	15	K3	CLO1
II	Analysis of Quantitative Data: Introduction-Data Analysis Tools-Data Analysis for Two Data Sets-Analysis of Time Series Data—Forecasting/Data Relationship Tools-Analysis of Cross-Sectional Data.	18	K2	CLO2
III	Presentation of Qualitative Data: Introduction Essentials of Effective Qualitative Data Presentation-Data Entry and Manipulation-Data queries with Sort, Filter, and Advanced Filter. Analysis of Qualitative Data: Introduction-Essentials of Qualitative Data Analysis-PivotChart or PivotTable Reports.	18	K3	CLO3
IV	Modeling and Simulation: Part 1: Introduction-An Example of Deterministic Modeling-Understanding the Important Elements of a Model-Model Building with Excel.	18	K4	CLO4
V	Modeling and Simulation: Part 2: Types of Simulation and Uncertainty-The Monte Carlo Sampling Methodology-A Financial Example—Income Statement.	18	K3	CLO5

Book for study:

Hector Guerrero, Excel Data Analysis Modeling and Simulation (2010) ,Springer Heidelberg Dordrecht London New York.

UNIT I: Chapter 2: Sec:2.1 – 2.5

UNIT II: Chapter 3: Sec 3.1 – 3.4

UNIT III: Chapter 4: 4.1 -4.4, Chapter-5: 5.1 – 5.3

UNIT IV: Modeling and Simulation Part 1: Chapter 7: 7.1 – 7.4(up to 7.4.2)

UNIT V: Modelling and Simulation Part 2: Chapter 8: Sec: 8.1 – 8.4

Books for References:

Pc Software for Windows 98 made simple, R.K.Taxali, McGraw Hill Education, 2001

Microsoft Office Excel 2007, Torben Lage Frandsen, Torben Lage Frandsen & Ventus Publishing Aps, 2010

Web Resources:

1. <https://nptel.ac.in/courses/111/104/111104092/>
2. <http://www.freebookcentre.net/SpecialCat/Free-Mathematics-Books-Download.html>

Rationale for Nature of the course

This course introduces modeling methods and simulation tools for natural phenomena like fluid motion, stellar dynamics, and population evolution. It teaches you how to create short programs to solve problems.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Case study, Formulation an Analysis plan and problem solving

Pedagogy

Lecture, Seminar, Quiz, Problem Solving, Tutorial, Group Discussion and Power point presentation.

Course Designer:

Dr.K.LAKSHMI, Assistant professor, PG and Research Department of Mathematics

Lecture Schedule

Unit	Description	Hours	Mode
I	Presentation of Quantitative Data: Introduction-Data Classification-Data Context and Data Orientation-Types of Charts and Graphs-An Example of Graphical Data Analysis and Presentation.	15	Lecture, Quiz, Tutorial, PPT
II	Analysis of Quantitative Data: Introduction-Data Analysis Tools-Data Analysis for Two Data Sets-Analysis of Time Series Data—Forecasting/Data Relationship Tools-Analysis of Cross-Sectional Data.	15	Lecture, Quiz
III	Presentation of Qualitative Data: Introduction Essentials of Effective Qualitative Data Presentation-Data Entry and Manipulation-Data queries with Sort, Filter, and Advanced Filter. Analysis of Qualitative Data: Introduction-Essentials of Qualitative Data Analysis-PivotChart or PivotTable Reports.	15	PPT, Lecture, Quiz
IV	Modeling and Simulation: Part 1: Introduction-An Example of Deterministic Modeling-Understanding the Important Elements of a Model-Model Building with Excel.	15	Lecture, Tutorial
V	Modeling and Simulation: Part 2: Types of Simulation and Uncertainty-The Monte Carlo Sampling Methodology-A Financial Example—Income Statement.	15	PPT, Lecture, Quiz
Total Hours		75	

Course Learning Outcomes

At the end of the course, Students will be able to

CLOs	Course Learning outcome	Knowledge level
CLO1	Classify the quantitative data and interpret the data using Excel.	Upto K3
CLO2	Present the quantitative data in excel.	Upto K3
CLO3	Analyse the qualitative data, interpret and model building through Excel.	Upto K3
CLO4	Model and simulate the data with Excel.	Upto K4
CLO5	Apply the Monte Carlo sampling method and create the financial statements.	Upto K5

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	2	2	1	-	-
CLO2	2	3	2	1	1
CLO3	3	3	3	1	1
CLO4	3	3	2	2	1
CLO5	3	3	2	2	1

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	2	1	1	-
CLO2	2	3	-	1	1	-
CLO3	3	2	-	1	1	1
CLO4	2	2	1	1	1	2
CLO5	3	2	2	1	1	2

3 – Advance Application

2 – Intermediate Level

1 – Basic Level

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

S. No.	CLOs	K-level	Section A		Section B		Section C	Section D
			MCQs		Short Answers		(Either/or Choice)	(Open Choice)
			No. of Questions	K-Level	No. of Questions	K-Level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K1	2(K2 & K2)	1(K3)
3	CLO 3	Up to K3	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2(K4 & K4)	1(K4)
5	CLO 5	Up to K4	2	K3 & K4	1	K3	2(K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - Solving Problems

K4 - Examining, analysing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	2	2	10	10	26	21.67	21.67%
K4	2	-	10	20	32	26.7	26.7%
K5	-	-	10	10	20	16.7	16.7%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS					CLASS: I M.Sc., Mathematics			
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/Week	CIA	Ext.	Total
II	Non-Major Elective	25P2MSEN2	BUSINESS STATISTICS	2	2	25	75	100

Nature of Course	Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	

Objectives:

- To explain the important concepts of statistics and mathematical data concept.
- To formulate the visualization of frequency distribution.
- To describe the relationship between two different variables in terms of positive and negative correlation, describe how strongly correlated two different variables are based on the proximity to a line of best fit on a scatter graph or a scatter graph without a line of best fit.

Unit	Description	Hours	K-level	CLO
I	Correlation: Introduction – Definitions – Types of correlation – Karl Pearson’s coefficient of correlation – Rank coefficient of correlation – Problems.	6	K2	CLO 1
II	Regression: Introduction – Definitions – Line of regression of x on y and y on x -Difference between correlation and regression – Problems.	6	K2	CLO 2
III	Index Numbers: Introduction – Definitions – Types of index number – Laspeyre’s method – Paasche’s method, Dorbish and Bowley’s method – Fisher’s ideal method – Marshall Edgeworth method – Problems.	6	K2	CLO 3
IV	Index Numbers (continued): Quantity index numbers – Value index numbers – Time reversal test – Factor reversal test – Consumer price index – Family Budget method – Problems.	6	K2	CLO 4
V	Time series: Introduction – Definitions – Measurements of secular trend – Semi average method –Moving average method – Method of Least squares – Measurement of Seasonal variation – Method of simple average - Problems	6	K2	CLO 5

Book for study:

Statistics Theory and Practice, R.S.N. Pillai and Bagavathi S. chand and company Reprint 2018.

Chapters 12, 13, 14, 15 (Relevant Topics only)**Books for Reference:**

1. Gupta S.C and Kapoor, V.K. (2002). Fundamentals of Mathematical Statistics, Sultan Chand & Sons Pvt. Ltd., New Delhi
2. Goon A.M. Gupta. A.K. and Das Gupta, B (1987). Fundamental of Statistics, vol.2 World Press Pvt. Ltd., Kolkatta
3. G.U.Yule and M.G. Kendall (1956). An introduction to the theory of Statistics, Charles Griffin.
4. M.R. Spiegel (1961). Theory and problems of Statistics, Schaum's outline series.
5. Anderson, T.W. and Sclove SL. (1978). An introduction to statistical analysis of data, Houghton Mifflin & co.

Web Resources

1. <https://geographyfieldwork.com/SpearmanRank.htm#:~:text=Spearman's%20Rank%20correlation%20coefficient%20is%20a%20technique%20which%20can%20be,between%20%20and%20minus%201.&text=Create%20a%20table%20from%20your,Rank%20the%20two%20data%20sets.>
2. <https://www.geeksforgeeks.org/laspeyres-paasches-and-fishers-methods-of-calculating-index-number/>
3. https://www.brainkart.com/article/Measurements-of-Trends--Methods-of-measuring-Seasonal-Variations-By-Simple-Averages_39019/

Rationale for nature of the course

Statistics is the part of mathematical science which pertains to the collection, classification, tabulation, analysis, interpretation and presentation of data. Some of the eminent researchers consider Statistics to be a separate mathematical science rather than a branch of mathematics.

Activities having direct bearing on Skill Development / Employability / Entrepreneurship

Students have the ability to work on challenging issues during class hours. The challenges can be discussed and further difficulties can be worked through in class.

Pedagogy

Lecture, Seminar, Quiz, Problem Solving, Tutorial, Group Discussion, PPT.

Course Designer(s):

1. Dr. C. Thangapandi, Associate Professor, Department of Mathematics.

Course Schedule

Unit	Topics	Hrs	Mode
I	Introduction – Definitions – Types of correlation.	2	Lecture, Tutorial, Quiz, Test.
	Karl Pearson's coefficient of correlation – Problems.	2	
	Rank coefficient of correlation – Problems.	2	
II	Introduction – Definitions and examples.	2	Lecture, PPT, Problem Solving.
	Line of regression of x on y and y on x and problems.	2	
	Difference between correlation and regression – problems.	2	
III	Introduction – Definitions – Types of index number and simple problems.	2	Lecture, Problem solving, Quiz, Test.
	Laspeyre's method – Paasche's method, Derbish and Bowley's method – Problems.	2	
	Fisher's ideal method – Marshall – Edge Worthy's method – Problems.	2	
IV	Quantity index numbers – Value index numbers – Problems.	2	Problem solving Lecture, Quiz Tutorial, Test.
	Time reversal test – Factor reversal test – simple problems.	2	
	Consumer price index – Family Budget method – Problems.	2	
V	Introduction – Definitions – Measurements of secular trend – Problems.	2	Seminar, Lecture, Quiz Lecture, Assignment.
	Semi-average method – Moving-average method – Simple problems.	2	
	Method of Least square – Measurement of Seasonal variation – Method of simple average problems.	2	
	Total	30	

Course Learning Outcomes:

After completion of the course the students will be able to,

CLO	Course Learning Outcomes	Knowledge Level
CLO 1	Identify the types of correlation, Karl Pearson's coefficient of correlation, Rank coefficient of correlation and Problems.	K2
CLO 2	Find line of regression of x on y and y on x and difference between correlation and regression, problems.	K2
CLO 3	Understand index numbers, Laspeyre's method, Paasche's method, Dorbish and Bowley's method, Fisher's ideal method, Marshall, Edgeworth method and Problems.	K2
CLO 4	Understand value index numbers, Time reversal test, Factor reversal test, Consumer price index, Family Budget method and Problems.	K2
CLO 5	Solve problem by using moving average method, Method of Least squares, and Measurement of Seasonal variation, Method of simple average and Problems.	K2

Mapping of CLOs with PSOs

CLO	PSO1	PSO2	PSO3	PSO4	PSO5
CLO 1	3	3	2	1	2
CLO 2	3	3	2	1	2
CLO 3	3	3	2	2	2
CLO 4	3	3	2	2	2
CLO 5	3	3	2	3	2

Mapping of CLOs with POs

CLO	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	1	1	1	1
CLO2	3	2	1	1	1	1
CLO3	3	2	1	1	1	1
CLO4	3	2	1	1	1	1
CLO5	3	2	1	1	1	1

Advance application– 3;**Intermediate level–2;****Basic level–1**

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

S. No.	CLO	K – Level	Section A	Section B	Section C
			Short Answers	(Either/OR Choice)	(Open Choice)
1	CLO1	K2	1(K1)	2(K2 &K2)	1(K1)
2	CLO2	K2	1(K1)	2(K2 &K2)	1(K1)
3	CLO3	K2	1(K1)	2(K2 &K2)	1(K1)
4	CLO4	K2	1(K1)	2(K2 &K2)	1(K1)
5	CLO5	K2	1(K1)	2(K2 &K2)	1(K1)
No. of Questions to be asked			5	10	5
No. of Questions to be answered			5	5	3
Marks for each question			2	7	10
Total Marks for each Section			10	35	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented-Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of section wise marks with K levels

K Level	Section A (No Choice)	Section B (Either /or Choice)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	10	-	50	60	46.15	46%
K2	-	70	-	70	53.85	54%
Total Marks	10	70	50	130	100	100%

DEPARTMET OF MATHEMATICS				CLASS: II M.Sc Mathematics			
Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
Major Core VIII	23P3MCCT8	PROBABILITY THEORY	5	6	25	75	100

Nature of the Course	Skill oriented	✓	Employability		Entrepreneurship oriented	

Course Objectives:

The objectives of the course are:

- To introduce axiomatic approach to probability theory.
- To analyze some statistical characteristics, discrete and continuous distribution functions and their properties, characteristic function and basic limit theorems of probability.
- To acquire a knowledge of Bernoulli, Binomial, Poisson and Normal distributions.

Course content:

Unit	Description	Hours	K-level	CLOs
I	Random Events and Random Variables: Algebra of Sets – Set Functions – The Probability Set Function – Random Variables – The Probability Density Function – The Distribution Function. Chapter 1: Sections 1.1 to 1.7	18	K2	CLO 1
II	Conditional Probability and Stochastic Independence Conditional Probability – Marginal Distributions – Conditional Distributions – The Correlation Coefficient – Stochastic Independence Chapter 2: Sections 2.1 to 1.4	18	K3	CLO 2
III	Probability Distributions The Binomial, Trinomial and Multinomial Distributions – The Poisson Distribution – The Gamma and Chi-Square Distributions – The Normal Distributions Chapter 3: Sections 3.1 to 3.4	18	K3	CLO 3

IV	Distributions of Functions of Random Variables Transformations of Variables of Discrete Type and Continuous Type – The t and F Distributions – Distributions of Order Statistics – The — Moment Generating Functions Technique – The Distributions of X and nS^2/σ^2 Chapter 4: Sections 4.2 to 4.4 and 4.6 to 4.8	18	K4	CLO 4
V	Limit Theorems : Stochastic convergence – Limiting Distributions – Stochastic Convergence – Limiting Moment – Generating Functions – The Central Limit Theorem – Some Theorems on Limiting Distributions Chapter 4: Sections 5.1 to 5.5	18	K4	CLO 5

Book for Study:

1. Robert V. Hogg., Allen T. Craig., Introduction to Mathematical Statistics, Fourth Edition, Macmillan Publishing Co., Inc., New York

Unit I : Chapter 1: Sections 1.1 to 1.7,

Unit II: Chapter 2 : Sections 2.1 to 2.4

Unit III: Chapter 3 : Sections 3.1 to 3.4

Unit III: Chapter 4 : Sections 4.1 to 4.4 and 4.6 to 4.8

Unit V: Chapter 5 : Section 5.1 to 5.4

Books for Reference:

1. M. Fisz, Probability Theory and Mathematical Statistics, John Wiley and Sons, New York, 1963
2. K.. L. Chung, A Course in Probability, Academic Press, New York, 1974
3. V. K. Rohatgi., An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern Limited, New Delhi, 1988 (3rd Print).
4. B. R. Bhat, Modern Probability Theory (3rd Edition), New Age International Private Limited, New Delhi, 1999.

Web Resources:

1. <http://mathforum.org>, <http://ocw.mit.edu/ocwweb/Mathematics>,
2. <http://www.opensource.org>, <http://www.probability.net>
3. https://www.usb.ac.ir/FileStaff/7344_2018-12-2-10-44-10.pdf

Rationale for Nature of the course:

Probability is a mathematical term for the likelihood that something will occur. It is the ability to understand and estimate the likelihood of any different combination of outcomes. This course, namely Probability Theory, has applications in various fields. This course will enable the students to acquire skills by which they can model certain real-life problems.

Activities having direct bearing on Skill development/ Employability Entrepreneurship:

During class hours, students can handle more difficulties involved in the problems can be discussed and resolved.

Pedagogy

Chalk and Talk, PPT, Quiz, Group discussion, Seminar, Interaction, Tutorial sessions

Course schedule

Unit	Description	Hours		Mode
I	Introduction: Algebra of Sets – Set Function – The Probability Set Function	7	18	Lecture, Chalk and Talk,
	Random Variables – The Probability Density Function – The Distribution Function	11		Problem Solving, Quiz, Test.
II	Conditional Probability – Marginal and Conditional Distributions	7	18	Lecture, Problem Solving
	The Correlation Coefficient - Stochastic Independence	11		Lecture, Chalk and Talk
III	Probability Distributions – The Binomial, Trinomial and Multinomial Distributions	6	18	PPT, Lecture, Quiz
	The Poisson Distributions – The Gamma Distribution	6		PPT, Tutorial, Problem Solving
	Chi-Square Distribution – The Normal Distribution	6		Lecture, PPT
IV	Transformations of Variables of Discrete Type and Continuous Type – The t and F Distributions	9	18	Lecture, Tutorial
	Distributions of Order Statistics – The Moment Generating Functions Technique – The ___ Distributions of X and nS^2/σ^2	9		Problem Solving, Assignment
V	Limiting Distributions – Stochastic Convergence – Limiting Moment – Generating Functions	10		Assignment,
	The Central Limit Theorem – Some Theorems on Limiting Distributions	8		Problem Solving, Quiz, Seminar.
	Total Hours		90	

Course learning Outcomes:

At the end of the course, the students will be able to,

CLO s	Description	K- level
CLO 1	Introduction – Algebra of Sets – Set Function – The Probability Set Function – Random Variables – The Probability Density Function – The Distribution Function	Upto K2
CLO 2	Conditional Probability – Marginal and Conditional Distributions – The Correlation Coefficient – Stochastic Independence	Upto K3
CLO 3	Probability Distributions: The Binomial, Trinomial and Multinomial Distributions – The Poisson Distribution – The Gamma and Chi-Square Distributions – The Normal Distributions	Upto K3
CLO 4	Transformations of Variables of Discrete Type and Continuous Type – The t and F Distributions – Distributions of Order Statistics – The Moment Generating — Functions Technique – The Distributions of X and nS^2/σ^2	Upto K4
CLO 5	Stochastic convergence – Limiting Distributions – Stochastic Convergence – Limiting Moment – Generating Functions – The Central Limit Theorem – Some Theorems on Limiting Distributions.	Upto K4

Mapping of CLOs with PSOs

CLOs	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	1	3	2	1
CLO2	2	1	3	1	2
CLO3	3	2	3	1	1
CLO4	1	2	3	2	1
CLO5	3	1	2	3	1

Mapping of CLOs with POs

CLO #	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	1	2	1	3
CLO2	3	2	1	2	1	3
CLO3	3	2	1	2	1	2
CLO4	3	2	1	2	1	1
CLO5	3	2	1	2	1	1

Advance application– 3

Intermediate level–2

Basic level–1

SUMMATIVE ASSESSMENT-BLUEPRINT

Units	CLOs	K- level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K-Level	No. of Questions	K- Level		
1	CLO 1	K2	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)
2	CLO 2	K3	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)
3	CLO 3	K3	2	K2 & K3	1	K1	2(K2 & K2)	1(K3)
4	CLO 4	K4	2	K3 & K4	1	K3	2(K4 & K4)	1(K4)
5	CLO 5	K4	2	K3 & K4	1	K2	2(K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30.00	30%
K4	2	-	20	20	42	35.00	35%
Total marks	10	10	50	50	120	100	100%

Course Designer:

1. Dr. R. Pandiselvi, Associate Professor, PG and Research Department of Mathematics.
2. Dr. M. Revathi, Assistant Professor, Department of Mathematics(S.F)



DEPARTMENT OF STATISTICS

Revised Curriculum

Based on the model curriculum of

TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION (TANSCH)

With elements from

Learning Outcome Based Education framework (LOBE) of UGC
(Choice Based Credit system with Outcome Based Education)

Academic Year 2023-2024 onwards

V and VI semesters (B.Sc. Statistics) – Regulation 2023

I and II semesters (M.Sc. Statistics) – Regulation 2025



THE MADURA COLLEGE, MADURAI DEPARTMENT OF STATISTICS

VISION

Vision of the Statistics department is to develop student's ability to think analytically, speculatively and amaginatively and to encourage them to pursue higher education for the purpose of continuous curriculum innovations.

MISSION

- To help students develop their intellect and faith.
- To provide excellent training in scientific data collections, data management, methods and procedure of data analysis.
- To facilitate students to see themselves as professional, as part of a discipline with skills and abilities valuable in business, teaching and publishing.

PROGRAMME OUTCOMES FOR B.Sc STATISTICS GRADUATES:

At the end of the program the graduates will be able to

PO 1: Students will acquire basic Practical skills & Technical knowledge along with domain knowledge of different subjects in the science & humanities stream.

PO 2: Students will become employable; Students will be eligible for career opportunities in education field, Industry, or will be able to opt for entrepreneurship

PO 3: Students will possess basic subject knowledge required for higher studies, professional and applied courses.

PO 4: The skills and knowledge gained leads to proficiency in analytical reasoning, which can be utilized in modelling and solving real life problems.

PO 5: Utilize Statistics to solve theoretical and applied problems by critical understanding, analysis and synthesis.

PO 6: Develop students into responsible citizens in a rapidly changing interdependent society.

Programme Specific Outcomes of B.Sc Degree programme in Statistics

PSO -1:Familiarize the students with suitable tools of statistical analysis to handle issues and problems in Statistics and related sciences.

PSO -2:Know when there is a need for information, to be able to identify, locate, evaluate, and effectively use that information for the issue or problem at hand.

PSO -3:Acquire good knowledge and understanding to solve specific theoretical and applied problems in advanced areas of Statistics.

PSO -4:Develop a range of generic skills helpful in employment, internships& societal activities.

PSO -5:Get adequate exposure to global and local concerns that provides platform for further exploration into multi-dimensional aspects of Mathematical sciences.



The Madura College, Madurai - 625 011
Department of Statistics
PROGRAMME STRUCTURE B.Sc. STATISTICS

Sem	Course category	Course code	Title of the Course	Hours	Credits
I	Language - I	23U1TLAN1	TAMIL	6	3
	Language - II	23U1NENG1	ENGLISH	6	3
	Core	23U1SCCT1	DESCRIPTIVE STATISTICS	4	4
	Core	23U1SCCT2	PROBABILITY THEORY	4	4
	Allied / GEC	23U1FGET1	OBJECT ORIENTED PROGRAMMING USING C++	6	5
	Foundation Course	23U1SFCT1	BRIDGE STATISTICS	2	2
	SEC	23U1SSED1	STATISTICAL PRACTICAL –I (Calculator based)	2	2
II	Language - I	23U2TLAN2	TAMIL	6	3
	Language - II	23U2NENG2	ENGLISH	6	3
	Core	23U2SCCT3	MATRIX AND LINEAR ALGEBRA	4	4
	Core	23U2SCCT4	DISTRIBUTION THEORY	4	4
	Allied /GEC	23U2FGET2	WEB DESIGNING	6	5
	SEC	23U2SSED2	STATISTICAL PRACTICAL – II (Calculator based)	2	2
	SEC	23U2SSED3	LAB PRACTICAL IN R	2	2
	Part V	23U2YRC1/ NCC/NSS	PART V	---	---
III	Language - I	23U3TLAN3	TAMIL	6	3
	Language - II	23U3NENG3	ENGLISH	6	3
	Core	23U3SCCT5	ESTIMATION THEORY	4	4
	Core	23U3SCCT6	SAMPLING TECHNIQUES	3	3
	Allied / GEC	23U3MGET1(S)	NUMERICAL METHODS	6	5
	SEC	23U3SSED4	STATISTICAL PRACTICAL – III (Calculator Based)	2	2
	SEC	23U3SSED5	DATABASE MANAGEMENT SYSTEM	2	2
IV	Language - I	23U4TLAN4	TAMIL	6	3
	Language - II	23U4NENG4	ENGLISH	6	3
	Core	23U4SCCT7	TESTING OF STATISTICAL HYPOTHESIS	4	4
	Core	23U4SCC T8	ACTUARIAL STATISTICS	3	3
	Allied / GEC	23U4MGET2(S)	REAL ANALYSIS	6	5
	SEC	23U4SSED6	STATISTICAL PRACTICAL –IV (Calculator Based)	2	2
	SEC	23U4SSED7	BIOSTATISTICS	2	2

	EVS	23U4EVST1	EVS	2	2
	Part V	23U4YRC2/ NCC/NSS	PART V	0	1
V	Core	23U5SCCT9	DESIGN OF EXPERIMENTS	5	4
	Core	23U5SCCT10	STATISTICAL QUALITY CONTROL	5	4
	Core	23U5SCCT11	OPERATIONS RESEARCH	5	4
	Core - Practical	23U5SCCP1	STATISTICAL PROBLEM SOLVING - I (Calculator Based Practical)	3	3
	Discipline Elective	23U5SDET1(A)	NON-PARAMETRIC STATISTICS	5	4
		23U5SDET1(B)	RELIABILITY THEORY AND SURVIVAL ANALYSIS		
	IDC	23U5SIDCT	ECONOMIC STATISTICS	5	4
	Value Education	23U5VENT1	VALUE EDUCATION	2	2
	Industrial Visit/ Internship Field Visit	23U5SINTR	INDUSTRIAL VISIT / INTERNSHIP FIELD VISIT	0	2
VI	Core	23U6SCCT12	STOCHASTIC PROCESSES	6	4
	Core	23U6SCCT13	REGRESSION ANALYSIS	6	4
	Core	23U6SCCT14	DEMOGRAPHY	6	4
	Core - Practical	23U6SCCP2	STATISTICAL PROBLEM SOLVING -II (Calculator Based Practical)	3	3
	Discipline Elective	23U6SDET2(A)	INDEX NUMBERS	4	2
		23U6SDET2(B)	APPLIED STATISTICS		
	SEC-PC	23U6SSED8	PRACTICAL IN PYTHON PROGRAMMING	2	2
	Project and viva-voce	23U6SPROV	Project and viva-voce	3	2
Total				180	141

Language I – Tamil / Hindi / Sanskrit

Language II : English

SEC – Skill Enhancement Course

GEC – Generic Elective Course

SEC-PC – Professional Competency Skill Enhancement Course

IDC – Interdisciplinary Course

MDC – Multidisciplinary Course

Language I – Tamil / Hindi / Sanskrit

Language II : English

SEC – Skill Enhancement Course

GEC – Generic Elective Course

SEC-PC – Professional Competency Skill Enhancement Course

IDC – Interdisciplinary Course

MDC – Multidisciplinary Course

DEPARTMENT OF STATISTICS				CLASS: III B.Sc., Statistics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
V	Core-IX	23U5SCCT9	DESIGN OF EXPERIMENTS	4	5	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	✓

Objectives:

- To expose the essential ideas about designing and interpreting statistical field experiments.
- To establish optimal process performance by finding the right settings for key process inputvariables.
- To know how to select the best agricultural inputs best fertilizers and reap the maximumyield.

Unit	Description	Hours	K-level	CLO
I	Introduction - Terminology in Experimental Designs – Principles of an Experimental Design – Replication – Randomization and Local Control – Size of the Plot - Assumption of ANOVA Test – One Way Classification – ANOVA for fixed effect model – Variance of the Estimated parameters – ANOVA for random effect model for one way classified data - Derivations and Problems.	15	Up toK2	1
II	Two way Classification – ANOVA for fixed effect model – Variance of the Estimated parameters – ANOVA for random effect model for two way classified data with one observation per cell – Completely Randomised Design(C.R.D) – Statistical Analysis of C.R.D - Derivations and problems	15	Up toK3	2
III	Randomised Block Design(R.B.D) – Statistical Analysis of R.B.D – Efficiency of R.B.D relative to C.R.D –Latin Square Design (L.S.D) – Statistical Analysis of $m \times m$ L.S.D for one Observation per Experimental Unit – Least Square Estimates of Parameters – Estimation of missing value in R.B.D – Estimation of missing value in L.S.D –Expectation of sum of squares.	15	Up toK3	3
IV	Factorial Experiments – 2^2 -Factorial Design – Statistical analysis of 2^2 design – Yates' method of computing Factorial Effect Totals 2^3 - Factorial Experiment – Statistical analysis of 2^3 -Design – Confounding in factorial designs - Confounding in 2^3 Experiment.	15	Up toK3	4
V	Balanced Incomplete Block Designs(B.I.B.D) – Parameters of B.I.B.D – Incidence Matrix – Symmetric (B.I.B.D) – Resolvable Design – Affine Resolvable Design – Intra block Analysis of BIBD	15	Up toK4	5

Books for study:

Kapoor V.K. and Gupta S.C., Fundamentals of Applied Statistics, 3rd extensively revised edn, Sultan Chand & Sons, New Delhi.

Chapters:

Unit I – Chapter 6 (6.1 – 6.3), Chapter 5.1 (5.1.1), 5.2 (5.2.1,5.2.2,5.2.3);

Unit II – Chapter 5.3 (5.3.1, 5.3.2,5.3.3), Chapter 6.4 (6.4.1,6.4.2,6.4.3,6.4.4,6.4.5);

Unit III – Chapter 6.5 (6.5.1,6.5.2,6.5.3,6.5.4,6.5.5,6.5.6,6.5.7), 6.6 (6.6.1,6.6.2);

Unit IV – Chapter 6.9 (6.9.1,6.9.2, 6.9.3), 6.10 (6.10.1);

Unit V – Chapter 6.13(6.13.1,6.13.2,6.13.3, 6.13.4,6.13.5,6.13.6).

Books for References:

1. Dean A.M., and Voss D.,(2006) Design and Analysis of Experiments, Springer, New York.
2. Montgomery D.C.(2012), Design and Analysis of Experiments, John Wiley & Sons, New Delhi.
3. Panneerselvam, R. (2012), Design and Analysis of Experiments, Prentice Hall.
4. Rangaswamy R, (2006), Agricultural statistics, New age international Pvt. New Delhi.
5. Das M.N. and Giri N.C.(1986), Design and Analysis of Experiments, Wiley Eastern, New Delhi.

Web Resources:

1. <https://www.youtube.com/watch?v=VnuWpEvY41s>
2. <https://egyankosh.ac.in/bitstream/123456789/20710/1/Unit-7.pdf>
3. <https://quantifyinghealth.com/randomized-block-design/>
4. <https://home.iitk.ac.in/~shalab/anova/chapter8-anova-factorial-experiment.pdf>

Rationale for Nature of the course

Experimental design can be used at the point of greatest leverage to reduce design costs by speeding up the design process, reducing late engineering design changes, and reducing product material and labor complexity. Designed Experiments are also powerful tools to achieve manufacturing cost savings by minimizing process variation and reducing rework, scrap, and the need for inspection.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

- Seminar
- Assignment preparation
- Group discussion
- Quiz

Pedagogy

Lecture, Seminar, Quiz, Problem Solving, Tutorial, Group Discussion, PPT.

Course Designer:

Prof.V.Vijayalakshmi, Assistant Professor, Department of Mathematics & Statistics.

Course Schedule

Unit	Topics	Hours	Mode
I	Introduction - Terminology in Experimental Designs – Principles of an Experimental Design – Replication – Randomization and Local Control – Size of the Plot.	5	Lecture, Quiz.
	Assumption of ANOVA Test – One Way Classification – ANOVA for fixed effect model – Variance of the Estimated parameters.	5	
	ANOVA for random effect model for one way classified data - Derivations and Problems.	5	
II	Two way Classification – ANOVA for fixed effect model – Variance of the Estimated parameters.	5	Lecture, Quiz.
	ANOVA for random effect model for two way classified data with one observation per cell.	5	
	Completely Randomised Design(C.R.D) – Statistical Analysis of C.R.D - Derivations and problems.	5	
III	Randomised Block Design(R.B.D) – Statistical Analysis of R.B.D – Efficiency of R.B.D relative to C.R.D – Estimation of missing value in R.B.D- Estimation of missing value in L.S.D .	5	Presentation, Lecture, Quiz.
	Latin Square Design (L.S.D) – Statistical Analysis of $m \times m$ L.S.D for one Observation per Experimental Unit.	5	
	Least Square Estimates of Parameters – Expectation of sum of squares.	5	
IV	Factorial Experiments – 2^2 -Factorial Design – Statistical analysis of 2^2 design – Yates' method of computing Factorial Effect Totals.	5	Presentation, Lecture, Quiz.
	2^3 - Factorial Experiment – Statistical analysis of 2^3 -Design.	5	
	Confounding in factorial designs - Confounding in 2^3 Experiment – Partial confounding.	5	
V	Balanced Incomplete Block Designs(B.I.B.D) – Parameters of B.I.B.D – Incidence Matrix.	5	Assignments and Seminar.
	Symmetric (B.I.B.D) – Resolvable Design – Affine Resolvable Design.	5	
	Intra block Analysis of BIBD – Comparison of Two Treatments.	5	
Total Hours		75	

COURSE OUTCOMES

At the end of the course, students will be able to:

CLO	Course Learning Outcomes	Knowledge Level
CLO 1	Describe how to design experiments, carry them out, and analyze the data they yield.	Up to K2
CLO 2	Investigate the logic of hypothesis testing, including analysis of variance and the detailed analysis of experimental data.	Up to K3
CLO3	Perform analysis of covariance in CRD and RBD and perform missing plot and analysis in RBD and LSD.	Up to K3
CLO 4	Apply principle of total and partial confounding in factorial experiments.	Up to K3
CLO 5	Analyze Balanced Incomplete Block Designs(B.I.B.D) and construct incomplete block designs.	Up to K4

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	3	3	2	1	2
CLO-2	3	3	1	2	3
CLO-3	1	1	3	2	2
CLO-4	3	3	2	3	3
CLO-5	3	3	3	2	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	3	2	3	3
CLO2	3	2	3	2	3	2
CLO3	2	1	3	2	3	2
CLO4	1	1	2	2	3	1
CLO5	3	1	1	2	3	3

Advance application– 3;**Intermediate level–2;****Basic level–1**

Summative - Blue – Print – Model

S.No.	CLOs	K – Level	Section A		Section B		SectionC (Either/or Choice)	SectionD (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K -Level	No. of Questions	K -Level		
1	CLO 1	Up to K2	2	K1 & K2	1	K1	2(K1 & K1)	1(K2)
2	CLO 2	Up to K3	2	K1 & K2	1	K1	2(K2 & K2)	1(K3)
3	CLO 3	Up to K3	2	K1 & K2	1	K2	2(K3 & K3)	1(K3)
4	CLO 4	Up to K3	2	K1 & K2	1	K2	2(K3 & K3)	1(K3)
5	CLO 5	Up to K4	2	K1 & K2	1	K2	2(K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1 - Remembering and recalling facts with specific answers.

K2 - Basic understanding of facts and stating main ideas with general answers.K3 - Application oriented - Solving Problems.

K4 - Examining, analyzing, presentation and make inferences with evidences.

Distribution of section wise marks with K levels

K Levels	Section A (No Choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	5	4	10	-	19	15.83	41.67%
K2	5	6	10	10	31	25.84	
K3	-	-	20	30	50	41.67	41.67%
K4	-		10	10	20	16.67	16.66%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF STATISTICS				CLASS: III B.Sc., Statistics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
V	Core-X	23U5SCCT10	STATISTICAL QUALITY CONTROL	4	5	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

COURSE OBJECTIVES

- To help students understand the concepts underlying statistical quality control and to develop their ability to apply those concepts to the design and management of quality control processes in industries.
- To understand the differences between attributes and variables.
- To introduce the students the basics of Statistical Quality Control and to enable they describe quality characteristics and relationships.

Unit	Description	Hours	K-level	CLO
I	Importance and need for statistical quality control techniques in industry – causes of variations in quality-uses of shewart's control charts- terminologies: specification limits, Tolerance limits, 3σ limits and warning limits-Theory of runs and its applications in quality control--Basis of sub grouping-Advantages and limitations of SQC-Control charts variables: control chart for mean($\bar{X}$ bar) and Range chart(R-chart)-standard deviation chart(S chart)-Control limits for $\bar{X}$ -chart-control limits for R-chart-Interpretation of $\bar{X}$ and R charts.	15	K3	1
II	Control charts for attributes- control chart for fraction defective(p- chart), control chart for number of Defectives(np- chart), control chart for number of defects per unit(c-chart) and control chart for number of defects per unit (u-chart)-construction of charts- Application of c chart-problems.	15	K2	2
III	Acceptance sampling plans for attributes–types of acceptance sampling plans, Methods of inspection 100% inspection and sampling inspection- lot formation-sampling methods - Advantages and limitation of sampling inspection-Industrial uses of Acceptance sampling-Terms used in acceptance Sampling plans: lot, lot size, sample size, lot quality, Acceptance number, Pa, AQL, LTPD- Producer's risk, Consumer's risk. AQL, RQL, IQL, AOQ, AOQL, ATI and ASN- problems.	15	K3	3
IV	Rectifying sampling plans- Characteristics of OC curve-Sampling plan –Single & Double sampling plan and Multiple sampling plan-Comparisons between single, double and multiple sampling plan- Characteristics of a good acceptance plan-AOQ, ATI and ASN curves for single and double sampling plans- problems.	15	K4	4

V	Advantages of acceptance sampling by variable-limitations-some different types of Acceptance criteria involving variables-The shanin lot plot method-Known- σ and unknown- σ variables sampling plans (one sided specification only)-Determination of n and k for one sided specification of OC curve-problems.	15	K3	5

Books for study:

1. Kapoor, V.K. and Gupta, S.C. (2007) Fundamentals of Applied Statistics, Sultan Chand & Sons.
2. Mahajan, M. (2002). Statistical Quality Control, (Third Edition), Dhanpat Rai and Co., Delhi.

Chapters: Book 1: UNIT I and UNIT II (Chapter: 1(1.1-1.9))
Book 2: UNIT III, IV (Chapter: 10) UNIT V (Chapter: 12)

Books for References:

1. Gupta, R.C.(1974) Statistical Quality Control, Khanna Publishing Co, New Delhi.
2. Montgomery, D.C. (2009). Introduction to Statistical Quality Control, Sixth Edition, Wiley India, New Delhi.

Web Resources:

1. <https://asq.org/quality-resources/control-chart>
2. <https://www.wallstreetmojo.com/acceptance-sampling/>
3. <https://www.slideshare.net/slideshow/operating-characteristic-curves/92447922>

Rationale for Nature of the course

Statistical quality control, the use of statistical methods in the monitoring and maintaining of the quality of products and services. One method, referred to as acceptance sampling, can be used when a decision must be made to accept or reject a group of parts or items based on the quality found in a sample.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Case study, Formulation an Analysis plan and problem solving

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Course Designer:

Dr. M. REVATHI, Assistant professor, Department of Mathematics and Statistics (SF)

Course Schedule

Unit	Topics	Hours	Mode
I	Importance and need for statistical quality control techniques in industry – causes of variations in quality-uses of shewart's control charts- terminologies: specification limits, Tolerance limits, 3σ limits and warning limits.	5	PPT, Chalk and Talk, Test
	Theory of runs and its applications in quality control--Basis of sub grouping-Advantages and limitations of SQC.	5	
	Control charts variables: control chart for mean ($\bar{X}$ bar) and Range chart(R-chart)- standard deviation chart(S chart)-Control limits for $\bar{X}$ -chart- control limits for R-chart-Interpretation of $\bar{X}$ and R charts.	5	
II	Control charts for attributes- control chart for fraction defective (p- chart), control chart for number of Defectives (np- chart).	5	PPT, Chalk and Talk and Test
	control chart for number of defects per unit(c-chart) and control chart for number of defects per unit (u-chart).	5	
	construction of charts- Application of c chart-problems.	5	
III	Acceptance sampling plans for attributes–types of acceptance sampling plans, Methods of inspection 100% inspection and sampling inspection.	3	PPT, Chalk and Talk, GD, Test Assignments
	lot formation-sampling methods -Advantages and limitation of sampling inspection-Industrial uses of Acceptance sampling.	3	
	Terms used in acceptance Sampling plans: lot, lot size, sample size, lot quality, Acceptance number, Pa, AQL, LTPD-	5	
	Producer's risk, Consumer's risk. AQL, RQL, IQL, AOQ, AOQL, ATI and ASN- problems.	4	
IV	Rectifying sampling plans- Characteristics of OC curve-Sampling plan –Single & Double sampling plan and Multiple sampling plan.	5	PPT, Chalk and Talk, Test, Assignments
	Comparisons between single, double and multiple sampling plan- Characteristics of a good acceptance plan.	5	
	AOQ, ATI and ASN curves for single and double sampling plans-problems.	5	
V	Advantages of acceptance sampling by variable-limitations-some different types of Acceptance criteria involving variables	8	GD, Assignments and Seminar
	The shanin lot plot method-Known- σ and unknown- σ variables sampling plans (one sided specification only)- Determination of n and k for one sided specification of OC curve-problems.	7	
	Total Hours		75

COURSE OUTCOMES

At the end of the course, students will be able to:

CLO	Course Learning Outcomes	Knowledge Level
CLO 1	How to design variables control charts, how to set up and use x-bar and R control charts, Determine the average run length for variables control charts.	Up to K3
CLO 2	Understand the statistical basis of the attributes control chart, how to design attributes control chart, how to set up and use the p-chart for fraction non- conforming, how to set up and use the np-control chart for the number of nonconforming items, Know how to set up and use the c- control chart for defects, how to set up and use the u- control chart for defects per unit	Up to K2
CLO 3	Describe acceptance sampling plans, producer's risk, consumer's risk, and low tolerance percentage defective.	Up to K3
CLO 4	Describe single sampling plan and a double sampling plan. Interpret and use OC curves in determining acceptable quality level.	Up to K4
CLO 5	Variables, of course, are quality characteristics that are measured on a numerical scale.	Up to K3

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	2	3	2	3
CLO2	3	1	-	2	3
CLO3	3	1	-	2	3
CLO4	2	2	-	2	3
CLO5	2	2	1	2	3

Mapping with CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	2	1	1	-
CLO2	3	3	1	1	1	-
CLO3	3	3	-	1	1	1
CLO4	2	2	-	1	1	2
CLO5	2	2	2	1	1	2

3- Advance Application

2- Intermediate Level

1- Basic Level

SUMMATIVE ASSESSMENT - BLUE PRINT

S.No.	CLOs	K – Level	Section A		Section B		Section C (Either/or Choice)	Section D(Open Choice)
			MCQs		Short Answers			
			No. of questions	K - Level	No. of questions	K - Level		
1	CLO 1	Up to K3	2	K1 & K2	1	K1	2(K2 & K2)	1(K3)
2	CLO 2	Up to K2	2	K1 & K2	1	K1	2(K2 & K2)	1(K2)
3	CLO 3	Up to K3	2	K1 & K2	1	K2	2(K3 & K3)	1(K3)
4	CLO 4	Up to K4	2	K1 & K2	1	K2	2(K4 & K4)	1(K4)
5	CLO 5	Up to K3	2	K1 & K2	1	K2	2(K3 & K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1 - Remembering and recalling facts with specific answers.

K2 - Basic understanding of facts and stating main ideas with general answers.

K3 - Application oriented - Solving Problems.

K4 - Examining, analysing, presentation and make inferences with evidences.

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	5	4	-	-	09	7.50	41.67%
K2	5	6	20	10	41	34.16	
K3	-	-	20	30	50	41.67	41.67%
K4	-		10	10	20	16.67	16.66%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF STATISTICS					CLASS: III B.Sc STATISTICS			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
V	CORE-XI	23U5SCCT11	OPERATIONS RESEARCH	4	5	25	75	100
Nature of course		Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented		

Objectives:

- To explain about the concept of linear programming problem and solve the programming models of real lifesituations.
- Make use of different methods to get optimality of linear programming, Transportation Problems and Assignment problems.
- To analyse the strategies of players using various types in game theory.
- To formulate a most economic replacement policy for replacing faulty units or to take some remedial special action to restore the efficiency of deteriorating units in real life situations.
- To construct networks for a given plan and schedule them by PERT / CPM.

Unit	Description	Hours	K-level	CLO
I	Mathematical formulation of LPP – Graphical solution method – Some exceptional cases- General Linear programming problem- Canonical and standard forms of LPP-The computational procedure- Simplex method-Problems only.	15	Up to K3	1
II	Transportation problem(TP) – TP formulation- North-West Corner, Least cost, Vogel's Approximation method – UV-method - Assignment problem- Mathematical Formulation of the Problem- Solution Methods of Assignment Problem-Problems only.	15	Up to K2	2
III	Replacement problems -Introduction- Replacement of equipment/Asset that deteriorates gradually-Replacement Policy when value of money does not change with time-Replacement Policy when value of money changes with time - Replacement of Equipment that fails suddenly-Problems only.	15	Up to K3	3
IV	Theory of Games – Basic definition –The Maximin and Minimax Principle– Solution of Games with saddle points – Two-by-Two (2x2) Games without saddle point – principle of dominance – problems based on dominance rule – Graphical method for (2xn) and (mx2) games-Problems only.	15	Up to K4	4
V	Network analysis by CPM/PERT -Introduction-Network-Logical sequencing- Rules of Network construction- Concurrent activities- Critical path analysis- Probability considerations in PERT- Problems only.	15	Up to K3	5

Books for study:

Operations Research by Kanti Swarup, P.K.Gupta and Manmohan, Sultan Chand & Sons, 2017(19th Ed)(Reprint 2019)

Unit I: Chapter-2, Chapter 3:(3.1-3.5) and Chapter 4:(4.3) only

Unit II: Chapter 10:10.1,10.2,10.9,10.10 , Chapter 11 : 11.1-11.3

Unit III: Chapter 18: 18.1-18.3

Unit IV: Chapter 17:17.1-17.7

Unit V: Chapter 25: 25.1-25.7

Books for References:

1. Operations Research, by R.K.Gupta , Krishna Prakashan India (p),Meerut Publications.
2. Introduction to Operations Research - Hillier, F.S. and G.J. Lieberman, 9th Ed., Tata McGrawHill, Singapore, 2009.
3. Operations Research, An Introduction - Hamdy A. Taha, 8th Ed., Prentice Hall India, 2006.
4. Linear Programming - Hadley, G. Narosa Publishing House, New Delhi, 2002.
5. Gupta P.K. and Hira D.S., Problems in Operations Research ,S.Chand& Co.

Web Resources

1. <http://ebooks.lpude.in.operationsresearch>
2. <https://ocw.mit.edu>
3. <https://nptel.ac.in>

Rationale for Nature of the course

Operations research helps in solving problems in different environments that needs decisions. This module aims to introduce students to use quantitative methods and techniques for effective decisions–making model formulation and applications that are used in solving business decision problems.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Course Designer:

Mrs. KRISHNA JAYANTHIS, Assistant Professor, Department of Mathematics & Statistics.

Unit	Topics	Hours	Mode
I	Mathematical formulation of LPP – Graphical solution method – Some exceptional cases	5	PPT, Chalk and Talk, Test
	General Linear programming problem-Canonical and standard forms of LPP-The computational procedure	5	
	Simplex method	5	
II	Transportation problem(TP) – TP formulation, North-West Corner	5	PPT, Chalk and Talk, Test
	Least cost Methods, Vogel's Approximation method, UV-method	5	
	Mathematical Formulation of the Problem , Solution Methods of Assignment Problem	5	
III	Replacement problems -Introduction- Replacement of equipment/Asset that deteriorates gradually, Replacement Policy when value of money does not change with time	5	PPT, Chalk and Talk, Test
	Replacement Policy when value of money changes with time - Assignment problem- Mathematical Formulation of the Problem	5	
	Replacement of Equipment that fails suddenly	5	
IV	Theory of Games – Basic definition –The Maximin and Minimax Principle– Solution of Games with saddle points	5	PPT, Chalk and Talk, Test
	Two-by-Two (2x2) Games without saddle point – principle of dominance – problems based on dominance rule	5	
	Graphical method for (2xn) and (mx2) games .	5	
V	Introduction-Network-Logical sequencing	5	Assignments and Seminar
	Rules of Network construction- Concurrent activities- Critical path analysis	5	
	Probability considerations in PERT	5	
Total Hours		75	

Course Schedule

Course Outcomes:

At the end of this course, the students will be able to

CO	Course Learning Outcome	K-level
CLO 1	Analyzing the theoretical workings of canonical and standard form and simplex method for linear programming and demonstrate their iterations.	Up to K3
CLO 2	Understand the specialized linear programming problems like the transportation using appropriate method and Assignment Problems.	Up to K2
CLO 3	Analyzing an optimal replacement period/policy for a given item/equipment/machine.	Up to K3
CLO 4	Identify the solution of linear programming model of two-person zero sum game.	Up to K4
CLO 5	Solve the constructions of networks of a project and optimal scheduling using CPM and PERT.	Up to K3

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	3	2	1	2	3
CLO-2	2	2	1	2	3
CLO-3	1	1	1	2	3
CLO-4	2	1	1	2	3
CLO-5	2	2	1	2	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	-	-	2	1
CLO2	3	3	-	-	2	1
CLO3	3	2	-	-	2	1
CLO4	2	2	-	-	1	1
CLO5	2	2	-	-	1	1

Advance application– 3;**Intermediate level–2;****Basic level–1**

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

S. No	CLOs	K – Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K - Level	No. of questions	K - Level		
1	CLO 1	Up to K3	2	K1 & K2	1	K1	2(K2 & K2)	1(K3)
2	CLO 2	Up to K2	2	K1 & K2	1	K1	2(K2 & K2)	1(K2)
3	CLO 3	Up to K3	2	K1 & K2	1	K2	2(K3 & K3)	1(K3)
4	CLO 4	Up to K4	2	K1 & K2	1	K2	2(K4 & K4)	1(K4)
5	CLO 5	Up to K3	2	K1 & K2	1	K2	2(K3 & K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	5	4	-		09	7.50	41.67%
K2	5	6	20	10	41	34.16	
K3	-	-	20	30	50	41.67	41.67%
K4	-		10	10	20	16.67	16.66%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF STATISTICS				CLASS: III B.Sc., STATISTICS				
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
V	CORE PRACTICAL-I	23U5SCCP1	STATISTICAL PROBLEM SOLVING - I (Calculator Based Practical)	3	3	25	75	100

Nature of Course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship oriented	

Objectives:

- To impart students a holistic view of the fundamentals of experimental designs, analysis tools and techniques, interpretation and applications. .
- Upon completion of this course, the students will know (i) the fundamentals of experiments and its uses, (ii) basic statistics including ANOVA and regression, (iii) experimental designs such as RCBD, BIBD, Latin Square, factorial and fractional factorial designs.
- To make them understand the concept of underlying statistical quality control and to develop their ability to apply those concepts to the design and management of quality control processes in industries.

S.No.	LIST OF PROBLEMS
1	Problems on One – Way Classification.
2	Problems on Two –Way Classification.
3	Problem on Latin Square Design .
4	Problem on Completely Randomised Design. .
5	Problems on Randomised Block Design.
6	Problems on 2^2 - Factorial Experiments.
7	Problems on 2^3 - Factorial Experiments.
8	Problems on Balanced Incomplete Block Designs .
9	Problems on Control Charts for $\bar{X}$ and R charts.
10	Problems on Control Charts for Standard Deviation.
11	Problems on Control Charts for Fraction Defective.
12	Problems on Control Chart for Number of Defectives
13	Problems on c-Chart Variable Sample Size.
14	Problems on Single sampling plan.
15	Problems on Double sampling plan.
16	Problems on Producer's risk and Consumer's risk.
17	Problems on Graphical solution of LPP.
18	Problems on Transportation problem.
19	Problems on Assignment problem.
20	Problems on PERT Network.

Books for References:

- Gupta.S.C and Kapoor.V.K (2007), "Fundamentals of Applied Statistics", 4th edition, Sultan Chand and Sons, New Delhi.
- Gupta.S.C and Kapoor.V.K (2019), "Fundamentals of Mathematical Statistics", Sultan Chand & Sons.

3. Mahajan, M. (2002). Statistical Quality Control, (Third Edition), Dhanpat Rai and Co., Delhi.
4. Kanti Swarup, Gupta.P.K. Man Mohan.,(2010): Operations Research, Sultan Chand & Sons.

Web Resources

1. https://onlinecourses.nptel.ac.in/noc21_mg48/preview
2. <https://www.kcl.ac.uk/short-courses/design-of-experiments-1>
3. <https://archive.nptel.ac.in/courses/109/104/109104150/>

Rationale for Nature of the course

This course is a discipline that teaches students how to design experiments and analyze the cost savings by minimizing process variation and reducing rework, scrap, and the need for inspection. By problem solving related to quality control, students will be able to know the use of statistical methods in the monitoring and maintaining of the quality of products and services.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Exercises, Seminars, Assignments, Problem solving using calculator and Quiz.

Pedagogy

Lecture with PPT, Quiz, Tutorial.

Course Designer:

Dr. S.VALLIRANI, Assistant Professor, Department of Mathematics & Statistics

Course Learning Outcomes:

At the end of this course the student will able to,

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Describe how to design experiments, carry them out, and analyze the data they yield.	Up to K3
CLO-2	Investigate the logic of hypothesis testing, including analysis of variance and the detailed analysis of experimental data.	Up to K3
CLO-3	How to design variables control charts, how to set up and use x-bar and R control charts, Determine the average run length for variables control charts.	Up to K3
CLO-4	Describe single sampling plan and a double sampling plan. Interpret and use OC curves in determining acceptable quality level.	Up to K3
CLO-5	Solve the constructions of networks of a project and optimal scheduling using PERT.	Up to K3

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	2	1	1	2	1
CLO-2	2	1	1	2	1
CLO-3	2	1	1	2	1
CLO-4	2	1	1	2	1
CLO-5	2	1	1	2	1

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	1	1	1	1
CLO2	3	2	1	1	1	1
CLO3	3	2	2	1	1	1
CLO4	3	2	2	1	1	1
CLO5	3	1	2	2	1	1

Advance application– 3;

Intermediate level–2;

Basic level–1

DEPARTMENT OF STATISTICS				CLASS: III B.Sc., STATISTICS				
Sem	Course type	Course code	Course title	Credits	Contact hours / Week	CIA	Ext	Total
V	Elective-I	23U5SDET1(A)	NON-PARAMETRIC STATISTICS	4	5	25	75	100

Nature of course	Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objectives:

- To find a data sample's kurtosis and skewness and determine if the sample meets acceptable levels of normality
- To construct a median confidence interval based on the difference between two independent samples.
- To perform contrasts to compare samples by Friedman test and Kruskal-Wallis H-test.
- To perform Chi-Square test for goodness of fit and independence.

Unit	Description	Hours	K-level	CLO
I	Introduction – Non-Parametric Tests – Ranking Data – Ranking data with tied values – Counts of observations – Computing and testing Kurtosis and Skewness for Sample normality – Computing the Kolmogorov–Smirnov One-Sample test.	15	Up to K3	CLO1
II	Computing the Mann–Whitney U-Test Statistic – Small Data Samples) – Confidence interval for the difference between Two location Parameters – Computing the Kolmogorov–Smirnov two-sample test statistic	15	Up to K3	CLO2
III	Computing the Friedman test statistic – Introduction – Sample Friedman's Test – Small data samples without ties and with ties – Large data samples without ties – Computing Kruskal–Wallis H-Test Statistic – Sample Kruskal–Wallis H-Test – Small data samples – Large data samples	15	Up to K3	CLO3
IV	Correlation of a Dichotomous variable and an interval Scale variable - Correlation of a Dichotomous Variable and a Rank-Order Variable - Sample Point-Biserial Correlation - Small data samples – Large data Samples - Sample Biserial Correlation for small data samples.	15	Up to K4	CLO4
V	Chi-Square test – Test for Goodness-of-fit – Test for independence – The Fisher exact test – Computing the Fisher exact test for 2×2 tables - Sample Fisher exact test.	15	Up to K3	CLO5

Books for study:

Gregory W. Corder & Dale I. Foreman, Nonparametric Statistics, A Step-by-Step Approach, John Wiley & Sons, Inc., Hoboken, New Jersey.

Unit I: Chapter 1 (1.4, 1.5, 1.6), Chapter 2 (2.4 – 2.4.1, 2.4.2, 2.5 – 2.5.1)

Unit II: Chapter 4 (4.2, 4.3, 4.4)

Unit III: Chapter 5 (5.2, 5.3 – 5.3.1, 5.3.2, 5.3.4), Chapter 6 (6.2, 6.3, - 6.3.1, 6.3.2)

Unit IV: Chapter 7 (7.5 – 7.5.1, 7.5.2, 7.5.3, 7.5.5, 7.5.6)

Unit V: Chapter 8 (8.2, 8.3 – 8.3.1, 8.3.2, 8.3.3, 8.4 – 8.4.1, 8.4.2, 8.5 – 8.5.5, 8.5.2)

Books for References:

1. Agarwal B. L, Basic Statistics, New Age International Publishers, New Delhi.
2. Gibbons J. D (1976), Non-Parametric Methods for Quantitative Analysis, Hold Rinehart and Winston, New York.
3. Hogg R. V and Tanis E. A (1987), Probability and Statistical Inference, Macmillan Publishing Company, New York.
4. Gibbons J. D and Chakraborty S (2003), Nonparametric Statistical Inference, (Fourth Edition), Marcel Dekker, CRC.

Web Resources

1. <https://people.stat.sc.edu/hitchcock/stat518.html>
2. <http://www.digimat.in/nptel/courses/video/111102143/L01.html>
3. <https://pmc.ncbi.nlm.nih.gov/articles/PMC4754273/>

Rationale for Nature of the course

There is a family of statistical tests that do not demand all the parameters, or rules, that we listed earlier. They are called nonparametric tests. They are used if the assumptions for the parametric tests are not met, and are commonly called distribution free tests. The advantage of non-parametric tests is that we do not assume that the data come from any particular distribution.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Quiz, Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved.

Pedagogy

Lecture with PPT, Seminar, Tutorial, Group Discussion, Assignments

Course Designer:

S. MEENAKSHI, Assistant Professor, Department of Mathematics & Statistics

Course Schedule

Unit	Topics	Hrs		Mode
I	Ranking Data – Ranking data with tied values – Counts of observations —	4	15	Lecture, Quiz Problem Solving
	Computing and testing Kurtosis and Skewness for Sample normality	6		
	Computing the Kolmogorov–Smirnov One-Sample test.	5		
II	Computing the Mann–Whitney U-Test Statistic – Small Data Samples) —	5	15	Lecture, Quiz Problem Solving, Group Discussion
	Confidence interval for the difference between Two location Parameters	5		
	Computing the Kolmogorov–Smirnov two-sample test statistic	5		
III	Computing the Friedman test statistic – Introduction	2	15	PPT, Lecture Problem Solving
	Sample Friedman’s Test – Small data samples without ties and with ties - Large data samples without ties	5		
	Computing Kruskal–Wallis H-Test Statistic –	3		
	Sample Kruskal–Wallis H-Test – Small data samples – Large data samples	5		
IV	Correlation of a Dichotomous variable and an interval Scale variable	4	15	Lecture, Tutorial Problem Solving
	Correlation of a Dichotomous Variable and a Rank-Order Variable -	3		
	Sample Point-Biserial Correlation - Small data samples – Large data Samples -	2		
	Sample Biserial Correlation for small data samples.	5		
V	Chi-Square test – Test for Goodness-of-fit	5	15	PPT, Tutorial, Seminar Assignment
	Test for independence	3		
	The Fisher exact test – Computing the Fisher exact test for 2×2 tables -	2		
	Sample Fisher exact test.	5		
Total Hours		75		

Course Learning Outcomes:

At the end of the course, the student will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Perform a Kolmogorov–Smirnov one-sample test to determine if a data sample meets acceptable levels of normality.	Upto K3
CLO2	Perform the Mann–Whitney U-test and the Kolmogorov–Smirnov two-sample test	Upto K3
CLO3	Compute the Friedman test and Kruskal–Wallis H-test.	Upto K3
CLO4	Compute the point-biserial correlation coefficient.	Upto K4
CLO5	Test the nominal scale data using Chi-square test.	Upto K3

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	3	3	3	3	3
CLO-2	3	3	3	3	2
CLO-3	3	3	3	3	3
CLO-4	3	3	3	3	3
CLO-5	3	3	2	2	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	2	1	2	1
CLO2	3	2	2	1	2	1
CLO3	3	2	2	1	2	1
CLO4	3	2	2	1	2	1
CLO5	3	2	2	1	2	1

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Unit	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K-Level	No. of Questions	K- Level		
1	CLO 1	Up to K3	2	K1 &K2	1	K1	2(K1 &K1)	1(K2)
2	CLO 2	Up to K3	2	K1 &K2	1	K2	2(K2 &K2)	1(K3)
3	CLO 3	Up to K3	2	K1 &K2	1	K2	2(K3 &K3)	1(K3)
4	CLO 4	Up to K4	2	K1 &K2	1	K1	2(K4 &K4)	1(K4)
5	CLO 5	Up to K3	2	K1 &K2	1	K2	2(K3 &K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1 – Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented –Solving Problems

K4 – Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	20	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100	100%

DEPARTMENT OF STATISTICS					CLASS: III B.Sc., STATISTICS				
Sem	Course type	Course code		Course title	Credits	Contact hours / Week	CIA	Ext	Total
V	Elective-I	23U5SDET1(B)		RELIABILITY THEORY AND SURVIVAL ANALYSIS	4	5	25	75	100
Nature of course		Skill oriented		Employability oriented			Entrepreneurship Oriented		

Objectives:

- Understand the concepts of reliability, coherent systems hazard function and its applications.
- Understand the concepts of censoring life distributions and ageing classes.
- Estimate non parametric survival function of the data.

Unit	Description	Hours	K-level	CLO
I	Reliability of Systems of independent components – Association of random variables – Bounds on system reliability – Improved bounds on system reliability.	15	Up to K3	CLO1
II	Life distributions of Coherent systems – Distributions with Increasing Failure Rate Average – Preservation of Life Distribution classes under reliability operations.	15	Up to K3	CLO2
III	Life Distributions for Series and Parallel Systems – Derivation of Extreme Value Distributions – Domains of Attraction	15	Up to K3	CLO3
IV	Survival Analysis – Censored data – Terminology and Notation – Goals of Survival analysis – Descriptive measures of Survival experience	15	Up to K4	CLO4
V	Kaplan-Meir Survival curves – General features – The log-rank test for two groups - The log-rank test for several groups	15	Up to K4	CLO5

Books for study:

1. Barlow R.E and Proschan, F. (1985). Statistical Theory of Reliability and Life testing Models, Marcel Dekker, New York.
Unit I: Chapter 2 (2.1 – 2.4)
Unit II: Chapter 4 (4.1 – 4.4)
Unit III: Chapter 8 (8.1 – 8.3)
2. David G.Kleinbaum, Mitchel Klein, Survival Analysis – A Self-learning Text, Third Edition, Springer
Unit IV: Chapter 1 (1.1 – 1.4, 1.7)
Unit V: Chapter 2 (2.2 – 2.5)

Books for References:

1. Cox, D R. and Oakes, D. (1984). Analysis of Survival Data, Chapman & Hall, New York.
2. Gross, A.J. and Clark, V.A. (1975). Survival distribution: Reliability applications in the Biomedical Sciences, Wiley, New Delhi.
3. Kalbfleisch, J D. and Prentice, R.L. (1980). The Statistical Analysis of Failure Time Data, Wiley, New York.
4. Lawless, J.F. (1982). Statistical Models and Methods of Life Time Data, Wiley, New York.

Web Resources

1. <https://archive.nptel.ac.in/courses/106/105/106105239/>
2. <https://gnedenko.net/Journal/>
3. <https://www.classcentral.com/course/youtube-survival-analysis-90289>

Rationale for Nature of the course

If the duration spent by an element or object in a given state is taken to be the lifetime, then the theory of reliability can readily find applications in life tables, nuptiality studies, period of service before leaving a particular job in manpower planning, and so on. Survival analysis refers to a branch of statistical analysis domain that is used to analyze data in which the time until the event is of interest. Survival analysis is also known as reliability analysis in the engineering discipline, duration analysis in the economics discipline, and event history analysis in the sociology discipline.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Quiz, Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved.

Pedagogy

Lecture with PPT, Seminar, Tutorial, Group Discussion, Assignments

Course Designer:

S. MEENAKSHI, Assistant Professor, Department of Mathematics & Statistics.

Course Schedule

Unit	Topics	Hrs		Mode
I	Reliability of Systems of independent components	4	15	Lecture, Quiz Problem Solving
	Association of random variables - Bounds on system reliability	6		
	Improved bounds on system reliability	5		
II	Life distributions of Coherent systems	5	15	Lecture, Quiz Problem Solving, Group Discussion
	Distributions with Increasing Failure Rate Average	5		
	Preservation of Life Distribution classes under reliability operations.	5		
III	Life Distributions for Series and Parallel Systems	5	15	PPT, Lecture Problem Solving
	Derivation of Extreme Value Distributions	5		
	Domains of Attraction	5		
IV	Survival Analysis	4	15	Lecture, Tutorial Problem Solving
	Censored data – Terminology and Notation	3		
	Goals of Survival analysis	2		
	Descriptive measures of Survival experience	5		
V	Kaplan-Meir Survival curves	5	15	PPT, Tutorial, Seminar Assignment
	General features	3		
	The log-rank test for two groups	2		
	The log-rank test for several groups	5		
Total Hours		75		

Course Learning Outcomes:

At the end of the course, the student will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Understand the Concept of reliability, the component and coherent system.	Upto K3
CLO2	Determine Estimate of parameters, increasing failure rate and decreasing failure rate distributions.	Upto K3
CLO3	Understand the concept of series structure, parallel structure and parallel-series structure.	Upto K3
CLO4	Recognize and describe the type of problem addressed by a survival analysis.	Upto K4
CLO5	Interpret a curve of Kaplan-Meier curves that compare two or more groups.	Upto K4

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	3	3	3	3	3
CLO-2	3	3	3	3	2
CLO-3	3	3	3	3	3
CLO-4	3	3	3	3	3
CLO-5	3	3	2	2	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	2	1	2	1
CLO2	3	2	2	1	2	1
CLO3	3	2	2	1	2	1
CLO4	3	2	2	1	2	1
CLO5	3	2	2	1	2	1

Advance application– 3;**Intermediate level–2;****Basic level–1**

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Unit	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K-Level	No. of Questions	K-Level		
1	CLO 1	Up to K3	2	K1 &K2	1	K1	2(K1&K1)	1(K2)
2	CLO 2	Up to K3	2	K1 &K2	1	K2	2(K2&K2)	1(K3)
3	CLO 3	Up to K3	2	K1 &K2	1	K2	2(K3&K3)	1(K3)
4	CLO 4	Up to K4	2	K1 &K2	1	K1	2(K4&K4)	1(K4)
5	CLO 5	Up to K4	2	K1 &K2	1	K2	2(K3&K3)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1 – Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented - Solving Problems

K4 – Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	20	10	31	25.83	
K3	-	-	20	20	40	33.3	33%
K4	-	-	10	20	30	25	25%
Total Marks	10	10	50	50	120	100	100%

DEPARTMENT OF STATISTICS				CLASS: III B.Sc, STATISTICS				
Semester	Course Type	Course Code	Course Title	Credits	Hrs	CIA	Ext	Total
V	IDC	23U5SIDTI	Economic Statistics	4	5	25	75	100

Nature of course	Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objectives:

1. To understand the concepts of interpretation of data and statistical fallacies.
2. To make the best decision by comparing all the possible alternatives.
3. To introduce fundamental concepts of Economics.
4. To Teach the Students about the Concept and Determination of Demand and Supply

Units	Descriptions	Hours	K -Levels	CLO
I	Interpretation of Data and Statistical Fallacies: Introduction – Meaning and need – Factors leading to mis- interpretation of data or statistical fallacies – Bias – Inconsistencies in Definitions – Faulty Generations – Inappropriate comparisons – Wrong Interpretation of statistical Measures – Technical Error – Problems.	15	Up to K2	1
II	Statistical Decision Theory: Introduction – Definitions – Ingredients of Decision problem – Acts – State of Nature or Events – payoff table – opportunity loss – Decision making Environment, under certainty and uncertainty – Optimal Decision – Maximax, Maximin and Minimax criterion – Problems.	15	Up to K2	2
III	Statistical Decision Theory (continued): Laplace criterion of Equal likelihoods – Hurwicz criterion of Realism – Expected Monetary Value (EMV) – Expected Opportunity Loss (EOL) – Expected Value of perfect information (EVPI) – Decision Tree – Problems.	15	Up to K2	3
IV	Money: Money – Meaning and Functions: Primary, Secondary and Contingency – Methods of Note Issues – Denomination of Indian Currency Standard – Cryptocurrency – Digital Currency – Currency Notes of G20 Countries.	15	Up to K2	4
V	Foreign Exchange Foreign Exchange: Meaning and Methods of Exchange Rate: Fixed Exchange Rate, Floating Exchange Rate, Spot Exchange Rate and Forward Exchange Rate – Introduction to American Dollar – Euro Dollar – Balance of Payments Vs. Balance of Trade – Meaning: Demonetization – Devaluation.	15	Up to K2	5

Book for Study:

1. S. C Gupta and Indra Gupta, Business Statistics, Himalaya Publishing House
2. Maria John Kennady, M. (2012). Micro Economics. Himalaya Publishing House. Pvt. Ltd., Mumbai.
3. Bose. D and Marimuthu A. (2015). An Introduction to Micro Economics. Himalaya Publishing House Pvt. Ltd., Mumbai.
4. Vaish, M.C. (2004), **Money, Banking and International Trade**, New Age International (P) Ltd: New Delhi.
5. Maria John Kennady, M. (2014), **International Economics**, PHI Learning Private Limited, Delhi.

Chapters:

Unit I : Chapters 17(17.1 – 17.3 (17.3.1 – 17.3.5, 17.3.7))

Unit II : Chapters 18(18.1, 18.2(18.2.1 – 18.2.7), 18.3 (18.3.1 – 18.3.3))

Unit III : Chapter 18(18.3(18.3.4 – 18.3.8), 18.4)

Book for References:

1. D.C. Sancheti and V.K. Kapoor, Statistics (Theory, Methods & Applications), Thoroughly revised seventh edition, Reprint 2019, Sultan Chand and Sons, New Delhi.
2. S. C Gupta and V.K. Kappor (Reprint 2019), Fundamentals of Mathematical Statistics, Sultan chandand sons, New Delhi.
3. Sundaram, K.P.M. (1996), “**Money, Banking and International Trade**”, Vikas Publications: New Delhi.
4. Sethi, T.T. (2003), “**Monetary Economics**”, S. Chand and Company Limited, New Delhi.
5. Mithani, D.M. (2010), “**International Economics**”, Himalaya Publishing House, New Delhi

Web Resources

1. <https://www.youtube.com/watch?v=BVE9e18zVVU>
2. <https://www.youtube.com/watch?v=HSc31v67590>
3. <https://www.youtube.com/watch?v=TUht9K5VXGs>
4. <https://d3bxy9euw4e147.cloudfront.net/oscmsrodcms/media/documents/Microeconomics2e-OP.pdf>
5. https://edisciplinas.usp.br/pluginfile.php/4292722/mod_resource/content/1/%288th%20Edition%29%20
6. <https://www.worldbank.org/>

Rationale for nature of the course

Interpretation of Data and Statistical Decision Theory helps in solving problems in different environments the needs decisions. This module aims to introduce students to use techniques for effective decision-making model formulation and applications that are used in solving business decision problem.

Activities having direct bearing on Skill Development / Employability / Entrepreneurship

Exercises, Seminars, Assignments Problem solving using calculator and Quiz.

Entrepreneurship

- Demand and Supply Analysis of Consumable Products
- Types of Goods and its preference

Pedagogy:

Lecture, Problem solving, Tutorial, Peer Teaching, OOC and ICT enabled teaching aids

Course Designer:

1. Prof.V.Vijayalakshmi, Assistant Professor, Department of Mathematics & Statistics.
2. Dr. M. Deepan

Course Outcome

At the end of the course, students will be able to:

CLO1	Understand the basic concepts of interpretation of data and statistical fallacies.	Up to K2
CLO2	Understanding the theory of statistical decision.	Up to K2
CLO3	Learn about Optimal decision and Decision Tree.	Up to K2
CLO4	Identify the functions of money and Indian Currency Standard	Up to K2
CLO5	Understand the Concepts of foreign exchange	Up to K2

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	3	3	2	1	2
CLO-2	3	3	1	2	3
CLO-3	1	1	3	2	2
CLO-4	3	3	2	3	3
CLO-5	3	3	3	2	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	3	2	3	3
CLO2	3	2	3	2	3	2
CLO3	2	1	3	2	3	2
CLO4	1	1	2	2	3	1
CLO5	3	1	1	2	3	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Course Schedule

Units	Description	Hours	Pedagogy
I	Introduction – Meaning and need – Factors leading to mis-interpretation of data or statistical fallacies.	7	Lecture
	Bias – Inconsistencies in Definitions – Faulty Generations – Inappropriate comparisons – Wrong Interpretation of statistical Measures – Technical Error – Problems.	8	Lecture, Quiz, Assignment
II	Introduction – Definitions –Ingredients of Decision problem – Acts – State of Nature or Events – payoff table	7	Lecture, problem solving, Quiz
	opportunity loss – Decision making Environment, under certainty and uncertainty – Optimal Decision – Maximax, Maximin and Minimax criterion – Problems.	8	Lecture, Seminar and Presentation
III	Laplace criterion of Equal likelihoods – Hurwicz criterion of Realism	5	Lecture
	Expected Monetary Value (EMV) – Expected Opportunity Loss (EOL)	5	Lecture & Presentation
	Expected Value of perfect information (EVPI) – Decision Tree – Problems.	5	Lecture, Quiz & Assignment
IV	Money – Meaning and Functions: Primary, Secondary and Contingency .	5	Lecture
	Methods of Note Issues – Denomination of Indian Currency Standard	5	Lecture & Presentation
	Cryptocurrency – Digital Currency – Currency Notes of G20 Countries	5	Lecture, Quiz & Assignment
V	Foreign Exchange: Meaning and Methods of Exchange Rate: Fixed Exchange Rate, Floating Exchange Rate, Spot Exchange Rate and Forward Exchange Rate .	6	Lecture & Presentation
	Introduction to American Dollar – Euro Dollar	4	
	Balance of Payments Vs. Balance of Trade – Meaning: Demonetization – Devaluation	5	Lecture, Quiz & Assignment
	Total Hours	75	

SUMMATIVE EXAMINATION – BLUE PRINT

Units	CLOs	K. Level	Section A		Section B		Section C (Either/or Choice)
			MCQs		Short Answers		
			No. of questions	K Level	No. of questions	K level	
1	CLO 1	Up to K2	1	K1	1	K2&K2	1(K2)
2	CLO 2	Up to K2	1	K1	1	K2&K2	1(K2)
3	CLO 3	Up to K2	1	K1	1	K2&K2	1(K2)
4	CLO 4	Up to K2	1	K1	1	K2&K2	1(K2)
5	CLO 5	Up to K2	1	K1	1	K2&K2	1(K2)
No. of Questions to be asked			5		10		5
No. of Questions to be answered			5		5		3
Marks for each question			2		7		10
Total Marks for each Section			10		35		30

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

Distribution of Section-wise Marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ OR)	Total marks	% of marks without choice	Consolidated
K1	10	-	-	10	7.69	8
K2	-	70	50	120	92.31	92
Total marks	10	70	50	130	100	100%

DEPARTMENT OF STATISTICS				CLASS: III B.Sc STATISTICS				
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
VI	CORE-XII	23U6SCCT12	STOCHASTIC PROCESSES	4	6	25	75	100

Nature of course	Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objectives:

- To study the basic concepts of theory of Stochastic Processes, the most important types of Stochastic Processes, various properties and characteristics (Poisson, Markov and others).
- To learn the notions of ergodicity, stationarity and applications.
- To formulate and solve problems which involve setting up stochastic models.

Unit	Description	Hours	K-level	CLO
I	Notion and specification of Stochastic Processes – Stationary Process – Markov Chains – Definition and examples – Higher transition probabilities: Chapman – Kolmogorov equations. Classification of States and Chains.	18	Up toK3	1
II	Markov Chains – Determination of Stability of a Markov System – Limiting Behaviour – Ergodic theorem. One dimensional random walk.	18	Up toK3	2
III	Markov Processes with discrete state space: Poisson Process – Postulates of Poisson process Properties of Poisson Process – Poisson process and related distributions. Pure Birth process – Yule-Furry process. Pure Death Process – Simple Birth and Death Process.	18	Up toK4	3
IV	Applications in Stochastic Models: Queuing Systems and Models: Simple queuing models M/M/1, M/M/s queuing systems (finite and infinite) steady state solution-simple problems with finite and infinite capacities.	18	Up toK3	4
V	Renewal Process – Definition, related concepts and examples – Renewal equation – Elementary Renewal Theorem – Basic Renewal Theorem.	18	Up toK3	5

Books for study:

- Medhi, J. (2019): Stochastic Processes, New Age International Publishers.
- KantiSwarup, Gupta.P.K. Man Mohan.,Reprint 2019, Operations Research, Sultan Chand & Sons.

Book-1:

Unit I- Chapter 2(2.1-2.3), 3(3.1, 3.2, 3.4)

Unit II- Chapter 3(3.6)

Unit III- Chapter4[4.1,4.2,4.3(4.3.3,4.3.4)4.4]

Unit IV- Chapter6 [6.1(6.1.1,6.1.2,6.1.5),6.3, 6.5(6.5.1,6.5.4)]

Book-2:

Unit V- Chapter 21[(21.7,21.8,21.9(Model I,II,III,V,VI)]

Books for References:

1. Karlin ,S. and Taylor, H.M.(1975): A first Course in Stochastic Processes, Academic Press, New York.
2. Ross, S.M. (1983): Stochastic Processes. John Wiley Eastern Ltd., New York.

Web Resources

1. <https://youtu.be/G342wMsN6Hc>
2. <https://youtu.be/dxRkcSd08Ms>
3. <https://youtu.be/qWUr3k8tpIw>
4. <http://www.randomservices.org/random/>
5. https://www.hajim.rochester.edu/ece/sites/gmateos/ECE440/Slides/block_3_markov_chains_part_b.pdf

Rationale for Nature of the course

The course consists of a short review of basic probability concepts and a discussion of conditional probability and conditional expectation, followed by an introduction to the basic concepts and an investigation of the long-run behaviour of Markov chains in discrete time, countable state space. The course also covers some important continuous-time stochastic processes including Poisson processes and other Markov pure jump processes, as well as Brownian motion and other related Gaussian processes as time permits.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Exercises, Seminars, Assignments, Problem solving using calculator and Quiz.

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Course Designer:

Dr.R.CHITRA, Assistant Professor, Department of Mathematics &Statistics.

Course Schedule

Unit	Topics	Hours	Mode
I	Notion and specification of Stochastic Processes – Stationary Process.	6	PPT, Chalk and Talk, Test, Quiz.
	Markov Chains – Definition and examples – Higher transition probabilities	6	
	Concept of Chapman – Kolmogorov equations and classification of States and Chains.	6	
II	Markov Chains – Determination of Stability of a Markov System	6	PPT, Chalk and Talk Test, Quiz.
	Limiting Behaviour – definition and Ergodic theorem. One dimensional random walk.	6	
	Concept of one dimensional random walk.	6	
III	Markov Processes with discrete state space- Poisson Process – Postulates of Poisson process Properties of Poisson Process.	6	PPT, Chalk and Talk, Test, Quiz.
	–Poisson process and related distributions. Pure Birth process – Yule-Furry process.	6	
	Pure Death Process – Simple Birth and Death Process-Problems.	6	
IV	Simple queuing models M/M/1 queuing systems (finite and infinite) steady state solution-Concepts and results	6	PPT, Chalk and Talk, Test, Quiz.
	M/M/s queuing systems (finite and infinite) steady state solution-Concepts and results	6	
	Simple problems with finite and infinite capacities.	6	
V	Renewal Process – Definition, related concepts and examples	6	Chalk and Talk, Test, Quiz. Assignments and Seminar
	Renewal equation – Elementary Renewal Theorem – Basic Renewal Theorem.	6	
	Related Concepts and Simple problems.	6	
	Total Hours	90	

Course Learning Outcomes:

At the end of the course , the students will be able to

CO	Course Learning Outcome	K-level
CLO 1	Classify of given stochastic process and to study its stationary properties.	Up to K3
CLO 2	Determine transition probability matrix for given Markov chain and its calculations	Up to K3
CLO 3	Perform computations related to Poisson Process, Birth and Death process and their differential and difference equations.	Up to K4
CLO 4	Apply the concept of Queuing models, their classifications and applications.	Up to K3
CLO 5	Infer renewal Process equation and elementary renewal theorem	Up to K3

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	3	3	2	1	2
CLO-2	3	3	1	2	3
CLO-3	1	1	3	2	2
CLO-4	3	3	2	3	3
CLO-5	3	3	3	2	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	3	2	3	3
CLO2	3	2	3	2	3	2
CLO3	2	1	3	2	3	2
CLO4	1	1	2	2	3	1
CLO5	3	1	1	2	3	3

Advance application– 3;**Intermediate level–2;****Basic level–1**

Summative - Blue – Print – Model

S. No.	CLOs	K - Level	Section A		Section B		Section C (Either/or Choice)	Section D(Open Choice)
			MCQs		Short Answers			
			No. of questions	K - Level	No. of questions	K - Level		
1	CLO 1	Up to K3	2	K1 & K2	1	K1	2(K2 & K2)	1(K3)
2	CLO 2	Up to K3	2	K1 & K2	1	K2	2(K2 & K2)	1(K3)
3	CLO 3	Up to K4	2	K1 & K2	1	K1	2(K4 & K4)	1(K4)
4	CLO 4	Up to K3	2	K1 & K2	1	K2	2(K3 & K3)	1(K3)
5	CLO 5	Up to K3	2	K1 & K2	1	K2	2(K3 & K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	5	4	-	-	09	7.50	33.33%
K2	5	6	20	-	31	25.83	
K3	-	-	20	40	60	50	50%
K4	-		10	10	20	16.67	16.67%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF STATISTICS				CLASS: III B.Sc., STATISTICS				
Sem	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
VI	CORE-XIII	23U6SCCT13	REGRESSION ANALYSIS	4	6	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

Objectives:

- To understand linear and nonlinear relationships between variables and training the students in applications oriented.
- To help student to be able to perform regression analysis and interpret the model.
- To perform model adequacy check before using Linear Regression models.
- To assess the fit of a model to data, and make suggestions as to how to improve it if it is unsatisfactory.

Unit	Description	Hours	K-level	CLO
I	Introduction to simple linear regression - Assumptions, least square estimation of model parameters, useful properties of least square fit - standard error of estimators, testing of hypotheses on slope and intercept (β 's), interval estimation of model parameters, prediction interval of a new observation, coefficient of determination, regression through origin.	18	Up to K2	1
II	Standard Gauss Markov setup - significance of regression (ANOVA, R^2 and adjusted R^2), individual regression coefficients – subset of regressor variables, general linear hypotheses - detecting hidden interpolation.	18	Up to K3	2
III	Model adequacy checking - residual plots for checking normality, homoscedasticity and detection of outliers. Test for Lack of fit of the model. Analytical methods for selecting a transformation generalized least squares - Detection of influential observations – Cooks statistic, DFFITS, DFBETAS.	18	Up to K4	3
IV	Variance stabilizing transforms and transforms to linearize the model - Box-Cox transformation on Y. Detection and removal of Heteroscedasticity – Analytical methods for selecting a transformation – generalized least squares and Weighted Least Square. Autocorrelation – Durbin-Waston Statistics – limitations of the Durbin-Waston Statistics.	18	Up to K3	4
V	Multicollinearity – sources, effects, diagnostics, Methods of dealing with multicollinearity (collection of additional data, model respecification, Ridge regression). Dummy (or indicator variables) – general concepts and their use. Selection of variables – forward selection, backward elimination and stepwise regression (algorithms only) – Nonlinear regression (concept only).	18	Up to K4	5

Book for Study:

Montgomery, D. C., Peck, E. A. and Vining, G. G. (2003): Introduction to Linear regression analysis, third edition, John Wiley and Sons, Inc.

Chapters:

UNIT-I: Chapter 2 (2.1-2.6,2.10)

UNIT-II: Chapter 3 (3.3,3.8)

UNIT-III: Chapter 4(4.2.1-4.2.4, 4.4, 4.5), chapter 6(6.1-6.4)

UNIT-IV: Chapter 5(5.2,5.3,5.4,5.5(5.5.1,5.5.2)),Chapter 14(14.2)

UNIT-V : Chapter 9 sections: 9.1-9.3, 9.4(9.4.1-9.4.3),9.5(9.5.1-9.5.3),Chapter 10:10.2

Books for References:

1. Zar, J.H. (2006): Biostatistical Analysis, fourth edition, Pearson education.
2. Iain Pardoe (2012): Applied regression Modeling, second edition, Wiley
3. Draper, N.R. and Smith, H. (2003): Applied Regression Analysis, third edition, John Wiley and Sons, Inc.
4. Johnston, J. (1984): Econometric methods, third edition, McGraw Hill International.
5. A. Sen, M. Srivastava, Regression Analysis — Theory, Methods, and Applications, Springer-Verlag, Berlin, 2011.

Web Resources

1. <https://archive.nptel.ac.in/courses/111/104/111104074/>
2. <https://home.iitk.ac.in/~shalab/course5.htm>
3. <https://spartan.ac.brocku.ca/~jvrbik/MATH3P82/notes.pdf>

Rationale for Nature of the course

Regression is perhaps the most widely used statistical technique. It estimates relationships between independent variables (predictors) and a dependent variable (outcome). Regression models can be used to help understand and explain relationships among variables; they can also be used to predict outcomes.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Problem solving, Analytical ability, Professional Competency and Professional communication.

Pedagogy

Lecture, Seminar, Quiz, Problem Solving, Tutorial Sessions, Group Discussions, PPT.

Course Designer:

Dr. B. SEETHALAKSHMI, Assistant Professor, Department of Mathematics & Statistics.

Course Schedule

Units	Description	Hours	Pedagogy
I	Introduction to simple linear regression - Assumptions, least square estimation of model parameters.	4	Lecture, Quiz, PPT & Group Discussions
	Useful properties of least square fit - standard error of estimators.	3	
	Useful properties of least square fit - standard error of estimators.	3	
	Testing of hypotheses on slope and intercept (β 's). Interval estimation of model parameters, prediction interval of a new observation.	4	
	Coefficient of determination, regression through origin.	4	
II	Standard Gauss Markov setup - significance of regression (ANOVA, R^2 and adjusted R^2).	5	Lecture, Quiz, Seminar, PPT & Group Discussions
	Individual regression coefficients.	3	
	Subset of regressor variables, general linear hypotheses.	5	
	Detecting hidden interpolation.	5	
III	Model adequacy checking - residual plots for checking normality, homoscedasticity and detection of outliers.	4	Lecture, Quiz, Seminar, PPT & Group Discussions
	Test for Lack of fit of the model.	3	
	Analytical methods for selecting a transformation generalized least squares.	3	
	Detection of influential observations.	4	
	Cooks statistic, DFFITS, DFBETAS.	4	
IV	Variance stabilizing transforms and transforms to linearize the model.	4	Lecture, Quiz, Seminar, PPT & Group Discussions
	Box-Cox transformation on Y. Detection and removal of Heteroscedasticity.	4	
	Analytical methods for selecting a transformation.	4	
	Generalized least squares and Weighted Least Square.	3	
	Autocorrelation – Durbin-Waston Statistics – limitations of the Durbin-Waston Statistics.	3	
V	Multicollinearity – sources, effects, diagnostics, Methods of dealing with multicollinearity (collection of additional data, model respecification, Ridge regression).	6	Lecture, Quiz, Seminar, PPT, Group Discussion Problem Solving, Seminar & Assignment
	Dummy (or indicator variables) – general concepts and their use. Selection of variables.	6	
	Forward selection, backward elimination and stepwise regression (algorithms only) – Nonlinear regression (concept only).	6	
Total Hours		90	

COURSE OUTCOMES:

At the end of the course, the student will be able to:

Number	Course Learning Outcome	Knowledge level
CLO1	Understand the concept of simple linear regression model and properties of model parameters.	Up to K2
CLO2	Understand linear and nonlinear models assumptions.	Up to K3
CLO3	Check model adequacy	Up to K4
CLO4	Know about variable selection	Up to K3
CLO5	Know about nonlinear regression models.	Up to K4

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	2	1	2	3	3
CLO-2	2	1	2	3	3
CLO-3	1	1	2	3	3
CLO-4	1	1	2	3	2
CLO-5	1	1	2	3	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	-	2	2	2
CLO2	3	3	-	2	2	2
CLO3	3	2	-	2	2	2
CLO4	2	2	2	2	1	2
CLO5	2	2	2	2	1	2

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model

Units	CLOs	K Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K Level	No. of Questions	K Level		
1	CLO 1	Up to K2	2	K1& K2	1	K1	2(K1& K1)	1(K2)
2	CLO 2	Up to K3	2	K1& K2	1	K1	2(K3& K3)	1(K3)
3	CLO 3	Up to K4	2	K1& K2	1	K2	2(K4& K4)	1(K3)
4	CLO 4	Up to K3	2	K1& K2	1	K2	2(K2& K2)	1(K3)
5	CLO 5	Up to K4	2	K1& K2	1	K2	2(K3& K3)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analysing, presentation and make inferences with evidences

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total Marks	% of marks with choice	Consolidated
K1	5	4	10	-	19	15.83	41.66%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	41.67%
K4	-	-	10	10	20	16.67	16.67%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF STATISTICS				CLASS: III B.Sc., STATISTICS				
Sem.	Course type	Course code	Course title	Credits	Contact hours / Week	CIA	Ext	Total
VI	Core-XIV	23U6SCCT14	DEMOGRAPHY	4	6	25	75	100

Nature of course	Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objectives:

- To learn population and demographic registration.
- To learn fertility and mortality measurements.
- To understand Life table uses.
- To learn migration effect solution.

Unit	Description	Hours	K-level	CLO
I	Sources of demographic data – Civil registration – Population census registers – Errors in demographic data – Methods of improvements.	18	Up to K2	CLO1
II	Fertility and Mortality measurements – General and specific rates – Standardized rates – Measurement of population growth - Gross and net reproduction rates.	18	Up to K3	CLO2
III	Life table – Structure – Forces of mortality – Construction – Relationship between the function of a life table – Abridged life table – Graduation of Mortality rates – Gompertz and Makeham's law	18	Up to K4	CLO3
IV	Spatial distribution of population – Migration – Kinds of migration – Factors important in migration analysis – Migration defining period and boundary – Migration data by vital statistics and survival ratio.	18	Up to K3	CLO4
V	Measurements of Population growth – Population Trend - Components of population growth and change - Demographic transition theory – Methods of population projection – Component method of projection	18	Up to K3	CLO5

Books for study:

1. Farhat Yusuf, Jo. M. Martins, David A. Swanson, *Methods of Demographic Analysis*, Springer
Unit I: Chapter 2 2.2, 2.3
2. Kapoor.V.K. and Gupta.S.P. (2007), *Fundamentals of Applied Statistics*, Sultan Chand & Sons.
Unit II: Chapter 9 - 9.4, 9.7, 9.8
Unit III: Chapter 9 - 9.5 (9.5.1, 9.5.3, 9.5.4, 9.5.5), 9.6, 9.9
3. Ghosh.B.N., *Fundamentals of demography*, Sterling Publishers Private Ltd., New Delhi
Unit IV: Chapter 3 (Pg no. 34 – 49)
Unit V: Chapter 4 (Pg no. 58 – 70 , 78 – 87)

Books for References:

1. Pathak. K.B. and Ram. F (1992): Techniques of Demography, Wiley Eastern.
2. Ram Kumar R (1986): Technical Demography, Wiley Eastern
3. Srivastava O.S.(1983) : A text book of Demography , Vikas Publishing.
4. Bogue, Donald J: Principles of Demography (1976), John Willey, New York

Web Resources

1. <https://archive.nptel.ac.in/courses/109/104/109104150/>
2. <https://www.khanacademy.org/test-prep/mcat/society-and-culture/demographics/v/population-dynamics>
3. <https://study.com/academy/lesson/video/fertility-rate-definition-calculation-quiz.html>
4. https://www.ined.fr/en/everything_about_population/videos/animation-measuring-fertility/

Rationale for Nature of the course

Demography is based on the systematic collection of data on people, such as through censuses or surveys. Demographers also use demographic theories and models to explain population processes. Demography studies the trends and processes associated with population including – changes in population size; patterns of births, deaths, and migration; and the structure and composition of the population, such as the relative proportions of women, men and different age groups.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Quiz, Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved.

Pedagogy

Lecture with PPT, Seminar, Tutorial, Group Discussion, Assignments

Course Designer:

S.MEENAKSHI, Assistant Professor, Department of Mathematics & Statistics.

Course Schedule

Unit	Topics	Hrs	Mode
I	Sources of demographic data	4	Lecture, Quiz Problem Solving
	Civil registration	4	
	Population census registers – Errors in demographic data	6	
	Methods of improvements.	4	
II	Fertility and Mortality measurements	4	Lecture, Quiz Problem Solving, Group Discussion
	General and specific rates	4	
	Standardized rates	4	
	Measurement of population growth - Gross and net reproduction rates.	6	
III	Life table – Structure	4	PPT, Lecture Problem Solving
	Forces of mortality – Construction – Relationship between the function of a life table	4	
	Abridged life table	4	
	Graduation of Mortality rates – Gompertz and Makeham’s law	6	
IV	Spatial distribution of population – Migration	4	Lecture, Tutorial Problem Solving
	Kinds of migration	4	
	Factors important in migration analysis – Migration defining period and boundary	4	
	Migration data by vital statistics	3	
	Survival ratio and National Growth rate methods.	2	
V	Measurements of Population growth – Population Trend	2	PPT, Tutorial, Seminar Assignment
	Components of population growth and change	6	
	Demographic transition theory	2	
	Methods of population projection	4	
	Component method of projection	4	
Total Hours		90	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	To understand the need of population study and its registration system	Upto K2
CLO-2	To understand fertility and mortality effect on population	Upto K3
CLO-3	To understand life table and its usage to real problems	Upto K4
CLO-4	To get effect of migration in population	Upto K3
CLO-5	To understand population growth and its effect	Upto K3

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	3	3	3	3	3
CLO-2	3	3	3	3	2
CLO-3	3	3	3	3	3
CLO-4	3	3	3	3	3
CLO-5	3	3	2	2	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	2	1	2	1
CLO2	3	2	2	1	2	1
CLO3	3	2	2	1	2	1
CLO4	3	2	2	1	2	1
CLO5	3	2	2	1	2	1

Advance application– 3;**Intermediate level–2;****Basic level–1**

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Unit	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K-Level	No. of Questions	K- Level		
1	CLO 1	Upto K2	2	K1 & K2	1	K1	2(K1&K1)	1(K2)
2	CLO 2	Upto K3	2	K1 & K2	1	K2	2(K2 &K2)	1(K3)
3	CLO 3	Upto K4	2	K1 & K2	1	K2	2(K4 &K4)	1(K4)
4	CLO 4	Upto K3	2	K1 & K2	1	K1	2(K3 &K3)	1(K3)
5	CLO 5	Upto K3	2	K1 & K2	1	K2	2(K3 &K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	20	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100	100%

DEPARTMENT OF STATISTICS				CLASS: III B.Sc., STATISTICS				
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
VI	Core Practical-II	23U6SCCP2	STATISTICAL PROBLEM SOLVING -II (Calculator Based Practical)	3	3	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

Objectives:

- To understand the concept of randomness and uncertainty shape complex systems over time.
- To make them understand the concept of Markov Chains in Stochastic Processes
- To help the students understand the concepts of set of statistical methods used to estimate relationships between a dependent variable and one or more independent variables.
- To learn fertility and mortality measurements.

S.No.	LIST OF PROBLEMS
1	Problems on Markov Chains in Stochastic Processes.
2	Problems on Classification of State of Markov Chain.
3	Problem on Stationary process.
4	Problem on Poisson process. .
5	Problems on M/M/1 queuing model with infinite capacity.
6	Problems on M/M/1 queuing model with finite capacity.
7	Problems on M/M/s queuing model with infinite capacity.
8	Problems on M/M/s queuing model with finite capacity.
9	Problems on standard error of estimators.
10	Problems on testing of hypothesis on slope and intercept ($\beta's$).
11	Problems on significance of regression (ANOVA, R^2 and adjusted R^2).
12	Problems on Durbin – Waston Statistics.
13	Problems on Multicollinearity.
14	Problems on homoscedasticity.
15	Problems on Measurement of Fertility
16	Problems on Specific Fertility rate and Total Fertility rate.
17	Problems on Measurement of Mortality.
18	Problems on Specific death rate and infant Mortality rate.
19	Problems on Life table.
20	Problems on reproduction rate

Books for References:

1. Medhi, J. (2019): Stochastic Processes, New Age International Publishers.
2. Kanti Swarup, Gupta.P.K. Man Mohan.,(2010): Operations Research, Sultan Chand & Sons.
3. Montgomery, D. C., Peck, E. A. and Vining, G. G. (2003): Introduction to Linear regression analysis, third edition, John Wiley and Sons, Inc.

4. Kapoor.V.K. and Gupta.S.P. (2007), *Fundamentals of Applied Statistics*, Sultan Chand& Sons.

Web Resources

1. <https://corporatefinanceinstitute.com/resources/data-science/regression-analysis/>
2. <https://study.com/academy/lesson/video/fertility-rate-definition-calculation-quiz.html>
3. <https://www.britannica.com/science/stochastic-process>

Rationale for Nature of the course

This course is a discipline that teaches students how to use analytical methods to solve problems and improve decision-making. By problem solving related to stochastic process, students will be able to know the concept of basic probability concepts and a discussion of conditional probability and conditional expectation, an investigation of the long-run behaviour of Markov chains in discrete time, countable state space. Regression models can be used to help understand and explain relationships among variables; they can also be used to predict outcomes.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Exercises, Seminars, Assignments, Problem solving using calculator and Quiz.

Pedagogy

Lecture with PPT, Quiz, Tutorial.

Course Designer:

Dr. S. VALLI RANI, Assistant Professor, Department of Mathematics & Statistics

Course Learning Outcomes:

At the end of this course the student will able to,

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Identify the stationary processes.	Up to K3
CLO-2	Classify the states of the markov chain.	Up to K3
CLO-3	Testing of the estimator and hypothesis.	Up to K3
CLO-4	Know about variable selection.	Up to K3
CLO-5	To understand fertility and mortality effect on population	Up to K3

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	2	1	1	2	1
CLO-2	2	1	1	2	1
CLO-3	2	1	1	2	1
CLO-4	2	1	1	2	1
CLO-5	2	1	1	2	1

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	1	1	1	1
CLO2	3	2	1	1	1	1
CLO3	3	2	2	1	1	1
CLO4	3	2	2	1	1	1
CLO5	3	1	2	2	1	1

Advance application- 3;

Intermediate level-2;

Basic level-1

DEPARTMENT OF STATISTICS				CLASS: III B.Sc., STATISTICS				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
VI	Elective-II	23U6SDET2(A)	INDEX NUMBERS	2	4	25	75	100

Nature of Course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship oriented	

COURSE OBJECTIVES:

- To help the students understand the concepts of Index numbers using various formula.
- To understand the differences between chain base index and fixed base index number.
- To enable the students to be acquainted with the basic study of changes in price, value or quantity with reference to change in time.
- To understand the ratio between the cost value of one item to the cost value of another item.

Unit	Description	Hours	K-level	CLO(s)
I	Introduction-Meaning, Definition-Characteristics- Uses-Types of Index Number-Interpretation of Index Numbers-Problems of Construction- Choice of Formula.	12	K3	1
II	Method of construction-Laspeyre's Method-Paasche's Method-Dorbish and Bowley's Method-Problems.	12	K2	2
III	Fisher's Ideal method-Marshall-Edgeworth method-Kelly's Method-Walsch's Method-Problems.	12	K3	3
IV	Quantity Index Numbers-Value Index Numbers-Time Reversal Test-Factor Reversal Test-circular Test-Practical problems.	12	K4	4
V	Chain base index number-Fixed base index number-Base shifting index number-Deflating of index number-Consumer price index number-Family budget index number-Limitation of index number-Practical problems.	12	K3	5

Book for study:

R.S.N. Pillai Bagavathi (2021), Statistics Theory and Practice, S. Chand.

Chapter: 14

Books for References:

1. Dr. S.P. Gupta, Statistical Methods, 46th Edition, Sultan Chand and sons, New Delhi.
2. S.C. Gupta and V.K. Kapoor (2008): Fundamentals of Applied Statistics, 4th Ed., Sultan Chand and Sons

Web Resources:

1. <https://ncert.nic.in/ncerts/l/kest108.pdf>
2. <https://unacademy.com/content/cbse-class-11/study-material/mathematics/introduction-to-index-numbers/>
3. <https://www.sarthaks.com/3212640/differentiate-between-fixed-base-and-chain-base-methods>
4. <https://study.com/academy/lesson/index-numbers-in-statistics-uses-examples.html>

Rationale for Nature of the course

An index number is a statistical device for measuring changes in the magnitude of a group of related variables. It represents the general trend of diverging ratios, from which it is calculated. It is a measure of the average change in a group of related variables over two different situations. An index number also measures changes in the value of the variables such as prices of specified list of commodities, volume of production in different sectors of an industry, production of various agricultural crops, cost of living etc.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Case study, Formulation and Analysis plan and problem solving

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Course Designer:

Dr. M. REVATHI, Assistant professor, Department of Mathematics and Statistics.

Course Schedule

Unit	Topics	Hours	Mode
I	Introduction-Meaning, Definition-Characteristics- Uses- Types of Index Number	6	PPT, Chalk and Talk, Test
	Interpretation of Index Numbers- Problems of Construction- Choice of Formula.	6	
II	Method of construction-Laspeyre's Method-Problems.	4	PPT, Chalk and Talk and Test
	Paasche's Method-Dorbish and Bowley's Method-Problems.	4	
	Dorbish and Bowley's Method-Problems.	4	
III	Fisher's Ideal method-Marshall-Edgeworth method-Problems.	6	PPT, Chalk and Talk, GD, Test Assignments
	Kelly's Method-Walsch's Method-Problems.	6	
IV	Quantity Index Numbers-Value Index Numbers- Practical problems.	4	PPT, Chalk and Talk, Test, Assignments
	Time Reversal Test-Factor Reversal Test- Practical problems.	4	
	Circular Test-Practical problems.	4	
V	Chain base index number-Fixed base index number-Base shifting index number-	4	GD, Assignments and Seminar
	Deflating of index number-Consumer price index number-Family budget index number	4	
	Limitation of index number-Practical problems.	4	
	Total Hours	60	

COURSE OUTCOMES

At the end of the course, students will be able to

CLO	Course Learning Outcomes	Knowledge Level
CLO 1	Understand the notation and formulae concerning the use and construction of index numbers.	Up to K3
CLO 2	Understand the different methods of Index numbers like Laspeyre's, Paasche's and Dorbish and Bowley's Method.	Up to K2
CLO 3	Understand the concept of Fisher's Ideal Index number, Marshall-Edgeworth method-Kelly's Method-Walsch's method.	Up to K3
CLO 4	To determine whether a given method will work both ways in time.	Up to K4
CLO 5	Find index number or weightage given relevant information.	Up to K3

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	2	3	2	3
CLO2	3	1	-	2	3
CLO3	3	1	-	2	3
CLO4	2	2	-	2	3
CLO5	2	2	1	2	3

Mapping with CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	2	1	1	-
CLO2	3	3	1	1	1	-
CLO3	3	3	-	1	1	1
CLO4	2	2	-	1	1	2
CLO5	2	2	2	1	1	2

3- Advance Application

2- Intermediate Level

1- Basic Level

SUMMATIVE ASSESSMENT - BLUE PRINT

S. No.	CLOs	K – Level	Section A		Section B		Section C (Either/or Choice)	Section D(Open Choice)
			MCQs		Short Answers			
			No. of questions	K - Level	No. of questions	K - Level		
1	CLO 1	Up to K3	2	K1 & K2	1	K1	2(K2 & K2)	1(K3)
2	CLO 2	Up to K2	2	K1 & K2	1	K1	2(K2 & K2)	1(K2)
3	CLO 3	Up to K3	2	K1 & K2	1	K2	2(K3 & K3)	1(K3)
4	CLO 4	Up to K4	2	K1 & K2	1	K2	2(K4 & K4)	1(K4)
5	CLO 5	Up to K3	2	K1 & K2	1	K2	2(K3 & K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1 - Remembering and recalling facts with specific answers.

K2 - Basic understanding of facts and stating main ideas with general answers.

K3 - Application oriented - Solving Problems.

K4 - Examining, analysing, presentation and make inferences with evidences.

Distribution of section wise marks with K level

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	5	4	-	-	09	7.50	41.67%
K2	5	6	20	10	41	34.16	
K3	-	-	20	30	50	41.67	41.67%
K4	-		10	10	20	16.67	16.66%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF STATISTICS					CLASS: III B.Sc STATISTICS			
Sem	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
VI	Elective-II	23U6SDET2(B)	APPLIED STATISTICS	2	4	25	75	100

Nature of course	Skill oriented		Employability oriented	✓	Entrepreneurship Oriented	✓

Objectives:

- To help students understand the concepts underlying statistical quality control and to develop their ability to apply those concepts to the design and management of quality control processes in industries.
- To understand the differences between attributes and variables.
- To introduce the students the basics of Statistical Quality Control and to enable them describe quality characteristics and relationships.
- To understand the differences between attributes and variables.

Unit	Description	Hours	K-level	CLO
I	Analysis of Time Series: Introduction, Components of Time Series: Trend –Periodic Changes- Irregular(or Random) Component, Analysis of Time Series-Mathematical Models for Time Series – Uses of Time Series, Measurement of Trend- Graphic Method-Method of Semi- averages – Method of curve Fitting by Principle of Least Squares- Growth curves and Their Fitting – Moving Average Method – Approximation to Moving Averages.	12	Up to K3	1
II	Measurement of Seasonal Variations: Method of Simple Averages – Ratio to Trend Method - Ratio to Moving Average Method – Link Relative Method – Deseasonalisation of Data, Measurement of Cyclic Variations, Auto – Regression Series- First Order auto regression Series (Markoff's series)	12	Up to K3	2
III	Measurement of Seasonal Variations(Continued): Second Order auto regression Series(Yule's series) – General Auto –regression, Auto – Correlation and Correlogram- Correlogram of Moving Average – Correlogram of Harmonic Series – Correlogram of Auto – regressive series, Random Component in a Time Series – Variate Difference Method.	12	Up to K4	3
IV	Association of attributes-Introduction-difference between correlation and association-notation and terminology-class frequencies-ultimate class frequencies-consistency of data association and disassociation-problems.	12	Up to K3	4
V	Proportion method-Yule's coefficient of association-criteria of independence-coefficient of colligation-problems.	12	Up to K3	5

Books for study:

1. Kapoor, V.K. and Gupta, S.P. 4th thoroughly revised edition, Reprint (2023), Fundamentals of Applied Statistics, Sultan Chand & Sons.

Unit I: Chapter 2(2.1-2.4)

Unit II: Chapter 2[2.5,2.6,2.7(2.7.1)]

Unit III: Chapter 2[2.7(2.7.2,2.7.3),2.8,2.9]

2. Gupta, S.P. 46th revised edition, Reprint (2022) “Statistical Methods”, Sultan Chand and sons.

Unit IV,V- Chapter 12[Pages(12.2-12.23)]

Books for References:

1. Arumugam, S.(2018) Statistics Quality Control, New Gamma Publishing House.
2. Pillai, R.S.N and Bagavathi Statistics Theory and Practice, Sultan Chand & Sons.
3. Goon, A.M. Gupta M.K. and Das Gupta B (1977) An Outline of Statistical Theory, Vol I, 6/e, World Press, Calcutta.
4. Mood A.M. Graybill F.A. and Boes D.C.B (1980) : Introduction to the Theory of Statistics 3/e, McGraw Hill, New York.

Web Resources:

1. <https://youtu.be/xQosDs4UiNQ>
2. <https://youtu.be/oadzdeYohes>
3. https://vikramuniv.ac.in/files/wp-content/uploads/ECOMNOMICS-analysis_of_time_series.doc
4. <https://www.investopedia.com/terms/m/movingaverage.asp>
5. <https://egyankosh.ac.in/bitstream/123456789/20469/1/Unit-15.pdf>

Rationale for Nature of the course:

Applied Statistics includes planning for the collection of data, managing data, analyzing, interpreting and drawing conclusions from data and identifying problems, solutions and opportunities using analysis. This major builds critical thinking and problem solving skills in data analysis and empirical research.

An attribute refers to the quality of a characteristic. The theory of attributes deals with qualitative types of characteristics that are calculated by using quantitative measurements. It is fundamental in both philosophy and logic, providing a framework for understanding and analyzing the properties of objects and concepts.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Exercises, Seminars, Assignments, Problem solving using calculator and Quiz.

Pedagogy:

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Course Designer:

Dr.R.CHITRA, Assistant Professor, Department of Mathematics & Statistics.

Course Schedule

Unit	Topics	Hours	Mode
I	Analysis of Time Series: Introduction, Components of Time Series: Trend –Periodic Changes-Irregular(or Random) Component.	4	PPT, Chalk and Talk, Test, Quiz.
	Concept of Analysis of Time Series: Mathematical Models for Time Series – Uses of Time Series- Measurement of Trend: Graphic Method- Method of Semi- averages – Method of curve.	4	
	Fitting by Principle of Least Squares- Growth curves and Their Fitting – Moving Average Method – Approximation to Moving Averages.	4	
II	Measurement of Seasonal Variations: Method of Simple Averages – Ratio to Trend Method - Ratio to Moving Average Method – Problems.	4	PPT, Chalk and Talk Test, Quiz.
	Link Relative Method – Deseasonalisation of Data, Measurement of Cyclic Variations, Auto.-Derivation and problems.	4	
	Concept of Regression Series- Derivation of First Order Auto- regression Series –Problems.	4	
III	Derivation of Second Order Auto- regression Series – General Auto –regression.Auto Correlation and Correlogram-problems.	4	PPT, Chalk and Talk, Test, Quiz.
	Correlogram of Moving Average – Correlogram of Harmonic Series - Correlogram of Auto	4	
	Concept and definition of Regressive series, Random Component in a Time Series – Variate difference Method-problems.	4	
IV	Association of attributes-Introduction-difference between correlation and association	4	PPT, Chalk and Talk, Test, Quiz.
	notation and terminology-class frequencies-ultimate class frequencies	4	
	Consistency of data association and disassociation-problems.	4	
V	Proportion method-Yule's coefficient of association-problems	4	Chalk and Talk, Test, Quiz. Assignments and Seminar
	Concept of criteria of independence-Problems	4	
	coefficient of colligation-Problems.	4	
	Total Hours	60	

Course Learning Outcomes:

At the end of the course, the students will be able to

CO	Course Learning Outcome	K-level
CLO 1	Explain time series with different structures.	Up to K3
CLO 2	Apply trend derivation method.	Up to K3
CLO 3	Analyze the variance of random component by variate component method.	Up to K4
CLO 4	Construct coefficient of colligation using proportion method.	Up to K3
CLO 5	Apply the criteria of independence and coefficient of colligation to the given data.	Up to K3

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	2	2	3	2	3
CLO-2	2	2	3	2	3
CLO-3	2	1	3	2	3
CLO-4	1	1	2	2	3
CLO-5	1	1	1	2	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	1	2	2	1
CLO2	3	3	2	1	2	1
CLO3	3	2	1	2	2	1
CLO4	2	2	2	1	1	1
CLO5	2	2	1	1	1	1

Advance application – 3;

Intermediate level-2;

Basic level-1

Summative - Blue – Print – Model

S. No.	CLOs	K – Level	Section A		Section B		Section C (Either/or Choice)	Section D(Open Choice)
			MCQs		Short Answers			
			No. of questions	K - Level	No. of questions	K - Level		
1	CLO 1	Up to K3	2	K1 & K2	1	K1	2(K2 & K2)	1(K3)
2	CLO 2	Up to K3	2	K1 & K2	1	K2	2(K2 & K2)	1(K3)
3	CLO 3	Up to K4	2	K1 & K2	1	K1	2(K4 & K4)	1(K4)
4	CLO 4	Up to K3	2	K1 & K2	1	K2	2(K3 & K3)	1(K3)
5	CLO 5	Up to K3	2	K1 & K2	1	K2	2(K3 & K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	5	4	-	-	09	7.50	33.33%
K2	5	6	20	-	31	25.83	
K3	-	-	20	40	60	50	50%
K4	-		10	10	20	16.67	16.67%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF STATISTICS				CLASS: III B.Sc., STATISTICS				
Sem.	Course type	Course code	Course title	Credits	Contact hours / Week	CIA	Ext	Total
VI	Professional Competency Skill	23U6SSED8	PRACTICAL IN PYTHON PROGRAMMING	2	2	25	75	100

Nature of the Course	Skill oriented	✓	Employability oriented	✓	Entrepreneur ship oriented	✓

Course Objectives:

- To introduce various concepts of programming to the students using Python.
- To learn how to build and package Python modules for reusability.
- To equip students with Statistical Programming Skills based on real life examples and datasets.

S.No.	LIST OF PROGRAMS
1	Develop a Python Program to create a Bar Chart.
2	Develop a Python Program to create a Multiple Bar Chart.
3	Develop a Python Program to create a Pie Chart.
4	Develop a Python Program to create a Scattered Plots.
5	Develop a Python Program to create a Histogram.
6	Develop a Python Program to do the Matrix Operations.
7	Develop a Python Program to compute the inverse of a Matrix.
8	Develop a Python Program to compute the mean, median and standard deviation.
9	Develop a Python Program to compute the skewness.
10	Develop a Python Program to compute the Karl Pearson's Coefficient of Correlation.
11	Develop a Python Program to compute the Spearman's Rank Correlation.
12	Develop a Python Program to compute the Regression Coefficient.
13	Develop a Python Program to compute the simple linear Regression Coefficient.
14	Develop a Python Program to compute the Probability of values using various distributions.
15	Develop a Python Program for testing one sample, two sample , more than two sample.

Books for Study

1. Nageswara Rao, R, Core Python Programming, 2nd edition, Dreamtech Press, New Delhi(2018).
2. Haslwanter, T, An Introduction to Statistics with Python with Application in the Life Sciences, Springer, Switzerland (2016).

Books for References:

1. Wesley J.Chun, Core Python programming, 2/e, Pearson education (2010).Gupta.S.P, "Statistical Methods", Sultan Chand and sons.
2. Mark Lutz, Programming Python, 4/e, O'Reilly Media (2010).
3. Mark Summerfield, Programming in Python 3, Pearson Education (2009).

Web Resources

1. <https://nptel.ac.in/courses/106/106/106106182>
2. <https://scipy-lectures.org/packages/statistics/index.html>

3. <https://www.kdnuggets.com/2016/07/statistical-data-analysis-python.html>
4. <https://bedford-computing.co.uk/learning/wp-content/uploads/2015/10/Python-for-DataAnalysis.pdf>

Rationale for Nature of the course

Python is used by market researchers, health researchers, survey companies, government entities, education researchers, marketing organizations, data miners, and many more for processing and analyzing survey data

Activities having direct bearing on Skill development / Employability Entrepreneurship

The goal for the lab is to provide an opportunity for you to become familiar with the Python software which is designed to solve problems in statistics and to analyze experimental data

Pedagogy

Demonstration and Practical session in computer lab.

Course Designer:

Mrs. S. KRISHNA JAYANTHI, Assistant Professor, Department of Mathematics & Statistics.

Course Learning Outcomes:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Understand how to use data visualization	Up to K3
CLO-2	Presenting data using relevant tables and summary statistics	Up to K3
CLO-3	Construct arrays and apply numpy in arrays and matrices for programs	Up to K3
CLO-4	Perform statistical analysis using correlation	Up to K3
CLO-5	Perform statistical analysis using correlation regressions	Up to K3

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	2	1	1	2	1
CLO-2	2	1	1	2	1
CLO-3	2	1	1	2	1
CLO-4	2	1	1	2	1
CLO-5	2	1	1	2	1

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	1	1	1	1
CLO2	3	2	1	1	1	1
CLO3	3	2	2	1	1	1
CLO4	3	2	2	1	1	1
CLO5	3	1	2	2	1	1

Advance application- 3;

Intermediate level-2;

Basic level-1

DEPARTMENT OF STATISTICS				CLASS: III B.Sc., STATISTICS				
Sem	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
VI	Project	23U6SPROV	PROJECT & VIVA	2	3	25	75	100



The Madura College, Madurai – 625 011

Department of Statistics

COURSE DESCRIPTION WITH DESCRIPTOR ELEMENTS AND PERCENTAGE OF REVISION

Course Code	Title of the Course	Hours	Credits	Nature of Course (Employability/ Entrepreneurship/ Skill Development)			Scope of Focus (Local / National / Global developmental needs)			Percentage of Syllabus Revision/New
				Empl	Ent	Skill	Local	National	Global	
23U1SCCT1	Descriptive Statistics	4	4	Y		Y			Y	55.71% Revised
23U1SCCT2	Probability Theory	4	4	Y		Y				20.45% No change
23U1SGET1	Statistical Methods and its Applications -I	6	5	Y		Y				New
23U1SSEN1	Statistical Practical –I (Calculator based)	2	2	Y	Y	Y	Y			New
23U1SFCT1	Bridge Statistics	2	2	Y		Y		Y		New
23U2SCCT3	Matrix and Linear Algebra	4	4	Y		Y			Y	52.9% Revised
23U2SCCT4	Distribution Theory	4	4	Y	Y	Y			Y	0% No change
23U2SGET2	Statistical Methods and its Applications -II	6	5	Y	Y	Y			Y	New
23U2SSEP2	Statistical Practical – II (Calculator based)	2	2	Y		Y			Y	New
23U2SSEP3	Lab Practical in R	2	2	Y	Y	Y			Y	20% Revised
23U3SCCT5	Estimation Theory	4	4	Y		Y			Y	No Change
23U3SCCT6	Sampling techniques	3	3	Y	Y	Y		Y		25% Revised
23U3SSEP4	Statistical Practical –III (Calculator based)	2	2	Y	Y	Y		Y		New
23U3SSED5	Database Management System	2	2	Y		Y			Y	New
	Add on Course – Statistics for Big Data			Y	Y	Y			Y	No change
23U4SCCT7	Testing of statistical hypothesis	4	4	Y	Y	Y			Y	46.67 % Revised

23U4SCCT8	Actuarial statistics	3	3	Y	Y	Y		Y		New
23U4SSEP5	Statistical Practical –IV (Calculator based)	2	2	Y	Y	Y	Y			New
23U4SSED7	Biostatistics	2	2	Y		Y	Y			New
	Add on Course – Combinatorics			Y	Y	Y			Y	No change
23U5SCCT9	Design of Experiments	5	4	Y	Y	Y		Y		0% No change
23U5SCCT10	Statistical Quality Control	5	4	Y	Y				Y	0% No change
23U5SCCT11	Operations Research	5	4	Y		Y			Y	0% No Change
23U5SCCP1	Statistical Problem Solving -I (Calculator Based Practical)	3	3	Y		Y			Y	20% Revised
23U5SDET1(A)	Non-Parametric Statistics	5	4			Y			Y	New
23U5SDET1(B)	Reliability Theory And Survival Analysis	5	4			Y			Y	33% Revised
23U5SIDCT	Economic Statistics(IDC)	5	4	Y		Y		Y		33% Revised
23U6SCCT12	Stochastic Processes	6	4			Y		Y		46.66% Revised
23U6SCCT13	Regression Analysis	6	4	Y		Y			Y	New
23U6SCCT14	Demography	6	4			Y			Y	70% Revised
23U6SCCP2	Statistical Problem Solving-II (Calculator Based Practical)	3	3	Y		Y			Y	New
23U6SDET2(A)	Index Numbers	4	2	Y	Y				Y	0% No change
23U6SDET2(B)	Applied Statistics	4	2	Y	Y				Y	28.57% Revised
23U6SSED8	Practical in Python Programming	2	2	Y	Y	Y			Y	80% New
23U6SPROV	Project And Viva	3	2							New

Emp- Employability; Ent- Entrepreneurship; Skill- Skill Development



THE MADURA COLLEGE, MADURAI

DEPARTMENT OF STATISTICS

Programme Outcomes (defined by TANSCHÉ)

PO1: Disciplinary Knowledge: Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate programme of study.

PO2: Critical Thinking: Capability to apply analytic thought to a body of knowledge; analyze and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development.

PO3: Problem Solving: Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real-life situations.

PO4: Analytical Reasoning: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples and addressing opposing viewpoints.

PO5: Scientific Reasoning: Ability to analyse, interpret and draw conclusions from quantitative / qualitative data; and critically evaluate ideas, evidence, and experiences from an open-minded and reasoned perspective.

PO6: Self-directed & Lifelong Learning: Ability to work independently, identify and manage a project. Ability to acquire knowledge and skills, including "learning how to learn", through self-placed and self-directed learning aimed at personal development, meeting economic, social and cultural objectives.

Programme Specific Outcomes (PSOs)

PSO1 – Placement: To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions.

PSO 2 – Entrepreneur: To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations.

PSO3 – Research and Development: Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development.

PSO4 – Contribution to Business World: To produce employable, ethical and innovative professionals to sustain in the dynamic business world.

PSO 5 – Contribution to the Society: To contribute to the development of the society by collaborating with stakeholders for mutual benefit.

Eligibility criteria for Admission

A candidate who has acquired B.Sc., degree in Statistics or B.Sc., degree in Mathematics shall permit to join the course.

Duration of the Course

The students shall undergo prescribed course of study for the period of two academic years under CBCS semester pattern with outcome based education.

Medium of Instruction: English

System: Choice Based Credit System with Outcome Based Model

Nature of the Course

Courses are classified according to the following nature

- Skill Oriented
- Employability Oriented
- Entrepreneurship Oriented

Teaching & Evaluation Pattern

- Outcome Based Education (OBE) & Assessment
- This curriculum is designed based on Tamilnadu State Council for Higher Education (TANSCHE) State Integrated Board of Studies and UGC.
- Students understanding must be built on and assessed for wide range of learning activities, which includes different approaches and are classified along several bases, such as

Based on Purpose

- **Formative** (Internal tests, Assignment, Seminar, Quiz, ICT based Assignment etc.)
- **Summative** (Evaluation of students learning at the end of instructional unit)
- **Based on Domain knowledge: (Post Graduate Up to K4 Levels)**
- Assessment through K1, K2, K3, K4

Evaluation

Methods	Marks
Formative (CIA)	25
Summative (External)	75
Total	100

Formative Test (CIA-Continuous Internal Assessment): 25 Marks

- Centralised system of Internal Assessment Tests
- There will be a two internal assessment tests
- Duration of Internal assessment test will be 1.5 hour
- Students shall write retest on the genuine grounds if they are absent in either Test I or Test II with the approval of HoD and the Principal.

Question Paper Pattern for Formative Test

The blue print for the internal test will be as follows.

Pattern	No. of questions	Marks per question	Total marks
Part A (Short answer type - no choice)	5	2	10
Part B (Paragraph answer type - Either-or)	2	5	10
Part C (Essay type - open choice – two questions to be answered out of 3 questions asked)	2	10	20
Total marks		40 (converted to 25)	

- K1- Remembering and recalling facts with specific answers
- K2- Basic understanding of facts and stating main ideas with general answers
- K3- Application oriented- Solving Problems
- K4- Examining, analyzing, presentation and make inferences with evidences
- For the purpose of Formative assessment (CIA), the course teacher may decide the CLO for the two tests as per the following conditions.
 - i. Any two CLOs shall be considered for the first test.
 - ii. Two CLOs (other than those already considered for the first test) shall be considered for the second test.
 - iii. The remaining CLO may be considered for assignment

Question Paper Pattern for Summative Examination

Section	Question pattern	Marks
A	Multiple choice (10 X 1 marks)	10
B	Short answer (5 X 2 marks)	10
C	Either / Or type (5 X 5 marks)	25
D	Open choice type (3 out of 5 X 10 marks)	30
Total		75

In respect of external examinations passing minimum is 45% for PG Courses and in total, aggregate of 50%. The curriculum is revised to suit the changing trends by propagation of ideas ensuring professional growth through innovative method of teaching.

Evaluation Pattern for Practical Papers

I) Continuous Internal Assessment: 40 Marks

Internal Components	Marks
Internal test	20
Observation	5
Total	25

II). External Assessment: 75 Marks

Total marks (I + II): 100 Marks

DEPARTMENT OF STATISTICS
THE MADURA COLLEGE (AUTONOMOUS), MADURAI

M.Sc. Statistics curriculum structure

(Under OBE pattern for the students admitted during the academic year 2024 - 25 onwards)

M.Sc. First Year Semester I

List of Courses	Course Code	Credit	Hours
Core-I (Real Analysis & Linear Algebra)	25P1SCCT1	5	6
Core-II (Distribution Theory)	25P1SCCT2	5	6
Core-III (Measure and Probability Theory)	25P1SCCT3	4	6
Discipline Elective – I (Official Statistics / Population Studies)	25P1SECT1(A)/ 25P1SECT1(B)	3	5
Discipline Elective – II (Actuarial Statistics / Clinical Trails)	25P1SECT2 (A)/ 25P1SECT2 (B)	3	5
Non-Major Elective (NME)-I (Statistical Survey)	25P1SSEN1	2	2
Total		22	30

M.Sc. First Year Semester II

List of Courses	Course Code	Credit	Hours
Core-IV (Estimation Theory)	25P2SCCT4	5	6
Core-V (Sampling Methods)	25P2SCCT5	5	6
Core Practical –I (Practical – I using R & Python)	25P2SCCP1	4	6
Discipline Elective – III (Linear Models / Simulation Analysis)	25P2SECT3(A)/ 25P2SECT3(B)	3	5
Discipline Elective – IV (Survival Analysis / Time Series Analysis)	25P2SECT4(A)/ 25P2SECT4(B)	3	5
Non-Major Elective (NME)-II (Elements of Operations Research)	25P2SSEN2	2	2
Total		22	30

M.Sc. Statistics - I Year – First Semester

List of Courses	Course Code	Credit	Hours
Core-I (Real Analysis & Linear Algebra)	25P1SCCT1	5	6
Core-II (Distribution Theory)	25P1SCCT2	5	6
Core-III (Measure and Probability Theory)	25P1SCCT3	4	6
Discipline Elective – I (Official Statistics / Population Studies)	25P1SECT1(A)/ 25P1SECT1(B)	3	5
Discipline Elective – II (Actuarial Statistics / Clinical Trails)	25P1SECT2 (A)/ 25P1SECT2 (B)	3	5
Non-Major Elective (NME)-I (Statistical Survey)	25P1SSEN1	2	2
Total		22	30

Semester wise Mapping of Course with Programme Specific Outcomes (PSOs)

Course Type	CC1	CC2	CC3	Elective - I	Elective - I	Elective - II	Elective – II	NME-I
Course Title	Real Analysis and Linear Algebra	Distribution Theory	Measure and Probability Theory	Official Statistics	Population Studies	Actuarial Statistics	Clinical Trails	Statistical Survey
PSO1	3	3	3	2	3	2	3	3
PSO2	2	3	3	2	3	2	3	2
PSO3	2	3	3	3	3	3	3	2
PSO4	3	2	2	2	3	2	3	3
PSO5	2	2	2	3	2	3	2	2

DEPARTMENT OF STATISTICS				CLASS: I M.Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	CORE-I	25P1SCCT1	Real Analysis & Linear Algebra	5	6	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented		Entrepreneurship Oriented	

Objectives:

1. To provide recollection as well as building Mathematical foundation in Real Analysis and Matrix Theory
2. To understand concepts and definition of metric space and theorems related to it
3. To know integration and differentiation concepts and its application, to know real functions in one variable as well as several variables, understand it on numerical problems
4. To know Linear space and its basis. Rank of a matrix, characteristic roots and its multiplicity, Different types of inverses, numerical examples and real life application
5. To know Different types of matrices, orthogonality, canonical forms, decomposition of matrix, quadratic forms, numerical examples and real life applications

Unit	Description	Hours	K-level	CLO
I	Metric Space – open, closed sets – Intervals (rectangles), Real valued Continuous functions- Discontinuities - compact sets, Bolzano – Weirstrass theorem, Heine – Borel theorem.	16	Up to K2	1
II	Derivatives - maxima and minima - Riemann integral & Riemann – Stieltjes integral with respect an increasing integrator – properties of R.S. integral. Functions of several variables, constrained and unconstrained maxima – minima of functions, partial and total derivatives	20	Up to K3	2
III	Basic properties of matrices (orthogonal, idempotent, Kronecker product, projection operators etc); Reduction of matrices, Echelon form, Hermite canonical form, diagonal reduction, rank factorization, triangular reduction Jordan form; Symmetric matrices and its properties;. Linear dependence, independence and rank of a matrix;	18	Up to K3	3

IV	Characteristic roots and polynomial, multiplicity of characteristic roots; Cayley Hamilton theorem; inverse of a matrix and determinants; Diagonalization Decomposition like, singular value decomposition, spectral decomposition, Cholesky decomposition etc	18	Up to K4	4
V	Matrix differentiation; Generalized inverse and its properties, Moore-Penrose inverse; Application of g-inverse; Quadratic forms, classification, definiteness, index and signature, extremum; transformation and reduction of quadratic form; applications of quadratic forms.	18	Up to K4	5

Books for Study:

1. Rudin, Walter (1976) : Principles of Mathematical Analysis, McGraw Hill.
2. Apostol, T.M. (1985) : Mathematical Analysis, Narosa, Indian Ed.
3. Graybill, F.A. (1983) : Matrices with application in Statistics, 2nd ed. Wadsworth.
4. Rao, C.R. & Bhimasankaran, P.(1992) : Linear algebra, Tata McGraw Hill Pub. Co. Ltd.
5. Searle, S.R. (1982) : Matrix Algebra useful for Statistics, John Wiley and Sons, Inc.

Books for References:

1. Royden, H.L.(1995) : Real analysis, 3ed., Prentice Hall of India.
2. Rangachari, M.S.(1996) : Real Analysis, Part 1, New Century Book House. Ash,
3. R.B. (1972): Real analysis and probability, Academic press.
4. Biswas, S. (1984): Topics in Algebra of Matrices, Academic Publications.
5. David, A.Harville(1997) : Matrix algebra from a statistician's perspective, Springer.
6. Hoffman, K. and Kunze, R. (1971) : Linear Algebra, 2nd ed. Prentice Hall, Inc.

Blended Mode:

Unit-IV

Eigen Values and Eigen Vectors:

<https://youtu.be/TQvxWaQnrqI?si=BdYh51MXPf9kyRH2>

Problems on Eigen Values and Diagonalization:

<https://youtu.be/V8oL2r5COlg?si=03EHvU2UoTE3v0O1>

Decomposition:

<https://youtu.be/wHAJzemKQW4?si=dL1lleR3PY-Vk13J>

Web Resources

1. Euclidean space and metric space:
<https://www.math.uci.edu/~gpatrick/source/205b06/chapviii.pdf>
2. Taylors theorem

<https://www.youtube.com/watch?v=LEspaisjDFE>

3. Riemann-Stieltjes integral

<https://www.youtube.com/watch?v=TpKIeWgcmC8>

4. Vector space

<https://www.youtube.com/watch?v=1XIT3Y2oyAU>

5. Linear transformation and matrix

https://amsi.org.au/ESA_Senior_Years/SeniorTopic8/8a/8a_2content_3.html

6. Linear algebra

<https://www.commonlounge.com/discussion/efdfcf2937b94fbeb7a3e1a309381d85>

Rationale for Nature of the Course

This course will enable the students to comprehend the theoretical and applied concepts of Real analysis and Linear Algebra which enables to apply for the statistical concepts.

Activities having direct bearing on Skill development / Employability/ Entrepreneurship

Problem solving sessions for various methodologies in Real Analysis

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Course Designer(s):

Dr. M.VENKATESWARAN

Course Schedule:

Unit	Topics	Hours	Mode
I	Metric Space – open, closed sets – Intervals (rectangles)	4	Chalk and Talk, PPT, problem solving and Assignments
	Real valued Continuous functions- Discontinuities	4	
	compact sets, Bolzano – Weirstrass theorem	4	
	Heine – Borel theorem.	4	
II	Derivatives - maxima and minima	5	Chalk and Talk, PPT, problem solving and Assignments
	Riemann integral & Riemann – Stieltjes integral with respect an increasing integrator properties of R.S. integral	5	
	Functions of several variables, constrained and unconstrained maxima – minima of functions	6	
	partial and total derivatives	4	
III	Basic properties of matrices (orthogonal, idempotent, Kronecker product, projection operators etc);	4	Chalk and Talk, PPT, problem solving and Assignments
	Reduction of matrices, Echelon form, Hermite canonical form, diagonal reduction	4	
	rank factorization, triangular reduction Jordan form; Symmetric matrices and its properties.	5	
	Linear dependence, independence and rank of a matrix	5	
IV	characteristic roots and polynomial, multiplicity of characteristic roots	5	Chalk and Talk, PPT, problem solving and Assignments
	Cayley Hamilton theorem; inverse of a matrix and determinants.	5	
	Decomposition like, singular value decomposition	4	
	spectral decomposition, Cholesky decomposition etc.	4	
V	Matrix differentiation; Generalized inverse and its properties	5	Chalk and Talk, PPT, problem solving and Assignments
	Moore-Penrose inverse; Application of g-inverse	4	
	Quadratic forms, classification, definiteness, index and signature, extremum;	5	
	transformation and reduction of quadratic form; applications of quadratic forms.	4	

COURSE OUTCOMES:

At the end of the course, the student will be able to:

	Course Outcome	K-level
CO1	Get a Mathematical foundation in Real analysis and Matrix Theory to understand univariate and multivariate concepts in Statistical Theory	K2
CO2	Get a clear understanding R.S. integral, partial differentiation in several variable functions, get theoretical knowledge by understanding the need and application of theorems like Bolzano – Weirstrass theorem, Heine– Borel theorem	K3
CO3	Understand concepts in matrix theory -rank and factorization, inverse of matrix, g-inverses and its applications, characteristic roots and its multiplicity, canonical forms and decomposition of matrix, orthogonality, quadratic forms and its index, solving linear system	K3
CO4	Able to get solve numerical problems and evaluate and interpret outcome	K4
CO5	analyze real life problems and explore research problems	K4

MAPPING WITH PROGRAMME OUTCOMES:

Mapping of Course Outcomes (**CLO**) against Programme Outcomes (**PO**) in the 3-point scale of STRONG(3), MEDIUM(2) and LOW(1).

CLO	POs						PSOs				
	1	2	3	4	5	6	1	2	3	4	5
CLO1	3	3	2	2	2	3	3	3	3	3	3
CLO2	3	3	3	3	2	3	3	3	3	3	3
CLO3	3	3	3	2	3	3	3	3	3	3	3
CLO4	2	3	3	3	3	3	3	3	3	3	3
CLO5	3	3	3	3	2	3	3	3	3	3	3

Assessment Schema**Components of CIA**

Component	Weight / Mark
Test	10
Assignment	5
Quiz	5
Seminar / Model display	5

Blueprint for Semester Examination

Units	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2 (K1&K1)	1 (K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K1	2 (K3&K3)	1 (K3)
3	CLO 3	Up to K3	2	K2 & K3	1	K2	2 (K2&K2)	1 (K3)
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2 (K4&K4)	1 (K4)
5	CLO 5	Up to K4	2	K3 & K4	1	K3	2 (K4&K4)	1 (K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

Distribution of Marks with K Level for Summative Examination

K - Level	Section A (MCQ)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Chioce)	Total Marks	% of (Marks without Choice)	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30.00	30%
K4	2	-	20	20	42	35.00	35%
K5	-	-		-			
Total	10	10	50	50	120	100	100

DEPARTMENT OF STATISTICS				CLASS: I M.Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	CORE-II	25P1SCCT2	Distribution Theory	5	6	25	75	100

Nature of Course						
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented		

Objectives:

- To provide theoretical knowledge on the concept of functions of random variables and its usage.
- To educate the knowledge on the both discrete and continuous distributions.
- To acquire the knowledge on deriving its characteristics of distributions.

Unit	Description	Hours	K-level	CLO
I	Brief review of distribution theory, functions of random variables and their distributions using Jacobian of transformation, Laplace and Cauchy distribution, lognormal distribution, gamma distribution, logarithmic series.	16	Up to K2	1
II	Bivariate Normal distribution – Moment generating function – marginal and conditional distributions. Moments – Distribution of correlation coefficient when population correlation coefficient is equal to zero.	18	Up to K3	2
III	Sampling distributions, non-central chi-square distribution, t and F distributions and their properties, distributions of quadratic forms under normality.	20	Up to K4	3
IV	Order statistics their distributions and properties, Joint and marginal distributions of order statistics, extreme value and their asymptotic distributions, approximating distributions of sample moment.	20	Up to K3	4
V	Kolmogorov Smirnov distributions, life distributions, exponential, Weibull and distributions classified by hazard rate.	16	Up to K4	5

Books for Study:

1. Gibbons (1971): Non-parametric inference, Tata McGraw Hill.
2. Rohatgi, V.K. and Md. Whsanesh Saleh, A.K.(2002): An introduction to probability & Statistics, John Wiley and Sons

Books for References:

1. Rao, C.R. (1973) : Linear statistical inference and its applications, 2ed, Wiley Eastern.
2. Mood, A.M. & Graybill, F.A. and Boes, D.C. : Introduction to the theory of statistics, McGraw Hill. Johnson, S. & Kotz, (1972): Distributions in Statistics, Vol. I, II & III, Houghton & Mifflin.
3. Dudewicz, E.J., Mishra, S.N. (1988) : Modern mathematical statistics, John Wiley. Searle, S.R. (1971) : Linear models, John Wiley

Blended Mode:

UNIT- 1.

Brief review of distribution theory,

<https://youtu.be/372zCgFvGDI?si=mo6eMahuCsXOfkfb>

functions of random variables and their distributions using Jacobian of transformation

<https://youtu.be/rehAYjJpRxQ?si=MOOpnzRB6ODjo1VY>

<https://youtu.be/PzR7wb6g0H8?si=J31rdqRZF753RV4C>

Cauchy Distribution

<https://youtu.be/Hhz307Ltx5o?si=w36bURNLYYAvtKkZ>

Laplace Distribution

https://youtu.be/KwQY1_cPzKI?si=xWfweHlyiBiP42-s

https://youtu.be/GUejaC_2jrg?si=AOrqr9ZawUtJvmeB

Log-normal distribution

<https://youtu.be/7DkWyfY-iK8?si=ps-V1k6FoxvImyT8>

Gamma distribution

https://youtu.be/WOJCC84zZHE?si=9IyKQcYJP7GD9O_g

Logarithmic series

<https://youtu.be/FE5gqGmkEhQ?si=Gb9ls36YXX6BhToc>

Web Resources

1. https://www.researchgate.net/publication/344320988_An_Introduction_to_Probability_and_Statistics
2. https://www.usb.ac.ir/FileStaff/7344_2018-12-2-10-44-10.pdf
3. <https://sistemas.fciencias.unam.mx/~misraim/Mood.pdf>

4. <https://www.stat.rice.edu/~dobelman/textfiles/DistributionsHandbook.pdf>
5. https://www.probabilitycourse.com/chapter5/5_3_2_bivariate_normal_dist.php
6. <https://www2.stat.duke.edu/courses/Spring12/sta104.1/Lectures/Lec22.pdf>
7. https://www.probabilitycourse.com/chapter5/5_3_3_solved_probs.php
8. <http://athenasc.com/Bivariate-Normal.pdf>
9. <https://pages.stat.wisc.edu/~shao/stat609/stat609-13.pdf>
10. http://amath2.nchu.edu.tw/honda/605Lecture/Lecture%2005_addendum_Chisquare,t%20and%20F%20distributions.PDF
11. <https://www.maths.dur.ac.uk/stats/courses/Proba34/1617Probability34H.pdf>
12. <https://www2.stat.duke.edu/courses/Spring12/sta104.1/Lectures/Lec15.pdf>
13. https://www.tutorialspoint.com/statistics/kolmogorov_smirnov_test.htm
14. <https://www.weibull.com/hotwire/issue128/relbasics128.htm>

Rationale for Nature of the course

Statistical Techniques provide scientific approaches to develop the domain of human knowledge largely through empirical studies.

Activities having direct bearing on Skill development / Employability/ Entrepreneurship

Seminar and Problem solving in various data fitting

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Course Designer(s):

Dr. M. RABERT

Course Schedule:

Unit	Topics	Hours	Mode
I	Brief review of distribution theory.	2	Chalk and Talk, PPT, problem solving and Assignments
	functions of random variables and their distributions using Jacobian of transformation	3	
	Laplace distribution	3	
	Cauchy distribution	3	
	lognormal distribution	2	
	Gamma distribution, logarithmic series	3	
II	Bivariate Normal distribution – Moment generating function	8	Chalk and Talk, PPT, problem solving and Assignments
	marginal and conditional distributions, moments	7	
	Distribution of correlation coefficient when population correlation coefficient is equal to zero	3	
III	Sampling distributions.	8	Chalk and Talk, PPT, problem solving, Assignments and Seminar
	non-central chi-square distribution, t and F distributions and their properties	8	
	distributions of quadratic forms under normality and related distribution theory	4	
IV	Order statistics their distributions and properties	6	Chalk and Talk, PPT, problem solving, Assignments and Seminar
	Joint and marginal distributions of order statistics	6	
	extreme value and their asymptotic distributions	4	
	approximating distributions of sample moment	4	
V	Kolmogorov Smirnov distributions	4	Chalk and Talk, PPT, problem solving, Assignments and Seminar
	life distributions, exponential, Weibull distributions	8	
	distributions classified by hazard rate	4	

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CLO's	Course Learning Outcomes	K-Level
CLO-1	To understand the knowledge on importance of the random variables and its role in the distribution theory.	Upto K2
CLO-2	To explain the moments for the data come from the univariate and bivariate distributions.	Upto K3
CLO-3	To interpret the properties of special univariate continuous distributions, truncated normal distribution and few non-central distributions.	Upto K4
CLO-4	To analyze data from multi-stage sampling method To interpret the distributions of order statistics with regard to Median, Sample Range and Joint distribution of order two.	Upto K3
CLO-5	To identify the data distribution based on One sample and two samples using KS tests.	Upto K4

MAPPING WITH PROGRAMME OUTCOMES:

Mapping of Course Outcomes (CLO) against Programme Outcomes (PO) in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1).

CLO	POs						PSOs				
	1	2	3	4	5	6	1	2	3	4	5
CLO1	3	3	3	2	3	2	3	3	3	3	3
CLO2	2	3	3	2	2	2	3	3	3	3	3
CLO3	3	3	3	3	3	2	3	3	3	3	3
CLO4	2	3	3	3	3	3	3	3	3	3	3
CLO5	3	2	3	3	3	2	3	3	3	3	3

Assessment Schema

Components of CIA

Component	Weight / Mark
Test	10
Assignment	5
Quiz	5
Seminar / Model Display	5

Blueprint for Semester Examination

S. No.	CLOs	K Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K Level	No. of questions	K level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K1	2(K2 & K2)	1(K3)
3	CLO 3	Up to K4	2	K3 & K4	1	K3	2(K4 & K4)	1(K4)
4	CLO 4	Up to K3	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)
5	CLO 5	Up to K4	2	K3 & K4	1	K2	2(K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

Distribution of section wise marks with K levels for Summative Examination

K Levels	Section A MCQs	Section B (Short Answers)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30	30%
K4	2	-	20	20	42	35	35%
K5	-	-	-	-	-	-	-
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF STATISTICS				CLASS: I M.Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	CORE-III	25P1SCCT3	Measure and Probability Theory	5	6	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented		Entrepreneurship Oriented	

Objectives:

- This paper provides mathematical background for the knowledge of Probability Theory extended from measure theoretical approach.
- The students will be able to understand the basic concepts of the distribution function and random variables that help in understanding for estimation and testing problems in Statistical Inference.
- The fundamentals of this course will pave the way for further research.

Unit	Description	Hours	K-level	CLO
I	Basic Probability – Events, sample space, different approaches to probability, -Measure Theory - Limits of sequence of sets, classes of sets – Field, Sigma Field and Monotone class, Measure and its types, Measure Space – Borel field – Measurable function	17	Up to K2	1
II	Lebesgue – Stieltjes measure, Measure integral and its properties, Dominated convergence theorem – Radon–Nikodym theorem, convergence of random variables, convergence in probability, almost surely, in the r-th mean and in distribution, their relationships, convergence of moments and measure.	18	Up to K3	2
III	Random variables and random vector, Distribution functions of random variables and random vector, Expectation and moments, basic, Markov, Chebyshev's, Holder's, Minkowski's and Jensen's inequalities.	20	Up to K3	3
IV	Independence of sequence of events and random variables, conditional probability, conditional expectation, Characteristic functions and their properties, inversion formula, Helly-Bray theorem, continuity theorem and convolution of distributions.	18	Up to K4	4

V	Central limit theorem, statement of CLT, Lindeberg, Levy and Liapounov forms with proof and Lindeberg Feller's form examples. Khintchine weak law of large numbers, Kolmogorov inequality, strong law of large numbers	17	Up to K4	5

Books for Study:

1. Bhat, B.R. (1985): Modern probability theory, 2nd ed. Wiley Eastern.
2. Chow, Y.S. and Teicher, H. (1979): Probability theory, Springer Verlag. Chung, K.L. et al: A course in probability theory, Academic press.

Books for References:

1. Parthasarathy, K.R. (1977): Introduction to probability and measure, MacMillan Co.,
2. Breiman, L. (1968): Probability, Addison Wesley.
3. Munroe, M.E. (1971): Measure and integration, 2nd ed. Addison Wesley.
4. Halmos, P.R. (1974): Measure theory, East-West.
5. De Barr, G. (1987): Measure theory and integration, Wiley Eastern.

Blended Mode:

Unit-I

1. Basic Probability:
https://youtu.be/qNGDD_Rh8ps?si=ygY34PqrfH3MPKe7
2. Measure theory:
<https://youtu.be/KIthHTWbfy4?si=MqKXtaQPgcbWuJcf>

Web Resources

1. Measure & Probability: <https://nptel.ac.in/courses/111/101/111101100/#>
2. Law of Large Numbers: <https://www.youtube.com/watch?v=VpuN8vCQ--M>
3. Central Limit Theorem: <https://www.youtube.com/watch?v=JNm3M9cqWyc>
4. <https://www.youtube.com/watch?v=YAIJCEDH2uY>
5. Inequalities in Probability: <https://www.youtube.com/watch?v=nrDkb2MAwSA>
6. <https://www.youtube.com/watch?v=DWsDqKIW7Z4>

Rationale for Nature of the course

Students will gain the skills related to identifying the concept, problems and solve them

Activities having direct bearing on Skill development / Employability/ Entrepreneurship

Problem solving sessions with real time scenario

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Course Designer(s):

Dr. M. VENKATESWARAN

Course Schedule:

Unit	Topics	Hours	Mode
I	Basic Probability - Events, sample space, different approaches to probability	3	Chalk and Talk, PPT, Problem-solving and Assignments
	Measure Theory - Limits of sequence of sets - classes of sets	3	
	Field, Sigma Field and Monotone class	3	
	Measure and its types	3	
	Measure Space – Borel Field, Measurable function	3	
II	Lebesgue – Stieltjes measure	4	Chalk and Talk, PPT, Problem-solving and Assignments
	Measure integral and its properties	3	
	Dominated convergence theorem	3	
	Radon–Nikodym theorem	2	
	Convergence of random variables- convergence in probability, almost surely, in the r-th mean and in distribution, their relationships	4	
	convergence in measure	2	
III	Random variables and random vector	3	Chalk and Talk, PPT, Problem-solving, Assignments and Seminar
	Distribution functions of random variables and random vector	4	
	Problems	4	
	Expectation and moments	3	
	basic, Markov, Chebyshev's	4	
	Holder's, Minkowski's and Jensen's inequalities	4	
IV	Independence of sequence of events and random variables	2	Chalk and Talk, PPT, problem-solving, Assignments and Seminar
	conditional probability, conditional expectation,	4	
	Characteristic functions and their properties	3	
	inversion formula, convergence of random variables	3	
	Problems on conditional probability	2	
	Problems on conditional expectation and variance	2	
	Helly-Bray theorem	2	
	continuity theorem and convolution of distributions	2	
V	Central limit theorem, statement of CLT	1	Chalk and Talk, PPT, Problem-solving, Assignments and Seminar
	Lindeberg, Levy and Liapounov forms with proof	5	
	Lindeberg Feller's form examples	2	
	Khintchine weak law of large numbers	2	
	Kolmogorov inequality	2	
	strong law of large numbers	3	

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CLO's	Course Learning outcomes	K-level
CO1	Resolve problems that occur in the sequences of sets and classes of sets.	Upto K2
CO2	Provide critical thinking in Integrals and their application to Probability Theory.	Upto K3
CO3	Evaluate, integrate, and apply appropriate tools in Probability and Conditional Probability.	Upto K3
CO4	Demonstrate the ability to apply basic methods in analyzing the convergence in Probability and rth mean and in Distribution and Characteristics functions.	Upto K4
CO5	Demonstrate critical thinking skills, such as problem solving using weak and strong law of large numbers and different forms of Central Limit Theorems.	Upto K4

MAPPING WITH PROGRAMME OUTCOMES:

Mapping of Course Outcomes (CLO) against Programme Outcomes (PO) in the 3-point scale of STRONG (3), MEDIUM(2) and LOW(1).

CLO	POs						PSOs				
	1	2	3	4	5	6	1	2	3	4	5
CLO1	3	3	3	3	3	3	3	3	3	3	3
CLO2	3	2	3	3	3	3	3	3	2	3	2
CLO3	3	3	2	3	2	3	3	3	3	3	3
CLO4	3	3	3	2	2	2	3	3	3	2	3
CLO5	3	3	3	2	2	3	3	3	3	3	3

Assessment Schema

Components of CIA

Component	Weight / Mark
Test	10
Assignment	5
Quiz	5
Seminar / Model display	5

Blueprint for Semester Examination

SL. No	CLOs	K-level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)	Total
			MCQs		Short Answers				
			No. of Questions	K-Level	No. of Questions	K-Level			
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2(K1& K1)	1(K2)	
2	CLO 2	Up to K3	2	K2& K3	1	K1	2(K2 & K2)	1(K3)	
3	CLO 3	Up to K3	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)	
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2(K4& K4)	1(K4)	
5	CLO 5	Up to K4	2	K3& K4	1	K3	2(K4& K4)	1(K4)	
No. of Questions to be asked			10		5		10	5	30
No. of Questions to be answered			10		5		5	3	23
Marks for each question			1		2		5	10	
Total Marks for each Section			10		10		25	30	75

Distribution of Marks with K Level for Summative Examination

K - Level	Section A (MCQ)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Chioce)	Total Marks	% of (Marks without Choice)	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30.00	30%
K4	2	-	20	20	42	35.00	35%
K5	-	-		-			
Total	10	10	50	50	120	100	100

DEPARTMENT OF STATISTICS				CLASS: I M.Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	DISCIPLINE ELECTIVE -I	25P1SECT1 (A)	Official Statistics	3	5	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	

Objectives:

- Gain knowledge about different survey organizations, their roles, and their significance in data collection and analysis.
- Explore various data collection techniques used in surveys, including their applications and challenges.
- Study the methods of collecting, processing, and interpreting agricultural data for policy-making and economic analysis.
- Develop the ability to calculate and analyze index numbers used in economic and statistical assessments.
- Understand different approaches to measuring national income and their implications for economic growth and policy decisions.

Unit	Description	Hours	K-level	CLO
I	Statistical System in India: Central and State Government Organizations, Functions of Central Statistical Organization (CSO), National Sample Survey Organization (NSSO). Organization of large scale sample surveys. General and special data dissemination systems.	12	Up to K2	1
II	Official statistics: Meaning, methods of collection, limitations and reliability. Principal publications containing data on the topics such as population, agriculture, industry, trade, prices, labour and employment, transport and communications - Banking and finance.	15	Up to K3	2
III	System of Collection of Agricultural Statistics - Crop forecasting and estimation - Productivity, fragmentation of	18	Up to K3	3

	holdings - Support prices - Buffer stocks - Impact of irrigation projects. Statistics related to industries, foreign trade - Balance of payment - Inflation - Social statistics.			
IV	Index Numbers: Price, Quantity and Value indices. Price Index Numbers: Construction, Uses, Limitations, Tests for index numbers, Chain Index Number. Consumer Price Index, Wholesale Price Index and Index of Industrial Production – Construction of index numbers and uses.	15	Up to K4	4
V	National Income – Measures of national income - Income, expenditure and production approaches - Applications in various sectors in India. Measurement of income inequality: Gini's coefficient, Lorenz curves, Application of Pareto and Lognormal as income distribution.	15	Up to K4	5

Books for study

1. Allen R. G. D. (1975). Index Numbers in Theory and Practice, Macmillan.
2. Bhaduri, A. (1990). Macroeconomics: The Dynamics of Commodity Production, Macmillan India Limited, New Delhi.
3. Branson, W. H. (1992). Macroeconomic Theory and Policy, Third Edition, Harper Collins Publishers India (P) Ltd., New Delhi.
4. C. S. O. (1990). Basic Statistics Relating to the Indian Economy.
5. C.S.O. (1995). Statistical System in India.
6. C. S. O. (1999). Guide to Official Statistics.

Books for Reference

1. Goon A. M., Gupta M. K., and Dasgupta. B. (2001), Fundamentals of Statistics, Vol. 2, World Press, India.
2. Mukhopadhyay, P. (2011). Applied Statistics, Second Edition, Books & Allied Ltd, India.
3. Panse, V. G. (1964). Estimation of Crop Yields (FAO), Food and Agriculture Organization of the United Nations.

Web Resources:

<https://www.youtube.com/watch?v=YJ0XTaEutU8>

<https://www.youtube.com/watch?v=7CiNPxoWOf0>

<https://www.youtube.com/watch?v=NY-2LNN1pS8>

<https://www.youtube.com/watch?v=9ZKdkgokxd8>

<https://www.youtube.com/watch?v=jIjLuuocKbs>

Blended mode:**Unit-V**

National Income:

https://www.youtube.com/watch?v=y9loAm_DIso

Measures of national income

<https://www.youtube.com/watch?v=13NjmCSykyo>

Income, expenditure and production approaches

<https://www.youtube.com/watch?v=tIPsU8ACCeY>

<https://www.youtube.com/watch?v=mx4MkXLe7Uk>

<https://www.youtube.com/watch?v=F-lj1f6SVRk>

Measurement of income inequality: Gini's coefficient

<https://www.youtube.com/watch?v=Fm73CPyxByE>

Measurement of income inequality: Lorenz curves

https://www.youtube.com/watch?v=iG3j4QJ_sy4

Application of Pareto as income distribution.

<https://www.youtube.com/watch?v=BJiNlMf-bHc>

Application of Lognormal as income distribution.

<https://www.youtube.com/watch?v=elRygaL9vr0>

Rationale for Nature of the course

This course provides the knowledge / skills implementing in Indian Statistical System. The skills transform to the employability under MoSPI

Activities having direct bearing on Skill development / Employability Entrepreneurship

Seminars / Assignments on Statistical surveys conducted by the NSO (MoSPI) in the society

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Course Designer(s):

Dr. R. Madhanagopal

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Statistical System in India: Central and State Government Organizations	3	Chalk and Talk, Test, Quiz and Seminar
	Functions of Central Statistical Organization (CSO),	3	
	National Sample Survey Organization (NSSO).	3	
	Organization of large scale sample surveys. General and special data dissemination systems.	3	
Unit II	Official statistics: Meaning, methods of collection, limitations and reliability.	4	Chalk and Talk, Test, Quiz and Seminar
	Principal publications containing data on the topics such as population, agriculture,	4	
	industry, trade, prices, labour and employment, transport and communications -	4	
	Banking and finance.	3	
Unit III	System of Collection of Agricultural Statistics - Crop forecasting and estimation	3	Chalk and Talk, Test, Quiz and Seminar
	Productivity, fragmentation of holdings -	3	
	Support prices - Buffer stocks	3	
	Impact of irrigation projects.	3	
	Statistics related to industries, foreign trade	3	
	Balance of payment - Inflation - Social statistics.	3	
Unit IV	Index Numbers: Price, Quantity and Value indices.	3	Chalk and Talk, Test, Quiz and Seminar
	Price Index Numbers: Construction, Uses, Limitations,	3	
	Tests for index numbers, Chain Index Number.	3	
	Consumer Price Index, Wholesale Price Index and Index of Industrial Production –	3	
	Construction of index numbers and uses.	3	
Unit V	National Income – Measures of national income -	3	Chalk and Talk, Assignment, Quiz and Seminar
	Income, expenditure and production approaches -.	3	
	Applications in various sectors in India.	3	
	Measurement of income inequality: Gini's coefficient, Lorenz curves,	3	
	Application of Pareto and Lognormal as income distribution	3	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Gain knowledge about different survey organizations, their roles, and their significance in data collection and analysis.	Up to K3
CLO2	Explore various data collection techniques used in surveys, including their applications and challenges.	Up to K3
CLO3	Study the methods of collecting, processing, and interpreting agricultural data for policy-making and economic analysis.	Up to K4
CLO4	Develop the ability to calculate and analyze index numbers used in economic and statistical assessments	Up to K4
CLO5	Understand different approaches to measuring national income and their implications for economic growth and policy decisions.	Up to K4

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO1	3	3	3	3	3	3	3
CLO2	3	3	3	3	3	3	3
CLO3	3	3	3	3	3	3	3
CLO4	3	3	3	3	3	3	3
CLO5	3	3	3	3	3	3	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5
CLO1	3	3	3	2	3
CLO2	3	3	3	3	3
CLO3	3	3	3	3	2
CLO4	3	3	3	3	3
CLO5	3	2	3	3	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K-Level	No. of Questions	K- Level		
1	CLO1	Up to K 2	2	K1 & K1	1	K1	2(K1& K1)	1(K2)
2	CLO2	Up to K 3	2	K2& K3	1	K1	2(K2 & K2)	1(K3)
3	CLO3	Up to K 3	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)
4	CLO4	Up to K 4	2	K3 & K4	1	K2	2(K4& K4)	1(K4)
5	CLO5	Up to K 4	2	K3& K4	1	K3	2(K4& K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30.00	30%
K4	2	-	20	20	42	35.00	35%
Total Marks	10	10	50	50	120	100	-

DEPARTMENT OF STATISTICS				CLASS: I M.Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	DISCIPLINE ELECTIVE-I	25P1SECT1 (B)	Population Studies	3	5	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	

Objectives:

- To understand the concept of population growth and its consequences.
- To know from where one can collect the data related to population.
- To know the structure and characteristics of population.
- To explain, reasoning and compare the population growths.

Unit	Description	Hours	K-level	CLO
I	Population studies: Nature and Scope – population studies and demography – Development of population studies – Development since second world war – II. Development of population studies in India: Pre – independence and post independent period – Interrelation between population studies and other disciplines.	15	Up to K2	1
II	Data Sources – Introduction – census method – sampling method of population data – Registration method: vital Registration System – population registration – government record – sample registration system in India. Other System of data sources: national sample surveys – double report system – international resources - adhoc surveys - standard fertility survey–national family health survey. Population statistics.	15	Up to K3	2
III	Population theories: History and Development of Population Theories - Mercantilist and Related Theories - Theories of Malthus and his Immediate Predecessors - Malthusianism and Neo-Malthusianism - Socialist and Marxist Writings - Growth	18	Up to K4	3

	Theory. Theory of Demographic Transition - India's Population: Size and Growth Trends - Trends in World Population.			
IV	Concepts of Fertility and Fecundity- Thoughts of Various Authors about Fertility - Determinants of Fertility - Need for Fertility Rate - Theory of Marriage and Family - Social Structure and Fertility - Regional Variations in Fertility Levels in India. Concepts of Mortality - Life Expectancy - Components of Mortality - Infant and Child Mortality - Causes of Death: Life and Working Years Lost - Morbidity and Mortality.	15	Up to K4	4
V	Concepts of Migration: Types of Migration, Forced Migration, Political, Economic and Social Consequences - In-Migration, Out-Migration, Immigrants, Emigrants. Theories of Migration–Ravenstein's Laws of Migration. Indian Population Policy - Kinds of Population Policy, Fertility Influencing Policy, Population Education.	12	Up to K3	5

Books for Study:

1. Asha A. Bhende and Tara Kanitkar (1994) Principles of population studies, Himalayan publication house, India.
2. Gupta S.C and Kapoor V.K (2009) Fundamentals of Applied Statistics, Sultan Chand and sons.

Books for References:

1. Rakhi Mittal (2018) Population Studies, Vikas publication house pvt ltd, New Delhi.
2. Asha A. Bhende and Tara Kanitkar (1994) Principles of population studies, Himalayan publication house, India.

Blended Mode:

Unit – 5:

Concept of migration:

<https://www.youtube.com/watch?v=IxwVOxSq18g>

Migrates, Immigrate and Emigrate:

https://www.youtube.com/watch?v=uCpxj_kLfDY

Ravenstein's Laws of Migration

<https://www.youtube.com/watch?v=9rRZXZbA1Eg>

Population policy of India

<https://www.youtube.com/watch?v=j3auolySzyo>

Fertility Influencing Policy

<https://www.youtube.com/watch?v=NgKKwJ5HbTY>

Education policy in India

<https://www.youtube.com/watch?v=gj1WaS7roEs>

Web Resources

1. Population studies

https://www.youtube.com/watch?v=pgmRT8VBwRA&list=PLFW6lRTa1g80WOAEi_LA2IKZu-eUlzEQq

https://www.youtube.com/watch?v=0PbQ5f0dexQ&list=PLFW6lRTa1g80WOAEi_LA2IKZu-eUlzEQq&index=2

2. Source of data

<https://www.youtube.com/watch?v=ZJphOd5V3oU>

3. Population size, Distribution and growth

<https://www.youtube.com/watch?v=8d8h1m3Zn4I>

4. Demographic transition Theory

<https://www.youtube.com/watch?v=Pui3XjlC2II>

Rationale for Nature of the course

Students will gain skill on basic of population structure and data collection, computations of mortality and fertility.

Activities having direct bearing on Skill development / Employability/ Entrepreneurship

Assignment on the Population data

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Course Designer(s):

Dr. R. MADHANAGOPAL

Course Schedule:

Unit	Topics	Hours	Mode
I	Population studies: Nature and Scope	2	Chalk and Talk, PPT, Problem-solving and Assignments
	population studies and demography	2	
	Development of population studies	2	
	Development since Second World War – II	3	
	Development of population studies in India: Pre-independence and post-independent period	3	
	Interrelation between population studies and other disciplines.	3	
II	Source of population data: Population census – Vital statistics or registration of vital events	3	Chalk and Talk, PPT, Problem-solving and Assignments
	Civil Registration in India	2	
	Sample surveys - Dual report system - population register - international publications	3	
	Population theories: Theory of Malthus	2	
	Marxist and socialist view	3	
	Growth Theories	2	
III	Population structure and characteristics	4	Chalk and Talk, PPT, Problem-solving, Assignments and Seminar
	Sex and Age structure	4	
	Marital status	4	
	Literacy and education attainment	3	
IV	Mortality: Rates and ratios of vital events	1	Chalk and Talk, PPT, problem-solving, Assignments and Seminar
	Crude death rate – Specified death rate Age-specific death rate – Infant mortality rate - Standardized death rate	5	
	Fertility: Crude birth rate – General fertility rate - Specific fertility rate – Age-specific fertility rate - Total fertility rate	5	
	Measure of population growth: Crude rate of natural increase	1	
	Pearle's vital index	1	
	Gross and Net reproduction rate.	2	
V	Migration: Concept	1	Chalk and Talk, PPT, Problem-solving, Assignments and Seminar
	Immigration and emigration - in and out migration - Internal migrations	4	
	methods of measuring internal migration	3	
	Internal migration in India	2	
	International migration	2	
	Population polices: Indian population policy	3	

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CLO's	Course Learning Outcomes	K-level
CLO1	Know how the population studies have developed and its outlines.	Upto K2
CLO2	Collect the data related to population from various sources.	Upto K3
CLO3	Understand and explain the characteristics and structure of the population	Upto K4
CLO4	Know to calculate and compare the mortality and fertility rates.	Upto K4
CLO5	Know how mitigation influences population and its policies.	Upto K3

MAPPING WITH PROGRAMME OUTCOMES:

Mapping of Course Outcomes (CLO) against Programme Outcomes (PO) in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1).

CLO	POs						PSOs				
	1	2	3	4	5	6	1	2	3	4	5
CLO1	3	2	2	2	2	3	3	3	3	2	3
CLO2	3	2	2	2	2	3	3	2	3	3	3
CLO3	3	3	3	3	3	3	3	3	3	2	3
CLO4	3	3	3	3	3	3	2	3	3	3	3
CLO5	3	3	3	3	3	3	3	3	3	3	2

Assessment Schema

Components of CIA

Component	Weight / Mark
Assignment	5
Quiz	5
Seminar / Model display	5

Blueprint for Semester Examination

SL. No	CLOs	K-level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)	Total
			MCQs		Short Answers				
			No. of Questions	K-Level	No. of Questions	K-Level			
1	CLO 1	Up to K 2	2	K1 & K1	1	K1	2(K1& K1)	1(K2)	
2	CLO 2	Up to K 3	2	K2& K3	1	K1	2(K2 & K2)	1(K3)	
3	CLO 3	Up to K 3	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)	
4	CLO 4	Up to K 4	2	K3 & K4	1	K2	2(K4& K4)	1(K4)	
5	CLO 5	Up to K 4	2	K3& K4	1	K3	2(K4& K4)	1(K4)	
No. of Questions to be asked			10		5		10	5	30
No. of Questions to be answered			10		5		5	3	23
Marks for each question			1		2		5	10	
Total Marks for each Section			10		10		25	30	75

Distribution of Marks with K Level for Summative Examination

K - Level	Section A (MCQ)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Chioce)	Total Marks	% of (Marks without Choice)	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30.00	30%
K4	2	-	20	20	42	35.00	35%
K5	-	-		-			
Total	10	10	50	50	120	100	100

DEPARTMENT OF STATISTICS				CLASS: I M.Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	DISCIPLINE ELECTIVE-II	25P1SECT2 (A)	Actuarial Statistics	3	5	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	✓

Objectives:

- Provides fundamental in mathematical and statistical methods.
- The knowledge of actuarial methods to summarize data

Unit	Description	Hours	K-level	CLO
I	Life tables, and its relation with survival function - life table assumptions and uses, analytical laws of mortality - Gompertz and Makeham's laws of mortality –ultimate and aggregate mortality tables.	15	Up to K2	1
II	Abridged life tables – construction of abridged life tables – methods by Read and Merrell, Greville's, Kings method. Utility Theory.	15	Up to K4	2
III	Models for individual claims and their sums – multiple life function – joint life status and last survival status.	15	Up to K3	3
IV	Policy Values: Nature of reserve - prospective and retrospective reserves - modified reserves - Surrender values and paid up policies - Industrial assurance - Children's deferred assurances	15	Up to K4	4
V	Pension Funds: Capital sums on retirement and death-widow's pensions - Sickness benefits - Benefits dependent on marriage	15	Up to K3	5

Books for Study:

1. S.C.Gupta and V.K.Kapoor(2007) Fundamentals of Applied Statistics, Sultan Chand & Sons, New Delhi
2. Mathematical Basis of Life Assurance (IC-81) (2000), Published by insurance institute of India, Bombay.
3. O.P Gupta, S.S.Chaudhary and M.A.Ansari- Applied Statistics, Kedar Nath Ram Nath, Meerut.
4. Parimal Mukhopadhyay(2011) –Applied Statistics, Books and Allied (P) Ltd, Kolkata.

Books for References:

1. Barcley G.W. (1970) Techniques of Population Analysis, Wiley, New York.
2. Borowiak, D.S. and Shapiro, A.F. (2013) Financial and Actuarial Statistics: An Introduction, CRC Press, London.
3. Donald, D.W.A. (1970) Compound Interest and Annuities-certain, For The Institute of Actuaries and the Faculty of Actuaries at the University Press.
4. Spurgeon, E.T. (2011) Life Contingencies, Cambridge University P press, Cambridge.
5. Hooker,P.F. Longley, L.H Cook (1957) Life and other contingencies, Cambridge.
6. Alistair Neill(1977) Life contingencies, Heinemann Professional Publishing, Portsmouth.
7. Hossack,I.B. Pollard, J.H. and Zehnwrith, B.(1999) Introductory statistics with applications in general insurance, Cambridge University Press, Cambridge.

Blended Mode:**Unit .3**

1. <https://www.youtube.com/watch?v=xcsbp9zewTY>
2. <https://www.youtube.com/watch?v=kcnc10and0k>

Web Resources

1. Measure of Mortality: Life tables
https://www.lkouniv.ac.in/site/writereaddata/siteContent/202004032240235577Anupama_Singh_Mortality_and_its_measures.pdf
2. Gompertz and Makeham's laws of mortality
https://en.wikipedia.org/wiki/Gompertz%E2%80%93Makeham_law_of_mortality
<https://web.stanford.edu/~jhj1/teachingdocs/Jones-mortmodel2005.pdf>
3. Abridged life tables – construction of abridged life tables
https://www.cdc.gov/nchs/data/series/sr_02/sr02_004.pdf
https://www.statsdirect.com/help/survival_analysis/abridged_life_table.htm
4. Policy Values
<https://www.math.umd.edu/~slud/s470/BookChaps/01Book.pdf>
5. https://www.actuariayfinanzas.net/images/sampledData/FundamentalsofActuarialMathematics_S.DavidPromislow2015.pdf

Rationale for Nature of the course

This course enables to prepare mortality tables and actuarial methods for summarizing the financial data towards insurance.

Activities having direct bearing on Skill development / Employability/ Entrepreneurship

Problem solving on Life tables & premium of insurance

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Course Designer(s):

Dr. P. VETRI SELVI

Course Schedule:

Unit	Topics	Hrs	Mode
I	Life tables, and its relation with survival function - life table assumptions and uses.	6	PPT, Chalk and Talk and Assignments
	analytical laws of mortality - Gompertz and Makeham's laws of mortality	4	
	ultimate and aggregate mortality tables	3	
II	Abridged life tables – construction of abridged life tables	3	PPT, Chalk and Talk and Assignments
	Methods by Read and Merrell, Greville's, Kings method.	6	
	Utility Theory.	4	
III	Models for individual claims and their sums .	4	PPT, Chalk and Talk and Seminar
	multiple life function.	4	
	Joint life status and last survival status.	4	
IV	Policy Values: Nature of reserve - prospective and retrospective reserves.	4	PPT, Chalk and Talk and Assignments
	modified reserves - Surrender values and paid up policies.	3	
	Industrial assurance - Children's deferred assurances.	4	
V	Pension Funds: Capital sums on retirement and death.	5	PPT, Chalk and Talk and Assignments
	widow's pensions - Sickness benefits.	3	
	Benefits dependent on marriage	3	

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CLO's	Course Outcomes	K-level
CO1	Acquire the knowledge of different mortality life tables	Up to k2
CO2	Know how to construct life tables and understand different types of insurances.	Up to k4
CO3	Knowledge about models for individual claims and their sums	Up to k3
CO4	Calculate quantities such as premiums, surrender values paid up policies, industrial assurance ,childrens deferred assurances using actuarial techniques.	Up to k4
CO5	Describe, explain and apply the fundamental theories of actuarial science as they apply in pension funds.	Up to k3

MAPPING WITH PROGRAMME OUTCOMES:

Mapping of Course Outcomes (CLO) against Programme Outcomes (PO) in the 3-point scale of STRONG (3), MEDIUM(2) and LOW(1).

CLO	POs						PSOs				
	1	2	3	4	5	6	1	2	3	4	5
CLO1	3	3	3	3	3	3	3	3	3	3	3
CLO2	3	3	3	3	3	3	3	3	3	3	3
CLO3	3	3	3	3	2	3	3	3	2	3	3
CLO4	3	3	3	2	3	3	3	3	3	2	3
CLO5	3	3	2	3	3	2	3	3	2	3	3

Assessment Schema

Components of CIA

Component	Weight / Mark
Test	10
Assignment	5
Quiz	5
Seminar / Model display	5

Blueprint for Semester Examination

Unit	CLOs	K Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K Level	No. of questions	K level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)
2	CLO 2	Up to K4	2	K3 & K4	1	K2	2(K4 & K4)	1(K4)
3	CLO 3	Up to K3	2	K2 & K3	1	K1	2(K2 & K2)	1(K3)
4	CLO 4	Up to K4	2	K3 & K4	1	K3	2(K4 & K4)	1(K4)
5	CLO 5	Up to K3	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

Distribution of section wise marks with K levels for Summative Examination

K Levels	Section A MCQs	Section B (Short Answers)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30	30%
K4	2	-	20	20	42	35	35%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF STATISTICS				CLASS: I M.Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	DISCIPLINE ELECTIVE – II	25P1SECT2 (B)	Clinical Trails	3	5	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	

Objectives:

- To make the students to understand the basic concepts of the clinical trials.
- To study the experimental design in clinical trial.
- To educate meta analysis and its methods.

Unit	Description	Hours	K-level	CLO
I	Clinical trials –Introduction- Research-defining clinical trials - Practicalities of Usage- Non experimental designs.	15	Up to K2	1
II	Random Error and Bias- the effects of Random and systematic Error are distinct- Hypothesis tests versus Significance Tests- Two types of random error- The properties of confidence intervals.	15	Up to K4	2
III	Clinical Bias- random error and bias, Bias from numerous sources, controlling structural bias, statistical bias.	15	Up to K3	3
IV	Experiment design in clinical trials-Trials as simple experiment designs-goals of experiment design, design concept.	15	Up to K4	4
V	Meta- Analyses- Introduction, cumulative Meta-Analysis, Limitations of Meta-Analysis, Sketch of Meta-Analysis methods.	15	Up to K3	5

Books for study:

1. Steven Piantadosi.(2017) Clinical Trials, A Methodological Prespective, Third edition by John Wiley & Sons, Inc.

Books for References:

1. Lawrence M.Friedman, Curt D. Furberg, and David L.DeMets (2015) Fundamentals of Clinical Trials, Fifth Edition by Springer.
2. David Machin, Simon Day and Sylvan Green(2004) Textbook of Clinical Trials, second edition by John Wiley & Sons., Ltd.
3. Weichung Joe Shih, Joseph Aisner (2015) Statistical Designand Analysis of Clinical Trials: Principles and methods, by Taylor and Francis Group
4. Stephen B Hulley MD, Steven R Cummings , Warren S Browner, Deborah G Grady , Thomas B Newman(2013), Designing Clinical Research, fourth edition by Lippincott Williams & Wilkins, Wolters Kluwer.
5. David L. De Mets (Editor), Thomas D. Cook (2007), Introduction to Statistical Methods for Clinical Trials, first edition by Taylor and Francis Group.

Blended Mode:**UNIT V**

1. <https://www.youtube.com/watch?v=vscz3amdZUY>
2. https://www.youtube.com/watch?v=EFI_drD6TZ4

Web Resources

1. Clinical Trials and Study Designing:
<https://youtu.be/q0cfYz2rg-4>
2. Experimental studies, Designing the clinical trials, various phases
<https://youtu.be/j06IC68RpPU>
3. Meta Analysis
<https://youtu.be/Omnq13QZ-3c>

Rationale for Nature of the course

The course provides knowledge of Clinical trials and its application. It is used in researches to determine new form of treatment and behavioural intervention.

Activities having direct bearing on Skill development / Employability/ Entrepreneurship

Analyzing the Datasets relevant towards medical

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Course Designer(s):

Dr. A. SABERUNNISA

Course Schedule:

Unit	Topics	Hours	Mode
I	Clinical trials –Introduction	4	Chalk and Talk, PPT
	Research -defining clinical trials	4	
	Practicalities of Usage	3	
	Non experimental designs	4	
II	Random Error and Bias	4	Chalk and Talk, PPT, problem
	the effects of Random and systematic Error are distinct	4	
	Hypothesis tests versus Significance Tests	4	
	Two types of random error- The properties of confidence intervals	3	
III	Clinical Bias	4	Chalk and Talk, PPT, problem solving and
	random error and bias	3	
	Bias from numerous sources	2	
	Controlling structural bias	2	
	Statistical bias	4	
IV	Experiment design in clinical trials	4	ChalkandTalk, PPT, problem solving
	Trials as simple experiment designs	3	
	goals of experiment design	2	
	design concept	6	
V	Meta- Analyses- Introduction	5	ChalkandTalk, PPT
	cumulative Meta-Analysis	4	
	Limitations of Meta-Analysis	2	
	Sketch of Meta-Analysis methods	4	

Course Learning Outcome (For Mapping with Pos and PSOs)

At the end of the Course, Students will be able to

CLO's	Course Learning Outcomes	Knowledge Level
CO1	Acquire the knowledge of clinical trials.	Upto K2
CO2	To identify the concepts of random error and bias.	Upto K4
CO3	Knowledge about clinical bias from numerous sources	Upto K3
CO4	Know how to design the experiments in clinical trials	Upto K4
CO5	Apply the concept of Meta analysis to strengthen the evidence on disease.	Upto K3

MAPPING CLOs WITH PSOs MAPPING WITH PROGRAMME OUTCOMES:

Mapping of Course Outcomes (**CLO**) against Programme Outcomes (**PO**) in the 3-point scale of STRONG(3), MEDIUM(2) and LOW(1).

CLO	Pos						PSOs				
	1	2	3	4	5	6	1	2	3	4	5
CLO1	3	2	2	1	1	1	3	3	3	3	3
CLO2	2	2	2	3	2	1	3	3	3	3	3
CLO3	3	2	2	2	1	1	3	3	3	3	3
CLO4	2	1	1	3	1	2	3	3	3	3	3
CLO5	1	1	1	3	2	2	3	3	3	3	3

Assessment Schema**Components of CIA**

Component	Weight / Mark
Test	10
Assignment	5
Quiz	5
Seminar / Model display	5

Summative Examination– Blue Print

Unit	CLOs	KLevel	Section A		Section B		Section C (Either/ or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No.of questions	K Level	No.of questions	K level		
1	CLO1	Up toK2	2	K1&K1	1	K1	2(K1&K1)	1(K2)
2	CLO2	Up toK4	2	K3&K4	1	K2	2(K4&K4)	1(K4)
3	CLO3	Up toK3	2	K2&K3	1	K1	2(K2&K2)	1(K3)
4	CLO4	Up toK4	2	K3&K4	1	K3	2(K4&K4)	1(K4)
5	CLO5	Up toK3	2	K2&K3	1	K2	2(K3&K3)	1(K3)
No.of Questions to be asked			10		5		10	5
No.of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

Distribution of section wise marks with K levels for Summative Examination

K Levels	Section AMCQs	Section B(Short Answers)	Section C(Either/or)	Section D(Open choice)	Total marks	%of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30	30%
K4	2	-	20	20	42	35	35%
Total Marks	10	10	50	50	120	100	100%

DEPARTMENT OF STATISTICS				CLASS: I M.Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	NME-I	25P1SSEN1	Statistical Survey	2	2	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented		Entrepreneurship Oriented	

Objectives:

- To give a practical knowledge as to how to organize a statistical survey.
- The students will be able to understand the basic concepts of data collection.

Unit	Description	Hours	K-level	CLO
I	Organizing a statistical survey- Planning the survey, Executing the survey – Drafting an effective questionnaire, difference between questionnaire and schedule.	6	Up to K2	1
II	Survey techniques: Census and Sample. Principal steps in sample survey – Sampling and Non-sampling errors.	6	Up to K2	2
III	Collection of data - Primary data - methods of collecting primary data, Secondary data – sources of secondary data and precautions while using secondary data.	6	Up to K2	3
IV	Classification of data – Types of Classification - Chronological classification, Geographical classification, Quantitative classification and Qualitative classification. Formation of discrete frequency distribution and Formation of continuous frequency distribution.	7	Up to K2	4
V	Tabulation of data - Parts of a table and general rules of tabulation. Types of tables - simple and complex table and cross tabulation.	5	Up to K2	5

Books for Study:

- 1 R.S.N.Pillai and V. Bagavathi (2008), Statistics Theory and Practice (Seventh Revised Edition) , S.Chand & company, New Delhi
- 2 Gupta. S.P (1995), Statistical Methods, Sultan Chand & Sons, New Delhi.

Books for References:

1. Daroga singh and F. S. Chaudhary (1986), Theory and analysis of sample survey design, New age international publisher, New Delhi.
2. Vic Barnett (2009) Sample survey principles and Methods, Wiley.
3. Arijit Chaudhuri (2019), Survey sampling, CRC Press, Taylor & Francis group, NW.
4. P.C. Tulasian and Bharat Jhunjhnuwala (2010), Business Statistics, S.Chand & company, New Delhi.

Blended Mode:

Unit - 5

Tabulation of the data

<https://www.youtube.com/watch?v=Xr0BgvtXWwA>

Types of tables – Simple, complex and cross tables

<https://www.youtube.com/watch?v=wkAOt0Gqhlw>

<https://www.youtube.com/watch?v=dsDOYdp41ac>

Web Resources

Sampling Survey methods:

<https://www.youtube.com/watch?v=-N3GBLeJRF8>

Drafting questionnaire:

<https://www.youtube.com/watch?v=XPh7TjVTCso>

Survey methods:

www.youtube.com/watch?v=SkiCtWyH3pw

<https://www.youtube.com/watch?v=v82xWthyuZY>

https://www.youtube.com/watch?v=AJdt2_qxulo

Data Collection:

https://www.youtube.com/watch?v=yOU_s0xzc-Y

<https://www.youtube.com/watch?v=rloOsJxluBk>

Classification of data:

<https://www.youtube.com/watch?v=1H8kV6bXHpk>

<https://www.youtube.com/watch?v=gLoZrTnMKsQ>

Tabulation of data:

<https://www.youtube.com/watch?v=Xr0BgvtXWwA>

<https://www.youtube.com/watch?v=bG-5GPjfT-I>

Rationale for Nature of the course

Students will gain the skills related to survey and data collection.

Activities having direct bearing on Skill development / Employability/ Entrepreneurship

Simple exercise problems with statistical data will be given

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Course Designer(s):

Dr. R. MADHANAGOPAL

Course Schedule:

Unit	Topics	Hours	Mode
I	Organizing a statistical survey	1	Chalk and Talk, PPT, Problem-solving and Assignments
	Planning the survey, Executing the survey	2	
	Drafting an effective questionnaire	2	
	difference between questionnaire and schedule	1	
II	Survey techniques: Census and Sample	2	Chalk and Talk, PPT, Problem-solving and Assignments
	Principal steps in sample survey	2	
	Sampling and non-sampling errors	2	
III	Collection of data - Primary data - methods of collecting primary data	2	Chalk and Talk, PPT, Problem-solving, Assignments and Seminar
	Secondary data – sources of secondary data	2	
	precautions while using secondary data	2	
IV	Classification of data – Types of Classification - Chronological classification, Geographical classification	2	Chalk and Talk, PPT, problem-solving, Assignments and Seminar
	Quantitative classification and Qualitative classification	1	
	Formation of discrete frequency distribution	2	
	Formation of continuous frequency distribution.	2	
V	Tabulation of data - Parts of a table and general rules of tabulation	3	Chalk and Talk, PPT, Problem-solving, Assignments and Seminar
	Types of tables - simple and complex table and cross-tabulation.	2	

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CLO's	Course Learning outcomes	K-level
CO1	Plan and organize a survey and frame the questionnaire.	Upto K2
CO2	Classify the census and survey methods and also know the errors of these methods.	Upto K2
CO3	Collect the data from different sources under both primary and secondary mode.	Upto K2
CO4	Classify the data into different categories and construct frequency tables.	Upto K2
CO5	Construct the different types of tables for data analysis.	Upto K2

MAPPING WITH PROGRAMME OUTCOMES:

Mapping of Course Outcomes (CLO) against Programme Outcomes (PO) in the 3-point scale of STRONG(3), MEDIUM(2) and LOW(1).

CLO	POs						PSOs				
	1	2	3	4	5	6	1	2	3	4	5
CLO1	3	3	3	3	3	3	3	3	3	3	3
CLO2	3	2	3	3	3	3	3	3	2	3	2
CLO3	3	3	2	3	2	3	3	3	3	3	3
CLO4	3	3	3	2	2	2	3	3	3	2	3
CLO5	3	3	3	2	2	3	3	3	3	3	3

Assessment Schema

Components of CIA

Component	Weight / Mark
Assignment	5
Seminar / Quiz	5
Library	5

Summative Examination -Blue Print

Units	CLOs	K-Level	Section – A		Section – B		Section – C	
			Short Answers		(Either / or Choice)		(Open Choice)	
			No. of Questions	K-Level	No. of Questions	K-Level	No. of Questions	K-Level
1	CLO 1	Up to K2	1	K1	1	K2/K2	1	K1
2	CLO 2	Up to K2	1	K1	1	K2/K2	1	K1
3	CLO 3	Up to K2	1	K1	1	K2/K2	1	K1
4	CLO 4	Up to K2	1	K1	1	K2/K2	1	K1
5	CLO 5	Up to K2	1	K1	1	K2/K2	1	K1
No. of Questions to be asked			5		5		5	
No. of Questions to be answered			5		5		3	
Marks for each question			2		7		10	
Total Marks for each section			10		35		30	

Distribution of Marks with K Level for Summative Examination

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (No Choice)	Total Marks	% of Marks (without choice)	Consolidated
K1	10	-	50	60	46.15	100
K2	-	70	-	70	53.85	
K3	-	-	-	-	-	-
K4	-	-	-	-	-	-
Total Marks	10	35	50	130	100.00	100

M.Sc. First Year Semester II

List of Courses	Course Code	Credit	Hours
Core-IV (Estimation Theory)	25P2SCCT4	5	6
Core-V (Sampling Methods)	25P2SCCT5	5	6
Core Practical –I (Practical – I using R & Python)	25P2SCCP1	4	6
Discipline Elective – III (Linear Models or Simulation Analysis)	25P2SECT3	3	5
Discipline Elective – IV (Survival Analysis or Time Series Analysis)	25P2SECT4	3	5
Non-Major Elective (NME)-II (Elements of Operations Research)	25P2SSEN2	2	2
Total		22	30

Semester wise Mapping of Course with Programme Specific Outcomes (PSOs)

Course Type	CC4	CC5	CCP1	Elective – III	Elective - III	Elective - IV	Elective - IV	NME-II
Course Title	Estimation Theory	Sampling Methods	Practical-I using R & Python	Linear Models	Simulation Analysis	Survival Analysis	Time Series Analysis	Statistical Survey
PSO1	3	3	3	2	3	2	3	3
PSO2	2	3	3	2	3	2	3	2
PSO3	2	3	3	3	3	3	3	2
PSO4	3	2	2	2	3	2	3	3
PSO5	2	2	2	3	2	3	2	2

DEPARTMENT OF STATISTICS				CLASS: I M.Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	CORE-IV	25P2SCCT4	Estimation Theory	5	6	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	

Objectives:

- To make the students to understand the basic concepts of the statistical estimation theory.
- To study the properties of ideal estimators like unbiasedness, consistency, sufficiency, completeness.
- To educate various estimation methods like method of moments, method of maximum likelihood, interval estimate, and Bayes estimate.

Unit	Description	Hours	K-level	CLO
I	Sufficient statistics, Neyman-Fisher Factorization theorem, Existence and Construction of Minimal Sufficient Statistics, Minimal sufficient statistics and exponential family, sufficiency and completeness.	18	Up to K2	1
II	Unbiased estimation: Minimum variance unbiased estimation, locally minimum variance unbiased estimators, Rao Blackwell–theorem. Completeness- Lehmann Scheffe theorem, Necessary and sufficient condition for unbiased estimators	17	Up to K3	2
III	Cramer- Rao lower bound, Bhattacharya system of lower bounds in the 1-Parameter regular case. Chapman –Robbins inequality.	17	Up to K3	3
IV	Method of estimation: Method of moments, Maximum likelihood estimation, computational routines, strong consistency of maximum likelihood estimators, Asymptotic Efficiency of maximum likelihood estimators, Best Asymptotically Normal estimators.	19	Up to K4	4
V	Bayesian Approach : Introduction, Prior and Posterior distributions, Non -informative Priors, Point estimation, Hypothesis Testing, Interval estimation, Decision Theory approach.	19	Up to K4	5

Books for Study:

1. Rajagopalan. M and Dhanavanthan P, (2012), Statistical Inference, PHI Learning Pvt. Ltd., New Delhi
2. V.K.Rohatgi.et.al., (2002): An introduction to probability and statistics, John Wiley.
3. Lehmann, E.L., (1983): Theory of point estimation, John Wiley.

Books for References:

1. Zacks, S.,(1971):The theory of statistical inference, JohnWiley.
2. Rao, C.R.,(1973):Linear statistical Inference and its applications,Wiley Eastern,2nded.
3. Ferguson,T.S.,(1967):Mathematicalstatistics,Adecisiontheoreticapproach,Academicpress, New York and London.
4. Lindley,D.V.,(1965):Introduction to probability and statistics,Part2, Inference, Cambridge University Press.

Blended Mode:

Unit 5:

1. <https://www.youtube.com/watch?v=o2Tpws5C2Eg>
2. <https://www.youtube.com/watch?v=25-PpMSrAGM>
3. <https://www.youtube.com/watch?v=BIlH-sIYo-8>
4. https://www.youtube.com/watch?v=U7yedbq7gjl&list=PL_hiZmDUXdGtVE2kR8iUmtNks3-TUOdSH

Web Resources

1. Point Estimation <http://web.mit.edu/14.381/www/Estimation.pdf>
2. Unbiased estimator https://www.math.arizona.edu/~jwatkins/N_unbiased.pdf
3. Properties of Point Estimators and Methods of Estimation http://www.utstat.toronto.edu/~olgac/sta255_2013/notes/sta255_Lecture9.pdf
4. Interval estimation <http://www.yorku.ca/ptryfos/ch5000.pdf>
5. Prior and posterior distributions https://www.probabilitycourse.com/chapter9/9_1_1_prior_and_posterior.php

Rationale for Nature of the course

The course provides knowledge to identify various types of estimators and their properties. The student estimates the result using various methodology in estimators.

Activities having direct bearing on Skill development / Employability/ Entrepreneurship

Problem solving on Hypothesis writing, identifying suitable test and proper interpretation

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Course Designer(s):

Dr. A. SABERUNNISA

Course Schedule:

Unit	Topics	Hours	Mode
I	Sufficient statistics	3	Chalk and Talk, PPT
	Neyman-Fisher Factorization theorem	4	
	Existence and Construction of Minimal Sufficient Statistics	3	
	Minimal Sufficient Statistics and Exponential Family	4	
	Sufficiency and Completeness	4	
II	Minimum Variance Unbiased Estimation	3	Chalk and Talk, PPT, problem solving and Assignments
	Locally Minimum Variance Unbiased Estimators	3	
	Rao Blackwell–theorem	3	
	Completeness-Lehmann Scheffe’s theorems	4	
	Necessary and sufficient condition for Unbiased Estimators	4	
III	Cramer- Rao lower bound	6	Chalk and Talk, PPT, problem solving and Assignments
	Bhattacharya system of lower bounds in the 1-parameter regular case	7	
	Chapman –Robbins Inequality	4	
IV	Maximum likelihood estimation, Computational Routines	5	Chalk and Talk, PPT, problem solving
	Strong Consistency of Maximum likelihood estimators	5	
	Asymptotic Efficiency of Maximum likelihood estimators	5	
	Best Asymptotically Normal estimators, Method of moments	4	
V	Bayesian Approach: Introduction	5	Chalk and Talk, PPT,
	Prior and Posterior Distributions, Non -informative priors, Point estimation	5	
	Hypothesis Testing ,Interval estimation	5	
	Decision Theory approach.	4	

Course Learning Outcome (for Mapping with POs and PSOs)

At the end of the Course, Students will be able to

CLO's	Course Learning Outcomes	Knowledge Level
CO1	To understand the consistency, sufficiency and unbiasedness.	Upto K2
CO2	To understand the concepts and drive the uniformly minimum variance unbiased estimators.	Upto K3
CO3	To derive the inequality including CR inequality, KCR inequality and Bhattacharya inequality.	Upto K3
CO4	To estimate the parameter using method of moments, method of MLE, Interval estimation and shortest with confidence intervals.	Upto K4
CO5	To learn the concepts and to apply simple numerical illustration for Loss function, Risk function and Bayes estimate.	Upto K4

MAPPING CLOs WITH PSOs

MAPPING WITH PROGRAMME OUTCOMES:

Mapping of Course Outcomes (CLO) against Programme Outcomes (PO) in the 3-point scale of STRONG(3), MEDIUM(2) and LOW(1).

CLO	POs						PSOs				
	1	2	3	4	5	6	1	2	3	4	5
CLO1	3	3	3	3	3	3	3	3	3	3	3
CLO2	3	3	3	3	2	3	3	3	3	3	3
CLO3	3	3	3	2	3	3	3	3	3	3	3
CLO4	3	3	3	3	3	3	3	3	3	3	3
CLO5	3	2	3	3	3	3	3	3	3	3	3

Assessment Schema

Components of CIA

Component	Weight / Mark
Test	10
Assignment	5
Quiz	5
Seminar / Model display	5

Blueprint for Semester Examination

S. No.	CLOs	K Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K Level	No. of Questions	K level		
1	CLO1	Upto K2	2	K1&K1	1	K1	2(K1 &K1)	1(K2)
2	CLO2	Upto K3	2	K2&K3	1	K1	2(K2 &K2)	1(K3)
3	CLO3	Upto K3	2	K2&K3	1	K2	2(K3 &K3)	1(K3)
4	CLO4	Upto K4	2	K3&K4	1	K2	2(K4 &K4)	1(K4)
5	CLO5	Upto K4	2	K3&K4	1	K3	2(K4 &K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be Answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

Distribution of section wise marks with K levels for Summative Examination

K Levels	Section A MCQs	Section B (Short Answers)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30	30%
K4	2	-	20	20	42	35	35%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF STATISTICS				CLASS: I M.Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	CORE-V	25P2SCCT5	Sampling Methods	4	6	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	

Objectives:

- To cover sampling design and analysis methods
- To explain and compare various sampling procedures.
- To understand the concepts of bias and sampling variability and strategies for reducing the bias and sampling variability.

Unit	Description	Hours	K-level	CLO
I	Introduction - Preliminaries – Simple Random Sampling, Systematic Sampling, Stratified Sampling, Cluster Sampling.(Concept and basic derivation in mean and variance)	18	Up to K3	1
II	Systematic Sampling Methods – Balanced, Modified and Centered systematic sampling methods- Yates corrected estimator - Stratified Sampling – Allocation Problems.	18	Up to K3	2
III	Unequal Probability Sampling– PPSWR and PPSWOR sampling methods – Ordered and Unordered estimators - Midzuno Scheme.	18	Up to K4	3
IV	Ratio Estimation – Unbiased Ratio Type estimators – Regression Estimation - Double Sampling for Ratio and Regression Estimation	18	Up to K4	4
V	Multistage Sampling - Randomized Response Methods – Call Back Techniques	18	Up to K2	5

Books for study:

1. S.Sampath., (2005): Sampling Theory and Methods, Narosa Publishing House.
2. W.G. Cochran (1965) : Sampling Techniques, Wiley and Sons

Books for References:

1. M.N.Murthy(1967) : Sampling Theory and Methods: Statistical Publishing Society, Calcutta
2. Parimal Mukhopadhyay (2005) : Theory and Methods of Survey Sampling , Prentice Hall of India
3. P.V.Sukhatme, B.V.Sukhatme, S.Sukhatme and C.Asok (1984) L Theory of Same Surveys with Applications, IASRI, New Delhi
4. Singh, D and Choudhary, F.S. (1977) Theory and Analysis of Sample Survey Designs.Wiley Eastern, New Delhi.

Blended Mode:**UNIT 5**

1. <https://www.youtube.com/watch?v=vvcaziHteAI>
2. <https://www.youtube.com/watch?v=iTJ1zD5tFAU>
3. <https://www.youtube.com/watch?v=vvcaziHteAI>

Web Resources

1. <https://egyankosh.ac.in/bitstream/123456789/73586/3/Unit-7.pdf>
2. <http://home.iitk.ac.in/~shalab/course1.htm>
3. https://ia801409.us.archive.org/35/items/Cochran1977SamplingTechniques_201703/Cochran_1977_Sampling%20Techniques.pdf
4. <http://www.mim.ac.mw/books/S.%20Sampath%20Sampling%20theory%20and%20methods%202001.pdf>
5. http://150.107.117.36/NPTEL_DISK4/NPTEL_Contents/Web_courses/Phase2_web/111104073/Module7/Lecture24.pdf
6. <https://npTEL.ac.in/content/storage2/courses/111104073/Module7/Lecture23.pdf>
7. <https://egyankosh.ac.in/bitstream/123456789/73586/3/Unit-7.pdf>
8. <https://egyankosh.ac.in/bitstream/123456789/73586/3/Unit-7.pdf>
9. <http://home.iitk.ac.in/~shalab/course1.htm>

Rationale for Nature of the course

Statistical Techniques provide scientific approaches to develop the domain of human knowledge largely through empirical studies.

Activities having direct bearing on Skill development / Employability/ Entrepreneurship

Seminars on Data collection with issues in the field work and decision of sample size

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Course Designer(s):

Dr. A. SABERUNNISA

Course Schedule:

Unit	Topics	Hours	Mode
I	Introduction - Preliminaries – Simple Random Sampling	6	Chalk and Talk, PPT, problem solving and Assignments
	Systematic Sampling, Stratified Sampling	6	
	Cluster Sampling (Concept and basic derivation in mean and variance)	6	
II	Systematic Sampling Methods – Balanced	4	Chalk and Talk, PPT, problem solving and Assignments
	Modified and Centered systematic sampling methods	5	
	Yates corrected estimator	4	
	Stratified Sampling – Allocation Problems.	5	
III	PPSWR sampling methods	5	Chalk and Talk, PPT, problem solving, Assignments and Seminar
	PPSWOR sampling methods	5	
	Ordered and Unordered estimators	4	
	Midzuno Scheme	4	
IV	Ratio Estimation	4	Chalk and Talk, PPT, problem solving, Assignments and Seminar
	Unbiased Ratio Type estimators	5	
	Regression Estimation	5	
	Double Sampling for Ratio and Regression Estimation	4	
V	Multistage Sampling	6	Chalk and Talk, PPT, problem solving, Assignments and Seminar
	Randomized Response Methods	6	
	Call Back Techniques	6	

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CLO's	Course Learning Outcomes	K-Level
CLO-1	To apply basics and advanced levels of sampling methods for different types of data	Upto K3
CLO-2	To draw a conclusion about the best sampling procedure.	Upto K3
CLO-3	To use practical applications of ratio and regression method of estimations.	Upto K4
CLO-4	To analyze data from multi-stage sampling methods.	Upto K4
CLO-5	To estimate the hidden responses using randomized response techniques.	Upto K2

MAPPING WITH PROGRAMME OUTCOMES:

Mapping of Course Outcomes (**CLO**) against Programme Outcomes (**PO**) in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1).

CLO	POs						PSOs				
	1	2	3	4	5	6	1	2	3	4	5
CLO1	3	2	3	3	3	3	3	3	3	3	3
CLO2	2	3	3	2	2	2	3	3	3	3	3
CLO3	3	2	3	3	3	2	3	3	3	3	3
CLO4	3	3	3	3	2	2	3	3	3	3	3
CLO5	3	2	3	2	2	2	3	3	3	3	3

Assessment Schema:**Components of CIA**

Component	Weight / Mark
Test	10
Assignment	5
Quiz	5
Seminar / Model Display	5

Blueprint for Semester Examination

S. No.	CLOs	K Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K Level	No. of questions	K level		
1	CLO 1	Upto K3	2	K2 & K3	1	K2	2(K2 & K3)	1(K3)
2	CLO 2	Upto K3	2	K2 & K3	1	K2	2(K2 & K3)	1(K3)
3	CLO 3	Upto K4	2	K3 & K4	1	K1	2(K4 & K4)	1(K4)
4	CLO 4	Upto K4	2	K3 & K4	1	K3	2(K4 & K4)	1(K4)
5	CLO 5	Upto K2	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

Distribution of Section wise marks with K levels for summative Examination

K Levels	Section A MCQs	Section B (Short Answers)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30	30%
K4	2	-	20	20	42	35	35%
K5	-	-	-	-	-	-	-
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF STATISTICS				CLASS: I M.Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	CORE PRACTICAL-I	25P2SCCP1	Practical – I using R & Python	4	6	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	✓

Objectives:

- Fitting of various distributions with random number generation using R & Python.
- Sampling distributions and its estimators using R & Python.

Description
List of Practicals using R and Python programming: 1. Visualizations of the data 2. Correlation and Regression Analysis 3. Fitting of various distributions with random number generation 4. Sample selection using random number 5. Simple random sampling 6. Stratified random sampling – PPSWR 7. Stratified random sampling – PPSWOR 8. Linear Systematic random sampling 9. Circular systematic random sampling 10. Method of Moments 11. Method of Maximum Likelihood Estimator

Web Resources

1. <https://homerhanumat.github.io/elemStats/sampling-and-surveys.html>
2. <https://rstudio.github.io/r-manuals/r-intro/Probability-distributions.html>
3. https://bookdown.org/siju_swamy/Stat_Lab/descriptive-statistics-probability-using-r.html

Rationale for Nature of the course

This course will enable the students to study on the various sampling techniques in collecting the data and able to fit the suitable distribution using R & Python.

Activities having direct bearing on Skill development / Employability/ Entrepreneurship

Problem solving

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Course Designer(s):

Dr. P. VETRI SELVI

COURSE OUTCOMES:

At the end of the course, the student will be able to:

	Course Outcome
CO1	Understand the basic concepts of sampling theory and learn how to represent a sample from a population.
CO2	Use R to implement different sampling techniques and analyze the results of a sampling study.
CO3	Apply sampling techniques like ratio estimation and regression estimation to real-world problems
CO4	Understand the basic concepts of probability and distribution theory and learn how to use R to simulate
CO5	Analyze different probability distributions and apply distribution theory to real-world problems.

MAPPING WITH PROGRAMME OUTCOMES:

Mapping of Course Outcomes (**CLO**) against Programme Outcomes (**PO**) in the 3-point scale of STRONG(3), MEDIUM(2) and LOW(1).

CLO	POs						PSOs				
	1	2	3	4	5	6	1	2	3	4	5
CLO1	3	3	2	2	2	3	3	3	3	3	3
CLO2	3	3	3	3	2	3	3	3	3	3	3
CLO3	3	3	3	2	3	3	3	3	3	3	3
CLO4	2	3	3	3	3	3	3	3	3	3	3
CLO5	3	3	3	3	2	3	3	3	3	3	3

DEPARTMENT OF STATISTICS				CLASS: I M.Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	DISCIPLINE ELECTIVE-III	25P2SECT3 (A)	LINEAR MODELS	3	5	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	

Objectives:

- To model cross sectional data using minimum number of parameters
- To estimate unbiased estimators for model parameters
- To estimate standard errors of estimates to construct the confidence intervals.
- To test the goodness of fit of the models

Unit	Description	Hours	K-level	CLO
I	Linear Models – Classification, Estimability. The General Linear Hypothesis of Full Rank – Gauss-Markov theorem, Testing the Hypothesis $\beta = \beta^*$.	17	Up to K3	1
II	Introduction to Generalized Linear Models: Components of Generalized Linear Model, Binomial Logit Model, Poisson Log linear Model, , Linear Probability Model, Logistic Regression Model,	17	Up to K3	2
III	Methods of Estimations – ordinary least squares, generalized least square, maximize likelihood, BLUE.	13	Up to K4	3
IV	General Linear Hypothesis – four common hypotheses – reduced models – null model.	13	Up to K4	4
V	Regression and dummy variables – grouped variables – unbalanced data - describing linear models- 1-way classification, 2- way classification, 3-way classification – main and interaction effects.	15	Up to K2	5

Books for Study:

1. S.R. Searle, Linear Models, John Wiley, 1971.

Books for References:

1. Alan Agresti, (2002): Categorical Data Analysis, WileyInterscience, John Wiley& Sons
2. Radhakrishna Rao, "Linear Statistical Inference and its Applications" Wiley- Inter-science

Blended mode: Unit-I

Linear model

<https://youtu.be/1Z3s6B-oZhI?si=AW9AM9xDUA2b-oD2>

Linear model classification

<https://youtu.be/GnDaW8tQu7U?si=pGB-F5Fzs03i4PMB>

Estimability

https://youtu.be/ILgNQPSQzxI?si=8OQcuf72S_2tFhj_

General linear hypothesis

<https://youtu.be/Zz6UhL6EXJM?si=4i66J0kFnLWLJlSe>

Gauss markov theorem

<https://youtu.be/Sw6IerLB5gI?si=FJlppNiquXEu0RNR>

Testing the Hypothesis $\beta = \beta^*$.

<https://youtu.be/FMpZUGl3RJA?si=AC3EjC1jTzRjBiJX>

Web Resources

1. Categorical Data Analysis
https://mybiostats.files.wordpress.com/2015/03/3rd-ed-alan_agresti_categorical_data_analysis.pdf
2. Generalized Linear Hypothesis
<https://home.iitk.ac.in/~shalab/anova/chapter2-anova-general-linear-hypothesis.pdf>
3. Linear Statistical Inference and its Applications
https://books.google.com/gi/books?id=gKXYxdw-24YC&printsec=frontcover&source=gbv_vpt_read#v=onepage&q&f=false

Rationale for Nature of the course

This course enables to understand the linear model building with the proper assumptions and able to apply for the real world problems.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Real time situation based problems will be given as assignment.

Pedagogy

Chalk & Talk with PPT, Assignment, Seminar and Quiz

Course Designer(s):

Dr. M. RABERT

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Linear Models – Classification, Estimability	6	Chalk & Talk, Test, Quiz, Seminar
	The General Linear Hypothesis of Full Rank	4	
	Gauss–Markov theorem	3	
	Testing the Hypothesis $\beta = \beta^*$.	4	
Unit II	Introduction to Generalized Linear Models: Components of Generalized Linear Model	6	Chalk & Talk, Test, Quiz, Seminar
	Binomial Logit Model, Poisson Log-linear Model	5	
	Linear Probability Model, Logistic Regression Model	6	
Unit III	Methods of Estimations	3	Chalk & Talk, Test, Quiz, Seminar
	ordinary least squares	3	
	generalized least square	3	
	maximize likelihood	2	
	BLUE	2	
Unit IV	General Linear Hypothesis	3	Chalk & Talk, Test, Quiz, Seminar
	four common hypotheses	3	
	reduced models	4	
	null model	3	
Unit V	Regression and dummy variables – grouped variables – unbalanced data -	6	Chalk & Talk, Quiz, Seminar Assignment
	Describing linear models 1-way classification, 2- way classification, 3-way classification – main and interaction effects	9	

Course Learning Outcomes:

At the end of the course, students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Understand about statistical modelling	Up to K2
CLO2	model the given cross sectional data	Up to K3
CLO3	evaluate the model	Up to K3
CLO4	Interpret the model based on the variables involved	Up to K4
CLO5	predict using fitted model	Up to K4

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	3	2	3	3	3	3
CLO2	2	3	3	2	2	2
CLO3	3	2	3	3	3	2
CLO4	3	3	3	3	2	2
CLO5	3	2	3	2	2	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5
CLO1	3	3	3	3	3
CLO2	3	3	3	3	3
CLO3	3	3	3	3	3
CLO4	3	3	3	3	3
CLO5	3	3	3	3	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K-Level	No. of Questions	K- Level		
1	CLO1	Upto K3	2	K2 & K3	1	K2	2(K2 & K3)	1(K3)
2	CLO2	Upto K3	2	K2 & K3	1	K2	2(K2 & K3)	1(K3)
3	CLO3	Upto K4	2	K3 & K4	1	K1	2(K4 & K4)	1(K4)
4	CLO4	Upto K4	2	K3 & K4	1	K3	2(K4 & K4)	1(K4)
5	CLO5	Upto K2	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30.00	30%
K4	2	-	20	20	42	35.00	35%
Total Marks	10	10	50	50	120	100	100

DEPARTMENT OF STATISTICS				CLASS: I M.Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/ week	CIA	Ext	Total
II	DISCIPLINE ELECTIVE-III	25P2SECT3 (B)	Simulation Analysis	3	5	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	

Objectives:

Provides grounding statistical models in simulation and programming methods its equips. With knowledge of simulation methods to summarize data.

Unit	Description	Hours	K-level	CLO
I	Introduction to Simulation: Advantages and Disadvantages of Simulation - Areas of Application - System Environment - Components of a system - Types of models - Discrete-event system simulation -Steps in a Simulation Study; Simulation examples	15	Up to K2	1
II	Statistical Models in Simulation: Useful Statistical model - Discrete Distribution - Continuous Distribution - Poisson Process - Empirical Distribution. Simulation of Manufacturing and Material Handling System: Modeling of manufacturing system - Models of martial Handling system - Goals and performance Measure .	15	Up to K4	2
III	Simulation of Queuing system: Queuing system Characteristics - Queueing Notation - Transient and Steady-State Behaviour of Queues - Steady-state Behaviour of Infinite-Population Markovian Models - Properties of Random Numbers -Techniques for generating Random Variate Generation: Inverse Transformation Technique - Uniform Distribution, Exponential Distribution, Triangular Distribution, Empirical Continuous Distribution.	15	Up to K3	3
IV	Input Data Analysis: Data Collection - Identifying the Distribution with Data - Parameter Estimation - Goodness-of fit Tests- Chi-square Test- Kolmogorov - Smirnov Test - Selecting Input models without Data - Multivariate and Time Series - Input Models. Verification and Validation of Simulation Models: Model Building - Verification and Validation.	15	Up to K4	4

V	Output Data Analysis: Stochastic Nature of Output Data - Types of Simulation with respect their Estimation - Output Analysis for Terminating Simulation - Output Analysis for Steady - State Simulations. Comparison and Evaluation of Alternative System Designs: Comparison of Two system Design.	15	Up to K3	5

Books for Study:

1. Deo, N. (1983) System Simulation with Digital Computer. Prentice Hall of India, New Delhi

Books for References:

1. Gardon, G. (1992) System Simulation, Prentice Hall of India, New Delhi.
2. Banks, J. Carson II, J.S. and Nelson, B.L. (1995) Discrete - Event System Simulation Prentice Hall, New Delhi.
3. Law, A.M. (2007) Simulation Modeling and Analysis, McGraw Hill, New York.

Blended Mode:

UNIT-III

1. <https://youtu.be/YdbxIDvid1I>
2. <https://youtu.be/DNQNFLyFsgY>
3. <https://youtu.be/tLWNeUn1Vv8>

Web Resources

1. <https://youtu.be/oZkNjGgaNVY>
2. <https://youtu.be/gYMcHmlezu4>
3. https://youtu.be/0YFdS_-5Ft0
4. <https://youtu.be/6FShQ4ez728>
5. <https://youtu.be/MjztG9U0YKc>

Rationale for Nature of the course

This course enhances the knowledge on simulation data using various statistical methods.

Activities having direct bearing on Skill development / Employability/ Entrepreneurship

Problem solving on Reliability i.e. Life time of a product with suitable distributions

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Course Designer(s):

Dr. M. RABERT

Course Schedule:

Unit	Topics	Hours	Mode
I	Introduction to Simulation: Advantages and Disadvantages of Simulation - Areas of Application	4	Chalk and Talk, PPT, problem solving and Assignments
	System Environment - Components of a system - Types of models	4	
	Discrete-event system simulation -Steps in a Simulation Study	4	
	Simulation examples	3	
II	Statistical Models in Simulation: Useful Statistical model	3	Chalk and Talk, PPT, problem solving and Assignments
	Discrete Distribution - Continuous Distribution - Poisson Process - Empirical Distribution.	4	
	Simulation of Manufacturing and Material Handling System:	4	
	Modeling of manufacturing system - Models of martial Handling system - Goals and performance Measure .	4	
III	Simulation of Queuing system: Queuing system Characteristics - Queueing Notation - Transient and Steady-State Behaviour of Queues - Steady-state	4	Chalk and Talk, PPT, problem solving and Assignments
	Behaviour of Infinite-Population Markovian Models - Properties of Random Numbers	3	
	Techniques for generating Random Variate Generation:- Inverse Transformation Technique	4	
	Uniform Distribution, Exponential Distribution, Triangular Distribution, Empirical Continuous Distribution	4	
IV	Input Data Analysis: Data Collection - Identifying the Distribution with Data	4	Chalk and Talk, PPT, problem solving and Assignments
	Parameter Estimation - Goodness-of fit Tests- Chi-square Test- Kolmogorov - Smirnov Test	4	
	Selecting Input models without Data - Multivariate and Time Series	3	
	Input Models. Verification and Validation of Simulation Models: Model Building - Verification and Validation.	4	
V	Output Data Analysis: Stochastic Nature of Output Data - Types of Simulation with respect their Estimation	4	Chalk and Talk, PPT, problem solving and Assignments
	Output Analysis for Terminating Simulation - Output Analysis for Steady - State Simulations.	4	
	Comparison and Evaluation of Alternative System Designs	4	
	Comparison of Two system Design.	3	

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CLO's	Course Outcomes	K-level
CO1	Acquire the knowledge of different Programming Languages for simulation	Up to k2
CO2	Know how to construct statistical models in simulation different types of simulations	Up to k4
CO3	Knowledge about model for queueing systems.	Up to k3
CO4	Calculate input data analysis using by different statistical methods.	Up to k4
CO5	Calculate input data analysis using by different statistical methods.	Up to k3

MAPPING WITH PROGRAMME OUTCOMES:

Mapping of Course Outcomes (**CLO**) against Programme Outcomes (**PO**) in the 3-point scale of STRONG (3), MEDIUM (2) and LOW(1).

CLO	POs						PSOs				
	1	2	3	4	5	6	1	2	3	4	5
CLO1	3	3	3	3	2	3	3	3	3	3	3
CLO2	3	3	3	2	3	3	3	3	3	2	3
CLO3	3	3	3	3	2	3	3	3	3	2	3
CLO4	3	3	3	3	3	3	3	3	3	3	3
CLO5	3	3	3	2	3	3	3	2	3	3	2

Assessment Schema**Components of CIA**

Component	Weight / Mark
Test	10
Assignment	5
Quiz	5
Seminar / Model display	5

Blueprint for Semester Examination

Unit	CLOs	K Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K Level	No. of questions	K level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)
2	CLO 2	Up to K4	2	K3 & K4	1	K2	2(K4 & K4)	1(K4)
3	CLO 3	Up to K3	2	K2 & K3	1	K1	2(K2 & K2)	1(K3)
4	CLO 4	Up to K4	2	K3 & K4	1	K3	2(K4 & K4)	1(K4)
5	CLO 5	Up to K3	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

Distribution of section wise marks with K levels for Summative Examination

K Levels	Section A MCQs	Section B (Short Answers)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30	30%
K4	2	-	20	20	42	35	35%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF STATISTICS				CLASS: I M.Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	DISCIPLINE ELECTIVE - IV	25P2SECT4 (A)	Survival Analysis	3	5	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	

Objectives:

1. To estimate and interpret survival and/or hazard functions from survival data
2. To compare survival and/or hazard functions.
3. To assess the relationship of explanatory variables to survival time

Unit	Description	Hours	K-level	CLO
I	Concepts of time, Order and random Censoring, likelihood in these cases. Life distributions Exponential, Gamma, Weibull, Lognormal, Pareto, Linear Failure rate. Parametric inference (Point estimation, scores, MLE)	15	Up to K2	1
II	Life tables, failure rate, mean residual life and their elementary properties. Concept of Ageing, Types of Ageing classes and their properties and relationship between them Bathtub Failure rate, Concept of Inverse Hazard rate.	15	Up to K3	2
III	Estimation of survival function Actuarial Estimator, Kaplan-Meier Estimator, Estimation under the assumption of IFR / DFR . Tests of exponentiality against non- parametric classesTotal time on test, Despande test.	15	Up to K4	3
IV	Two sample problem- Gehan test, Log rank test. Mantel Haenszel test, Tarone Ware tests. Introduction to Semi-parametric regression for failure rate, Cox's proportional hazards(PH) model with one and several covariates and estimation problems in Cox's PH Model. Rank test for the regression coefficients.	15	Up to K3	4
V	Introduction to Competing risks analysis and estimation problems in competing risk model for parametric and non-parametric semi parametric set up. Ideas of Multiple decrement life table and its applications.	15	Up to K4	5

Books for Study:

1. Miller, R.G. (1981) : Survival analysis (John Wiley).
2. Cox, D.R. and Oakes, D. (1984): Analysis of Survival Data, Chapman and Hall, New York.
3. Elisha T Lee, John Wenyu Wang and Timothy Wenyu Patt(2003): Statistical Methods for Survival data Analysis, 3/e, Wiley Inter Science.

Books for References:

1. Gross, A.J. and Clark, V.A. (1975) : Survival distribution : Reliability applications in the Biomedical Sciences, John Wiley and Sons.
2. Elandt Johnson, R.E. Johnson N.L.: Survival Models and Data Analysis, John Wiley and sons.
3. Kalbfleisch J.D. and Prentice R.L. (1980), The Statistical Analysis of Failure Time Data, John Wiley.
4. Klein P. John and Moeschberger (2003): Survival Analysis: Techniques for Censored and Truncated Data, 2/e, Springer.
5. Lawless J.F. (1982) Statistical Models and Methods of Life Time Data; John Wiley & Sons.

Blended Mode:**Unit-III**

1. Survival Analysis: <https://youtu.be/nGANjEVsw2o>
2. Actuarial estimator calculation in practical: https://youtu.be/U_2wjOEK9vs

Web Resources

1. Survival Analysis: <https://youtu.be/nGANjEVsw2o>
2. Actuarial estimator calculation in practical: https://youtu.be/U_2wjOEK9vs
3. Competing risk analysis: <https://youtu.be/3BmCqNMOXZo>

Rationale for Nature of the course

This course is a powerful tool that can be used to answer a variety of questions about the time to an event and relatively complex statistical technique. Applied in variety of fields like banking and pharmaceutical.

Activities having direct bearing on Skill development / Employability/ Entrepreneurship

Data Simulation techniques will be developed

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Course Designer(s)

Dr. M. VENKATESWARAN

Course Schedule:

Unit	Topics	Hours	Mode
I	Concepts of time, Order and random Censoring, likelihood in these cases.	3	Chalk and Talk, PPT, problem solving and Assignments
	Life distributions Exponential, Gamma, Weibull , Lognormal , Pareto ,	2	
	Linear Failure rate.	2	
	Parametric inference (Point estimation, scores, MLE)	2	
II	Life tables, failure rate, mean residual life and their elementary properties.	3	Chalk and Talk, PPT, problem solving and Assignments
	Concept of Ageing, Types of Ageing classes and their properties and	2	
	relationship between them Bathtub Failure rate	2	
	Concept of Inverse Hazard rate.	2	
III	Estimation of survival function Actuarial Estimator,	2	Chalk and Talk, PPT, problem solving and Assignments
	Kaplan- Meier Estimator, Estimation under the assumption of IFR / DFR .	2	
	Tests of exponentiality against non- parametric classes	2	
	Total time on test, Deshpande test.	3	
IV	Two sample problem- Gehan test, Log rank test. Mantel Haenszel test, Tarone Ware tests.	3	Chalk and Talk, PPT, problem solving and Assignments
	Introduction to Semi- parametric regression for failure rate,	2	
	Cox's proportional hazards(PH) model with one and several covariates and estimation problems in Cox's PH Model.	2	
	Rank test for the regression coefficients	2	
V	Introduction to Competing risks analysis and	3	Chalk and Talk, PPT, problem solving and Assignments
	estimation problems in competing risk model for parametric and	2	
	non- parametric semi parametric set up.	2	
	Ideas of Multiple decrement life table and its applications.	2	

COURSE OUTCOMES:

At the end of the course, the student will be able to:

	Course Outcome	K-level
CO1	Understand the fundamental concepts of survival analysis	Upto K2
CO2	Learn various parametric and non-parametric survival models	Upto K3
CO3	Master data preprocessing techniques for survival analysis	Upto K4
CO4	Develop skills in model assessment and interpretation	Upto K3
CO5	Apply survival analysis in real-world scenarios	Upto K4

MAPPING WITH PROGRAMME OUTCOMES:

CLO	POs						PSOs				
	1	2	3	4	5	6	1	2	3	4	5
CLO1	3	3	3	3	3	3	2	3	3	2	2
CLO2	3	3	2	3	3	2	3	3	3	3	3
CLO3	3	3	3	3	2	3	3	3	3	3	2
CLO4	3	3	3	2	2	3	3	3	2	2	3
CLO5	3	3	3	3	3	2	3	3	2	2	3

Assessment Schema**Components of CIA**

Component	Weight / Mark
Test	10
Assignment	5
Quiz	5
Seminar / Model display	5

Blueprint for Semester Examination

S. No.	CLOs	K Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K Level	No. of questions	K level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K1	2(K2 & K2)	1(K3)
3	CLO 3	Up to K4	2	K3 & K4	1	K3	2(K4 & K4)	1(K4)
4	CLO 4	Up to K3	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)
5	CLO 5	Up to K4	2	K3 & K4	1	K2	2(K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

Distribution of section wise marks with K levels for Summative Examination

K Levels	Section A MCQs	Section B (Short Answers)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30	30%
K4	2	-	20	20	42	35	35%
K5	-	-	-	-	-	-	-
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF STATISTICS				CLASS: I M.Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	DISCIPLINE ELECTIVE - IV	25P2SECT4 (B)	Time Series Analysis	3	5	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	

Objectives:

1. Understanding of various components of time series and forecasting univariate time series
2. Apply different methods for fitting time series models
3. Understanding various important concepts in forecasting and smoothing methods
4. Understanding stationary and non-stationary nature of time series data

Unit	Description	Hours	K-level	CLO
I	Time Series: Introduction – Uses of time series - Components of time series — Mathematical models for time series: Additive and multiplicative method - Measurements of trend: Graphical method – method of semi-averages – method of curve fitting – Measurements of seasonal variations: method of simple average and ratio to trend method.	12	Up to K2	1
II	Exploring time series data patterns – Measuring the forecast error: Absolute measure - Mean absolute error (MAE), Mean Squared error (MSE), Root mean squared error (RMSE). Relative measure: Percentage error (PE) Mean absolute percentage error (MAPE) and mean percentage error (MPE). Moving averages and Smoothing methods: Naïve models - Forecasting methods based on average: Simple average - Moving average – double moving average – Weighted Moving Average. Exponential smoothing methods: Single exponential smoothing - Double exponential smoothing (Holt method) - Triple exponential smoothing (Holt-Winter's method).	14	Up to K3	2
III	Decomposition method: Additive and Multiplicative decomposition. Stationary and non-stationary time series – Construction of Auto correlation function (ACF) and Partial Auto correlation function (PACF) - Portmanteau tests: Ljung–Box test. Parametric test for identifying the stationarity: Unit root test – Augmented Dickey filler (ADF) test and	18	Up to K3	3

	Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test. Differencing method to convert non-stationary series to stationary series.			
IV	Stationary ARIMA models: Random model (ARMA (0,0,0)) - Autoregressive model order one (AR (1,0,0)) - Moving average model of order one (ARIMA (0,0,1)) – Simple mixed model ARIMA (1, 0, 1) – Simple mixed model ARIMA (p, 0, q). Non-stationary ARIMA models: Random model (ARMA (0,1,0)) - Autoregressive model order one (AR (1,1,0)) - Moving average model of order one (ARIMA (0,1,1)) – Simple mixed model ARIMA (1, 1, 1) – Simple mixed model ARIMA (p, d, q).	18	Up to K4	4
V	Seasonal time series ARIMA (p,d,q) (P, D,Q) – Model identification – Diagnostic checking - Forecasting: point forecasts. ARCH and GARCH models: Description and properties of these models (Without proof).	13	Up to K4	5

Books for Study:

1. Rob J Hyndman and George Athanasopoulos (2021), Forecasting: principles and practice, 3rd edition, OTexts: Melbourne, Australia. OTexts.com/fpp3.
2. John E. Hanke and Dean Wichern (2014), Business forecasting, ninth edition, Pearson education limited, United Kingdom.
3. S.C Gupta and V.K. Kappor (2007) Fundamentals of applied Statistics, fourth edition, Sultan Chand and sons, New Delhi.
4. Philip Hans Franses, Dick van Dijk and Anne Opschoor (2014), Time series models for business and economic forecasting, Second edition, University Printing House, United Kingdom.
5. Spyros Makridakis, Steven C. Wheelwright and Rob J. Hyndman (2008) Forecasting methods and applications, Third edition, Wiley.
6. Søren Bisgaard and Murat Kulahci (2011), Time series analysis and forecasting example, John Wiley and sons Inc., New Jersey.

Books for References:

1. Montgomery, D. C., Peck, E. and Vining, G. G. (2003): Introduction to Linear regression analysis, third edition, John Wiley and Sons, Inc.
2. Draper, N.R. and Smith, H. (2000) : Applied Regression Analysis, 2nd edition, John Wiley & Sons.
3. Spyros Makridakis, Steven C. Wheelwright and Victor E. McGee (2012), Forecasting Methods and Applications – Second Edition, John Wiley & Sons.
4. T.M.J.A.Coaray(2008): Applied Time Series Analysis and Forecasting, NAROS A publishing house Pvt. Ltd

Blended Mode:

Unit: 2

Measuring the forecast error:

<https://www.youtube.com/watch?v=KzHJXdFJSIQ>

Moving averages and Smoothing methods:

Naïve Forecasting:

<https://www.youtube.com/watch?v=sR6gtBUht0M>

Moving average:

<https://www.youtube.com/watch?v=afyhQWYWaGo>

Double moving average:

<https://www.youtube.com/watch?v=PhrPS5i0od4>

Exponential smoothing methods:

Simple Exponential Smoothing:

<https://www.youtube.com/watch?v=PIvvWrvFDvY>

Double exponential smoothing:

<https://www.youtube.com/watch?v=3mpCzheoXeM>

Triple exponential smoothing:

<https://www.youtube.com/watch?v=2b1i4iiTw9E>

Web Resources

1. <http://mathforum.org>,
2. <http://ocw.mit.edu/ocwweb/Mathematics>,
3. <http://www.opensource.org>
4. www.mathpages.com

Rationale for Nature of the course

1. The course provides the knowledge on the forecasting techniques with suitable ARIMA models by analysing the old data.
2. The course identifies the best model in forecast the data.

Activities having direct bearing on Skill development / Employability/ Entrepreneurship**Pedagogy**

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Course Designer(s):

Dr. R. MADHANAGOPAL

Course Schedule:

Unit	Topics	Hrs	Mode
I	Time Series: Introduction – Uses of time series	2	PPT, Chalk and Talk and Assignments
	Components of time series	1	
	Mathematical models for time series	2	
	Measurements of trend	4	
	Measurements of seasonal variations	3	
II	Exploring time series data patterns	2	PPT, Chalk and Talk and Assignments
	Absolute measures – Mean absolute error, Mean error, Mean square error.	2	
	Relative measures – Percentage error, Mean percentage error, Mean absolute percentage error.	2	
	Naïve models	1	
	Forecasting methods based on average	2	
	Exponential smoothing methods	5	
III	Decomposition method: Additive and Multiplicative decomposition.	2	PPT, Chalk and Talk and Seminar
	Stationary and non-stationary time series	2	
	Construction of ACF and PACF	6	
	Portmanteau tests: Ljung–Box test	2	
	Augmented Dickey filler (ADF) test and Kwiatkowski-Phillips-Schmidt-Shin (KPSS)	4	
	Differencing method to convert non-stationary series to stationary series.	2	
IV	Stationary ARIMA models	8	PPT, Chalk and Talk and Assignments
	Non-stationary ARIMA models	7	
V	Seasonal time series ARIMA (p,d,q) (P, D,Q)	4	PPT, Chalk and Talk and Assignments
	Model identification	2	
	Diagnostic checking	2	
	Forecasting: point forecasts	2	
	ARCH and GARCH models: Description and properties of these models (Without proof).	3	

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CLO's	Course Outcomes	K-level
CO1	Identifying the stationary of the time series.	Up to K2
CO2	Describing the concept of standard statistical measures for time series.	Up to K3
CO3	Modelling time series using exponential methods.	Up to K3
CO4	Structuring the time series data based on seasonal and non- seasonal nature.	Up to K4
CO5	Fitting ARIMA model and evaluating goodness of fit	Up to K4

MAPPING WITH PROGRAMME OUTCOMES:

Mapping of Course Outcomes (**CLO**) against Programme Outcomes (**PO**) in the 3-point scale of STRONG(3), MEDIUM(2) and LOW(1).

CLO	POs						PSOs				
	1	2	3	4	5	6	1	2	3	4	5
CLO1	3	3	3	3	3	3	3	3	3	3	3
CLO2	3	3	3	3	3	3	3	3	3	3	3
CLO3	3	3	3	3	3	2	3	3	3	2	3
CLO4	3	3	2	3	3	3	3	3	2	3	3
CLO5	3	3	3	3	3	3	3	3	3	3	3

Assessment Schema**Components of CIA**

Component	Weight / Mark
Test	10
Assignment	5
Quiz	5
Seminar / Model display	5

Blueprint for Semester Examination

SL.No	CLOs	K-level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)	Total
			MCQs		Short Answers				
			No. of Questions	K- Level	No. of Questions	K- Level			
1	CLO 1	Up to K 2	2	K1 & K1	1	K1	2(K1& K1)	1(K2)	
2	CLO 2	Up to K 3	2	K2& K3	1	K1	2(K2 & K2)	1(K3)	
3	CLO 3	Up to K 3	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)	
4	CLO 4	Up to K 4	2	K3 & K4	1	K2	2(K4& K4)	1(K4)	
5	CLO 5	Up to K 4	2	K3& K4	1	K3	2(K4& K4)	1(K4)	
No. of Questions to be asked			10		5		10	5	30
No. of Questions to be answered			10		5		5	3	23
Marks for each question			1		2		5	10	
Total Marks for each Section			10		10		25	30	75

Distribution of Section wise marks with K levels for summative Examination

K - Level	Section A (MCQ)	Section B (Short Answer Questions)	Section C (Either / Or Choice)	Section D (Open Chioce)	Total Marks	% of (Marks without Choice)	Consolidated
K1	2	4	10	-	16	13.33	33.33
K2	2	2	10	10	24	20.00	
K3	4	4	10	20	38	31.67	31.67
K4	2	-	20	20	42	35	35
K5	-	-		-			
Total	10	10	50	50	120	100	100

DEPARTMENT OF STATISTICS				CLASS: I M.Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	NME-II	25P2SSEN2	Elements of Operations Research	2	2	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	

Objectives:

- To understand the concepts of linear programming problem
- To understand the concepts of Transportation and Assignment problems.

Unit	Description	Hours	K-level	CLO
I	Formulation - Graphical and simplex methods of solving LPP - Use of artificial variables - Two-phase method and Big-M method.	5	Up to K2	1
II	Transportation problem: Transportation problem formulation- North-West Corner, Least cost, Vogel's Approximation method - UV-method.	9	Up to K2	2
III	Assignment problem - Hungarian Method - Travelling Salesman Problem.	4	Up to K2	3
IV	Network analysis by CPM/PERT: Basic Concept - Constraints in Network - Construction of the Network - Time calculations - Concept of slack and float in Network Analysis - Network crashing.	6	Up to K2	4
V	Sequencing problems with 2 machines n jobs and 3 machines n jobs.	6	Up to K2	5

Books for Study:

1. Operations Research by KantiSwarup, Gupta, P K and Man Mohan, Sultan Chand & Sons, Nineteenth Edition, New Delhi (2017).
2. Operations Research: An Introduction by Taha, H, Third Edition, McMillan Publishing Co-, Inc, London (1982).

Books for References:

1. Introduction to Operations Research by Hillier F S and Lieberman GJ, Fifth Edition, McGraw-Hill, NY (1990).
2. Operations Research: Theory, Methods and Applications by Sharma SD, KedarNath, RarNath and Co, Meerut (2017).
3. Principles of Operations Research with Application to Managerial Decisions by Wagner H M Second Edition, Prentice Hall India Learning Private Limited and New Delhi (1980).

Web Resources

e-books, online tutorials taken from MOOC/SWAYAM platform for this subject.

Rationale for Nature of the course

This course enables the students to gain in-depth knowledge on operation research.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Seminars/Assignments on the different methods of operation research

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem Solving

Course Designer(s):

Dr. A. SABERUNNISA

Course Schedule

Unit	Topics	Hours	Mode
I	Formulation	1	Chalk and Talk, Test, Quiz, Seminar
	Graphical and simplex methods of solving LPP	1	
	Use of artificial variables	1	
	Two-phase method	1	
	Big-M method	1	
II	Transportation problem formulation	2	Chalk and Talk, Test, Quiz, Seminar
	North-West Corner	1	
	Least cost	2	
	Vogel's Approximation method	1	
	UV-method	3	
III	Assignment problem	1	Chalk and Talk, Test, Quiz, Seminar
	Hungarian Method	1	
	Travelling Salesman Problem	2	
IV	Network analysis by CPM/PERT- Basic Concept	1	Chalk and Talk, Test, Quiz, Seminar
	Constraints in Network	2	
	Construction of the Network	1	
	Time calculations - Concept of slack and float in Network Analysis	1	
	Network crashing	1	
V	Sequencing problems with 2 machines n jobs	3	Chalk and Talk, Quiz, Seminar, Assignment
	3 machines n jobs.	3	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Formulate and solve linear programming problems (LPP) using graphical and simplex methods to find optimal solutions.	Up toK2
CLO2	Will possess the skills to formulate transportation problems.	Up toK2
CLO3	Formulate assignment problems and applying the Hungarian Method to find optimal solutions.	Up toK2
CLO4	Demonstrate a solid understanding of the basic concepts of CPM/PERT, will also be able to implement network crashing techniques to optimize project schedules.	Up toK2
CLO5	Acquire the ability to formulate and solve sequencing problems.	Up toK2

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO1	3	3	3	3	3	3	3
CLO2	3	3	2	3	2	3	3
CLO3	3	3	3	3	3	3	3
CLO4	3	3	3	2	3	3	3
CLO5	3	3	3	3	3	3	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5
CLO1	3	3	3	3	3
CLO2	3	2	3	3	3
CLO3	3	3	2	3	2
CLO4	3	3	3	2	2
CLO5	3	3	3	2	2

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D(Open Choice)
			MCQs		Short answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO1	Up to K2	1	K1	1	K2/K2	1	K1
2	CLO2	Up to K2	1	K1	1	K2/K2	1	K1
3	CLO3	Up to K2	1	K1	1	K2/K2	1	K1
4	CLO4	Up to K2	1	K1	1	K2/K2	1	K1
5	CLO5	Up to K2	1	K1	1	K2/K2	1	K1
No. of Questions to be asked			5		5		5	
No. of Questions to be answered			5		5		3	
Marks for each question			2		7		10	
Total marks for each			10		35		30	

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	10	-	50	60	46.15	100	10
K2	-	70	-	70	53.85		-
K3	-	-	-	-	-	-	-
K4	-	-	-	-	-	-	-
Total Marks	10	35	50	130	100.00	100	10



**THE MADURA COLLEGE (AUTONOMOUS),
MADURAI
DEPARTMENT OF STATISTICS
PG Programme Structure**

Semester	Course Code	Title of the Course	Hours	Credits	Nature of Course (Employability / Entrepreneurship / Skill development)				Scope of focus (Local / National / Global developmental needs)			Percentage of Syllabus Revision / New
					Emp	Ent	Skill	Kno	Local	National	Global	
I	25P1SCCT1	Real Analysis & Linear Algebra	6	5			Yes	Yes			Yes	0
	25P1SCCT2	Distribution Theory	6	5	Yes		Yes	Yes			Yes	0
	25P1SCCT3	Measure and Probability Theory	6	4	Yes		Yes	Yes			Yes	0
	25P1SECT1 (A)	Official Statistics	5	3	Yes		Yes	Yes			Yes	New
	25P1SECT1 (B)	Population Studies			Yes		Yes	Yes			Yes	46
	25P1SECT2 (A)	Actuarial Statistics	5	3	Yes		Yes	Yes			Yes	0
	25P1SECT2 (B)	Clinical Trails			Yes		Yes	Yes			Yes	16
	25P1SEN1	Statistical Survey	2	2	Yes	Yes	Yes	Yes			Yes	0
	Total number of hours and credits		30	22								
II	25P2SCCT4	Estimation Theory	6	5	Yes		Yes	Yes			Yes	23
	25P2SCCT5	Sampling Methods	6	5	Yes		Yes	Yes			Yes	19
	25P2SCCP1	Practical-I in R & Python	6	4	Yes		Yes	Yes			Yes	New
	25P2SECT3 (A)	Linear Models	5	3	Yes	Yes	Yes	Yes			Yes	0
	25P2SECT3 (B)	Simulation Analysis			Yes		Yes	Yes			Yes	0
	25P2SECT4 (A)	Survival Analysis	5	3	Yes		Yes	Yes			Yes	0
	25P2SECT4 (B)	Time Series Analysis			Yes		Yes	Yes			Yes	27
	25P2SEN2	Elements of Operations Research	2	2	Yes	Yes	Yes	Yes			Yes	0
	Total number of hours and credits		30	22								

III	25P3SCCT6	Testing of Statistical Hypothesis	6	5	Yes		Yes	Yes			Yes	
	25P3SCCT7	Multivariate Analysis	6	5	Yes		Yes	Yes			Yes	
	25P3SCCP2	Practical-II in R & Python	6	4	Yes	Yes	Yes	Yes			Yes	
	25P3SSED1	Skill Enhancement Course – Machine Learning techniques	5	3	Yes	Yes	Yes	Yes			Yes	
	25P3SMDC	Econometrics and Cost Analysis	5	3	Yes	Yes	Yes	Yes			Yes	
	25P3SIKS	Indian Knowledge System	2	2	Yes		Yes	Yes			Yes	
	25P3SINTR	Internship / Industrial activity [credits]	-	2	Yes	Yes	Yes	Yes			Yes	
Total number of hours and credits			30	24								
IV	25P4SCCT8	Stochastic Processes	6	5	Yes		Yes	Yes			Yes	
	25P4SCCT9	Design of Experiments	6	4	Yes		Yes	Yes			Yes	
	25P4SCCT10	Research and Publication Ethics	4	2	Yes	Yes	Yes	Yes			Yes	
	25P4SPROV	Project with Viva Voce	6	6	Yes	Yes	Yes	Yes			Yes	
	25P4SECT6 (A)	Statistical Quality Control	4	3	Yes	Yes	Yes	Yes			Yes	
	25P4SECT6 (B)	Reliability Theory			Yes	Yes	Yes	Yes			Yes	
	25P4SSED2	Statistics for Competitive Examination	4	2	Yes	Yes	Yes	Yes			Yes	
	25P4SEXTN	Extension Activity	-	1	Yes	Yes	Yes	Yes			Yes	
Total number of hours and credits			30	23								
Grand Total number of hours and Credits			120	91								

Emp-Employability;

Ent-Entrepreneurship;

Skill-Skill Development

Kno-Knowledge



DEPARTMENT OF PHYSICS

Revised Curriculum

Based on the model curriculum of

TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION (TANSCH)

With elements from

Learning Outcome Based Education framework (LOBE) of UGC
(Choice Based Credit system with Outcome Based Education)

Academic Year 2023-2024 onwards

V and VI semesters (B.Sc. Physics) – Regulation 2023

I and II semesters (M.Sc. Physics) – Regulation 2025

VISION

To inculcate scientific temper and spirit of inquiry among students through academic programmes integrated with theoretical knowledge and practical applications enabling the students to apply knowledge and skills to achieve professional goals and ultimately the advancement of humanity.

MISSION

- To create globally competent citizens by providing quality physics education.
- To produce lifelong learners with scientific temper and spirit of inquiry for the advancement of science.
- To sensitize students to be deeply rooted to the society to which they belong.
- To produce innovators who provide solutions to the problems in the society and moot the advancement of humanity.
- To create dutiful citizens who are high on moral and spiritual values.

Programme Outcomes (defined by TANSCHÉ)

PO1: Disciplinary Knowledge: Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate programme of study.

PO2: Critical Thinking: Capability to apply analytic thought to a body of knowledge; analyze and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development.

PO3: Problem Solving: Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real-life situations.

PO4: Analytical Reasoning: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples and addressing opposing viewpoints.

PO5: Scientific Reasoning: Ability to analyse, interpret and draw conclusions from quantitative / qualitative data; and critically evaluate ideas, evidence, and experiences from an open-minded and reasoned perspective.

PO6: Self-directed & Lifelong Learning: Ability to work independently, identify and manage a project. Ability to acquire knowledge and skills, including “learning how to learn”, through self-placed and self-directed learning aimed at personal development, meeting economic, social and cultural objectives.

Programme Educational Objectives (PEOs)

After successful completion of the programme the graduate will

- **PEO–1** Apply knowledge and skills acquired in the disciplinary domain for providing solutions to real life problems.
- **PEO–2** Choose a suitable career option or higher education and excel in Competitive examination.
- **PEO–3** Acquire interpersonal skills, be social, be responsible, excel in team work and become leaders in their domain.
- **PEO–4** Communicate effectively and set high moral and ethical standards.
- **PEO–5** Adapt to the constantly evolving technology and be life– long learners

Programme specific learning outcomes (PSO) aligned with Graduate Attributes

At the end of the programme, the students will be able to

	Programme specific learning outcomes	Graduate Attributes
PSO – 1	Demonstrate a fundamental/systematic or coherent understanding of the academic field of Physics, its different learning areas and applications in basic Physics like Properties of Matter & Sound, Heat & Thermodynamics, Electricity, Electro Magnetism, Introductory Physics, Instrumentation physics, Life sciences, Environmental sciences, Atmospheric Physics, Computer science, Information Technology.	Knowledge core in competency
PSO – 2	Tackle problems and offer out of the box solutions based on analysis and critical thinking deeply rooted in concepts of Physics.	Problem analysis
PSO – 3	Problem–solving skills that are required to solve different types of Physics related problems with well defined solutions, and tackle open–ended problems that belong to the disciplinary–area boundaries.	Design and development of solution for Complex problems
PSO – 4	Demonstrate the ability to use skills in Physics and its related areas of technology for formulating and tackling Physics related problems and identifying and applying appropriate physical principles and methodologies to solve a wide range of problems associated with Physics.	Modern tool usage

PSO – 5	Recognize the importance of mathematical modeling simulation and computing, and the role of approximation and mathematical approaches to describing the physical world.	Modern tool usage
PSO – 6	Plan and execute Physics-related experiments or investigations, analyze and interpret data/information collected using appropriate methods, including the use of appropriate software such as programming languages and purpose-written packages, and report accurately the findings of the experiment /investigations while relating the conclusions/ findings to relevant theories of Physics.	Individual and team work, project management, Communication.
PSO – 7	Relate and apply concepts of Physics to real life situations.	Lifelong learning



The Madura College, Madurai – 625 011
Department of Physics
PROGRAMME STRUCTURE – B.Sc. PHYSICS

SEM	Course category	Course code	Title of the Course	Hours	Credits
I	Language - I	23U1TLAN1	Tamil	6	3
	Language - II	23U1NENG1	English	6	3
	Core	23U1PCCT1	Properties of Matter and Acoustics	5	5
	Core - Practical	23U1PCCP1	Practical – I	3	3
	Allied / GEC	23U1MGET1(P)	Allied Mathematics – I	6	5
	Foundation Course	23U1PFCT1	Introductory Physics	2	2
	SEC	23U1PSED1	Physics of Everyday Life	2	2
II	Language - I	23U2TLAN2	Tamil	6	3
	Language - II	23U2NENG2	English	6	3
	Core	23U2PCCT2	Heat, Thermodynamics and Statistical Physics	5	5
	Core - Practical	23U2PCCP2	Practical – II	3	3
	Allied /GEC	23U2MGET2(P)	Allied Mathematics – II	4	4
	SEC	23U2PSED2	Astrophysics	2	2
	SEC	23U2PSED3	Basic Instrumentation	2	2
	Part V	23U2YRC1/ NCC/NSS	YRC/NCC/NSS	-	-
III	Language - I	23U3TLAN3/	Tamil	6	3
	Language - II	23U3NENG3	English	6	3
	Core	23U3PCCT3	Mechanics	4	4
	Core - Practical	23U3PCCP3	Practical – III	3	3
	Allied / GEC	23U3CGET1	Allied Chemistry – I	4	4
	Allied - Practical	23U3CGEP1	Allied Practical – I	2	1
	SEC	23U3PSED4	Electrical wiring	2	2
	SEC	23U3PSED5	Biomedical Instrumentation	2	2
IV	Language - I	23U4TLAN4	Tamil	6	3
	Language - II	23U4NENG4	English	6	3
	Core	23U4PCCT4	Optics and LASER Physics	4	4
	Core - Practical	23U4PCCP4	Practical – IV	3	3
	Allied / GEC	23U4PGET2	Allied Chemistry –II	4	4
	Allied - Practical	23U4PGEP2	Allied Practical–II	2	1

	SEC	23U4PSED6	Energy Physics	2	2
	SEC	23U4PSED7	Science of Materials	2	2
	EVS	23U4EVST1	E.V.S	2	2
	Part V	23U4YRC2/ NCC/NSS	YRC/NCC/NSS	-	1
V	Core	23U5PCCT5	Electricity, Magnetism and Electromagnetism	5	4
	Core	23U5PCCT6	Atomic and Nuclear Physics	5	4
	Core	23U5PCCT7	Analog and Communication Electronics	5	4
	Core - Practical	23U5PCCP5	Practical – V	3	3
	Discipline Elective	23U5PDET1(A)	PYTHON Programming	5	4
		23U5PDET1(B)	Mathematical Physics		
	IDC	23U5PIDCT	NanoScience	5	4
	Value Education	23U5VENT1	Value Education	2	2
VI	Industrial Visit/ Internship Field Visit	23U5PINTR	Industrial Visit/ Internship Field Visit	0	2
	Core	23U6PCCT8	Relativity and Quantum Mechanics	6	4
	Core	23U6PCCT9	Solid state Physics	6	4
	Core	23U6PCCT10	Digital Electronics and Microprocessor 8085	6	4
	Core - Practical	23U6PCCP6	Practical – VI	3	3
	Discipline Elective	23U6PDET2(A)	Spectroscopy and Fibre Optics	4	2
		23U6PDET2(B)	Numerical Methods with C++		
	SEC-PC	23U6PSED8	Professional Competency Skill	2	2
	Project and viva-voce	23U6_PROV	Project and viva-voce	3	2
Total				180	141

Language I – Tamil / Hindi / Sanskrit

Language II : English

SEC – Skill Enhancement Course

GEC – Generic Elective Course

SEC-PC – Professional Competency Skill Enhancement Course

IDC – Interdisciplinary Course

MDC – Multidisciplinary Course

Language I – Tamil / Hindi / Sanskrit

Language II : English

SEC – Skill Enhancement Course

GEC – Generic Elective Course

SEC-PC – Professional Competency Skill Enhancement Course

IDC – Interdisciplinary Course

MDC – Multidisciplinary Course

DEPARTMENT OF PHYSICS					CLASS: III B.Sc			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
V	Core	23U5PCCT5	Electricity, Magnetism and Electromagnetism	4	5	25	75	100

Nature of course				
Skill oriented	✓	Employability oriented		Entrepreneurship Oriented

Objectives:

- To classify materials based on their electrical and magnetic properties.
- To analyze the working principles of electrical gadgets.
- To understand the behavior of dc, ac and transient currents.
- To know about the communication by electromagnetic waves.

Unit	Description	Hours	K– level	CLO
I	Capacitors and Thermoelectricity Capacitor –principle – capacitance of spherical and cylindrical capacitors – capacitance of a parallel plate capacitor (with and without dielectric slab) – effect of dielectric –Carey Foster bridge – temperature coefficient of resistance – See beck effect – laws of thermo EMF – Peltier effect – Thomson effect – thermoelectric diagrams –uses of thermoelectric diagrams – thermodynamics of thermo couple – determination of Peltier and Thomson coefficients.	15	K2	1
II	Magnetic Effects Of Current: Biot and Savart's law – magnetic induction due to circular coil – magnetic induction due to solenoid – Helmholtz tangent galvanometer –force on a current element by magnetic field – force between two infinitely long conductors – moving coil ballistic galvanometer – damping correction – Ampere's circuital law – differential form – divergence of magnetic field – magnetic induction due to toroid.	15	K3	2
III	Magnetism and Electromagnetic Induction: Magnetic induction B – magnetization M – relation between B, H and M – magnetic susceptibility – magnetic permeability – experiment to draw B– H curve – energy loss due to hysteresis – Importance of hysteresis curves – Faraday and Lenz laws – vector form – self– induction – coefficient of self– inductance of solenoid – Anderson's method – mutual induction – coefficient of mutual inductance	15	K2	3

	between two coaxial solenoids – coefficient of coupling – earth inductor– determination of angle of dip(Φ)			
IV	Transient and Alternating Currents Growth and decay of current in a circuit containing resistance and inductance – growth and decay of charge in a circuit containing resistance and capacitor – growth and decay of charge in an LCR circuit (expressions for charge only) – peak, average and rms values of ac – LCR series and parallel circuits – resonance condition – Q factor – power factor.	15	K4	4
V	Maxwell's Equations and Electromagnetic Waves: Maxwell's equations in vacuum, material media – physical significance of Maxwell's equations – displacement current – plane electromagnetic waves in free space – velocity of light – Poynting vector – electromagnetic waves in a linear homogenous media – refractive index.	15	K3	5

Text book for study:

1. Murugesan. R., – Electricity and Magnetism, 10th Edn, 2006, S.Chand and Co, New Delhi.

Sections:

UNIT – I: Chapter 4– 4.1,4.2,4.3,4.4,4.5,4.5.1,4.5.2,6.7

Chapter 8– 8.1, 8.2, 8.4,8.5,8.6,8.7

UNIT – II: Chapter 10– 10.2, 10.4, 10.4.1, 10.5,10.6,10.7,10.8,10.9,10.11

UNIT – III: Chapter 14:14.1, 14.2,14.3,14.4,14.5,14.17,14.19

Chapter 11:11.1,11.2,11.3,11.4,11.6,11.15,11.16,11.17,11.19,11.20

UNIT – IV: Chapter 12:12.1,12.2,12.3,12.6,12.7,13.1,13.3,13.4

UNIT – V: Chapter 15:15.1,15.2,15.4,15.7,15.8,15.11

Books for study:

1. Sehgal D.L., Chopra K.L, Sehgal N.K., – Electricity and Magnetism,
2. Sultan Chand and Sons, New Delhi.
3. M. Narayanamurthy and N. Nagarathnam, Electricity and Magnetism, 4th Edition. National Publishing Co., Meerut.

Books for References:

1. Brijlal and Subramanian, Electricity and Magnetism, 6th Edn.,Ratanand Prakash, Agra.
2. Brijlal, N.Subramanyan and JivanSeshan, Mechanics and Electrodynamics (2005), Eurasia Publishing House (Pvt.) Ltd., New Delhi.

3. David J. Griffiths, Introduction to Electrodynamics, 2ndEdn. 1997, Prentice Hall of India Pvt. Ltd., New Delhi
4. D. Halliday, R. Resnik and J. Walker – Fundamentals of Physics, 6thEdn., Wiley, NY, 2001.

Web Resources

1. <https://www.edx.org/course/electricity>
2. <https://www.udemy.com/courses/electricity>
3. <https://www.edx.org/course/magnetism>
4. <http://www.hajim.rochester.edu/optics/undergraduate/courses.html>

Activities having direct bearing on Skill development / Employability Entrepreneurship

The test of all knowledge is theoretical results are illustrated by matching the experimental data in the activities and uses of electromagnetic theory.

Pedagogy

Chalk and talk, materials, PPT, Quiz, Assignment, Seminar, Problem solving, Group discussion, interaction and field visit.

Course Designer(s):

1. Dr.M.Kavitha

Lecture Schedule

Unit	Topics	Hrs	Mode
Unit I	Capacitor –principle – capacitance of spherical and cylindrical capacitors	3	PPT, Chalk and talk, Quiz and assignment
	Capacitance of a parallel plate capacitor (with and without dielectric slab) – effect of dielectric	4	
	Carey Foster bridge – temperature coefficient of resistance – Seebeck effect – laws of thermo emf	4	
	Peltier effect – Thomson effect – thermoelectric diagrams –uses of thermoelectric diagrams	3	
	Thermodynamics of thermo couple – determination of Peltier and Thomson coefficients.	1	
Unit II	Biot and Savart's law – magnetic induction due to circular coil	4	Chalk and talk, and assignment
	magnetic induction due to solenoid – Helmholtz tangent galvanometer –force on a current element by magnetic field	3	
	force between two infinitely long conductors – moving coil ballistic galvanometer	4	
	Damping correction – Ampere's circuital law – differential form – divergence of magnetic field – magnetic induction due to toroid.	4	
Unit III	magnetic induction B – magnetization M – relation between B, H and M	4	PPT, Chalk and talk and Quiz
	magnetic susceptibility – magnetic permeability – experiment to draw B– H curve – energy loss due to hysteresis	3	
	Importance of hysteresis curves – Faraday and Lenz laws –vector form – self– induction	3	
	coefficient of self– inductance of solenoid– Anderson's method – mutual induction – coefficient of mutual inductance between two coaxial solenoids	3	
	coefficient of coupling – earth inductor–determination of angle of dip(Φ)	2	
Unit IV	growth and decay of current in a circuit containing resistance and inductance	4	PPT, Chalk and talk, Quiz and assignment
	parallel circuits – resonance condition – Q factor – power factor	4	
	peak, average and rms values of ac – LCR series	3	
	growth and decay of charge in an LCR circuit	2	

	(expressions for charge only)	2	
	– growth and decay of charge in a circuit containing resistance and capacitor		
Unit V	Maxwell's equations in vacuum, material media– physical significance of Maxwell's equations	5	PPT, Chalk and talk
	displacement current – plane electromagnetic waves in free space – velocity of light – Poynting vector	5	
	electromagnetic waves in a linear homogenous media – refractive index	5	

Course Learning Outcomes:

At the end of the course the student will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Describe various thermo– electric effects and their properties.	K2
CLO-2	Apply Biot and Savart law to study the magnetic effect of electric current	K3
CLO-3	Using the idea of electromagnetic induction in various bridges	K2
CLO-4	Analyze the time variation of current and potential difference in AC circuits.	K4
CLO-5	Relate different physical quantities used to explain magnetic properties of materials	K3
K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate		

Mapping of CLOs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	1	1	2
CO2	3	3	3	1	1	2
CO3	3	3	3	1	1	2
CO4	3	3	3	1	1	2
CO5	3	3	3	1	1	2

Mapping of CLOs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO 7
CO1	3	3	3	1	1	2	2
CO2	3	3	3	1	1	2	2
CO3	3	3	3	1	1	2	2
CO4	3	3	3	1	1	2	1
CO5	3	3	3	1	1	2	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Assessment Scheme
Blue print for Semester Examination

Learning Outcome Based Education (LOBE) & Assessment Articulation
Mapping– K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K– Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K– Level	No. of Questions	K– Level		
1	CLO1	UptoK2	2	K1&K1	1	K1	2(K2&K2)	1(K2)
2	CLO2	UptoK3	2	K1&K2	1	K2	2(K3&K3)	1(K3)
3	CLO3	UptoK2	2	K2&K1	1	K1	2(K1&K1)	1(K2)
4	CLO4	UptoK4	2	K2&K2	1	K2	2(K4&K4)	1(K4)
5	CLO5	UptoK3	2	K2&K1	1	K2	2(K3&K3)	1(K3)
No .of Questions to be Asked			10		5		10	5
No. of Questions to be Answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1– Remembering and recalling facts with specific answers

K2– Basic understanding of facts and stating main ideas with general answers

K3– Application oriented –Solving Problems

K4– Examining, analyzing, presentation and make inferences with evidences

Distribution of Section– wise Marks with K Levels

K Levels	Section A(No Choice)	Section B(No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5	4	10	–	19	15.8	42%
K2	5	6	10	10	31	25.8	
K3	–	–	20	30	50	41.7	42%
K4	–	–	10	10	20	16.7	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF PHYSICS					CLASS: III B.Sc.,			
Sem.	Course type	Course code	Course title	Credits	Contact hours/ week	CIA	Ext	Total
V	Core	23U5PCCT6	Atomic and Nuclear Physics	4	5	25	75	100

Nature of course				
Skill oriented	✓	Employability oriented		Entrepreneurship Oriented

Objectives:

- To enlighten students in the understanding of structure of atoms
- To impart knowledge in the area of nuclear models and nuclear radioactivity
- To understand the origin of primary and secondary cosmic rays
- To know the concepts in nuclear reactions

Unit	Description	Hours	K– level	CLO
I	Atom models Rutherford atom model – Bohr atom model – Energy levels and spectra – Quantization of orbital's – Atomic excitation – Frank – Hertz experiment – Davison – Goucher method– Vector atom model – Quantum numbers associated with vector atom model Self study: Frank – Hertz experiment – Davison – Goucher method	15	K4	1
II	Atomic Structure Coupling schemes – Pauli's exclusion principle –The periodic table – magnetic dipole moment– Stern and Gerlach experiment – Zeeman effect – Larmor's theorem – Quantum mechanical explanation of normal Zeeman effect – Anomalous Zeeman effect – Paschen – Back effect – Stark effect– Spin– orbit coupling. Self– study: Spin– orbit coupling, Stark effect	15	K3	2

III	Radioactivity: Discovery of radioactivity – natural radio activity – properties of alpha rays, beta rays and gamma rays – Geiger– Nuttal law – alpha particle spectra – beta ray spectra – neutrino theory of beta decay – non– conservation of parity in weak interactions – nuclear isomerism – internal conversion – law of radioactive disintegration. Self– study: non– conservation of parity in weak interactions	15	K3	3
IV	Nuclear Reactions: Discovery of artificial transmutation – Q– value equation for a nuclear reaction – threshold energy – conservation laws of nuclear reaction – artificial radio activity – application of radio isotopes – classification of neutrons – models of nuclear structure – liquid drop model – shell model. Self– study: application of radio isotopes	15	K3	4
V	Elementary Particles: Discovery of cosmic rays – primary and secondary cosmic rays – latitude effect– altitude effect – comic ray showers – Classification of elementary particles – fundamental interactions – elementary particle quantum numbers – iso– spin and strangeness quantum number – Conservation laws and symmetry – quarks – quark model (elementary ideas only) Self– study: Conservation laws and symmetry	15	K2	5

Books for Study:

1. Concepts of Modern Physics by Arthur Beiser, Shobit Mahajan and Rai Choudury, Seventh edition, Tata McGraw Hill, New Delhi.
Unit I: Chapters: 4.1, 4.2, 4.5, 4.6, 4. 9
Unit II: Chapter: 7.8
2. Modern Physics by R. Murugesan & K. Sivaprasath, S. Chand & Co. Ltd, 18thEdn, 2005, New Delhi.
Unit I: Chapters: 4.12, 4.13

Unit II: Chapters: 4.14 – 4.20, 4.23 – 4.28

Unit III: Chapters: 20.1, 20.4, 20.4.1, 20.6, 20.10 (20.10.1 excluded), 20.10.2, 20.10.3, 20.11, 20.14, 20.15, 20.18, 20.18.1

Unit IV: Chapters: 21.1, 21.2 (up to pg. no 422), 21.2.4, 21.4 (21.4.1 excluded), 21.6,

21.8, 21.9, 21.10.1, 17.10, 17.12

Unit V: Chapters: 24.1 – 24.7, 23.1 – 23.6

Books for reference:

1. Atomic Physics – Max Born, The English Language Book Society, U.K.
2. Atomic and Nuclear Physics – Shatendra Sharma, Dorling Kindersley Indie (2005)

Web Resources:

1. <http://hyperphysics.phy-astr.gsu.edu/hbase/quantum/zeeman.html>
2. <https://www.mpi-hd.mpg.de/hfm/CosmicRay/Showers.html>

Rationale for nature of course

The students will be able to appreciate and apply modern physics principles to understand the nature of atoms and nucleus.

Activities having direct bearing on skill development

Students will be able to solve problems that help them understand the nature of the atomic and nuclear world and understand the properties of atoms and nucleus.

Pedagogy

Chalk and Talk, PPT, Quiz, Group discussion, Seminar, Interaction, Problem solving.

Course Designer(s):

Prof. T. Vivekanandan

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Rutherford atom model – Bohr atom model – Energy levels and spectra	5	Chalk and talk, Quiz and assignment
	Quantization of orbital's– Atomic excitation – Frank– Hertz experiment	5	
	Vector atom model – Quantum numbers associated with vector atom model	5	
Unit II	Coupling schemes – Pauli's exclusion principle – The periodic table – magnetic dipole moment	5	PPT, Chalk and talk, and Group discussion
	Stern and Gerlach experiment – Zeeman effect – Larmor's theorem – Quantum mechanical explanation of normal Zeeman effect	5	
	Anomalous Zeeman effect – Paschen Back effect – Stark effect.	5	
Unit III	discovery of radioactivity – natural radio activity – properties of alpha rays, beta rays and gamma rays – Geiger– Nuttal law	5	PPT, Chalk and talk, Quiz and Group discussion
	alpha particle spectra – beta ray spectra – neutrino theory of beta decay– non– conservation of parity in weak interactions.	5	
	nuclear isomerism – internal conversion – law of radioactive disintegration	5	
Unit IV	discovery of artificial transmutation– Q– value equation for a nuclear reaction – threshold energy	5	PPT, Chalk and talk, Assignment
	conservation laws of nuclear reaction – scattering cross section – artificial radio activity – application of radio isotopes	5	
	classification of neutrons – models of nuclear structure – liquid drop model – shell model.	5	
Unit V	classification of elementary particles – fundamental interactions – elementary particle quantum numbers – iso– spin and strangeness quantum number	5	Chalk and talk, Quiz and Interaction
	Conservation laws and symmetry – quarks – quark model (elementary ideas only)	5	
	discovery of cosmic rays – primary and secondary cosmic rays – latitude effect– altitude effect– cosmic ray showers.	5	

Course Learning Outcomes:

On the successful completion of the course, students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Differentiate Bohr atom model from Rutherford atom model	K4
CLO-2	Make use of quantum theory to explain anomalous Zeeman effect	K3
CLO-3	Prepare a list of properties of alpha, beta and gamma rays	K3
CLO-4	Develop Q- value equation for a nuclear reaction	K3
CLO-5	Explain the cascade theory of cosmic ray showers	K2

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7
CLO-1	3	3	3	3		2	1
CLO-2	3	3	3	3		2	1
CLO-3	3	3	3	3		2	1
CLO-4	3	3	3	3		2	1
CLO-5	3	3	3	3		2	1

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	2	2	2	1	1	1
CLO2	2	2	2	1	1	1
CLO3	2	2	2	1	1	1
CLO4	2	2	2	1	1	1
CLO5	2	2	2	1	1	1

Advance application- 3;

Intermediate level-2;

Basic level-1

Summative – Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K– Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K– Level	No. of Question s	K– Level		
1	CLO 1	Up to K4	2	K1 & k2	1	K2	2 (K4 & K4)	1 (K4)
2	CLO 2	Up to K3	2	K1 & K2	1	K2	2 (K2 & K2)	1 (K3)
3	CLO 3	Up to K3	2	K1 & K2	1	K2	2 (K3 & K3)	1 (K3)
4	CLO 4	Up to K3	2	K1 & K2	1	K1	2 (K3 & K3)	1 (K3)
5	CLO 5	Up to K2	2	K1 & K2	1	K1	2 (K1 & K1)	1 (K2)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1– Remembering and recalling facts with specific answers

K2– Basic understanding of facts and stating main ideas with general answers

K3– Application oriented –Solving Problems

K4– Examining, analyzing, presentation and make inferences with evidences

Distribution of Section– wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5	4	10	—	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	—	—	20	30	50	41.67	42%
K4	—	—	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF PHYSICS				CLASS: III B.Sc. Physics				
Sem	Course type	Course code	Course title	Credits	Contact hours/week	CIA	Ext	Total
V	Core	23U5PCCT7	Analog & Communication Electronics	4	5	25	75	100

Nature of course				
Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented
				✓

Course Objectives:

The objective of the course is

- To study the design, working and applications of semiconducting devices
- To construct various electronic circuits and to study them in detail.
- To study the basis of audio and video communication systems and the aspects of satellite and Fiber Optic Communications.

Unit	Description	Hours	K-level	CLO
I	Diodes Semiconductor diode – crystal diode as a rectifier – important terms – half wave rectifier, center tapped and bridge full wave rectifiers, calculation of efficiency and ripple factor – comparison of rectifiers – diode characteristics – filter circuits – qualitative description of shunt capacitor filter – clipper circuits, clamping circuits – Zener diode as voltage regulator.	15	K4	1
II	Transistor Amplifier Transistor –Naming the transistor terminals– Action– Symbols– Transistor as an amplifier– Transistor connections (CB,CE,CC)– Characteristics (CE only)– Transistor load line analysis– Operating points– Methods of transistor biasing – Voltage Divider Bias— Single stage transistor amplifier – Transistor amplification and its graphical demonstration– Practical circuits of transistor amplifier – RC coupled amplifier – Classification of power amplifier –Class A, Class B and Class C. Self Study : Performance of power amplifier	15	K3	2
III	Oscillators : Feedback –Principle of negative feedback amplifier– Advantages of negative feedback– Feedback circuit – Oscillators– Types of sinusoidal oscillations– Oscillatory circuits– Un damped oscillation from tank circuit– Explanation of Barkhausen criterion–Phase Shift Oscillator – Hartley Oscillator. Self Study : Multi vibrators	15	K3	3

IV	Operational amplifiers: OPAMP characteristics– Differential amplifiers–IC 741 pin configuration – inverting and non– inverting amplifiers – unity follower –summing and difference amplifiers – differentiator and integrator – astable multivibrator (square wave generator).	15	K3	4
V	Modulation and Demodulation Carrier and signal – need for modulation – methods of modulation – Amplitude modulation – percent modulation – upper and lower sidebands – mathematical analysis of a modulated carrier wave – power relations in an AM wave – forms of amplitude modulation – methods of amplitude modulation – block diagram of AM transmitter – Frequency modulation – frequency deviation and carrier swing – modulation index – deviation ratio – percent modulation – FM sidebands – mathematical expression for FM wave – demodulation – essentials of AM detection – diode detector for AM signals – FM detection – super heterodyne AM receiver – FM receiver – comparison between AM and FM.	15	K2	5

Books for Study

- Principles of electronics, V.K.Mehta& Rohit Mehta. XIthEdn., S. Chand and Co. Ltd (2013)
Unit I: Sections 6.1,6.2,6.6 – 6.15, 6.19,6.20,6.24,6.25, 18.18– 18.23, 1.12– 1.16,5.1,5.8– 5.13,6.18 – 6.21,6.27,7.2– 7.10
Unit II: Sections 8.1– 8.7,8.12,8.17,8.18,9.7,9.12,24.1– 24.2,10.1– 10.4,11.5,12.6
Unit III: Sections 13.1– 13.5,14.1– 14.4, 14.7,14.11,14.13
Unit IV : Sections 25.24, 25.26,25.27, 25.32 – 25.35, 25.37, 25.39
Unit V : Sections 18.15– 18.23, 20.1– 20.9, 21.11,21.13– 21.15
- Basic Electronics : Solid State – B.L.Theraja – S.Chand Co. (2001)
Unit IV: Chapter 30

Books for Reference

- A Text Book of applied electronics, R.S. Sheda, S.Chand& Co., 2003.
- Electronic Communication systems – Kennedy & Davis 4thEdn Tata McGraw Hill
- Electronic Communication systems – Gothman

Web Resources:

- <https://www.queenmaryscollege.edu.in/eresources/undergraduateprogram/py157>
- www.ocw.mit.edu>...> Circuits and Electronics
- www.ocw.mit.edu>...> Introductory Analog Electronics Laboratory
- [https:// www.elprocus.com](http://www.elprocus.com)> semiconductor devices
- [https:// www.britannica.com](http://www.britannica.com)>technology

Rationale for Nature of the course

This course will enable the students to comprehend the theory, concepts, characteristics and working principles of electronic devices like linear circuit's, semiconductor diodes and their applications in electronic circuits.

Activities having direct bearing on Skill development / Employability /Entrepreneurship

The knowledge of various devices acquired by the students will enable them to solve problems involving circuits and design circuits for various physical applications.

Pedagogy

Chalk and Talk, PPT, Quiz, Group discussion, Seminar, Interaction, Problem solving.

Course Designers:

1. Dr.R.Vishnu Priya
2. Dr.S.Angayarkanni

Lecture Schedule

Unit	Topics	Hours	Mode
Unit I	Semiconductor diode – crystal diode as a rectifier – important terms	3	Chalk and talk, Quiz and assignment
	Half wave rectifier, center tapped	3	
	Bridge full wave rectifiers, calculation of efficiency and ripple factor comparison of rectifiers	3	
	Diode characteristics – filter circuits – Qualitative description of shunt capacitor filter	3	
	Clipper circuits, clamping circuits – Zener diode as voltage regulator	3	
Unit II	Transistor –Naming the transistor terminals– Action– Symbols– Transistor as an amplifier– Transistor connections(CB,CE,CC)	3	PPT, Chalk and talk, and Group discussion
	Characteristics (CE only – DC load line analysis– Operating points– Methods of transistor biasing – Hybrid parameter– Determination of h– parameter	3	
	Voltage Divider Bias – Single stage transistor amplifier – Transistor amplification and its graphical demonstration	3	
	Practical circuits of transistor amplifier – RC coupled amplifier	3	
	Classification of power amplifier –Class A, Class B and Class C.	3	
Unit III	Feedback – Principle of negative feedback amplifier– Advantages of negative feedback	3	PPT, Chalk and talk, Quiz and Group discussion
	Feedback circuit – Oscillators– Types of sinusoidal oscillations– Oscillatory circuits	3	
	Un damped oscillation from tank circuit– Explanation of Barkhausen criterion– Hartley oscillator	3	
	Phase Shift Oscillator	3	
	Problem solving	3	
Unit IV	OPAMP characteristics– Differential amplifiers	3	PPT, Chalk and talk, Assignment
	IC 741 pin configuration – inverting and non-inverting amplifiers	3	
	Unity follower –summing and difference amplifiers	3	
	Differentiator and integrator– Applications	3	
	Astable multivibrator (square wave generator)– Problem solving	3	

Unit V	Carrier and signal – need for modulation – methods of modulation – Amplitude modulation – percent modulation – upper and lower sidebands	3	Chalk and talk, Quiz and Interaction
	Mathematical analysis of a modulated carrier wave – power relations in an AM wave – forms of amplitude modulation	3	
	Methods of amplitude modulation – block diagram of AM transmitter – Frequency modulation – frequency deviation and carrier swing	3	
	Modulation index – deviation ratio – percent modulation – FM sidebands – mathematical expression for FM wave – demodulation – essentials of AM detection – diode detector for AM signals – FM detection – super heterodyne AM receiver – FM receiver – comparison between AM and FM.	3	

Course learning Outcomes

On the successful completion of the course, students will be able to

CLO's	Course Learning Outcome	Knowledge level
CLO – 1	Explain the basic concepts of semiconductor devices.	K4
CLO – 2	Know and classify the basic principles of biasing and transistor amplifiers	K3
CLO – 3	Acquire the fundamental concepts of oscillators.	K3
CLO – 4	Understand the working of operational amplifiers.	K3
CLO – 5	Learn and analyze the modulator and demodulator circuits	K2

Mapping with CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7
CLO-1	3	2	2	3			1
CLO-2	3	2	3	2			1
CLO-3	3	2	2				1
CLO-4	3	3	2	3			1
CLO-5	3	2	1	2			1

Mapping of CLOs with Pos

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	1	2			
CLO2	3	1	2	1		1
CLO3	3	2	2	1		
CLO4	3	1	1		2	
CLO5	3	3	2	1		2

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative – Blue – Print – Model
(Mapping with Course Learning Outcomes(CLOs))

Units	CLOs	K– Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K– Level	No. of Questions	K– Level		
1	CLO 1	Up to K4	2	K1 &K2	1	K2	2 (K4& K4)	1 (K4)
2	CLO 2	Up to K3	2	K1 &K2	1	K2	2 (K3& K3)	1 (K3)
3	CLO 3	Up to K3	2	K1 &K2	1	K1	2 (K1& K1)	1 (K3)
4	CLO 4	Up to K3	2	K1 &K2	1	K1	2 (K3 & K3)	1 (K3)
5	CLO 5	Up to K2	2	K1 &K2	1	K2	2 (K2 & K2)	1 (K2)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1– Remembering and recalling facts with specific answers

K2– Basic understanding of facts and stating main ideas with general answers

K3– Application oriented –Solving Problems

K4– Examining, analyzing, presentation and make inferences with evidences

Distribution of Section– wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	4	10	—	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	—	—	20	30	50	41.67	42%
K4	—	—	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF PHYSICS					CLASS: III B.Sc			
Sem	Course type	Course code	Course title	Credits	Contact hours/ week	CIA	Ext	Total
V	Core Practical	23U5PCCP5	Practical – V	3	3	25	75	100

Nature of course				
Skill oriented	✓	Employability oriented		Entrepreneurship Oriented

Objective:

- To improve the practical skills in Electricity, optics and Electronics.
- To gain practical knowledge by applying the experimental methods to correlate with the Physics theory
- To develop intellectual communication skills and discuss the basic principles of scientific concepts in a group

S.No	Experiments (Any Seven)
1	Cauchy's Constant
2	$i-i'$ curve – spectrometer
3	Low pass filter, High and Band Pass Filter
4	Biprism – Spectrometer
5	Calibration of High range voltmeter – Potentiometer
6	Absolute Value of Capacitance – BG
7	Voltage Regulator – Zener diode
8	Hartley Oscillator
9	Astable Multi vibrator using discrete components
10	Single Stage CE Amplifier
11	Transistor Characteristics CE mode
12	Logic gates using discrete components – AND, OR, NOT, NAND and NOR Gates

Books for Reference:

1. Advanced Practical Physics, S.P Singh, Pragati Prakasan
2. A course on experiment with He– Ne Laser, R. S. Sirohi, John Wiley & Sons (Asia) Pvt. ltd Electronic lab manual Vol II, Kuriachan T.D, Syam Mohan, Ayodhya Publishing
3. Electronic Laboratory Primer a design approach, S. Poornachandra, B. Sasikala, Wheeler Publishing, New Delhi.
4. M.N.Srinivasan, S.Balasubramanian, R.Ranganathan, A Text Book of Practical Physics, 2007, Sultan Chand & Sons.
5. Indu Prakash & Ramakrishna, A Text Book of Practical Physics, 2011, Kitab Mahal Agencies, New Delhi. .
6. S.R. Govinda Rajan, T. Murugaiyan, S. Sundara Rajan, Practical Physics, 2007, Rochouse& Sons.
7. Practical Physics, Gupta and Kumar, Pragati Prakasan
8. Electronic lab manual Vol I, K A Navas, Rajath Publishing
9. Relevant reference from web Sources

Learning outcome:

On the successful completion of the course, student will be able to

CLOs	Course learning outcomes	Knowledge level
1	Understand the basic laws of physics that can be used to determine the various physical parameters.	Upto K2
2	Apply knowledge of physics and able to construct the relevant circuits.	Up to K3
3	Complete the experiment and the relevant data can be recorded.	Upto K3
4	Analyse the collected data from the experiment and relevant graphs can be drawn.	Upto K4
5	Interpret the results and proper views can be expressed.	Upto K2

The student will be able to appreciate practical methods of determining physical quantities, verify laws of physics and be able to develop experimental skills.

Mapping of CLO's with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO1	3	2		3		2	3
CLO2	3	3	3	3		3	2
CLO3	3	2		3		2	3
CLO4	3	3	2	3		2	2
CLO5	3	2	1	3		2	3

Mapping of CLO's with Pos

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	1	3				
CLO2	1	3	2			
CLO3		3	1			
CLO4	1	3	2			
CLO5		3	2			

DEPARTMENT OF PHYSICS					CLASS:III B.Sc. PHYSICS			
Sem	Course type	Course code	Course title	Credits	Contact hours/ Week	CIA	Ext	Total
V	DE 1	23U5PDET1(A)	Python Programming	4	5	25	75	100

Nature of course				
Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented

Objectives:

- To introduce the python programming language and its versatility
- To enable students to tap the power of data structures built into python.
- To expose the students to the concept of object oriented programming and its benefits over traditional programming paradigms.
- To introduce students to the power of numpy and data visualization tools of python.
- To enable students to write simple programs in python

Unit	Description	Hours	K– level	CLO
I	BASIC PROGRAMMING Introduction – The format() method – data types in python – variables – input() – escape sequences and indentation – basic programs	15	K2	1
II	ADVANCED PROGRAMMING CONCEPTS Operators and expressions – flowcharts – Control flow : conditional and looping statements – FOR statements – programs.	15	K3	2
III	STRINGS AND DATA STRUCTURES Working with strings and built– in functions – list – lambda – tuple – dictionary – set.	15	K4	3
IV	FUNCTIONS AND INTRODUCTION TO OOP Function – recursive functions – module : random – OOP concepts in python – class and objects – simple programs.	15	K3	4
V	NUMPY AND DATA VISUALIZATION Processing arrays with numpy – histogram – box plot – bar chart – scatter plot – pie chart.	15	K4	5

Books for Study:

1. Swapnip Saurav, Learn and Practice Python Programming, 2nd edition, eks publishers, Hyderabad, 2020
Unit 1 : Chapters 1 and 2 (Pages 5– 22, 216– 220)
Unit 2 : Chapter 3 (Pages 24– 39, 221– 225)
Unit 3 : Chapter 4 and 5 (Pages 40– 59, 225– 229,232)
Unit 4 : Chapters 6 and 7 (Pages 60– 65, 77– 78,80– 84)
Unit 5 : Chapters 15 and 19 (Pages 149– 154, 206– 209, 211– 213)

Books for References:

1. Yashwant Kanetkar, Let us Python, 3rd Edition, bpb publishers, New Delhi, 2021.

Web Resources

1. <https://wiki.python.org/moin/BeginnersGuide/Programmers>
2. <https://pyflo.net/>
3. https://www.w3schools.com/python/python_intro.asp
4. <https://www.programiz.com/python-programming/getting-started>
5. <https://docs.python.org/3/tutorial/index.html>

Rationale for Nature of the course:

Students are introduced to Python programming language. Students are trained in data structures and simple data handling techniques including data visualization.

Activities having direct bearing on Skill development / Employability Entrepreneurship:

Students will have lab sessions and practical hands on training in python programming

Pedagogy

Chalk and Board, flipped classroom, Group discussion, Programming assignment, Seminar

Course Designer(s):

1. Mr.S.Sivaramakrishnan

Lecture Schedule

Unit	Topics	Hrs	Mode
Unit I	BASIC PROGRAMMING Introduction – The format() method – data types in python – variables – input() – escape sequences and indentation – basic programs	10	Chalk and Board, PPT, Seminar
	Flipped classroom – Basic programs	5	Flipped classroom / hands– on
Unit II	ADVANCED PROGRAMMING CONCEPTS Operators and expressions – flowcharts – Control flow : conditional and looping statements – FOR statements	10	Chalk and Board, PPT, Seminar
	Flipped classroom – Programming	5	Flipped classroom / hands– on
Unit III	STRINGS AND DATA STRUCTURES Working with strings and built– in functions – list – lambda – tuple – dictionary – set.	10	Chalk and Board, Quiz, Seminar
	Flipped classroom – Programming	5	Flipped classroom / hands– on
Unit IV	FUNCTIONS AND INTRODUCTION TO OOP Function – recursive functions – module : random – OOP concepts in python – class and objects	10	Chalk and Board, PPT, group discussion,
	Flipped classroom – Simple programs	5	Flipped classroom / hands– on
Unit V	NUMPY AND DATA VISUALIZATION Processing arrays with numpy – histogram – box plot – bar chart – scatter plot – pie chart.	15	Chalk and Board, Seminar

Course Learning Outcomes:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Understand the versatility and simplicity of python as a programming language and write simple programs in python	K2
CLO-2	Apply the concepts of conditional branching and looping to achieve complex tasks using python	K3
CLO-3	Analyze, sort and interpret data using various data structures in python.	K4
CLO-4	Use Object Oriented Programming constructs to write code efficient and modular programs using python.	K3
CLO-5	Visualize data using plots and use libraries to perform complex tasks using arrays	K4

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7
CLO-1	3	2	3	2	2	2	2
CLO-2	3	2	3	3	3	3	2
CLO-3	3	3	3	3	2	2	3
CLO-4	3	2	3	2	3	3	2
CLO-5	3	3	3	3	3	3	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	3	2	2	3
CLO2	3	2	3	3	3	2
CLO3	3	2	3	2	2	3
CLO4	3	2	3	2	2	2
CLO5	3	2	3	2	2	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative – Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K– Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K– Level	No. of Questions	K– Leve l		
1	CLO 1	Up to K2	2	K1 & K2	1	K1	2 (K1&K1)	1 (K2)
2	CLO 2	Up to K3	2	K1 & K2	1	K2	2 (K2&K2)	1 (K3)
3	CLO 3	Up to K4	2	K1 & K2	1	K1	2 (K3&K3)	1 (K4)
4	CLO 4	Up to K3	2	K1 & K2	1	K2	2 (K3&K3)	1 (K3)
5	CLO 5	Up to K4	2	K1 & K2	1	K2	2 (K4&K4)	1 (K3)
No. of Questions to be asked			10			5	10	5
No. of Questions to be answered			10			5	5	3
Marks for each question			1			2	5	10
Total marks for each			10			10	25	30

K1– Remembering and recalling facts with specific answers

K2– Basic understanding of facts and stating main ideas with general answers

K3– Application oriented –Solving Problems

K4– Examining, analyzing, presentation and make inferences with evidences

Distribution of Section– wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice
K1	5	4	10	–	19	15.8
K2	5	6	10	10	31	25.8
K3	–	–	20	30	50	41.7
K4	–	–	10	10	20	16.7
Total Marks	10	10	50	50	120	100.00

DEPARTMENT OF PHYSICS				CLASS: III B.Sc. Physics				
Sem.	Course type	Course code	Course title	Credits	Contact hours /week	CIA	Ext	Total
V	DEC1	23U5PDET1(B)	Mathematical Physics	4	5	25	75	100
Nature of course								
Skill oriented		✓	Employability oriented		Entrepreneurship Oriented			

Objectives:

- To know the basic ideas on differentiations and its applications
- To know the basic concepts of higher order differential equations
- To acquire skills in the concept of vectors in high level.
- To apply the knowledge of partial derivatives in real life problems

Unit	Description	Hours	K– level	CLO
I	Differentiation rules and Applications Derivatives of polynomials and exponential functions – derivatives of logarithmic functions – rates of changes in the natural sciences – exponential growth and decay– related rates – linear approximation and differentials – Maximum and minimum values – derivatives affect the shape of a graph – graphing with calculus. Self study :Hyperbolic functions	15	K3	1
II	Differential equations Models – Euler’s method – separable equations – population growth – linear equations –first order – applications – second order differential equations – applications of second order differential equations. Self Study : Series solutions	15	K4	2
III	Partial derivatives Function of several variables – limits and continuity – partial derivatives – chain rule – directional derivatives and gradient vector – maximum and minimum values – applications. Self Study : Linear approximations	15	K2	3
IV	Vector Algebra I Review of vector algebra – addition, multiplication, orthogonal resolution, product of two, three and four vectors, reciprocal and differentiation of vectors – Gradient of scalar – Line, Surface and Volume integrals – Divergence of vector – curl of vector – physical significance – vector identities.	15	K3	4
V	Vector Algebra II Gauss divergence theorem – deduction from Gauss divergence theorem – Stoke’s theorem – deductions from Stoke’s theorem – Green’s theorem in a plane – orthogonal curvilinear coordinates – application of vector to hydrodynamics – Poisson’s equation.	15	K4	5

Books for Study:

1. Calculus Early Transcendentals James Stewart, third Indian reprint, 2018, Cengage Learning India Private limited, Delhi.
Unit I: 3.1, 3.6 – 3.10, 4.1, 4.6.
Unit II: 9.1 – 9.5, 17.1, 17.3
Unit III: 14.1 – 14.3, 14.5 – 14.7.
2. Mathematical Physics with Classical Mechanics Satyaprakash, sixth revised edition, 2016 Reprint, Sultan chand& Sons, Delhi.
Unit IV: 1.1 – 1.6,
Unit V : 1.7 – 1.12, 1.15, 1.19 (a only, c (2))

Books for Reference:

1. Vectors analysis, M. R. Spiegel, Schaum's outline series, MHI, 1974.
2. Mathematical methods in Physical Sciences, Mary L Boas, Wiley Eastern, III Edition, 200
3. Mathematical Methods for Physicists: A concise introduction, – TAI L. CHOW – Cambridge University Press
4. Mathematical physics– Piyooshkumartyagi , RBSA Publishers

Web Resources

1. <https://math24.net/derivatives-logarithmic-functions.html>
2. <https://tutorial.math.lamar.edu/classes/de/introsecondorder.aspx>
3. https://learn.lboro.ac.uk/archive/olmp/olmp_resources/pages/workbooks_1_50_jan2008/Workbook28/28_3_orthog_cvlnr_coords.pdf
4. <https://tutorial.math.lamar.edu/classes/calci/chainrule.aspx>
5. <https://tutorial.math.lamar.edu/classes/calciiii/IteratedIntegrals.aspx>

Rationale for Nature of the course

This course will build up the students to understand the basic ideas of differential and integral calculus and how to apply them in physics.

Activities having direct bearing on Skill development/ Employability/ Entrepreneurship

Solving of problems will develop the analytical skill.

Pedagogy

Chalk and Talk, PPT, Quiz, Group discussion, Seminar, Interaction, Problem solving.

Course Designer(s):

1. Prof T.Vivekanandan
2. Dr. S.Ramakrishnan

Lecture Schedule

Unit	Topics	Hrs	Mode
I	Derivatives of polynomials and exponential functions – derivatives of logarithmic functions	5	Chalk and talk, Quiz and assignment
	rates of changes in the natural sciences – exponential growth and decay– related rates – linear approximation and differentials	5	
	Maximum and minimum values – derivatives affect the shape of a graph – graphing with calculus	5	
II	Models – Euler’s method – separable equations – population growth	5	PPT, Chalk and talk, and Group discussion
	linear equations first order – applications	5	
	Second order differential equations – applications of second order differential equations.	5	
III	Function of several variables – limits and continuity – partial derivatives	5	Quiz and Group discussion
	chain rule – directional derivatives and gradient vector	5	
	Maximum and minimum values – applications.	5	
IV	Review of vector algebra – addition, multiplication, orthogonal resolution, product of two, three and four vectors, reciprocal and differentiation of vectors –	5	PPT, Chalk and talk
	Gradient of scalar – Line, Surface and Volume integrals	5	
	Divergence of vector – curl of vector – physical significance – vector identities.	5	
V	Gauss divergence theorem – deduction from Gauss divergence theorem	5	Chalk and talk, Quiz and Interaction
	Stoke’s theorem – deductions from Stoke’s theorem – Green’s theorem in a plane	5	
	Orthogonal curvilinear coordinates – Application of vector to hydrodynamics –Poisson’s equation.	5	

Course Learning Outcomes:

On the successful completion of the course, students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Collect the different knowledge in various differential polynomials.	K3
CLO-2	Examine the real- life problems using the basic idea of differential equations	K4
CLO-3	Explain the primary ideas of partial differential equations in physics	K2
CLO-4	Develop the physical equations using curl and divergence idea of vectors	K3
CLO-5	Examine the physical problems using the basic idea of vector ideas	K4

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7
CLO-1	3	1	2	3	1	1	1
CLO-2	3	1	2	2	2	1	1
CLO-3	3	1	2	2	2	1	1
CLO-4	3	1	2	1	1	11	3
CLO-5	3	1	2	1	1	3	3

Mapping of CLOs with Pos

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	2	2	1	1
CLO2	3	2	2	2	1	2
CLO3	3	2	2	2	1	1
CLO4	3	2	2	2	1	2
CLO5	3	2	2	2	1	1

Advance application- 3;

Intermediate level-2;

Basic level-1

Summative – Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K– Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K– Level	No. of Questions	K– Level		
1	CLO 1	Up to K3	2	K1 & K2	1	K1	2 (K3& K3)	1 (K3)
2	CLO 2	Up to K4	2	K1 & K2	1	K2	2 (K3& K3)	1 (K4)
3	CLO 3	Up to K2	2	K1 & K2	1	K2	2 (K1& K1)	1 (K2)
4	CLO 4	Up to K3	2	K1 & K2	1	K1	2 (K2& K2)	1 (K3)
5	CLO 5	Up to K4	2	K1 & K2	1	K2	2 (K4& K4)	1 (K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1– Remembering and recalling facts with specific answers

K2– Basic understanding of facts and stating main ideas with general answers

K3– Application oriented –Solving Problems

K4– Examining, analyzing, presentation and make inferences with evidences

Distribution of Section– wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5	4	10	– –	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	–	–	20	30	50	41.67	42%
K4	–	–	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF PHYSICS				CLASS: III B.Sc. Physics				
Sem.	Course type	Course code	Course title	Credits	Contact hours /week	CIA	Ext	Total
V	IDC	23U5PIDT1	Nano science	4	5	25	75	100

Nature of course				
Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented

Course Objectives:

- To understand the field of nano science and nanotechnology
- To gain knowledge about carbon nano tubes

Unit	Description	Hours	K– level	CLO
I	Introduction to Nano materials Definition of Nano meter, Nano material and Nano technology – Broad definition – Narrow definition – Classification of Nano material – Example of Nano structure material – Increased surface area of Nano material.	15	Upto K2	1
II	Growth techniques of Nano materials Top down Vs Bottom up techniques – Evaporation – thermal evaporation techniques – electron beam evaporation – Sol–Gel techniques – Ball milling – Hydrothermal process – hydrothermal process advanced materials – advantages.	15	Upto K2	2
III	Characterization tools of Nano materials X– Ray diffraction and Scherer method – Electron microscopy – Scanning Electron Microscopy (SEM) – SEM techniques – Electron Gun – Specimen Interaction – TEM Analysis.	15	Upto K2	3
IV	Novel Properties of Nano materials Comparison of nano and bulk materials properties – Size and shape dependence physical properties – Optical, Vibrational, thermal, Electrical and Magnetic – Chemical properties– reactivity and catalytic and photo catalytic properties	15	Upto K2	4
V	Carbon Nano materials Synthesis – Arc discharge – Thermal synthesis process – Chemical vapor deposition – Properties and application– Carbon Nano tubes – Single Wall Nano Tube (SWNT) – Multi Wall Nano Tube (MWNT)	15	Upto K2	5

Text Books

1. M.S. Ramachandra Rao, Subra Singh , Nano Science & Nano technology Fundamentals of frontiers, Reprint Edition 2014, Willey India PVT.Ltd.
Unit I: Sections 1.1, 1.2, 1.2.1, 1.2.2, 1.3, 1.3.1, 1.3.2
Unit III: Sections 8.2
2. K.K. Chattopadhyay & A.N. Banerjee. Introduction to Nano Science & Nano technology, 2009, PHI Learning PVT Ltd.
Unit II: Sections 6.1, 6.2, 6.4.3, 6.4.3.1, 6.4.3.2 , 6.4.7 only, 6.4.9(a) only.
Unit III : Sections 7.3, 7.3.1 , 7.3.3 , 7.3.4 , 7.3.5 , 7.3.6 .
3. B.S Murthy P Shankar, Baldev Raj, BB Rath, James Murday, Textbook of Nanosciene and Nanotechnology – – Orient Black swan Private Limited – New Delhi, 2013.
4. Nanostructures & Nanomaterials: Synthesis, Properties & Applications, Guozhong Cao and Ying Wang, World Scientific (2011), ISBN: 13 978–981–4324–55–7 (pbk)
5. Rao, C.N.R., Müller, A. and Cheentham, A.K. (Eds.), “Chemistry of Nanomaterials”, Wiley – VCH. 2005

Books for Reference

1. A.K. Bandyopadhyay, Nanomaterials, II nd Edition, 2010, New Age International Publishers.
2. Vincent Rotello, Nano Particles Building Blocks of Nano technology, 2004, Springer (India) Private Limited.

Web Resources:–

1. <https://www.elprocus.com/nanomaterials-classifications-and-its-properties/>
2. <https://asana.com/resources/top-down-approach>
3. <https://www.sciencedirect.com/topics/chemistry/thermal-evaporation>
4. <https://www.sciencedirect.com/topics/chemistry/sol-gel-process>
5. <https://www.sciencedirect.com/topics/engineering/scanning-electron-microscopy>
6. https://en.wikipedia.org/wiki/Electron_microscope
7. https://www.nanowerk.com/nanotechnology/introduction/introduction_to_nanotechnology_22.php
8. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000831ME/P001852/M030135/ET/1525855083Module-8_unit-3_NSNT.pdf
9. <https://iopscience.iop.org/article/10.1088/1757-899X/146/1/012001/pdf>

Rationale for Nature of the course

The student will be able to comprehend the field of nanoscience and nanotechnology and describe microscope for investigating nanosystems.

Pedagogy

Chalk and Talk, PPT, Quiz, Group discussion, Seminar, Interaction, Problem solving.

Course Designed by

1. Department of Physics
2. Department of Chemistry

Lecture Schedule

Unit	Topics	Hours	Mode
Unit I	Definition of Nano meter, Nano material and Nano technology	3	Chalk and talk, Quiz and assignment
	Broad definition – Narrow definition	3	
	Classification of Nano material – Hydrothermal process– hydrothermal process advanced materials– advantages	3	
	Example of Nano structure material – Increased surface area of Nano material	3	
Unit II	Top down Vs Bottom up techniques	3	PPT, Chalk and talk, and Group discussion
	Evaporation ,thermal evaporation techniques, electron beam evaporation	3	
	Sol – Gel techniques.	3	
	Ball milling.		
Unit III	X– Ray diffraction and Scherrer method	3	PPT, Chalk and talk, Quiz and Group discussion
	Electron microscopy	3	
	Scanning Electron Microscopy (SEM) – SEM techniques	3	
	Electron Gun – Specimen Interaction– TEM analysis	3	
Unit IV	Comparison of nano and bulk materials properties.	3	PPT, Chalk and talk, Assignment
	Size and shape dependence – Physical properties– Optical, vibrational.	3	
	Thermal, Electrical and Magnetic.	3	
	Chemical properties– reactivity and catalytic and photocatalytic properties	3	
Unit V	Synthesis – Arc discharge	3	Chalk and talk, Quiz and Interaction
	Thermal synthesis process– chemical vapor deposition.	3	
	Properties and application– Carbon Nano tubes	3	
	Single Wall Nano Tube (SWNT) – Multi Wall Nano Tube (MWNT)	3	

Course learning Outcomes

On the successful completion of the course, students will be able to

CLO's	Course Learning Outcome	Knowledge level
CLO – 1	Understand the basics of Nanotechnology	Upto K2
CLO – 2	Infers the various types of growth techniques of Nano materials	Upto K2
CLO – 3	Comprehend the various characterization techniques for analyzing nano materials.	Upto K2
CLO – 4	Comprehends the, properties and of nano materials.	Upto K2
CLO – 5	Appreciates the synthesis, properties and applications of Carbon Nano materials	Upto K2

Mapping with CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7
CLO-1	3	2	2	3			1
CLO-2	3	2	3	2			1
CLO-3	3	2	2				2
CLO-4	3	3	2	3			2
CLO-5	3	2	1	2			2

Mapping of CLOs with Pos

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	1	2			
CLO2	3	1	2	1		
CLO3	3	2	2	1		
CLO4	3	1	1		2	
CLO5	3	3	2	1		

Advance application– 3; Intermediate level–2; Basic level–1

Continuous Internal Assessment (CIA): 25 Marks

Components	Total Marks	K Level
Test (Average of two tests) (Conducted for 40 marks and converted into 10 marks)	10	Refer next table
Assignment	5	K2
Seminar	5	K2
Quiz	5	K2
Total	25	

Learning Outcome Based Education & Assessment (LOBE)
Formative – Blue Print –
Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs) for
Interdisciplinary course

Units	CLOs	K– Level	Section A		Section B (Either/or Choice)	Section C (Open Choice)
			Short Answers			
			No of Questions	K – Level		
1	CLOX	Up to K2	2	K1	2(K2&K2)	2(K2)
2	CLOY	Up to K2	1	K1	2(K2&K2)	1(K2)
No. of Questions to be asked			3		4	3
No. of Questions to be answered			3		2	2
Marks for each question			2		7	10
Total Marks for each section			6		14	20

Distribution of Section– wise Marks with K Levels (CIA I & II)

Internal	K – Levels	Section A (No choice)	Section B (Nochoice)	Section C (Either/or)	Total Marks	% of Marks without choice	Consolidated %
CIA I	K1	6	–	–	6	9.38%	100
	K2	–	28	30	58	90.62%	
	Marks	6	28	30	64	100.00	
CIA I	K1	6	–	–	6	9.38%	100
	K2	–	28	30	58	90.62%	
	Marks	6	28	30	64	100.00	

Assessment scheme

Distribution of Section– wise Marks with K Levels

Blueprint for Semester Examination

Units	CLOs	K Level	Section A		Section B		Section C (Open Choice)
			Short Answers		(Either/or Choice)		
			No of Questions	K Level	No of Questions	K Level	
1	CLO 1	Upto K2	1	K1	1	K2&K2	1 (K2)
2	CLO 2	Upto K2	1	K1	1	K2&K2	1 (K2)
3	CLO 3	Upto K2	1	K1	1	K2&K2	1 (K2)
4	CLO 4	Upto K2	1	K1	1	K2&K2	1 (K2)
5	CLO 5	Upto K2	1	K1	1	K2&K2	1 (K2)
No of Questions to be asked			5		5		5
No of Questions to be answered			5		5		3
Marks for each Question			2		7		10
Total Marks			10		35		30

DEPARTMENT OF PHYSICS					CLASS: III B.Sc.,			
Sem.	Course type	Course code	Course title	Credits	Contact hours/ week	CIA	Ext	Total
V	Internship	23U5PINTR	Internship	2	-	-	-	-

Nature of course					
Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	✓

Course Objectives:

1. To motivate students to take up internship in research institutions /industry.
2. To develop the employability of students.
3. To promote entrepreneurial tendencies among students.

During the fourth semester vacation, students shall undertake internship for a minimum period of two weeks and submit a report and certificate from the company/ industry/ institution offering internship.

At the end of the internship, the students will be able to

CLOs	Course Learning Outcomes	K level
CLO1	Work independently and as a team in mission critical projects in real-time	K4
CLO2	Develop into a critical thinker and solve every day problems in the industry.	K4
CLO3	Learn and analyze problems faced by the industry and work force at large.	K4
CLO4	Survey the job market/ understand entrepreneurial opportunities/ research opportunities available to them.	K2
CLO5	Communicate precisely and accurately with team members and supervisors.	K3

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7
CLO-1	2	1	3	3	1	2	3
CLO-2	1	2	2	2	3	3	3
CLO-3	2	3	2	1	3	2	1
CLO-4	2	2	3	3	1	2	3
CLO-5	1	3	2	2	2	1	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	2	1	2	3	3	3
CLO2	1	2	2	3	3	3
CLO3	2	2	3	3	3	3
CLO4	1	2	2	3	3	3
CLO5	1	2	2	3	3	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Valuation schema for Internship

The student will be grade don as even point scale with corresponding GPAs as mentioned below.

Grade	GPA
Outstanding	10
Excellent	9
Very Good	8
Good	7
Average	6
Below average	5
Reappearance	1-4

DEPARTMENT OF PHYSICS					CLASS: III B.Sc			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
VI	Core	23U6PCCT8	Relativity and Quantum Mechanics	4	6	25	75	100
Nature of course								
Skill oriented		✓	Employability oriented		Entrepreneurship Oriented			

Objectives:

- To understand the theory of relativity, its postulates and the consequences.
- To learn the importance of transformation equations and also to differentiate between special and general theory of relativity.
- To interpret the wave theory of matter with various theoretical and experimental evidences.
- To derive and use Schrodinger's wave equation and also learn about various operators.

Unit	Description	Hours	K-level	CLO
I	SPECIAL THEORY OF RELATIVITY – I Frames of reference – Galilean Relativity – Michelson–Morley experiment – postulates of special theory of relativity – Lorentz transformation – Length contraction – time dilation – Doppler effect – variation of mass with velocity.	18	K2	1
II	SPECIAL THEORY OF RELATIVITY –II Transformation of velocity, mass, energy and momentum– velocity addition – Einstein's mass–energy relation– relativistic momentum – pair production – General Theory of Relativity – Principle of equivalence – Other findings of General theory of Relativity.	18	K3	2
III	PHOTONS AND MATTER WAVES Origin of quantum theory – black body radiation – Planck's law – Einstein's photoelectric Effect – Compton effect –De Broglie waves – phase velocity and group velocity – Davisson and Germer's experiment – uncertainty principle .	18	K3	3
IV	OPERATORS AND SCHRÖDINGER EQUATION Postulates of quantum mechanics – Wave function and its interpretation – Schrödinger's equation – linear operators – Eigen value – Hermitian operator – properties of Hermitian operator– operators for position, linear Momentum, – expectation values of position and momentum .	18	K3	4

V	SOLVING SCHRÖDINGER EQUATION FOR SIMPLE PROBLEMS: One– dimensional problems: (i) particle in a box, (ii) barrier penetration problem – quantum mechanical tunneling, (iii) linear harmonic oscillator. Rigid rotator (qualitative)	18	K4	5

Text Book(s):

1. Concepts of Modern Physics, A.Beiser, 7th Ed., McGraw– Hill, 2017.
 Unit I – Chapter : 1.1.1, 1.1.2, 1.2, 1.3, 1.4, page no. 38, 39
 Unit II – Chapter: 1.7, 1.8, 1.9, 1.10, 1.11.12 , pages 40 – 45
 Unit III – Chapter : 2.2, 2.2.2, 2.3, 2.7, 2.8, 3.1, 3.4, 3.5, 3.7
 Unit IV– Chapter 5.1.1, 5.1.2, 5.3, 5.5, 5.6, 5.6.1, 5.7.1, 5.7.2
 Unit V– Chapter : 5.8, 5.10, 5.11.
2. Modern Physics, R. Murugesan, KiruthigaSivaprasath,S. Chand and Co.,17th Revised Edition, 2014.
 Unit IV – Chapter : 12.1
 Unit V – Chapter : 11.15

Books for reference:

1. Fundamentals of Modern Physics, Peter J. Nolan, 1st Edition, 2014.
2. Quantum Mechanics, V. Devanathan, Narosa Pub. House, Chennai, 2005.
3. Quantum Mechanics, V.K. Thangappan, New Age International, New Delhi.
4. A Text Book of Quantum Mechanics, Mathews and Venkatesan, Tata McGraw Hill, New Delhi.
5. Special Theory of Relativity, S.P.Puri, *Pearson Education, India, 2013.*

Web Resources

1. <http://hyperphysics.phy-astr.gsu.edu/hbase/qapp.html>
2. https://swayam.gov.in/nd2_arp19_ap83/preview
3. https://swayam.gov.in/nd1_noc20_ph05/preview
4. <https://www.khanacademy.org/science/physics/special-relativity/minkowski-spacetime/v/introduction-to-special-relativity-and-minkowski-spacetime-diagrams>

Activities having direct bearing on Skill development / Employability Entrepreneurship

This course will help to learn various concepts in quantum mechanics and relativity and build problem solving and experimental skill using them.

Pedagogy

Chalk and talk, materials, PPT, Quiz, Assignment, Seminar, Problem solving, Group discussion, interaction and field visit.

Course Designer(s):

1. Dr.M.Prema Rani
2. Dr.J.SivaSubramanian

Lecture Schedule

Unit	Topics	Hrs	Mode
Unit I	Frames of reference – Galilean Relativity	3	PPT, Chalk and talk, Quiz and assignment
	Michelson– Morley experiment	4	
	postulates of special theory of relativity	3	
	Lorentz transformation – Length contraction – time dilation	4	
	Doppler effect –variation of mass with velocity.	4	
Unit II	Transformation of velocity, mass, energy and momentum	4	Chalk and talk, and assignment
	Velocity addition	2	
	Einstein's mass– energy relation	3	
	relativistic momentum– Principle of equivalence –	5	
	Other findings of General theory of Relativity	4	
Unit III	Origin of quantum theory – black body radiation	3	PPT, Chalk and talk and Quiz
	Planck's law – Einstein's photoelectric Effect	4	
	Compton effect – pair production.	3	
	De Broglie waves – phase velocity and group velocity	4	
	Davisson and Germer's experiment – uncertainty principle	4	
Unit IV	Postulates of quantum mechanics – Wave function and its interpretation	3	PPT, Chalk and talk, Quiz and assignment
	Schrödinger's equation – linear operators.	4	
	Eigen value – Hermitian operator – properties of Hermitian operator	3	
	operators for position, linear Momentum, –.	4	
	expectation values of position and momentum .	4	
Unit V	One– dimensional problems: (i) particle in a box	5	PPT, Chalk and talk
	barrier penetration problem quantum mechanical tunneling	5	
	Linear harmonic oscillator.	4	
	Rigid rotator (qualitative)	4	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CLO	Content	K level
CLO 1	Understand various postulates of special theory of relativity.	K2
CLO 2	Appreciate the importance of transformation equations and also the general theory of relativity..	K3
CLO 3	Realize the wave nature of matter and understand its importance	K3
CLO 4	Derive Schrodinger equation and also realize the use of operators.	K3
CLO 5	Apply Schrödinger equation to simple problems.	K4
K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate		

Mapping of CLOs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	2	3	1
CO2	3	2	1	3	3	1
CO3	3	3	3	2	3	1
CO4	3	3	4	2	3	2
CO5	3	3	3	3	3	3

Mapping of CLOs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	1	1	1	1	1
CO2	3	2	1	1	2	2	2
CO3	3	2	1	1	2	2	2
CO4	3	2	1	1	1	1	1
CO5	3	3	3	1	2	2	2

Assessment Scheme
Summative – Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K– Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K– Level	No. of Questions	K– Level		
1	CLO1	UptoK2	2	K1&K1	1	K1	2(K2&K2)	1(K2)
2	CLO2	UptoK3	2	K2&K1	1	K2	2(K3&K3)	1(K3)
3	CLO3	UptoK3	2	K2&K1	1	K1	2(K1&K1)	1(K3)
4	CLO4	UptoK3	2	K2&K1	1	K2	2(K3&K3)	1(K3)
5	CLO5	UptoK4	2	K2&K2	1	K2	2(K4&K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1– Remembering and recalling facts with specific answers

K2– Basic understanding of facts and stating main ideas with general answers

K3– Application oriented – Solving Problems

K4– Examining, analyzing, presentation and make inferences with evidences

Distribution of Section– wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5	4	10	—	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	—	—	20	30	50	41.67	42%
K4	—	—	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF PHYSICS				CLASS: III B.Sc				
Sem.	Course type	Course code	Course title	Credits	Contact hours/ Week	CIA	Ext	Total
VI	Core	23U6PCCT9	Solid State Physics	4	6	25	75	100

Nature of course				
Skill oriented	✓	Employability oriented		Entrepreneurship Oriented

Objectives:

- To understand crystal lattices and simple crystal structures in crystallography
- To gain knowledge on the X– ray diffraction and different types of bonding in solids.
- To acquire knowledge on the basics of magnetic phenomena on materials and various types of magnetic materials.
- To learn about the dielectric properties of solid materials.
- To explore on the properties of ferroelectric and super conducting materials.

Unit	Description	Hours	K– level	CLO
I	CRYSTAL STRUCTURE: Crystal lattice – Lattice translational vectors –Unit cell – Basis –Two– Dimensional and Three– Dimensional Bravais lattices – – Atomic radius – Density of crystal – Crystal planes and Miller indices – Procedure for finding them– Structure of crystals – Packing fraction of Simple Cubic, Face– Centered and Body Centered Cubic Structures – Structures of NaCl and diamond crystals.	18	K3	1
II	CRYSTAL DIFFRACTION AND CRYSTAL BONDING: X– rays – Bragg's law – X– Ray diffraction experimental methods: Laue method – Powder method – Rotating crystal method – Types of bonding – Ionic bonding – Covalent bonding – Metallic bonding – Van der Waals bonding– Hydrogen bonding – Binding energy of NaCl molecule– Evaluation of Madelung constant for NaCl.	18	K2	2
III	MAGNETIC PROPERTIES OF SOLIDS: Permeability – Susceptibility– Relation between them – Classification of Magnetic Materials – Properties of dia, para, ferromagnetism – Langevin's theory of diamagnetism – Langevin's theory of paramagnetism – Curie– Weiss law – Weiss theory of ferromagnetism – Heisenberg's quantum theory of ferromagnetism –	18	K3	3

	Domain theory of ferromagnetism – Hysteresis – Discussion of B– H curve – Soft and Hard magnetic materials.			
IV	DIELECTRIC PROPERTIES OF MATERIALS: Polarization and Electric Susceptibility – Polarization Processes: Electronic Polarization– Calculation of Polarizability – Ionic, Orientational and Space Charge Polarization – Frequency and temperature effects on polarization– Dielectric loss – Local field or internal field–Clausius– Mosotti relation – Dielectric breakdown and its types.	18	K3	4
V	FERROELECTRICS AND SUPERCONDUCTIVITY: Ferroelectrics – Classification – Curie– Weiss Law – Ferroelectric domains – P– E hysteresis loop – Spontaneous Polarization – Semi conductors – Carrier mobility in Semiconductor – Hall effect – Experimental determination of Hall coefficient – Uses of Hall effect. Superconductivity: Experimental results – Critical temperature –Critical magnetic field – Meissner effect – Type– I and Type– II superconductors – London equations and penetration depth – Isotope effect – Idea of BCS theory (no derivation)	18	K4	5

Booksfor Study:

1. S.L.Kakani, C.Hemrajani, Solid State Physics, 4th Edition, 2005, Sultan Chand & Sons, New Delhi.
Unit 1:Sections1.3– 1.5, 1.7–1.10
Unit 2: Sections 3.2– 3.6, 3.8
Unit 5: Sections9.3, 9.4(f), 9.4(h), 11.11, 14.1, 14.2(a), 14.2(d), 14.5(b), 14.5(c)
2. Dr.M.Arumugam, Materials Science, 3rd Edition, 2002, Anuradha publications, Chennai.
Unit 2: Section3.8
Unit 3: Sections7.1 –7.9
Unit 4:Sections6.1–6.7, 6.9

Books for References:

1. S. O. Pillai – Solid State Physics, Narosa publication
2. Puri and Babber – Solid State Physics – S.Chand and Co. New Delhi.
3. Kittel – Introduction to solid state physics, Wiley and Sons, 7th edition.
4. Raghavan – Materials science and Engineering, PHI
5. Azaroff– Introduction to solids, TMH
6. A.J. Dekker – Solid State Physics, McMillan India Ltd.

7. J.P. Srivastava, Elements of Solid State Physics, 2nd Edition, 2006, Prentice– Hall of India

Web Resources

1. <https://nptel.ac.in/courses/115105099>
2. <https://nptel.ac.in/courses/115106061>
3. <https://mathworld.wolfram.com/MadelungConstants.html>
4. <https://demonstrations.wolfram.com/TheSevenCrystalClasses/>
5. [https://eng.libretexts.org/Bookshelves/Materials_Science/Supplemental_Modules_\(Materials_Science\)/Magnetic_Properties/Diamagnetism](https://eng.libretexts.org/Bookshelves/Materials_Science/Supplemental_Modules_(Materials_Science)/Magnetic_Properties/Diamagnetism)
6. https://en.wikipedia.org/wiki/Meissner_effect

Rationale for Nature of the course:

This course will enable the students to understand the types and properties of bonding and structure of crystalline solids. They will realize the important role of magnetic and electric materials in our day– to– day life.

Activities having direct bearing on Skill development/Employability Entrepreneurship:

Study on theories of magnetic, dielectric and ferroelectric materials will enhance the analytical skill.

Pedagogy

Chalk and Board, PPT, Group discussion, Assignment, Seminar, Quiz.

Course Designer(s):

Dr.G.Gowri

Course Schedule

Unit	Topics	Hrs	Mode
I	Crystal lattice – Lattice translational vectors – Unit cell –Basis	4	Chalk and Board, PPT, Seminar, Test, Quiz
	Two– Dimensional and Three– Dimensional Bravais lattices – Atomic radius – Density of crystal	4	
	Crystal planes and Miller indices – Procedure for finding them	2	
	Structure of crystals – Packing fraction of Simple Cubic, Face– Centered and Body Centered Cubic Structures	5	
	Structures of NaCl and diamond crystals	3	
II	X– rays – Bragg's law – X– Ray diffraction experimental methods: Laue method	4	Chalk and Board, PPT, Seminar, Test, Quiz
	Powder method – Rotating crystal method	2	
	Types of bonding – Ionic bonding – Covalent bonding – Metallic bonding	5	
	Van der Waals bonding– Hydrogen bonding	3	
	Binding energy of NaCl molecule– Evaluation of Madelung constant for NaCl	4	
III	Permeability – Susceptibility– Relation between them – Classification of Magnetic Materials – Properties of dia, para, ferromagnetism	5	Chalk and Board, Quiz, Test, Seminar
	Langevin's theory of diamagnetism – Langevin's theory of paramagnetism – Curie– Weiss law – Weiss theory of ferromagnetism	6	
	Heisenberg's quantum theory of ferromagnetism – Domain theory of ferromagnetism	3	
	Hysteresis – Discussion of B– H curve – Soft and Hard magnetic materials	4	
IV	Polarization and Electric Susceptibility – Polarization Processes: Electronic Polarization	4	Chalk and Board, PPT, group discussion, Seminar, Test, Quiz
	Calculation of Polarizability	3	
	Ionic, Orientational and Space Charge Polarization – Frequency and temperature effects on polarization	4	

	Dielectric loss – Local field or internal field	3	
	Clausius– Mosotti relation – Dielectric breakdown and its types	3	
V	Ferroelectrics – Classification – Curie– Weiss Law – Ferroelectric domains	4	Chalk and Board, Seminar, Quiz, Assignment
	P– E hysteresis loop –Spontaneous Polarization	3	
	Semi conductors – Carrier mobility in Semiconductor – Hall effect – Experimental determination of Hall coefficient – Uses of Hall effect.	5	
	Superconductivity: Experimental results – Critical temperature –Critical magnetic field – Meissner effect –Type– I and Type– II superconductors	3	
	London equations and penetration depth – Isotope effect – Idea of BCS theory (no derivation)	3	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Classify crystal lattices and simple crystal structures in crystallography	K3
CLO2	Understand X– ray diffraction and different types of bonding in solids	K2
CLO3	Give reason for classifying magnetic material on the basis of their behavior.	K3
CLO4	Comprehend the dielectric behavior of materials.	K3
CLO5	Appreciate the ferroelectric and super conducting properties of materials.	K4
K1– Remember; K2–Understand; K3– Apply; K4– Analyze		

Mapping of CLOs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	2	2	2
CO2	2	3	2	3	2	2
CO3	3	2	2	2	2	2
CO4	3	3	3	3	2	2
CO5	3	2	2	3	3	2

Mapping of CLOs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	2	2	2	2	1
CO2	3	2	2	2	2	2	2
CO3	3	2	2	3	2	2	2
CO4	3	2	2	3	2	2	1
CO5	3	2	2	3	2	2	2

Advanceapplication–3;

Intermediatelevel–2;

Basiclevel–1

Summative – Blue – Print
Mode I (Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K– Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K– Level	No. of Questions	K– Level		
1	CLO1	UptoK3	2	K1&K2	1	K1	2(K1&K1)	1 (K3)
2	CLO2	Up toK2	2	K1&K2	1	K2	2(K2&K2)	1 (K2)
3	CLO3	Up toK3	2	K1&K2	1	K1	2(K3&K3)	1 (K3)
4	CLO4	Up toK3	2	K1&K2	1	K2	2(K3&K3)	1 (K3)
5	CLO5	Up to K4	2	K1&K2	1	K2	2(K4&K4)	1 (K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

Distribution of Section– wise Marks with K Levels

K Levels	Section A(No Choice)	Section B(No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5	4	10	–	19	15.8	42%
K2	5	6	10	10	31	25.8	
K3	–	–	20	30	50	41.7	42%
K4	–	–	10	10	20	16.7	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF PHYSICS					CLASS: III B.Sc			
Sem	Course type	Course code	Course title	Credits	Contact hours/ Week	CIA	Ext	Total
VI	Core	23U6PCCT10	Digital Electronics And Microprocessor 8085	4	6	25	75	100
Nature of course								
Skill oriented		✓	Employability oriented		Entrepreneurship Oriented			

Objectives:

1. To introduce digital fundamentals to the students and to study the basic building blocks of Memory and arithmetic circuits which are the back bone of modern computers.
2. To understand the basics of microprocessor

Unit	Description	Hours	K-level	CLO
I	Digital Fundamentals Binary number system – Binary to Decimal conversion Decimal to Binary conversion – BCD Code – Octal number system – Hexadecimal number. Basic gates – Universal Logic Gates – Boolean algebra – NOR gate – NAND gate – Boolean laws and theorems – Sum of products method – truth table to Karnaugh map – Pairs, Quads, and Octets Karnaugh simplifications – Product of Sums method – Product of sums simplification.	18	K3	1
II	Flip– Flops and Multiplexers RS Flip– Flops – Gated Flip– Flops – Edge – Triggered RS FlipFlops– Edge – Triggered D Flip– Flops Edge – Triggered JK FlipFlops– JK Master – slave Flip– Flops– Flip Flop timing– Multiplexers – Multiplexer – 1– of – 16 Decoder – BCD to Decimal decoder – Seven segment Decoders – Encoders – Parity generator and checkers.	18	K2	2
III	Combinational Logic circuits Types of Registers – Serial in – Serial out, Serial in – Parallel out, Parallel in– Serial out, Parallel in– Parallel out – Asynchronous & Synchronous counters (mod 3, mod 4, mod 8 up counters only)– D/A Converters: Variable resistor Networks A/D converter – simultaneous conversion.	18	K3	3

IV	8085 Microprocessor Architecture of 8085 registers, flags, ALU, address and data bus, control bus – Pin out diagram Functions of different pins – 8085 Instruction– Instruction set of 8085– data transfer, arithmetic, logic branching and machine control group of instructions addressing modes register indirect, direct, immediate and implicit addressing modes.	18	K3	4
V	Microprocessor – Programs Simple programs and examples– Addition of two 8– bit numbers– 8– bit subtraction– Addition of two 16– bit numbers– Find larger of two numbers– Find Largest number in a data array– Arrange a series of number in descending order– Find smaller of two numbers– Find the smallest number in a data array– Arrange a data array in ascending order.	18	K3	5

Books for Study:

- Digital Principles and Applications, Malvino, Leach& Saha.8th Edition, McGraw Hill, 1995.
Unit I: 5.1– 5.7,5.10, 6.5, 2.1– 2.2, 3.1– 3.5, 3.7,3.8
Unit II:8.1 8.5,8.6, 8.8, 4.1,4.2,4.4,4.6 ,4.8,4.9
Unit III: 9.1– 9.5, 10.1, 10.3, 12.1, 12.3.5
- Fundamentals of Microprocessor and microcomputers, B.Ram sixth edition Dhanpat Rai Publications
Unit IV: 3.1, 3.1.1, 3.1.2, 3.1.3,3.1.4,3.1.5,3.1.6,4.1, 4.2, 4.3, 4.3.1,4.3.2,4.3.3, 4.3.4,4.3.5.
Unit V :6.1, 6.2, 6.3, 6.4, 6.5 6.20, 6.21, 6.22,6.23,6.24,6.25

Books for References:

- M.Morris Mano, “Digital Design “3rd Edition, PHI, NewDelhi.
- Ronald J. Tocci. “Digital Systems– Principles and Applications” 6/e. PHI. New Delhi. 1999.(UNITS I to IV)
- S.Salivahanaand S. Arivazhagan– Digital circuits and design .
- Microprocessor Architecture, Programming and Applications with the 8085 – Penram International Publishing, Mumbai.– Ramesh S.Gaonakar

Web Resources

- <https://youtu.be/–paFaxTcKI>
- https://youtu.be/s1DSZEaCX_g

Rationale for Nature of the course

This course will enable the students to comprehend the basics of Boolean laws, theorem, registers and will give them a overview about the 8085 microprocessor.

Activities having direct bearing on Skill development / Employability Entrepreneurship

The knowledge of various devices acquired by the students will help them to expose themselves to the basics of signal propagation through optical fibers, fiber impairments, components and devices and system design and also they will become familiar with 8085 microprocessor.

Pedagogy

Chalk and talk, materials, PPT, Quiz, Assignment, Seminar, Problem solving, Group discussion, interaction and field visit.

Course Designer(s):

1. Dr.R.Vishnupriya
2. Dr.S.Angayarkanni

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Binary number system – Binary to Decimal conversion Decimal to Binary conversion	2	PPT, Chalk and talk, Quiz and seminar, Test
	BCD Code – Octal number system – Hexadecimal number system – Gray Code representation.	3	
	Basic gates– Universal Logic Gates	3	
	Boolean algebra – NOR gate– NAND gate– Boolean laws and theorems		
	Sum of products method – Truth table to Karnaugh map – Pairs, Quads, and Octets	3	
	Karnaugh simplifications – Product of Sums method – Product of sums simplification	3	
Unit II	RS Flip– Flops – Gated Flip– Flops s	3	PPT, Chalk and talk, Quiz and seminar, test
	Edge– Triggered RS Flip Flops – Edge– Triggered D Flip– Flop	3	
	Edge– Triggered JK Flip Flops – JK Master– slave Flip– Flops– Flip Flop timing	3	
	Multiplexer – 1– of – 16 Decoder	3	
	BCD to Decimal decoder – Seven segment Decoders– Encoders	3	
	Parity generator and checkers – Magnitude comparator.	3	
Unit III	Types of Registers – Serial in– Serial out Serial in– Parallel out	3	Chalk and talk, Quiz and seminar, test
	Parallel in– serial out .Parallel in – parallel in – parallel out.	3	
	Asynchronous counters – Synchronous counters – Variableresistor Networks	3	
	Binary ladders– D/A Converters– Accuracy and resolution	3	
	A/D converter– simultaneous conversion– Counter method	3	
Unit IV	Architecture of 8085 registers, flags	3	Chalk and talk, Quiz and seminar, test.
	ALU, address and databus, control bus	3	
	Pin out diagram Functions of different pins	3	
	8085 Instruction– Instruction set of 8085– data transfer, arithmetic, logic branching	3	
	machine control group of instructions addressing modes register indirect, direct, immediate and implicit addressing modes.	3	

Unit V	Simple programs and examples	3	PPT, Chalk and talk, Quiz, seminar and assignment
	Addition of two 8– bit numbers– 8– bit subtraction	3	
	Addition of two 16– bit numbers	3	
	Find larger of two numbers– Find Largest number in a data array	3	
	Arrange a series of number in descending order– Find smaller of two numbers–	3	
	Find the smallest number in a data array– Arrange a data array in ascending order	3	

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Learn about number systems, Boolean algebra, logical operation and logic gates	Upto K3
CLO2	Understand the working of adder, subtractors, multiplexers and de multiplexers.	Upto K2
CLO3	Get knowledge on flip– flops and storage devices.	Upto K3
CLO4	Gain inputs on architecture of microprocessor 8085.	Upto K3
CLO5	Develop program writing skills on microprocessor 8085.	Upto K4
K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze		

Mapping of CLOs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	2	2	2
CO2	2	3	2	3	2	2
CO3	3	2	2	2	2	2
CO4	3	3	3	3	2	2
CO5	3	2	2	3	3	2

Mapping of CLOs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	3	3	3	3	3
CO2	2	3	3	2	3	2	3
CO3	3	2	2	3	2	2	2
CO4	3	3	3	2	3	3	3
CO5	3	2	3	3	3	2	3

Advanceapplication–3;

Intermediatelevel–2;

Basiclevel–1

Summative – Blue – Print
Model (Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K– Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K– Level	No. of Questions	K– Level		
1	CLO1	Up toK3	2	K1&K2	1	K1	2(K1&K1)	1 (K3)
2	CLO2	Up toK2	2	K1&K2	1	K2	2(K2&K2)	1 (K2)
3	CLO3	Up toK3	2	K1&K2	1	K1	2(K3&K3)	1 (K3)
4	CLO4	Up toK3	2	K1&K2	1	K2	2(K3&K3)	1 (K3)
5	CLO5	Up toK4	2	K1&K2	1	K2	2(K4&K4)	1 (K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

Distribution of Section– wise Marks with K Levels

K Levels	Section A(No Choice)	Section B(No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5	4	10	–	19	15.8	42%
K2	5	6	10	10	31	25.8	
K3	–	–	20	30	50	41.7	42%
K4	–	–	10	10	20	16.7	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF PHYSICS					CLASS: III B.Sc			
Sem	Course type	Course code	Course title	Credits	Contact hours/ week	CIA	Ext	Total
VI	Core Practical	23U6PCCP6	Practical – VI	3	3	25	75	100
Nature of course								
Skill oriented		✓	Employability oriented		Entrepreneurship Oriented			

Objective:

- To improve the practical skills in Electricity, optics and Electronics.
- To gain practical knowledge by applying the experimental methods to correlate with the Physics theory
- To develop intellectual communication skills and discuss the basic principles of scientific concepts in a group

S.No	Experiments (Any Seven)
1	Oblique Incidence- grating
2	Small angled prism
3	Potentiometer – Conversion of G to V
4	B.G. Figure of Merit
5	Potentiometer – Calculation of R and ρ
6	Rydberg Constant
7	OP Amp – Adder , Integrator, Subtractor and Differentiator
8	Universality of NAND or NOR
9	Half Subtractor and Full Subtractor
10	Microprocessor 8085 – simple programs
11	Monte Carlo simulation (value of pi) using MS– Excel.
12	Python Programming : Curve fitting by Least square method

Books for Reference:

1. Advanced Practical Physics, S.P Singh, Pragati Prakasan
2. A course on experiment with He– Ne Laser, R. S. Sirohi, John Wiley & Sons (Asia) Pvt. ltd Electronic lab manual Vol II, Kuriachan T.D, Syam Mohan, Ayodhya Publishing
3. Electronic Laboratory Primer a design approach, S. Poornachandra, B. Sasikala, Wheeler Publishing, New Delhi.
4. M.N.Srinivasan, S.Balasubramanian, R.Ranganathan, A Text Book of Practical Physics, 2007, Sultan Chand & Sons.
5. Indu Prakash & Ramakrishna, A Text Book of Practical Physics, 2011, Kitab Mahal Agencies, New Delhi. .
6. S.R. Govinda Rajan, T. Murugaiyan, S. Sundara Rajan, Practical Physics, 2007, Rochouse& Sons.
7. Practical Physics, Gupta and Kumar, Pragati Prakasan
8. Electronic lab manual Vol I, K A Navas, Rajath Publishing
9. Relevant reference from web Sources

Learning outcome:

On the successful completion of the course, student will be able to

CLOs	Course learning outcomes	Knowledge level
1	Understand the basic laws of physics that can be used to determine the various physical parameters.	Upto K2
2	Apply knowledge of physics and able to construct the relevant circuits.	Up to K3
3	Complete the experiment and the relevant data can be recorded.	Upto K3
4	Analyse the collected data from the experiment and relevant graphs can be drawn.	Upto K4
5	Interpret the results and proper views can be expressed.	Upto K2

The student will be able to appreciate practical methods of determining physical quantities, verify laws of physics and be able to develop experimental skills.

Mapping of CLO's with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO1	3	2		3		2	3
CLO2	3	3	3	3		3	2
CLO3	3	2		3		2	3
CLO4	3	3	2	3		2	2
CLO5	3	2	1	3		2	3

Mapping of CLO's with Pos

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	1	3				
CLO2	1	3	2			
CLO3		3	1			
CLO4	1	3	2			
CLO5		3	2			

DEPARTMENT OF PHYSICS				CLASS: III BSc PHYSICS				
Sem	Course type	Course code	Course title	Credits	Contact hours/ Week	CIA	Ext	Total
VI	DEC 2	23U6PDET2 (A)	Spectroscopy and Fiber Optics	2	4	25	75	100

Nature of Course				
Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented

Objectives:

This course allows the students

- To impart the knowledge of Spectroscopy to extract the dynamic information about the molecules
- To understand atomic and molecular spectra and the instrument techniques.
- To gain information about fibre optic communication.

Unit	Description	Hours	K– level	CLO
I	Microwave Spectroscopy Introduction– Microwave spectroscopy – sources and detector –Microwave Oven— Techniques and instrumentation – Nuclear magnetic resonance spectroscopy –Nuclear quadruple resonance spectroscopy – Electron spin resonance spectroscopy– Mossbauer Spectroscopy.	12	Up to K2	1
II	Infra red Spectroscopy Instrumentation and Techniques in Infrared spectroscopy –Sources – mono chromators – Sample cells – Detectors – Single beam Infrared spectrometer – Double beam Infrared spectrometer – vibrating diatomic molecules	12	Up to K3	2
III	Raman Spectroscopy Raman Spectroscopy – Quantum theory of Raman Effect– Instrumentation and Techniques in Raman Spectrometer– Introduction of Mass Spectrometer– Ion Sources– Mass analyzer– Detector and Data System	12	Up to K4	3
IV	Fibre Optics I Introduction – Optical fibre – Necessity of cladding – Optical fibre cable – Total internal reflection – Propagation of light through optical fibre – Critical angle propagation – Acceptance angle – Fractional refractive index change – Numerical aperture.	12	Up to K3	4

V	Fibre Optics II Types of rays – Meridional and Skew rays - Classification of optical fibres – Single mode step index fibre – Multimode step index fibre – Graded index fibre – Applications of optical fibre – Fibre optic communication system and Applications– Advantageous and disadvantages of optical fibre.	12	Up to K3	5

Books for Study:

1. Fundamentals of Molecular Spectroscopy – Colin N Banwell and Elaine– M McCash Fifth Edition 2013,
Unit I: 1.1, 1.2, 1.3, 2.1, 2.5, 2.7, 7.2, 7.3.4, 7.5.1, 9.1
Unit II: 3.8.1, 3.8.2, 3.1, 3.2, 3.3
Unit III: 4.1.1, 4.6, 10.1, 10.1.1– 10.1.3
2. Brijlal, Subramaniam, Avadhanulu, A text Book of Optics, 2014, S.Chand & Co. Ltd.
Unit IV: 24.1, 24.2, 24.2.1 – 24.2.3, 24.3, 24.4, 24.4.1– 24.4.2, 24.5, 24.6.
Unit V: 24.9, 24.10, 24.11.1– 24.11.3, 24.20, 24.21, 24.22, 24.22.1.

Books for References:

1. Molecular structure and spectroscopy – G.Aruldhass, PHI Pvt Ltd, , II Edition, New Delhi, 2007.
2. Subir Kumar Sarkar, Optical Fibres and Fibre optic communication systems, 2003, S.Chand & Co. Ltd.

Web Resources

Spectroscopy and Instrumentation:

1. http://loke.as.arizona.edu/~ckulesa/camp/spectroscopy_intro.html
2. <https://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/spectrpy/spectro.htm>
3. https://chem.libretexts.org/Courses/Northeastern_University/10%3A_Spectroscopic_Methods/10.1%3A_Overview_of_Spectroscopy
4. http://delloyd.50megs.com/MOBILE/infrared_spectroscopy.html
5. <https://teaching.shu.ac.uk/hwb/chemistry/tutorials/molspec/irspec3.htm>

Fibre Optics:

6. <https://courses.lumenlearning.com/physics/chapter/25-4-total-internal-reflection/>
7. <https://vlab.amrita.edu/?brch=189&cnt=1&sim=343&sub=1>
8. https://www.brainkart.com/article/The-Fiber-Optic-Communication-System--Principle,Working,-and-Advantages_6891/

Rationale for Nature of the course

This course will help to learn various concepts in spectroscopy & fibre optics and their applications in spectroscopic studies, fibre communication field etc.

Activities having direct bearing on Skill development / Employability

Entrepreneurship

The students can apply spectroscopic concepts to various physical problems. Derivations and discussions on theories of fibre optics will develop the analytical skill.

Pedagogy

Chalk and talk, materials, PPT, Quiz, Assignment, Seminar, Problem solving, Group discussion, interaction and field visit.

Course Designer(s):

1. Prof. V Meenakshi Sundaram
2. Dr. J. Sivasubramanian

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Spectroscopy introduction– Microwave spectroscopy	2	PPT, Chalk and talk, Quiz, Seminar, and Test
	sources and detector – Microwave Oven— Techniques and instrumentation	3	
	Nuclear magnetic resonance spectroscopy – Nuclear quadrupole resonance spectroscopy	3	
	Electron spin resonance spectroscopy– Mossbauer Spectroscopy.	4	
Unit II	Instrumentation and Techniques in Infrared spectroscopy	3	Chalk and talk, Quiz, Seminar, and Test
	Sources – monochromators – Sample cells – Detectors	3	
	Single beam Infrared spectrometer – Double beam Infrared spectrometer	3	
	vibrating diatomic molecules	3	
Unit III	Raman Spectroscopy – Quantum theory of Raman Effect	3	Chalk and talk, Quiz, Seminar and Assignment
	Instrumentation and Techniques in Raman Spectrometer	3	
	Introduction of Mass Spectrometer– Ion Sources	3	
	Mass analyzer– Detector and Data System	3	
Unit IV	Introduction , Optical fibre , necessity of cladding	2	PPT, Chalk and talk, Quiz, Seminar, Group discussion and Test
	optical fibre cable ,Total internal reflection	3	
	propagation of light through optical fibre	2	
	critical angle propagation, acceptance angle	3	
	fractional refractive index change , Numerical aperture.	2	
Unit V	Types of rays , Classification of optical fibres	2	PPT, Chalk and talk, Quiz, Seminar and Test
	Single mode step index fibre , Multimode step index fibre , Graded index fibre	3	
	Applications of optical fibre	2	
	Fibre optic communication system and Applications	3	
	Advantageous and disadvantages of optical fibre.	2	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
1	Understanding the spectroscopic knowledge to determine the molecular functions	K2
2	Apply the various instrumentation knowledge to identify the different types of molecules	K3
3	Categorize the instrumentation technique to analyse the mass of the molecules	K4
4	Collect the basic principles of fibre optics	K3
5	Develop the knowledge in different modes of optical fibres.	K3

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO6	PSO 7
CLO-1	3	3	2	2	1	2	2
CLO-2	3	2	3	2	2	2	2
CLO-3	3	2	3	1	3	2	2
CLO-4	3	3	2	2	2	2	1
CLO-5	3	2	3	3	3	2	3

Mapping of CLOs with Pos

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	3	1	2	2
CLO2	3	3	2	2	2	1
CLO3	3	2	2	2	2	1
CLO4	3	2	3	2	1	2
CLO5	3	3	2	2	2	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative – Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K– Level	Section– A		Section– B		Sec– C	Sec– D
			MCQs.		Short Answers		(Either OR)	Open Choice
			No. of Questions	K– Level	No. of Questions	K– Level		
1	CLO1	UptoK2	2	K1&K2	1	K1	2(K1&K1)	1(K2)
2	CLO2	UptoK3	2	K1&K2	1	K2	2(K2&K2)	1(K3)
3	CLO3	UptoK4	2	K1&K2	1	K2	2(K4&K4)	1(K4)
4	CLO4	UptoK3	2	K1&K2	1	K2	2(K3&K3)	1(K3)
5	CLO5	UptoK3	2	K1&K2	1	K1	2(K3&K3)	1(K3)
No. of Questions to be asked			10			5	10	5
No. of Questions to be answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each section			10			10	25	30

K1– Remembering and recalling facts with specific answers

K2– Basic understanding of facts and stating main ideas with general answers

K3– Application oriented –Solving Problems

K4– Examining, analyzing, presentation and make inferences with evidences

Distribution of Section– wise Marks with K Levels

K Levels	Section A(No Choice)	Section B(No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5	4	10	–	19	15.8	42%
K2	5	6	10	10	31	25.8	
K3	–	–	20	30	50	41.7	42%
K4	–	–	10	10	20	16.7	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF PHYSICS					CLASS: III B.Sc			
Sem	Course type	Course code	Course title	Credits	Contact hours/ Week	CIA	Ext	Total
VI	DEC 2	23U6PDET2(B)	Numerical Methods With C++	2	4	25	75	100

Nature of Course						
Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented		

Objectives:

- To make students to understand different numerical approaches to solve a problem.
- To understand the basics of programming.

Unit	Description	Hours	K-level	CLO
I	UNIT I: Solutions of Equations Solution of algebraic and transcendental equations – Sufficient condition for convergence of iterations – Roots of algebraic equations and transcendental equations using Newton-Raphson method – Rate of Convergence of Newton's method – conditions for convergence of Newton-Raphson method.	12	K2	1
II	UNIT II: Linear System of Equations Solution of linear algebraic equations–Gaussian elimination method – Gauss Jordan method – Iterative Method – Gauss Jacobi Iterative Method – Gauss– seidal Iterative method – Inverse of a Matrix –Gauss Jordanmethod– Eigen values and eigenvectors.	12	K4	2
III	UNIT III: Interpolation Interpolation – Lagrange interpolation formula for unequal intervals – Inverse Interpolation – Divided difference – Newton's Divided difference formula – Finite difference – Newton forward and backward interpolation.	12	K3	3
IV	UNIT IV: Differentiation, Integration And Solution Of Differential Equations Numerical integration – Trapezoidal rule – Simpson's 1/3 rule – Gauss quadrature formula – Gauss two point formula – Gauss quadrature three point formula– Euler's method and Runge Kutta methods.	12	K4	4

V	UNIT V: Programming With C++ Operators – Features of iostream.h– C in & C out instructions – if...else statement – For loop – Programs for the following computational methods: (a) Smallest positive – negative root by the bisection method, (b) Smallest positive – negative root by Newton– Raphson method,(c) Newton’s forward and backward interpolation, Lagrange Interpolation, (d) Numerical integration using Trapezoidal and Simpson’s Rules.	12	K3	5

Books for Study:

1. Dr. A. Singaravelu, Numerical Methods, Meenakkshi Agency, Chennai, Revised edition 2017
Unit I – Chapter 1 – 1.1-1.40
Unit II – Chapter 1 – 1.41- 1.114
Unit III – Chapter 2- 2.1 – 2.84
Unit IV – Chapter 3 & 4 – 3.26, 3.27, 3.55, 3.64, 4.25, 4.43
2. D. Ravichandran, Programming with C++, 3rd Edition Tata McGraw – Hill Pub. Co. Ltd., New Delhi
Unit V – Chapter 1, 2 & 3 – 1.3, 2.4, 3.1, 3.2
3. T. Veerarajan& T. Ramachandran, 2004, Numerical Methods with programs in C and C++, Tata McGraw Hill Publishing company limited

Books for References:

1. V. Rajaraman, 1993, Computer oriented Numerical Methods, 3rd Edition. PHI, New Delhi
2. M. K .Jain, S. R. Iyengar and R. K. Jain, 1995, Numerical Methods for Scientific and Engineering Computation, 3rd Edition, New Age Intl., New Delhi
3. S. S. Sastry, Introductory Methods of Numerical analysis, PHI, New Delhi
4. F. Scheid, 1998, Numerical Analysis, 2nd Edition, Schaum’s series, McGraw Hill, New York
5. W. H. Press, S. A. Teukolsky, W. T. Vetterling and B. P. Flannery, 1992, Numerical Recipes in FORTRAN, 2nd Edition, Cambridge Univ. Press.

Web Resources

1. [https://www.scribd.com/doc/202122350/Computer– Oriented– Numerical– Methods– by– V– RajaRaman](https://www.scribd.com/doc/202122350/Computer-Oriented-Numerical-Methods-by-V-RajaRaman)
2. [https://www.scirp.org/\(S\(lz5mqp453edsnp55rrgjt55\)\)/reference/referencespapers.aspx?referenceid=1682874](https://www.scirp.org/(S(lz5mqp453edsnp55rrgjt55))/reference/referencespapers.aspx?referenceid=1682874)
3. <https://nptel.ac.in/course/122106033/>
4. <https://nptel.ac.in/course/103106074/>
5. https://onlinecourses.nptel.ac.in/noc20_ma33/preview

Rationale for Nature of the course

When the computer is used to find a solution for a specific mathematical model (problem which can be modeled using mathematical equations) we can say that Numerical method in C++ is used.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Numerical methods give an in– depth introduction to mathematical methods used in modern physics, and it concentrates on different approaches and techniques that help to solve a variety of problems in theoretical and applied areas of physics. It will review and develop methods of Complex Analysis and their applications to the calculation of integrals, finding and analyzing solutions of differential equations which appear in physical problems.

Pedagogy

Chalk and talk, materials, PPT, Quiz, Assignment, Seminar, Problem solving, Group discussion and interaction.

Course Designer(s):

1. Dr. R. Vishnu Priya
2. Dr. M. Revathi

Lecture Schedule

Unit	Topics	Hrs	Mode
Unit I	Solution of algebraic equation and transcendental equations –Sufficient condition for convergence of iterations.	4	PPT, Chalk and talk, Quiz, assignment and seminar
	Roots of polynomials, nonlinear algebraic equations and transcendental equations using Bisection and Newton-Raphson methods	4	
	Convergence of solutions in Bisection and Newton-Raphson methods – conditions of Bisection and Newton-Raphson methods.	4	
Unit II	Solution of linear algebraic equations–Gaussian elimination method	4	PPT, Chalk and talk, Quiz, assignment and seminar
	Gauss Jordan method – Iterative Method – Gauss Jacobi Iterative Method	4	
	Gauss– seidal Iterative method – Inverse of a Matrix –Gauss Jordan method – Eigen values and eigenvectors.	4	
Unit III	Interpolation – Lagrange interpolation formula for unequal intervals.	4	PPT, Chalk and talk, Quiz, assignment and seminar
	Inverse Interpolation – Divided difference – Newton’s Divided difference formula	4	
	Finite difference – Newton forward and backward interpolation.	4	
Unit IV	Numerical integration – Trapezoidal rule – Simpson’s 1/3 rule.	4	PPT, Chalk and talk, Quiz, assignment and seminar
	Error estimates – Gauss quadrature formula – Gauss two point formula	4	
	Gauss quadrature three point formula– Euler’s method and RungeKutta methods.	4	
Unit V	Operators – Features of iostream.h– Cin & Cout instructions – if...else statement – For loop.	4	PPT, Chalk and talk, Quiz, assignment and seminar
	Programs for the following computational methods: (a) Smallest positive – negative root by the bisection method, (b) Smallest positive – negative root by Newton– Raphson method.	4	
	(c) Newton’s forward and backward interpolation, Lagrange Interpolation, (d) Numerical integration using Trapezoidal and Simpson’s Rules.	4	

Course Learning Outcomes:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Recall the transcendental equations and analyze the different root finding methods. Understand the basic concept involved in root finding procedure such as Newton Raphson and Bisection methods, their limitations.	K2
CLO-2	Relate Simultaneous linear equations and their matrix representation Distinguish between various methods in solving simultaneous linear equations.	K4
CLO-3	Understand how interpolation will be used in various realms of physics and Apply to some simple problems Analyze the newton forward and backward interpolation.	K3
CLO-4	Recollect and apply methods in numerical differentiation and integration. Assess the trapezoidal and Simson's method of numerical integration.	K4
CLO-5	Understand the basics of C++ programming and conditional statements.	K3

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7
CLO-1	3	2	2	3	2		
CLO-2	3	2	2	3	2		
CLO-3	3	2	2	3	2		
CLO-4	3	2	2	3	2		
CLO-5	3	2	2	3	2		

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	2	2	2	3
CLO2	3	2	2	2	2	3
CLO3	3	2	2	2	2	3
CLO4	3	2	2	2	2	3
CLO5	3	2	2	2	2	3

Advance application- 3;**Intermediate level-2;****Basic level-1**

Assessment Scheme
Blue print for Semester Examination

Units	CLOs	K– Level	Section A		Section B		Section C(Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K– Level	No. of Questions	K– Level		
1	CLO1	Up to K2	2	K1&K2	1	K1	2 (K1&K1)	1(K2)
2	CLO2	Up to K4	2	K1&K2	1	K2	2 (K4&K4)	1(K4)
3	CLO3	Up to K3	2	K1&K2	1	K2	2 (K3&K3)	1(K3)
4	CLO4	Up to K4	2	K1&K2	1	K2	2 (K3&K3)	1(K3)
5	CLO5	Up to K3	2	K1&K2	1	K1	2(K2&K2)	1(K3)
No. of Questions to be Asked			10			5	10	5
No. of Questions to be Answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each Section			10			10	25	30

K1– Remembering and recalling facts with specific answers

K2– Basic understanding of facts and stating main ideas with general answers

K3– Application oriented–Solving Problems

K4– Examining, analyzing, presentation and make inferences with evidences

Distribution of Section– wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	4	10	– –	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	–	–	20	30	50	41.67	42%
K4	–	–	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF PHYSICS					CLASS:III B.Sc. PHYSICS			
Sem	Course type	Course code	Course title	Credits	Contact hours/ Week	CIA	Ext	Total
VI	SEC	23U6PSED8	Professional Competency Skill	2	2	25	75	100

Nature of course						
Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented		

Objectives:

- To orient students to General Studies paper for TNPSC Group I / II examination.
- To enable students to critically answer reasoning questions in general science and mental ability.
- To expose students to objective physics and numerical ability questions at the level of TNPSC / UPSC in General studies.

Unit	Description	Hours	K-level	CLO
I	Numerical ability – I Simplification – numbers – ratio and proportion – Percentage	6	K3	1
II	Numerical ability – II Profit and loss – averages and mixtures – time and work – simple interest and compound interest	6	K4	2
III	Numerical ability – III Statistics – Data interpretation	6	K4	3
IV	Reasoning Alphanumeric reasoning – visual reasoning	6	K3	4
V	General Science Everyday physics	6	K4	5

Books for Study:

1. Sura's guide for TNPSC / UPSC General Studies, V.V.K.Subburaj, Sura Publishers, New Delhi (2024)
Unit V: Chapter 6 – General Science
2. Manual for TNPSC examinations (General studies) Group I, II & IV, M.Karthikeyan,
McGraw Hill Education (India) Pvt. Ltd., New Delhi (2020)
Unit I : Part Ten ; Chapter 1– 4
Unit II : Part Ten : Chapter 5– 8
Unit III : Part Ten : Chapter 10– 11
Unit IV : Part Ten : Chapter 12– 13

Books for References:

1. Hugh D Young, Roger A Freedman, A Lewis Ford, Sears and Zemansky's University Physics with Modern Physics, Addison Wesley (2015)
2. Paul G Hewitt, Conceptual Physics, 13th Edition, Pearson India (2024)

Rationale for Nature of the course:

Students learn to solve critical analytical questions related to general science paper for TNPSC which will orient and help students to clear TNPSC examination and get placed in ministerial service of Govt, of Tamilnadu.

Activities having direct bearing on Skill development / Employability Entrepreneurship:

Students solve analytical questions and objective questions in physics at the level of TNPSC Group I examination.

Pedagogy

Chalk and Board, flipped classroom, Group discussion, Programming assignment, Seminar.

Course Designer(s):

1. Dr.K.Neyvasagam
2. Mr.S.Sivaramakrishnan

Lecture Schedule

Unit	Topics	Hrs	Mode
Unit I	Numerical ability – I Simplification – numbers – ratio and proportion – Percentage	3	Chalk and Board, PPT, Seminar
	Flipped classroom – Solving Objective questions	3	Flipped classroom / hands– on
Unit II	Numerical ability – II Profit and loss – averages and mixtures – time and work – simple interest and compound interest	3	Chalk and Board, PPT, Seminar
	Flipped classroom – Solving Objective questions	3	Flipped classroom / hands– on
Unit III	Numerical ability – III Statistics – Data interpretation	3	Chalk and Board, Quiz, Seminar
	Flipped classroom – Solving Objective questions	3	Flipped classroom / hands– on
Unit IV	Reasoning Alphanumeric reasoning – visual reasoning	3	Chalk and Board, PPT, group discussion,
	Flipped classroom – Solving Objective questions	3	Flipped classroom / hands– on
Unit V	Every day Physics General Physics	6	Chalk and Board, Seminar Flipped classroom / hands– on

Course Learning Outcomes:

CLOs	Course Learning Outcomes	Knowledge Level
CLO–1	Apply numeracy to solve problems related to ratios and percentages	K3
CLO–2	Analyze and solve problems related to work– time and mixtures	K4
CLO–3	Statistically analyze raw data and provide meaning information and insights.	K4
CLO–4	Use reasoning to logically arrive at solutions for problems.	K3
CLO–5	Use laws of physics to everyday situations and reason why physical systems have certain properties.	K4

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7
CLO-1	3	2	3	2	2	2	2
CLO-2	3	2	3	3	3	3	3
CLO-3	3	3	3	3	2	2	2
CLO-4	3	2	3	2	3	3	3
CLO-5	3	3	3	3	3	3	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	3	2	2	3
CLO2	3	2	3	3	3	2
CLO3	3	2	3	2	2	3
CLO4	3	2	3	2	2	2
CLO5	3	2	3	2	2	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative – Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K– Level	Section A		Section B		Section C (Open Choice)
			MCQs		Paragraph Answers (Open Choice)		
			No. of Questions	K– Level	No. of Questions	K– Level	
1	CLO 1	Up to K3	6	K3	1	K1	1 (K3)
2	CLO 2	Up to K4	6	K4	1	K2	1 (K3)
3	CLO 3	Up to K4	6	K4	1	K2	1 (K2)
4	CLO 4	Up to K3	6	K3	1	K3	1 (K2)
5	CLO 5	Up to K4	6	K4	1	K3	1 (K2)
No. of Questions to be asked			30			5	5
No. of Questions to be answered			30			3	3
Marks for each question			1			5	10
Total marks for each			30			15	30

K1– Remembering and recalling facts with specific answers

K2– Basic understanding of facts and stating main ideas with general answers

K3– Application oriented –Solving Problems

K4– Examining, analyzing, presentation and make inferences with evidences

Distribution of Section– wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Open Choice)	Section C (Open Choice)	Total Marks	% of Marks with choice
K1	–	5	–	5	4.8
K2	–	10	30	40	38.1
K3	12	10	20	42	40.0
K4	18	–	–	18	17.6
Total Marks	30	10	50	105	100.00

DEPARTMENT OF PHYSICS				CLASS III B.Sc.				
Sem.	Course type	Course code	Course title	Credits	Contact hours/ week	CIA	Ext.	Total
VI	Project	23U6PROV	Project	2	3	25	75	100

Nature of course					
Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

Course Objectives:

- To motivate students in research methodology
- To promote the experimental and analytical knowledge
- To enhance the knowledge of preparation of project report.

During the sixth semester, students shall undertake a project work and submit the project report.

CLOs	Course Learning Outcomes	K level
CLO1	Identify the scientific problem by identifying gaps in understanding.	K4
CLO2	Design a scientific study taking practical constraints into account	K4
CLO3	Perform the scientific study taking practical constraints into account.	K3
CLO4	Analyze the results.	K4
CLO5	Communicate the findings based on ethical standards of reporting.	K3

Mapping of CLOs with Pos

#	PO1	PO2	PO3	PO4	PO 5	PO 6
CLO1	3	3	3	3	3	3
CLO2	3	3	3	3	3	3
CLO3	3	3	3	3	3	3
CLO4	3	3	3	3	3	3
CLO5	3	3	3	3	3	3

Advanceapplication–3,I ntermediatelevel –2,Basiclevel–1

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	3	3	3	3	3	
CLO2	3	3	3	3	3	
CLO3	3	3	3	3	3	
CLO4	3	3	3	3	3	
CLO5	3	3	3	3	3	

Advanceapplication–3, Intermediatelevel –2, Basiclevel–1

Internal & External Valuation for Project

Internal(25marks)	External(75 marks)
Guide Evaluation: 1.10 Marks for Students ability and interest 2.10 Marks for Regularity and Punctuality 3.5Marksfor Quality of the work and Presentation	External Evaluation: 1.25MarksforViva voce. 2.50Marksforreport, Presentation, Quality of work (in the presence of HOD every guide jointly with external examiner)



The Madura College, Madurai – 625 011
Department of Physics
PROGRAMME STRUCTURE – B.Sc. PHYSICS

Course Code	Title of the Course	Hours	Credits	Nature of Course (Employability/ Entrepreneurship/ Skill Development)			Scope of Focus (Local / National / Global developmental needs)			Percentage of Syllabus Revision/ New
				Empl	Ent	Skill	Local	National	Global	
23U1PCCT1	Properties of Matter and Acoustics	5	5			Y			Y	28
23U1PCCP1	Practical – I	3	3			Y			Y	61
23U1PGET1/ 23U3PGET1	Allied Physics – I	4	4			Y			Y	73
23U1PGEP1/ 23U3PGEP1	Allied Practical – I	2	1			Y			Y	61
23U1PFCT1	Introductory Physics	2	2			Y			Y	100
23U1PSED1	Physics of Everyday Life	2	2			Y			Y	100
23U2PCCT2	Heat, Thermodynamics and Statistical Physics	5	5			Y			Y	39
23U2PCCP2	Practical – II	3	3			Y			Y	50
23U1PGET1/ 23U3PGET1	Allied Physics – II	4	4			Y			Y	62
23U1PGEP1/	Allied Practical – II	2	1			Y			Y	50

23U3PGEP1										
23U2PSED2	Astrophysics	2	2			Y			Y	100
23U2PSED3	Basic Instrumentation	2	2			Y			Y	0
23U3PCCT3	Mechanics	4	4			Y				39.6
23U3PCCP3	Practical – III	3	3			Y				66.6
23U3PSED4	Electrical wiring	2	2	Y		Y				New
23U3PSED5	Biomedical Instrumentation	2	2			Y				10
23U4PCCT4	Optics and LASER Physics	4	4			Y				55
23U4PCCP4	Practical – IV	3	3			Y				50
23U4PSED6	Energy Physics	2	2			Y				07
23U4PSED7	Science of Materials	2	2			Y				New
23U5PCCT5	Electricity, Magnetism and Electromagnetism	5	4			Y				10
23U5PCCT6	Atomic and Nuclear Physics	5	4			Y				16
23U5PCCT7	Analog and Communication Electronics	5	4	Y	Y	Y				20
23U5PCCP5	Practical – V	3	3			Y				No change
23U5PDET1(A)	PYTHON Programming	5	4			Y				New
23U5PDET1(B)	Mathematical Physics					Y				17
23U5PIDCT	NanoScience	5	4	Y		Y				No change
23U5VENT1	Value Education	2	2			Y				
23U5PINTR	Industrial Visit/ Internship	0	2			Y				New

	Field Visit									
23U6PCCT8	Relativity and Quantum Mechanics	6	4			Y				No change
23U6PCCT9	Solid state Physics	6	4			Y				25
23U6PCCT10	Digital Electronics and Microprocessor 8085	6	4			Y				20
23U6PCCP6	Practical – VI	3	3			Y				No change
23U6PDET2(A)	Spectroscopy and Fibre Optics	4	2	Y		Y				07
23U6PDET2(B)	Numerical Methods with C++			Y						New
23U6PSED8	Professional Competency Skill	2	2	Y						New
23U6PPROV	Project and VIVA	3	2			Y				New
Total			141							

Emp– Employability; Ent– Entrepreneurship; Skill – Skill Development

**The Madura College (Autonomous)
Re–accredited (4th cycle) with “A” grade by NAAC
Vidya Nagar, TPK road, Madurai–625011**



Research Centre & PG Department of Physics

Revised Curriculum
TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION (TANSCHE)
(Choice Based Credit system with Outcome Based Education)
Academic Year 2025– 2026 onwards

Curriculum – M.Sc. Physics

(To be implemented from the academic year 2025–2026)(Regulation 2025)

	Programme specific learning outcomes	Graduate Attributes
PSO–1	Demonstrate a fundamental/systematic or coherent understanding of the academic field of physics its different core learning areas like Classical, Statistical and Quantum mechanics, Electro Magnetic theory, Modern optics, Condensed Matter Physics, Nuclear and Particle Physics and also in applied areas like spectroscopy, Instrumentation, Electronics and Communication and also in non domain areas of interest to the students.	Knowledge in core competency
PSO–2	Apply the principles of mathematical modelling and the power of computation to describing the physical world.	Problem analysis
PSO–3	Plan and execute physics related experiments or investigations analyze and interpret data/information collected using appropriate methods including the use of appropriate software such as programming languages and purpose – written packages, and report accurately the findings of the experiments/investigations while relating the conclusion/findings to relevant theories of physics.	Design and development of solution for complex problems
PSO–4	Apply skills in areas related to his specialization within the disciplinary area of physics and also in current and emerging developments in the field of physics.	Modern tool usage
PSO–5	Demonstrate relevant generic skills and global companies such as (i) problem solving skills that are required to solve different types of physics –related problems with well defined solutions and tackle open– ended problems that belong to the disciplinary– are boundaries; (ii) Investigate skills, including skills of independent investigation of physics– related issues and problems; (iii) Communication skills involving the ability to listen carefully, to read texts and research papers analytically and to present complex information in a concise manner to different groups/audiences of technical or popular nature; (iv) Analytical skills involving paying attention to detail and ability to construct logical arguments using correct technical language related to physics and ability to translate	Individual and team work, project management, communication, Lifelong learning

	them with popular language when needed; (v) ICT skills; (vi) Personal skills such as the ability to work both independently and in a group.	

PROGRAMME EDUCATION OBJECTIVES

- PEO1.** To produce graduates with ethical values and professional skills who excel in the competencies in the rapidly evolving global community and contribute to the development of the society.
- PEO2.** To motivate the students to prepare for competitive examinations and pursue higher education in the reputed institutions globally with focus on research and development.
- PEO3.** To endow the students with critical and analytical thinking, problem solving skills which will equip them to become entrepreneurs.
- PEO4.** To promote capacity to work effectively in diverse teams in classroom, and in laboratory.
- PEO5.** To enhance the digital efficiency to use computation and appropriate softwares, e– library to retrieve and evaluate Physics information.



The Madura College, Madurai – 625 011
Department of Physics
Programme Structure of M.Sc. PHYSICS

Sem	Course Type	Course Code	Title of the Course	Hours	Credits
I	Core I	25P1PCCT1	Mathematical Physics	6	5
	Core II	25P1PCCT2	Classical Mechanics & Relativity	6	5
	Core Practical I	25P1PCCP1	Practical I	6	4
	Discipline Elective I	25P1PECT1 (A)	Linear and Digital ICs & Applications	5	3
		25P1PECT1 (B)	Digital Communication		
	Discipline Elective II	25P1PECT2 (A)	Energy Physics	5	3
		25P1PECT2 (B)	Physics of Nano Science & Technology		
	NME I	-----	NME	2	2
II	Core III	25P2PCCT3	Statistical Mechanics	6	5
	Core IV	25P2PCCT4	Quantum Mechanics –I	6	5
	Core Practical II	25P2PCCP2	Practical II	6	4
	Discipline Elective III	25P2PECT3(A)	Bio Physics	5	3
		25P2PECT3 (B)	Plasma Physics		
	Discipline Elective IV	25P2PECT4 (A)	Advanced Optics	5	3
		25P2PECT4 (B)	Solid Waste Management		
	NME II	-----	NME	2	2
Total				60	44

DEPARTMENT OF PHYSICS				CLASS: I M.Sc				
Sem	Course type	Course code	Course title	Credits	Contact hours/ Week	CIA	Ext	Total
I	Core	25P1PCCT1	Mathematical Physics	5	6	25	75	100

Nature of course				
Skill oriented	√	Employability oriented		Entrepreneurship Oriented

Objectives:

- To equip students with the mathematical techniques needed for understanding theoretical treatment in different courses taught in their program
- To extend their manipulative skills to apply mathematical techniques in their fields
- To help students apply Mathematics in solving problems of Physics

Unit	Description	Hours	K-level	CLO
I	Linear vector spaces Basic concepts – Definitions – examples of vector space – Linear operator – Linear independence – Change of basis – Scalar product – Orthogonality and completeness – Gram–Schmidt orthogonalization procedure. Blended Learning: Linear independence – Change of basis Orthogonality and completeness – Gram–Schmidt orthogonalization procedure.	18	K3	1
II	Complex variables and Integrals Review of Complex Numbers – Functions of a Complex Variable – Differentiability – Analytic functions – Cauchy – Riemann conditions – Harmonic Functions – Cauchy’s Integral Theorem – Evaluation of line integrals by indefinite integration – Cauchy’s integral Formula – Cauchy Residue theorem.	18	K3	2
III	Matrices Types of Matrices and their properties – Rank of a Matrix – Conjugate of a matrix – Adjoint of a matrix – Inverse of a matrix – Hermitian and Unitary Matrices – Trace of a matrix – Transformation of matrices – Characteristic equation – Eigen values and Eigen vectors – Cayley–Hamilton theorem –Diagonalization.	18	K4	3

IV	Fourier and Laplace Transform Definitions – Fourier transform and its inverse – Fourier transform of derivatives – Cosine and sine transforms – Convolution theorem – Simple Applications of Fourier Transform – Laplace transform and its inverse – Transforms of derivatives and integrals.	18	K4	4
V	Special Functions Second order differential equation – Legendre polynomials – Generating function – Rodrigue’s formula – Orthogonality properties – Recurrence relations – Hermite polynomials – Generating function – Orthogonality properties – Recurrence relations.	18	K3	5

Books for Study:

1. Mathematical Physics with classical mechanics, Sathya Prakash, V Edition (2009) Sultan Chand and sons, Newdelhi.

Unit 1 : Sections 1.18

Unit 2 : Sections 2.5, 2.7, 2.10, 2.15, 2.16, 2.18, 2.19, 2.23, 2.28, 2.31, 2.32,2.35

Unit 3 : Sections 6.1, 6.2, 6.7, 6.8, 6.9, 6.10, 6.11, 6.14, 6.15, 6.16, 6.24

Unit 4 : Sections 10.2, 10.3– 10.5, 10.8, 10.9– 10.12, 10.17

Unit 5 : Sections 7.11– 7.15, 7.33– 7.37

Books for References:

1. George Arfken and Hans J Weber, 2012, Mathematical Methods for Physicists – A Comprehensive Guide (7th edition), Academic press.
2. P.K. Chattopadhyay, 2013, Mathematical Physics (2nd edition), New Age, New Delhi
3. A W Joshi, 2017, Matrices and Tensors in Physics, 4th Edition (Paperback), New Age International Pvt. Ltd., India
4. B. D. Gupta, 2009, Mathematical Physics (4th edition), Vikas Publishing House, New Delhi.
5. H. K. Dass and Dr. Rama Verma, 2014, Mathematical Physics, Seventh Revised Edition, S. Chand & Company Pvt. Ltd., New Delhi.

Web Resources

1. www.khanacademy.org
2. https://youtu.be/LZnRIOA1_2I
3. <http://hyperphysics.phy-astr.gsu.edu/hbase/hmat.html#hmath>
4. https://www.youtube.com/watch?v=_2jymuM7OUU&list=PLhkiT_RYTEU27vS_SlED56gNjVJGO2qaZ
5. <https://archive.nptel.ac.in/courses/115/106/115106086/>

Blended Learning

1. Link: <https://nptel.ac.in/courses/115103036/>

Unit 1: Lecture No: 9, 11, and 12 – Linear independence – Change of basis – Orthogonality and completeness – Gram– Schmidt orthogonalization procedure.

Rationale for Nature of the course:

Mathematical Physics course offers the necessary skills required for modelling real life physical systems and solving real life physical systems. Linear vector spaces offer the mathematical basis for solving problems in quantum mechanics. Solutions of differential equations by way of special functions help in solving physical systems.

Activities having direct bearing on Skill development / Employability

Entrepreneurship:

Mathematical skills for modeling physical systems and solving real life physical problems.

Pedagogy

Chalk and Board, PPT, Group discussion, Assignment, Seminar, Quiz.

Course Designer(s):

1. Dr.K.Neyvasagam

Course Schedule

Unit	Topics	Hrs	Mode
I	Basic concepts – Definitions – examples of vector space – Linear operator	7	Chalk and Board, PPT, Seminar, Test, Quiz
	Linear independence – Change of basis – Scalar product	6	
	Orthogonality and completeness – Gram– Schmidt orthogonalization procedure.	5	
II	Review of Complex Numbers – Functions of a Complex Variable – Differentiability	6	Chalk and Board, PPT, Seminar, Test, Quiz
	Analytic functions – Cauchy– Riemann conditions – Harmonic Functions – Cauchy’s Integral Theorem	6	
	Evaluation of line integrals by indefinite integration– Cauchy’s integral Formula – Cauchy Residue theorem.	6	
III	Types of Matrices and their properties – Rank of a Matrix – Conjugate of a matrix – Adjoint of a matrix.	7	Chalk and Board, Quiz, Test, Seminar
	Inverse of a matrix – Hermitian and Unitary Matrices – Trace of a matrix– Transformation of matrices	5	
	Characteristic equation – Eigen values and Eigen vectors – Cayley–Hamilton theorem –Diagonalization.	6	
IV	Definitions – Fourier transform and its inverse – Fourier transform of derivatives	6	Chalk and Board, PPT, group discussion, Seminar, Test, Quiz
	Cosine and sine transforms – Convolution theorem – Simple Applications of Fourier Transform	7	
	Laplace transform and its inverse – Transforms of derivatives and integrals.	5	
V	Second order differential equation – Legendre polynomials – Generating function	7	Chalk and Board, Seminar, Quiz, Assignment
	Orthogonality properties – Recurrence relations – Hermite polynomials	5	
	Generating function – Orthogonality properties – Recurrence relations.	6	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Understand use of linear operator and explain them complete ortho normal set of basis vector and transformations.	K3
CLO2	Able to understand analytic functions, do complex integration, by applying Cauchy Integral Formula. Able to compute many real integrals and infinite sums via complex integration.	K3
CLO3	Analyze characteristics of matrices and its different types, and the process of diagonalization.	K4
CLO4	Solve equations using Laplace transform and analyze the Fourier transformations of different function, grasp how these transformations can speed up analysis and correlate their importance in technology	K4
CLO5	Find the solutions for physical problems using linear differential equations and to solve boundary value problems using Green's function. Apply special functions in computation of solutions to real world problems	K3
K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate		

Mapping with PO's and PSO's

CLO	POs						PSOs				
	1	2	3	4	5	6	1	2	3	4	5
CLO1	3	2	3	2	3	2	3	2	3	1	2
CLO2	3	2	3	2	2	2	3	2	2	2	2
CLO3	3	2	3	2	2	2	3	2	3	1	2
CLO4	3	2	3	2	2	2	3	2	3	1	2
CLO5	3	2	3	2	2	2	3	2	3	2	2

Summative – Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K– Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K– Level	No. of Questions	K– Level		
1	CLO 1	Up to K3	2	K1 & K1	1	K1	² (K3&K3)	1 (K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K2	² (K1&K1)	1 (K3)
3	CLO 3	Up to K4	2	K3 & K4	1	K1	² (K4&K4)	1 (K4)
4	CLO 4	Up to K4	2	K3 & K4	1	K3	² (K4&K4)	1 (K4)
5	CLO 5	Up to K3	2	K2 & K3	1	K2	² (K2&K2)	1 (K3)
No. of Questions to be asked			10			5	10	5
No. of Questions to be Answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each section			10			10	25	30

K1– Remembering and recalling facts with specific answers

K2– Basic understanding of facts and stating main ideas with general answers

K3– Application oriented –Solving Problems

K4– Examining, analyzing, presentation and make inferences with evidences

Distribution of Section– wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice
K1	2	4	10	–	16	13.33
K2	2	4	10	10	26	21.67
K3	4	2	10	20	36	30.00
K4	2	–	20	20	42	35.00
Total Marks	10	10	50	50	120	100.00

DEPARTMENT OF PHYSICS				CLASS: I M.Sc				
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
I	Core	25P1PCCT2	Classical Mechanics and Relativity	5	6	25	75	100

Nature of course					
Skill oriented	√	Employability oriented		Entrepreneurship Oriented	

Objectives:

- To understand fundamentals generalized coordinates in classical mechanics.
- To understand Lagrangian formulation of mechanics and apply it to solve equation of motion.
- To understand Hamiltonian formulation of mechanics and apply it to solve equation of motion.
- To discuss the theory of small oscillations of a system.
- To learn the relativistic formulation of mechanics of a system.

Unit	Description	Hours	K– level	CLO
I	Unit I: Principles Of Classical Mechanics Mechanics of a system of particles – External and internal forces – Centre of mass– Conservation of linear and angular momentum – Conservation of energy – Constraints – Holonomic & Nonholonomic constraints –Some examples of Holonomic and non– holonomic constraints – Generalized coordinates –Transformation equations – Principle of virtual work. Blended Learning: Constraints, Generalized coordinates, Principle of virtual work.	18	K2	1
II	Unit II: Lagrangian Formulation D'Alembert's principle – Lagrangian equations of motion for conservative systems – Applications: (i) Simple Pendulum (ii) Atwood's machine (iii) Compound Pendulum (iv) Lagrange's equation for L– C circuits (v) Motion under central force. Blended Learning: D'Alembert's principle, Lagrangian equations of motion.	18	K3	2
III	Unit III: Hamiltonian Formulation Phase space – Generalized momentum and Cyclic coordinates – Conjugate momentum – Hamiltonian function and Conservation of energy – Hamilton's canonical equations of motion – Applications: (i) Simple pendulum (ii) One dimensional simple	18	K4	3

	harmonic oscillator (iii) Motion of particle in a central force field. Blended Learning: Hamiltonian function, Hamilton's canonical equations of motion			
IV	Unit IV: Small Oscillations General theory of small oscillation– Secular equation and Eigen value equation– Solution of the Eigen value equation– Small oscillation in normal coordinates– Example of two coupled oscillator and double pendulum– Vibration of linear tri atomic molecule. Blended Learning: Theory of small oscillation, Secular equation and Eigen value equation, Solution of the Eigen value equation, small oscillation in normal coordinates.	18	K3	4
V	Unit V: Relativity Inertial and non– inertial frames – Lorentz transformation equations – Length contraction and time dilation – relativistic addition of velocities – Einstein's mass– energy relation – Minkowski space – Four vectors – Position, velocity, momentum, acceleration and force in for vector notation and their transformations. Blended Learning: Lorentz transformation equations , length contraction and time dilation.	18	K4	5

Books for Study:

1. J. C. Upadhyaya, Classical Mechanics, Himalaya Publishing. House Pvt Ltd. New Delhi 2014.
Unit 1: Sections 1.7,1.7.1 – 1.7.5,1.7.8, 2.1,2.3, 2.3.1– 2.3.3,2.4, 2.5.
Unit 2: Sections 2.6, 2.7, Ex– 2,3, 5, 7, 8.
Unit 3: Sections 3.1, 3.2, 3.4, 3.5, 3.7(1), (2),Ex.1
Unit 4: Sections 9.4,9.4.1,9.4.2,9.4.3,9.5,9.6
2. R.Murugesan, Modern Physics, S.Chand, Revised edition
Unit 5: Sections 1.1,1.2,1.8,1.9,1.10,1.12,1.14,1.15

Books for References:

1. H. Goldstein, *Classical Mechanics*, 3rd Edition, Pearson Edu.2002.
2. R. Resnick, *Introduction to Special Theory of Relativity*, Wiley Eastern, New Delhi 1968.
3. R. G. Takwala and P.S. Puranik, *Introduction to Classical Mechanics* ,Tata – McGraw Hill, New Delhi, 1980.
4. N. C. Rana and P.S. Joag, *Classical Mechanics* – Tata McGraw Hill, 2001
5. K. R. Symon, *Mechanics*, Addison Wesley, London 1971.
6. S. N. Biswas, *Classical Mechanics*, Books & Allied, Kolkata 1999.
7. Gupta , Kumar and sharma, *Classical Mechanics*,PragatiPrakashan 2001.

Web Resources

1. http://poincare.matf.bg.ac.rs/~zarkom/Book_Mechanics_Goldstein_Classical_Mechanics_optimized.pdf
2. <https://pdfcoffee.com/classical-mechanics-j-c-upadhyay-2014-editionpdf-pdf-free.html>
3. <https://nptel.ac.in/courses/122/106/122106027/>
4. <https://ocw.mit.edu/courses/physics/8-09-classical-mechanics-iii-fall-2014/lecture-notes/>
5. <https://www.britannica.com/science/relativistic-mechanics>

Blended Learning link:

1. <https://nptel.ac.in/courses/115105098>
Week 8: Unit I : constraints, generalized coordinates, principle of virtual work.
Unit II: D'Alembert's principle
Week 9: Unit II: Lagrangian equations of motion.
Week 11: Unit IV: theory of small oscillation, Secular equation and Eigen value equation,
solution of the Eigen value equation, small oscillation in normal coordinates.
2. <https://nptel.ac.in/courses/115106123>
Week 2 & 12: Unit III: Hamiltonian function, Hamilton's canonical equations of motion. <https://nptel.ac.in/courses/115101011>
3. L5, L6, L7 : Unit V: Lorentz transformation equations , length contraction and time dilation.

Rationale for Nature of the Course

In this course, Classical Mechanics which is the study of macroscopic mechanical systems is considered from different perspectives of Lagrangian and Hamiltonian methods. Practical applications of these general principles towards simple problems of oscillatory systems would enhance comprehension of the principles of Classical Mechanics and develop the skills necessary to analyze the behavior of the mechanical systems based on variety of mathematical models of Classical Mechanics.

Activities having direct bearing on Skill development / Employability

Entrepreneurship

Lagrangian and Hamiltonian equations of motion derived for different systems develops the application of mathematical and simulation skills to understand various practical applications involving macroscopic and microscopic objects in motion.

Pedagogy

Chalk and talk, materials, PPT, Quiz, Assignment, Seminar, Test, Problem solving, Group discussion, interaction and field visit.

Course Designer(s):

1. Prof. V.Meenakshi Sundaram
2. Dr.M.Kavitha

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Mechanics of a system of particles, External and internal forces, Centre of mass.	4	PPT, Chalk and talk Quiz, Seminar, and Test
	Conservation of linear and angular momentum, Conservation of energy.	5	
	Constraints, holonomic & Nonholonomic constraints, some examples of holonomic and non-holonomic constraints.	5	
	Generalized coordinates, transformation equations, principle of virtual work.	4	
Unit II	D'Alembert's principle	1	Chalk and talk, , Quiz, Seminar, and Test
	Lagrangian equations of motion for conservative systems.	5	
	applications: simple pendulum, Atwood's machine	5	
	Compound pendulum.	3	
	Lagrange's equation for L- C circuits, Motion under central force.	4	
Unit III	Phase space	2	PPT, Chalk and talk Quiz, Seminar, and Test
	Generalized momentum and cyclic coordinates, conjugate momentum.	4	
	Hamiltonian function and conservation of energy.	3	
	Hamilton's canonical equations of motion	4	
	Applications: simple pendulum, one dimensional simple harmonic oscillator, motion of particle in a central force field.	5	
Unit IV	General theory of small oscillation- Secular equation and Eigen value equation	5	PPT, Chalk and talk, Quiz, Seminar, and Test
	solution of the Eigen value equation- small oscillation in normal coordinates	5	
	Example of two coupled oscillator and double pendulum	4	
	Vibration of linear tri atomic molecule.	4	
Unit V	Inertial and non- inertial frames – Lorentz transformation equations	5	PPT, Chalk and talk , Quiz, Seminar, and Assignment
	length contraction and time dilation – relativistic addition of velocities	5	
	Einstein's mass- energy relation – Minkowsk's space – four vectors	4	
	Position, velocity, momentum, acceleration and force in for vector notation and their transformations.	4	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
1	Understand the fundamentals of classical mechanics.	K2
2	Apply the principles of Lagrangian mechanics to solve the equations of motion of physical systems.	K3
3	Analyze the principles of Hamiltonian mechanics to solve the equations of motion of physical systems.	K4
4	Analyze the small oscillations in systems and determine their normal modes of oscillations.	K4
5	Organize the principles of relativistic kinematics to the mechanical systems.	K3
K1– Remember;K2–Understand;K3– Apply;K4– Analyze;K5–Evaluate		

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	2	2	2	3
CLO2	3	2	2	2	3
CLO3	3	2	2	2	3
CLO4	3	2	2	2	3
CLO5	3	2	2	2	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO-1	3	3	3	2	3	3
CLO-2	3	3	3	2	3	3
CLO-3	3	3	3	2	3	3
CLO-4	3	3	3	2	3	3
CLO-5	3	3	3	2	3	3

Advance application –3, Intermediate level –2, Basic level–1

Assessment Scheme
Blueprint for Semester Examination
 Learning Outcome Based Education (LOBE) & Assessment Articulation
 Mapping– K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K– Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K– Level	No. of Questions	K– Level		
1	CLO1	Upto K2	2	K1&K1	1	K1	2(K1&K1)	1(K2)
2	CLO2	Upto K3	2	K2&K3	1	K1	2(K2&K2)	1(K3)
3	CLO3	Upto K4	2	K3&K4	1	K2	2(K4&K4)	1(K4)
4	CLO4	Upto K4	2	K3&K4	1	K2	2(K4&K4)	1(K4)
5	CLO5	Upto K3	2	K2&K3	1	K3	2(K3&K3)	1(K3)
No. of Questions to be Asked			0		5		10	5
No. of Questions to be Answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1– Remembering and recalling facts with specific answers

K2– Basic understanding of facts and stating main ideas with general answers

K3– Application oriented–Solving Problems

K4– Examining, analyzing, presentation and make inferences with evidences

Distribution of Section– wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/ or)	Section D (Open Choice)	Total Marks	%of Marks without choice
K1	2	4	10	–	16	13.33
K2	2	4	10	10	26	21.67
K3	4	2	10	20	36	30.00
K4	2	–	20	20	42	35.00
Total Marks	10	10	50	50	120	100.00

DEPARTMENT OF PHYSICS					CLASS: I M.Sc.			
Sem	Course type	Course code	Course title	Credits	Contact hours/ Week	CIA	Ext	Total
I	Core	25P1PCCP1	PRACTICAL – I	4	6	25	75	100

Nature of course				
Skill oriented	√	Employability oriented		Entrepreneurship Oriented

Objectives:

- To design and conduct experiments to verify physical laws, to determine physical quantities.
- To present results in concise quantitative measurements.
- To study various phenomena and their associated quantities.

List of experiments:

(Any Twelve Experiments from the following)

1. Study of attenuation characteristics of Wien's bridge network and design of Wien's bridge oscillator using Op– Amp
2. Determination of Young's modulus and Poisson's ratio by Elliptical fringes – Cornu's Method
3. Construction of IC Regulated Dual Power supply.
4. Determination of Solar constant
5. Determination of Self inductance and Mutual inductance by constructing Owens bridge
6. Construction of Adder, Subtractor, Integrator, Differentiator by Op– Amp of IC 741.
7. Construction of Full adder and Full Subtractor using IC 74151.
8. Monte Carlo Simulation and Integration.
9. Arc Spectrum
10. Refractive index of water by using LASER and Hollow Prism.
11. FP Etalon
12. Determination of Thickness of air film.
13. Solar spectrum – Hartmann's formula. Edser and Butler fringes.
14. Measurement of Band gap energy– Thermistor
15. Determination of Planck Constant – LED Method
16. Determination of Specific charge of an electron – Thomson's Method
17. Determination of Compressibility of a liquid using Ultrasonic's
18. Determination of Wavelength, Separation of wavelengths – Michelson Interferometer
19. GM counter – Characteristics, inverse square law and absorption coefficient.
20. Measurement of Conductivity – Four probe method.

Text books:

1. Practical Physics, Gupta and Kumar, Pragati Prakashan.
2. Kit Developed for doing experiments in Physics– Instruction manual, R. Srinivasan K.R Priolkar, Indian Academy of Sciences.

3. Electronic Laboratory Primer a design approach, S. Poornachandra, B. Sasikala, Wheeler Publishing, New Delhi.
4. Electronic lab manual Vol I, K A Navas, Rajath Publishing.
5. Electronic lab manual Vol II, K A Navas, PHI eastern Economy Edition

Books for Reference :

1. Advanced Practical Physics, S.P Singh, PragatiPrakasan.
2. An advanced course in Practical Physics, D. Chattopadhyay, C.R Rakshit, New Central Book Agency Pvt. Ltd
3. Op– Amp and linear integrated circuit, Ramakanth A Gaykwad, Eastern Economy Edition.
3. A course on experiment with He– Ne Laser, R.S. Sirohi, John Wiley & Sons (Asia) Pvt. Ltd.
4. Electronic lab manual Vol II, Kuriachan T.D, Syam Mohan, Ayodhya Publishing

Web Resources

1. <https://www.electronics-tutorials.ws/power/unijunction-transistor.html>
2. <https://www.geeksforgeeks.org/4-bit-binary-adder-subtractor/>
3. <https://www.electronicshub.org/ic-741-op-amp-basics/>
4. <https://www.physicsglobe.com/2021/03/four-point-probe-method-engineering.html>

Rationale for nature of course

Analysing the concepts of Physics through experiments in the laboratory will enhance effective comprehension.

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CLOs	Course Learning Outcomes	Knowledge level	Marks
CLO1	Understand the given problem in terms of domain knowledge in the field of physics.	Upto K2	15
CLO2	Design appropriate Experiment /Test for the given problem.	Upto K3	10
CLO3	Demonstrate skill in doing the experiment by choosing the appropriate technique and instruments and record data.	Upto K3	15
CLO4	Analyze the data collected and infer the outcome and represent the analysis in meaningful form.	Upto K4	20
CLO5	Communicate the findings in appropriate scientific terminology.	Upto K2	5
K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate			

Mapping of CLO's with POs

CLO	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	2	2	3	2	2	3
CLO2	2	3	3	3	3	3
CLO3	2	3	3	3	3	3
CLO4	2	3	3	3	3	3
CLO5	2	3	3	3	3	3

Mapping of CLO's with PSOs

CLO	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	2	1	3	2	2
CLO2	2	1	3	2	2
CLO3	2	1	3	2	2
CLO4	2	1	3	2	2
CLO5	2	1	3	2	2

DEPARTMENT OF PHYSICS					CLASS: I M.Sc			
Sem	Course type	Course code	Course title	Credits	Contact hours/ Week	CIA	Ext	Total
I	Discipline Elective	25P1PECT1 (A)	Linear and Digital ICS Applications	3	5	25	75	100
Nature of course								
Skill oriented	✓	Employability oriented			Entrepreneurship Oriented			

Objectives:

- To introduce the basic building blocks of linear integrated circuits.
- To teach the linear and non– linear applications of operational amplifiers.
- To introduce the theory and applications of PLL.
- To introduce the concepts of waveform generation and introduce one special function ICs.

Unit	Description	Hour	K–level	CLO
I	Integrated Circuits and Operational Amplifier Introduction– Classification of IC's– basic information of Op– Amp741and its features–The ideal Operational amplifier– Open Loop operation of Op– Amp – Feedback in Ideal Op– Amp– The inverting amplifier – The non inverting amplifier – Op– Amp internal circuit– Differential Amplifier and Op– Amp transfer Characteristics. BLENDED LEARNING Introduction – Basic information of Op– Amp– Op– Amp Characteristics – Differential Amplifier	15	K3	1
II	Applications of OP– AMP Linear Applications of OP– AMP: Inverting summing amplifier – subtractor – Instrumentation amplifiers –V to I and I to V converters – Differentiator – Integrator – Solution to simultaneous equations. Non– Linear Applications Of OP– AMP: Sample and Hold circuit– Log and Antilog amplifier –multiplier and divider –Comparators –Schmitt trigger –Mono stable Multi vibrator.	15	K3	2
III	Active Filters & Timer and Phase Locked Loops Active Filters: Introduction, Butterworth filters – 1st order low pass and high pass filters – band pass filters – Wide band pass – Narrow band pass. Timer And Phase Locked Loops: Introduction to IC	15	K4	3

	555 timer – description of functional diagram – 555 as a Monostable multivibrator – Monostable operation – Monostable multivibrator application – Frequency divider– 555 as a astable multivibrators – Astable operation – Astable multivibrator application– Square wave oscillator. BLENDED LEARNING Butterworth filters – 1st order low pass and high pass filter, Band pass filters – Introduction to IC 555 timer – description of functional diagram – 555 as a Mono stable multi vibrator – Mono stable operation – Mono stable multi vibrator application 555 as a astable multivibrators			
IV	D to A and A to D Converters & Registers Voltage D to A And A to D Converters: Introduction, basic DAC techniques – Weighted resistor DAC, R– 2R ladder DAC – Inverted R– 2R DAC – A to D converters – Simultaneous conversion– type ADC– Counter type ADC – Successive approximation ADC and dual slope ADC, DAC and ADC – Specifications. Shift Registers– SISO– SIPO– PISO and PIPO registers BLENDED LEARNING Weighted resistor DAC – R– 2R ladder DAC – Inverted R– 2R DAC A to D converters	15	K4	4
V	Combinational Circuits & Sequential Circuits Solving digital problems using maps – SOP & POS reduction (4 & 5– variables only) – Incompletely specified functions –Flip– flops –Ripple counters – Shortened modulus – Down counters – Type T – Down counters – Nonsequential counting – Type JK design – Controlling the counter – cycle counter.	15	K3	5

Books for Study:

1. D.Roy Choudhury, ShailB.Jain(2012),Linear Integrated Circuit,4th edition, New Age International Pvt. Ltd., New Delhi,India
Unit 1 : Sections 1.1– 1.2,2.1 – 2.3 (2.3.1– 2.3.4, 2.3.6), 2.4 (2.4.1– 2.4.2)
Unit 2 : Sections 4.2 ,4.3,4.5, 4.7– 4.12, 5.2– 5.4,5.6
2. Ramakant A. Gayakwad, (2012), OP– AMP and Linear Integrated Circuits, 4th edition, Prentice Hall / Pearson Education, New Delhi.
Unit 3 : Sections 7.3,7.5, 7.8, 9.4 (9.4.1– 9.4.1(a)), (9.4.2– 9.4.2(a)), (9.4.3– 9.4.3(a)), (9.4.4– 9.4.4(a)),
3. Malvino and Leach(2005), Digital Principles and Applications 7th Edition, Tata McGraw Hill, New Delhi
Unit 4 : Sections 12.1– 12.2, 12.5– 12.9, 9.1– 9.5

- William H. Gothmann, Digital Electronics, An introduction to theory and practice, 2nd Edition, Prentice– Hall.
Unit 5 :Sections 6.4– 6.6,6.8,7.1– 7.4,7.6

Books for References:

- Sergio Franco (1997), Design with operational amplifiers and analog integrated circuits, McGraw Hill, New Delhi.
- Gray, Meyer(1995),Analysis and Design of Analog Integrated Circuits, Wiley International, New Delhi.
- Floyd,Jain (2009), Digital Fundamentals, 8th edition, Pearson Education, New Delhi.
- Integrated Electronics, Millman &Halkias,TataMcGrawHill,17th Reprint(2000)

Web Resources

- <https://nptel.ac.in/course.html/digitalcircuits/>
- <https://nptel.ac.in/course.html/electronics/operationalamplifier/>
- <https://www.allaboutcircuits.com/textbook/semiconductors/chpt-7/field-effect-controlled-thyristors/>
- <https://www.electrical4u.com/applications-of-op-amp/>
- <https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/>

Blended Learning link:

- https://youtube.com/playlist?list=PLuv3GM6-gsE3npYPJJDnEF3pdiHJT6Kj3&si=2U-dXohJp_wcvHn1
UNIT 1: Integrated Circuits and Operational Amplifier
Introduction – Lec 15
Basic information of Op– Amp – Lec 16
Op– Amp Characteristics – Lec 17,18
Differential Amplifier –Lec– 21
- <https://youtube.com/playlist?list=PLwdnzlV3ogoUdwipmit62VoN9fr1fP9Re&si=21KH7hpyvG1BwMaG>
UNIT 3 : Active Filters & Timer and Phase Locked Loop
Butterworth filters – 1st order low pass and high pass filter – Lec– 15,17,18
Band pass filters – Lec– 19 ,20
Introduction to IC 555 timer, description of functional diagram – Lec– 26
555 as a Monostable multivibrator, monostable operation– Lec– 27
Monostable multivibrator application – Lec– 28
555 as a astable multivibrators – Lec– 29
UNIT 4 : D to A and A to D Converters & Registers
Weighted resistor DAC – Lec– 37
R– 2R ladder DAC – Lec– 38
Inverted R– 2R DAC –Lec– 39
A to D converters –Lec– 40

Rationale for Nature of the course:

Develop skills to design linear and non– linear applications circuits and solving real life physical problems.

Activities having direct bearing on Skill development / Employability/**Entrepreneurship:**

Students acquire problems solving skill and quantitative reasoning skill on designing of circuits using OP– amp.

Pedagogy

Chalk and Board, PPT, Group discussion, Assignment, Seminar, Quiz.

Course Designer(s):

1. Dr.J.Suresh
2. Dr.R.Vishnu Priya

Course Schedule

Unit	Topics	Hrs	Mode
I	Introduction – Classification of IC's– basic information of Op– Amp741and its features	5	Chalk and Board, PPT, Seminar, Test, Quiz
	The ideal Operational amplifier– Open Loop operation of Op– Amp – Feedback in Ideal Op– Amp– The inverting amplifier – The non inverting amplifier	5	
	Op– Amp internal circuit– Differential Amplifier and Op– Amp transfer Characteristics	5	
II	Linear Applications of OP– AMP: Inverting summing amplifier – Subtractor – Instrumentation amplifiers –V to I and I to V converters.	5	Chalk and Board, PPT, Seminar, Test, Quiz
	Differentiator – Integrator – Solution to simultaneous equations Non– Linear Applications Of OP– AMP: Sample and Hold circuit– Log and Antilog amplifier	5	
	Multiplier and divider –Comparators –Schmitt trigger – Monostable Multivibrator.	5	
III	Active Filters: Introduction, Butterworth filters – 1st order low pass and high pass filters – band pass filters – Wide band pass – Narrow band pass.	5	Chalk and Board, Quiz, Test, Seminar
	Timer And Phase Locked Loops: Introduction to IC 555 timer – description of functional diagram – 555 as a Monostable multivibrator – Monostable operation.	5	
	Monostable multivibrator application – Frequency divider– 555 as a astable multivibrators – Astable operation – Astable multivibrator application– Square wave oscillator.	5	
IV	Voltage D to A And A to D Converters: Introduction, basic DAC techniques – Weighted resistor DAC, R– 2R ladder DAC	5	Chalk and Board, PPT, group discussion, Seminar, Test, Quiz
	Inverted R– 2R DAC – A to D converters – Simultaneous conversion– type ADC– Counter type ADC – Successive approximation ADC and dual slope ADC, DAC and ADC – Specifications.	6	
	Shift Registers– SISO– SIPO– PISO and PIPO registers	4	
V	Solving digital problems using maps – SOP & POS reduction (4 & 5– variables only) – Incompletely specified functions	6	Chalk and Board, Seminar, Quiz, Assignment
	Flip– flops –Ripple counters – Shortened modulus – Down counters – Type T – Down counters	4	
	Nonsequential counting – Type JK design – Controlling the counter – cycle counter.	5	

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CLOs	Course Learning Outcomes	KLevel
CLO1	Learn about the basic concepts for the circuit configuration for the Design of linear integrated circuits and develops skill to solvesproblems	K3
CLO2	Develop skills to design linear and non– linear applications circuits using Op– Amp and design the active filters circuits.	K4
CLO3	Gain knowledge about PLL ,and develop the skills to design the simple Circuits using IC555 timer and can solve problems related to it.	K3
CLO4	Learn about various techniques to develop A/D and D/A converters.	K4
CLO5	Acquire the knowledge about the, combinational andSequential circuits	K4
K1– Remember; K2–Understand;K3– Apply;K4– Analyze;K5–Evaluate		

MAPPING WITH PROGRAMME OUTCOMES:

Mapping of Course Outcomes (**CLO**) against Programme Outcomes (**PO**) in the 3– point scale of STRONG(3), MEDIUM(2) and LOW(1).

CLO	POs						PSOs				
	1	2	3	4	5	6	1	2	3	4	5
CLO1	3	2	3	1	2	2	3	3	3	2	3
CLO2	3	2	3	2	3	2	3	2	2	1	2
CLO3	3	2	3	2	2	2	3	2	3	1	2
CLO4	3	2	3	2	2	2	3	2	3	1	3
CLO5	3	2	3	2	3	2	3	3	3	2	3

Assessment Scheme Blue print for Semester Examination
Learning Outcome Based Education (LOBE) & Assessment Articulation
Mapping– K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K– Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K– Level	No. of Questions	K– Level		
1	CLO1	UptoK3	2	K1&K1	1	K1	2(K3&K3)	1 (K2)
2	CLO2	UptoK3	2	K2&K3	1	K2	2(K1&K1)	1 (K3)
3	CLO3	UptoK4	2	K3&K4	1	K1	2(K4&K4)	1 (K4)
4	CLO4	UptoK4	2	K3&K4	1	K3	2(K4&K4)	1 (K4)
5	CLO5	UptoK3	2	K2&K3	1	K2	2(K2&K2)	1 (K3)
No. of Questions to be Asked			10			5	10	5
No. of Questions to be Answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each Section			10			10	25	30

K1– Remembering and recalling facts with specific answers

K2– Basic understanding of facts and stating main ideas with general answers

K3– Application oriented –Solving Problems

K4– Examining, analyzing, presentation and make inferences with evidences

Distribution of Section– wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/ or)	Section D (Open Choice)	Total Marks	%of Marks without choice
K1	2	4	10	–	16	13.33
K2	2	4	10	10	26	21.67
K3	4	2	10	20	36	30.00
K4	2	–	20	20	42	35.00
Total Marks	10	10	50	50	120	100.00

DEPARTMENT OF PHYSICS					CLASS: I M.Sc			
Sem	Course type	Course code	Course title	Credits	Contact hours/ Week	CIA	Ext	Total
I	Elective	25P1PECT1(B)	Digital Communication	3	5	25	75	100

Nature of course

Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objectives:

1. To understand the use of Fourier, transform in analyzing the signals
2. To learn about the quanta of transmission of information
3. To make students familiar with different types of pulse modulation
4. To have an in depth knowledge about the various methods of error controlling codes
5. To acquire knowledge about spread spectrum techniques in getting secured communication

Unit	Description	Hours	K– level	CLO
I	SIGNAL ANALYSIS Fourier transforms of gate functions, delta functions at the origin – Two delta function and periodic delta function – Properties of Fourier transform – Frequency shifting – Time shifting – Convolution – Graphical representation – Convolution theorem – Time Convolution theorem – Frequency Convolution theorem – Sampling theorem.	15	K3	1
II	INFORMATION THEORY Communication system – Measurement of information – Coding – Bandot Code CCITT Code – Hartley Law – Noise in an information Carrying Channel– Effects of noise– Capacity of noise in a channel – Shannon Hartley theorem – Redundancy.	15	K3	2
III	PULSE MODULATION Pulse amplitude modulation – natural sampling – Instantaneous sampling – Transmission of PAM Signals – Pulse width modulation – Time division multiplexing – Band width requirements for PAM Signals. Pulse Code Modulation – Principles of PCM – Quantizing noise – Generation and demodulation of PCM – Effects of noise – Companding – Advantages and application	15	K4	3

IV	ERROR CONTROL CODING Introduction to Linear Block Codes, Hamming Codes, BCH Coding, RS Coding, Convolutional Coding, Coding Gain Viterbi Coding	15	K4	4
V	SPREAD SPECTRUM SYSTEMS Pseudo Noise sequences, generation and Correlation properties, direct sequence spread spectrum systems, frequency HOP Systems, processing gain, anti-jam and multipath performance	15	K3	5

Books for Study:

1. George Kennedy, Electronic Communication Systems, 3rd Edition, Mc Graw Hill.

Books for References:

1. John Proakis, 1995, Digital Communication, 3rd Edition, McGraw Hill, Malaysia.
2. M. K. Simen, 1999, Digital Communication Techniques, Signal Design and Detection, Prentice Hall of India.
3. Dennis Roddy and Coolen, 1995, Electronics communications, Prentice Hall of India IV Edition.
4. Wave Tomasi, 1998, “Advanced Electronics communication System” 4th Edition Prentice Hall, Inc.
5. M.Kulkarni, 1988, “Microwave and Radar Engineering”, Umesh Publications.

Web Resources

1. <http://nptel.iitm.ac.in/>
2. <http://web.ewu.edu/>
3. <http://www.ece.umd.edu/class/enee630.F2012.html>
4. <http://www.atcourses.com/Advanced%20Topics%20in%20Digital%20Signals>
5. <http://nptel.iitm.ac.in/courses/117101051.html>

Rationale for Nature of the course:

Students learn techniques for digital communication

Activities having direct bearing on Skill development / Employability

Entrepreneurship:

Students acquire problems solving skill and quantitative reasoning skill on designing of circuits for digital communication and will be able to appreciate digital modulation techniques and its applications.

Pedagogy

Chalk and Board, PPT, Group discussion, Assignment, Seminar, Quiz.

Course Designer(s):

1. Prof .V.Seenivasan

Course Schedule

Unit	Topics	Hrs	Mode
I	Fourier transforms of gate functions, delta functions at the origin – Two delta function and periodic delta function	5	Chalk and Board, PPT, Seminar, Test, Quiz
	Properties of Fourier transform – Frequency shifting –Time shifting – Convolution	5	
	Graphical representation – Convolution theorem – Time Convolution theorem –Frequency Convolution theorem – Sampling theorem.	5	
II	Communication system – Measurement of information – Coding – Bandot Code CCITT Code	5	Chalk and Board, PPT, Seminar, Test, Quiz
	Hartley Law – Noise in an information Carrying Channel	5	
	Effects of noise– Capacity of noise in a channel – Shannon Hartley theorem –Redundancy.	5	
III	Pulse amplitude modulation – natural sampling – Instantaneous sampling – Transmission of PAM Signals – Pulse width modulation	5	Chalk and Board, Quiz, Test, Seminar
	Time division multiplexing – Band width requirements for PAM Signals. Pulse Code Modulation –Principles of PCM – Quantizing noise	5	
	Generation and demodulation of PCM – Effects of noise – Companding – Advantages and application	5	
IV	Introduction to Linear Block Codes, Hamming Codes	5	Chalk and Board, PPT, group discussion, Seminar, Test, Quiz
	BCH Coding, RS Coding, Convolutional Coding	5	
	Coding Grain Viterbi Coding	5	
V	Pseudo Noise sequences, generation and Correlation properties,	5	Chalk and Board, Seminar, Quiz, Assignment
	direct sequence spread spectrum systems, frequency HOP Systems,	5	
	processing gain, anti– jam and multipath performance	5	

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Apply the techniques of Fourier transform, convolution and sampling theorems in signal processing	K3
CLO2	Apply different information theories in the process of study of coding of information, storage and communication	K3
CLO3	Explain and compare the various methods of pulse modulation techniques	K4
CLO4	Apply the error control coding techniques in detecting and correcting errors– able to discuss, analyze and compare the different error control coding	K4
CLO5	Apply, discuss and compare the spread spectrum techniques for secure communications	K3
K1– Remember; K2–Understand;K3– Apply;K4– Analyze;K5–Evaluate		

MAPPING WITH PROGRAMME OUTCOMES:

Mapping of Course Outcomes (**CLO**) against Programme Outcomes (**PO**) in the 3– point scale of STRONG(3), MEDIUM(2) and LOW(1).

CLO	POs						PSOs				
	1	2	3	4	5	6	1	2	3	4	5
CLO1	3	2	3	1	2	2	3	3	3	2	3
CLO2	3	2	3	2	3	2	3	2	2	1	2
CLO3	3	2	3	2	2	2	3	2	3	1	2
CLO4	3	2	3	2	2	2	3	2	3	1	3
CLO5	3	2	3	2	3	2	3	3	3	2	3

Assessment Scheme Blue print for Semester Examination
Learning Outcome Based Education (LOBE) & Assessment Articulation Mapping–
K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K– Level	Section A		Section B		Section C (Either/or Choice)	SectionD (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K– Level	No. of Questions	K– Level		
1	CLO1	UptoK3	2	K1&K1	1	K1	2(K3&K3)	1 (K2)
2	CLO2	UptoK3	2	K2&K3	1	K2	2(K1&K1)	1 (K3)
3	CLO3	UptoK4	2	K3&K4	1	K1	2(K4&K4)	1 (K4)
4	CLO4	UptoK4	2	K3&K4	1	K3	2(K4&K4)	1 (K4)
5	CLO5	UptoK3	2	K2&K3	1	K2	2(K2&K2)	1 (K3)
No. of Questions to be Asked			10			5	10	5
No. of Questions to be Answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each Section			10			10	25	30

K1– Remembering and recalling facts with specific answers

K2– Basic understanding of facts and stating main ideas with general answers

K3– Application oriented –Solving Problems

K4– Examining, analyzing, presentation and make inferences with evidences

Distribution of Section– wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/ or)	SectionD (Open Choice)	Total Marks	%of Marks without choice
K1	2	4	10	–	16	13.33
K2	2	4	10	10	26	21.67
K3	4	2	10	20	36	30.00
K4	2	–	20	20	42	35.00
Total Marks	10	10	50	50	120	100.00

DEPARTMENT OF PHYSICS					CLASS: I M.Sc			
Sem	Course type	Course code	Course title	Credits	Contact hours/ Week	CIA	Ext	Total
I	Elective	25P1PECT2(A)	Energy Physics	3	5	25	75	100
Nature of course								
Skill oriented		✓	Employability oriented		Entrepreneurship Oriented			

Objectives:

1. To learn about various renewable energy sources.
2. To know the ways of effectively utilizing the oceanic energy.
3. To study the method of harnessing wind energy and its advantages.
4. To learn the techniques useful for the conversion of biomass into useful energy.
5. To know about utilization of solar energy.

Unit	Description	Hours	K-level	CLO
I	Introduction To Energy Sources Energy consumption as a measure of prosperity – Conventional and non- conventional energy sources and their availability–Hydrogen energy – Magneto hydro dynamic generator – Advantages of renewable energy– prospects of Renewable energy sources Blended Learning: Hydrogen energy	15	K2	1
II	Solar Energy Sources Solar radiation and its measurements–solar cells: Solar cells for direct conversion of solar energy to electric powers–solar cell parameter–solar cell electrical characteristics–solar water Heater –solar distillation– solar cooking–solar greenhouse – Solar Pond and its applications. Blended Learning: solar cells: Solar cells for direct conversion of solar energy to electric powers–solar cell parameter.	15	K4	2
III	Wind Energy Sources Basic principles of wind energy conversion–The nature of the wind – power in the wind– Site selection consideration – Wind energy conversion– Advantages and disadvantages of wind energy conversion systems (WECS) – Energy storage – Applications of wind energy. Blended Learning: Wind energy conversion	15	K3	3

IV	Bio Mass Energy Biomass conversion Technologies– wet and dry process– Photosynthesis – Biogas Generation: Introduction–basic process: Aerobic and anaerobic digestion – Advantages of anaerobic digestion– factors affecting bio digestion and generation of gas – properties of biogas. Blended Learning: Aerobic and anaerobic digestion	15	K4	4
V	Ocean energy Ocean thermal energy conversion systems (OTEC) – Methods of ocean thermal electric power generation – Open cycle OTEC system – The closed OTEC cycle – Site selection – Energy utilization Energy from tides–Basic principle of tidal power– utilization of tidal energy Blended Learning: Open cycle OTEC system – The closed OTEC cycle	15	K4	5

Book for Study:

1. G.D. Rai, Reprint2018, Non – conventional energy sources, 6th edition, Khanna publishers, New Delhi.
 Unit I: Sections 1.2, 1.4, 1.4.1, 1.4.2, 1.6, 1.9, 1.11, 1.14.1, 1.15
 Unit II: Sections 2.1, 2.2, 2.3.1, 2.3.2,2.3.3, 2.3.4, 2.6, 2.6.1, 2.6.2, 2.6.3, 2.7, 4.3.1, 4.3.2, 4.3.1, 5.2, 5.6, 5.8, 5.11, 5.12
 Unit III: Sections6.1, 6.2.1, 6.2.2 (Page no: 178 to 181), 6.2.4, 6.4, 6.7, 6.12, 6.13
 Unit VI: Sections7.2, 7.2.1, 7.2.2, 7.3, 7.4, 7.5, 7.20
 Unit V: Sections 9.1, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.2.7, 9.3.1, 9.3.2, 9.3.4

Books for References:

1. Renewable energy resources, John Twidell and Tonyweir, Taylor and Francis group, London and New York.
2. Applied solar energy, A.B.MeinelandA.P.Meinal
3. John Twidell and Tony Weir, Renewable energy resources, Taylor and Francis group, London and New York.
4. Renewal Energy Technologies: A PracticalGuide for Beginners C.S. Solanki– PHI Learning
5. Introduction to Non– Conventional Energy Resources – Raja et. al., Sci. Tech Publications

Web Resources

1. <https://www.open.edu/openlearn/ocw/mod/oucontent/view.php?id=2411&printable=1>
2. <https://www.nationalgeographic.org/encyclopedia/tidal-energy/>
3. <https://www.ge.com/renewableenergy/wind-energy/what-is-wind-energy>
4. <https://www.reenergyholdings.com/renewable-energy/what-is-biomass/>
5. <https://www.acciona.com/renewable-energy/solar-energy/>

Blended Learning:

Unit 1:Hydrogen energy

Link:<https://archive.nptel.ac.in/courses/103/101/103101215/>

NPTEL Video Course: NOC:Hydrogen Energy: Production, Storage, Transportation and Safety, Lecture 04

Unit 2:Open cycle OTEC system and the closed OTEC cycle

Link:<https://understand-energy.stanford.edu/energy-resources/renewable-energy/ocean-energy/>

Core Lecturer, Civil and Environmental Engineering, Stanford University

Unit 3:Wind energy conversion

Link:<https://understand-energy.stanford.edu/energy-resources/renewable-energy/wind/>

Core Lecturer, Civil and Environmental Engineering, Stanford University

Unit 4:Aerobic and anaerobic digestion

Link:<https://www.digimat.in/nptel/courses/video/105107207/L59.html>NPTEL

Video Course: NOC: Water and Waste Water Treatment

Lecture 59 – Anaerobic and Aerobic digestion of sludge

Unit 5: solar cells: Solar cells for direct conversion of solar energy to electric powers-solar cell parameter

Link:<https://ocw.mit.edu/courses/2-627-fundamentals-of-photovoltaics-fall-2013/resources/2011-lecture-1-introduction/>

Lecture 1, Introduction to Fundamentals of Photovoltaics Massachusetts Institute of Technology

Rationale for Nature of the course:

This course will provide the basic knowledge about the energysources and harvesting techniques.

Activities having direct bearing on Skill development / Employability

Entrepreneurship:

Students will learn the basic principle and functions of some energyharvesting instruments.

Pedagogy

Chalk and Board, PPT, Group discussion, Assignment, Seminar, Quiz.

Course Designer(s):

1. Dr.J.Sivasubramanian

Course Schedule

Unit	Topics	Hrs	Mode
I	Energy consumption as a measure of prosperity – Conventional energy sources and their availability	3	Chalk and Board, PPT, Seminar, Test, Quiz
	non– conventional energy sources and their availability	4	
	Hydrogen energy – Magneto hydro dynamic generator	4	
	Advantages of renewable energy– prospects of Renewable energy sources	4	
II	Ocean thermal energyconversion systems (OTEC) – Methods of ocean thermal electric power generation	4	Chalk and Board, PPT, Seminar, Test, Quiz
	Open cycle OTEC system – The closed OTEC cycle	4	
	Site selection – Energy utilization Energy from tides	3	
	Basic principle of tidal power– utilization of tidal energy	4	
III	Solar radiation and its measurements	3	Chalk and Board, Quiz, Test, Seminar
	solar cells: Solar cells for direct conversion of solar energy to electric powers	3	
	solar cell parameter–solar cell electrical characteristics	2	
	solar water Heater –solar distillation– solar cooking	4	
IV	solar greenhouse – Solar Pond and its applications.	3	Chalk and Board, PPT, group discussion, Seminar, Test, Quiz
	power in the wind– Wind energy conversion	3	
	Site selection consideration – Advantages and disadvantages of wind energy conversion systems (WECS)	3	
	Energy storage– Applications of wind energy.	4	
V	Biomass conversion Technologies– wet and dry process	4	Chalk and Board, Seminar, Quiz, Assignment
	Photosynthesis – Biogas Generation: Introduction, basic process	5	
	Aerobic and anaerobic digestion – Advantages of anaerobic digestion	3	
	factors affecting bio digestion and generation of gas – properties of biogas.	3	

COURSE OUTCOMES:

At the end of the course, the student will able to:

CLOs	Course Learning Outcomes	K Level
CLO1	Identify various forms of renewable and non– renewable energy sources	K2
CLO2	Understand the principle of utilizing the oceanic energy and apply it for practical applications.	K4
CLO3	Understand the components of solar radiation, their measurement and apply them to utilize solar energy.	K4
CLO4	Discuss the working of a windmill and analyze the advantages of wind energy.	K3
CLO5	Distinguish aerobic digestion process from an aerobic digestion	K4
K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate		

MAPPING WITH PROGRAMME OUTCOMES:

Mapping of Course Outcomes (**CLO**) against Programme Outcomes (**PO**) in the 3– point scale of STRONG (3), MEDIUM (2) and LOW (1).

CLO	POs						PSOs				
	1	2	3	4	5	6	1	2	3	4	5
CLO1	3	3	3	2	2	2	3	3	2	3	1
CLO2	3	3	3	2	1	2	3	3	3	2	1
CLO3	3	3	3	3	1	1	3	2	3	3	1
CLO4	3	2	3	3	2	1	3	3	3	2	1
CLO5	3	2	3	3	1	2	3	2	3	3	1

Assessment Scheme
Blueprint for Semester Examination
Learning Outcome Based Education (LOBE) & Assessment Articulation
Mapping– K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K– Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K– Level	No. of Questions	K– Level		
1	CLO 1	Up to K2	2	K1&K1	1	K1	2 (K1& K1)	1 (K2)
2	CLO 2	Up to K3	2	K2&K2	1	K2	2 (K2& K2)	1 (K3)
3	CLO 3	Up to K4	2	K3&K3	1	K2	2 (K3& K3)	1 (K3)
4	CLO 4	Up to K4	2	K3&K3	1	K1	2 (K4&K4)	1 (K4)
5	CLO 5	Up to K4	2	K4&K4	1	K3	2 (K4 &K4)	1 (K4)
No. of Questions to be Asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1– Remembering and recalling facts with specific answers

K2– Basic understanding of facts and stating main ideas with general answers

K3– Application oriented –Solving Problems

K4– Examining, analyzing, presentation and make inferences with evidences

Distribution of Section– wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice
K1	2	4	10	– –	16	13.33 %
K2	2	4	10	10	26	21.67%
K3	4	2	10	20	36	30.00 %
K4	2	–	20	20	42	35.00 %
Total Marks	10	10	50	50	120	100%

DEPARTMENT OF PHYSICS					CLASS: I M.Sc			
Sem	Course type	Course code	Course title	Credits	Contact hours/ Week	CIA	Ext	Total
I	Elective	25P1PECT2 (B)	Physics of Nano science & Technology	3	5	25	75	100
Nature of course								
Skill oriented		✓	Employability oriented		Entrepreneurship Oriented			

Objectives:

1. Physics of Nano science and Technology is concerned with the study, creation, manipulation and applications at nanometer scale.
2. To provide the basic knowledge about nano science and technology.
3. To learn the structures and properties of nano materials.
4. To acquire the knowledge about synthesis methods and characterization techniques and its applications.

Unit	Description	Hours	K– level	CLO
I	Fundamentals of Nano science and Technology Fundamentals of NANO – Historical Perspective on Nanomaterial and Nanotechnology – – Classification of Nanomaterials – Metal and Semiconductor Nanomaterials – 2D, 1D, 0D nanostructured materials – Quantum dots – Quantum wires – Quantum wells – Surface effects of nanomaterials. Blended Learning: Classification of Nano materials	15	K2	1
II	Properties of Nanomaterials Physical properties of Nanomaterials: Melting points, specific heat capacity, and lattice constant – Mechanical behavior: Elastic properties – strength – ductility – super plastic behavior – Optical properties: – Surface Plasmon Resonance – Quantum size effects – Electrical properties – Conductivity, Ferroelectrics and dielectrics – Magnetic properties – super para magnetism – Diluted magnetic semiconductor (DMS). Blended Learning: Magnetic properties – super para magnetism – Diluted magnetic semiconductor (DMS)	15	K4	2
III	Synthesis and Fabrication Physical vapour deposition – Chemical vapour deposition – sol– gel – Wet deposition techniques – electrochemical deposition method – Plasma arching	15	K3	3

	– Electros pinning method – ball milling technique – pulsed laser deposition – Nanolithography: photolithography – Nano manipulator. Blended Learning: Nanolithography: photolithography – Nano manipulator.			
IV	Characterization Techniques Powder X– ray diffraction – X– ray photoelectron spectroscopy (XPS) – UV– visible spectroscopy – Photoluminescence – Scanning electron microscopy (SEM) – Transmission electron microscopy (TEM) – Scanning probe microscopy (SPM) – Scanning tunneling microscopy (STM) – Vibrating sample Magnetometer.	15	K4	4
V	Applications of Nanomaterials Sensors: Nano sensors based on optical and physical properties – Electrochemical sensors – Nano– biosensors. Nano Electronics: Nano bots – display screens – GMR read/write heads – Carbon Nano tube Emitters – Photo catalytic application: Air purification, water purification – Medicine: Imaging of cancer cells – biological tags – drug delivery – photodynamic therapy – Energy: fuel cells – rechargeable batteries – supercapacitors – photovoltaic's.	15	K3	5

Books for Study:

1. A textbook of Nanoscience and Nanotechnology, Pradeep T., Tata McGraw– Hill Publishing Co. (2012).
2. Principles of Nanoscience and Nanotechnology, M.A. Shah, Tokeer Ahmad, Narosa Publishing House Pvt Ltd., (2010).
3. Introduction to Nanoscience and Nanotechnology, K. K. Chattopadhyay and A.N. Banerjee, PHI Learning Pvt. Ltd., New Delhi, (2012).
4. Nanostructured Materials and Nanotechnology, Hari Singh Nalwa, Academic Press, (2002).
5. Nanotechnology and Nanoelectronics, D.P. Kothari, V. Velmurugan and Rajit Ram Singh, Narosa Publishing House Pvt. Ltd, New Delhi. (2018)

Books for References:

1. Nanostructures and Nanomaterials – Huozhong Gao – Imperial College Press (2004).
2. Richard Booker and Earl Boysen, (2005) Nanotechnology, Wiley Publishing Inc. USA
3. Nano particles and Nano structured films; Preparation, Characterization and Applications, J. H. Fendler John Wiley and Sons. (2007)

4. Textbook of Nanoscience and Nanotechnology, B. S. Murty, et al., Universities Press. (2012)
5. The Nanoscope (Encyclopedia of Nanoscience and Nanotechnology), Dr. Parag Diwan and Ashish Bharadwaj (2005) Vol. IV – Nanoelectronics Pentagon Press, New Delhi.

Web Resources

1. www.its.caltec.edu/feyman/plenty.html
2. <http://www.library.ualberta.ca/subject/nanoscience/guide/index.cfm>
3. <http://www.understandingnano.com>
4. <http://www.nano.gov>
5. <http://www.nanotechnology.com>

Blended Learning link: <https://nptel.ac.in/courses/118102003>

Unit 1: Lecture No: 1– Classification of Nanomaterials

Unit 2: Lecture No: 34 – Magnetic properties – super para magnetism – Diluted magnetic semiconductor (DMS)

Unit 3: Lecture No: 3 – Nanolithography: photolithography – Nano manipulator.

Rationale for Nature of the course:

This course aims to present a number of topics in nanotechnology and science, with emphasis on the role of size on mechanical, optical, thermal and electrical properties of materials. The course also introduces various modern techniques developed to produce Nanostructures and Nano devices and to characterize them. The course incorporates Lab visits.

Activities having direct bearing on Skill development / Employability

Entrepreneurship:

Nanoscience and technology has emerged recently as a promising area in the knowledge bank with lots of scope for innovation to address the challenging problems faced by science, society and humanity.

Pedagogy

Chalk and Board, PPT, Group discussion, Assignment, Seminar, Quiz.

Course Designer(s):

1. Mr. V. Seenivasan

Course Schedule

Unit	Topics	Hrs	Mode
I	Fundamentals of NANO – Historical Perspective on Nanomaterial and Nanotechnology	5	Chalk and Board, PPT, Seminar, Test, Quiz
	Classification of Nanomaterials – Metal and Semiconductor Nanomaterials – 2D, 1D, 0D nanostructured materials –	5	
	Quantum dots – Quantum wires – Quantum wells – Surface effects of nanomaterials.	5	
II	Physical properties of Nanomaterials: Melting points, specific heat capacity, and lattice constant	5	Chalk and Board, PPT, Seminar, Test, Quiz
	Mechanical behavior: Elastic properties – strength – ductility– super plastic behavior – Optical properties: – Surface Plasmon Resonance – Quantum size effects	5	
	Electrical properties – Conductivity, Ferroelectrics and dielectrics – Magnetic properties – super para magnetism – Diluted magnetic semiconductor (DMS).	5	
III	Physical vapor deposition – Chemical vapor deposition – sol– gel – Wet deposition techniques	5	Chalk and Board, Quiz, Test, Seminar
	Electrochemical deposition method – Plasma arching – Electros pinning method – ball milling technique.	5	
	pulsed laser deposition – Nanolithography: photolithography – Nano manipulator.	5	
IV	Powder X– ray diffraction – X– ray photoelectron spectroscopy (XPS) – UV– visible spectroscopy	5	Chalk and Board, PPT, group discussion, Seminar, Test, Quiz
	Photoluminescence – Scanning electron microscopy (SEM) – Transmission electron microscopy (TEM)	5	
	Scanning probe microscopy (SPM) – Scanning tunneling microscopy (STM) – Vibrating sample Magnetometer.	5	
V	Sensors: Nano sensors based on optical and physical properties – Electrochemical sensors – Nano– biosensors. Nano Electronics: Nano bots – display screens.	5	Chalk and Board, Seminar, Quiz, Assignment
	GMR read/write heads – Carbon Nano tube Emitters – Photo catalytic application: Air purification, water purification	5	
	Medicine: Imaging of cancer cells – biological tags – drug delivery – photodynamic therapy – Energy: fuel cells – rechargeable batteries – supercapacitors – photovoltaic's.	5	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Describe the basic of nano science and explore the different types of nano materials and should comprehend the surface effects of the nano materials.	K2
CLO2	Categorize the various physical, mechanical, optical, electrical and magnetic properties of nano materials.	K4
CLO3	Demonstrate the process and mechanism of synthesis and fabrication of nano materials.	K3
CLO4	Analyze the various characterizations of Nano– products through diffraction, spectroscopic, microscopic and other techniques.	K4
CLO5	Apply the concepts of nano science and technology in the field of sensors, robotics, purification of air and water and in the energy devices.	K3
K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate		

MAPPING WITH PROGRAMME OUTCOMES:

Mapping of Course Outcomes (**CLO**) against Programme Outcomes (**PO**) in the 3– point scale of STRONG(3), MEDIUM(2) and LOW(1).

CLO	POs						PSOs				
	1	2	3	4	5	6	1	2	3	4	5
CLO1	3	3	1	2	3	3	3	3	3	2	3
CLO2	3	3	1	2	3	3	3	3	3	2	3
CLO3	3	3	1	2	3	3	3	3	3	3	3
CLO4	3	3	2	2	3	3	3	3	3	3	3
CLO5	3	3	3	2	3	3	3	3	3	3	3

Assessment Scheme

Distribution of Section– wise Marks with K Levels Blueprint for Semester Examination

Units	CLOs	K– Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K– Level	No. of Questions	K– Level		
1	CLO 1	Up to K2	2	K1&K2	1	K1	2 (K1&K1)	1(K2)
2	CLO 2	Up to K4	2	K3&K4	1	K1	2 (K3&K3)	1(K4)
3	CLO 3	Up to K3	2	K2&K3	1	K2	2 (K4&K4)	1(K3)
4	CLO 4	Up to K4	2	K3&K4	1	K3	2 (K4&K4)	1(K4)
5	CLO 5	Up to K3	2	K2&K3	1	K2	2(K3&K3)	1(K3)
No. of Questions to be asked			10			5	10	5
No. of Questions to be answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each Section			10			10	25	30

Distribution of Section– wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice
K1	2	4	10	–	16	13.33
K2	2	4	10	10	26	21.67
K3	4	2	10	20	36	30.00
K4	2	–	20	20	42	35.00
Total Marks	10	10	50	50	120	100.00

DEPARTMENT OF PHYSICS					CLASS:PG NME			
Sem	Course type	Course code	Course title	Credits	Contact hours/ Week	CIA	Ext	Total
I	NME	25P1PSEN1	Astrobiology	2	2	25	75	100

Nature of course				
Skill oriented	✓	Employability oriented		Entrepreneurship Oriented

Objectives:

- To introduce the students to the interdisciplinary field of Astrobiology.
- To make the students appreciate the scope of astrobiology in light of our understanding of life, as we know it in the present form and the on the basis of discovery of exoplanets in the habitable zone.
- To appreciate the origin of life and environment of our earth and extrapolate the findings to our solar system.

Unit	Description	Hours	K-level	CLO
I	Astronomy and Astrobiology Introduction – Life from the perspective of physics – the bare necessities of life – Basic astronomy – Formation of stars and galaxies –nucleo synthesis – HR diagram – spectral classification of stars – theory of formation of planets – the age of earth and moon.	6	K2	1
II	Origin of life and environment The early earth – origin of life – role of atmosphere – the great oxidation event – advent of animal life	6	K2	2
III	Life in the solar system Habitable bodies in the solar system – Sunlight's effect on habitability of inner planets – Life on Venus – early atmosphere and climate on mars – Interest on europa and titan	6	K2	3
IV	Life outside solar system Hunt for exoplanets (astrometry, stellar Doppler shift, transitlemetry, gravitational microlensing) – the habitable zone – bio signatures	6	K2	4
V	Extra terrestrial intelligence Drake's equation – SETI– Fermi's paradox – Rare earth Hypothesis	6	K2	5

Books for Study:

1. Astrobiology : A Very short introduction, David C. Catling, Oxford University Press, 2013

Unit 1 : Chapter 1 : Pages 1– 12
Chapter 2 :Pages 14– 27
Unit II : Chapter 3 : Pages 28– 37
Chapter 4 :Pages44– 53
Unit III :Chapter 6 : Pages 82– 88, 94– 96, 100– 106
Unit IV : Chapter 7 : Pages 110– 119
Unit V :Chapter 7,8 : Pages 120– 127

Books for References:

1. Des Marais, David J., et al. *The NASA Astrobiology Roadmap*. Larchmont, NY: Mary Ann Liebert, Inc., 2008.
2. Dick, Steven J., and Mark L. Lupisella. *Cosmos and Culture: Cultural Evolution in a Cosmic Context*. Washington, DC: National Aeronautics and Space Administration, 2009. ISBN: 9780160831195
3. Kaufman, Marc. *First Contact: Scientific Breakthroughs in the Hunt for Life Beyond Earth*. New York, NY: Simon and Schuster, 2011. ISBN: 9781439109007
4. Meltzer, Michael. *When Biospheres Collide: A History of NASA's Planetary Protection Programs*. Washington, DC: NASA Aeronautics and Space Administration: For sale by the Supt. of Docs., U.S. Govt. Print. Off., 2011. ISBN: 9780160853272
An Astrobiology Strategy for the Exploration of Mars. Washington, DC: National Academies Press, 2007. ISBN: 9786610934669

Web Resources

1. https://www.terc.edu/terc_products/astrobiology—an-integrated-science—approach/
2. <https://guides.lib.uw.edu/c.php?g=341353&p=2303542>
3. <http://astrobiology.com/>

Rationale for Nature of the course:

The course introduces the students to the basic astronomy alongwith the multi– disciplinary aspects of the same.

Activities having direct bearing on Skill development / Employability Entrepreneurship:

Basic astronomy – techniques for exoplanets discovery – Understanding of habitability of planets – taking part in citizen science project of NASA.

Pedagogy

Chalk and Board, PPT, Group discussion, Assignment, Seminar

Course Designer(s):

S.Sivaramakrishnan

Lecture Schedule

Unit	Topics	Hrs	Mode
Unit I	Introduction – Life from the perspective of physics – the bare necessities of life	3	Chalk and Board, PPT, Seminar
	Basic astronomy – Formation of stars and galaxies – nucleosynthesis – HR diagram – spectral classification of stars – theory of formation of planets – the age of earth and moon.	3	
Unit II	The early earth – origin of life – role of atmosphere	3	Chalk and Board, PPT
	the great oxidation event – advent of animal life	3	
Unit III	Habitable bodies in the solar system – Sunlight's effect on habitability of inner planets	3	Chalk and Board, Quiz, Seminar
	– Life on Venus – early atmosphere and climate on mars – Interest on europa and titan	3	
Unit IV	Hunt for exoplanets (astrometry, stellar Doppler shift, transit telemetry, gravitational microlensing)	3	Chalk and Board, PPT, group discussion,
	The habitable zone – bio signatures	3	
Unit V	Drake's equation – SETI	3	Chalk and Board, Seminar
	Fermi's paradox – Rare earth Hypothesis	3	

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Understand the origin of universe and its evolution	K2
CLO2	Explain the early universe and appreciate the factors that led to the occurrence of advanced life on earth.	K3
CLO3	Comprehend the idea of habitability and identify objects in the solar system that can / could have harbored life.	K4
CLO4	Understand the techniques used to detect exoplanets and look for bio signatures.	K3
CLO5	Understand Drake's equation and its implication to extra terrestrial intelligent life forms.	K4

MAPPING WITH PROGRAMME OUTCOMES:

Mapping of Course Outcomes (CLO) against Programme Outcomes (PO) in the 3– point scale of STRONG(3), MEDIUM(2) and LOW(1).

CLO	POs						PSOs				
	1	2	3	4	5	6	1	2	3	4	5
CLO1	3	2	1	1	2	3	3	2	2	1	1
CLO2	3	1	2	2	2	3	3	2	2	1	2
CLO3	3	1	3	3	3	3	3	2	2	1	1
CLO4	3	2	3	3	3	3	3	2	2	1	2
CLO5	3	3	3	3	2	3	3	2	2	1	1

Summative – Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K– Level	Section B		Section C (Either or Choice)	Section D(Open Choice)
			Short answers			
			No. of Questions	K– Level		
1	CLO 1	Up to K2	1	K1	2 (K2&K2)	1 (K2)
2	CLO 2	Up to K2	1	K1	2 (K2&K2)	1 (K2)
3	CLO 3	Up to K2	1	K1	2 (K2&K2)	1 (K2)
4	CLO 4	Up to K2	1	K1	2 (K2&K2)	1 (K2)
5	CLO 5	Up to K2	1	K1	2 (K2&K2)	1 (K2)
No. of Questions to be asked				5	10	5
No. of Questions to be answered				5	5	3
Marks for each question				2	7	10
Total marks for each				10	35	30

K1– Remembering and recalling facts with specific answers

K2– Basic understanding of facts and stating main ideas with general answers

K3– Application oriented –Solving Problems

K4– Examining, analyzing, presentation and make inferences with evidences

Distribution of Section– wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either / or)	Section C (Open choice)	Total Marks	% of Marks with choice
K1	5			16	10.5
K2		5	5	85	89.5
Total Marks	10	35	50	95	100.00

DEPARTMENT OF PHYSICS					CLASS: I M.Sc			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
II	Core	25P2PCCT3	Statistical Mechanics	5	6	25	75	100

Nature of course				
Skill oriented	✓	Employability oriented		Entrepreneurship Oriented

Objectives:

- To acquire the knowledge of thermodynamic potentials and to understand phase transition in thermodynamics
- To identify the relationship between statistic and thermodynamic quantities
- To comprehend the concept of partition function, canonical and grand canonical ensembles
- To grasp the fundamental knowledge about the three types of statistics
- To get in depth knowledge about phase transitions and fluctuation of thermodynamic properties that vary with time

Unit	Description	Hours	K– level	CLO
I	Phase transition: Entropy– thermodynamic functions– third law of thermodynamics– general condition for equilibrium– thermodynamics phase transition – Macrostate– Microstate– Phasespace– Statistical ensemble– Liouville’s theorem– statistical density matrix. Blended Learning: Introduction to thermodynamics–Law of thermodynamics.	18	K2	1
II	Micro canonical ensemble: MicrocanonicalEnsembles– Entropy of a perfect gas –entropy and probability– canonical distribution– quantum canonical partition function– equipartition theorem– thermodynamic function for the canonical ensembles– calculation of free energy of an ideal gas Gibbs paradox. Blended Learning: Second law of Thermodynamics– Entropy	18	K3	2
III	Grand canonical and ideal gases: Grand canonical distribution– thermodynamic function for the grand canonical ensembles– The ideal gases in micro canonical ensembles– Maxwell Boltzmann statistics– Bose– Einstein Statistics–	18	K4	3

	Fermi Dirac Statistics– ideal gas molecules with internal motion– The ideal gases in grand canonical ensemble– landau theory of liquid HeII Blended Learning: Free energy thermodynamics– Maxwell relation			
IV	Classical statistical mechanics of interacting systems: Deviation of imperfect gases from the ideal state: Vander Waals equation of state– cluster explanation for classical system– Virial expansion of the equation of state– Intermolecular potential models– Evaluation of Virial coefficient of the equation of state	18	K4	4
V	Quantum Statistical mechanics of interacting systems: Cluster expansion of quantum system– Virial expansion of the equation of state– Second Virial coefficient at low temperature– second Virial coefficient at high temperature– quantum field theory for interacting system– Ising model –Ising model in zeroth approximation– Exact solution of one dimension Ising Model.	18	K3	5

Text Book:

1. S.K.Sinha, Introduction to statistical Mechanicas,Narosa publishing.
Unit– I:Chapter1– 1.6, Chapter2– 2.2,2.3,2.6,2.7,2.8
Unit– II:Chapter3– 3.2,3.4,3.6, Chapter4– 4.2,4.4,4.5,4.6
Unit– III:Chapter5– 5.2,5.3, Chapter6– 6.4,6.5,6.6,6.8,6.14,6.12,7.6
Unit– IV:Chapter9– 9.1,9.2,9.3,9.4,9.5
Unit– V:Chapter10– 10.1,10.2,10.3,10.5,10.6,13.9,13.10,13.11

Books for Reference :

1. B. K. Agarwal and M. Eisner, 1998, Statistical Mechanics, Second Edition New Age International, New Delhi.
2. J. K. Bhattacharjee, 1996, Statistical Mechanics: An Introductory Text, Allied Publication, New Delhi.
3. F. Reif, 1965, Fundamentals of Statistical and Thermal Physics, McGraw – Hill, New York.
4. M. K. Zemansky, 1968, Heat and Thermodynamics, 5th edition, McGraw– Hill New York.
5. R. K. Pathria, 1996, Statistical Mechanics, 2nd edition, Butter WorthHeinemann, New Delhi. L. D. Landau and E. M. Lifshitz, 1969, Statistical Physics, Pergamon Press, Oxford.
6. K. Huang, 2002, Statistical Mechanics, Taylor and Francis, London

7. W. Greiner, L. NeiseandH.Stoecker, Thermodynamics and Statistical Mechanics, Springer Verlang, New York.
8. B. Gupta, H. Roy, 2002, Thermal Physics, Books and Allied, Kolkata.

Web Resources

1. <https://byjus.com/chemistry/third-law-of-thermodynamics/>
2. <https://web.stanford.edu/~peastman/statmech/thermodynamics.html>
3. https://en.wikiversity.org/wiki/Statistical_mechanics_and_thermodynamics
4. https://en.wikipedia.org/wiki/Grand_canonical_ensemble
5. https://en.wikipedia.org/wiki/Ising_model

Blended Learning link:

UNIT- 1:

Introduction to thermodynamics: <https://www.youtube.com/watch?v=4Jxlxc8Zn78&t=1s>

Laws of thermodynamics: <https://www.youtube.com/watch?v=nxKveefDueE>

UNIT- 2

Second law of thermodynamics :<https://www.youtube.com/watch?v=Ish6pFp3w2g>

Entropy: <https://www.youtube.com/watch?v=sCL9dovdDPo>

UNIT- 3

Free energy of thermodynamics: <https://www.youtube.com/watch?v=Qzsl4ffPTSs>

Maxwell's relations: <https://www.youtube.com/watch?v=JVBHQcJL4NU>

<https://www.youtube.com/watch?v=RKdWmgpvIbQ>

<https://www.youtube.com/watch?v=imsjcPEzNKs>

Rationale for Nature of the course

Knowledge of Laws of thermodynamics, phase transition, entropy, ensembles, partition function, classical and quantum statistics, thermal equilibrium.

Activities having direct bearing on Skill development / Employability Entrepreneurship

The test of all knowledge is theoretical results are illustrated by matching the experimental data in the activities and uses of electromagnetic theory.

Pedagogy

Chalk and talk, materials, PPT, Quiz, Assignment, Seminar, Problem solving, Group discussion, interaction and field visit.

Course Designer(s):

1. Dr.M.Kavitha

Lecture Schedule

Unit	Topics	Hrs	Mode
Unit I	Phase transition: Entropy– thermodynamic functions	3	PPT, Chalk and talk, Quiz and assignment
	third law of thermodynamics – general condition for equilibrium	4	
	thermodynamics phase transition– Macostate– Microstate	4	
	Macostate– Microstate– Phasespace– Statistical ensemble	3	
	Liouville's theorem– statistical density matrix.	4	
Unit II	Micro canonical ensembles: Microcanonical ensembles– Entropy of a perfect gas	4	Chalk and talk, and assignment
	entropy and probability– canonical distribution	3	
	quantum canonical partition function– equipartition theorem	4	
	Thermodynamic function for the canonical ensembles– calculation of free energy of an ideal gas Gibbs paradox.	4	
Unit III	Grand canonical and ideal gases: Grand canonical distribution– thermodynamic function for the grand canonical ensembles	4	PPT, Chalk and talk and Quiz
	The ideal gases in micro canonical ensembles– Maxwell Boltzmann statistics	3	
	Bose– Einstein Statistics– Fermi Dirac Statistics	4	
	ideal gas molecules with internal motion	3	
	The ideal gases in grand canonical ensemble– Landau theory of liquid HeII	4	
Unit IV	Classical statistical mechanics of interacting systems: Deviation of imperfect gases from the ideal state:	4	PPT, Chalk and talk, Quiz and assignment
	cluster explanation for classical system– Virial expansion of the equation of state	4	
	Virial expansion of the equation of state– Intermolecular potential models	3	
	Evaluation of virial coefficient of the equation of state	3	
	Intermolecular potential models– Evaluation of virial coefficient of the equation of state	4	

Unit V	Quantum Statistical mechanics of interacting systems: Cluster expansion of quantum system– Virial expansion of the equation of state–	6	PPT, Chalk and talk
	Second virial coefficient at low temperature– second virial coefficient at high temperature– quantum field theory for interacting system	6	
	Ising model –Ising model in zeroth approximation– Exact solution of one dimension Ising Model.	6	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CO1	To examine and elaborate the effect of changes in thermodynamic quantities on the states of matter during phase transition	K2
CO2	To analyze the macroscopic properties such as pressure, volume, temperature, specific heat, elastic moduli etc. using microscopic properties like intermolecular forces, chemical bonding, atomicity etc.	K3
CO3	Differentiate between canonical and grand canonical ensembles and to interpret the relation between thermodynamical quantities and partition function	K4
CO4	To recall and apply the different statistical concepts to analyze the behavior of ideal Fermi gas and ideal Bose gas and also to compare and distinguish between the three types of statistics.	K4
CO5	To discuss and examine the thermodynamical behavior of gases under fluctuation and also using Ising model	K3
K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes (**CO**) for each course with program outcomes (**PO**) and program specific outcomes (**PSO**) in the 3– point scale of STRONG (3), MEDIUM (2) and LOW (1).

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	1	1	2
CO2	3	3	3	1	1	1
CO3	3	3	3	1	1	2
CO4	3	3	3	1	1	2
CO5	3	3	3	1	1	2

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	1	1
CO2	3	3	3	1	1
CO3	3	3	3	1	1
CO4	3	3	3	1	1
CO5	3	3	3	1	1

Assessment Scheme
Blueprint for Semester Examination
 Learning Outcome Based Education (LOBE) & Assessment Articulation
 Mapping– K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K– Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No .of Questions	K– Level	No. of Questions	K– Level		
1	CLO1	UptoK2	2	K1&K1	1	K1	2(K2&K2)	1(K2)
2	CLO2	UptoK3	2	K2&K3	1	K1	2(K3&K3)	1(K3)
3	CLO3	UptoK4	2	K2&K2	1	K3	2(K3&K3)	1(K4)
4	CLO4	UptoK4	2	K3&K4	1	K2	2(K3&K3)	1(K3)
5	CLO5	UptoK3	2	K3&K4	1	K2	2(K4&K4)	1(K4)
No. of Questions to be Asked			10		5		10	5
No. of Questions to be Answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1– Remembering and recalling facts with specific answers

K2– Basic understanding of facts and stating main ideas with general answers

K3– Application oriented –Solving Problems

K4– Examining, analyzing, presentation and make inferences with evidences

Distribution of Section– wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No choice)	Section C (Either/or)	SectionD (Open Choice)	Total Marks	% of Marks without choice
K1	2	4	10	–	16	13.33
K2	2	4	10	10	26	21.67
K3	4	2	10	20	36	30.00
K4	2	–	20	20	42	35.00
Total Marks	10	10	50	50	120	100.00

DEPARTMENT OF PHYSICS					CLASS: I M.Sc			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
II	Core	25P2PCCT4	Quantum Mechanics I	5	6	25	75	100

Nature of course				
Skill oriented	✓	Employability oriented		Entrepreneurship Oriented

Objectives:

- To develop the physical principles and the mathematical background important to quantum mechanical descriptions.
- To describe the propagation of a particle in a simple, one– dimensional potential.
- To formulate and solve the Schrodinger’s equation to obtain eigen vectors and energies for particle in a three– dimensional potential.
- To explain the mathematical formalism and the significance of constants of motion, and see their relation to fundamental symmetries in nature
- To discuss the Approximation methods like perturbation theory, Variational and WKB methods for solving the Schrödinger equation.

Unit	Description	Hours	K– level	CLO
I	BASIC FORMALISM Interpretation of the wave function – Time dependent Schrodinger equation – Time independent Schrodinger equation – Stationary states – Ehrenfest theorem – Linear vector space – Linear operator – Eigen functions and Eigen Values – Hermitian Operator – Postulates of Quantum Mechanics – Simultaneous measurability of observables – General Uncertainty relation Blended Learning: Stationary states, Linear vector space	18	K3	1
II	ONE DIMENSIONAL AND THREE– DIMENSIONAL ENERGY EIGEN VALUE PROBLEMS Square – well potential with rigid walls – Square well potential with finite walls – Square potential barrier– Alpha emission – Linear harmonic oscillator: Operator method–Particle moving in a spherically symmetric potential–System of two interacting particles–Hydrogen atom– Rigid rotator Blended Learning: Square – well potential with rigid walls – Square well potential with finite walls	18	K4	2

III	GENERAL FORMALISM Dirac notation – Equations of motions: Schrodinger representation – Heisenberg representation – Interaction representation – Coordinate representation–Momentum representation—Unitary transformation– Symmetries and conservation laws: Symmetry transformations – Conservation of angular momentum– Parity conservation–Time reversal. Blended Learning: Dirac notation, Equations of motions : Schrodinger representation – Heisenberg representation	18	K3	3
IV	APPROXIMATION METHODS Time independent perturbation theory for non-degenerate energy levels –Degenerate energy levels– Stark effect in Hydrogen atom–Ground and excited state – The variational principle – Rayleigh– Ritz method – Variation method for excited states – Helium atom – WKB approximation: WKB method – Connection formulae– Validity of WKB method.	18	K4	4
V	ANGULAR MOMENTUM Angular momentum operators –Commutation relations –Eigen values J^2 and J_z – Angular momentum matrices –Spin angular momentum – Spin vectors for spin- 1/2 system – Addition of angular momenta – Clebsh– Gordan Coefficients – Computation of CG Coefficients. Blended Learning: Clebsh– Gordan Coefficients, Computation of CG Coefficients.	18	K4	5

Books for Study:

1. G. Aruldas, Quantum Mechanics, 2nd Edition, Prentice– Hall of India, NewDelhi,2009 Unit 1 : Sections 2.5 – 2.9, 3.1 – 3.7
Unit 2 : Sections 4.1 – 4.4., 4.8, 5.1 – 5.4
Unit 3 : Sections 3.8 – 3.10, 6.7, 7.1, 7.4 –7.6
Unit 4 : Sections 9.1 , 9.2, 9.5 – 9.7, 10.1 – 10.3, 10.5, 11.1 – 11.3
Unit 5 : Sections 8.1 , 8.2, 8.5– 8.9

Books for References:

1. E.Merzbacher, Quantum Mechanics, 2nd Edition, John Wiley and Sons, New York, 1970.
2. V. K. Thankappan, Quantum Mechanics, 2nd Edition, Wiley Eastern Ltd, New Delhi, 1985.
3. L.D.Landau and E.M.Lifshitz, Quantum Mechanics,1st edition, Pergomon Press, Oxford, 1976.
4. S.N.Biswas, Quantum Mechanics, Books and Allied Ltd., Kolkata,1999.

5. V.Devanathan, Quantum Mechanics, 2nd edition, Alpha Science International Ltd, Oxford, 2011.

Web Resources

1. http://research.chem.psu.edu/lxjgroup/download_files/chem565-c7.pdf
2. http://www.feynmanlectures.caltech.edu/III_20.html
3. <http://web.mit.edu/8.05/handouts/jaffe1.pdf>
4. https://hepwww.pp.rl.ac.uk/users/haywood/Group_Theory_Lectures/Lecture1.pdf
5. <https://theory.physics.manchester.ac.uk/~xian/qm/chapter3.pdf>

Blended Learning link:

1. <https://archive.nptel.ac.in/courses/115/101/115101107/>
Unit 1 : Stationary states – Week1: Lecture 4
Linear vector space – Week 3: Lecture 12
Unit 2 : Square well potential with rigid walls – Week1: Lecture 3
Square well potential with finite walls – Week1: Lecture 4
Unit 3 : Dirac notation – Week 3: Lecture 13 &15
Equations of motion: Schrodinger representation – Week 6: Lecture 32
Equations of motion: Heisenberg representation – Week 6: Lecture 33
Unit 5 : Clebsch– Gordan Coefficients, Computation of CG Coefficients.
Week 11: Lecture 63 & 64

Rationale for Nature of the course:

Students will be able to solve one dimensional and three dimensional wave equations for quantum mechanical systems and explain the behaviour of atoms and sub- atomic particles.

Activities having direct bearing on Skill development / Employability

Entrepreneurship:

Students acquire problems solving skill and quantitative reasoning skill using quantum mechanical principles/concepts.

Pedagogy

Chalk and Board, PPT, Group discussion, Assignment, Seminar, Quiz.

Course Designer(s):

1. Dr.G.Gowri
2. Mr.S.Sivaramakrishnan

Course Schedule

Unit	Topics	Hrs	Mode
I	Interpretation of the wave function – Time dependent Schrodinger equation – Time independent Schrodinger equation – Stationary states –	7	Chalk and Board, PPT, Seminar, Test, Quiz
	Ehrenfest theorem – Linear vector space – Linear operator – Eigen functions and Eigen Values – Hermitian Operator	6	
	Postulates of Quantum Mechanics – Simultaneous measurability of observables – General Uncertainty relation	5	
II	Square – well potential with rigid walls – Square well potential with finite walls	6	Chalk and Board, PPT, Seminar, Test, Quiz
	Square potential barrier– Alpha emission – Linear harmonic oscillator: Operator method–Particle moving in a spherically symmetric potential	6	
	System of two interacting particles–Hydrogen atom–Rigid rotator	6	
III	Dirac notation – Equations of motions – Schrodinger representation – Heisenberg representation – Interaction representation –	7	Chalk and Board, Quiz, Test, Seminar
	Coordinate representation–Momentum representation–Unitary transformation.	5	
	Symmetries and conservation laws: Symmetry transformations – Conservation of angular momentum– Parity conservation–Time reversal	6	
IV	Time independent perturbation theory for non-degenerate energy levels –Degenerate energy levels	6	Chalk and Board, PPT, group discussion, Seminar, Test, Quiz
	Stark effect in Hydrogen atom–Ground and excited state – The variational principle – Rayleigh– Ritz method – Variation method for excited states	7	
	Helium atom – WKB approximation: WKB method – Connection formulae– Validity of WKB method.	5	
V	Angular momentum operators –Commutation relations – Eigen values J^2 and J_z	7	Chalk and Board, Seminar, Quiz, Assignment
	Angular momentum matrices –Spin angular momentum – Spin vectors for spin– 1/2 system .	5	
	Addition of angular momenta – Clebsh– Gordan Coefficients – Computation of CG Coefficients	6	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Demonstrates a clear understanding of the basic postulates of quantum mechanics which serve to formalize the rules of quantum Mechanics	K3
CLO2	Apply the Schrodinger equation to solve one dimensional problems and three dimensional problems and analyze the results	K4
CLO3	Discuss the various representations, space time symmetries and formulations of time evolution.	K3
CLO4	Formulate and analyze the approximation methods for various quantum mechanical problems	K4
CLO5	Apply non- commutative algebra for topics such as angular and spin angular momentum.	K4
K1– Remember; K2–Understand; K3– Apply; K4– Analyze		

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	3	2	2	2	3
CLO-2	3	2	2	2	3
CLO-3	3	2	2	2	2
CLO-4	3	2	2	2	3
CLO-5	2	2	2	2	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	3	2	2	3
CLO2	3	2	3	2	2	2
CLO3	3	2	3	2	2	3
CLO4	3	2	3	2	2	2
CLO5	3	2	3	2	2	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative – Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K– Level	Section A		Section B		Section C(Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K– Level	No. of Questions	K– Level		
1	1	Up to K3	2	K1&K1	1	K1	2 (K1&K1)	1 (K2)
2	2	Up to K4	2	K3&K4	1	K2	2(K4&K4)	1 (K3)
3	3	Up to K3	2	K2&K3	1	K1	2 (K2&K2)	1 (K3)
4	4	Up to K4	2	K2&K3	1	K3	2 (K4&K4)	1 (K4)
5	5	Up to K4	2	K3& K4	1	K2	2 (K3&K3)	1 (K4)
No. of Questions to be asked			10			5	10	5
No. of Questions to be answered			10			5	5	3
Marks for each question			1			2	5	10
Total marks for each			10			10	25	30

K1– Remembering and recalling facts with specific answers

K2– Basic understanding of facts and stating main ideas with general answers K3– Application oriented –Solving Problems

K4– Examining, analyzing, presentation and make inferences with evidences

Distribution of Section– wise Marks with K Levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	–	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30.00	30%
K4	2	–	20	20	42	35.00	35%
Total Marks	10	10	50	50	120	100	100%

DEPARTMENT OF PHYSICS					CLASS: I M.Sc. Physics			
Sem	Course type	Course code	Course title	Credits	Contact hours / Week	CIA	Ext	Total
II	Core Practical II	25P2PCCP2	Practical– II	4	6	25	75	100

Nature of course				
Skill oriented	✓	Employability oriented		Entrepreneurship Oriented

Objectives:

- To design and conduct experiments to verify physical laws, to determine physical quantities.
- To present results in concise quantitative measurements.
- To study various phenomena and their associated quantities.

List of experiments: (Any Twelve Experiments from the following)

1. Construction of Schmidt trigger circuit using IC555
2. Determination of Self inductance and Mutual inductance by constructing Anderson's Bridge.
3. Solving simultaneous equations – IC 741.
4. Hyperbolic Fringes.
5. Construction of 8– 3 Encoder and 3– 8 Decoder using ICs.
6. Construction of Wien's Bridge Oscillator using npn transistor.
7. Determination of resolving power of Prism.
8. Grating – Oblique incidence.
9. LASER Diffraction.
10. Karnaugh Map Simplification.
11. Measurement of Coefficient of linear expansion– Air wedge Method
12. Measurement of Susceptibility of liquid – Quincke's method
13. B– H curve using CRO
14. Measurement of Magnetic Susceptibility – Guoy's method
15. Determination of Numerical Apertures and Acceptance angle of optical fibers using Laser Source.
16. Determination of e/m – Millikan's method
17. Construction of Current to Voltage and Voltage to Current Conversion using IC 741.
18. Construction of second order butter worth multiple feedback narrow band pass filter
19. Realization of analog to digital converter (ADC) using 4– bit DAC and synchronous counter IC74193
20. Construction of Multiplexer and Demultiplexer using ICs.

Text books:

1. Practical Physics, Gupta and Kumar, Pragati Prakasan.
2. Kit Developed for doing experiments in Physics– Instruction manual, R. Srinivasan K.R Priolkar, Indian Academy of Sciences.
3. Electronic Laboratory Primer a design approach, S. Poornachandra, B. Sasikala, Wheeler Publishing, New Delhi.
4. Electronic lab manual Vol I, K ANavas, Rajath Publishing.
5. Electronic lab manual Vol II, K ANavas, PHI eastern Economy Edition

Books for reference :

1. Advanced Practical Physics, S.P Singh, PragatiPrakasan.
2. An advanced course in Practical Physics, D. Chattopadhyay, C.R Rakshit, New Central Book Agency Pvt. Ltd
3. Op– Amp and linear integrated circuit, Ramakanth A Gaykwad, Eastern Economy Edition.
4. A course on experiment with He– Ne Laser, R.S. Sirohi, John Wiley & Sons (Asia) Pvt. Ltd.
5. Electronic lab manual Vol II, Kuriachan T.D, Syam Mohan, Ayodhya Publishing

Web resources :

1. <https://www.electronics-tutorials.ws/power/unijunction-transistor.html>
2. <https://www.geeksforgeeks.org/4-bit-binary-adder-subtractor/>
3. <https://www.electronicshub.org/ic-741-op-amp-basics/>
4. <https://www.physicsglobe.com/2021/03/four-point-probe-method-engineering.html>

Rationale for nature of course

Analyzing the concepts of Physics through experiments in the laboratory will enhance effective comprehension.

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CLOs	Course Learning Outcomes	Knowledge level	Marks
CLO1	Understand the given problem in terms of domain knowledge in the field of physics.	Upto K2	15
CLO2	Design appropriate Experiment /Test for the given problem.	Upto K3	10
CLO3	Demonstrate skill in doing the experiment by choosing the appropriate technique and instruments and record data.	Upto K3	15
CLO4	Analyze the data collected and infer the outcome and represent the analysis in meaningful form.	Upto K4	20
CLO5	Communicate the findings in appropriate scientific terminology.	Upto K2	5
K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate			

Mapping of CLO's with POs

CLO	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	2	2	3	2	2	3
CLO2	2	3	3	3	3	3
CLO3	2	3	3	3	3	3
CLO4	2	3	3	3	3	3
CLO5	2	3	3	3	3	3

Mapping of CLO's with PSOs

CLO	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	2	1	3	2	2
CLO2	2	1	3	2	2
CLO3	2	1	3	2	2
CLO4	2	1	3	2	2
CLO5	2	1	3	2	2

DEPARTMENT OF PHYSICS					CLASS:I M.Sc. Physics			
Sem	Course type	Course code	Course title	Credits	Contact hours / Week	CIA	Ext	Total
II	DE III	25P2PECT3 (A)	Biophysics	3	5	25	75	100

Nature of course				
Skill oriented	✓	Employability oriented		Entrepreneurship Oriented

Objectives:

1. The aim of this course is to bring knowledge about the cell functions in terms of physical principles.
2. To understand the fundamentals of macromolecular structures involved in propagation of life, biophysical functions of membrane and neurons, various kinds of radiation and their effects on living systems.
3. To bring the knowledge about the hazardous effect of radiation and precautionary measurements.
4. To understand the physical principles behind the various techniques available for interrogating biological macromolecules.

Unit	Description	Hours	K-level	CLO
I	Cellular Biophysics Architecture and Life Cycle of cells – Organelles of Prokaryotic and Eukaryotic cell – Cell size and shape – Fine structure of Prokaryotic and Eukaryotic cell organization – Compartment & assemblies membrane system – Extracellular matrix – Molecular mechanisms of Vesicular traffic – Electrical activities of cardiac and neuronal cells. Blended Learning: Electrical activities of cardiac and neuronal cells.	15	K2	1
II	Molecular Biophysics Macromolecular structure: Protein structure – amino acids, peptide bonds, primary, secondary, tertiary, and quaternary structures of proteins Nucleic acid structure: nucleosides and nucleotides, RNA structure, DNA structure and conformation. Special Bio– macromolecules: Metallo proteins, nucleoproteins	15	K4	2

III	Membrane and Neuro Biophysics Biological membranes and dynamics – Membrane Capacitors – Transport across cell and organelle membranes – Ion channels. Nervous system: Organization of the nervous system –Membrane potential – Origins of membrane potential – Electrochemical potentials – Nernst equation – Goldman equation. Blended Learning: Electrochemical potentials, Nernst equation	15	K3	3
IV	Radiation Biophysics Radioactivity – Natural Radioactivity – Artificial Radioactivity – Radioactive disintegration – Geiger– Muller counter – Proportional counter – Scintillation counter – Autoradiography – Biological effects of radiation – Radiation hazards and protection Blended Learning: Radiation hazards and protection	15	K4	4
V	Physical Methods in Biology Spectroscopy: UV– Visible absorption spectro photometry – Optical Rotatory Dispersion (ORD) – Structure Determination: X– ray Crystallography, Electron spin resonance (ESR) and biological applications. Chromatography: Gas liquid chromatography (GLC) – Centrifugation: Differential centrifugation, density gradient centrifugation. Electrophoresis: Gel electrophoresis Blended Learning: Structure Determination: X– ray Crystallography, Electron spin resonance (ESR) and biological applications.	15	K4	5

Books for study:

1. Biology 2e, 2018, OpenStax, Rice University, Texas.
 Unit I: Section 4, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 35.1, 35.2, 40.3.
 Unit II: Section 3.1, 3.2, 3.3, 3.4, 3.5
 Unit III: Section 5.1, 5.2, 5.3, 35.
2. Biophysics, 2002, Vasantha Pattabhiand N. Gautham, Kluwer academic publishers
 Unit III: Section 13.1, 13.2, 13.3, 13.3.1
 Unit IV: Section 1.8, 18.3, 1.8.4
3. Biophysics principles and techniques, M.A. Subramanian, 2005, MJP Publishers
 Unit III: Section 2.11.6
 Unit IV: Section 9.1, 9.1.1, 9.1.2, 9.1.3, 9.2, 9.3, 9.4, 9.5, 9.7, 9.8
 Unit V: Section 5.7.1, 5.7.2, 5.15, 5.21, 6.1.1, 6.1.2, 6.1.3, 6.2, 6.10, 6.11, 6.13, 7.1.1, 7.1.2

Books for References:

1. Chemical Biophysics by Daniel A Beard (Cambridge University Press, 2008).
2. Essential cell biology by Bruce Albert et al (Garland Science)
3. Biophysics, W. Hoppe, W. Lohmann, H. Markl and H. Ziegler. Springer Verlag, Berlin (1983).
4. Membrane Biophysics by Mohammad Ashrafuzzaman, Jack A. Tuszynski, (Springer science & business media).
5. Biological spectroscopy by Iain D. Campbell, Raymond A. Dwek

Web Resources

1. General Bio: <http://www.biology.arizona.edu/DEFAULT.html>
2. Spectroscopy: <http://www.cis.rit.edu/htbooks/nmr/inside.htm>
3. Electrophoresis: <http://learn.genetics.utah.edu/content/labs/gel/>
4. Biological membranes and dynamics :<https://www.mbi.nus.edu.sg/mbinfo/membrane-dynamics/>
5. Radiation Biophysics: <http://csri.iit.edu/~howard/bootcamp/lehtml/intro.html>

Blended Learning:

1. Unit 1:Electrical activities of cardiac and neuronal cells
Link:<https://oyc.yale.edu/biomedical-engineering/beng-100/lecture-15>
Open Yale Courses
Frontiers of Biomedical Engineering
Lecture 15 – Cardiovascular Physiology
2. Unit 3:Electrochemical potentials
Link:<http://kcl.digimat.in/nptel/courses/video/102104062/L11.html>
NPTEL Video Course: NOC: Bioelectrochemistry
Lecture 11 – Relationship between Standard electrode potential (E°) and equilibrium constant (K)
3. Unit 4:Radiation hazards and protection
Link:<https://www.cdc.gov/radiation-emergencies/index.html>
Centers for Disease Control and Prevention (CDC)
Lecture – radiation emergency
4. Unit 5:Electron spin resonance (ESR) and biological applications
Link:http://ndl.iitkgp.ac.in/he_document/nptel/courses_115_105_1151051_21_video_lec29
National Digital Library of India
5. NOC:Experimental Physics III, WEEK 6, Lecture 29: Electron Spin Resonance

Rationale for Nature of the course:

This course will provide the basic knowledge about the biological system and provide the knowledge to investigate the biological system through the physics principals.

Activities having direct bearing on Skill development / Employability Entrepreneurship:
Students will learn the function of biomedical instruments such as Principle, operations and operating procedures which are used to find the basic role of Biomolecule in the biological system

Pedagogy

Chalk and Board, PPT, Group discussion, Assignment, Seminar, Quiz.

Course Designer(s):

Dr.J.Sivasubramanian

Course Schedule

Unit	Topics	Hrs	Mode
I	Architecture and Life Cycle of cells – Organelles of Prokaryotic and Eukaryotic cell – Cell size and shape	5	Chalk and Board, PPT, Seminar, Test, Quiz
	Fine structure of Prokaryotic and Eukaryotic cell organization – Compartment & assemblies membrane system	5	
	Extracellular matrix – Molecular mechanisms of Vesicular traffic – Electrical activities of cardiac and neuronal cells.	5	
II	Macromolecular structure: Protein structure – amino acids, peptide bonds, primary, secondary, tertiary, and quaternary structures of proteins	5	Chalk and Board, PPT, Seminar, Test, Quiz
	Nucleic acid structure: nucleosides and nucleotides, RNA structure, DNA structure and conformation.	5	
	Special Bio– macromolecules: Metalloproteins, nucleoproteins	5	
III	Biological membranes and dynamics – Membrane Capacitors – Transport across cell and organelle membranes – Ion channels.	5	Chalk and Board, Quiz, Test, Seminar
	Nervous system: Organization of the nervous system – Membrane potential – Origins of membrane potential	6	
	Electrochemical potentials – Nernst equation – Goldman equation.	4	
IV	Radioactivity – Natural Radioactivity – Artificial Radioactivity – Radioactive disintegration	5	Chalk and Board, PPT, group discussion, Seminar, Test, Quiz
	Geiger– Muller counter – Proportional counter – Scintillation counter	5	
	Autoradiography – Biological effects of radiation – Radiation hazards and protection	5	
V	UV– Visible absorption spectrophotometry – Optical Rotatory Dispersion (ORD)	4	Chalk and Board, Seminar, Quiz, Assignment
	Structure Determination: X– ray Crystallography, Electron spin resonance (ESR) and biological applications. Chromatography: Gas liquid chromatography (GLC)	6	
	Centrifugation: Differential centrifugation, density gradient centrifugation. Electrophoresis: Gel electrophoresis	5	

COURSE OUTCOMES:**At the end of the course, the student will able to:**

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Understand the structural organization and function of living cells and should able to apply the cell signaling mechanism and its electrical activities.	K2
CLO2	Comprehension of the role of bio molecular conformation to function.	K4
CLO3	Conceptual understanding of the function of biological membranesand also, to understand the functioning of nervous system.	K3
CLO4	To know the effects of various radiations on living systems and howto prevent ill effects of radiations.	K4
CLO5	Analyze and interpret data from various techniques viz.,spectroscopy, crystallography, chromatography etc.,	K4

MAPPING WITH PROGRAMME OUTCOMES:

Mapping of Course Outcomes (**CLO**) against Programme Outcomes (**PO**) in the 3– point scale of STRONG (3), MEDIUM (2) and LOW (1).

CLO	POs						PSOs				
	1	2	3	4	5	6	1	2	3	4	5
CLO1	3	3	3	2	1	2	3	3	3	2	1
CLO2	3	3	3	2	1	2	3	3	3	2	1
CLO3	3	3	3	3	1	1	3	3	3	3	1
CLO4	3	3	3	2	1	1	3	3	3	2	1
CLO5	3	3	3	3	1	1	3	3	3	3	1

Assessment Scheme
Blueprint for Semester Examination

Units	CLOs	K– Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K– Level	No. of Questions	K– Level		
1	CLO 1	Up to K2	2	K1&K1	1	K1	2 (K1& K1)	1 (K2)
2	CLO 2	Up to K4	2	K3&K3	1	K2	2 (K3& K3)	1 (K3)
3	CLO 3	Up to K3	2	K2&K2	1	K2	2 (K2& K2)	1 (K3)
4	CLO 4	Up to K4	2	K3&K3	1	K1	2 (K4&K4)	1 (K4)
5	CLO 5	Up to K4	2	K4&K4	1	K3	2 (K4 &K4)	1 (K4)
No. of Questions to be Asked			10		5		10	5
No. of Questions to be Answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each Section			10		10		25	30

K1– Remembering and recalling facts with specific answers

K2– Basic understanding of facts and stating main ideas with general answers

K3– Application oriented –Solving Problems

K4– Examining, analyzing, presentation and make inferences with evidences

Distribution of Section– wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	2	4	10	– –	16	15.83	13.33 %
K2	2	4	10	10	26	25.83	21.67%
K3	4	2	10	20	36	41.67	30.00 %
K4	2	–	20	20	42	16.67	35.00 %
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF PHYSICS					CLASS: I M.Sc. Physics			
Sem	Course type	Course code	Course title	Credits	Contact hours / Week	CIA	Ext	Total
II	DE III	25P2PECT3 (B)	Plasma Physics	3	5	25	75	100

Nature of course

Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objectives:

1. To explore the plasma universe by means of in-site and ground-based observations.
2. To understand the model plasma phenomena in the universe.
3. To explore the physical processes which occur in the space environment.

Unit	Description	Hours	K-level	CLO
I	FUNDAMENTAL CONCEPTS OF PLASMA Kinetic pressure in a partially ionized - mean free path and collision cross section - Mobility of charged particles - Effect of magnetic field on the mobility of ions and electrons-Thermal conductivity- Effect of magnetic field- Quasi-neutrality of plasma Debye shielding distance - Optical properties of plasma.	15	K2	1
II	MOTION OF CHARGED PARTICLES IN ELECTRIC AND MAGNETIC FIELD Particle description of plasma- Motion of charged particle in electrostatic field- Motion of charged particle in uniform magnetic field - Motion of charged particle in electric and magnetic fields-Motion of charged particle inhomogeneous magnetic field - Motion of charged particle in magnetic mirror confinement - motion of an electron in a time varying electric field- Magneto- hydrodynamics - Magneto-hydrodynamic equations – Condition for magneto hydrodynamic behaviour.	15	K4	2
III	PLASMA OSCILLATIONS AND WAVES Introduction, theory of simple oscillations - electron oscillation in a plasma – Derivations of plasma oscillations by using Maxwell's equation - Ion oscillation and waves in a magnetic field - thermal effects on plasma oscillations - Landau damping - Hydro magnetic waves - Oscillations in an electron beam.	15	K3	3

IV	PLASMA DIAGNOSTICS TECHNIQUES Single probe method - Double probe method - Use of probe technique for measurement of plasma parameters in magnetic field - microwave method - spectroscopic method - laser as a tool for plasma diagnostics-X-ray diagnostics of plasma – acoustic method - conclusion.	15	K4	4
V	APPLICATIONS OF PLASMA PHYSICS Magnetohydrodynamic Generator - Basic theory - Principle of Working-Fuel in MHD Generator - Generation of Microwaves Utilizing High Density Plasma - Plasma Diode.	15	K4	5

Books for Study:

1. Plasma Physics- Plasma State of Matter - S. N.Sen, PragatiPrakashan, Meerut.

Books for References:

1. Chen, F. F. Introduction to Plasma Physics. 2nd ed. New York, NY: Springer, 1984. ISBN: 9780306413322.
2. Introduction to Plasma Theory-D.R. Nicholson
3. Shohet, J. L. The Plasma State. San Diego, CA: Academic Press Inc., 1971. ISBN: 9780126405507.
4. Hazeltine, R. D., and F. L. Waelbroeck. The Framework of Plasma Physics. Boulder, CO: Westview Press, 2004. ISBN: 9780813342139.
5. Huddleston, R. H., and S. L. Leonard. Plasma Diagnostic Techniques. San Diego, CA: Academic Press, 1965

Web Resources

1. <https://fusedweb.llnl.gov/Glossary/glossary.html>
2. <http://farside.ph.utexas.edu/teaching/plasma/lectures1/index.html>
3. <http://www.plasmas.org/>
4. <http://www.phy6.org/Education/whplasma.html>
5. <http://www.plasmas.org/resources.htm>

Rationale for Nature of the course:

This course will provide the basic knowledge about the plasma as the fourth state of matter along with its applications and physical basis.

Activities having direct bearing on Skill development / Employability

Entrepreneurship:

Students will learn the function plasma diagnostic systems.

Pedagogy

Chalk and Board, PPT, Group discussion, Assignment, Seminar, Quiz.

Course Designer(s):

1. Dr.J.Sivasubramanian

Course Schedule

Unit	Topics	Hrs	Mode
I	Kinetic pressure in a partially ionized - mean free path and collision cross section - Mobility of charged particles	5	Chalk and Board, PPT, Seminar, Test, Quiz
	Effect of magnetic field on the mobility of ions and electrons-Thermal conductivity- Effect of magnetic field	5	
	Quasi- neutrality of plasma Debye shielding distance - Optical properties of plasma.	5	
II	Particle description of plasma- Motion of charged particle in electrostatic field- Motion of charged particle in uniform magnetic field - Motion of charged particle in electric and magnetic fields	5	Chalk and Board, PPT, Seminar, Test, Quiz
	Motion of charged particle inhomogeneous magnetic field - Motion of charged particle in magnetic mirror confinement - motion of an electron in a time varying electric field	5	
	Magneto- hydrodynamics - Magneto-hydrodynamic equations – Condition for magneto hydrodynamic behaviour.	5	
III	Introduction, theory of simple oscillations - electron oscillation in a plasma	5	Chalk and Board, Quiz, Test, Seminar
	Derivations of plasma oscillations by using Maxwell's equation - Ion oscillation and waves in a magnetic field	5	
	Thermal effects on plasma oscillations - Landau damping - Hydro magnetic waves - Oscillations in an electron beam.	5	
IV	Single probe method - Double probe method - Use of probe technique for measurement of plasma parameters in magnetic field	5	Chalk and Board, PPT, group discussion, Seminar, Test, Quiz
	microwave method - spectroscopic method -laser as a tool for plasma diagnostics	5	
	X-ray diagnostics of plasma - acoustic method - conclusion	5	

V	Magneto hydrodynamic Generator - Basic theory - Principle of Working	5	Chalk and Board, Seminar, Quiz, Assignment
	Fuel in MHD Generator	5	
	Generation of Microwaves Utilizing High Density Plasma - Plasma Diode.	5	

COURSE OUTCOMES:

At the end of the course, the student will able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Understand the collision, cross section of charged particles and to able to correlate the magnetic effect of ion and electrons in plasma state.	K2
CLO2	Understand the plasma and learn the magneto-hydrodynamics concepts applied to plasma.	K4
CLO3	Explore the oscillations and waves of charged particles and thereby apply the Maxwell's equation to quantitative analysis of plasma.	K3
CLO4	Analyze the different principle and techniques to diagnostics of plasma.	K4
CLO5	Learn the possible applications of plasma by incorporating various electrical and electronic instruments.	K4

MAPPING WITH PROGRAMME OUTCOMES:

Mapping of Course Outcomes (**CLO**) against Programme Outcomes (**PO**) in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1).

CLO	POs						PSOs				
	1	2	3	4	5	6	1	2	3	4	5
CLO1	3	3	3	2	1	2	3	3	3	2	1
CLO2	3	3	3	2	1	2	3	3	3	2	1
CLO3	3	3	3	3	1	1	3	3	3	3	1
CLO4	3	3	3	2	1	1	3	3	3	2	1
CLO5	3	3	3	3	1	1	3	3	3	3	1

Assessment Scheme
Blueprint for Semester Examination

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K-Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1&K1	1	K1	2 (K1& K1)	1 (K2)
2	CLO 2	Up to K4	2	K3&K3	1	K2	2 (K3& K3)	1 (K3)
3	CLO 3	Up to K3	2	K2&K2	1	K2	2 (K2& K2)	1 (K3)
4	CLO 4	Up to K4	2	K3&K3	1	K1	2 (K4&K4)	1 (K4)
5	CLO 5	Up to K4	2	K4&K4	1	K3	2 (K4 &K4)	1 (K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	2	4	10	--	16	15.83	13.33 %
K2	2	4	10	10	26	25.83	21.67%
K3	4	2	10	20	36	41.67	30.00 %
K4	2	-	20	20	42	16.67	35.00 %
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF PHYSICS				CLASS: I M.Sc PHYSICS				
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
II	Elective	25P2PECT4 (A)	Advanced Optics	3	5	25	75	100

Nature of course					
Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objectives:

- To know the concepts behind polarization and could pursue research work on application aspects of laser
- To impart an extensive understanding of fiber and non– linear optics
- To study the working of different types of LASERS
- To differentiate first and second harmonic generation
- Learn the principles of magneto– optic and electro– optic effects and its applications

Unit	Description	Hours	K– level	CLO
I	Unit – I: Matrix Optics Mathematical representation of polarized light – Jones's vectors – Mathematical representation of polarizers – Jones's matrices – Linear polarizer, phase retarder, rotator. Matrix method – Ray tracing equation – Transformation matrices, Refraction matrices, combined operations, conjugate planes. Single lens system – Principal plane : General transformation –Application to thick lens – General concept of image formation.	15	K4	1
II	Unit II: LASERS Basic principles – Spontaneous and Stimulated emissions – Main Components of the laser – Resonator – Lasing action – Types of lasers and its applications – Solid state lasers – Ruby laser – Gas lasers – He– Ne laser – CO ₂ laser – HCl laser – Semiconductor laser. Blended Learning: Spontaneous and Stimulated emissions, Solid State lasers, Gas lasers, CO ₂ laser, Semiconductor laser.	15	K2	2
III	Unit III: Fiber Optics Introduction – Total internal reflection – The Optical Fiber – Glass fibers – The Coherent Bundle – Numerical Aperture – Attenuation in Optical Fibers – Multi– mode Fibers – Pulse Dispersion in Multimode Optical Fibers – Ray Dispersion in	15	K4	3

	Multimode Step Index Fibers – Fiber Optic Sensor: Precision Displacement Sensor– Precision Vibration Sensor. Blended Learning: Total internal reflection , The Optical Fiber , Numerical Aperture, Multi– mode Fibers			
IV	Unit IV: Non– Linear Optics Harmonic generation – Second Harmonic Generation – Phase matching – Third Harmonic Generation – Optical Mixing – Parametric Generation of light – Self– focusing of light. Blended Learning: Second Harmonic Generation , Phase Matching , Third Harmonic Generation.	15	K3	4
V	Unit V: Magneto– Optics And Electro– Optics Magneto– Optical Effects – Faraday effect – Voigt effect – Cotton Mouton effect – Kerr magneto– Optic effect – Electro– Optical effects – Kerr electro– Optic effect – Pockels Electro– Optic effect	15	K3	5

Books for study:

1. Frank L. Pedrotti and Leno S. Pedrotti, Introduction to Optics, Prentice Hall Inc. 1993.
Unit I : 14, 14.1, 14.2.
2. Optics , Mikes V. Klein and Thomas E. Furtak – John Wiley & Sons, Inc– Second Edition 1986.
Unit I : Chapter : 3.3A (full), 3.3B (full), 3.3C (1,2 Only), 3.4 A (only).
3. Optics , Ajoy Ghatak, 6th edition, Mcgraw Hill Education (India) Private Ltd., 2017.
Unit II: 27.1 , 27.1.1 , 27.1.2 , 27.1.4, 27.1.5 , 27.3 , 27.4 .
Unit III: 28.1, 28.3, 28.4, 28.4.1, 28.5, 28.6, 28.7, 28.8, 28.8.1, 28.9, 28.9.1, 28.10, 28.10.1, 28.14, 28.14.1, 28.14.2.
4. B.B. Laud, Lasers and Non– Linear Optics, New Age International Publishers, 2011.
Unit II. 8.5.1, 9.1, 9.2, 9.3, 9.4, 10.3, 10.3.1.
Unit IV: 13.1, 13.2, 13.3, 13.4, 13.5, 13.6, 13.7.
5. Grant R. Fowles , Introduction to Modern Optics , Dover Publications, Inc. New York Second edition , 1989.
Unit 6: 6.10, 6.11

Books for References:

1. William T. Silfvast, 1996, Laser Fundamentals Cambridge University Press, New York
2. J. Peatros, Physics of Light and Optics, a good (and free!) electronic book
3. B. Saleh, and M. Teich, Fundamentals of Photonics, Wiley– Interscience,
4. F. S. Jenkins and H. E. White, 1981, Fundamentals of Optics, (4th Edition), McGraw – Hill International Edition.
5. Dieter Meschede, 2004, Optics, Light and Lasers, Wiley – VCH, Varley GmbH.
6. Lipson, S. G. Lipson and H. Lipson, 2011, Optical Physics, 4th Edition, Cambridge University Press, New Delhi, 2011.

7. Y. B. Band, Light and Matter, Wiley and Sons (2006)
8. R. Guenther, Modern Optics, Wiley and Sons (1990)

Web Resources

1. <https://www.youtube.com/watch?v=WgzynezPiyC>
2. <https://www.youtube.com/watch?v=ShQWwobpW60>
3. <https://www.ukessays.com/essays/physics/fiber-optics-and-its-applications.php>
4. <https://www.youtube.com/watch?v=0kEvr4DKGRI>
5. <http://optics.byu.edu/textbook.aspx>

Blended Learning link:

Unit II :<https://nptel.ac.in/courses/115101639>

week1: Spontaneous and stimulated emissions

week9: Solid state lasers, gas lasers

week11: CO₂ laser

week12. Semiconductor laser.

Unit III:<https://nptel.ac.in/courses/115107095>

Week 1 : Total internal reflection , The optical fiber , The numerical aperture, multi- mode fibers.

Unit IV: https://onlinecourses.nptel.ac.in/noc25_ph19/preview

Week 11. Second harmonic generation , Phase matching , Third harmonic generation.

Rationale for Nature of the course

Aim of the course to provide basic knowledge in all the main fields of

Advanced optics , including polarisation , lasers , fibre optics , NLO methods and magneto optics effects.

Activities having direct bearing on Skill development / Employability

Entrepreneurship

Students will do some experiments in the laboratory related to lasers and also solve the problems in polarisation and fibre optics.

Pedagogy

Chalk and talk, materials, PPT, Quiz, Assignment, Seminar, Test, Problem solving, Group discussion, interaction and field visit.

Course Designer:

1. Prof V Meenakshi Sundaram

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Mathematical representation of polarized light , Jone's vectors, Mathematical representation of polarizers .	4	PPT, Chalk and talk Quiz, Seminar, and Test
	Jone's matrices , Linear polarizer, phase retarder, rotator. Matrix method, Ray tracing equation.	4	
	Transformation matrices, Refraction matrices, combined operations, conjugate planes. Single lens system.	4	
	principal plane : General transformation , Application to thick lens , General concept of image formation.	3	
Unit II	Basic principles , Spontaneous and stimulated emissions .	3	Chalk and talk, , Quiz, Seminar, and Test
	Main Components of the laser , Resonator , Lasing action.	4	
	Types of lasers and its applications , Solid state lasers , Ruby laser , gas lasers , He– Ne laser .	4	
	CO ₂ laser , HCl laser , Semiconductor laser.	4	
Unit III	Introduction , Total internal reflection , The optical fiber , Glass fibers .	4	PPT, Chalk and talk Quiz, Seminar, and Test
	The coherent bundle , The numerical aperture , Attenuation in optical fibers , multi– mode fibers .	4	
	Pulse dispersion in multimode optical fibers , Ray dispersion in multimode step index fibers .	4	
	Fiber optic sensor: precision displacement sensor, Precision vibration sensor	3	
Unit IV	Harmonic generation , Second harmonic generation.	4	PPT, Chalk and talk, Quiz, Seminar, and Test
	Phase matching, Third harmonic generation .	4	
	Optical mixing	3	
	Parametric generation of light , Self– focusing of light	4	
Unit V	Magneto– optical effects , Faraday effect .	4	PPT, Chalk and talk , Quiz, Seminar, and Assignment
	Voigt effect , Cotton mouton effect .	4	
	Kerr magneto– optic effect , Electro– optical effects.	4	
	Kerr electro– optic effect , Pockels electro– optic effect.	3	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
1	Analyze the basic idea of polarization phenomena and matrix optics.	K4
2	Able to understand all the fundamental processes involved in laser devices and to apply the design and operation of the devices	K3
3	Demonstrate the basic configuration of a fiber optic system and advantages	K4
4	Discuss the properties of nonlinear interactions of light and matter	K2
5	Interpret the group of experiments which depend for their action on an applied magnetic and electric field	K4
K1– Remember;K2–Understand;K3– Apply;K4– Analyze;K5–Evaluate		

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	2	2	2	2
CLO2	3	2	2	3	1
CLO3	3	3	2	3	2
CLO4	3	1	1	2	1
CLO5	3	3	2	3	1

Mapping of CLOs with Pos

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO-1	3	2	2	1	2	1
CLO-2	3	2	2	1	2	2
CLO-3	3	2	3	1	2	3
CLO-4	3	1	2	1	1	1
CLO-5	3	2	2	1	2	2

Advance application –3, Intermediate level –2, Basic level–1

Assessment Scheme
Blueprint for Semester Examination
 Learning Outcome Based Education (LOBE) & Assessment Articulation
 Mapping– K Levels with Course Learning Outcomes (CLOs)

Units	CLOs	K– Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K– Level	No. of Questions	K– Level		
1	CLO1	Upto K4	2	K3&K3	1	K1	2(K4&K4)	1(K4)
2	CLO2	Upto K3	2	K2&K3	1	K1	2(K2&K2)	1(K3)
3	CLO3	Upto K4	2	K3&K4	1	K3	2(K4&K4)	1(K4)
4	CLO4	Upto K2	2	K1&K1	1	K2	2(K1&K1)	1(K2)
5	CLO5	Upto K3	2	K2&K4	1	K2	2(K3&K3)	1(K3)
No of Questions to be Asked			10		5		10	5
No. of Questions to be Answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1– Remembering and recalling facts with specific answers

K2– Basic understanding of facts and stating main ideas with general answers

K3– Application oriented– Solving Problems

K4– Examining, analyzing, presentation and make inferences with evidences

Distribution of Section– wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/ or)	Section D (Open Choice)	Total Marks	% of Marks with out choice
K1	2	4	10	–	16	13.33
K2	2	4	10	10	26	21.67
K3	4	2	10	20	36	30.00
K4	2	–	20	20	42	35.00
Total Marks	10	10	50	50	120	100.00

DEPARTMENT OF PHYSICS				CLASS: I M Sc PHYSICS				
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
II	Elective	25P2PECT4 (B)	Solid Waste Management	3	5	25	75	100

Nature of course					
Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objectives:

- To gain basic knowledge in solid waste management procedures.
- To gain industry exposure and be equipped to take up a job.
- To harness entrepreneurial skills.
- To analyze the status of solid waste management in the nearby areas.
- To sensitize the importance of healthy practices in waste managements.

Unit	Description	Hours	K-level	CLO
I	Unit – I: SOLID WASTE MANAGEMENT Introduction – Definition of solid waste – Types – Hazardous Waste: Resource conservation and Renewal act – Hazardous Waste: Municipal Solid waste and non-municipal solid waste.	15	K4	1
II	Unit II: SOLID WASTE CHARACTERISTICS Solid Waste Characteristics: Physical and chemical characteristics – SWM hierarchy – factors affecting SW generation.	15	K2	2
III	Unit III: TOOLS AND EQUIPMENT Tools and equipment – Transportation– Disposal techniques – Composting and land filling technique.	15	K4	3
IV	Unit IV: ECONOMIC DEVELOPMENT SWM for economic development and environmental protection Linking SWM and climate change and marine litter.	15	K3	4
V	Unit V: INDUSTRIAL VISIT SWM Industrial visit – data collection and analysis – presentation.	15	K3	5

Books for Study:

1. Handbook of Solid Waste Management /Second Edition, George Tchobanoglous, McGraw Hill (2002).
2. Prospects and Perspectives of Solid Waste Management, Prof. B BHosetti, New Age International (P) Ltd (2006).
3. Solid and Hazardous Waste Management, Second Edition, M.N Rao, PSB / snoitacilbuP S B Books (2020).

4. Integrated Solid Waste Management Engineering Principles and Management, Tchobanoglous, McGraw Hill (2014).
5. Solid Waste Management (SWM), Vasudevan Rajaram, PHI learning private limited (2016).

Books for References:

1. Municipal Solid Waste Management, Christian Ludwig, Samuel Stucki, Stefanie Hellweg, Springer Berlin Heisenberg, 2012.
2. Solid Waste Management Bhide A. D Indian National Scientific Documentation Centre, New Delhi Edition 1983 ASIN: B0018MZ0C2
3. Solid Waste Tchobanoglous George; Kreith, Frank McGraw Hill Publication, New Delhi 2002, ISBN 9780071356237
4. Environmental Studies Manjunath D. L. Pearson Education Publication, New Delhi, 2006 ISBN- I3: 978- 8131709122
5. Solid Waste Management Sasikumar K. PHI learning, New Delhi, 2009 ISBN 8120338693

Web Resources

1. <https://www.meripustak.com/Integrated-Solid-Waste-Management-Engineering-Principles-And-Management-Issues-125648>
2. <https://testbook.com/learn/environmental-engineering-solid-wastemanagement/>
3. https://www.meripustak.com&gclid=Cj0KCQjwuuKXBhCRARIsAgM0iVpismAJN93CHA1sX6NuNeOKLXfQJjxHCOVH3QXjJ1iACq30KofoaAmFsEALw_wcB
4. <https://images.app.goo.gl/tYiW2gUPfS2cxdD28>
5. <https://amzn.eu/d/5VUSTDI>

Rationale for Nature of the course

Solid waste management is an extremely indispensable criterion to preserve the ecological sustainability of the nature.

Activities having direct bearing on Skill development / Employability

Entrepreneurship

This course renders the employability and entrepreneurial skills in the field of solid waste management.

Pedagogy

Chalk and talk, materials, PPT, Quiz, Assignment, Seminar, Test, Problem solving, Group discussion, interaction and field visit.

Course Designer:

1. Prof V Meenakshi Sundaram

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Introduction, Definition of solid waste, Types.	5	PPT, Chalk and talk Quiz, Seminar, and Test
	Hazardous Waste: Resource conservation and Renewal act .	5	
	Hazardous Waste: Municipal Solid waste and non-municipal solid waste.	5	
Unit II	Solid Waste Characteristics	5	Chalk and talk, , Quiz, Seminar, and Test
	Physical and chemical characteristics	5	
	SWM hierarchy , factors affecting SW generation.	5	
Unit III	Tools and equipment	5	PPT, Chalk and talk Quiz, Seminar, and Test
	Transportation , Disposal techniques	5	
	Composting and land filling technique.	5	
Unit IV	SWM for economic development	5	PPT, Chalk and talk, Quiz, Seminar, and Test
	SWM for environmental protection Linking SWM	5	
	climate change and marine litter.	5	
Unit V	SWM Industrial visit	5	PPT, Chalk and talk , Quiz, Seminar, and Assignment
	data collection and analysis	5	
	presentation.	5	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
1	Gained knowledge in solid waste management	K1
2	Equipped to take up related job by gaining industry exposure	K5
3	Develop entrepreneurial skills	K3
4	Will be able to analyze and manage the status of the solid wastes in the nearby areas	K4
5	Adequately sensitized in managing solid wastes in and around his/her locality	K5
K1– Remember; K2–Understand; K3– Apply; K4– Analyze; K5–Evaluate		

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	1	1	2	2
CLO2	3	3	3	3	3
CLO3	3	3	2	2	2
CLO4	3	3	3	2	2
CLO5	3	3	3	3	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO-1	3	2	1	1	2	3
CLO-2	3	2	3	3	3	3
CLO-3	3	2	2	2	2	3
CLO-4	3	2	3	3	2	3
CLO-5	3	3	3	3	3	2

Advance application –3, Intermediate level –2, Basic level–1

Assessment Scheme
Blueprint for Semester Examination
 Learning Outcome Based Education (LOBE) & Assessment Articulation
 Mapping– K Levels with Course Learning Outcomes (CLOs)

Units	CLOs	K– Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K– Level	No. of Questions	K– Level		
1	CLO1	Upto K3	2	K1&K1	1	K1	2 (K1&K1)	1(K3)
2	CLO2	Upto K4	2	K3&K3	1	K2	2 (K4&K4)	1(K4)
3	CLO3	Upto K3	2	K3&K3	1	K2	2(K3&K3)	1(K3)
4	CLO4	Upto K4	2	K4&K4	1	K3	2(K4&K4)	1(K4)
5	CLO5	Upto K2	2	K2&K2	1	K1	2(K2&K2)	1(K2)
No. of Questions to be Asked			10		5		10	5
No. of Questions to be Answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1– Remembering and recalling facts with specific answers

K2– Basic understanding of facts and stating main ideas with general answers

K3– Application oriented– Solving Problems

K4– Examining, analyzing, presentation and make inferences with evidences

Distribution of Section– wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/ or)	Section D (Open Choice)	Total Marks	% of Marks without choice
K1	2	4	10	–	16	13.33
K2	2	4	10	10	26	21.67
K3	4	2	10	20	36	30.00
K4	2	–	20	20	42	35.00
Total Marks	10	10	50	50	120	100.00

DEPARTMENT OF PHYSICS					CLASS: PG NME			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
II	NME	25P2PSENT2	Astrophysics	2	2	25	75	100

Nature of course				
Skill oriented	✓	Employability oriented		Entrepreneurship Oriented

Objectives:

- To introduce principles of astrophysics describing the science of formation and evolution of stars
- Interpretation of various heavenly phenomena
- Provides an understanding of the physical nature of celestial bodies along with the instrumentation and techniques used in astronomical research

Unit	Description	Hours	K– level	CLO
I	Unit I: Early astronomy Phases of the moon – distance of sun and moon – sizes of sun and moon – size of earth – shape of earth – seasons on earth – day and night on earth – Copernican revolution	6	K2	1
II	Unit II : The Sun: Solar interior and zones – solar atmosphere– photosphere–chromosphere–solar corona– prominences–sunspots	6	K2	2
III	Unit III: Solar System: Emmanuel Kant theory of formation of solar system – Constituents of solar system – Titus Bode Law of planetary distances–meteors, meteorites, comets, asteroids–Kuiperbelt objects –Oort cloud	6	K2	3
IV	Unit IV: Telescopes and Eclipses: Optical telescopes – lens telescope – mirror telescope – space based telescope – solar eclipse – lunar eclipse	6	K2	4
V	Unit V: Stellar Evolution: H–R diagram – birth & death of low mass, intermediate mass and massive stars – Chandrasekar limit – white dwarfs – neutron stars – pulsars – black holes – supernovae. Galaxies: classification of galaxies–dark matter–expanding universe..	6	K2	5

Books for Study

1. Mohit Kumar Sharma, Suresh Chandra, A textbook of astronomy and astrophysics, dreamtech press, New Delhi, 2023
Unit I : Chapter 1 – Sections 1.1– 1.7, 2
Unit II : Chapter 8 – Sections 14,15,17,18,20,21.1 (Kant's theory only)
Unit III : Chapter 4 – Sections 5.1, 5.3, 7, 8, 10, 11, 14
Unit IV : Chapter 6 – Sections 1, 2(relevant sections), 3.1– 3.3, Chapter 10 – Sections 4,5,7.4,8
Unit V : Chapter 7 – Sections 1, 2.1, 2.2, 2.5,2.8,2.9,,

Books for References:

1. K.D.Abhyankar,Astrophysics,Universitypress(India)Ltd.,2001,Hyderabad.
2. DavidCatling, Astrobiology:Averyshortintroduction, OxfordUniversityPress,2013.
3. BaidyanathBasu,AnintroductiontoAstrophysics,Fourthprinting,Prentice Hall of India(P)Ltd,2001,NewDelhi.
4. K.S.Krishnaswamy,Astrophysics–amodernperspective,NewAge International(P)Ltd,2002,NewDelhi.
5. B.S.Shylaja,&H.R.Madhusudan,Eclipse:ACelestial ShadowPlay,OrientBlackSwan,1999.

Web Resources

1. <https://www.space.com/2621>
2. <https://en.wikipedia.org/wiki/Astrophysics8-astrophysics.html><https://science.nasa.gov/astrophysics>

Rationale for Nature of the course

Fundamental knowledge provided in this course is highly essential for science students those who wish to apply and appear for recruitment procedures for vacancy positions in national observatories and space research organizations.

Activities having direct bearing on Skill development / Employability Entrepreneurship

1. Student can develop models to demonstrate eclipses/ planetary motion
2. Student can conduct case study pertaining to any topic in this paper

Pedagogy

Lecture, documentary screening, model making and display, seminar, assignment, quiz

Course Designer(s):

Mr.S. Sivaramakrishnan

Lecture Schedule

Unit	Topics	Hrs	Mode
Unit I	Optical telescopes – magnifying power, brightness, resolving power and f / aratio – types of reflecting and refracting telescopes	4	Lecture, Quiz
	detectors and image processing – radio telescopes – Hubble space telescope.	2	
Unit II	The Sun: Physical and orbital data – solar atmosphere – photosphere – chromosphere – solar corona	3	Lecture, Chart, Quiz, Assignment
	prominences – sunspots – 11 years solar cycle – solar flares.	3	
Unit III	Bode's law of planetary distances – meteors, meteorites, comets, asteroids – Kuiper belt – Oort cloud	4	Lecture, Assignment, Quiz
	Detection of gravitational waves – recent advancements in astrophysics.	2	
Unit IV	Types of eclipses – solar eclipse – total and partial solar eclipse – lunar eclipse – total and partial lunar eclipse – transits.	6	Lecture, model making, quiz, assignment
Unit V	H-R diagram – birth & death of low mass, intermediate mass and massive stars – Chandrasekar limit – white dwarfs – neutron stars – pulsars – black holes – supernovae.	3	Lecture, Assignment, Quiz
	Galaxies: classification of galaxies – galaxy clusters – interaction of galaxies, dark matter and superclusters – evolving universe.	3	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CLO'S	Course Learning Outcomes	K-level
CLO1	Classify the types of telescopes	K2
CLO2	Explain Bode's law in estimating the planetary distances	K2
CLO3	Discuss total and partial eclipses	K2
CLO4	Describe H-R diagram for identifying the spectral classification of a star	K2
CLO5	Demonstrate eclipses by developing models	K2

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	3	1	2	1	1
CLO-2	3	1	2	1	1
CLO-3	3	1	2	1	1
CLO-4	3	1	2	1	1
CLO-5	3	1	2	1	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	1	1	1	3
CLO2	3	2	1	1	1	3
CLO3	3	2	1	1	1	3
CLO4	3	2	1	1	1	3
CLO5	3	2	1	1	1	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative – Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K– Level	Section A		Section B (Either or Choice)	Section C (Open Choice)
			Short answers			
			No. of Questions	K– Level		
1	CLO 1	K2	1	K1	K2	K2
2	CLO 2	K2	1	K1	K2	K2
3	CLO 3	K2	1	K1	K2	K2
4	CLO 4	K2	1	K1	K2	K2
5	CLO 5	K2	1	K1	K2	K2
No. of Questions to be asked			5		5	5
No. of Questions to be answered			5		5	3
Marks for each question			2		7	10
Total marks for each			10		35	30

K1– Remembering and recalling facts with specific answers

K2– Basic understanding of facts and stating main ideas with general answers

K3– Application oriented –Solving Problems

K4– Examining, analyzing, presentation and make inferences with evidences

Distribution of Section– wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5			10	10.5	100
K2		5	5	85	89.5	
Total Marks	10	35	50	95	100	

MOOC courses– Equivalence against Major Elective (M.Sc. Physics)

The following MOOC courses offered in Swayam / NPTEL shall be considered as equivalent against Major Elective courses offered in M.Sc. (Physics). Courses at PG level (NCrFlevel 6/6.5) with 3 credits duration of atleast 12 weeks shall be considered. Students are also permitted to take courses other than listed with equivalence certified by Chairman, BoS.

Name of the course	Offered by	Link
An Introduction to Lasers and Laser Systems	Prof. Dhruba J. Biswas, Prof. J. Padma Nilaya, Homi Bhabha National Institute(HBNI)	https://onlinecourses.nptel.ac.in/noc25_ph03/preview
Bio photonics	Prof. Basudev Lahiri	https://onlinecourses.nptel.ac.in/noc25_ge05/preview
Climate Change Science	Prof. J.Srinivasan, IISc Bangalore	https://onlinecourses.nptel.ac.in/noc25_ce09/preview
Optical Spectroscopy and Microscopy : Fundamentals of optical measurements and instrumentation	Prof. Balaji Jayaprakash IISc Bangalore	https://onlinecourses.nptel.ac.in/noc25_bt37/preview
Introduction to Atmospheric and Space Sciences	Prof. MV Sunil Krishna IIT Roorkee	https://onlinecourses.nptel.ac.in/noc25_ph13/preview
The Science of Light Amplification: An Extensive Laser course	Prof. Paramita Deb Bhabha Atomic Research Centre(BARC)_IIT Bombay	https://onlinecourses.nptel.ac.in/noc25_ph26/preview
Plasma Physics and Applications	Prof. MV Sunil Krishna IIT Roorkee	https://onlinecourses.nptel.ac.in/noc25_ph21/preview
Scientific Computing using Matlab	Prof. Mani Mehra, Prof. Vivek K. Aggarwal IIT Delhi, DTU Delhi	https://onlinecourses.nptel.ac.in/noc25_ma51/preview
Fundamentals of Attosecond Science and Technology (FAST)	Prof. Sivarama Krishnan IIT Madras	https://onlinecourses.nptel.ac.in/noc25_ph11/preview

Physics of Biological Systems	Prof. Mithun Mitra IIT Bombay	https://onlinecourses.nptel.ac.in/noc25_ph18/preview
Quantum Information and Computing	Prof.Dipan Ghosh Department of Physics IIT Bombay	https://archive.nptel.ac.in/courses/115/101/115101092/
Characterization of Materials	Dr. A. Perumal Department of Physics IIT Guwahati	https://archive.nptel.ac.in/courses/115/103/115103030/
Physics of functional materials and devise	Prof.Amreesh Chandra Department of Physics IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc23_ph34/preview
Radio astronomy	Prof. Abhirup Datta IIT Indore	https://onlinecourses.nptel.ac.in/noc23_ph42/preview



The Madura College, Madurai – 625 011
Department of Physics
Programme Structure of M.Sc. PHYSICS

Course Code	Title of the Course	Hours	Credits	Nature of Course(Employability/ Entrepreneurship/ Skill Development)			Scope of Focus (Local / National / Global developmental needs)			Percentage of Syllabus Revision/New
				Empl	Ent	Skill	Local	National	Global	
25P1PCCT1	Mathematical Physics	6	5			Y			Y	<10
25P1PCCT2	Classical Mechanics & Relativity	6	5			Y			Y	<10
25P1PCCP1	Practical I	6	4	Y	Y	Y			Y	20
25P1PECT1 (A)	Linear and Digital ICs & Applications	5	3	Y	Y				Y	<10
25P1PECT1 (B)	Digital Communication			Y						<10
25P1PECT2 (A)	Energy Physics	5	3			Y			Y	20
25P1PECT2 (B)	Physics of Nano Science & Technology									<10
25P1PSEN1	Astrobiology	2	2			Y			Y	New

25P2PCCT3	Statistical Mechanics	6	5			Y			Y	33
25P2PCCT4	Quantum Mechanics –I	6	5			Y			Y	<10
25P2PCCP2	Practical II	6	4			Y			Y	20
25P2PECT3(A)	Bio Physics	5	3	Y					Y	20
25P2PECT3 (B)	Plasma Physics			Y					Y	<10
25P2PECT4 (A)	Advanced Optics	5	3			Y			Y	<10
25P2PECT4 (B)	Solid Waste Management					Y			Y	<10
25P2PSEN2	Astrophysics	2	2			Y			Y	20

Emp– Employability; Ent– Entrepreneurship; Skill– Skill Development



DEPARTMENT OF CHEMISTRY

Revised Curriculum

Based on the model curriculum of

TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION (TANSCH)

With elements from

Learning Outcome Based Education framework (LOBE) of UGC

(Choice Based Credit system with Outcome Based Education)

Academic Year 2023-2024 onwards

V and VI semesters (B.Sc. Chemistry) – Regulation 2023

I and II semesters (M.Sc. Chemistry) – Regulation 2025



THE MADURA COLLEGE
An Autonomous Institution affiliated to Madurai Kamaraj University
Re-accredited (4th Cycle) with 'A' grade by NAAC
Vidya Nagar, T.P.K. Road, Madurai – 625 011

SEMESTER- V

S.No	Course Title	Course Code	Title of the Paper	Credit	Hours
1	CORE - THEORY	23U5CCCT5	Organic chemistry-I	4	5
2	CORE - THEORY	23U5CCCT6	Inorganic chemistry-I	4	5
3	CORE - THEORY	23U5CCCT7	Physical chemistry-I	4	5
4	CORE - PRACTICAL	23U5CCCP5	Organic estimation & Gravimetric estimation	3	3
5	DISCIPLINE ELECTIVE COURSE - I	23U5CDET1	Fundamentals of spectroscopy (A) (Or) Nano science (B)	4	5
6	IDC	23U5CIDT1	Industrial chemistry	4	5
7	VALUE EDUCATION	23U5VENT1	Value education	2	2
8	INDUSTRIAL VISIT/INTERNSHIP	23U5CINTR	INDUSTRIAL VISIT	2	-
TOTAL				27	30

SEMESTER- VI

S.No	Course Title	Course Code	Title of the Paper	Credit	Hours
1	CORE - THEORY	23U6CCCT8	Organic chemistry-II	4	6
2	CORE - THEORY	23U6CCCT9	Inorganic chemistry-II	4	6
3	CORE - THEORY	23U6CCCT10	Physical chemistry-II	4	6
4	CORE - PRACTICAL	23U6CCCP6	Physical chemistry practicals	3	3
5	DISCIPLINE ELECTIVE COURSE - II	23U6CDET2	Bio chemistry (A) (Or) Batteries and fuel cells (B)	2	4
6	DISCIPLINE ELECTIVE COURSE -III	23U6CSED1	Competency skills in Chemistry	2	2
7	Project and viva-voce	23U6CPROV	Project and viva-voce	2	3
TOTAL				21	30

DEPARTMENT: CHEMISTRY					CLASS: III B.Sc CHEMISTRY			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
V	Major Core	23U5CCCT5	ORGANIC CHEMISTRY - I	4	5	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

Objectives: The objective of this course is to make the student to

- Know the Stereoisomerism in chirals and geometric isomerism in olefins, conformations of ethane and butane
- Explain the Preparation and properties of aromatic and aliphatic nitro compounds and amines
- Identify the Preparation of different dyes, food colour and additives
- Demonstrate the Preparation and properties of five membered heterocycles like pyrrole, furan and thiophene
- Deduce the Preparation and properties of six membered heterocycles like pyridine, quinoline and isoquinoline.

Unit	Description	Hours	K-level	CLO
I	Stereochemistry Fischer Projection, Newmann and Sawhorse Projection formulae and their interconversions; Geometrical isomerism: cis-trans, syn-anti isomerism, E/Z notations. Optical Isomerism: Optical activity, specific rotation, asymmetry, enantiomers, distereoisomers, meso structures - molecules with one and two chiral centres, racemisation- methods of racemisation; resolution- methods of resolution. C.I.P rules. R and S notations for one and two chirality (stereogenic) centres. Molecules with no asymmetric carbon atoms – allenes and biphenyls. Conformational analysis of ethane and butane.	15	Upto K4	1
II	Chemistry of Nitrogen Compounds – I Nitroalkanes: Nomenclature, isomerism, preparation from alkyl halides, halo acids, alkanes; physical properties; reactions – reduction, halogenations, Grignard reagent, and Pseudo acid character. Nitro - aci nitro tautomerism. Aromatic nitro compounds: Nomenclature, preparation – nitration, from diazonium salts, physical properties; reactions - reduction of nitrobenzene in different medium, Electrophilic substitution reactions, preparation and properties of TNT.	15	Upto K2	2

	Amines: Aliphatic amines: Nomenclature, isomerism, preparation – Hofmann's degradation reaction, Gabriel's phthalimide synthesis. Physical properties, reactions – alkylation, acylation, carbylamine reaction, Mannich reaction, oxidation, basicity of amines.			
III	Chemistry of Nitrogen Compounds-II Aromatic amines: Nomenclature, preparation – from nitro compounds, Hofmann's method; Schmidt reaction, properties - basic nature, ortho effect; reactions – alkylation, acylation, carbylamine reaction, reaction with nitrous acid, aldehydes, oxidation, Electrophilic substitution reactions, diazotization and coupling reactions; sulphanilic acid - zwitter ion formation. Distinction between primary, secondary and tertiary amines - aliphatic and aromatic Diazonium compounds: Diazomethane, Benzene diazonium chloride - preparations and synthetic applications. Dyes: Theory of colour and constitution; classification based on structure and application; preparation –Martius yellow, aniline yellow, methyl orange, alizarin, indigo, malachite green.	15	Upto K3	3
IV	Heterocyclic compounds-I Nomenclature and classification. General characteristics - aromatic character and reactivity. Five-membered heterocyclic compound-Pyrrole – preparation - from succinimide, Paal Knorr synthesis; reactions – reduction, basic character, acidic character, electrophilic substitution reactions, ring opening. Furan – preparation from mucic acid and pentosan; reactions – hydrogenation, reaction with oxygen, Diels Alder reactions, formation of thiophene and pyrrole; Electrophilic substitution reaction. Thiophene synthesis - from acetylene; reactions –reduction; oxidation, electrophilic substitution reactions.	15	Upto K3	4
V	Heterocyclic compounds-II Six-membered heterocyclic compounds Pyridine – synthesis - from acetylene, Physical properties; reactions - basic character, oxidation, reduction, electrophilic substitution reactions; nucleophilic substitution- uses Condensed ring systems Quinoline – preparation - Skraup synthesis and Friedlander's synthesis; reactions – basic nature, reduction, oxidation; electrophilic substitutions; nucleophilic substitutions – Chichibabin reaction Isoquinoline – preparation by the Bischler – Napieralski reaction, reduction, oxidation; electrophilic substitution.	15	Upto K3	5

Books for Study:

1. M.K. Jain, S.C.Sharma, Modern Organic Chemistry, Vishal Publishing, fourth reprint, 2009.
2. S.M. Mukherji, and S.P. Singh, Reaction Mechanism in Organic Chemistry, Macmillan India Ltd., third edition, 2009.
3. ArunBahl and B.S. Bahl, Advanced organic chemistry, New Delhi, S.Chand& Company Pvt. Ltd., Multicolour edition, 2012.

Books for References:

1. R. T. Morrison and R. N. Boyd, Organic Chemistry, Pearson Education, Asia, sixth edition, 2012.
2. T.W.Graham Solomons, Organic Chemistry, John Wiley & Sons, eleventh edition, 2012.
3. A. Carey Francis, Organic Chemistry, Tata McGraw-Hill Education Pvt. Ltd., New Delhi, seventh edition, 2009.
4. I. L. Finar, Organic Chemistry, Vol. (1& 2), England, Wesley Longman Ltd, sixth edition, 2006.
5. J. A. Joule, and G. F. Smith, Heterocyclic Chemistry, Wiley, Fifth Edition, 2010.

Web Resources:

1. <https://archive.nptel.ac.in/courses/104/105/104105086/>
2. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000005CH/P000656/M014409/ET/1536916568CHE_P1_M30_etext.pdf
3. <https://archive.nptel.ac.in/courses/104/105/104105034/>

Rationale for Nature of the Course

This course content provides comprehensive foundation in stereochemistry, chemistry of nitrogen compounds and heterocyclic compounds which are essential for advanced studies in organic chemistry and related fields. By mastering these concepts, students will gain expertise in Organic chemistry research, Pharmaceutical industry, Dyes and pigments manufacturing, Food and cosmetics industries.

Activities having direct bearing on Skill development / Employability Entrepreneurship

To enhance skill development and employability related to the outlined content, students may participate in experiments aimed at synthesizing aromatic and aliphatic amines, nitro compounds, and heterocycles. Furthermore, students can explore the application of dyes in the textile industry and food additives in culinary contexts, presenting their findings in a seminar format. Additionally, visits to chemical or dye manufacturing facilities will provide students with valuable insights into production processes and potential career opportunities.

Pedagogy

- Chalk-Talk class room Activities
- Group Discussion
- Seminar
- Quiz through ICT- Mode

Name of the course Designer

Dr. J. Shanmugapriya

Course Schedule

Unit	Descriptions	Hours	Lecture
I	Stereochemistry Fischer Projection, Newmann and Sawhorse Projection formulae and their interconversions; Geometrical isomerism: cis-trans, syn-anti isomerism, E/Z notations.	3	Chalk & talk/ppt Problem Solving/Quiz/ Test
	Optical Isomerism: Optical activity, specific rotation, asymmetry, enantiomers, diastereoisomers, meso structures	3	
	Molecules with one and two chiral centres, racemisation- methods of racemisation	3	
	Resolution- methods of resolution. C.I.P rules. R and S notations for one and two chirality (stereogenic) centres.	3	
	Molecules with no asymmetric carbon atoms – allenes and biphenyls. Conformational analysis of ethane and butane	3	
II	Chemistry of Nitrogen Compounds – I Nitroalkanes: Nomenclature, isomerism, preparation from alkyl halides, halo acids, alkanes	2	Chalk & talk/ppt Problem Solving/Quiz/ Test
	Reactions – reduction, halogenations, Grignard reagent, and Pseudo acid character. Nitro - aci nitro tautomerism.	3	
	Aromatic nitro compounds: Nomenclature, preparation – nitration, from diazonium salts, physical properties	2	
	Reactions - reduction of nitrobenzene in different medium, Electrophilic substitution reactions, TNT.	3	
	Amines: Aliphatic amines: Nomenclature, isomerism, preparation – Hofmanns' degradation reaction, Gabriel's phthalimide synthesis.	2	
	Physical properties, reactions – alkylation, acylation, carbylamine reaction, Mannich reaction, oxidation, basicity of amines. preparation and properties of TNT	3	
III	Chemistry of Nitrogen Compounds-II Aromatic amines: Nomenclature, preparation – from nitro compounds, Hofmann's method; Schmidt reaction	2	Chalk & talk/ppt Problem Solving/Quiz/ Test
	Properties - basic nature, ortho effect; reactions – alkylation, acylation, carbylamine reaction, reaction with nitrous acid, aldehydes, oxidation,	3	
	Electrophilic substitution reactions, diazotization and coupling reactions; sulphanilic acid - zwitter ion formation.	2	
	Distinction between primary, secondary and tertiary amines - aliphatic and aromatic.	2	
	Diazonium compounds: Diazomethane, Benzene diazonium chloride - preparations and synthetic applications.	2	
	Dyes: Theory of colour and constitution; classification based on structure and application	2	

	Preparation –Martius yellow, aniline yellow, methyl orange, alizarin, indigo, malachite green.	2	
IV	Heterocyclic compounds-I Nomenclature and classification. General characteristics - aromatic character and reactivity. Five-membered heterocyclic compound-Pyrrole – preparation - from succinimide, Paal Knorr synthesis	4	Chalk& talk/ppt Problem Solving/Quiz/ Test
	Reactions – reduction, basic character, acidic character, electrophilic substitution reactions, ring opening.	2	
	Furan – preparation from mucic acid and pentosan; reactions – hydrogenation, reaction with oxygen, Diels Alder reactions, formation of thiophene and pyrrole	5	
	Electrophilic substitution reaction.Thiophene synthesis - from acetylene; reactions –reduction; oxidation, electrophilic substitution reactions.	4	
V	Heterocyclic compounds-II Six-membered heterocyclic compounds Pyridine – synthesis - from acetylene, Physical properties; reactions	3	Chalk& talk/ppt Problem Solving/Quiz/ Assignment
	Basic character, oxidation, reduction, electrophilic substitution reactions; nucleophilic substitution- uses	3	
	Condensed ring systems Quinoline – preparation - Skraup synthesis and Friedlander's synthesis; reactions – basic nature, reduction, oxidation;	3	
	Electrophilic substitutions; nucleophilic substitutions – Chichibabin reaction	3	
	Isoquinoline – preparation by the Bischler – Napieralski reaction, reduction, oxidation; electrophilic substitution.	3	

COURSE LEARNING OUTCOMES

At the end of the course, the student will be able to:

	CLO Statement	K-level
CLO1	Inspect RS notations to chirals and E Z notations to olefins and explain conformations of ethane and butane.	Upto K4
CLO2	Explain preparation and properties of aromatic and aliphatic nitro compounds and amines	Upto K2
CLO3	Analyze the preparation and properties of aromatic amines and diazonium compounds, and evaluate the color and constitution of dyes and food additives.	Upto K3
CLO4	Apply their understanding to discuss the preparation methods and properties of five-membered heterocycles such as pyrrole, furan, and thiophene.	Upto K3
CLO5	Examine the preparation methods and properties of six-membered heterocycles, such as pyridine, quinoline, and isoquinoline, and illustrate their significance in various applications.	Upto K3

Mapping of CLOs and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	3	3	3	3
CLO2	3	3	3	3	3	3
CLO3	3	3	3	3	3	3
CLO4	3	3	3	3	3	3
CLO5	3	3	3	3	3	3

Mapping of CLOs and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	3	3	3	3	3	3
CLO2	3	3	3	3	3	3
CLO3	3	3	3	3	3	3
CLO4	3	3	3	3	3	3
CLO5	3	3	3	3	3	3

3- Advance Application

2 – Intermediate Level

1 – Basic Level

Blueprint for Summative Examination
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K4	2	K1 & K2	1	K2	2 (K4 & K4)	1(K4)
2	CLO 2	Up to K2	2	K1 & K2	1	K1	2 (K1 & K1)	1(K2)
3	CLO 3	Up to K3	2	K1 & K2	1	K1	2 (K3 & K3)	1(K3)
4	CLO 4	Up to K3	2	K1 & K2	1	K2	2 (K3 & K3)	1(K3)
5	CLO 5	Up to K3	2	K1 & K2	1	K2	2 (K2 & K2)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either / or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF CHEMISTRY					CLASS: III. B.Sc. Chemistry			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
V	Major Core	23U5CCCT6	INORGANIC CHEMISTRY- I	4	5	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

Objectives: The objective of this course is to make the student to

- Recall the nomenclature, isomerism and theory of coordination compounds, and chelate complexes
- Understand crystal field theory, magnetic properties, stability of complexes and Jahn Teller Effect
- Demonstrate the preparation and properties of metal carbonyls
- Explain the characteristics of Lanthanides and actinides
- Exemplify the preparation and properties of inorganic polymers

Unit	Description	Hours	K-level	CLO
I	Co-ordination Chemistry - I IUPAC Nomenclature of coordination compounds, Isomerism in coordination compounds. Werner's coordination theory – effective atomic number (EAN) – interpretation of geometry and magnetic properties by Pauling's theory (VBT) Chelates Types of ligands forming chelates – Stability of chelates, applications of chelates in qualitative and quantitative analysis– Application of DMG, Oxine and EDTA in analysis.	15	Up to K3	1
II	Co-ordination Chemistry - II Crystal field theory (CFT) –Crystal field splitting of energy levels in octahedral and tetrahedral complexes, Crystal field stabilization energy (CFSE), spectrochemical series - calculation of CFSE in octahedral and tetrahedral complexes - Factors influencing the magnitude of crystal field splitting, - Jahn – Teller effect – Comparison of VBT and CFT – Stability of complexes in aqueous solution, stability constants- factors affecting the stability of a complex ion, thermodynamic and kinetic stability (elementary idea)..	15	Up to K2	2

III	Organometallic compounds Metal Carbonyls : Mono and polynuclear carbonyls, General methods of preparation of carbonyls of Ni, Fe, Cr, Co, Mn, Ru and Os – general properties of binary carbonyls – bonding in carbonyls – EAN rule as applied to metal carbonyls. Ferrocene -Methods of preparation, physical and chemical properties	15	Up to K3	3
IV	Inner transition elements (Lanthanides and Actinides) General characteristics of f-block elements - Comparative account of lanthanides and actinides - Occurrence, Oxidation states, Magnetic properties, Colour and spectra - Lanthanides and Actinides separation by ion-Exchange and Solvent extraction methods – Lanthanides contraction. Chemistry of thorium and Uranium - Occurrence, Ores, Extraction, properties and uses. Preparation, Properties and uses of ceric ammonium sulphate, thorium dioxide and uranyl acetate.	15	Up to K3	4
V	Inorganic polymers General properties – classification of inorganic polymers based on element in the backbone (Si, S, B and P) Preparation and properties of silicon based polymer: silicones (polydimethylsiloxane and polymethylhydrosiloxane) Preparation and properties of Phosphorous based polymer (polyphosphazenes and polyphosphonitrilic chloride) Preparation and properties of sulphur based polymer (polysulfide and polymeric sulphur nitride) Preparation and properties of boron based polymers (borazine polymers) – industrial applications of inorganic polymers.	15	Up to K4	5

Books for Study:

1. Puri B R, Sharma L R, Kalia K C (2011), Principles of Inorganic Chemistry, 31th Edition, Milestone Publishers & Distributors, Delhi.
2. Satya Prakash, Tuli G. D., Basu S. K., Madan R. D. (2009), Advanced Inorganic Chemistry, 18th Edition, S. Chand & Co., New Delhi
3. Lee J D, (1991), Concise Inorganic Chemistry, 4th Edition, ELBS William Heinemann, London.

Books for References:

1. Madan R D, Sathya Prakash, (2003), Modern Inorganic Chemistry, 2nd ed., S.Chand and Company, New Delhi.

2. Gopalan R, (2009) Inorganic Chemistry for Undergraduates, 1st Edition, University Press (India) Private Limited, Hyderabad
3. Sivasankar B, (2013) Inorganic Chemistry 1st Edition, Pearson, Chennai
4. Alan G. Sharp (1992), Inorganic Chemistry, 3rd Edition, Addison Wesley, England
5. Peter Atkins, Tina Overton, Jonathan Rourke and Mark Weller, (2014) Inorganic Chemistry, Oxford University Press, sixth edition,

Web Resources:

1. <https://www.toppr.com/guides/chemistry/coordination-compounds/>
2. <https://rb.gy/3ar3lv>
3. <https://www.britannica.com/science/silicone>

Rationale for Nature of the course

This course will enable the students to enrich their knowledge on nomenclature, isomerism and theory of coordination compounds, and chelate complexes. Understand the concept of organometallics and their preparation and uses. Understand the preparation and properties of metal carbonyls, Lanthanides and actinides, inorganic polymers

Activities having direct bearing on Skill development / Employability Entrepreneurship

The inorganic chemistry course can incorporate various activities that directly contribute to skill development and enhance employability among students. Here are some activities that can have a direct bearing on these aspects like **i)** conduct quiz competition on theories of coordination chemistry **ii)** group discussion on fundamentals of Lanthanides and actinides **iii)** Assignment on preparation and properties organometallics. Hence the students will have chance to get skill oriented jobs in various industries.

Pedagogy

- Chalk-Talk class room Activities
- Group Discussion
- Seminar
- Quiz through ICT- Mode

Course Designer:

Dr. M. Boominathan

Course Schedule

Unit	Topics	Hrs	Mode
I	Co-ordination Chemistry - I and Chelates		
	IUPAC Nomenclature of coordination compounds, Isomerism in coordination compounds.	2	Chalk and talk/PPT/ Animated Videos/quiz/seminar/test
	Werner’s coordination theory – effective atomic number (EAN) – interpretation of geometry and magnetic properties by Pauling’s theory (VBT)	4	
	Types of ligands forming chelates – Stability of chelates, applications of chelates in qualitative and quantitative analysis–	4	
	Application of DMG and Oxine in gravimetric analysis –Estimation of hardness of water using EDTA, metal ion indicators –	3	
	Role of metal chelates in living systems – haemoglobin and chlorophyll	2	
II	Co-ordination Chemistry – II		
	Crystal field theory (CFT) –Crystal field splitting of energy levels in octahedral and tetrahedral complexes,	4	Chalk and talk/PPT/ Animated Videos/quiz/seminar/test
	Crystal field stabilization energy (CFSE), spectrochemical series - calculation of CFSE in octahedral and tetrahedral complexes -	4	
	Factors influencing the magnitude of crystal field splitting, -	2	
	Jahn – Teller effect – Comparison of VBT and CFT	2	
	Stability of complexes in aqueous solution, stability constants- factors affecting the stability of a complex ion, thermodynamic and kinetic stability (elementary idea)..	3	
III	Organometallic compounds		
	Metal Carbonyls : Mono and polynuclear carbonyls	2	Chalk and talk/Assignment quiz/seminar
	General methods of preparation of carbonyls of Ni, Fe, Cr, Co, Mn Ru and Os	5	
	General properties of binary carbonyls	2	
	Bonding in carbonyls – EAN rule as applied to	3	

	metal carbonyls.		
	Ferrocene -Methods of preparation, physical and chemical properties	3	
IV	Inner transition elements (Lanthanides and Actinides)		
	General characteristics of f-block elements - Comparative account of lanthanides and actinides	3	Chalk and talk/ Animated Videos/ seminar/quiz/test
	Occurrence, Oxidation states, Magnetic properties, Colour and spectra -	3	
	Lanthanides and Actinides separation by ion-Exchange and Solvent extraction methods – Lanthanides contraction.	4	
	Chemistry of thorium and Uranium - Occurrence, Ores, Extraction, properties and uses.	2	
	Preparation, Properties and uses of ceric ammonium sulphate, thorium dioxide and uranyl acetate	3	
V	Inorganic polymers		
	General properties – classification of inorganic polymers based on element in the backbone (Si, S, B and P).	3	Chalk and talk/PPT/ Animated Videos/ seminar/quiz/test
	preparation and properties of silicones (polydimethylsiloxane and polymethylhydrosiloxane)	3	
	phosphorous based polymer (polyphosphazines and polyphosphonitrilic chloride)	3	
	sulphur based polymer (polysulfide and polymeric sulphur nitride)	3	
	boron based polymers (borazine polymers) – industrial applications of inorganic polymers	3	

COURSE LEARNING OUTCOMES:

At the end of the course, the student will be able to:

CLO	Course Learning Outcomes	K-level
CLO1	Apply nomenclature, isomerism and theory of coordination compounds, and chelate complexes	Up to K3
CLO2	Explain the crystal field theory, magnetic properties, stability of complexes and Jahn Teller effect	Up to K2
CLO3	Build knowledge about the preparation and properties of metal carbonyls	Up to K3
CLO4	Explain the characteristics of Lanthanides and actinides.	Up to K3
CLO5	Illustrate the preparation and properties of inorganic polymers	Up to K4

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	3	3	2	2	3	2
CLO2	3	3	2	2	3	2
CLO3	3	3	3	3	3	2
CLO4	3	3	2	2	3	2
CLO5	3	3	3	3	3	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	2	2	3	2
CLO2	3	2	2	2	3	2
CLO3	3	3	3	3	3	2
CLO4	3	2	2	2	3	2
CLO5	3	2	2	2	3	2

Advance application – 3;

Intermediate level – 2;

Basic level - 1

Blueprint for Summative Examination
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K3	2	K1 & K2	1	K2	2 (K2 & K2)	1(K3)
2	CLO 2	Up to K2	2	K1 & K2	1	K1	2 (K1 & K1)	1(K2)
3	CLO 3	Up to K3	2	K1 & K2	1	K1	2 (K3 & K3)	1(K3)
4	CLO 4	Up to K3	2	K1 & K2	1	K2	2 (K3 & K3)	1(K3)
5	CLO 5	Up to K4	2	K1 & K2	1	K2	2 (K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either / or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total marks	10	10	50	50	120	100.00	100%

DEPARTMENT: Chemistry					CLASS: III. B. Sc. Chemistry			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
V	Core	23U5CCCT7	Physical Chemistry - I	4	5	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	✓

Objectives: The objective of this course is to make the student to

- Understand of Gibbs free energy, Helmholtz free energy, Ellingham's diagram and partial molar properties
- Study the chemical kinetics and different types of chemical reactions
- Give basic ideas of adsorption, homogeneous and heterogeneous catalysis
- Explain importance of colloids and macromolecules
- Explore the photochemistry, fluorescence and phosphorescence

Unit	Description	Hours	K-level	CLO
I	Thermodynamics - III Free energy and work functions - Gibbs free energy, Helmholtz free energy - their variation with temperature, pressure and volume, criteria for spontaneity; Gibbs-Helmholtz equation – derivations and applications; Maxwell relationships, thermodynamic equations of state; Thermodynamics of mixing of ideal gases, Ellingham Diagram-application. Partial molar properties – chemical potential, Gibbs Duhem equation, variation of chemical potential with temperature and pressure, chemical potential of a system of ideal gases, Gibbs- Duhem-Margules equation.	15	Up to K2	1
II	Chemical Kinetics Rate of reaction - Average and instantaneous rates, factors influencing rate of reaction - molecularity of a reaction - rate equation - order of reaction. order and molecularity of simple and complex reactions, Rate laws - Rate constants – derivation of rate constants and characteristics for zero, first order and second order (equal initial concentration) – Half-life of reaction- Half-life of first order reaction and second order reaction -Methods of determination of order - Half-life period method, - graphical method and Ostwald's isolation method. Effect of temperature on reaction rate – temperature coefficient - concept of activation energy - Arrhenius equation.	15	Up to K3	2

III	Adsorption – Chemical and physical adsorption and their general characteristics- distinction between them Different types of isotherms – Freundlich and Langmuir. Adsorption isotherms and their limitations – BET theory, kinetics of enzyme catalysed reaction –Michaelis- Menten equation Catalysis – general characteristics of catalytic reactions, auto catalysis, promoters, negative catalysis, poisoning of a catalyst – theories of homogenous and heterogeneous catalysis – Kinetics of Acid – base and enzyme catalysis. Heterogeneous catalysis	15	Up to K3	3
IV	Colloids and Surface Chemistry Colloids: Types of Colloids, Characteristics Colloids (Lyophilic and Lyophobic sols), Preparation of Sols-Dispersion methods, aggregation methods, Properties of Sols-Optical properties, Electrical properties - Electrical double layer, Electro Kinetic properties- Electro-osmosis, Electrophoresis, Coagulation or precipitation, Stability of sols, associated colloids, Emulsions, Gels-preparation of Gels, Applications of colloids Macromolecules: Molecular weight of Macromolecules- Number average molecular weight- average molecular weight, Determination of Molecular weight of molecules- Osmotic pressure method	15	Up to K3	4
V	Photochemistry Laws of photo chemistry – Lambert – Beer, Grothaus – Draper and Stark – Einstein. Quantum efficiency. Photochemical reactions – rate law – Kinetics of $\text{H}_2\text{-Cl}_2$, $\text{H}_2\text{-Br}_2$ and $\text{H}_2\text{-I}_2$ reactions, comparison between thermal and photochemical reactions. Fluorescence – applications including fluorimetry – sensitised fluorescence, phosphorescence – applications - chemiluminescence and photosensitisation – examples Chemistry of Vision – 11-cis retinal vitamin A as a precursor - colour perception of vision	15	Up to K4	5

Books for Study:

1. B.R. Puri and L.R. Sharma, Principles of Physical Chemistry, Shoban Lal Nagin Chand and Co., forty eighth edition, 2021.
2. Peter Atkins, and Julio de Paula, James Keeler, Physical Chemistry, Oxford University press, International eleventh edition, 2018.
3. ArunBahl, B.S. Bahl, G. D. Tuli Essentials of physical chemistry, 28th edition 2019, S, Chand & Co.

Books for References:

1. J. Rajaram and J.C. Kuriacose, Chemical Thermodynamics, Pearson, 1st edition, 2013.
2. Keith J. Laidler, Chemical kinetics, third edition, Pearson, 2003.
3. P. W. Atkins, and Julio de Paula, Physical Chemistry, Oxford University press, seventh edition, 2002.

Web Resources:

1. <https://vajiramandravi.com/quest-upsc-notes/heat-and-thermodynamics/>
2. https://www.sggscollegepatnacity.ac.in/wp-content/uploads/2022/02/file_61fb4310e03bb.pdf
3. <https://www.uou.ac.in/sites/default/files/slm/MSCH-604.pdf>

Rationale for Nature of the course

This course will enable the students to comprehend the basic of physical chemistry concepts in thermodynamics, chemical kinetics, photochemistry,

Activities having direct bearing on Skill development / Employability Entrepreneurship

The basic knowledge in thermodynamic system, reaction rates and types of photochemical reactions can be studied. Knowledge in various thermodynamic properties, kinetics of acid base catalysis was studied.

Pedagogy

- Chalk-Talk class room Activities
- Group Discussion
- Seminar
- Quiz through ICT- Mode

Name of the course Designer

Dr. R. RAMACHANDRAN

Course Schedule

Unit	Topics	Hrs	Mode
I	Thermodynamics - III		
	Free energy and work functions - Need for free energy functions, Gibbs free energy,	2	Chalk and talk/PPT/ Animated Videos/quiz/seminar/test
	Helmholtz free energy - their variation with temperature, pressure and volume, criteria for spontaneity; Partial molar properties – chemical potential,	3	
	Gibbs-Helmholtz equation – derivations and applications; Maxwell relationships, thermodynamic equations of state;	2	
	Thermodynamics of mixing of ideal gases, Ellingham Diagram-application.	3	
	Gibbs Duhem equation, variation of chemical potential with temperature and pressure, chemical potential of a system of ideal gases, Gibbs- Duhem-Margules equation	4	
II	Chemical Kinetics		
	Rate of reaction - Average and instantaneous rates, factors influencing rate of reaction - molecularity of a reaction - rate equation -	2	Chalk and talk/PPT/ Animated Videos/quiz/seminar/test
	Order of reaction. order and Molecularity of simple and complex reactions, Rate laws - Rate constants	2	
	Derivation of rate constants and characteristics for zero, first order, second and third order (equal initial concentration) Half-life of reaction- Half-life of first order reaction and second order reaction	3	
	Derivation of time for half change with examples. Methods of determination of order of half-life and Ostwald method.	5	
	Effect of temperature on reaction rate – temperature coefficient - concept of activation energy - Arrhenius equation.	5	

III	Adsorption and Catalysis		
	Chemical and physical adsorption and their general characteristics- distinction between them Different types of isotherms – Freundlich and Langmuir.	2	Chalk and talk/Assignment quiz/seminar
	Adsorption isotherms and their limitations – BET theory, kinetics of enzyme catalysed reaction	2	
	Lineweaver- Burk plot – inhibition – reversible – competitive, noncompetitive and uncompetitive (no derivation of rate equations)– theories of homogenous and heterogeneous catalysis – Kinetics of Acid – base and enzyme catalysis. Heterogenous catalysis	3	
	Catalysis – general characteristics of catalytic reactions, auto catalysis, promoters, negative catalysis, poisoning of a catalyst	3	
	Theories of homogenous and heterogeneous catalysis – Kinetics of Acid – base and enzyme catalysis. Heterogenous catalysis- Michaelis- Menten equation	5	
IV	Colloids and Surface Chemistry Colloids:		
	Types of Colloids, Characteristics Colloids (Lyophilic and Lyophobic sols), Preparation of Sols- Dispersion methods, aggregation methods	3	Chalk and talk/ Animated Videos/ seminar/quiz/test
	Properties of Sols- Optical properties, Electrical properties - Electrical double layer,	3	
	Electro Kinetic properties- Electro-osmosis, Electrophoresis, Coagulation or precipitation,	3	
	Stability of sols, associated colloids, Emulsions, Gels-preparation of Gels, Applications of colloids	2	
	Macromolecules: Molecular weight of Macromolecules-Number average molecular weight- average molecular weight- Determination of Molecular weight of molecules	4	

V	Photochemistry		
	Laws of photo chemistry – Lambert – Beer, Grotthus – Draper and Stark – Einstein. Quantum efficiency.	3	Chalk and talk/PPT/ Animated Videos/ seminar/quiz/test
	comparison between thermal and photochemical reactions.	3	
	Fluorescence – applications including fluorimetry – sensitised fluorescence, phosphorescence – applications	3	
	chemiluminescence and photosensitisation – examples Chemistry of Vision – 11	2	
	Photochemical reactions – rate law – Kinetics of $\text{H}_2\text{-Cl}_2$, $\text{H}_2\text{-Br}_2$ and $\text{H}_2\text{-I}_2$ reactions- cis retinal vitamin A as a precursor - colour perception of vision	4	

COURSE LEARNING OUTCOMES:

At the end of the course, the student will be able to:

CLO	CO Statement	K-level
CLO1	Explain Gibbs and Helmholtz free energy functions, partial molar quantities and Ellingham's	Upto K2
CLO2	Apply the concepts of chemical kinetics to predict the rate of the reaction and order of the reaction, demonstrate the effect of temperature on reaction rate, and the significance of free energy and entropy of activation.	Upto K3
CLO3	Compare chemical and physical adsorption, Freundlich and Langmuir adsorption isotherms, and differentiate between homogenous and heterogeneous catalysis.	Upto K3
CLO4	Demonstrate the types and characteristics of colloids, preparation of sols and emulsions, and determine the molecular weights of macromolecules.	Upto K3
CLO5	Utilize the concepts of photochemistry in fluorescence, phosphorescence, chemiluminescence and color perception of vision.	Upto K4

Mapping of CLOs and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	1	1	1	2	2	1
CLO2	1	2	3	1	2	3
CLO3	2	2	1	2	1	2
CLO4	1	2	1	2	1	2
CLO5	2	2	2	2	1	1

Mapping of CLOs and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	3	3	3	3	3	3
CLO2	3	3	3	3	3	3
CLO3	3	3	3	3	3	3
CLO4	3	3	3	3	3	3
CLO5	3	3	3	3	3	3

Blueprint for Summative Examination

Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1 & K2	1	K1	2 (K1 & K1)	1(K2)
2	CLO 2	Up to K3	2	K1 & K2	1	K2	2 (K2 & K2)	1(K3)
3	CLO 3	Up to K3	2	K1 & K2	1	K2	2 (K3 & K3)	1(K3)
4	CLO 4	Up to K3	2	K1 & K2	1	K1	2 (K3 & K3)	1(K3)
5	CLO 5	Up to K4	2	K1 & K2	1	K1	2 (K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analysing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either / or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total marks	10	10	50	50	120	100.00	100%

DEPARTMENT:CHEMISTRY					CLASS: III B.Sc CHEMISTRY			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
V	Major Core Practical	23U5CCCP5	Organic Estimation and Gravimetric Estimation	3	3	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	✓

Objectives: The objective of this course is to make the student to

- Learn glassware and apparatus to conduct experiments in gravimetric and organic estimation
- Demonstrate the laboratory techniques of Gravimetric estimation
- Encourage more hands-on training to undergraduate students to estimate organic compounds
- Develop the skill on precise estimation of amount of inorganic analyte using gravimetric method
- Explain the intellectual and psychomotor skills of the students by imparting knowledge in organic estimation and Gravimetric Estimation

Organic Estimation

1. Estimation of Aniline
2. Estimation of phenol.
3. Estimation of Glycine

Gravimetric Estimation

1. Estimation of Barium as Barium Chromate.
2. Estimation of Lead as Lead Chromate.
3. Estimation of Calcium as Calcium Oxalate.
4. Estimation of Nickel as Nickel Dimethyl Glyoximate.

Books for study:

1. Jeffery G. H. Bassett.J, Mendham. J. and Denney R. C., Vogel's Textbook of Quantitative Chemical Analysis; 6th ed., ELBS, 1989.
2. Gurtu J. N. and Kapoor R., Advanced Experimental Chemistry, S. Chand and Co., 2011
3. Yadav J. B., Advanced Practical Physical Chemistry, Goel Publishing House, 2001

Books for References:

1. V.Ramamoorthy, R. Veeraswamy, and A.R. Kulandaivelu Basic Principles of Practical Chemistry, Sultan Chand and sons, 2011, 2001
2. Gnanapragasam N. S. and Ramamurthy G., Organic Chemistry – Labmanual, S. Viswanathan Co.Pvt. Ltd, 2009.
3. Gurtu J. N. and Kapoor R., Advanced Experimental Chemistry, S. Chand and Co., 2011

Web Resources

1. <https://tech.chemistrydocs.com/Books/Physical/Advanced-Physical-Chemistry-Experiments-by-J-N-Gurtu-&-Amit-Gurtu.pdf>
2. <https://www.sciencedirect.com/book/9780080125411/experiments-in-physical-chemistry>
3. <https://staff.run.edu.ng/oermedia/4315493995176.pdf>

Rationale for Nature of the course

This course will enable the students to comprehend the basic knowledge of organic estimation and inorganic estimations through gravimetric methods. They will acquire skills through organic estimation and gravimetric methods by connecting the principles of estimation. .

Activities having direct bearing on Skill development / Employability Entrepreneurship

The knowledge of organic and gravimetric estimation develops the students handling experimental and apparatus handling of various procedures involved in organic and gravimetric estimation.

Pedagogy

Demonstration and practical session

Name of the course Designer

Dr. P. Gajendran

COURSE LEARNING OUTCOMES:

At the end of the course, the student will be able to:

CLO	CO Statement	K-level
CLO1	Show a detailed scientific notebook.	Up to K2
CLO2	Analyse the possible error occurring in organic and gravimetric estimation	Up to K4
CLO3	Estimate amount Pb, Ca, Ba and Ag by gravimetric method using suitable precipitating agent	Up to K4
CLO4	Illustrate the estimation of aniline and phenol using brominating mixture	Up to K3
CLO5	Make use of apparatus and tools for gravimetric estimation and calculation of gravimetric error.	Up to K3

Mapping of CLOs and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	2	2	1	1
CLO2	3	3	1	1	2	2
CLO3	3	3	1	1	1	1
CLO4	2	2	1	1	2	1
CLO5	1	2	1	1	2	3

Mapping of CLOs and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	1	1	2	2	2	2
CLO2	1	2	2	2	1	2
CLO3	1	2	2	2	2	3
CLO4	1	2	2	2	1	2
CLO5	1	2	3	2	1	1

Evaluation:

Continuous Internal Assessment: 25 Marks

External Assessment : 75 Marks

Total : 100 Marks

Formative Assessment:

CIA Components	Marks
Internal Test	10
Observation/Record	5
Continuous class assessment	10
Total Marks	25

Summative Assessment:

	CO Statement	K-level	Marks
CLO1	Maintain a detailed scientific notebook	Up to K2	10
CLO2	Analyse the possible error occurring in gravimetric estimation	Up to K4	10
CLO3	Estimate amount Pb, Ca, Ba and Ag by gravimetric method	Up to K4	25
CLO4	Estimate amount of aniline and phenol	Up to K3	20
CLO5	Make use of apparatus and tools for gravimetric estimation	Up to K3	10
Total Marks			75

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

DEPARTMENT: CHEMISTRY					CLASS: III B.Sc CHEMISTRY			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
V	Discipline Elective course-I	23U5CDET1 (A)	Fundamentals of Spectroscopy	4	5	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

Objectives: The objective of this course is to make the student to

- Know electrical and magnetic properties of organic and inorganic compound
- Explain basic principles of microwave, UV-Visible, infrared, Raman, NMR and Mass spectrometrys
- Identify the required instrumentation of NMR and Mass spectrometry
- Applications of various spectral techniques in structural elucidation
- Solving combined spectral problems.

Unit	Description	Hours	K-level	CLO
I	Electrical and Magnetic properties of molecules Dipole moment – polar and nonpolar molecules – polarisability of molecules. Application of dipole moments in the study of organic and inorganic molecules. Magnetic permeability, volume susceptibility, mass susceptibility and molar susceptibility; diamagnetism, paramagnetism – determination of magnetic susceptibility using Guoy balance, ferromagnetism, anti ferromagnetism Microwave spectroscopy Rotation spectra - diatomic molecules (rigid rotator approximation) selection rules – determination of bond length, effect of isotopic substitution – instrumentation and applications	15	Upto K4	1
II	Ultraviolet and Visible spectroscopy Electronic spectra of diatomic molecules (Born Oppenheimer approximation) - vibrational coarse structure – rotational fine structure of electronic vibration transitions – Frank Condon principle –Various types of electronic transitions- σ-σ^*, π-π^*, n-σ^*, n-π^* transitions. Applications of UV-Woodward – Fieser rules as applied to conjugated dienes and α, β - unsaturated ketones. Elementary Problems. Colorimetry - principle and applications (estimation of Fe^{3+})	15	Upto K2	2

III	Infrared spectroscopy Vibration spectra –diatomic molecules – harmonic oscillator and anharmonic oscillator; Vibration – rotation spectra – diatomic molecule as rigid rotator and anharmonic oscillator (Born-Oppenheimer approximation oscillator) - selection rules, vibrations of polyatomic molecules – stretching and bending vibrations – applications – determination of force constant, moment of inertia and internuclear distance – isotopic shift – application of IR spectra to simple organic and inorganic molecules – (group frequencies) Raman Spectroscopy Rayleigh scattering and Raman scattering of light – Raman shift – classical theory of Raman effect – quantum theory of Raman effect – Vibrational Raman spectrum – selection rules – mutual exclusion principle.	15	Upto K3	3
IV	Nuclear magnetic resonance spectroscopy: PMR – theory of PMR – instrumentation - number of signals – chemical shift – peak areas and proton counting – spin-spin coupling – applications. Problems related to shielding and deshielding of protons, chemical shifts of protons in hydrocarbons, and in simple monofunctional organic compounds; spin-spin splitting of neighbouring protons in vinyl and allyl systems.	15	Upto K3	4
V	Mass spectrometry Principle – different kinds of ionisation – instrumentation – the mass spectrum – types of ions – determination of molecular formula- fragmentation and structural elucidation – McLafferty rearrangement; Retro Diels Alder reaction - illustrations with simple organic molecules. Solving structure elucidation problems using multiple spectroscopic data (NMR, MS, IR and UV-Vis).	15	Upto K3	5

Books for Study:

1. Gopalan, R.; Subramaniam, P. S.; Rengarajan, K. Elements of Analytical Chemistry; S Chand: New Delhi, 2003.
2. Banwell, C.N.; Mc Cash, E. M. Fundamentals of Molecular Spectroscopy, 4th ed.; Tata McGraw Hill, New Delhi, 2017.
3. B.K.Sharma, Spectroscopy, 22nd ed., Goel Publishing House, 2011

Books for References:

1. Srivastava, A. K.; Jain, P. C. Chemical Analysis an Instrumental Approach, 3rded.; S.Chand, New Delhi, 1997.
2. Robert D Braun. Introduction to Instrumental Analysis; Mc.Graw Hill: New York, 1987.
3. Skoog, D. A.; Crouch, S. R.; Holler, F.J.; West, D. M. Fundamentals of Analytical Chemistry, 9thed.; Harcourt college Publishers: USA, 2013.

4. Madan, R. L.; Tuli, G. D. Physical Chemistry, 2nded.; S.Chand: New Delhi, 2005.
5. Puri, B. R.; Sharma, L. R.; Pathania, M.S. Principles of Physical Chemistry, 43rd ed.; Vishal Publishing: Delhi, 2008.

Web Resources:

1. <chromeextension://efaidnbmninnbpcajpcglclefindmkaj/https://archive.nptel.ac.in/content/storage2/courses/104103071/pdf/mod9.pdf>
2. <https://archive.nptel.ac.in/courses/104/108/104108078/>

Rationale for Nature of the course

This course focuses on the electrical and magnetic properties of molecules, as well as various spectroscopic techniques essential for understanding molecular structure and behavior. Spectroscopic techniques (microwave, UV-Vis, IR, Raman, NMR, and mass spectrometry) are indispensable tools in modern chemistry. They enable students to analyze and characterize compounds, determine molecular structures, and assess functional groups, enhancing their practical laboratory skills.

Activities having direct bearing on Skill development / Employability Entrepreneurship

To enhance skill development and employability through the outlined content on molecular properties and spectroscopy, we propose organizing hands-on sessions in which students operate various spectrometers, including UV-Vis, IR, NMR, and mass spectrometers. During these sessions, students will analyze real samples, thereby improving their technical skills and familiarity with instrumentation. Additionally, students will receive datasets from spectroscopic analyses for interpretation and compound identification, further developing their analytical skills and ability to work with real-world data.

Pedagogy

- Chalk-Talk class room Activities
- Group Discussion
- Seminar
- Quiz through ICT- Mode

Name of the course Designer

Dr P.S. Harikrishnan

Lecture Schedule

Unit	Descriptions	Hours	Lecture
I	Electrical and Magnetic properties of molecules Dipole moment – polar and nonpolar molecules – polarisability of molecules.	3	Chalk& talk, ppt Problem Solving, Quiz
	Application of dipole moments in the study of organic and inorganic molecules, Magnetic permeability, volume susceptibility, mass susceptibility and molar susceptibility; diamagnetism, paramagnetism	3	
	determination of magnetic susceptibility using Guoy balance, ferromagnetism, anti-ferromagnetism	3	
	Microwave spectroscopy Rotation spectra - diatomic molecules (rigid rotator approximation) selection rules	3	
	Determination of bond length, effect of isotopic substitution – instrumentation and applications	3	
II	Ultraviolet and Visible spectroscopy Electronic spectra of diatomic molecules (Born Oppenheimer approximation) - vibrational coarse structure – rotational fine structure of electronic vibration transitions	4	Chalk& talk, ppt Problem Solving, Quiz
	Frank Condon principle – various types of electronic transitions – method of evaluation of dissociation energy	3	
	pre-dissociation transition - $\sigma - \sigma^*$, $\pi - \pi^*$, $n - \sigma^*$, $n - \pi^*$ transitions.	2	
	Applications of UV-Woodward – Fieser rules as applied to conjugated dienes and α , β - unsaturated ketones.	4	
	Elementary Problems. Colorimetry - principle and applications (estimation of Fe^{3+})	2	
III	Infrared spectroscopy Vibration spectra –diatomic molecules – harmonic oscillator and anharmonic oscillator; Vibration – rotation spectra – diatomic molecule as rigid rotator and anharmonic oscillator (Born-Oppenheimer approximation oscillator)	4	Chalk& talk, ppt Problem Solving, Quiz, Assignment
	selection rules, vibrations of polyatomic molecules – stretching and bending vibrations – applications – determination of force constant, moment of inertia and internuclear distance	3	
	Isotopic shift – application of IR spectra to simple organic and inorganic molecules – (group frequencies)	3	
	Raman Spectroscopy Rayleigh scattering and Raman scattering of light – Raman shift – classical theory of Raman effect – quantum theory of Raman effect	3	
	Vibrational Raman spectrum – selection rules – mutual exclusion principle – instrumentation (block diagram) – applications.	2	

IV	Nuclear magnetic resonance spectroscopy:		Chalk& talk, ppt Problem Solving, Quiz
	PMR – theory of PMR – instrumentation - number of signals – chemical shift	4	
	peak areas and proton counting – spin-spin coupling – applications	3	
	Problems related to shielding and deshielding of protons, chemical shifts of protons in hydrocarbons, and in simple monofunctional organic compounds	4	
	Spin-spin splitting of neighbouring protons in vinyl and allyl systems.	4	
V	Mass spectrometry		Chalk& talk, ppt Problem Solving, Quiz, Assignment
	Principle – different kinds of ionisation – instrumentation – the mass spectrum	4	
	Types of ions – determination of molecular formula- fragmentation and structural elucidation	4	
	McLafferty rearrangement; Retro Diels Alder reaction - illustrations with simple organic molecules.	3	
	Solving structure elucidation problems using multiple spectroscopic data (NMR, MS, IR and UV-Vis).	4	

COURSE LEARNING OUTCOMES

At the end of the course, the student will be able to:

	CO Statement	K-level
CO1	Explain electrical and magnetic properties of materials and microwave spectroscopy	K2
CO2	Apply their understanding to explain the theory, instrumentation, and applications of Infrared and Raman spectroscopy, highlighting how each component contributes to molecular analysis.	K3
CO3	Utilize selection rules to analyze spectral transitions and apply Woodward-Fieser rules to calculate the wavelength maximum of conjugated dienes.	K3
CO4	Employ the principles of NMR spectroscopy to articulate its theoretical foundations, detail the instrumentation used, and illustrate its diverse applications in molecular analysis.	K3
CO5	Implement the principles of mass spectrometry to elucidate its theoretical framework, outline the instrumentation involved, and demonstrate its applications in molecular analysis.	K4

Mapping of CLOs and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	3	3	3	3
CLO2	3	3	3	3	3	3
CLO3	3	3	3	3	3	3
CLO4	3	3	3	3	3	3
CLO5	3	3	3	3	3	3

Mapping of CLOs and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	3	3	3	3	3	3
CLO2	3	3	3	3	3	3
CLO3	3	3	3	3	3	3
CLO4	3	3	3	3	3	3
CLO5	3	3	3	3	3	3

3- Advance Application

2 – Intermediate Level

1 – Basic Level

Blueprint for Summative Examination

Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1 & K2	1	K1	2 (K1 & K1)	1(K2)
2	CLO 2	Up to K3	2	K1 & K2	1	K2	2 (K2 & K2)	1(K3)
3	CLO 3	Up to K3	2	K1 & K2	1	K1	2 (K3 & K3)	1(K3)
4	CLO 4	Up to K3	2	K1 & K2	1	K2	2 (K3 & K3)	1(K3)
5	CLO 5	Up to K4	2	K1 & K2	1	K2	2 (K4 & K4)	1(K4)
No. of Questions to be Asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either / or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF CHEMISTRY					CLASS: III. B.Sc. Chemistry			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
V	Discipline Elective course-I	23U5CDET1 (B)	NANO SCIENCE	4	5	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

Objectives: The objective of this course is to make the student to

- introduce to nanoparticles/clusters and nanocomposites
- explain the properties of nanomaterials
- discuss characterization of nanomaterials by different methods
- outline the synthesis of carbon nanotubes, graphene, quantum dots, self-assembled nanomaterials
- illustrate the applications of nanomaterials

Unit	Description	Hours	K-level	CLO
I	Introduction to Nanoscience Definition of terms – nanoscience, nanoparticles, clusters, quantum dots, nanostructures and nanocomposites - bulk material and nanomaterials. Synthesis and stabilization of nanomaterials - Top down approach (physical methods), mechanical dispersion – ball milling, methods based on evaporation of a precursor- ion sputtering, spray pyrolysis,. Bottom–up approach (chemical methods) - solvothermal synthesis, sonochemical synthesis, electro deposition, sol-gel method, nanomaterials via chemical routes- solvents reducing agents, capping agents-stabilization of nanoparticles -electrostatic and steric stabilization, common stabilizers.	15	Up to K3	1
II	Properties of materials on a nanoscale Optical properties of metal and semiconductor nanomaterials- surface Plasmon resonance (SPR), surface enhanced Raman spectra (SERS), quantum confinement effect. Magnetic properties – Fe ₃ O ₄ particle, supra magnetic properties, electronic properties, Chemical properties- chemical process on the surface of nanoparticles, catalysis, mechanical properties.	15	Up to K2	2

III	Techniques employed for characterization of nanomaterials Spectroscopy – UV-visible, Photoelectron spectroscopy – Electron microscopy – Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Scanning probe microscopy (SPM) – Atomic Force Microscopy (AFM), Scanning Tunneling Microscopy (STM), X-ray diffraction (XRD) [Principle and Block diagram only].	15	Up to K3	3
IV	Special nanomaterials Carbon Nano Structures, Carbon nanotubes: Introduction - types - zigzag, armchair, helical, synthesis by CVD - Functionalization of Carbon Nanotubes, Reactivity of Carbon Nanotubes, Field emission, Fuel Cells, Display devices. Other Important Carbon based materials: Preparation of Fullerene, Graphene, and Applications Semiconductor nanoparticles: Quantum dots, synthesis – chemical synthesis using clusters, porous silicon – electrochemical etching, aerogel – types – silica aerogel, resorcinol formaldehyde (RF) aerogels – applications. Self-Assembled Nanomaterials: Self Assembled Monolayers (SAMS) – inorganic, organic molecules.	15	Up to K3	4
V	Application of nanomaterials Biomedical Applications- drug, drug delivery, biolabelling, artificial implants, cancer treatment. Sensors – Natural nanoscale sensors, chemical sensors, biosensors, electronic noses. Optics & Electronics – Nanomaterials in the next generation computer technology, high definition TV, flat panel displays, quantum dot laser, and single electron transistors [SET]. Nanotechnology in agriculture – Fertilizer and pesticides nanomaterials for water purification, nanomaterials in food and packaging materials, fabric industry. Impacts of Nanotechnology – human & environmental safety risks	15	Up to K4	5

Books for Study:

1. Sulabha K. Kulkarni, Nanotechnology: Principles and Practices, Capital Publishing Co., New Delhi. 2014.

2. Pradeep. T, Nano: The Essentials, Understanding Nanoscience and Nanotechnology; Tata McGraw-Hill Publishing Company Limited, NewDelhi, 2007.
3. Shah. M.A.; Tokeer Ahmad, Principles of Nanoscience and Nanotechnology; Narosa Publishing House, New Delhi, 2010.

Books for References:

1. Sharma. P.K., Understanding Nanotechnology; Vista International Publishing House, Delhi. 2008.
2. Charles P. Poole Jr.; Frank J. Owens. Introduction to Nanotechnology; A John Wiley & Sons, INC., Publication, 2003.
3. Viswanathan B., Nano Materials;Narosa Publishing House, New Delhi, 2009.
4. C.N.R. Rao; Muller.A; Cheetham. A.K. Nanomaterials Chemistry Recent Developments and New Directions, WILEY-VCH, Verlag GMBH & Co.,KGaA, Darmstad. 2007
5. Jing Zhong Zhang, Optical properties and spectroscopy of Nanomaterials; World Scientific Publishing Pvt. Ltd., Singapore.

Web Resources:

- 1) <http://www.nanotechnology.com/docs/wtd015798.pdf>
- 2) <http://nccr.iitm.ac.in/Nanomaterials.pdf>
- 3) [https://www.deshbandhucollege.ac.in/pdf/resources/1590038900_P\(H\)-VI-Nanomaterials-Unit-5.pdf](https://www.deshbandhucollege.ac.in/pdf/resources/1590038900_P(H)-VI-Nanomaterials-Unit-5.pdf)

Rationale for Nature of the course

This course will enable the students to enrich their knowledge on nanoparticles/clusters and nanocomposites, and properties of nanomaterials. Understand the principals involved in characterization of nanomaterials by different methods and synthesis of carbon nanotubes, graphene, quantum dots, and self-assembled nanomaterials. Envisioned the applications of nanomaterials.

Activities having direct bearing on Skill development / Employability Entrepreneurship

The Nanoscience course can incorporate various activities that directly contribute to skill development and enhance employability among students. Here are some activities that can have a direct bearing on these aspects like **i)** conduct quiz competition on nanoparticles/clusters, nanocomposites and properties of nanomaterials **ii)** group discussion on characterization of nanomaterials by different methods **iii)** Assignment on synthesis of carbon nanotubes, graphene, quantum dots, self-assembled nanomaterials. Hence the students will have chance to get skill oriented jobs in various industries.

Pedagogy

- Chalk-Talk class room Activities
- Group Discussion
- Seminar
- Quiz through ICT- Mode

Course Designer:

Dr. M. Boominathan

Course Schedule

Unit	Topics	Hrs	Mode
I	Introduction to Nanoscience		
1.	Definition of terms - nanoscience, nanoparticles, clusters, quantum dots, nanostructures and nanocomposites - bulk material and nanomaterials.	2	Chalk and talk/PPT/ Animated Videos/quiz/ seminar/test
2.	Synthesis and stabilization of nanomaterials - Top down approach (physical methods), mechanical dispersion – ball milling, methods based on evaporation of a precursor- ion sputtering, spray pyrolysis	4	
3.	Bottom–up approach (chemical methods) - solvothermal synthesis, sonochemical synthesis, electro deposition, sol-gel method,	4	
4.	Nanomaterials via chemical routes- solvents reducing agents, capping agents-	3	
5.	Stabilization of nanoparticles -electrostatic and steric stabilization, common stabilizers.	2	
II	Properties of materials on a nanoscale		
1.	Optical properties of metal and semiconductor nanomaterials- surface Plasmon resonance (SPR),	3	Chalk and talk/PPT/ quiz/seminar/ test
2.	surface enhanced Raman spectra (SERS),	2	
3.	Quantum confinement effect. Magnetic properties – Fe3O4 particle	3	
4.	Supra magnetic properties, electronic properties	3	
5.	Chemical properties- chemical process on the surface of nanoparticles, catalysis, mechanical properties	4	
III	Techniques employed for characterization of nanomaterials		
1.	Spectroscopy – UV-visible, Photoelectron spectroscopy –	3	Chalk and talk/ Assignment quiz/seminar
2.	Electron microscopy – Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM),	4	
3.	Scanning probe microscopy (SPM) – Atomic Force Microscopy (AFM),	4	
4.	Scanning Tunnelling Microscopy (STM),	2	
5.	X-ray diffraction (XRD) [Principle and Block diagram only].	2	
IV	Special nanomaterials		
1.	Carbon Nano Structures, Carbon nanotubes: Introduction - types - zigzag, armchair, helical, synthesis by CVD -	3	Chalk and talk/
2.	Functionalization of Carbon Nanotubes, Reactivity of Carbon	3	Animated

	Nanotubes, Field emission, Fuel Cells, Display devices.		Videos/ seminar/ quiz/test
3.	Other Important Carbon based materials: Preparation of Fullerene, Graphene, and Applications	2	
4.	Semiconductor nanoparticles: Quantum dots, synthesis – chemical synthesis using clusters, porous silicon – electrochemical etching, aerogel – types – silica aerogel, resorcinol formaldehyde (RF) aerogels – applications.	5	
5.	Self-Assembled Nanomaterials: Self Assembled Monolayers (SAMS) – inorganic, organic molecules	2	
V	Application of nanomaterials		
1.	Biomedical Applications- drug, drug delivery, biolabelling, artificial implants, cancer treatment.	2	Chalk and talk/PPT/ Animated Videos/ seminar/quiz/ test
2.	Sensors – Natural nanoscale sensors, chemical sensors, biosensors, electronic noses.	3	
3.	Optics & Electronics – Nanomaterials in the next generation computer technology, high definition TV, flat panel displays, quantum dot laser, and single electron transistors [SET].	4	
4.	Nanotechnology in agriculture – Fertilizer and pesticides nanomaterials for water purification, nanomaterials in food and packaging materials, fabric industry.	4	
5.	Impacts of Nanotechnology – human & environmental safety risks	2	

COURSE LEARNING OUTCOMES:

At the end of the course, the student will be able to:

CLO	Course Learning Outcomes	K-level
CLO1	Apply concept of nanoparticles/clusters and nanocomposites	Up to K3
CLO2	Explain the properties of nanomaterials and	Up to K2
CLO3	Build knowledge on characterization of nanomaterials by different methods	Up to K3
CLO4	Develop the knowledge on synthesis of carbon nanotubes, graphene, quantum dots, self-assembled nanomaterials	Up to K3
CLO5	Illustrate the applications of nanomaterials	Up to K4

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	3	3	2	2	3	2
CLO2	3	3	2	2	3	2
CLO3	3	3	3	3	3	2
CLO4	3	3	2	2	3	2
CLO5	3	3	3	3	3	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	2	2	3	2
CLO2	3	2	2	2	3	2
CLO3	3	3	3	3	3	2
CLO4	3	2	2	2	3	2
CLO5	3	2	2	2	3	2

Advance application – 3;**Intermediate level – 2;****Basic level - 1**

Blueprint for Summative Examination

Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K3	2	K1 & K2	1	K2	2 (K2 & K2)	1(K3)
2	CLO 2	Up to K2	2	K1 & K2	1	K1	2 (K1 & K1)	1(K2)
3	CLO 3	Up to K3	2	K1 & K2	1	K1	2 (K3 & K3)	1(K3)
4	CLO 4	Up to K3	2	K1 & K2	1	K2	2 (K3 & K3)	1(K3)
5	CLO 5	Up to K4	2	K1 & K2	1	K2	2 (K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either / or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total marks	10	10	50	50	120	100.00	100%

DEPARTMENT					CLASS: III B.Sc chemistry			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
5	IDC	23U5CITD1	Industrial chemistry	4	5	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	✓

Objectives: This course enables the students to

- Understand Definition ,classification, analysis and production of fuels
- Grasp the properties of composite materials and their types
- Know the various properties of Refractories and abrasives
- Analyse and find out crystal structure and their Bravais lattice
- Correlate theory behind electrical properties of solids

Unit	Description	Hours	K-level	CLO
I	Fuels: Classification, characteristics of fuels. Petroleum - characteristics; Gasoline aviation petrol knocking in internal combustion engine, antiknock agents; unleaded petrol-octane number, eous fuel: advantages over solid and liquid fuels; water gas, producer gas, preparations - uses. Natural gas: LPG- composition, advantages, application;	15	Up to K3	1
II	Composite material: Introduction Definitions, Composites, Reinforcements and matrices, Types of reinforcements, Types of matrices, Types of composites, Carbon Fibre composites, Properties of composites in comparison with standard materials, Applications of metal, ceramic and polymer matrix composites	15	Up to K2	2
III	Refractories and Abrasives: Introduction - Classification - Manufacture of Refractories - Cermets - Insulating refractories - Requirements of a refractory. Abrasives - introduction - Natural Abrasives - Artificial Abrasives – Grinding Wheels	15	Up to K1	3
IV	X-Ray Analysis Debroglie hypothesis - Experimental study of matter wave - Davisson and Germer experiment - X-ray diffraction - Bragg's Law - Lattice points and space lattice - Basis and crystal structure - Metallic crystal structure - Simple cubic - BCC – FCC - Hexagonal close packed structure	15	Up to K2	4
V	Electrical Properties of solid Band theory of solids - Band structure of semiconductor - Electrical conductivity - N-type semiconductor - P-type semiconductor - Generation and recombination - Hall effect - Determination of Hall co-efficient - Application of Hall Effect - PN junctions	15	Up to K1	5

Books for study:

1. Sharma, B.K. Industrial Chemistry, 9th ed.; Goel Publishing House: Meerut, 1998.
2. Jayashree Ghosh, Applied Chemistry, S. Chand : New Delhi, 2006. .
3. S.O.Pillai, Solid state physics, 7th Edn; New Age International Publication Private Limited.

Books for References:

1. Jain, P.C.; Jain, M. Engineering Chemistry, 16th ed.; Dhanapet Rai: Delhi, 1992 .
2. Shankuntala Manay, N.; Shadaksharaswamy, M. Food Facts and Principles, 3rd ed.; New Age Publication, 2008
3. Charles Kittel, Introduction to Solid state Physics, 7th Edn; Wiley India Publication.
4. Ashcroft and Mermin, Solid State Physics, International Student Edn, Thomson Brooks/Cole Publication.

Web Resources:

1. http://www.sciencecases.org/irradiation/irradiation_notes.asp
2. <http://discovery.kcpc.usyd.edu.au//9.5.5/>
3. <https://www.wipo.int/about-ip/en/>
4. file:///D:/Downloads/Engineering%20Chemistry%20Jain%20n%20Jain.pdf

Rationale for Nature of the course

Industrial chemistry utilises chemical and physical Techniques to convert raw material into products that are needed for mankind. This comprises the production of fundamental chemical for manufacturing material for various industrial divisions. Industrial chemistry can be viewed as the production of synthetic products for natural material

Activities having direct bearing on Skill development / Employability Entrepreneurship

The industrial chemistry course designed to engage various activities which directly contribute to skill development, Entrepreneurship and Employability among students. Here are some activities that can have a direct bearing on these aspects like i) industrial visit ii) conducting certificate and diploma courses. Hence the students will have more chance to get jobs in various industries

Pedagogy

- Chalk-Talk class room Activities
- Group Discussion
- Seminar
- Quiz through ICT- Mode

Name of the course Designer

Dr. S. Vidhyasankar

Course Schedule

Unit	Topics	Hours	Mode
I	Classification, characteristics of fuels Solid Fuels	2	Chalk and talk/PPT/Animated Videos/ quiz/ and Test
	analysis of coal- proximate analysis and ultimate analysis calorific value-determination, carbonisation of coal	2	
	Liquid fuels: Petroleum - characteristics; Gasoline aviation petrol knocking in internal combustion engines, antiknock agents	2	
	unleaded petrol-octane number, cetane number	2	
	Gaseous fuel: advantages over solid and liquid fuels; water gas, producer gas, carburetted water gas - preparations – uses	3	
	Natural gas: LPG-composition, advantages, application	2	
	Gobar gas production, composition, advantages, application.	2	
II	Introduction Definitions	2	Chalk and talk/PPT/Animated Videos/ quiz/Test
	Composites, Reinforcements and matrices	2	
	Types of reinforcements Types of matrices	2	
	Types of composites, Carbon Fibre composites	2	
	Properties of composites in comparison with standard materials	2	
	Applications of metal, ceramic composites	2	
	Applications of polymer matrix composites	3	
III	Introduction - Classification	2	Chalk and talk/PPT/Animated Videos/ quiz/seminar and Test
	Manufacture of Refractories - Cermets	2	
	Cermets - Insulating refractories	3	
	Requirements of a good refractory	2	
	Abrasives – introduction	2	
	Abrasives-classification	2	
	Natural Abrasives Artificial Abrasives	2	
	Application of Abrasives	2	
IV	Debroglie hypothesis - Experimental study of matter wave	2	Chalk and talk/PPT/Animated Videos/ quiz/ Test
	Davisson and Germer experiment	2	
	X-ray diffraction - Bragg's Law	2	
	Lattice points and space lattice - Basis and crystal	3	

	structure		
	Metallic crystal structure -	2	
	Simple cubic - BCC – FCC	2	
	Hexagonal close packed structure.	2	
V	Band theory of solids	2	
	Band structure of semiconductor	2	
	Electrical conductivity	2	Chalk and talk/PPT/Animated Videos/ quiz/ Test
	N-type semiconductor - P-type semiconductor - Generation and recombination	3	
	Hall effect -Determination of Hall co-efficient	2	
	Application of Hall Effect	2	
	PN junction	2	

COURSE LEARNING OUTCOMES

At the end of the course, the student will be able to:

	CO Statement	K-level
CO1	Understand the properties of fuels which include petroleum, water gas, natural gas and	K1
CO2	Know the properties and application of composite	K2
CO3	Grasp the properties of Refractories and abrasive along with their applications	K3
CO4	analyse and find out crystal structure and their Bravais lattice	K2
CO5	correlate theory behind electrical properties of solids	K2

Mapping of CLOs and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	2	1	2	2	2	2
CLO2	1	1	1	1	2	2
CLO3	1	1	1	1	1	1
CLO4	2	1	1	1	1	2
CLO5	2	1	1	1	1	1

Mapping of CLOs and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	2	2	1	1	1	1
CLO2	1	1	1	1	1	2
CLO3	2	2	1	1	1	1
CLO4	1	1	1	1	1	1
CLO5	1	1	1	1	1	1

Advance application -3;

Intermediate level -2;

Basic level-1

Blueprint for Summative Examination
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

S. No .	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K1	2	K1 & K1	1	K1	2 (K1 &K1)	1(K1)
2	CLO 2	Up to K2	2	K1 & K2	1	K2	2 (K2 &K2)	1(K2)
3	CLO 3	Up to K2	2	K2 & K2	1	K2	2 (K2 &K2)	1(K2)
4	CLO 4	Up to K3	2	K1 & K1	1	K3	2 (K2 &K2)	1(K3)
5	CLO 5	Up to K3	2	K1 & K2	1	K3	2 (K3 &K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analysing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either / or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	4	10	-	19	15.83	42 %
K2	5	6	10	10	31	23.83	
K3	-	-	20	30	50	41.67	42 %
K4	--	--	10	10	20	16.67	16 %
Total marks	10	10	50	50	120	100.00	100%

CLASS: I B.A. / B.Sc./B.Com.								
Semester	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
V	Common to all	23U5VENT1	Value Education	2	2	25	75	100

CLOs	K- Level	Course Learning Outcomes: The students will be able to
CLO 1	Up to K 2	Describe the various value system and its familiarity
CLO 2	Up to K 2	List forty virtues and eighty values
CLO 3	Up to K 4	Outline the foundations on value oriented moral values
CLO 4	Up to K4	Focus on relevance of various religion values and its similarities
CLO 5	Up to K 3	Build a value system and ethics in Education, Business and Teaching

Unit - I: Value System: Perceptions and Perspectives

(6 Hours)

Truth, Good and Beauty – Objectivity and Reality of Values – Various Definitions of Values – Types of Values – Intrinsic and Instrumental Aspects – Positive and Negative Values.

Unit - II: Listing and Classification of Values

(6 Hours)

Forty Virtues, Eighty-three Values – Classification of Values – Traditional and Functional Values.

Unit - III: Value Oriented Moral Lessons

(6 Hours)

At Our Home – While at College – While at Party – Food Habits – Good Manner – Faith – Concentration and Prayer

Unit – IV: Values and Religion

(6 Hours)

Karmayoga in Hinduism – Love and Justice in Christianity – Brotherhood in Islam – Compassion in Buddhism

Unit – V: Professional Ethics

(6 Hours)

Codes of Ethics – Building a Value Systems – Need to go beyond Ethics – Characteristics of Ancient Indian Education System

Books for Study

1. Swami Vivekananda (2001), **Universal Ethics and Moral Conduct**, Adhyaksha Advaita Ashrama, Mayavan Uttarkhand.

2. Subrahmanyam (2010), **Value Education**, Vivekananda Kendra Prakashan Trust, Chennai.
3. Vedanta Kesari (2000), **Values: The Key to a Meaningful Life**, Sri Ramakrishna Math, Chennai.
4. Chakraborty, S. K. and Debangshu Chakraborty (2014), **Human Values and Ethics: In Search of Organisational Integrity**, Himalaya Publishing House, Mumbai.
5. Nikhil Kulshrestha, Sandeep Sharma and Shweta Dutt Sharma (2010), **Values and Ethics**, Vayu Education of India, New Delhi.
6. Gupta, N. L. (2002), **Human Values in Education**, Concept Publishing Company, New Delhi.
7. Swami Raghavananda, **Value Oriented Moral Lessons**, Sri Ramakrishna Math, Chennai.
8. Neeru Vasishth and Namith Rajput, **Business Ethics and Values**, Taxmann Publishing (P) Ltd., New Delhi.

Pedagogy:

Chalk & Talk,

Web based Assignments,

Group Exercises,

PPTs,

Caselets

Case studies

Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs)

Courses Outcome s (CLOs)	Programme Outcomes (with Graduate Attributes)					
	PO 1 (Knowledge Base)	PO 2 (Problem Analysis & Investigation)	PO 3 (Communication Skills & Design)	PO 4 (Individual and Team Work)	PO 5 (Professionalism Ethics and equity)	PO 6 (Life Long Learning)
CLO 1	3	-	2	2	3	3
CLO 2	3	-	2	2	3	3
CLO 3	3	-	2	2	3	3
CLO 4	2	-	2	2	3	3
CLO 5	3	2	2	2	3	3

3- Advanced Application

2- Intermediate Development

1 - Introductory

LESSON PLAN (Total hours: 30)

Unit	Description	Staff Name	Hours	Mode
I	Truth, Good and Beauty – Objectivity and Reality of Values		2	Chalk & Talk, Web based Assignments, Group Exercises, PPTs, Caselets & Case studies
	Various Definitions of Values – Types of Values – Intrinsic and Instrumental Aspects		2	
	Positive and Negative Values		2	
II	Forty Virtues, Eighty-three Values		3	
	Classification of Values – Traditional and Functional Values		3	
III	Value Oriented Moral Lessons at Our Home– While at College – While at Party		2	
	Food Habits – Good Manner		2	
	Faith – Concentration and Prayer.		2	
IV	Karmayoga in Hinduism – Love and Justice in Christianity – Brotherhood in Islam		3	
	Compassion in Buddhism		3	
V	Professional Ethics: Codes of Ethics – Building a Value Systems		3	
	Need to go beyond Ethics – Characteristics of Ancient Indian Education System		3	

Name of the Course Designer:

1. Dr. C. S. Theenadayalan, Head & Associate Professor, Department of Economics & Centre for Research in Economics
2. Dr. A. Mayil Murugan, Head & Associate Professor, Department of Commerce & Centre for Research in Commerce

EVALUATION (THEORY)

Internal (Formative) : 25 marks

External (Summative) : 75 marks

Total :100 marks

*Summative valuation will be single and done by the internal examiner only

Continuous Internal Assessment : 25 Marks

Components	Marks
Test (Average of two tests) Conducted for 40 marks and converted into 10 marks)	10
Assignment	5
Quiz/ Documentation/ Case lets/ ICT based Assignment/ Mini Projects	5
Attendance	5
Total	25

BLUE PRINT FOR INTERNAL ASSESSMENT - I

Articulation Mapping - K Levels with Course Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)	Total
			MCQs		Short Answers				
			No. of Questions	K- Level	No. of Questions	K- Level			
1	CLO 1 & 2	Up to K2	2	K1& K2	1	K1	2 (K2&K2)	2(K2&K2)	
2	CLO 3	Up to K4	2	K1& K2	2	K2	2 (K3&K3)	1(K4)	
No. of Questions to be asked			4		3		4	3	14
No. of Questions to be answered			4		3		2	2	11
Marks for each question			1		2		5	10	
Total Marks for each section			4		6		10	20	40

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

BLUE PRINT FOR INTERNAL ASSESSMENT - II
Articulation Mapping - K Levels with Course Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)	Total
			MCQs		Short Answers				
			No. of Questions	K- Level	No. of Questions	K- Level			
1	CLO 4	Up to K4	2	K1& K2	1	K1	2 (K2&K2)	2(K2/K 4)	
2	CLO 5	Up to K3	2	K1& K2	2	K2	2 (K3&K3)	1(K3)	
No. of Questions to be asked			4		3		4	3	14
No. of Questions to be answered			4		3		2	2	11
Marks for each question			1		2		5	10	
Total Marks for each section			4		6		10	20	40

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	2	2		--	4	6.67	50
K2	2	4	10	10	26	43.33	
K3	-	-	10	10	20	33.33	33
K4	-	-	-	10	10	16.67	17
Total Marks	4	6	20	30	60	100.00	100%

Question Paper Pattern for External Examination: 75 Marks

Section	Marks
A- Multiple Choice Questions (10 X 1mark)	10
B- Short answer type (5 X 2 mark)	10
C- Either/Or type (5X 5 marks)	25
D- Open Choice type (3out of 5 X10 marks)	30
Total	75

BLUE PRINT
Articulation Mapping - K Levels with Course Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K 2	2	K1& K2	1	K1	2 (K1&K1)	1(K2)
2	CLO 2	Up to K 2	2	K1& K2	1	K1	2 (K2&K2)	1(K2)
3	CLO 3	Up to K 4	2	K1& K2	1	K2	2 (K3&K3)	1(K3)
4	CLO 4	Up to K 4	2	K1& K2	1	K2	2 (K4&K4)	1(K4)
5	CLO 5	Up to K 3	2	K1& K2	1	K2	2 (K3&K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	4	10	--	19	15.83	50%
K2	5	6	10	20	41	34.17	
K3	-	-	20	20	40	33.33	33%
K4	-	-	10	10	20	16.67	17%
Total Marks	10	10	50	50	120	100.00	100%

In respect of external examinations passing minimum is 35% for Under Graduate Courses and in total, aggregate of 40%.

DEPARTMENT OF CHEMISTRY					CLASS: III B. Sc. Chemistry			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
VI	Major Core	23U6CCCT8	Organic Chemistry-II	4	6	25	75	100

Nature of course		Skill oriented	√	Employability oriented	√	Entrepreneurship Oriented	

Objectives:

The objective of this course is to make the student to

- Learn the basic concepts and to elucidate the structure determination of natural products.
- Illustrate the classification and structural features of Carbohydrates
- Explain the need and principles of Green chemistry.
- Identify the proper reagents for a given particular conversion under given conditions.
- Understand about rearrangement reactions and its synthetic applications.

Unit	Description	Hours	K-level	CLO
I	Natural Products: Alkaloids: Classification, isolation, general properties - Hofmann Exhaustive Methylation; Structure elucidation – Coniine, piperine, nicotine. Terpenes: Classification, Isoprene rule, isolation and structural elucidation of Citral, alpha terpineol and Menthol.	18	Up to K3	1
II	Carbohydrates-I Definition and Classification of Carbohydrates with examples. Relative configuration of sugars. Determination of configuration (Fischer's Proof). Definition of enantiomers, diastereomers, epimers and anomers with suitable examples. Monosaccharides– configuration – D and L hexoses – aldohexoses and ketohexoses - mutarotation. Glucose, Fructose – Occurrence, preparation, properties, reactions, structural elucidation, uses. Interconversions of sugar series – ascending, descending, aldose to ketose and ketose to aldose.	18	Up to K2	2
III	Carbohydrates-II and Green Chemistry <i>Disaccharides</i> – sucrose, lactose, maltose - preparation, properties and uses (no structural elucidation) – inversion of sugars. <i>Polysaccharides</i> – Source, constituents and biological	18	Up to K3	3

	importance of homopolysaccharides- starch and cellulose, heteropolysaccharides – hyaluronic acid, heparin. Green Chemistry: Twelve Principles, chemistry behind each principle and applications in chemical synthesis, Atom economy, Green reaction media – green solvents, green reagents and catalysts; tools used like microwave and ultrasound in chemical synthesis.			
IV	Special reagents in organic synthesis AIBN, 9BBN, BINAP, BOC, DABCO, DCC, DIBAL-H, DMAP, NBS, PCC, TBHP, TEMPO. Organometallic compounds in Organic Synthesis Preparation, Properties and applications: Organo Magnesium compounds: Grignard Reagents, Organo Lithium Compounds: Preparation and reactions, Organocopper compounds: Lithium organocuprates, Ziegler – Natta, Wilkinson catalyst, Metal Carbonyls – Iron and Cobalt carbonyls, Zeiss's Salt.	18	Up to K4	4
V	Molecular rearrangements: Molecular Rearrangement: Type of rearrangements, Mechanism for Wagner-Meerwein, Pinacol-pinacolone Baeyer-Villiger, Benzidine, Favorskii, Claisen, Fries, Hofmann, Curtius, Lossen, Schmidt, Beckmann and Wolff rearrangement.	18	Up to K3	5

Books for Study:

1. Finar, I. L. "Organic Chemistry Volume II: Stereochemistry and Chemistry of Natural Products", 5th edition, Pearson Education India, 2002.
2. Morrison, R. T., Boyd, R. N., Bhattacharjee, S. K., "Organic Chemistry", 7th edition, Pearson Education India, 2010.
3. Mundy, B. P., Ellerd, M. G., "Name reactions and reagents in organic synthesis", 2nd edition, John Wiley & Sons, 2005.

Books for References:

1. Chatwal, G. R. "Organic Chemistry of Natural Products" Volume I and II, 5th edition, Himalaya Publishing house, 2011.
2. Srivastava, M. M., Sanghi, R. "Chemistry for Green Environment", Narosa Publishing House, 2005.
3. Sanyal, S. N. "Reactions, Rearrangements and Reagents", 4th edition, Bharathi Bhawan Publishers, 2019.
4. Bahl, A., Bahl, B. S., "Advanced Organic Chemistry", 6th edition, S. Chand and Co. Ltd., 2022
5. Li, J. J. "Name Reactions: A collection of detailed reaction mechanisms" 3rd Expanded edition, Springer Publications, 2006.

Web Resources

1. https://onlinecourses.nptel.ac.in/noc25_cy27/preview
2. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SCYA7201.pdf
3. <https://commonorganicchemistry.com/index.htm>
4. <https://www.organic-chemistry.org/>

Rationale for Nature of the course

This course will enable the students to know the chemistry of natural products, carbohydrates and reagents to improve their knowledge in elucidation of structure of a given natural product and also to do the conversion between molecules.

Activities having direct bearing on Skill development / Employability Entrepreneurship

The basic knowledge gained through this course, students can analyse the ways to elucidate the structure of an unknown natural product or similar compounds, to achieve this molecules which are not present in the curriculum will be given for analysis. They can derivatise various functional groups and several tasks will be given to attain this.

Pedagogy

- Chalk-Talk Class room Activities
- Group discussion & Seminar
- Assignment and Quiz through ICT

Course Designer(s):

Dr. S. V. Karthikeyan

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Natural Products: Alkaloids: Classification, isolation, general properties - Hofmann Exhaustive Methylation.	3	PPT, Chalk and talk, Group Discussion, Quiz/Seminar
	Structure elucidation – Coniine, piperine, nicotine.	6	
	Terpenes: Classification, Isoprene rule, isolation	3	
	and structural elucidation of Citral, alpha terpineol and Menthol	6	
Unit II	Carbohydrates-I Definition and Classification of Carbohydrates with examples. Relative configuration of sugars. Determination of configuration (Fischer's Proof). Definition of enantiomers, diastereomers, epimers and anomers with suitable examples.	4	PPT, Chalk and talk, Group Discussion, Quiz/Seminar
	Monosaccharides– configuration – D and L hexoses – aldohexoses and ketohexoses.	4	
	Glucose, Fructose – Occurrence, preparation, properties, reactions, structural elucidation, uses.	5	
	Interconversions of sugar series – ascending, descending, aldose to ketose and ketose to aldose.	5	
Unit III	Carbohydrates-II <i>Disaccharides</i> – sucrose, lactose, maltose - preparation, properties and uses (no structural elucidation).	5	PPT, Chalk and talk, Group Discussion, Quiz/Seminar
	<i>Polysaccharides</i> – Source, constituents and biological importance of homopolysaccharides- starch and cellulose, heteropolysaccharides – hyaluronic acid, heparin.	5	
	Green Chemistry: Principles, chemistry behind each principle and applications in chemical synthesis. Green reaction media	4	
	Green solvents, green reagents and catalysts; tools used like microwave and ultra-sound in chemical synthesis.	4	
Unit IV	Special reagents in organic synthesis AIBN, 9BBN, BINAP/BINOL, BOC, DABCO, DCC	5	PPT, Chalk and talk, Group Discussion, Quiz/Seminar
	DIBAL, DMAP, NBS/NCS, NMP, PCC, TBHP, TEMPO	5	
	Organometallic compounds in Organic Synthesis Preparation, Properties and applications: Grignard Reagents	4	
	Organo Lithium Compounds: Preparation and reactions, Ziegler – Natta, Wilkinson, Metal Carbonyl, Zeiss's Salt.	4	

Unit V	Molecular Rearrangement: Type of rearrangements, Mechanism for Wagner-Meerwein,	4	PPT, Chalk and talk, Assignment
	Pinacol-pinacolone Baeyer-Villiger, Benzidine,	4	
	Favorskii, Claisen, Fries, Hofmann, Curtius, Lossen	6	
	Schmidt, Beckmann and Wolff rearrangement.	4	

Course Learning Outcomes:

After successful completion of this course, the student will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Identify the importance of natural products and describe structural elucidation of alkaloids and terpenoids.	Up to K3
CLO-2	Summarise the chemistry of monosaccharides	Up to K2
CLO-3	Develop the synthetic route in green aspects.	Up to K3
CLO-4	Inspect the synthetic methodology by using special reagents and organometallic compounds.	Up to K4
CLO-5	Utilise the rearrangement reactions for given conversion.	Up to K3

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CLO-1	3	3	3	3	3	2
CLO-2	3	3	3	3	3	2
CLO-3	3	3	3	3	3	2
CLO-4	3	3	3	3	3	2
CLO-5	3	3	3	3	3	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	3	2	3	2
CLO2	3	3	3	3	3	2
CLO3	3	3	3	3	3	2
CLO4	3	3	3	3	3	2
CLO5	3	3	3	3	3	2

Advance application- 3;

Intermediate level-2;

Basic level-1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K-Level	MCQs	K- Level		
1	CLO 1	Up to K3	2	K1 & K2	1	K1	2 (K2 & K2)	1 (K3)
2	CLO 2	Up to K2	2	K1 & K2	1	K1	2 (K1 & K1)	1 (K2)
3	CLO 3	Up to K3	2	K1 & K2	1	K2	2 (K3 & K3)	1 (K3)
4	CLO 4	Up to K4	2	K1 & K2	1	K2	2 (K4 & K4)	1 (K4)
5	CLO 5	Up to K3	2	K1 & K2	1	K2	2 (K3 & K3)	1 (K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	4	10	-	19	15.83	42
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42
K4	-	-	10	10	20	16.67	16
Total Marks	10	10	50	50	120	100.00	100

DEPARTMENT OF CHEMISTRY					CLASS: III B.Sc CHEMISTRY			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
VI	Major Core	23U6CCCT9	INORGANIC CHEMISTRY –II	4	6	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	✓

Objectives: The objective of this course is to make the student to

- Understand the tracer elements and their role in the biological system.
- Explain the Iron transport and storage proteins
- Study the metallo enzymes, oxygen transport proteins
- Learn the Silicates and their applications
- Explore the industrial applications of refractories, alloys, paints and pigments

Unit	Description	Hours	K-level	CLO
I	Bioinorganic Chemistry Essential and trace elements: Role of Na ⁺ , K ⁺ , Mg ²⁺ , Ca ²⁺ , Fe ³⁺ , Cu ²⁺ and Zn ²⁺ in biological systems. Effect of excess intake (Toxicity) of Metal ions – trace elements - As, Cd, Pb and Hg. Structure and function of chlorophyll in photosynthetic process.	18	Up to K2	1
II	Metal ion transport and storage Iron – storage and transport - Transferrin and Ferritin; Iron-porphyrins – myoglobin, haemoglobin – oxygen transport – Cooperative effect and Bohr effect; Sodium/potassium pump, calcium pump; transport and storage - copper and zinc- structure of cyanocobalamin (Vitamin B12), nature of Co-C bond;	18	Up to K3	2
III	Metallo enzymes Metalloenzymes - functions of carboxy peptidase A, zinc metalloenzyme – mechanism and uses, Zn-Cu enzyme - structure and function, carbonic anhydrase, Iron-sulphur proteins - 2Fe-2S – rubredoxin, 4Fe-2S – ferridoxin, Types of nitrogen fixation – biological functions of nitrogenase and molybdo enzymes.	18	Up to K3	3
IV	Silicates Introduction – general properties of silicates, structure – types of silicates – ortho silicates(zircon), pyrosilicates -(thortveitite), chain silicates(pyroxenes), ring silicates(beryl), sheet silicates(talc, mica, asbestos), silicates having three dimensional structure (feldspars, zeolites, ultramarines)	18	Up to K3	4

V	Industrial Applications of Inorganic Compounds Refractories, pyrochemical, explosives. Alloys, anti-knocking agents, anti-skinning agents, plasticizers, binders-application; varnishes- oils, spirit; enamels. Nanocomposite Hydrogels: synthesis, characterization and uses. Industrial visits and internship mandatory	18	Up to K4	5

Books for Study:

1. Puri B R, Sharma L R, Kalia K C (2011), Principles of Inorganic Chemistry, 31th ed., Milestone Publishers & Distributors, Delhi. 41
2. Satya Prakash, Tuli G. D., Basu S. K., Madan R. D. (2009), Advanced Inorganic Chemistry, 18th Edition, S. Chand & Co., New Delhi
3. Lee J D, (1991), Concise Inorganic Chemistry, 4th ed., ELBS William Heinemann, London.

Books for References:

1. Sivasankar B, (2013) Inorganic Chemistry. 1st Edition, Pearson, Chennai
2. Alan G. Sharp (1992), Inorganic Chemistry, 3rd Edition, Addison Wesley, England
3. Peter Atkins, Tina Overton, Jonathan Rourke and Mark Weller, Inorganic Chemistry, Oxford University Press, sixth edition, 2014
4. W V Malik, G D Tuli, R D Madan, (2000), Selected Topics in Inorganic Chemistry, Schand and Company Ltd.
5. A. K. De, Text book of Inorganic Chemistry, Wiley East Ltd, seventh edition, 1992

Web Resources:

1. <https://acs.digitellinc.com/p/s/medicinal-applications-of-bioinorganic-chemistry-619643>
2. <https://elearn.nptel.ac.in/shop/nptel/bioinorganic-chemistry/?v=c86ee0d9d7ed>
3. https://www.google.com/search?sca_esv=d8c2e9d81984a267&q=Silicates+pdf&sa=X&ved=2ahUKEwj1aqC-7CKAxU_7jgGHdCAD-wQ1QJ6BAhqEAE&biw=1440&bih=773&dpr=1

Rationale for Nature of the course

This course will enable the students to enrich the understanding capacity in bioinorganic chemistry and industrial applications of inorganic compounds. Understand the concept of type of silicates and used of inorganic compounds in day to day life. . Understand the concept of metal ions in biological systems.

Activities having direct bearing on Skill development / Employability Entrepreneurship

The general chemistry course can incorporate various activities that directly contribute to skill development and enhance employability among students. Here are some activities that can have a direct bearing on these aspects like i) conduct quiz competition on physical properties of gases, liquids and solids ii) group discussion on fundamentals of nuclear chemistry and nuclear waste management iii) Assignment on halogen derivatives and alcohol derivatives. Hence the students will have chance to get skill oriented jobs in various industries.

Pedagogy

- Chalk-Talk class room Activities
- Group Discussion
- Seminar
- Quiz through ICT- Mode

Name of the course Designer

Dr. P. Gajendran

Lecture Schedule

Unit	Descriptions	Hours	Lecture
I	Bioinorganic Chemistry		
	Essential and trace elements: Role of Na ⁺ , K ⁺ , Mg ²⁺ , Ca ²⁺ ,	4	Chalk and talk/ PPT/ Animated Videos/quiz/ seminar and Test
	Fe ³⁺ , Cu ²⁺ and Zn ²⁺ in biological systems	4	
	Effect of excess intake (Toxicity) of Metal ions – trace elements - As, Cd,	4	
	Effect of excess intake (Toxicity) of Metal ions	4	
	Toxicity of Metal ions Trace elements Pb, Hg	2	
II	Metal ion transport and storage		
	Iron – storage, transport - Transferrin and Ferretin;	4	Chalk and talk/ PPT/ Animated Videos/quiz/ seminar and Test
	Iron-porphyrins – myoglobin, haemoglobin	4	
	Oxygen transport - Bohr effect	4	
	Sodium/potassium pump, calcium pump;	3	
	Transport and storage - copper and zinc.	3	
III	Metallo enzymes		
	Structure of cyanocobalamin (Vitamin B12), nature of Co-C bond	5	Chalk and talk/ PPT/ Animated Videos/quiz/ seminar and Test
	A, zinc metalloenzyme – mechanism and uses, Zn-Cu enzyme - structure and function	4	
	Metalloenzymes - functions of carboxy peptidase carbonic anhydrase, Iron-sulphur proteins - 2Fe-2S – rubredoxin, 4Fe-2S – ferridoxin,	5	
	Types of nitrogen fixation – biological functions of nitrogenase and molybdo enzymes	4	
IV	Silicates		
	Introduction – general properties of silicates, structure – types of silicates	5	Chalk and talk/ PPT/ Animated Videos/quiz/ seminar and Test
	ortho silicates(zircon), pyrosilicates (thortveitite)	5	
	chain silicates(pyroxenes), ring silicates(beryl)	4	
	sheet silicates(talc, mica, asbestos), silicates having three dimensional structure (feldspars, zeolites, ultramarines	4	

V	Industrial Applications of Inorganic Compounds		
	Refractories, pyrochemical, explosives. Alloys, Paints and pigments - requirements of a good paint; classification,	4	Chalk and talk/PPT/ Animated Videos/quiz/ seminar /Assignment
	constituents of paints – pigments, vehicles, thinners, driers, extenders,	4	
	varnishes- oils, spirit; enamels. Nanocomposite Hydrogels: synthesis, characterization and uses. Industrial visits and internship mandatory	5	
	anti-knocking agents, anti-skinning agents, plasticizers, binders-application;	5	

COURSE LEARNING OUTCOMES:

At the end of the course, the student will be able to:

CLO	CO Statement	K-level
CLO1	Explore the importance of tracer elements on biological system.	Up to K2
CLO2	Analyze the metal ion transport, Bohr effect, Na, K pump.	Up to K3
CLO3	Understand the function of Vitamin B12, Zn-Cu enzyme, ferredoxin, cluster enzymes.	Up to K3
CLO4	Classification and structure of silicates.	Up to K3
CLO5	Explain the manufacture of refractories, explosives, paints and pigments	Up to K4

Mapping of CLOs and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	2	2	1	1
CLO2	3	3	1	1	2	2
CLO3	3	3	1	1	1	1
CLO4	2	2	1	1	2	1
CLO5	1	2	1	1	2	3

Mapping of CLOs and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	1	1	2	2	2	2
CLO2	1	2	2	2	1	2
CLO3	1	2	2	2	2	3
CLO4	1	2	2	2	1	2
CLO5	1	2	3	2	1	1

Blueprint for Summative Examination

Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Leve l		
1	CLO 1	Up to K2	2	K1 & K2	1	K1	2 (K1 & K1)	1(K2)
2	CLO 2	Up to K3	2	K1 & K2	1	K2	2 (K2 & K2)	1(K3)
3	CLO 3	Up to K3	2	K1 & K2	1	K2	2 (K3 & K3)	1(K3)
4	CLO 4	Up to K3	2	K1 & K2	1	K1	2 (K3 & K3)	1(K3)
5	CLO 5	Up to K4	2	K1 & K2	1	K1	2 (K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analysing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either / or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF CHEMISTRY					CLASS: III B.Sc CHEMISTRY			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
VI	CORE	23U6CCCT10	Physical Chemistry-II	4	6	25	75	100

Nature of course	Skill oriented	√	Employability oriented	√	Entrepreneurship Oriented	

Objectives: The objective of this course is to make the student to

- explain an overall view of phase diagram of one and two component system chemical equilibrium
- Illustrate separation techniques for binary liquid mixtures.
- Address the electrical conductance and transport number, galvanic cells.
- provide an overall view of emf and its applications
- elaborate the concept of chemical equilibrium

Unit	Description	Hours	K-level	CLO
I	Phase rule Definition of terms; derivation of phase rule ; application to one -component systems – water and sulphur - super cooling, sublimation ; two component systems – solid liquid equilibria- simple eutectic (lead - silver and bismuth - cadmium), freezing mixtures (potassium iodide- water), compound formation with-congruent melting points (magnesium – zinc and ferric chloride – water system), solid solution (gold-silver); copper - sulphate – water system.	18	UptoK3	1
II	Chemical equilibrium Law of mass action – thermodynamic derivation – relationship between K_p and K_c –application to the homogeneous equilibria – dissociation of PCl_5 gas, N_2O_4 gas –equilibrium constant and degree of dissociation - formation of HI, NH_3 , and SO_3 –heterogeneous equilibrium – decomposition of solid calcium carbonate –Lechatelier principle – van't Hoff reaction isotherm – temperature dependence of equilibrium constant – van't Hoff reaction isochore – Clayperon equation – Clausius Clayperon equation and its applications	18	UptoK2	2
III	Binary liquid mixtures Ideal liquid mixtures – non ideal solutions – azeotropic mixtures –fractional distillation – partially	18	UptoK3	3

	miscible mixtures – phenol-water, triethylamine-water, nicotine-water – effect of impurities on critical solution temperature; immiscible liquids- steam distillation; Nernst distribution law – applications			
IV	Electrical Conductance and Transference Arrhenius theory of electrolytic dissociation – Ostwald's dilution law, limitations of Arrhenius theory; behaviour of strong electrolytes – interionic effects – Debye Huckel theory –Onsager equation (no derivation), significance of Onsager equation, Debye Falkenhagen effect, Wien effect. Ionic mobility – Discharge of ions on electrolysis (Hittorf's theoretical device), transport number –determination – Hittorf's method, moving boundary method –Kohlrausch's law-applications; molar ionic conductance; applications of conductance measurements – determination of - degree of dissociation of weak electrolyte, dissociation constant of weak acid and weak base, ionic product of water, solubility and solubility product of sparingly soluble salts - conductometric titrations – acid base titrations.	18	UptoK4	4
V	Galvanic Cells and Applications Galvanic cell, representation, reversible and irreversible cells, EMF and its measurement – standard cell; relationship between electrical energy and chemical energy; sign of EMF and spontaneity of a reaction, thermodynamics and EMF – calculation of ΔG , ΔH , and ΔS from EMF data; reversible electrodes, electrode potential, standard electrode potential, primary and secondary reference electrodes, Nernst equation for electrode potential and cell EMF; electrochemical series – applications of electrochemical series. Applications of EMF measurements– determination of activity coefficient of electrolytes, transport number, valency of ions, solubility product, pH using hydrogen gas electrode, quinhydrone electrode and glass electrode, potentiometric titrations – acid base titrations, redox titrations, precipitation titrations, ionic product of water and degree of hydrolysis; redox indicators - Galvanic cells- lead storage battery.	18	UptoK3	5

Books for Study:

1. B.R. Puri and L.R. Sharma, Principles of Physical Chemistry, Shoban Lal Nagin Chand and Co., forty eighth edition, 2021.
2. Peter Atkins, and Julio de Paula, James Keeler, Physical Chemistry, Oxford University press, International eleventh edition, 2018.

3. ArunBahl, B.S. Bahl, G. D. Tuli Essentials of physical chemistry, 28th edition 2019.

Books for References:

1. J K. L. Kapoor, A Textbook of Physical Chemistry, Macmillan India Ltd, third edition, 2009.
2. Gilbert. W. Castellen, Physical Chemistry, Narosa Publishing House, third edition, 1985.
3. P. W. Atkins, and Julio de Paula, Physical Chemistry, Oxford University press, seventh edition, 2002.
4. B.R. Puri, L.R. Sharma and M.S. Pathania, Principles of Physical Chemistry, Shobanlal Nagin Chand and Co. Jalendhar, forty first, edition, 4, 2001
5. D.N.Bajpai, Advanced Physical Chemistry, S.Chand&Co., edition, 5, 2001

Web Resources:

1. <https://nptel.ac.in> <https://swayam.gov.in>
2. <https://www.studysmarter.co.uk/explanations/chemistry/physical-chemistry/measuring-emf/>
3. Introduction to chemical equilibrium – MIT opencourse ware
4. <https://www.scribd.com/document/642733700/Two-component-system-Pb-Ag-and-Zn-Mg-pdf>

Rationale for Nature of the course

This course content provides comprehensive foundation and knowledge on the concept of phase rule, electrical conductance, Binary solutions EMF and its applications.

Activities having direct bearing on Skill development / Employability Entrepreneurship

This course can incorporate various activities that directly contribute to skill development, enhance employability, and foster entrepreneurship among students. Further, students can explore the application of EMF. This course will develop the students to approach towards accurate measurement of concentration, molecular mass and rate constant of chemical reactions which involves various techniques. Incorporate various activities that directly contribute to skill development and enhance employability among students, as it includes Knowledge, Analytical ability and professional competency and data interpretation.

Pedagogy

- Chalk-Talk class room Activities
- Group Discussion
- Seminar
- Quiz through ICT- Mode
- Problem solving

Course Designer:

Dr. M. Malarvizhi

Lecture Schedule

Unit	Descriptions	Hours	Mode of teaching
I	Phase rule		
	Definition of terms; derivation of phase rule	4	Chalk and talk/PPT/ Animated Videos/quiz/ seminar/ Test
	application to one -component systems – water and sulphur	4	
	super cooling, sublimation ; two component systems – solid liquid equilibria- simple eutectic (lead - silver and bismuth - cadmium),	4	
	freezing mixtures (potassium iodide- water), compound formation with- congruent melting points (magnesium – zinc and ferric chloride – water system), solid solution (gold-silver); copper - sulphate – water system.	6	
II	Chemical equilibrium		
	Law of mass action – thermodynamic derivation – relationship between K_p and K_c –application to the homogeneous equilibria —heterogeneous equilibrium	6	Chalk and talk/PPT/ Animated Videos/quiz/ seminar/ problem solving/Test
	dissociation of PCl_5 gas, N_2O_4 gas –equilibrium constant and degree of dissociation - formation of HI, NH_3 ,and SO_3	6	
	decomposition of solid calcium carbonate –Lechatelier principle – van't Hoff reaction isotherm – temperature dependence of equilibrium constant – van't Hoff reaction isochore – Clayperon equation – Clausius Clayperon equation and its applications	6	
III	Binary liquid mixtures		
	Ideal liquid mixtures – non ideal solutions – azeotropic mixtures –fractional distillation	6	Chalk and talk/PPT/ Animated Videos/quiz/ seminar/ Test
	– partially miscible mixtures – phenol-water, triethylamine-water, nicotine-water – effect of impurities on critical solution temperature;	6	
	immiscible liquids- steam distillation; Nernst distribution law – applications	6	
IV	Electrical Conductance and Transference		
	Arrhenius theory of electrolytic dissociation – Ostwald's dilution law, limitations of Arrhenius theory; behavior of strong electrolytes – interionic effects – Debye Huckel theory – Onsager equation (no derivation), significance of Onsager equation,	6	Chalk and talk/PPT/ Animated Videos/ problem

	Debye Falkenhagen effect, Wien effect. Ionic mobility – Discharge of ions on electrolysis (Hittorf’s theoretical device), transport number –determination – Hittorf’s method, moving boundary method –Kohlrausch’s law- applications; molar ionic conductance and viscosity (Walden’s rule);	6	solving/quiz/ seminar /Test
	applications of conductance measurements – determination of - degree of dissociation of weak electrolyte, dissociation constant of weak acid and weak base, ionic product of water, solubility and solubility product of sparingly soluble salts - conductometric titrations – acid base titrations.	6	
V	Galvanic Cells and Applications		
	Galvanic cell, representation, reversible and irreversible cells, EMF and its measurement – standard cell; relationship between electrical energy and chemical energy; sign of EMF and spontaneity of a reaction, thermodynamics and EMF – calculation of ΔG , ΔH , and ΔS from EMF data; reversible electrodes, electrode potential, standard electrode potential, primary and secondary reference electrodes, Nernst equation for electrode potential and cell EMF;	6	Chalk and talk/PPT/ Animated Videos/quiz/ seminar/ Assignment
	electrochemical series – applications of electrochemical series.Chemical cells with and without transport, applications of EMF measurements – determination of activity coefficient of electrolytes, transport number, valency of ions, solubility product, pH using hydrogen gas electrode, quinhydrone electrode and glass electrode,	6	
	potentiometric titrations – acid base titrations, redox titrations, precipitation titrations, ionic product of water and degree of hydrolysis; Galvanic cells- lead storage battery.	6	

COURSE LEARNING OUTCOMES:

At the end of the course, the student will be able to:

	CO Statement	K-level
CLO1	Construct and explain the phase diagram for one component and two component systems, explain the properties of freezing mixture, components with congruent melting points and solid solutions.	Upto K2
CLO 2	Apply the concepts of chemical equilibrium in dissociation of PCl_5 , N_2O_4 and formation of HI , NH_3 , SO_3 and decomposition of calcium carbonate. Demonstrate important principles such as Le chatelier principle, van't Hoff reaction isotherm and Clausius-Clayperon equation	Upto K4
CLO3	Identify an appropriate distillation method for the separation of binary liquid mixtures such as azeotropic mixtures, partially miscible mixtures and immiscible liquids.	Upto K3
CLO4	Illustrate the significance of Arrhenius theory, Debye-Huckel theory, Onsager equation and Kohlrausch's law in conductance.	Upto K3
CLO5	Construct electrochemical cell with the help of electrochemical series and calculate cell EMF. Demonstrate the applications of EMF and significance of potentiometric titrations.	Upto K3

Mapping of CLOs and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	2	2	3	2
CLO2	3	3	2	3	3	2
CLO3	3	2	1	2	1	3
CLO4	3	3	2	2	3	2
CLO5	3	2	2	2	3	3

Mapping of CLOs and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	3	2	1	2	3	2
CLO2	3	2	2	2	3	2
CLO3	3	1	2	2	3	3
CLO4	3	2	2	2	3	3
CLO5	3	2	2	3	3	2

Blueprint for Summative Examination
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Unit s	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K-Level	No. of Questions	K- Level		
1	CLO 1	Up to K3	2	K1 & K2	1	K1	2 (K2 & K2)	1 (K3)
2	CLO 2	Up to K2	2	K1 & K2	1	K1	2 (K1 & K1)	1 (K2)
3	CLO 3	Up to K3	2	K1 & K2	1	K2	2 (K3 & K3)	1 (K3)
4	CLO 4	Up to K4	2	K1 & K2	1	K2	2 (K4 & K4)	1 (K4)
5	CLO 5	Up to K3	2	K1 & K2	1	K2	2 (K3 & K3)	1 (K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	4	10	-	19	15.83	42
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42
K4	-	-	10	10	20	16.67	16
Total Marks	10	10	50	50	120	100.00	100

DEPARTMENT OF CHEMISTRY					CLASS: III B.Sc chemistry			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
VI	Core Practical	23U6CCCP6	PHYSICAL CHEMISTRY PRACTICAL – II	3	3	25	75	100
Nature of course		Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented		✓

Objectives: The objective of this course is to make the student to

- Have hands on experience in carrying out the physical chemistry experiments
- Apply Beer-Lambert's law for determine the concentration of copper sulphate solution by colorimetry
- determine rate constant of acid catalyzed ester hydrolysis
- construct the Freundlich isotherm for the adsorption of acetic acid on activated charcoal
- determine the molecular weight of an organic compound by Rast - macro method.

List of Experiments

1. Determination of rate constant of acid catalysed hydrolysis of an ester (Ethyl acetate).
2. Determination of molecular weight of an organic compound by Rast - macro method using
3. Naphthalene or diphenyl as solvent
4. Determination of cell constant
5. Determination of molar conductance of strong electrolyte
6. Determination of dissociation constant of acetic acid
7. Determination of concentration of copper sulphate solution by colorimetry.
8. Construction of Freundlich isotherm for the adsorption of acetic acid/ oxalic acid on activated charcoal
9. Determination of heat of neutralisation of a strong acid by a strong base.

Books for Study:

1. Jeffery G. H. Bassett.J, Mendham. J. and Denney R. C., Vogel's Textbook of Quantitative Chemical Analysis; 6th ed., ELBS, 1989.
2. Gurtu J. N. and Kapoor R., Advanced Experimental Chemistry, S. Chand and Co., 2011
3. Yadav J. B., Advanced Practical Physical Chemistry, Goel Publishing House, 2001

Books for References:

1. V.Ramamoorthy, R. Veeraswamy, and A.r. Kulandaivelu Basic Principles of Practical Chemistry, Sultan Chand and sons, 2011, 2001
2. Gnanapragasam N. S. and Ramamurthy G., Organic Chemistry – Labmanual, S. Viswanathan Co.Pvt. Ltd, 2009.

3. Gurtu J. N. and Kapoor R., Advanced Experimental Chemistry, S. Chand and Co., 2011
Yadav J. B., Advanced Practical Physical Chemistry, Goel Publishing House, 2001

Web Resources

1. [https://tech.chemistrydocs.com/Books/Physical/Advanced-Physical-Chemistry-Experiments-by- J-N-Gurtu-&-Amit-Gurtu.pdf](https://tech.chemistrydocs.com/Books/Physical/Advanced-Physical-Chemistry-Experiments-by-J-N-Gurtu-&-Amit-Gurtu.pdf)
2. <https://www.sciencedirect.com/book/9780080125411/experiments-in-physical-chemistry>
3. <https://staff.run.edu.ng/oermedia/4315493995176.pdf>

Rationale for Nature of the course

Physical chemistry practicals are a widely-used in quantitative analytical method. As the name implies, this method involves the measurement of concentration of analyte and determination of rate constant of reactions and distribution co-efficient.

Activities having direct bearing on Skill development/ Employability/Entrepreneurship

The knowledge of this paper develops the students to approach towards accurate measurement of concentration, molecular mass and rate constant of chemical reactions which involves various techniques.

Activities having direct bearing on Skill development / Employability Entrepreneurship

This course will develop the students to approach towards accurate measurement of concentration, molecular mass and rate constant of chemical reactions which involves various techniques. Incorporate various activities that directly contribute to skill development and enhance employability among students, as it includes Knowledge, Analytical ability and Professional Competency and data interpretation.

Pedagogy

Demonstration, Hands on experience

Course Designer(s):

Dr. M. Malarvizhi

Course Learning Outcomes: After successful completion of this course, the student will be able to

CLO	Course Learning Outcomes	Knowledge Level
CLO1	Recall the principles associated with various physical chemistry experiments.	Up to K2
CLO2	Scientifically plan and perform the experiments	Up to K3
CLO3	Observe and record systematically the readings in all the experiments	Up to K3
CLO4	Calculate and process the experimentally measured values and compare with graphical data.	Up o K4
CLO5	Interpret the experimental data scientifically to improve student's efficiency for societal developments.	Up to K4

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7
CLO-1	3	3	2	3	2	3	2
CLO-2	3	3	2	3	3	3	2
CLO-3	3	3	2	3	3	2	3
CLO-4	2	2	3	3	3	3	3
CLO-5	3	3	3	2	2	2	3

Mapping of CLOs with POs

CLO	PO1	PO2	PO3	PO4	PO5
CLO1	3	3	3	3	3
CLO2	3	3	3	3	3
CLO3	3	3	3	3	3
CLO4	3	3	3	3	3
CLO5	3	3	3	3	3

Advance application– 3;**Intermediate level–2;****Basic level–1**

	Components for External Examination	K level	Marks
CLO1	To recall the principles associated with various physical chemistry experiments.	Up to K2	10
CLO2	To scientifically plan and perform all the experiments.	Up to K3	20
CLO3	To observe and record systematically the readings in all the experiments.	Up to K3	15
CLO4	To calculate and process the experimentally measured values and compare with graphical data.	Up to K4	20
CLO5	To interpret the experimental data scientifically to improve students' efficiency for societal developments.	Up to K4	10

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analysing, presentation and make inferences with evidences

DEPARTMENT:CHEMISTRY					CLASS: III B.Sc CHEMISTRY			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
VI	Discipline Elective Course-II	23U6CDET2 (A)	BIO-CHEMISTRY	2	4	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	✓

Objectives: This course aims at providing knowledge to

- Understand relationship between biochemistry and medicine, composition of blood
- Analyze the structure and properties of amino acids, peptides, enzyme, vitamins and proteins
- Assess the biological functions of proteins, enzymes, vitamins and hormones
- Distinguish the biochemistry of nucleic acids and lipids
- interpret the metabolism of lipids

Unit	Description	Hours	K-level	CLO
I	Logic of Living Organisms Relationship of Biochemistry and Medicine-Blood - Composition of Blood, Blood Coagulation – Mechanism. Hemophilia and Sickle Cell Anaemia-Maintenance of pH of Blood – Bicarbonate Buffer, Acidosis, Alkalosis	12	Up to K2	1
II	Peptides and Proteins Amino acids – nomenclature, classification – essential and Non-essential; Synthesis - Gabriel Phthalimide, Strecker; properties – zwitter ion and isoelectric point, electrophoresis and reactions. Peptides – peptide bond – nomenclature – synthesis of simple peptides – solution and solid phase Proteins – structure of proteins – primary, secondary, tertiary and quaternary. Colour reaction of proteins. Metabolism of Amino acids – general aspects of metabolism- urea cycle.	12	Up to K4	2
III	Enzymes and Vitamins Nomenclature and classification, characteristics, factors influencing enzyme activity – mechanism of enzyme action – Lock and key hypothesis, Koshland's induced fit model. Vitamins as coenzymes – functions of, NAD, FMN, FAD, pyridoxal phosphate, CoA, folic acid, biotin, cyanocobalamin	12	Up to K3	3

IV	Nucleic acids Components of nucleic acids - nitrogenous bases and pentose sugars, structure of nucleosides and nucleotides, DNA- structure & functions RNA –types– structure - functions; biosynthesis of proteins	12	Up to K3	4
V	Lipids Occurrence, biological significance of fats, classification of lipids. Simple lipids – Oils and fats, chemical composition, properties, reactions – hydrolysis, hydrogenation, trans-esterification, saponification, rancidity; analysis of oils and fats – saponification number, iodine number, acid value, R.M. value. Distinction between animal and vegetable fats. Compound lipids – Lipoproteins -VLDL, LDL, HDL- Biological significance	12	Up to K3	5

Books for study:

1. Jain, J. L.; Fundamentals of Biochemistry, 2nd ed.; S.Chand: New Delhi, 1983.
2. Shanmugam, A. Fundamentals of Biochemistry for Medical Students, 6th ed. Published by the author, 1999.
3. Bahl, B.S.; Bhal, A. Advanced Organic Chemistry, 3rd ed.; S. Chand: New Delhi, 2003.

Books for References:

1. Jain, M.K.; Sharma, S.C. Modern Organic Chemistry, Vishal Publications: New Delhi, 2017.
2. Veerakumari, L. Biochemistry, 1st ed.; MJP Publications: Chennai, 2004.
3. Lehninger, A. L. Principles of Biochemistry, 2nd ed.; CBS Publisher: Delhi, 1993.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc19_cy07/preview
2. <http://library.med.utah.edu/NetBiochem/nucacids.html>
3. <https://swayam.gov.in/courses/4384-biochemistry> Biochemistry

Rationale for Nature of the course

This course will enable to the students to enrich their knowledge biochemistry of living organisms

Activities having direct bearing on Skill development / Employability Entrepreneurship

The course can incorporate various activities that directly contribute to enhance employability and entrepreneurship among students. Hence students will have chance to develop business plans for entrepreneurial ventures in the field of bio chemistry.

Pedagogy

- Chalk-Talk class room activities
- Group Discussion
- Seminar
- Quiz through ICT- Mode

Name of the course Designer

Dr. M. Karpagavalli

Lecture Schedule

Unit	Descriptions	Hours	Lecture
I	Logic of Living Organisms		
	Relationship of Biochemistry and Medicine Blood , Composition of Blood, Blood Coagulation – Mechanism	4	Chalk and talk/PPT/ Animated Videos/quiz/seminar, Test
	Hemophilia and Sickle Cell Anaemia, Maintenance of pH of Blood	4	
	Bicarbonate Buffer, Acidosis, Alkalosis	4	
	II	Peptides and Proteins	
Amino acids – nomenclature, classification – essential and Non- essential; Synthesis - Gabriel Phthalimide, Strecker; properties – zwitter ion and isoelectric point, electrophoresis and reactions.		4	Chalk and talk/PPT/ Animated Videos/quiz/seminar, Test
Peptides – peptide bond – nomenclature – synthesis of simple peptides – solution and solid phase.		4	
Proteins –colour tests for proteins; structure of proteins – primary, secondary, tertiary and quaternary Metabolism of Amino acids – general aspects of metabolism - urea cycle.		4	
III	Enzymes and Vitamins		
	Nomenclature and classification, characteristics, factors influencing enzyme activity, mechanism of enzyme action – Lock and key hypothesis	4	Chalk and talk/PPT/ Animated Videos/quiz/seminar, Test
	Koshland’s induced fit model. Vitamins as coenzymes- functions of, NAD, FMN, FAD,	4	
	pyridoxal phosphate, CoA, folic acid, biotin, cyanocobalamin	4	
IV	Nucleic acids		
	Components of nucleic acids - nitrogenous bases and pentose sugars		Chalk and talk/PPT/ Animated Videos/quiz/seminar Test
	structure of nucleosides and nucleotides	4	
	DNA- structure & functions	4	
	RNA –types– structure- functions biosynthesis of proteins	4	

V	Lipids		
	Occurrence, biological significance of fats, classification of lipids.	4	Chalk and talk/PPT/ Animated Videos/quiz/seminar and Assignment
	trans-esterification, saponification, rancidity; analysis of oils and fats – saponification number, iodine number, acid value	4	
	R.M. value. Distinction between animal and vegetable fats. Compound lipids – Lipoproteins - VLDL, LDL, HDL Biological significance	4	

COURSE LEARNING OUTCOMES:

At the end of the course, the student will be able to:

	CO Statement	K-level
CO1	Compare the molecular logic of living organisms, composition of blood and blood coagulation	Up to K2
CO2	Categorize synthesis and properties of amino acids, determination of structure of peptides and proteins	Up to K4
CO3	Apply factors influencing enzyme activity and vitamins as coenzymes	Up to K3
CO4	Identify RNA and DNA structure and functions	Up to K3
CO5	Develop biological significance of simple and compound lipids	Up to K3

Mapping of CLOs and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	2	2	3	2
CLO2	3	3	2	3	3	2
CLO3	3	2	1	2	1	3
CLO4	3	3	2	2	3	2
CLO5	3	2	2	2	3	3

Mapping of CLOs and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	3	2	1	2	3	2
CLO2	3	2	2	2	3	2
CLO3	3	1	2	2	3	3
CLO4	3	2	2	2	3	3
CLO5	3	2	2	3	3	2

Blueprint for Summative Examination
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1 & K2	1	K1	2 (K1 & K1)	1(K2)
2	CLO 2	Up to K4	2	K1 & K2	1	K2	2 (K4 & K4)	1(K4)
3	CLO 3	Up to K3	2	K1 & K2	1	K1	2 (K3 & K3)	1(K3)
4	CLO 4	Up to K3	2	K1 & K2	1	K2	2 (K3 & K3)	1(K3)
5	CLO 5	Up to K3	2	K1 & K2	1	K2	2 (K3& K2)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either / or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total marks	10	10	50	50	120	100.00	100%

DEPARTMENT: Chemistry					CLASS: III. B. Sc. Chemistry			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
V	Discipline Elective Course-II	23U6CDET2 (B)	Batteries and Fuel cells	2	4	25	75	100

Nature of course	Skill oriented	√	Employability oriented	√	Entrepreneurship Oriented	√

Objectives: The objective of this course is to make the student to

- Study various sources of energy
- Basic idea of electrochemical energy storage system
- Familiarize the classification of batteries
- Get basic idea of applications of batteries
- Know the basic idea of E-vehicle system

Unit	Description	Hours	K-level	CLO
I	Energy demands and Energy sources World Energy consumptions-Energy in developing countries Indian Energy Sources.-Non- conventional renewable energy resources. Potential of renewable energy sources-Solar energy types, wind energy, wave, Tidal energy sources	12	Up to K2	1
II	Introduction to Electrochemical energy storage system Introduction to battery system- Electromotive force- Reversible cells- Relation between electrical energy and energy content of a cell-Free energy changes and electromotive force in cell-Single Electrode potential.	12	Up to K3	2
III	Classification of Batteries High energy density and Power density batteries-Operational characteristics -Primary cell- Voltaic cell, Dry cell, Alkaline cell . Secondary batteries- Lead acid Batteries Lithium battery Nickel metal hydride battery Construction and its application.	12	Up to K3	3
IV	Recent development in battery system Recent development of electrode materials in lithium ion batteries- Recent development of solid electrolytes and their application to solid state batteries-Polymer solid electrolytes for lithium ion conduction Metal air batteries (principle only) Thin Film solid state Batteries	12	Up to K3	4

V	Fuel Cells and E-vehicle System Fuel cells Basic concept and types Proton exchange membrane FC-Methanol FC-solid oxide FC- (principle only)- Advantages and Disadvantages of fuel cell-Hydrogen Economy- Hydrogen storage Super capacitors.	12	Up to K4	5

Books for study

1. Wakihara. M , Yamamoto. O, Lithium ion Batteries Fundamental and Performance, Published by Wiley VCH Verlag G mbH,1999.
2. Skundin, M.L, Bagotski, V.S Electrochemical power sources:Batteries Fuel Cell and supercapacitors, Wiley 2015
3. Sharma. B.K. - Industrial Chemistry, Goel Publishing House, New Delhi, 1994

Books for References:

1. Wakihara. M , Yamamoto. O, Lithium ion Batteries Fundamental and Performance, Published by Wiley VCH Verlag G mbH, 1999.
2. Skundin, M.L, Bagotski, V.S Electrochemical power sources:Batteries Fuel Cell and supercapacitors, Wiley 2015
3. Sharma. B.K. - Industrial Chemistry, Goel Publishing House, New Delhi, 1994

Web Resources:

1. <https://www.batterysolutions.com/recycling-information/battery-types/>
2. <https://www.energy.gov/eere/fuelcells/hydrogen-fuel-basics>
3. <https://afdc.energy.gov/vehicles/how-do-fuel-cell-electric-cars-work>

Rationale for Nature of the course

This course will enable the students to comprehend the energy storage system such as battery and fuel cell and to study the various types of battery and its working mechanism.

Activities having direct bearing on Skill development / Employability Entrepreneurship

The basic knowledge in energy storage system such battery and fuel cell will help the students to learn future energy devices. They can get useful information about modern fuel cell and super capacitor.

Pedagogy

Chalk-Talk Class room Activities
Group discussion & Seminar
Assignment and Quiz through ICT

Name of the course Designer

Dr. R. RAMACHANDRAN

Course Schedule

Unit	Topics	Hrs	Mode
I	Energy demands and Energy sources		
	World Energy consumptions-Energy in developing countries Indian Energy Sources	3	Chalk and talk/PPT/ Animated Videos/quiz/ seminar/test
	Non- conventional renewable energy resources	3	
	Potential of renewable energy sources-Solar energy types, wind energy,	3	
	Wave, Tidal energy sources	3	
II	Introduction to Electrochemical energy storage system		
	Introduction to battery system- Reversible cells- Relation between electrical energy and energy content of a cell	3	Chalk and talk/PPT/ Animated Videos/quiz/ seminar/test
	Electromotive force	3	
	Relation between electrical energy and energy content of a cell	3	
	Free energy changes and electromotive force in cell- Single Electrode potential.	3	
III	Classification of Batteries		
	High energy density and Power density batteries-.	3	Chalk and talk/Assignment quiz/seminar
	Operational characteristics -Primary cell- Voltaic cell, Dry cell, Alkaline cell	3	
	Secondary batteries- Lead acid Batteries Lithium battery	3	
	Nickel metal hydride battery Construction and its application	3	
IV	Recent development in battery system		
	Recent development of electrode materials in lithium ion batteries	3	Chalk and talk/ Animated Videos/ seminar/quiz/test
	Recent development of solid electrolytes and their application to solid state batteries	3	
	-Polymer solid electrolytes for lithium ion conduction Metal air batteries (principle only)	3	
	Thin Film solid state Batteries	3	
V	Fuel Cells and E-vehicle System		
	Fuel cells Basic concept and types Proton exchange membrane FC-Methanol -	3	Chalk and talk/PPT/ Animated Videos/ seminar/quiz/test
	-solid oxide FC- (principle only)	3	
	FC- Advantages and Disadvantages of fuel cell	3	
	Hydrogen Economy- Hydrogen storage Super capacitors.	3	

COURSE LEARNING OUTCOMES:

At the end of the course, the student will be able to:

	CO Statement	K-level
CO1	Compare and classify the various energy storage systems	Upto K2
CO2	Analyse concepts of thermodynamics and kinetics involved in electrochemical reactions	Upto K3
CO3	Develop components and processes of various battery systems	Upto K3
CO4	Identify the recent developments in battery systems including electrode and electrolyte materials	Upto K3
CO5	Utilize fuel cells and E-vehicle system	Upto K4

Mapping of CLOs and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	2	2	1	2	1	1
CLO2	2	2	1	2	1	1
CLO3	2	2	1	2	1	1
CLO4	2	2	1	2	2	2
CLO5	2	2	1	2	2	1

Mapping of CLOs and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	2	2	1	1	-	3
CLO2	2	2	1	2	-	3
CLO3	1	2	1	2	-	3
CLO4	1	2		1	-	3
CLO5	1	1		1	-	3

Blueprint for Summative Examination

Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1 & K2	1	K1	2 (K1 & K1)	1(K2)
2	CLO 2	Up to K3	2	K1 & K2	1	K2	2 (K2 & K2)	1(K3)
3	CLO 3	Up to K3	2	K1 & K2	1	K2	2 (K3 & K3)	1(K3)
4	CLO 4	Up to K3	2	K1 & K2	1	K1	2 (K3 & K3)	1(K3)
5	CLO 5	Up to K4	2	K1 & K2	1	K1	2 (K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analysing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either / or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF CHEMISTRY					CLASS:III B.Sc. CHEMISTRY			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
VI	Major SEC	23U6CSEDT1	Competency Skills in Chemistry	2	2	25	75	100

Nature of course	Skill oriented	√	Employability oriented	√	Entrepreneurship Oriented	

Objectives: The objectives of this course is to make the student to

- Critically answer the reasoning questions
- Learn the chemistry of vitamins and hormones
- Gain knowledge on treatment of water for domestic as well as industrial purpose.
- Aware of various drugs viz., analgesics, antibiotics, antiseptics etc.
- Evaluate the analytical data using error analysis

Unit	Description	Hours	K-level	CLO
I	Quantitative Aptitude & Reasoning Coding - letter coding, number coding, symbol coding; Missing number series; Alphanumeric reasoning – visual reasoning.	6	K4	1
II	Vitamins and Hormones Classification of vitamins - Sources, functions and deficiency of the following vitamins: Vitamin A, D, E, K, C and B1, B2, folic acid, biotin and B12. Hormones – structure (elucidation not necessary) and functions of testosterone, progesterone and thyroxine.	6	K3	2
III	Water Treatment Hardness of water - types of harness. Requirements of boiler feed water - Boiler troubles - scale and sludge formation in boilers - Softening of water - external treatment - ion-exchange process - zeolite process. Internal treatment – colloidal, phosphate and calgon conditioning. Purification of water for domestic use. Desalination – Reverse osmosis.	6	K4	3
IV	Pharmaceutical Chemistry Terminology - pharmacology, toxicology, chemotherapy; Drugs- Structure & uses of the following: Analgesics - Aspirin & Ibuprofen; Antibiotics - Penicillin & Tetracycline; Antiseptics - Dettol & Salol; Anaesthetics - Chloroform & Procaine; Sedatives – Veronal & Bazedrin	6	K3	4

V	Mathematical Treatment in Error Analysis Evaluation of analytical data Reporting of analytical data - uncertainty in results. Statistical treatment of analytical data - Calculation of confidence limit. Rejection of a result - Q test, F-test and t test.	6	K4	5

Books for Study:

1. Aggarwal R.S., Quantitative Aptitude, New revised edition, S Chand and Company Ltd, U.P., 2025.
2. Arun Bahl and Bahl B.S., Advanced organic chemistry, Multicolour edition S. Chand& Company Pvt. Ltd., New Delhi, 2012.
3. Jain & Jain, Engineering Chemistry, 17th edition, Dhanpat Rai Publishing Company, 2015.

Books for References:

1. Arvind Sharma, Abhilasha Khanna, SURA`S Quantitative Aptitude and Arithmetic for Competitive Exams, Sura College of Competition, Chennai, 2024.
2. Jain M.K and Sharma S.C., Modern Organic Chemistry, 4th edition, Vishal Publishing Co., 2012.
3. Soni P.L., Mohan Katyal, Textbook of Inorganic Chemistry, Sulthan Chand & Sons, 1991.
4. Skoog, D. A.; Crouch, S. R.; Holler, F.J.; West, D. M. Fundamentals of Analytical Chemistry, 9th edition, Harcourt college Publishers: USA, 2013.

Web Resources:

1. <https://byjus.com/govt-exams/coding-decoding-questions/>
2. <https://talentbattle.in/practice-logical-reasoning-questions/visual-reasoning>
3. https://www.asdlib.org/onlineArticles/ecourseware/Analytical%20Chemistry%202.0/Text_files_files/Chapter4.pdf

Rationale for Nature of the course:

Students learn to solve critical analytical questions related to paper for TNPSC which will orient and help students to clear TNPSC examination and get placed in ministerial service of Govt, of Tamilnadu.

Activities having direct bearing on Skill development / Employability Entrepreneurship:

Students solve aptitude questions and objective questions in Chemistry at the level of TNPSC Group I, JAM and other competitive examinations.

Pedagogy

Chalk and Board, Group discussion, Assignment, Quiz and Seminar.

Course Designer:

Dr. M. Hasmath Farzana

Lecture Schedule

Unit	Topics	Hrs	Mode
Unit I	Quantitative Aptitude & Reasoning Coding - letter coding, number coding	2	Chalk and Board, Group discussion, Problem solving Test, Seminar & Quiz
	symbol coding; Missing number series;	2	
	Alphanumeric reasoning – visual reasoning.		
Unit II	Vitamins and Hormones Classification of vitamins - Sources, functions and deficiency of the following vitamins: Vitamin A, D, E, K, C and B1, B2, folic acid, biotin and B12.	4	Chalk and Board, PPT, Test, Seminar& Quiz
	Hormones – structure (elucidation not necessary) and functions of testosterone, progesterone and thyroxine.	2	
Unit III	Water Treatment Hardness of water - types of harness. Requirements of boiler feed water - Boiler troubles - scale and sludge formation in boilers -	2	Chalk and Board, PPT, Test, Seminar & Quiz
	Softening of water - external treatment - ion-exchange process - zeolite process. Internal treatment – colloidal, phosphate and calgon conditioning.	2	
	Purification of water for domestic use. Desalination – Reverse osmosis.	2	
Unit IV	Pharmaceutical Chemistry Terminology - pharmacology, toxicology, chemotherapy; Drugs - Structure & uses of the following: Analgesics - Aspirin & Ibuprofen; Antibiotics - Penicillin & Tetracycline;	3	Chalk and Board, PPT, Test, Seminar & Quiz
	Antiseptics - Dettol & Salol; Anaesthetics - Chloroform & Procaine; Sedatives – Veronal & Benzedrin.	3	
Unit V	Mathematical Treatment in Error Analysis Evaluation of analytical data Reporting of analytical data - uncertainty in results. Statistical treatment of analytical data - Calculation of confidence limit.	3	Chalk and Board, Problem solving, Seminar, Quiz & Assignment
	Rejection of a result - Q test, F-test and t test.	3	

Course Learning Outcomes: At the end of the course the student will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Analyse and answer the reasoning questions effectively.	K4
CLO-2	Apply knowledge on functions of vitamins and hormones.	K3
CLO-3	Explain the treatment of water for both domestic as well as industrial purpose.	K4
CLO-4	Develop knowledge on structure and uses of various drugs.	K3
CLO-5	Analyze the data using error analysis.	K4

Mapping of CLOs with PSOs

#	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CLO-1	1	1	3	3	3	3
CLO-2	2	2	2	2	3	2
CLO-3	3	3	3	3	3	3
CLO-4	3	2	3	2	3	3
CLO-5	2	2	2	3	3	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	3	3	3	3
CLO2	3	2	2	2	3	3
CLO3	3	2	3	2	3	3
CLO4	3	3	3	2	3	2
CLO5	3	3	3	3	3	2

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K-Level	Section A		Section B		Section C (Open Choice)
			MCQs		Paragraph Answers (Open Choice)		
			No. of Questions	K-Level	No. of Questions	K-Level	
1	CLO 1	Up to K4	6	K4	1	K2	1 (K2)
2	CLO 2	Up to K3	6	K3	1	K3	1 (K2)
3	CLO 3	Up to K4	6	K4	1	K2	1 (K3)
4	CLO 4	Up to K3	6	K3	1	K1	1 (K2)
5	CLO 5	Up to K4	6	K4	1	K3	1 (K3)
No. of Questions to be asked			30			5	5
No. of Questions to be answered			30			3	3
Marks for each question			1			5	10
Total marks for each			30			15	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Open Choice)	Section C (Open Choice)	Total Marks	% of Marks with choice
K1	-	5	-	5	4.7
K2	-	10	30	40	38.1
K3	12	10	20	42	40.0
K4	18	-	-	18	17.1
Total Marks	30	25	50	105	100.00

DEPARTMENT OF CHEMISTRY				CLASS: III B. Sc. Chemistry				
.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
VI	Major Project	23U6CPROV	Project & Viva-voce	2	3	25	75	100

Nature of course		Skill oriented	√	Employability oriented	√	Entrepreneurship Oriented	

Course Objectives:

The objective of this course is to make the student to

- Motivate students to take up research projects in their field of interest.
- Promote scientific temper and systematic approach to problem solving and research methodology.
- Promote research writing aptitude among students.

During the final semester, students shall undertake a project work and submit the project report.

Course Learning Outcomes: After successful completion of this course, the student will be able to

CLOs	Course Learning Outcomes	K level
CLO 1	Survey scientific literature available and identify gaps in existing studies	K4
CLO 2	Design a scientific study taking practical constraints into account	K5
CLO 3	Perform the scientific study taking practical constraints into account.	K3
CLO 4	Analyze the results.	K4
CLO 5	Communicate the findings based on ethical standards of reporting.	K3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO 1	3	3	3	3	3	3
CLO 2	3	3	3	3	3	3
CLO 3	3	3	3	3	3	3
CLO 4	3	3	3	3	3	3
CLO 5	3	3	3	3	3	3

Advance application –3, Intermediate level –2 , Basic level–1

Mapping of CLOs with PSOs

#	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CLO 1	3	3	3	3	3	3
CLO 2	3	3	3	3	3	3
CLO 3	3	3	3	3	3	3
CLO 4	3	3	3	3	3	3
CLO 5	3	3	3	3	3	3

Advance application –3, Intermediate level –2 , Basic level–1

Internal& External Valuation for Project

Internal	External
25 marks	75 Marks
Guide Evaluation: ➤ 10 Marks for Students ability and interest ➤ 10 Marks for Regularity and Punctuality ➤ 5 Marks for Quality of the work and Presentation	Department Evaluation: 25 marks ➤ 15 Marks for Presentation using ICT tools. ➤ 10 Marks for Quality and Publications / Presentation in Seminar/ conferences External Evaluation: 50 marks ➤ 20 Marks for the Report ➤ 30 Marks for Presentation, Quality of work and Viva voce.

Course Designer(s):

Dr. S. V. Karthikeyan



Thee Madura College, Madurai – 625 011

Department of Chemistry

COURSE DESCRIPTION WITH DESCRIPTOR ELEMENTS AND PERCENTAGE OF REVISION

(Kindly note: Only courses offered by the department need to be mentioned here)

Semester	Course Code	Title of the Course	Hours	Credits	Nature of Course (Employability/ Entrepreneurship/ Skill Development)			Scope of Focus (Local / National / Global developmental needs)			Percentage of Syllabus Revision/ New
					Empl	Ent	Skill	Local	National	Global	
V	23U5CCCT5	Organic chemistry-I	4	5	Yes		Yes			Yes	11
	23U5CCCT6	Inorganic chemistry-I	4	5	Yes	Yes	Yes			Yes	23
	23U5CCCT7	Physical chemistry-I	4	5	Yes		Yes			Yes	20
	23U5CCCP5	Organic estimation & Gravimetric estimation	3	3	Yes		Yes			Yes	10
	23U5CDET1	Fundamentals of spectroscopy(A) (Or)Nano science(B)	4	5	Yes		Yes			Yes	33
	23U5CIDT1	Industrial chemistry	4	5	Yes	Yes	Yes			Yes	New
	23U5VENT1	Value education	2	2							
	23U5CINTR	Industrial visit	2	-							New
VI	23U6CCCT8	Organic chemistry-II	4	6	Yes		Yes			Yes	47
	23U6CCCT9	Inorganic chemistry-II	4	6			Yes			Yes	21
	23U6CCCT10	Physical chemistry-II	4	6	Yes		Yes			Yes	25
	23U6CCCP6	Physical chemistry practicals	3	3	Yes	Yes	Yes			Yes	80
	23U6CDET2	Bio chemistry (A) (Or)Batteries and fuel cells(B)	2	4	Yes	Yes	Yes			Yes	New
	23U6CSED1	Competency skills in chemistry	2	2	Yes		Yes			Yes	New
	23U6CPROV	Project and viva-voce	2	3							New



THE MADURA COLLEGE
An Autonomous Institution affiliated to Madurai Kamaraj University
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Vidya Nagar, T.P.K. Road, Madurai – 625 011

PROGRAMME OUTCOMES

PO1: Problem Solving Skill

Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context.

PO2: Decision Making Skill

Foster analytical and critical thinking abilities for data-based decision-making.

PO3: Ethical and Moral Value

Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities and ability to embrace moral/ethical values in conducting one's.

PO4: Communication Skill and Multicultural competence

Ability to develop communication, managerial and interpersonal skills, Possess knowledge of the values and beliefs of multiple cultures and a global perspective.

PO5: Individual and Team Leadership Skill

Capability to lead themselves and the team to achieve organizational goals and contribute significantly to society.

PO6: Employability Skill and: Entrepreneurial Skill

Inculcate contemporary business practices to enhance employability skills in the competitive environment and Equip with skills and competencies to become an entrepreneur.

PROGRAMME SPECIFIC OUTCOMES

PSO1: Placement

To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions.

PSO2: Entrepreneur

To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations.

PSO3: Research and Development

Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development.

PSO4: Contribution to Business World

To produce employable, ethical and innovative professionals to sustain in the dynamic business world.

PSO5: Contribution to the Society

To contribute to the development of the society by collaborating with stakeholders for mutual benefit.

PSO6: Contribution to the Multicultural Competence

To exhibit leadership qualities to work individually and within a team in organizing curricular, co- curricular and extracurricular activities and exhibit competence in educational, industrial and research pursuits.



The Madura College, Madurai – 625 011
Department of Chemistry
Programme Structure of M.Sc., Chemistry

Sem	Course Type	Course Code	Title of the Course	Hours	Credits	Nature of Course (Employability/ Entrepreneurship / Skill Development)			Scope of Focus (Local / National / Global developmental needs)			Percentage of Syllabus Revision /New
						Empl	Ent	Skill	Local	National	Global	
I	Core I	25P1CCCT1	Organic Reaction Mechanism - I	6	5			Yes			Yes	25
	Core II	25P1CCCT2	Structure and Bonding in Inorganic Compounds	6	5			Yes			Yes	17
	Core Practical I	25P1CCCP1	Organic Practicals	6	4	Yes	Yes	Yes			Yes	20
	Discipline Elective I	25P1CECT1 (A)	Nanomaterials and Nanotechnology	5	3	Yes	Yes	Yes			Yes	30
		25P1CECT1 (B)	Pharmaceutical Chemistry			Yes		Yes			Yes	20
	Discipline Elective II	25P1CECT2 (A)	Molecular Spectroscopy	5	3	Yes		Yes			Yes	22
		25P1CECT2 (B)	Electrochemistry			Yes		Yes			Yes	20
	NME I	25P1CSEN1	Applied Chemistry	2	2		Yes	Yes		Yes		70

II	Core III	25P2CCCT3	Organic Reaction Mechanism - II	6	5	Yes		Yes			Yes	23
	Core IV	25P2CCCT4	Physical Chemistry - I	6	5	Yes		Yes			Yes	20
	Core Practical II	25P2CCCP2	Inorganic Practicals	6	4	Yes		Yes			Yes	20
	Discipline Elective III	25P2CECT3 (A)	Green Chemistry	5	3	Yes		Yes			Yes	65
		25P2CECT3 (B)	Medicinal Chemistry			Yes		Yes			Yes	33
	Discipline Elective IV	25P2CECT4 (A)	Bio-Inorganic Chemistry	5	3			Yes		Yes		20
		25P2CECT4 (B)	Material Science			Yes		Yes			Yes	18
	NME II	25P2CSEN2	Chemistry Behind the Traditional Medicinal Plants	2	2	Yes	Yes	Yes		Yes		New
	Total			60	44							

Emp – Employability; Ent – Entrepreneurship; Skill – Skill Development

DEPARTMENT: CHEMISTRY					CLASS: I M.Sc., CHEMISTRY			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
I	CORE	25P1CCCT1	Organic reaction mechanism - I	5	6	25	75	100

Nature of course	Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objectives:

The objective of this course is to make the student to

- Understand the feasibility and the mechanism of various organic reactions and comprehend the techniques in the determination of reaction mechanisms
- Correlate aromaticity and appreciate the differences involved in the various types of organic reaction mechanisms.
- Design feasible synthetic mechanism for the preparation of organic compounds.
- Understand the concept of stereochemistry involved in organic compounds.
- Determine and Synthesis of various molecules and its applications

Unit	Description	Hours	K-level	CLO
I	Methods of Determination of Reaction Mechanism: Reaction intermediates- carbocations, carbanions, free radicals, carbenes, nitrenes. The transition state, Reaction coordinate diagrams, Thermodynamic and kinetic requirements of reactions: Hammond postulate. Methods of determining mechanism: non-kinetic methods - product analysis, determination of intermediates-isolation, detection, and trapping. Cross-over experiments, isotopic labelling, isotope effects and stereo chemical evidences. Kinetic methods - relation of rate and mechanism. Effect of structure on reactivity: Hammett and Taft equations. Linear free energy relationship, substituent and reaction constants.	18	Up to K2	1
II	Aromaticity and Aromatic Electrophilic Substitution: a. Aromaticity: Criteria for Aromaticity, A molecular orbital description of Aromaticity and Anti aromaticity, Homoaromaticity, Aromaticity in benzenoid, non-benzenoid, heterocyclic compounds - Fulvene, Ferrocene, Azulene, Tropilones, Annulenes. NMR and aromaticity. b. Aromatic electrophilic substitution: Orientation and reactivity of di- and polysubstituted phenol, nitrobenzene and halobenzene. Partial rate factor, Reactions involving nitrogen electrophiles: nitration and diazonium coupling; Sulphur electrophiles: sulphonation; Halogen electrophiles: chlorination and bromination; Carbon electrophiles: Friedel-Crafts alkylation, acylation and arylation reactions	18	Up to K3	2

III	Aromatic and Aliphatic Nucleophilic Substitution: a. Aromatic nucleophilic substitution: Mechanisms - S_NAr, S_N1 and Benzyne mechanisms - Evidences - Reactivity, Effect of structure, leaving group and attacking nucleophile. Reactions: Oxygen and Sulphur-nucleophiles, Bucherer and Rosenmund reactions, von Richter, Sommelet- Hauser and Smiles rearrangements. b. S_N1, ion pair, S_N2 mechanisms and evidences. Neighbouring group participations in unsaturated, phenyl and saturated systems. Aliphatic nucleophilic substitutions at an allylic carbon, S_N1, S_N2, S_Ni mechanism - Ambident nucleophiles.	18	Up to K4	3
IV	Stereochemistry a. Optical isomerism due to asymmetric and dissymmetric molecules with C, N, S based chiral centers. prochirality, enantiotopic and diastereotopic atoms, groups, faces, chirality due to helical shape- asymmetric synthesis-Cram's and Prelog's rules: R, S-notations, proR, proS, side phase and re phase Cahn-Ingold-Prelog rules, axial and planar chirality-cyclooctene, Stereoselective and stereospecific synthesis. b. Conformation and reactivity of acyclic systems- Curtin-Hammett Principle. Stability of five and six-membered rings: mono-, di- and polysubstituted cyclohexanes, conformation and reactivity in cyclohexane systems. Fused and bridged rings: bicyclic, poly cyclic systems, decalins and Brett's rule. Optical rotatory dispersion, octant rule, axial α-haloketone rule.	18	Up to K4	4
V	Asymmetric Synthesis Terminology and analytical methods-strategy and classification of methods-First generation methods: use of chiral substrates-Second generation methods: Use of chiral auxiliaries, alkylation of chiral enolates, chiral aza enolates, alkylation of chiral imines and hydrazones, alkylation α to nitrogen Asymmetric diels alder reaction, self-regeneration of stereocentres, chiral sulfoxides - Third generation methods: use of chiral reagents, Asymmetric reduction using lithium aluminium hydride, asymmetric reduction using boron reagents, asymmetric hydroboration, asymmetric wittig type reactions,- Fourth generation methods: asymmetric catalysis, catalytic asymmetric alkylation, catalytic asymmetric conjugate addition, catalytic asymmetric hydrogenation, asymmetric oxidations, asymmetric aziridination and cyclopropanation, reactions catalysed by enzymes and other proteins	18	Up to K4	5

Books for study:

1. J. March and M. Smith, Advanced Organic Chemistry, 5th edition, John-Wiley and Sons.2001.
2. P. Y. Bruice, Organic Chemistry, 7th edn, Prentice Hall, 2013.
3. J.Clayden, N. Greeves, S. Warren, Organic Compounds, 2ndedition, Oxford University Press, 2014.

Books for References:

1. F.A. Carey and R.J. Sundberg, Advanced Organic Chemistry Part-A and B, 5th edition, Kluwer Academic / Plenum Publishers, 2007.
2. D. G. Morris, Stereochemistry, RSC Tutorial Chemistry Text 1, 2001.
3. N.S. Isaacs, Physical Organic Chemistry, ELBS, Longman, UK, 1987.
4. E. L. Eliel, Stereochemistry of Carbon Compounds, Tata-McGraw Hill, 2000.
5. I. L. Finar, Organic chemistry, Vol-1 & 2, 6th edition, Pearson Education Asia, 2004.

Web Resources:

1. <https://sites.google.com/site/chemistryebookscollection02/home/organic-chemistry/organic>
2. <https://www.organic-chemistry.org/>
3. <https://www.youtube.com/watch?v=iaj0YISzWzU&list=PLnvaVenEZ6Q5gB6DOL0jT5IH4si7W6d0K>

Blended Learning Resources:

For unit 1- carbenes, nitrenes

https://onlinecourses.nptel.ac.in/noc25_cy30/preview

Week 1 : Structure and Reactivity of carbenes

Week 2 : Generation of carbenes

Week 3 : Different types of reactions with carbenes

Week 4 : Generation and different reactions of nitrenes and related intermediates.

For Unit 3 - S_N1, ion pair, S_N2 mechanisms and evidences. Neighbouring group participations

https://onlinecourses.nptel.ac.in/noc25_cy32/preview

Week 9 : Stereochemical aspects of basic organic reactions: S_N1, S_N2, S_Ni, NGP, mechanism

For Unit 4 - Optical rotatory dispersion, octant rule, axial α -haloketone rule.

https://onlinecourses.nptel.ac.in/noc25_cy32/preview

Week 5 : Stereoisomerism in chiral molecules- optical isomerism, Circular Dichroism (CD) and Optical Rotatory Dispersion (ORD) and their applications, racemization, D/L and R/S nomenclature, meso-compounds etc.

Rationale for Nature of the course

This course will enhance the students to comprehend the mechanism and stereochemistry of organic chemistry. It will help the students in synthesis of natural products of some of the alkaloids and terpenoids.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Laboratory training is an essential component of skill development for students in the field of organic chemistry and are crucial for understanding the synthesis of organic compounds for Pharmaceutical industries. Projects will give students with an opportunity to develop strategies for new organic compounds based on their natural products.

Pedagogy

- Chalk-Talk class room Activities
- Group Discussion
- Seminar
- Quiz through ICT- Mode

Name of the course Designer

Dr. M. Karpagavalli

Lecture Schedule

Unit	Descriptions	Hours	Lecture
I	Methods of Determination of Reaction Mechanism: Reaction intermediates- carbocations, carbanions, free radicals, carbenes, nitrenes. The transition state, Reaction coordinate diagrams,	4	Chalk & talk, ppt Problem Solving, Quiz, Test-I
	Thermodynamic and kinetic requirements of reactions: Hammond postulate. Methods of determining mechanism: non-kinetic methods - product analysis	4	
	determination of intermediates-isolation, detection, and trapping. Cross-over experiments, isotopic labelling, isotope effects and stereo chemical evidences. Kinetic methods - relation of rate and mechanism	5	
	Effect of structure on reactivity: Hammett and Taft equations. Linear free energy relationship, substituent and reaction constants.	5	
II	Aromaticity and Aromatic Electrophilic Substitution: a. Aromaticity: Criteria for Aromaticity, A molecular orbital description of Aromaticity and Anti aromaticity, Homoaromaticity,	3	Chalk& talk, ppt Problem Solving, Quiz, Test-I
	Aromaticity in benzenoid, non-benzenoid, heterocyclic compounds - Fulvene, Ferrocene, Azulene, Tropones, Annulenes. NMR and aromaticity.	3	
	b. Aromatic electrophilic substitution: Orientation and reactivity of di- and polysubstituted phenol, nitrobenzene and halobenzene. Partial rate factor,	4	
	Reactions involving nitrogen electrophiles: nitration and diazonium coupling; Sulphur electrophiles: sulphonation;	4	
	Halogen electrophiles: chlorination and bromination; Carbon electrophiles: Friedel-Crafts alkylation, acylation and arylation reactions	4	
III	Aromatic and Aliphatic Nucleophilic Substitution: a. Aromatic nucleophilic substitution: Mechanisms - S_NAr , S_N1 and	3	Chalk& talk, ppt Problem Solving, Quiz, Test-II
	Benzyne mechanisms - Evidences - Reactivity, Effect of structure, leaving group and attacking nucleophile. Reactions: Oxygen and Sulphur-nucleophiles,	4	
	Bucherer and Rosenmund reactions, von Richter, Sommelet- Hauser and Smiles rearrangements.	3	
	b. S_N1 , ion pair, S_N2 mechanisms and evidences.	4	

	Neighbouring group participations in unsaturated, phenyl and saturated systems.		
	Aliphatic nucleophilic substitutions at an allylic carbon, S _N 1, S _N 2, S _N i mechanism - Ambident nucleophiles	4	
IV	Stereochemistry a. Optical isomerism due to asymmetric and dissymmetric molecules with C, N, S based chiral centers. prochirality, enantiotopic and diastereotopic atoms, groups, faces, chirality due to helical shape- asymmetric synthesis-Cram's and Prelog's rules: R, S-notations, proR, proS, side phase and re phase Cahn-Ingold-Prelog rules, axial and planar chirality-cyclooctene-Topicity and prostereoisomerism, Stereoselective and stereospecific synthesis.	5	Chalk& talk, ppt Problem Solving, Quiz Test-II
	b. Conformation and reactivity of acyclic systems- Curtin-Hammett Principle. Stability of five and six-membered rings: mono-, di- and polysubstituted cyclohexanes,	4	
	conformation and reactivity in cyclohexane systems. Fused and bridged rings: bicyclic, poly cyclic systems, decalins and Brett's rule.,	5	
	Optical rotation and optical rotatory dispersion, conformational asymmetry	4	
V	Asymmetric Synthesis Terminology and analytical methods-strategy and classification of methods-First generation methods: use of chiral substrates	4	Chalk& talk, ppt Problem Solving, Quiz, Assignment
	Second generation methods: Use of chiral auxiliaries, alkylation of chiral enolates, chiral aza enolates, alkylation of chiral imines and hydrazones, alkylation α to nitrogen Asymmetric diels alder reaction, self-regeneration of stereocentres, chiral sulfoxides	5	
	Third generation methods: use of chiral reagents, Asymmetric reduction using lithium aluminium hydride, asymmetric reduction using boron reagents, asymmetric hydroboration, asymmetric wittig type reactions	4	
	Fourth generation methods: asymmetric catalysis, catalytic asymmetric alkylation, catalytic asymmetric conjugate addition, catalytic asymmetric hydrogenation, asymmetric oxidations, asymmetric aziridination and cyclopropanation, reactions catalysed by enzymes and other proteins	5	

COURSE LEARNING OUTCOMES

At the end of the course, the student will be able to

	CLO Statement	K-level
CLO1	Recall the basic principles of organic chemistry. Apply the principles of kinetic and non-kinetic methods to determine the mechanism of reactions	K2
CLO2	Understand the formation and detection of reaction intermediates of organic reactions.	K3
CLO3	Predict the reaction mechanism of organic reactions and stereochemistry of organic compounds.	K4
CLO4	Propose and construct new organic compounds by applying the stereochemistry principles.	K4
CLO5	Design and synthesize new organic compounds by correlating the mechanism and stereochemistry of organic compounds	K4

Mapping of CLOs and POs

CLO	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	3	3	3	3
CLO2	3	3	3	3	3	3
CLO3	3	3	3	3	3	3
CLO4	3	3	3	3	3	3
CLO5	3	3	3	3	3	3

Mapping of CLOs and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	3	3	3	3	3	3
CLO2	3	3	3	3	3	3
CLO3	3	3	3	3	3	3
CLO4	3	3	3	3	3	3
CLO5	3	3	3	3	3	3

3- Advance Application

2 – Intermediate Level

1 – Basic Level

Blueprint for Summative Examination
Articulation Mapping-K Levels with Course Learning Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO1	Up to K2	2	K1 & K1	1	K1	2 (K1 & K1)	1 (K2)
2	CLO2	Up to K3	2	K2 & K3	1	K1	2 (K2 & K2)	1 (K3)
3	CLO3	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1 (K4)
4	CLO4	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1 (K4)
5	CLO5	Up to K4	2	K2 & K3	1	K3	2 (K3 & K3)	1 (K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A & B (No Choice)	Section C (Either /or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated %
K1	6	10	-	16	13.3	35
K2	6	10	10	26	21.7	
K3	6	10	10	26	21.7	22
K4	2	20	30	52	43.3	43
Total marks	20	50	50	120	100	100

DEPARTMENT OF CHEMISTRY					CLASS: I M. Sc., Chemistry			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
II	Core	25P1CCCT2	Structure and Bonding in Inorganic Compounds	5	6	25	75	100

Nature of course	Skill oriented	√	Employability oriented	√	Entrepreneurship Oriented	

Objectives:

The objective of this course is to make the student

- To determine the structural properties of main group compounds and clusters.
- To gain fundamental knowledge on the structural aspects of ionic crystals.
- To familiarize various diffraction and microscopic techniques.
- To study the effect of point defects and line defects in ionic crystals.
- To evaluate the structural aspects of solids.

Unit	Description	Hours	K-level	CLO
I	Structure of main group compounds and clusters: Valence bond approach to bonding-Hitler-London, Pauling and Slater refinements, concept of hybridization and structure of molecules, VSEPR theory shapes of molecules. M.O. approach to covalent bonding symmetry and overlap of atomic orbitals symmetry of molecular orbitals Structural and bonding features of B-N, S-N and P-N compounds; Polyacids - types, examples and structures; Borane cluster: Structural features of closo, nido, arachano and klado; carboranes, hetero and metalloboranes; Wade's rule to predict the structure of borane cluster.	18	Up to K2	1
II	Solid state chemistry – I: Ionic crystals: Packing of ions in simple, hexagonal and cubic close packing, voids in crystal lattice, Radius ratio, Crystal systems and Bravis lattices, Symmetry operations in crystals, glide planes and screw axis; point group and space group; Solid state energetics: Lattice energy - Born-Lande equation - Kapustinski equation, Madelung constant.	18	Up to K3	2
III	Solid state chemistry – II: Structural features of the crystal systems: Rock salt, zinc blende & wurtzite, fluorite and anti-fluorite, rutile and anatase, cadmium iodide and nickel arsenide; Spinel –normal and inverse types and perovskite structures. Crystal Growth methods: From melt and solution (hydrothermal, sol-gel methods) – principles and	18	Up to K4	3

	examples. Structure of silicates –Classification-isomorphous replacements in silicates – ortho, meta and pyro silicates – one dimensional, two dimensional and three-dimensional silicates- Zeolite and ultramarine.			
IV	Techniques in solid state chemistry: X-ray diffraction technique: Bragg's law, Powder diffraction method - Principle and Instrumentation; Interpretation of XRD data Phase purity, Scherrer formula, lattice constants calculation; Systematic absence of reflections; Electron diffraction technique – principle, instrumentation and application. Blended Learning Electron microscopy – difference between optical and electron microscopy, theory, principle, instrumentation, sampling methods and applications of SEM and TEM	18	Up to K4	4
V	Band theory and defects in solids: Band theory - features and its application of conductors, insulators and semiconductors, Intrinsic and extrinsic semiconductors; Superconductivity and its occurrence – destruction of Superconductivity by magnetic field – Meissner effect –Defects in crystals - point defects (Schottky, Frenkel, metal excess and metal deficient) and their effect on the electrical and optical property, laser Blended Learning Type I and II super conductors - salient features of the BCS theory of super conductivity	18	Up to K4	5

Books for Study:

1. A R West, Solid state Chemistry and its applications, 2nd Edition (Students Edition), John Wiley & Sons Ltd., 2014.
2. A K Bhagi and G R Chatwal, A textbook of inorganic polymers, Himalaya Publishing House, 2001.
3. L Smart, E Moore, Solid State Chemistry – An Introduction, 4th Edition, CRC Press, 2012.

Books for References:

1. D. E. Douglas, D.H. McDaniel and J. J. Alexander, Concepts and Models in Inorganic Chemistry, 3rd Ed, 2006.
2. R J D Tilley, Understanding Solids - The Science of Materials, 2nd edition, Wiley Publication, 2013.
3. C N R Rao and J Gopalakrishnan, New Directions in Solid State Chemistry, 2nd Edition, Cambridge University Press, 2000.
4. T. Moeller, Inorganic Chemistry, A Modern Introduction; John Wiley: New York, 1982.

5. D. F. Shriver, P. W. Atkins and C.H. Langford; Inorganic Chemistry; 3rd ed.; Oxford University Press: London, 2001.
6. K. F. Purcell and J. C. Kotz, Inorganic Chemistry; W.B. Saunders company: Philadelphia, 2008.
7. J. E. Huheey, E. A. Keiter and R. L. Keiter, Inorganic Chemistry; 4th ed.; Harper and Row: New York, 2006.

Web Resources

1. https://ocw.mit.edu/courses/3-091-introduction-to-solid-state-chemistry-fall-2018/video_galleries/lecture-videos/

Blended Learning link:

UNIT IV:

Lecture 31: Light Microscopy

<https://archive.nptel.ac.in/content/storage2/courses/102103047/PDF/mod6.pdf>

Lecture 31: Introduction to scanning electron microscopy

<https://archive.nptel.ac.in/courses/113/106/113106034/>

UNIT V:

Week 2: Type-I and Type-II superconductors, linear response theory, BCS theory, Boundary value problems at high frequencies

<https://archive.nptel.ac.in/courses/115/103/115103108/>

Rationale for Nature of the course

This course will be useful to the students to learn fundamental aspects of structure of inorganic molecules and bonding feature of various types of molecules and basic aspects of solid state.

Activities having direct bearing on Skill development / Employability Entrepreneurship

The basic knowledge gained through this course, students can predict the structural details of various main group elements, type of silicates, and crystal details of various simple mixed spinels. This course introduces the type of defects and electrical conductivity of semiconductor and superconductors. Gives insight knowledge of solids characterization techniques like SEM, TEM and X-ray analysis.

Pedagogy

- Chalk-Talk Class room Activities
- Group discussion & Seminar
- Assignment and Quiz through ICT

Course Designer(s):

Dr. P. Gajendran

Course Schedule

Unit	Descriptions	Hours	Lecture
I	Structure of main group compounds and clusters Valence bond approach to bonding-Hitler-London, Pauling and Slater refinements, concept of hybridization and structure of molecules, –	4	Chalk& talk/ppt Problem Solving/Quiz/ Test
	VSEPR theory shapes of molecules. M.O. approach to covalent bonding symmetry and overlap of atomic orbitals symmetry of molecular orbitals	4	
	Structural and bonding features of B-N, S-N and P-N compounds;	4	
	Polyacids – types, examples and structures;	3	
	Borane cluster: Structural features of closo, nido, arachano and klado; carboranes, hetero and metalloboranes; Wade's rule to predict the structure of borane cluster;	3	
II	Solid state chemistry – I: Ionic crystals: Packing of ions in simple, hexagonal and cubic close packing, voids in crystal lattice,.	4	Chalk& talk/ppt Problem Solving/Quiz/ Test
	Radius ratio, Crystal systems and Bravis lattices	4	
	Symmetry operations in crystals, glide planes and screw axis; point group and space group;	4	
	Solid state energetics: Lattice energy – Born-Lande equation	4	
	Kapustinski equation, Madelung constant	2	
III	Solid state chemistry – II: Structural features of the crystal systems: Rock salt, zinc blende & wurtzite, fluorite and anti-fluorite, Structural features of the crystal systems- wurtzite, fluorite and anti-fluorite	5	Chalk& talk/ppt Problem Solving/Quiz/ Test
	rutile and anatase, cadmium iodide and nickel arsenide; Spinel – normal and inverse types and perovskite structures.	5	
	Crystal Growth methods: From melt and solution (hydrothermal, sol-gel methods) – principles and examples.	4	
	Structure of silicates – applications of Paulings rule of electrovalence - isomorphous replacements in silicates	4	
	- ortho, meta and pyro silicates – one dimensional, two dimensional and three-dimensional silicates- Zeolite and ultramarine.	4	
IV	Techniques in solid state chemistry: X-ray diffraction technique: Bragg's law, Powder diffraction method – Principle and Instrumentation; Interpretation of XRD data	5	Chalk& talk/ppt Problem Solving/Quiz/ Test
	Phase purity, Scherrer formula, lattice constants calculation;	4	

	Systematic absence of reflections; Electron diffraction technique - principle, instrumentation and application	4	
	Electron microscopy – difference between optical and electron microscopy, theory, principle, instrumentation, sampling methods and applications of SEM and TEM	5	
V	Band theory and defects in solids: Band theory – features and its application of conductors, insulators and semiconductors. Intrinsic and extrinsic semiconductors;	3	Chalk& talk/ppt Problem Solving/Quiz/ Assignment
	Defects in crystals – point defects (Schottky, Frenkel, metal excess and metal deficient);	3	
	Superconductivity and its occurrence – destruction of Superconductivity by magnetic field – Meissner effect – Type I and II super conductors - salient features of the BCS theory of super conductivity	4	
	and their effect on the electrical and optical property, laser and phosphors	4	
	Linear defects and its effects due to dislocations	4	

Course Learning Outcomes

After successful completion of this course, the student will be able to

CLOs	CLO Statements	K-level
CLO1	Predict the geometry of main group compounds and clusters.	K2
CLO2	Apply Born - Lande equation and Kapustinski equation	K3
CLO3	Understand the various types of ionic crystal systems and analyze their structural features.	K4
CLO4	Outline structural detail of various crystals and crystal growth methods	K4
CLO5	Examine the crystal defects and conduction mechanism of semiconductor and super conductor.	K4

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CLO-1	3	3	3	2	2	2
CLO-2	3	3	2	3	2	2
CLO-3	3	3	2	3	2	2
CLO-4	3	3	2	3	2	2
CLO-5	3	3	3	3	2	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	2	2	1	1	1	2
CLO2	2	2	1	1	1	3
CLO3	2	2	1	1	1	3
CLO4	2	2	1	1	1	3
CLO5	2	2	1	1	1	3

Advance application – 3;

Intermediate level – 2;

Basic level – 1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2 (K1 & K1)	1 (K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K1	2 (K2 & K2)	1 (K3)
3	CLO 3	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1 (K4)
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1 (K4)
5	CLO 5	Up to K4	2	K2 & K3	1	K3	2 (K3 & K3)	1 (K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented - Solving Problems

K4- Examining, analysing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A & B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated %
K1	6	10	-	16	13.3	35
K2	6	10	10	26	21.7	
K3	6	10	20	36	30	30
K4	2	20	20	42	35	35
Total marks	20	50	50	120	100	100

DEPARTMENT: CHEMISTRY					CLASS: I M.Sc., CHEMISTRY			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
I	CORE	25P1CCCP1	Organic Practicals	4	6	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	✓

Objectives:

The objective of this course is to make the student to

- Understand the concept of separation, qualitative analysis and preparation of organic compounds.
- Develop analytical skill in the handling of chemical reagents for separation of binary and ternary organic mixtures.
- Analyze the separated organic components systematically and derivative them suitably.
- Construct suitable experimental setup for the organic preparations involving two stages.
- Experiment different purification and drying techniques for the compound processing.

Course Outline

Separation and analysis:

- Two component mixtures.

Estimations:

- Estimation of Ethyl methyl ketone (iodimetry)
- Estimation of Glucose (redox)
- Estimation of Ascorbic acid (iodimetry)
- Estimation of Aromatic nitro groups (reduction)
- Estimation of Glycine (acidimetry)
- Estimation of Formalin (iodimetry)
- Saponification of oil
- Estimation of Acetyl group in ester (alkalimetry)
- Estimation of Hydroxyl group (acetylation)
- Estimation of Amino group (acetylation))

Two stage preparations:

- Benzanilide from benophenone
- p-Nitroaniline from acetanilide
- 2-naphthol aniline dye from aniline
- Acetyl salicyclic acid from methyl salicylate
- Benzilic acid from benzoin
- Anthranilic acid from Pthalimide
- m-Nitrobenzoic acid from methyl benzoate

Extraction of Natural Products:

- Isolation of lactose from milk
- Isolation of citric acid from citral
- Isolation of lycopene from tomato

Books for study:

1. N. S. Gnanaprakasam and G. Ramamurthy, Organic Chemistry Lab Manual; S. V. Printers, 1987.
2. A. I. Vogel, A. R. Tatchell, B. S. Furnis, A. J. Hannaford and P. W. G. , Prentice Hall, 1989

Books for References:

1. J. Mohan, Organic Analytical Chemistry, Theory and Practice; Narosa, 2003.
2. V. K. Ahluwalia, P. Bhagat and R. Agarwal, Laboratory Techniques in Organic Chemistry; I. K. International, 2005.
3. Dey and Sitaraman. “Laboratory manual of Organic chemistry”; Allied Publishers, 1992.

Web Resources:

1. <https://www.youtube.com/watch?v=o3h6TpFA1CE>
2. <https://www.youtube.com/watch?v=Y4NMpO1xI8U>
3. <https://www.youtube.com/watch?v=mtPBIHu0EZM>
4. <https://nptel.ac.in/courses/104106131>

COURSE OUTCOMES:

At the end of the course, the student will be able to

CLOs	CLO Statement	K-level	Marks
CLO1	Recall the basic principles of organic separation, qualitative analysis and preparation.	K2	15
CLO2	Explain the method of separation and analysis of separated organic mixtures and convert them as derivatives by suitable preparation method.	K3	15
CLO3	Determine the characteristics of separation of organic compounds by various chemical reactions.	K4	15
CLO4	Develop strategies to separate, analyze and prepare organic compounds.	K4	15
CLO5	Formulate a method of separation, analysis of organic mixtures and design suitable procedure for organic preparations	K4	15

MAPPING WITH PROGRAMME OUTCOMES:

CLO	POs						PSOs					
	1	2	3	4	5	6	1	2	3	4	5	6
CLO1	2	3	1	1	1	2	1	1	2	3	1	1
CLO2	2	3	1	1	1	2	1	1	2	3	1	1
CLO3	2	3	1	1	1	2	1	1	2	3	1	1
CLO4	2	3	1	1	1	2	1	1	2	3	1	1
CLO5	2	3	1	1	1	2	1	1	2	3	1	1

Advance application – 3;

Intermediate level – 2;

Basic level – 1

Assessment Scheme

Components of CIA

Component	Weight/Mark
Internal Test	15
Observation/Record	5
Continuous class assessment	5
Total Marks	25

Name of the course Designer

Dr. M. Karpagavalli

DEPARTMENT: CHEMISTRY					CLASS: I M.Sc., CHEMISTRY			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
I	Elective (Discipline Centric)	25P1CECT1	Nano Materials And Nano Technology	3	5	25	75	100
Nature of course		Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented		✓

Objectives:

The objective of this course is to make the student to

- Explain the fundamental and basic concept of nanomaterials
- Understand the bonding and structure of nanomaterials
- Illustrate the various types of nanomaterials and their properties.
- Correlate the characteristics of various nanomaterials synthesized by new technologies.
- Exemplify the applications of synthetically important nanomaterials.

Unit	Description	Hours	K-level	CLO
I	Fundamental and basic concept of Nanomaterials Background to nanoscience – Historical perspectives and Scientific revolutions – Definitions and Classifications based on dimension : Zero, One, Two And Three - Clusters, Quantum dots, Nanowires, Rods and tubes, and thin films; Hard sphere model: Grain and Grain boundary concepts; Synthesis-Bottom–Up and Top–Down approach.	15	Upto K2	1
II	Bonding and structure of the Nanomaterials Predicting the Type of Bonding in a Substance crystal structure. Metallic nanoparticles, Surfaces of Materials, Nanoparticle Size and Properties. Synthesis- Physical and chemical methods, arc discharge, laser ablation, sol-gel, solvothermal -CVD-types, plasma enhanced, and low-pressure CVD. Microwave assisted synthesis.	15	Upto K3	2
III	Mechanical properties Mechanical properties of materials, theories relevant to mechanical properties. Techniques to study mechanical properties of nanomaterials, adhesion and friction, thermal properties of nanomaterials Nanoparticles: gold and silver, metal oxides: silica, iron oxide and alumina - synthesis and properties.	15	Upto K4	3

IV	Electrical properties Electrical properties, Conductivity and Resistivity, Classification of Materials based on Conductivity, magnetic properties, electronic properties of materials. Semiconductor materials – classification - Ge, Si, GaAs, SiC, GaN, GaP, CdS, PbS. Identification of materials as p and n–type semiconductor-Hall effect - Applications of semiconductors: p-n junction as transistors and rectifiers, photovoltaic and photogalvanic cell.	15	Upto K4	4
V	Characterization and Industrial Applications of Nanomaterials Nanocomposites characterization using SEM, TEM, AFM and X-ray. Nano-Materials in Bone Substitutes and Dentistry, Food and Cosmetic Applications. Textiles, Paints, Catalysis, Drug Delivery and Its Applications, Biochips - Analytical Devices, Biosensors.	15	Upto K4	5

Books for Study:

1. S. Mohan and V. Arjunan, Principles of Materials Science, MJP Publishers, 2016.
2. M. Arumugam, Materials Science, Anuradha Publications, 2007.
3. Giacavazzo et. al., Fundamentals of Crystallography, International Union of Crystallography. Oxford Science Publications, 2010.

Books for References:

1. M. M. Woolfson, An Introduction to Crystallography, Cambridge University Press, 2012.
2. James F. Shackelford and Madanapalli K. Muralidhara, Introduction to Materials Science for Engineers. 6th ed., PEARSON Press, 2007.
3. T. Varghese and K. M. Balakrishna, An introduction to synthesis, properties and application of nanomaterials, Atlantic Publisher, 2024.
4. K. K. Chattopadhyay and A. N. Banerjee, Introduction to nanoscience and nanotechnology, Prentice Hall India publisher, 2009.
5. A. K. Das An Introduction to Nanomaterials and Nanoscience, CBS Publisher, 2024.

Web Resources:

1. https://www.agc.ac.in/resources/Introduction_to_Nanomaterials_and_Nanotechnology.pdf
2. https://ion2.upm.edu.my/article/introduction_to_nanomaterials-68574
3. <https://news.umich.edu/nanotechnology-theory-predicts-new-type-of-bond-that-assembles-nanoparticle-crystals/>
4. <https://www.degruyter.com/document/doi/10.1515/ntrev-2020-0021/html?lang=en>
5. <https://www.hindawi.com/journals/jnm/2015/892542/>
6. <https://nptel.ac.in/courses/113106093> (carbon nanotubes)-**blended mode-unit-I**

Rationale for Nature of the course

This course will enable to the students to enrich their knowledge on concept of nanomaterials and nanotechnology, various types of nanomaterials and their properties, its characterization and applications of nanomaterials.

Activities having direct bearing on Skill development / Employability Entrepreneurship

The General chemistry course can incorporate various activities that directly contribute to skill development and enhance employability among students. Here are some activities that can have a direct bearing on these aspects like i) conduct quiz competition on fundamental and basic concept of nanomaterials ii) group discussion on bonding and structure of the nanomaterials iii) Assignment on properties of nanomaterials and its applications. Hence the students will have chance to get skill oriented jobs in various industries.

Pedagogy

- Chalk-Talk class room Activities
- Group Discussion
- Seminar
- Quiz through ICT- Mode

Name of the course Designer

Dr. P. Prasanna

Unit	Topics	Hours	Lecture
I	Fundamental and basic concept of Nanomaterials		
	Background to nanoscience – Historical perspectives and Scientific revolutions	3	Chalk and talk/PPT/ Animated Videos/quiz/ seminar/test
	Definitions and Classifications based on dimension: Zero, One, Two and Three - Clusters	3	
	Quantum dots, Nanowires, Rods and tubes, and thin films;	3	
	Hard sphere model: Grain and Grain boundary concepts	3	
	Synthesis-Bottom–Up and Top–Down approach.	3	
II	Bonding and structure of the Nanomaterials		
	Predicting the Type of Bonding in a Substance crystal structure. Metallic nanoparticles	3	Chalk and talk/PPT/ Animated Videos/quiz/ seminar/test
	Surfaces of Materials, Nanoparticle Size and Properties.	3	
	Synthesis- Physical and chemical methods, arc discharge, laser ablation,	3	
	sol-gel, solvothermal -CVD-types, plasma enhanced, and low-pressure CVD.	3	
	Microwave assisted synthesis.	3	
III	Mechanical properties		
	Mechanical properties of materials, theories relevant to mechanical properties.	3	Chalk and talk/PPT/ Animated Videos/ seminar/ quiz/test
	Techniques to study mechanical properties of nanomaterials, adhesion and friction	3	
	thermal properties of nanomaterials Nanoparticles	3	
	gold and silver, metal oxides: silica	3	
	iron oxide and alumina - synthesis and properties.	3	
IV	Electrical properties		
	Electrical properties, Conductivity and Resistivity	3	Chalk and talk/ Animated Videos/ seminar/ quiz/test
	Classification of Materials based on Conductivity, magnetic properties	3	
	electronic properties of materials. Semiconductor materials	3	
	Classification-Ge, Si, GaAs, SiC, GaN, GaP, CdS, PbS. Identification of materials as p and n–type semiconductor-Hall effect	3	
	Applications of semiconductors: p-n junction as transistors and rectifiers, photovoltaic and photogalvanic cell.	3	

V	Characterization and Industrial Applications of Nanomaterials		
	Nanocomposites characterization using SEM, TEM, AFM and X-ray.	3	Chalk and talk/ Assignment quiz/seminar
	Nano-Materials Materials In Bone Substitutes and Dentistry	3	
	Food and Cosmetic Applications.	3	
	Textiles, Paints, Catalysis, Drug Delivery and Its Applications	3	
	Biochips -Analytical Devices, Biosensors.	3	

COURSE OUTCOMES:

At the end of the course, the student will be able to

CLO	CLO Statement	K-level
CLO1	Discuss the fundamental, basic concept of nanomaterial.	K2
CLO2	Find the bonding, structure of the nanomaterials and organize its physical and chemical synthetic methods.	K3
CLO3	Illustrate the mechanical and thermal properties of nanomaterials	K4
CLO4	Classify the materials based on Conductivity, magnetic properties, electronic properties of materials and applications of semiconductors.	K4
CLO5	Analyse nanocomposites and application of nanomaterial in different fields.	K4

Mapping of CLOs and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	2	2	1	1	2	2
CLO2	2	2	1	1	2	3
CLO3	2	2	1	1	2	3
CLO4	2	2	1	1	2	3
CLO5	2	2	1	1	2	3

Mapping of CLOs and PSOs

CLOs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	3	3	3	2	2	3
CLO2	3	3	2	3	2	3
CLO3	3	3	2	3	2	3
CLO4	3	3	2	3	2	3
CLO5	3	3	3	3	2	3

3 - Advance Application

2 – Intermediate Level

1 – Basic Level

Blueprint for Semester Examination
Articulation Mapping-K Levels with Course Outcomes (COs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO1	Up to K2	2	K1 & K1	1	K1	2 (K1 & K1)	1 (K2)
2	CLO2	Up to K3	2	K2 & K3	1	K1	2 (K2 & K2)	1 (K3)
3	CLO3	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1 (K4)
4	CLO4	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1 (K4)
5	CLO5	Up to K4	2	K2 & K3	1	K3	2 (K3 & K3)	1 (K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A & B (No Choice)	Section C (Either /or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated %
K1	6	10	-	16	13.3	35
K2	6	10	10	26	21.7	
K3	6	10	20	36	30	30
K4	2	20	20	42	35	35
Total marks	20	50	50	120	100	100

DEPARTMENT: CHEMISTRY					CLASS: I M.Sc.,CHEMISTRY			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
I	CORE	25P1CECT1	Pharmaceutical chemistry	3	5	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	✓

Objectives:

The objective of this course is to make the student to

- Understand the advanced concepts of pharmaceutical chemistry.
- Recall the principle and biological functions of various drugs.
- Train the students to know the importance as well the Consequences of various drugs.
- Have knowledge on the various analysis and techniques.
- Familiarize on the drug dosage and its structural activities

Unit	Description	Hours	K-level	CLO
I	Physical properties in Pharmaceuticals: Physical properties of drug molecule: physical properties. Refractive index- Definition, explanation, formula, importance, determination, specific & molar refraction. Optical activity\rotation- monochromatic & polychromatic light, optical activity, angle of rotation, specific rotation examples, measurement of optical activity. Dielectric constant & Induced Polarization- Dielectric constant explanation & determination. Rheology of pharmaceutical systems: Introduction, Definition, Applications, concept of viscosity, Newton's law of flow, Kinematic, Relative, Specific, Reduced & Intrinsic viscosity. Newtonian system, non-Newtonian system- Plastic flow, Pseudoplastic flow, Dilatent flow. Viscosity measurements-selection of viscometer for Newtonian and non-Newtonian system.	15	Up to K2	1
II	Isotopic Dilution analysis: Principle and applications, Neutron activation analysis: Principle, advantages and limitations, Scintillation counters: Body scanning. Introduction to radiopharmaceuticals. Properties of various types of radiopharmaceuticals, Radiopharmaceuticals as diagnostics, as therapeutics, for research and sterilization. Physico Chemical Properties and drug action. Physico chemical properties of drugs (a) Partition coefficient, (b) solubility (c) surface activity, (d) degree of ionization.	15	Up to K3	2

III	Drug dosage and product development: Introduction to drug dosage Forms & Drug Delivery system Definition of Common terms. Drug Regulation and control, pharmacopoeias formularies, sources of drug, drug nomenclature, routes of administration of drugs products, need for a dosage form, classification of dosage forms. Drug dosage and product development. Introduction to drug dosage Forms & Drug Delivery system. Definition of Common terms. Drug Regulation and control, pharmacopoeias formularies, sources of drug, drug nomenclature, routes of administration of drugs products, need for a dosage form, classification of dosage forms.	15	Up to K4	3
IV	Development of new drugs: Introduction, procedure followed in drug design, the research for lead compounds, molecular modification of lead compounds. Structure-Activity Relationship (SAR): Factors effecting bioactivity, resonance, inductive effect, isoterism, bioisosterism, spatial considerations, biological properties of simple functional groups, theories of drug activity, occupancy theory, rate theory, induced-fit theory, Quantitative structure activity relationship (QSAR): Development of QSAR, drug receptor interactions, the additivity of group contributions, physico-chemical parameters, lipophilicity parameters, electronic parameter, ionization constants, steric parameters, chelation parameters, redox potential, indicator-variables.	15	Up to K4	4
V	Computers in Pharmaceutical Chemistry: Molecular Modeling and Structure - molecular modeling today: overview of problems, tools, and solution analysis, minitutorials with protein and nucleic acid structure as example. Techniques for Conformational Sampling- Monte Carlo, global optimization Introduction to Density Functional Theory (DFT) methods: Hohenberg-Kohn theorems, Kohn-Sham orbitals, exchange correlation functional, local density approximation, generalized gradient approximation, hybrid functional (only the basic principles and terms need to be introduced).	15	Up to K4	5

Books for Study:

1. Text Book of Physical Pharmaceutics, IInd edition, Vallabh Prakashan-. C.V.S. Subramanyam.
2. Medicinal Chemistry (Organic Pharmaceutical Chemistry), G.R Chatwal, Himalaya Publishing house. Oxford University Press, 2014.
3. Pharmaceutical Chemistry by Dr. S. Lakshmi, Sultan chand & Sons.

Books for References:

1. Computers in chemistry, K.V. Raman, Tata Mc. Graw-Hill, 1993.
2. Computers for Chemists, S.K Pundir, Anshu bansal, A pragate prakashan., 2 nd edition, New age international (P) limited, New Delhi.

3. Physical Pharmacy and Pharmaceutical Sciences by Martins, Patrick J. Sinko, Lippincott. William and Wilkins

Web Resources:

1. <https://sites.google.com/site/chemistryebookscollection02/home/organicchemistry/organic>
2. <https://www.organic-chemistry.org/>
3. <https://www.youtube.com/watch?v=gcWw53hsDtw>

Blended Learning Resources:

For unit 4 - Quantitative structure activity relationship (QSAR): Development of QSAR, drug receptor interactions

https://onlinecourses.nptel.ac.in/noc21_bt29/preview

Week 6: QSAR/Pharmacophore

For unit -5 molecular modeling today: overview of problems, tools, and solution analysis, minitutorials with protein and nucleic acid structure as example

https://onlinecourses.nptel.ac.in/noc21_bt29/preview

Week 7: Enzymes/proteins structures/docking

Rationale for Nature of the course

This course will enhance the students to understand the physico chemical properties, mechanism of action of drugs and are able to design new drugs.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Laboratory training is an essential component of skill development for students and are crucial for understanding the synthesis of new drugs for Pharmaceutical industries. Projects will give students with an opportunity to visit industries and develop strategies for new drugs.

Pedagogy

- Chalk-Talk class room Activities
- Group Discussion
- Seminar
- Quiz through ICT- Mode

Name of the course Designer

Dr. M. Karpagavalli

Lecture Schedule

Unit	Descriptions	Hours	Lecture
I	Physical properties in Pharmaceuticals: Physical properties of drug molecule: physical properties. Refractive index- Definition, explanation, formula, importance, determination, specific & molar refraction. Optical activity\rotation- monochromatic & polychromatic light, optical activity, angle of rotation, specific rotation examples, measurement of optical activity.	3	Chalk& talk, ppt Problem Solving, Quiz, Test-I
	Dielectric constant & Induced Polarization- Dielectric constant explanation & determination.	2	
	Rheology of pharmaceutical systems: Introduction, Definition, Applications, concept of viscosity, Newton's law of flow, Kinematic, Relative, Specific, Reduced & Intrinsic viscosity.	5	
	Newtonian system, non-Newtonian system- Plastic flow, Pseudoplastic flow, Dilatent flow. Viscosity measurements- selection of viscometer for Newtonian and non-Newtonian system.	5	
II	Isotopic Dilution analysis: Principle and applications, Neutron activation analysis: Principle, advantages and limitations, Scintillation counters: Body scanning.	5	Chalk& talk, ppt Problem Solving, Quiz, Test-I
	Introduction to radiopharmaceuticals. Properties of various types of radiopharmaceuticals, Radiopharmaceuticals as diagnostics, as therapeutics, for research and sterilization.	5	
	Physico Chemical Properties and drug action. Physico chemical properties of drugs (a) Partition coefficient, (b) solubility (c) surface activity, (d) degree of ionization.	5	
III	Drug dosage and product development: Introduction to drug dosage Forms & Drug Delivery system Definition of Common terms	3	Chalk& talk, ppt Problem Solving, Quiz, Test-II
	Drug Regulation and control, pharmacopoeias formularies, sources of drug, drug nomenclature, routes of administration of drugs products, need for a dosage form	4	
	Classification of dosage forms. Drug dosage and product development.	3	
	Introduction to drug dosage Forms & Drug Delivery system. Definition of Common terms. Drug Regulation and control,	2	

	pharmacopoeias formularies, sources of drug, drug nomenclature, routes of administration of drugs products, need for a dosage form, classification of dosage forms.	3	
IV	Development of new drugs: Introduction, procedure followed in drug design, the research for lead compounds, molecular modification of lead compounds. Structure-Activity Relationship (SAR): Factors effecting bioactivity, resonance, inductive effect, isoterism, bioisosterism, spatial considerations, biological properties of simple functional groups,	5	Chalk& talk, ppt Problem Solving, Quiz Test-II
	theories of drug activity, occupancy theory, rate theory, induced-fit theory	2	
	Quantitative structure activity relationship (QSAR): Development of QSAR, drug receptor interactions, the additivity of group contributions,	3	
	physico-chemical parameters, lipophilicity parameters, electronic parameter, ionization constants, steric parameters, chelation parameters, redox potential, indicator-variables.	5	
V	Computers in Pharmaceutical Chemistry: Molecular Modeling and Structure - molecular modeling today: overview of problems, tools, and solution analysis, minitutorials with protein and nucleic acid structure as example.	1	Chalk& talk, ppt Problem Solving, Quiz, Assignment
	Techniques for Conformational Sampling- Monte Carlo, global optimization	5	
	Introduction to Density Functional Theory (DFT) methods: Hohenberg-Kohn theorems, Kohn-Sham orbitals, exchange correlation functional	5	
	local density approximation, generalized gradient approximation, hybrid functional (only the basic principles and terms need to be introduced).	4	

COURSE LEARNING OUTCOMES

At the end of the course, the student will be able to

CLOs	CLO Statement	K-level
CLO1	Recall the physical principles of organic chemistry.	K2
CLO2	Understand the physcio and chemical properties of drugs	K3
CLO3	Predict the drug dosage and apparise the drug regulations	K4
CLO4	Propose and construct new drugs	K4
CLO5	Design and synthesize new drugs by computational chemistry	K4

Mapping of CLOs and POs

CLOS	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	3	3	3	3
CLO2	3	3	3	3	3	3
CLO3	3	3	3	3	3	3
CLO4	3	3	3	3	3	3
CLO5	3	3	3	3	3	3

Mapping of CLOs and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	3	3	3	3	3	3
CLO2	3	3	3	3	3	3
CLO3	3	3	3	3	3	3
CLO4	3	3	3	3	3	3
CLO5	3	3	3	3	3	3

3 - Advance Application

2 – Intermediate Level

1 – Basic Level

Blueprint for Summative Examination
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2 (K1 & K1)	1 (K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K1	2 (K2 & K2)	1 (K3)
3	CLO 3	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1 (K4)
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1 (K4)
5	CLO 5	Up to K4	2	K2 & K3	1	K3	2 (K3 & K3)	1 (K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A & B (No Choice)	Section C (Either /or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated %
K1	6	10	-	16	13.3	35
K2	6	10	10	26	21.7	
K3	6	10	10	26	21.7	22
K4	2	20	30	52	43.3	43
Total marks	20	50	50	120	100	100

DEPARTMENT: CHEMISTRY					CLASS: I M.Sc., CHEMISTRY			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
I	Core Elective	25P1CECT2	Molecular Spectroscopy	3	5	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

Objectives:

The objective of this course is to make the student to

- understand the influence of rotation and vibrations on the spectra of the diatomic and polyatomic molecules.
- study the principle of Raman spectroscopy, fragmentation patterns in Mass spectroscopy.
- highlight the significance of Franck-Condon principle to interpret the selection rule, intensity and types of electronic transition.
- Enlighten and the principle, applications of XPS and LASER.
- interpret the first order NMR spectra in terms of splitting and coupling patterns
- deduce the principle of Mass, and ESR Spectroscopy, and carry out the structural elucidation of molecules using different spectral techniques.

Unit	Description	Hours	K-level	CLO
I	Rotational and Raman Spectroscopy Rotational spectra of diatomic and polyatomic molecules. Intensities of rotational spectral lines, effect of isotopic substitution. Non-rigid rotators. Classical theory of the Raman effect, polarizability as a tensor, quantum theory of the Raman effect, Pure rotational Raman spectra of linear and asymmetric top molecules, Stokes and anti-Stokes lines. Vibrational Raman spectra, Raman activity of vibrations, rule of mutual exclusion, rotational fine structure-O and S branches, Polarization of Raman scattered photons.	15	Upto K2	1
II	Vibrational Spectroscopy Vibrations of molecules, harmonic and anharmonic oscillators-vibrational energy expression, energy level diagram, vibrational wave functions and their symmetry, selection rules, expression for the energies of spectral lines, hot bands, effect of isotopic substitution. Diatomic vibrating rotor, vibrational-rotational spectra of diatomic molecules, P, R branches, breakdown of the Born-Oppenheimer approximation. Vibrations of polyatomic molecules – symmetry properties, overtone and combination frequencies. Influence of rotation on vibrational spectra of polyatomic molecule, P, Q, R branches. Blended Learning Vibrations of molecules, harmonic and anharmonic oscillators-vibrational energy expression	15	Upto K3	2

III	Electronic spectroscopy Electronic Spectroscopy: Electronic spectroscopy of diatomic molecules, Frank-Condon principle, dissociation and predissociation –Fortrat diagram- $\pi \rightarrow \pi^*$, $n \rightarrow \pi^*$ transitions and their selection rules. Photoelectron Spectroscopy: Basic principles, photoelectron spectra of simple molecules, X-ray photoelectron spectroscopy (XPS). Lasers: Laser action, population inversion, properties of laser radiation, examples of simple laser systems. Blended Learning Electronic Spectroscopy: Electronic spectroscopy of diatomic molecules, Frank-Condon principle-Fortrat diagram	15	Upto K4	30
IV	NMR spectroscopy Proton NMR-Chemical shift, Factors influencing chemical shifts: electronegativity and electrostatic effects; Mechanism of shielding and deshielding. Spin-spin interactions: Homonuclear coupling interactions - AX, AX ₂ , AB types. Vicinal, germinal and long-range coupling-spin decoupling. Factors influencing coupling constants and Relative intensities. ¹³ C -NMR –Introduction-Multiplicity-Broad band Decoupling-off resonance decoupling-line intensities-Chemical shift equivalence and values-factors affecting chemical shift values -Problems related to structural elucidation using NMR.	15	Upto K4	4
V	ESR Spectroscopy and Mass Spectrometry ESR spectroscopy: Characteristic features of ESR spectra, line shapes and line widths; The g value and the hyperfine coupling parameter (A), origin of hyperfine interaction. Interpretation of ESR spectra and structure elucidation of organic radicals using ESR spectroscopy. Mass Spectrometry; Ionization techniques- Electron ionization (EI), chemical ionization (CI), electrospray ionization (ESI), isotope abundance, Effect of isotopes on the appearance of mass spectrum - molecular ion, fragmentation processes of organic molecules, deduction of structure through mass spectral fragmentation, high resolution Mass Spectrometry.	15	Upto K4	5

Books for Study:

1. C. N. Banwell and E. M. McCash, *Fundamentals of Molecular Spectroscopy*, 4th Ed., Tata McGraw Hill, New Delhi, 2000.
2. R. M. Silverstein and F. X. Webster, *Spectroscopic Identification of Organic Compounds*, 6th Ed., John Wiley & Sons, New York, 2003.
3. W. Kemp, *Applications of Spectroscopy*, English Language Book Society, 1987.
4. D. H. Williams and I. Fleming, *Spectroscopic Methods in Organic Chemistry*, 4th Ed., Tata McGraw-Hill Publishing Company, New Delhi, 1988.

Books for References:

1. P.W. Atkins and J. de Paula, *Physical Chemistry*, 7th Ed., Oxford University Press, Oxford, 2002.
2. I. N. Levine, *Molecular Spectroscopy*, John Wiley & Sons, New York, 1974.
3. A. Rahman, *Nuclear Magnetic Resonance-Basic Principles*, Springer-Verlag, New York, 1986.

4. K. Nakamoto, *Infrared and Raman Spectra of Inorganic and coordination Compounds*, Part B: 5th ed., John Wiley & Sons Inc., New York, 1997.
5. J. A. Weil, J. R. Bolton and J. E. Wertz, *Electron Paramagnetic Resonance*; Wiley Interscience, 1994.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc20_cy08/preview
2. <https://www.digimat.in/nptel/courses/video/104106122/L14.html>
3. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/chemistry/08.physical_spectroscopy/11.photoelectron_spectroscopy_of_atoms/et/5579_et_et.pdf

Blended Learning link:

1. https://onlinecourses.nptel.ac.in/noc25_cy24/preview

UNIT II: Vibrational Spectroscopy

Vibrations of molecules, harmonic and anharmonic oscillators- vibrational energy expression.

Week 2; Molecular Spectroscopy: A Physical Chemist's perspective course

2. https://onlinecourses.nptel.ac.in/noc25_cy24/preview

UNIT III: Electronic spectroscopy

Electronic spectroscopy of diatomic molecules, Frank-Condon principle, Fortrat diagram

Week 9; Molecular Spectroscopy: A Physical Chemist's perspective course**Rationale for Nature of the course**

This course content provides comprehensive foundation on spectroscopy, by mastering these concepts, students will gain expertise in spectral techniques, and interpretation of structure of compounds

Activities having direct bearing on Skill development / Employability Entrepreneurship

Students acquire problems solving skill related to spectral analysis of simple molecules, Furthermore; it will provide valuable insights into structural and potential career opportunities.

Pedagogy

- Chalk-Talk class room Activities
- Group Discussion
- Seminar
- Quiz through ICT- Mode

Name of the course Designer

Dr. M. Malarvizhi

Course Schedule

Unit	Descriptions	Hours	Lecture
I	Rotational and Raman Spectroscopy Rotational spectra of diatomic and polyatomic molecules. Intensities of rotational spectral lines, effect of isotopic substitution.	5	Chalk& talk/ppt Problem Solving/Quiz/ Test
	Non-rigid rotators. Classical theory of the Raman effect, polarizability as a tensor, quantum theory of the Raman effect, Pure rotational Raman spectra of linear and asymmetric top molecules, Stokes and anti-Stokes lines.	5	
	Vibrational Raman spectra, Raman activity of vibrations, rule of mutual exclusion, rotational fine structure-O and S branches, Polarization of Raman scattered photons.	5	
II	Vibrational Spectroscopy Vibrations of molecules, harmonic and anharmonic oscillators-vibrational energy expression, energy level diagram, vibrational wave functions and their symmetry, selection rules, expression for the energies of spectral lines, hot bands, effect of isotopic substitution.	5	Chalk& talk/ppt Problem Solving/Quiz/ Test
	Diatomic vibrating rotor, vibrational-rotational spectra of diatomic molecules, P, R branches, breakdown of the Born-Oppenheimer approximation.	5	
	Vibrations of polyatomic molecules – symmetry properties, overtone and combination frequencies. Influence of rotation on vibrational spectra of polyatomic molecule, P, Q, R branches	5	
III	Electronic spectroscopy Electronic Spectroscopy: Electronic spectroscopy of diatomic molecules, Frank-Condon principle,.	5	Chalk& talk/ppt Problem Solving/Quiz/ Test
	dissociation --Fortrat diagram and predissociation spectra. $\pi \rightarrow \pi^*$, $n \rightarrow \pi^*$ transitions and their selection rules. Photoelectron Spectroscopy: Basic principles, photoelectron spectra of simple molecules,	5	
	X-ray photoelectron spectroscopy (XPS). Lasers: Laser action, population inversion, properties of laser radiation, examples of simple laser systems.	5	
IV	NMR spectroscopy Proton NMR-Chemical shift, Factors influencing chemical shifts: electronegativity and electrostatic effects; Mechanism of shielding	5	Chalk& talk/ppt Problem

	and deshielding. Spin-spin interactions.		Solving/Quiz/ Test
	Homonuclear coupling interactions - AX, AX ₂ , AB types. Vicinal, germinal and long-range coupling-spin decoupling. Factors influencing coupling constants and Relative intensities.	5	
	¹³ C NMR –Introduction-Multiplicity- Broad band Decoupling-off resonance decoupling-line intensities-Chemical shift equivalence and values-factors affecting chemical shift values -Problems related to structural elucidation using NMR.	5	
V	ESR Spectroscopy and Mass Spectrometry ESR spectroscopy: Characteristic features of ESR spectra, line shapes and line widths; The g value and the hyperfine coupling parameter (A), origin of hyperfine interaction. Interpretation of ESR spectra and structure elucidation of organic radicals using ESR spectroscopy.	5	Chalk& talk/ppt Problem Solving/Quiz/ Assignment
	Mass Spectrometry; Ionization techniques- Electron ionization (EI), chemical ionization (CI), electrospray ionization (ESI),	5	
	isotope abundance, Effect of isotopes on the appearance of mass spectrum - molecular ion, fragmentation processes of organic molecules, deduction of structure through mass spectral fragmentation, high resolution Mass Spectrometry.	5	

COURSE LEARNING OUTCOMES:

At the end of the course, the student will be able to

CLOs	CLO Statement	K-level
CLO1	Understand the importance of rotational and Raman spectroscopy.	Upto K2
CLO2	Apply the vibrational spectroscopic techniques to diatomic and polyatomic molecules	Upto K3
CLO3	Evaluate different electronic spectra of simple molecules using electronic spectroscopy and understand the principle of XPS and LASER.	Upto K4
CLO4	Analyze the NMR, ¹³ C NMR, of molecules.	Upto K4
CLO5	Inspect structure of simple molecules using Mass Spectrometry, and ESR spectroscopic techniques	Upto K4

Mapping of CLOs and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	2	3	2	3	2	3
CLO2	3	3	2	3	3	2
CLO3	1	3	2	2	2	3
CLO4	3	3	2	2	3	1
CLO5	3	3	2	3	3	3

Mapping of CLOs and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	3	3	3	3	3	3
CLO2	3	3	3	3	3	3
CLO3	3	3	3	3	3	3
CLO4	3	3	3	3	3	3
CLO5	3	3	3	3	3	3

3 - Advance Application

2 – Intermediate Level

1 – Basic Level

Blueprint for Summative Examination
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO1	Up to K2	2	K1 & K1	1	K1	2 (K1 & K1)	1 (K2)
2	CLO2	Up to K3	2	K2 & K3	1	K1	2 (K2 & K2)	1 (K3)
3	CLO3	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1 (K4)
4	CLO4	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1 (K4)
5	CLO5	Up to K4	2	K2 & K3	1	K3	2 (K3 & K3)	1 (K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A& B (No Choice)	Section C (Either /or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated %
K1	6	10	-	16	13.3	35
K2	6	10	10	26	21.7	
K3	6	10	10	26	21.7	22
K4	2	20	30	52	43.3	43
Total marks	20	50	50	120	100	100

DEPARTMENT: CHEMISTRY					CLASS: I M.Sc., CHEMISTRY			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
I	CORE	25P1CECT2	Electrochemistry	3	5	25	75	100

Nature of course	Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objectives:

The objective of this course is to make the student to

- Understand the behaviour of electrolytes in terms of conductance, ionic atmosphere, interactions.
- To familiarize the structure of the electrical double layer of different models.
- To compare electrodes between current density and over potential.
- To discuss the mechanism of electrochemical reactions.
- To highlight the different types of over voltages and its applications in electroanalytical techniques

Unit	Description	Hours	K-level	CLO
I	Ionics: Arrhenius theory -limitations, van't Hoff factor and its relation to colligative properties. Deviation from ideal behavior. Ionic activity, mean ionic activity and mean ionic activity coefficient-concept of ionic strength, Debye Huckel theory of strong electrolytes, activity coefficient of strong electrolytes Determination of activity coefficient ion solvent and ion-ion interactions. Debye-Huckel Bjerrum model. Derivation of Debye-Huckel limiting law at appreciable concentration of electrolytes modifications and applications. Electrolytic conduction-Debye-Huckel Onsager treatment of strong electrolyte-qualitative and quantitative verification and limitations. Evidence for ionic atmosphere. Blended Learning Derivation of Debye-Huckel limiting law at appreciable concentration of electrolytes modifications and applications.	15	Upto K2	1
II	Electrode-electrolyte interface: Interfacial phenomena -Evidences for electrical double layer, polarizable and non-polarizable interfaces, Electrocapillary phenomena - Lippmann equation electro capillary curves. Electro-kinetic phenomena electro-osmosis, electrophoresis, streaming and sedimentation potentials, colloidal and poly electrolytes. Structure of double layer: Helmholtz -Perrin, Guoy- Chapman and Stern models of electrical double layer. Zeta potential and potential at zero charge. Applications and limitations	15	Upto K3	2

III	Electrodics of Elementary Electrode Reactions: Anodic and Cathodic currents, condition for the discharge of ions. Nernst equation, polarizable and non-polarizable electrodes. Model of three electrode system, over potential. Rate of electro chemical reactions: Rates of simple elementary reactions. Butler-Volmer equation-significance of exchange current density, net current density and symmetry factor. Low and high field approximations. symmetry factor and transfer coefficient Tafel equations and Tafel plots.	15	Upto K4	3
IV	Bio-sensors and solar cells: Principle of photovoltaic conversion of solar energy, types of solar cells - Photovoltaic applications: battery charger, domestic lighting, street lighting, water pumping etc - solar PV power plant. Generations of biosensors; Basic principle and instrumentation of different biosensors: electrochemical sensors; Application of biosensors for food samples and real sample analysis.	15	Upto K4	4
V	Concentration Polarization, Batteries and Fuel cells: Modes of Transport of electro active species - Diffusion, migration and hydrodynamic modes. Role of supporting electrolytes. Polarography-principle and applications. Principle of square wave polarography. Cyclic voltammetry- anodic and cathodic stripping voltammetry and differential pulse voltammetry. Sodium and lithium-ion batteries and redox flow batteries. Mechanism of charge storage: conversion and alloying. Capacitors- mechanism of energy storage, charging at constant current and constant voltage. Energy production systems: Fuel Cells: classification, alkaline fuel cells, phosphoric acid fuel cells, high temperature fuel cells	15	Upto K4	5

Books for study:

1. D. R. Crow, Principles and applications of electrochemistry, 4th edition, Chapman & Hall/CRC, 2014.
2. J. Rajaram and J.C. Kuriakose, Kinetics and Mechanism of chemical transformations Macmillan India Ltd., New Delhi, 2011.
3. Text books: 1. Biosensors and modern bio-specific analytical techniques, L. Gorton (ed) Volume XLIV Elsevier 2005.
4. Sukhatme, S.P., Solar Energy, Tata McGraw Hill, 1984.

Books for References:

1. J.O.M. Bockris, A.K.N. Reddy and M.G. Aldeco Morden Electro chemistry, vol. 2A, Springer, Plenum Press, New York, 2008.
2. Philip H. Rieger, Electrochemistry, 2nd edition, Springer, New York, 2010.
3. L.I. Antropov, Theoretical electrochemistry, Mir Publishers, 1977.
4. K.L. Kapoor, A Text book of Physical chemistry, volume-3, Macmillan, 2001.
5. S. Glasstone, Electro chemistry, Affiliated East-West Press, Pvt., Ltd., New Delhi, 2008.

6. B. Viswanathan, S. Sundaram, R. Venkataraman, K. Rengarajan and P.S. Raghavan, Electrochemistry-Principles and applications, S. Viswanathan Printers, Chennai, 2007.
7. Joseph Wang, Analytical Electrochemistry, 2nd edition, Wiley, 2004.
8. Twidell, J.W. and Weir, A., Renewable Energy Sources, EFN Spon Ltd., 1986
9. Advances in biosensors, B. D. Malhotra & A. P. F. Turner (eds), Volume 5, Elsevier science 2003.

Web Resources:

1. <https://www.pdfdrive.com/modern-electrochemistry-e34333229>.

Blended Learning link:

UNIT-I

Week 6: https://onlinecourses.nptel.ac.in/noc25_cy12/preview

Rationale for Nature of the course

This course will enhance the students to comprehend understand the behavior of electrolytes in solution and compare the structures of electrical double layer of different models and energy storage devices. It will help the students electrochemistry oriented aspects and solar cell and biosensor applications

Activities having direct bearing on Skill development / Employability Entrepreneurship

In the research laboratory training is an essential component of skill development for students in the field of electrochemistry and are crucial for understanding the electrochemical application biosensors and solar cell studies. Projects will give students with an opportunity to develop strategies for new type of device fabrications.

Pedagogy

- Chalk-Talk class room Activities
- Group Discussion
- Seminar
- Quiz through ICT- Mode

Name of the course Designer

Dr. R. Ramachandran

Lecture Schedule

Unit	Descriptions	Hours	Lecture
I	Ionics Arrhenius theory -limitations, van't Hoff factor and its relation to colligative properties. Deviation from ideal behavior. Ionic activity, mean ionic activity and mean ionic activity coefficient-concept of ionic strength,	4	Chalk& talk, ppt Problem Solving, Quiz, Test
	Debye Huckel theory of strong electrolytes, activity coefficient of strong electrolytes Determination of activity coefficient ion solvent and ion-ion interactions.	4	
	Debye-Huckel Bjerrum model. Derivation of Debye-Huckel limiting law at appreciable concentration of electrolytes modifications and applications.	4	
	Electrolytic conduction-Debye-Huckel Onsager treatment of strong electrolyte-qualitative and quantitative verification and limitations. Evidence for ionic atmosphere.	3	
II	Electrode-electrolyte interface Interfacial phenomena -Evidences for electrical double layer, polarizable and non-polarizable interfaces	3	Chalk& talk, ppt Problem Solving, Quiz, Test
	Electrocapillary phenomena - Lippmann equation electro capillary curves.	3	
	Electro-kinetic phenomena electro-osmosis, electrophoresis, streaming and sedimentation potentials, colloidal and poly electrolytes.	3	
	Structure of double layer: Helmholtz -Perrin, Guoy- Chapman and Stern models of electrical double layer.	3	
	Zeta potential and potential at zero charge. Applications and limitations	3	
III	Electrodics of Elementary Electrode Reactions Anodic and Cathodic currents, condition for the discharge of ions. Nernst equation, polarizable and non-polarizable electrodes.	3	Chalk& talk, ppt Problem Solving, Quiz, Test
	Model of three electrode system, over potential. Rate of electro chemical reactions: Rates of simple elementary reactions.	3	
	Butler-Volmer equation-significance of exchange current density,	3	
	Net current density and symmetry factor. Low and high field approximations.	2	
	Symmetry factor and transfer coefficient Tafel equations and Tafel plots.	4	
IV	Bio-sensors and solar cells Principle of photovoltaic conversion of solar energy, types of solar cells	4	Chalk& talk, ppt Problem Solving, Quiz, Test

	Photovoltaic applications: battery charger, domestic lighting, street lighting, water pumping etc - solar PV power plant.	4	
	Generations of biosensors; Basic principle and instrumentation of different biosensors:	4	
	Electrochemical sensors; Application of biosensors for food samples and real sample analysis.	3	
V	Concentration Polarization, Batteries and Fuel cells Transport of electro active species - Diffusion, migration and hydrodynamic modes. Role of supporting electrolytes.	4	Chalk& talk, ppt Problem Solving, Quiz, Assignment
	Polarography-principle and applications. Principle of square wave polarography. Cyclic voltammetry- anodic and cathodic stripping voltammetry and differential pulse voltammetry.	4	
	Sodium and lithium-ion batteries and redox flow batteries. Mechanism of charge storage: conversion and alloying. Capacitors- mechanism of energy storage, charging at constant current and constant voltage.	4	
	Energy production systems: Fuel Cells: classification, alkaline fuel cells, phosphoric acid fuel cells, high temperature fuel cells	3	

COURSE OUTCOMES:

At the end of the course, the student will be able to

CLOs	CLO Statement	K-level
CLO1	Understand the behaviour of electrolytes in solution and compare the structures of electrical double layer of different models	K2
CLO2	Predict the kinetics of electrode reactions applying Butler-Volmer and Tafel equations	K3
CLO3	Study different thermodynamic mechanism of corrosion,	K4
CLO4	Discuss the principle, theories and applications of solar cells and biosensors	K4
CLO5	Have knowledge on storage devices and electrochemical reaction mechanism	K4

MAPPING WITH PROGRAMME OUTCOMES:

CLO	POs						PSOs					
	1	2	3	4	5	6	1	2	3	4	5	6
CLO1	2	2	2	1	1	2	3	3	3	2	2	2
CLO2	2	2	1	1	1	3	3	3	2	3	2	2
CLO3	2	1	1	1	1	3	3	3	2	3	2	2
CLO4	2	2	1	1	1	3	3	3	2	3	2	2
CLO5	2	1	1	1	1	3	3	3	3	3	1	1

Blueprint for Semester Examination
Articulation Mapping-K Levels with Courses Learning Outcomes (COs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO1	Up to K2	2	K1 & K1	1	K1	2 (K1 & K1)	1 (K2)
2	CLO2	Up to K3	2	K2 & K3	1	K1	2 (K2 & K2)	1 (K3)
3	CLO3	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1 (K4)
4	CLO4	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1 (K4)
5	CLO5	Up to K4	2	K2 & K3	1	K3	2 (K3 & K3)	1 (K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A & B (No Choice)	Section C (Either /or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated %
K1	6	10	-	16	13.3	35
K2	6	10	10	26	21.7	
K3	6	10	20	36	30	30
K4	2	20	20	42	35	35
Total marks	20	50	50	120	100	100

DEPARTMENT OF CHEMISTRY					CLASS: NME-Chemistry			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
I	NME-I	25P1CSEN1	Applied Chemistry	2	2	25	75	100
Nature of course		Skill oriented	√	Employability oriented		Entrepreneurship Oriented		√

Objectives:

The objective of this course is to make the student to

- Know the preparation of household items.
- Explain the food poison, adulterants and their determination.
- Identify the soap and detergents.
- Study about the good fuels.
- Understand the agriculture areas.

Unit	Description	Hours	K-level	CLO
I	Preparation of household items Introduction- preparation of Phenoyl-Liquid soap-Detergent powder-dishwashing powder-candle, ink and Agar batti.	6	Up to K2	1
II	Food chemistry Food poison- MSG , Sodium benzoate- food additives-adulteration of Milk and their products-oil and fats-sweetening agents – Food grains and their products-Detection of adulterated foods like milk , Ghee, sugar and salt , Tea and Chilli powder	6	Up to K2	2
III	Soap, detergent and Textile chemistry Classification of soap and detergent- preparation of soap-saponification- Cleansing action of soaps- perfumes used in soap Textile: Classification of textile fibre- chemistry behind wool, silk, jute and cotton	6	Up to K2	3
IV	Fuels Classification of fuels-characteristics of good fuel-petroleum-cracking-knocking-Anti knocking agent- Octane number- Properties, composition and application of Kerosene, Natural gas, producer gas, Water gas and coal gas	6	Up to K2	4
V	Agriculture Classification of fertilizer -Role of elements in plant growth-preparation and properties of Urea and NPK fertilizer with example. Pesticides: Definition- classification with examples Insecticides: Definition – Preparation and uses of DDT, BHC. Fungicides: Preparation and uses of Limes and Bordeaux mixture	6	Up to K2	5

Books for Study:

1. O.Roussak , H. D. Gesser Applied Chemistry: A Textbook for Engineers and Technologists, September 2012.
2. Jain Jain Industrial chemistry Vishal Publishing, fourth print, 2005.
3. Soaps, Detergents and Disinfectants Technology Handbook (3rd Revised Edition) , January 2021

Books for References:

1. Ajay Kumar Gupta,NPCS Handbook on Manufacture of Indian Kitchen Spices (Masala Powder) with Formulations, Processes and Machinery Details (6th Edition- January 2022
2. Dr. GAYATRI VAIDYA, Textbook of Food Chemistry. First edition.2022
3. Talashilkar SC, Principles Of Manures, Fertilizers And Agro-chemicals Publisher:M/s AGROBIOS (INDIA)-2016

Web Resources

1. <https://www.solverchem.com/e-books/chemical-fertilizers-formulations-encyclopedia>
2. <https://shop.elsevier.com/books/sittigs-handbook-of-pesticides-and-agricultural-chemicals/pohanish/978-1-4557-3148-0>
3. <https://web.fscj.edu/milczanowski/eleven/soap>.

Rationale for Nature of the course

This course content provides comprehensive foundation in applied chemistry and knows the method of preparation of soap and detergents, Food and textile industries, agricultural chemistry.

Activities having direct bearing on Skill development / Employability Entrepreneurship

To enhance skill development and employability related to the outlined content, students may participate in knowledge about house hold items and varies adulterants in food. To know your textile industry. Additionally, acquire various roles in plant growth and production of energy source.

Pedagogy

- Chalk-Talk Class room Activities
- Group discussion & Seminar
- Assignment and Quiz through ICT

Course Designer(s):

Dr. S. SELVAKUMAR

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Preparation of household items Introduction- preparation of Phenoyl- candle,	2	Chalk & talk, Group Discussion, Quiz/Seminar, Test
	Liquid soap-Detergent powder-dishwashing powder-	2	
Unit II	ink and Agar batti.	2	PPT, Chalk and talk, Group Discussion, Quiz/Seminar Test
	Food chemistry Introduction -Food poison- MSG , Sodium benzoate	2	
	food additives-adulteration of Milk and their products- oil and fats-sweetening agents	2	
	Food grains and their products-Detection of adulterated foods like milk	1	
	Ghee, sugar and salt, Tea and Chilli powder.	1	
Unit III	Soap, detergent and Textile chemistry Classification of soap and detergent	1	PPT, Chalk and talk, Group Discussion, Quiz/Seminar, Test
	preparation of soap-saponification- Cleansing action of soaps	2	
	perfumes used in soap	1	
	Textile: Classification of textile fibre-	1	
	chemistry behind wool, silk, jute and cotton	1	
Unit IV	Fuels Classification of fuels-characteristics of good fuel	1	PPT, Chalk and talk, Group Discussion, Quiz/Seminar, Test
	Petroleum- cracking-knocking-Anti knocking agent- Octane number-	2	
	Properties, composition and application of Kerosene	1	
	Natural gas, producer gas	1	
	Water gas and coal gas	1	
Unit V	Agriculture Classification of fertilizer -Role of elements in plant growth- preparation and properties of Urea and NPK fertilizer with example	2	PPT, Chalk and talk, Assignment
	Pesticides: Definition- classification with examples	1	
	Insecticides: Definition – Preparation and uses of DDT, BHC	2	
	Fungicides: Preparation and uses of Limes and Bordeaux mixture- Revision	1	

Course Learning Outcomes

After successful completion of this course, the student will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Prepare the household items	Up to K2
CLO2	Identify the food adulterants present in various food items	Up to K2
CLO3	Recognize the textile chemistry	Up to K2
CLO4	Classify fuels	Up to K2
CLO5	Study the significance of fertilizers used in agriculture.	Up to K2

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	2	2	3	2	2	2
CLO2	3	3	2	3	2	3
CLO3	1	1	2	3	3	2
CLO4	3	3	2	2	2	2
CLO5	2	3	3	3	2	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	3	1	3	2
CLO2	1	2	2	2	1	3
CLO3	2	2	1	2	2	3
CLO4	2	2	1	1	1	3
CLO5	1	2	2	1	2	3

Advance application – 3;

Intermediate level – 2;

Basic level – 1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

S. No.	CLOs	K- Level	Section A		Section B		Section C (Open Choice)
			Short answers		(Either/or Choice)		
			No. of Questions	K- Level	No. of Questions	K- Level	
1	CLO1	Up to K2	1	K1	1	2 (K2 & K2)	1 (K1)
2	CLO2	Up to K2	1	K1	1	2 (K2 & K2)	1 (K1)
3	CLO3	Up to K2	1	K1	1	2 (K2 & K2)	1 (K1)
4	CLO4	Up to K2	1	K1	1	2 (K2 & K2)	1 (K1)
5	CLO5	Up to K2	1	K1	1	2 (K2 & K2)	1 (K1)
No. of Questions to be asked			5		5		5
No. of Questions to be answered			5		5		3
Marks for each question			2		7		10
Total Marks for each section			10		35		30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either /or)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated %
K1	10	-	50	60	46	46
K2	-	70		70	54	54
Total Marks	10	70	50	130	100	100

DEPARTMENT OF CHEMISTRY					CLASS: I M.Sc., Chemistry			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
II	Core	25P2CCCT3	Organic Reaction Mechanism II	5	6	25	75	100

Nature of course		Skill oriented	√	Employability oriented	√	Entrepreneurship Oriented	

Objectives:

The objective of this course is to make the student to

- Understand the concepts of elimination and free radical reactions.
- Understand various oxidation and reduction of organic molecules with variety of reagents, conditions, etc.
- Recognize about rearrangement reactions and its synthetic applications.
- Explain the various addition reactions such as Carbon-Carbon multiple bonds and Carbon-heteroatom multiple bonds with mechanism and stereochemical aspects.
- Understand the applications of synthetically important reagents for novel synthetic routes.

Unit	Description	Hours	K-level	CLO
I	Elimination and Free Radical Reactions: (18 Hrs) Elimination reactions: Mechanisms: E2, E1, and E1cB mechanisms. Orientation of the double bond: Hoffmann and Saytzeff rules. Reactivity: Effect of substrate, attacking bases, leaving group and medium. Stereochemistry of eliminations - Syn- and anti-eliminations – Elimination in cyclic systems, pyrolytic elimination – Cope Elimination Free radical reactions:– Production of radicals, Detection, structure and stability of radicals - reactions of free radicals; Substitution, halogenation at an alkyl carbon, addition, Neighbouring group assistance Reactivity: Reactivity on aliphatic, aromatic substrates at a bridge head carbon, reactivity in the attacking radical, effect of solvent. Specific reactions: Glaser reaction, Gomberg Bachmann reaction, Hunsdicker reaction, Reed reaction. Blended learning: Production of radicals, Detection, structure and stability of radicals - reactions of free radicals.	18	Up to K2	1

II	Oxidation and Reduction Reactions Mechanisms: Direct electron transfer, hydride transfer, hydrogen atom transfer, displacement, addition-elimination, oxidation reactions: Elimination of Hydrogen: Aromatisation of six membered rings, Dehydrogenations to carbon carbon double bonds, Dehydrogenation of alcohols, Phenols, amines, hydrazines. Oxidative cleavage of glycols and cyclic ketones. Oxidation by chromium trioxide-pyridine, DMSO-Oxalyl chloride (Swern oxidation), Selenium dioxide and Corey-Kim oxidation, Reduction of Alkanes, alkenes and alkynes by various methods, reduction with Trialkyl and triphenyltin hydrides, McFadyen-Steven's reduction, Homogeneous hydrogenation, Hydroboration with cyclic systems, MPV and Bouveault-Blanc reduction. Blended learning: Swern Oxidation, Selenium dioxide.	18	Up to K3	2
III	Rearrangements: Rearrangements to electron deficient carbon: Pinacol-pinacolone and semi-pinacolone rearrangements - applications and stereochemistry, Wagner-Meerwein, Demjanov, Dienone-phenol, Baker-Venkataraman, Benzilic acid and Wolff rearrangements. Rearrangements to electron deficient nitrogen: Hofmann, Curtius, Schmidt, Lossen, Beckmann Rearrangements to electron deficient oxygen: Baeyer-Villiger oxidation and Dakin rearrangements. Rearrangements to electron rich atom: Favorskii, Quasi-Favorskii, Stevens, Wittig rearrangements. Fries and Photo Fries rearrangement. Intramolecular rearrangements – Claisen, Cope, oxy-Cope, Benzidine rearrangements.	18	Up to K4	3
IV	Addition to Carbon Multiple Bonds: Mechanisms: Electrophilic addition, Nucleophilic addition, Free radical addition (a) Addition to carbon-carbon multiple bonds- Addition reactions involving electrophiles, nucleophiles, free radicals, carbenes and cyclic mechanisms-Orientation and reactivity, hydrogenation of double and triple bonds, Michael reaction, addition of oxygen. (b) Addition to carbon-hetero atom multiple bonds: Mannich reaction, acids, esters, nitrites, addition of Grignard reagents, Wittig reaction, Prins reaction. Stereochemical aspects of addition reactions. (c) Addition to Carbon-Hetero atom multiple bonds: Addition of Grignard reagents, organozinc and organolithium reagents to carbonyl and unsaturated	18	Up to K4	4

	carbonyl compounds. Mechanism of condensation reactions involving enolates –Stobbe reactions.			
V	Reagents and Modern Synthetic Reactions: Reagents: Lithium diisopropylamine (LDA), Azobisisobutyronitrile (AIBN), meta-Chloroperbenzoic acid (m-CPBA), Dimethyl aminopyridine (DMAP), Diazobicyclo[5.4.0]undec-7-ene (DBU), Diisopropylazodicarboxylate (DIAD), Diethylazodicarboxylate (DEAD), N-bromo succinimide (NBS), Tetramethyl piperidin-1-oxyl (TEMPO), Phenyltrimethyl-ammonium tribromide (PTAB). Pyridinium chlorochromate (PCC), Pyridinium dichromate (PDC). Modern synthetic reactios: Suzuki coupling, Heck reaction, Negishi reaction, Hiyama, Kumada cross coupling reaction, Stille, Sonogashira, Baylis-Hillman reaction, Simmons Smith, Tsuji-Trost reaction, Japp-Klingemann reaction, Bamford-Stevens reaction, Shapiro reaction.	18	Up to K4	5

Books for Study:

1. M. B. Smith, March's Advanced Organic Chemistry: Reactions, Mechanism and structure, 7th ed., Wiley student edition 2015.
2. R.O.C. Norman and J. M. Coxon, Principles of Organic Synthesis, 3rd ed., CRC Press, 1993.
3. J. Clayden, N. Greeves, S. Warren, Organic Chemistry, 2nd ed., Oxford University Press, 2012.

Books for References:

1. J.J. Li, Name Reactions: A Collection of Detailed Mechanisms and Synthetic Applications, 5th ed., Springer, 2014.
2. P.S. Kalsi, Stereochemistry Confirmation and Mechanism, 11th ed., New Age International Publishers, 2022.
3. S.N. Sanyal, Reactions, Rearrangements and Reagents, 4th ed, Bharati Bhawan Publishers, 2019.

Web Resources:

1. <https://www.organic-chemistry.org/>
2. https://onlinecourses.nptel.ac.in/noc23_cy54/preview
3. https://onlinecourses.nptel.ac.in/noc23_cy57/preview

Blended learning link:

Unit-I: Production of radicals, Detection, structure and stability of radicals - reactions of free radicals

https://onlinecourses.swayam2.ac.in/cec24_cy08/preview (Week 11 and week 12)

Unit-II: Swern Oxidation, Selenium dioxide

https://onlinecourses.nptel.ac.in/noc25_cy15/preview (Unit-I)

Rationale for Nature of the course

This course will enable the students to know about the principles of organic reactions and techniques to identify correct reagent for given conversion of reactions.

Activities having direct bearing on Skill development / Employability Entrepreneurship

The basic knowledge gained through this course, students can predict the way of proceeding addition and elimination reactions. Students will be given task for the effective usage of reagents and name reactions. By employing these ideas, students will find out suitable reagents/reactions/conversions to solve the given problems.

Pedagogy

- Chalk-Talk Class room Activities
- Group discussion & Seminar
- Assignment and Quiz through ICT

Course Designer(s):

Dr. S.V. Karthikeyan

Course Schedule

Unit	Topics	Hours	Mode
Unit I	Elimination reactions: Mechanisms: E2, E1, and E1cB mechanisms. Orientation of the double bond: Hoffmann and Saytzeff rules.	3	PPT, Chalk and talk, Group Discussion, Quiz/Seminar, Test
	Reactivity: Effect of substrate, attacking bases, leaving group and medium. Stereochemistry of eliminations - Syn- and anti-eliminations	3	
	Elimination in cyclic systems, pyrolytic elimination – Cope Elimination	3	
	Free radical reactions:– Production of radicals, Detection, structure and stability of radicals - reactions of free radicals; Substitution, halogenation at an alkyl carbon, addition, Neighbouring group assistance	3	
	Reactivity: Reactivity on aliphatic, aromatic substrates at a bridge head carbon, reactivity in the attacking radical, effect of solvent	3	
	Specific reactions: Glaser reaction, Gomberg Bachmann reaction, Hunsdicker reaction, Reed reaction.	3	
Unit II	Mechanisms: Direct electron transfer, hydride transfer, hydrogen atom transfer, displacement, addition-elimination, oxidation reactions:	3	PPT, Chalk and talk, Group Discussion, Quiz/Seminar, Test
	Elimination of Hydrogen: Aromatisation of six membered rings, Dehydrogenations to carbon carbon double bonds, Dehydrogenation of alcohols, Phenols, amines, hydrazines	3	
	Oxidative cleavage of glycols and cyclic ketones. Oxidation by chromium trioxide-pyridine, DMSO-Oxalyl chloride (Swern oxidation) and Corey-Kim oxidation,	4	
	Reduction of Alkanes, alkenes and alkynes by various methods, reduction with Trialkyl and triphenyltin hydrides, McFadyen-Steven's reduction.	4	
	Homogeneous hydrogenation, Hydroboration with cyclic systems, MPV and Bouveault-Blanc reduction.	4	
Unit III	Rearrangements to electron deficient carbon: Pinacol-pinacolone and semi-pinacolone rearrangements - applications and stereochemistry, Wagner-Meerwein, Demjanov, Dienone-phenol,	4	PPT, Chalk and talk, Group Discussion, Quiz/Seminar, Test
	Baker-Venkataraman, Benzilic acid and Wolff rearrangements. Rearrangements to electron deficient nitrogen: Hofmann, Curtius, Schmidt, Lossen, Beckmann	4	

	Rearrangements to electron deficient oxygen: Baeyer-Villiger oxidation and Dakin rearrangements	3	
	Rearrangements to electron rich atom: Favorskii, Quasi-Favorskii, Stevens, Wittig rearrangements. Fries and Photo Fries rearrangement	4	
	Intramolecular rearrangements – Claisen, Cope, oxy-Cope Benzidine rearrangements.	3	
Unit IV	Mechanisms: Electrophilic addition, Nucleophilic addition, Free radical addition	2	PPT, Chalk and talk, Group Discussion, Quiz/Seminar, Test
	Addition to carbon-carbon multiple bonds- Addition reactions involving electrophiles, nucleophiles, free radicals, carbenes and cyclic mechanisms	3	
	Orientation and reactivity, hydrogenation of double and triple bonds, Michael reaction, addition of oxygen	3	
	Addition to carbon-hetero atom multiple bonds: Mannich reaction, acids, esters, nitrites, addition of Grignard reagents	3	
	Wittig reaction, Prins reaction. Stereochemical aspects of addition reactions.	2	
	Addition to Carbon-Hetero atom multiple bonds: Addition of Grignard reagents, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds.	3	
	Mechanism of condensation reactions involving enolates –Stobbe reactions.	2	
Unit V	Lithium diisopropylamine (LDA), Azobisisobutyronitrile (AIBN), meta-Chloroperbenzoic acid (m-CPBA),	3	PPT, Chalk and talk, Assignment
	Dimethyl aminiopyridine (DMAP), Diazobicyclo[5.4.0]undec-7-ene (DBU), Diisopropyl-azodicarboxylate (DIAD)	3	
	Diethylazodicarboxylate (DEAD), N-bromo succinimide (NBS), Tetramethyl piperidin-1-oxyl (TEMPO)	3	
	Phenyltrimethyl-ammonium tribromide (PTAB). Pyridinium chlorochromate (PCC), Pyridinium dichromate (PDC)	3	
	Suzuki coupling, Heck reaction, Negishi reaction, Hiyama, Kumada cross coupling reaction, Stille, Sonogashira, Baylis-Hillman reaction, Simmons Smith	3	
	Tsuji-Trost reaction, Japp-Klingemann reaction, Bamford-Stevens reaction, Shapiro reaction.	3	

Course Learning Outcomes:

After successful completion of this course, the student will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Describe the mechanism of elimination and free radical reactions on various substrate.	Up to K2
CLO2	Identify suitable oxidising and reducing agent for given conversion.	Up to K3
CLO3	Inspect the type of rearrangements involved for the given conversion of molecules.	Up to K4
CLO4	Analyse new routes to synthesis organic compounds via addition to Carbon multiple bonds.	Up to K4
CLO5	Examine the suitable reagents for the conversion of selective organic compounds.	Up to K4

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	3	3	3	2	2	2
CLO2	3	3	2	3	2	2
CLO3	3	3	2	3	2	2
CLO4	3	3	2	3	2	2
CLO5	3	3	3	3	2	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	2	2	1	1	1	2
CLO2	2	2	1	1	1	3
CLO3	2	2	1	1	1	3
CLO4	2	2	1	1	1	3
CLO5	2	2	1	1	1	3

Advance application – 3;

Intermediate level – 2;

Basic level – 1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO1	Up to K2	2	K1 & K1	1	K1	2 (K1 & K1)	1 (K2)
2	CLO2	Up to K3	2	K2 & K3	1	K1	2 (K2 & K2)	1 (K3)
3	CLO3	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1 (K4)
4	CLO4	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1 (K4)
5	CLO5	Up to K4	2	K2 & K3	1	K3	2 (K3 & K3)	1 (K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A& B (No Choice)	Section C (Either /or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated %
K1	6	10	-	16	13.3	35
K2	6	10	10	26	21.7	
K3	6	10	20	36	30	30
K4	2	20	20	42	35	35
Total marks	20	50	50	120	100	100

DEPARTMENT: CHEMISTRY					CLASS: I M.Sc., CHEMISTRY			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
II	CORE	25P2CCCT4	PHYSICAL CHEMISTRY-I	5	6	25	75	100

Nature of course	Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objectives:

The objective of this course is to make the student

- To recall the fundamentals of thermodynamics and the composition of partial molar quantities.
- To understand the classical and statistical approach of the functions
- To compare the significance of Maxwell-Boltzman, Fermi-Dirac and Bose-Einstein
- To correlate the theories of reaction rates for the evaluation of thermodynamic parameters.

Unit	Description	Hours	K-level	CLO
I	Classical Thermodynamics Partial molar properties-Chemical potential with variation of temperature and pressure, Gibb's-Duhem equation. Determination of partial molar quantities. Thermodynamics of real gases - Fugacity- determination of fugacity by graphical and equation of state methods-dependence of temperature, pressure and composition. Thermodynamics of ideal and non-ideal binary mixtures, Duhem-Margulus equation applications of ideal and non-ideal mixtures. Determination-vapour pressure, EMF and freezing point methods.	18	Upto K2	1
II	Statistical thermodynamics Introduction of statistical thermodynamics concepts of thermodynamic and mathematical probabilities-distribution of distinguishable and non-distinguishable particles. Assemblies, ensembles, canonical particles. Maxwell - Boltzmann, Fermi Dirac & Bose-Einstein Statistics- comparison Partition functions-evaluation of translational, vibrational and rotational partition functions for monoatomic, diatomic and polyatomic ideal gases. Thermodynamic functions in terms of partition functions-calculation of equilibrium constants. Statistical approach to Thermodynamic properties: pressure, internal energy, entropy, enthalpy, Gibb's function, Helmholtz function residual entropy, equilibrium constants. Heat capacity of mono and di atomic gases. Heat capacity of solids-Einstein and Debye models. Blended Learning Maxwell - Boltzmann, Fermi Dirac & Bose-Einstein Statistics	18	Upto K3	2

III	Irreversible Thermodynamics and phase rule: Heat in open system: Entropy and absolute temperature (Second law of thermodynamics); The chemical potential; Other extensive state variable-The Helmholtz function and Gibbs function; Equilibrium in homogeneous system; Equilibrium in heterogeneous system; Conservation of energy in open system; Entropy flow and entropy production in open system; entropy production in closed system; Phenomenological equation; Onsager's Reciprocity relation; Transport phenomenon; Prigogine theorem of minimum entropy production ; Application of irreversible thermodynamics to biological systems. Phase rule:Phase diagram for three component systems: Type I-Type II-Formation of one pair of partially miscible liquids; Formation of two pairs of partially miscible liquids; Type III-Formation of three pairs of partially miscible liquids; Solid liquid systems:	18	Upto K4	3
IV	Kinetics of Reactions Theories of reactions-effect of temperature on reaction rates, collision theory of reaction rates, Unimolecular reactions - Lindeman and Christiansen hypothesis- molecular beams, collision cross sections, effectiveness of collisions, Potential energy surfaces. Transition state theory-evaluation of thermodynamic parameters of activation-applications of ARRT to reactions between atoms and molecules, time and true order-kinetic parameter evaluation. Factors determine the reaction rates in solution - primary salt effect and secondary salt effect, Homogeneous catalysis- acid- base catalysis-mechanism of acid base catalyzed reactions-Bronsted catalysis law, enzyme catalysis-Michelis-Menton catalysis	18	Upto K4	4
V	Kinetics of complex and fast reactions: Kinetics of complex reactions, reversible reactions, consecutive reactions, parallel reactions, chain reactions. Chain reactions-kinetics of $H_2 - Cl_2$ & $H_2 - Br_2$ reactions (Thermal and Photochemical reactions) - Rice Herzfeld mechanism. Study of fast reactions-relaxation methods- temperature and pressure jump methods -stopped flow flash photolysis methods and pulse radiolysis. Kinetics of polymerization-free radical, cationic, anionic polymerization - Polycondensation.	18	Upto K4	5

Books for Study:

1. J. Rajaram and J.C. Kuriacose, Thermodynamics for Students of Chemistry, 2nd edition, S.L.N.Chand and Co., Jalandhar, 2003.
2. I.M. Klotz and R.M. Rosenberg, Chemical thermodynamics, 6th edition, W.A. Benjamin Publishers, California, 2017.
3. Gurdeep Raj, Advanced physical chemistry, 30th edition: 2004.

Books for References:

1. D.A. Mcquarrie And J.D. Simon, Physical Chemistry - A Molecular Approach, Viva Books Pvt. Ltd., New Delhi, 2001.
2. R.P. Rastogi and R.R. Misra, Classical Thermodynamics, Vikas Publishing, Pvt. Ltd., New Delhi, 2005.
3. S.H. Maron and J.B. Lando, Fundamentals of Physical Chemistry, Macmillan Publishers, New York, 2003
4. K.B. Ytsiimiriski, "Kinetic Methods of Analysis", Pergamom Press, 2000.
5. Gurdeep Raj, Phase rule, Goel Publishing House, 2011.

Web Resources:

1. <https://nptel.ac.in/courses/104/103/104103112/>
2. <https://bit.ly/3tL3GdN>

Blended Learning link:**UNIT-II**

Lecture 7: Bose Einstein and Fermi Dirac Statistics

https://onlinecourses.nptel.ac.in/noc25_me71/unit?unit=24&lesson=27

Rationale for Nature of the course

This course will enhance the students to comprehend understand the approach to classical and statistical thermodynamic properties: pressure, internal energy, entropy, enthalpy, Gibb's function, Helmholtz function residual entropy, equilibrium constants. It will help the students for the study of chemical kinetics aspects rates of the reactions.

Activities having direct bearing on Skill development / Employability Entrepreneurship

In the research laboratory training is an essential component of skill development for students in the field of classical and statistical thermodynamic aspects. Projects will give students with an opportunity to develop strategies for new type classical and statistical thermodynamic studies.

Pedagogy

- Chalk-Talk class room Activities
- Group Discussion
- Seminar
- Quiz through ICT- Mode

Name of the course Designer

Dr. R. Ramachandran

Lecture Schedule

Unit	Descriptions	Hours	Lecture
I	Classical Thermodynamics Partial molar properties-Chemical potential with variation of temperature and pressure, Gibb's-Duhem equation.	5	Chalk& talk, ppt Problem Solving, Quiz, Test
	Determination of partial molar quantities. Thermodynamics of real gases	3	
	Fugacity- determination of fugacity by graphical and equation of state methods-dependence of temperature, pressure and composition. Thermodynamics of ideal and non-ideal binary mixtures.	5	
	Duhem-Margulus equation applications of ideal and non-ideal mixtures. Determination-vapour pressure, EMF and freezing point methods.	5	
II	Statistical thermodynamics Introduction of statistical thermodynamics concepts of thermodynamic and mathematical probabilities-distribution of distinguishable and non-distinguishable particles.	4	Chalk& talk, ppt Problem Solving, Quiz, Test
	Assemblies, ensembles, canonical particles. Maxwell - Boltzmann, Fermi Dirac & Bose-Einstein Statistics- comparison Partition functions	4	
	Evaluation of translational, vibrational and rotational partition functions for monoatomic, diatomic and polyatomic ideal gases.	4	
	Thermodynamic functions in terms of partition functions-calculation of equilibrium constants. Statistical approach to Thermodynamic properties:	3	
	Pressure, internal energy, entropy, enthalpy, Gibb's function, Helmholtz function residual entropy, equilibrium constants. Heat capacity of mono and di atomic gases. Heat capacity of solids-Einstein and Debye models.	3	
III	Irreversible Thermodynamics and phase rule Heat in open system: Entropy and absolute temperature (Second law of thermodynamics); The chemical potential; Other extensive state variable-The Helmholtz function and Gibbs function	4	Chalk& talk, ppt Problem Solving, Quiz, Test
	Equilibrium in homogeneous system; Equilibrium in heterogeneous system; Conservation of energy in open system; Entropy flow and entropy production in open system; entropy production in closed system;	4	
	Phenomenological equation; Onsager's Reciprocity relation; Transport phenomenon; Prigogine theorem of minimum entropy production ; Application of irreversible thermodynamics to biological systems.	4	

	Phase diagram for three component systems: Type I- Type II- Formation of one pair of partially miscible liquids	3	
	Formation of two pairs of partially miscible liquids; Type III- Formation of three pairs of partially miscible liquids; Solid liquid systems:	3	
IV	Kinetics of Reactions Theories of reactions-effect of temperature on reaction rates, collision theory of reaction rates, Unimolecular reactions -Lindeman and Christiansen hypothesis	4	Chalk& talk, ppt Problem Solving, Quiz, Test
	Molecular beams, collision cross sections, effectiveness of collisions, Potential energy surfaces.	4	
	Transition state theory-evaluation of thermodynamic parameters of activation-applications of ARRT to reactions between atoms and molecules, time and true order-kinetic parameter evaluation.	5	
	Factors determine the reaction rates in solution - primary salt effect and secondary salt effect, Homogeneous catalysis- acid- base catalysis-mechanism of acid base catalyzed reactions-Bronsted catalysis law, enzyme catalysis-Michelis-Menton catalysis	5	
V	Kinetics of complex and fast reactions Kinetics of complex reactions, reversible reactions, consecutive reactions, parallel reactions, chain reactions.	4	Chalk& talk, ppt Problem Solving, Quiz, Assignment
	Chain reactions- kinetics of $H_2 - Cl_2$ & $H_2 - Br_2$ reactions (Thermal and Photochemical reactions)	4	
	Rice Herzfeld mechanism. Study of fast reactions-relaxation methods- temperature and pressure jump methods -stopped flow flash photolysis methods and pulse radiolysis.	5	
	Kinetics of polymerization-free radical, cationic, anionic polymerization - Polycondensation.	5	

COURSE OUTCOMES:

At the end of the course, the student will be able to

CLOs	CLO Statement	K-level
CLO1	Explain the classical and statistical concepts of thermodynamics.	K2
CLO2	Apply the concepts of thermodynamics to study the kinetics of chemical reactions.	K3
CLO3	Discuss the Irreversible Thermodynamics and phase rule	K4
CLO4	Evaluate the thermodynamic methods for real gases and mixtures	K4
CLO5	Compare the theories of reactions rates and fast reactions.	K4

MAPPING WITH PROGRAMME OUTCOMES:

CLOs	POs						PSOs					
	1	2	3	4	5	6	1	2	3	4	5	6
CLO1	2	2	1	1	1	2	3	3	3	2	2	2
CLO2	2	2	1	1	1	3	3	3	2	3	2	2
CLO3	2	2	1	1	1	3	3	3	2	3	2	2
CLO4	2	2	1	1	1	3	3	3	2	3	2	2
CLO5	2	2	1	1	1	3	3	3	3	3	2	2

Blueprint for Semester Examination
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO1	Up to K2	2	K1 & K1	1	K1	2 (K1 & K1)	1 (K2)
2	CLO2	Up to K3	2	K2 & K3	1	K1	2 (K2 & K2)	1 (K3)
3	CLO3	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1 (K4)
4	CLO4	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1 (K4)
5	CLO5	Up to K4	2	K2 & K3	1	K3	2 (K3 & K3)	1 (K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A& B (No Choice)	Section C (Either /or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated %
K1	6	10	-	16	13.3	35
K2	6	10	10	26	21.7	
K3	6	10	20	36	30	30
K4	2	20	20	42	35	35
Total marks	20	50	50	120	100	100

DEPARTMENT: CHEMISTRY					CLASS: I M.Sc., CHEMISTRY			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
II	Core	25P2CCCP2	Inorganic Practicals	4	6	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

Objectives:

The objective of this course is to make the student to

- understand and enhance the visual observation as an analytical tool for the quantitative estimation of ions.
- recall the principle and theory in preparing standard solutions.
- train the students for improving their skill in estimating the amount of ion accurately present in the solution
- estimate metal ions, present in the given solution accurately without using instruments.
- determine the amount of ions, present in a binary mixture accurately

Description
Analysis of mixture of cations: Analysis of a mixture of four cations containing two common cations and two rare cations. Cations to be tested. 1. Group-I : W, and Pb. 2. Group-II : Se, Te, Mo, Cu, Bi and Cd. 3. Group-III : Tl, Ce, Th, Zr, V, Ti and U. 4. Group-IV : Zn, Ni, Co and Mn. 5. Group-V : Ca, Ba and Sr. 6. Group-VI : Li and Mg
Preparation of metal complexes: Preparation of inorganic complexes: a. Preparation of trithioureacopper(II)sulphate dihydrate b. Preparation of potassium trioxalate chromate(III) c. Preparation of tetramminecopper(II) sulphate d. Preparation of hexamine cobalt (III) chloride e. Preparation of hexathioureacopper(I) chloride dihydrate f. Preparation of hexathiourealead(II) nitrate
Complexometric Titration: 1. Estimation of nickel by EDTA method 2. Estimation of magnesium EDTA method 3. Estimation of mixture of metal ions-pH control, masking and demasking agents. 4. Determination of manganese in the presence of iron. 5. Determination of nickel in the presence of iron 6. Estimation of zinc by potassium ferrocyanide method 7. Estimation of Copper by EDTA method 8. Estimation of Lead by EDTA method

Books for study:

1. O.P. Pandey, N. Bajpai, S. Giri, "Practical Chemistry" S. Chand and Co Ltd., ISBN: 9788121908122, 9788121908122, 2010.
2. Henry W. Schimpf "A text book of volumetric analysis", Biolife Publishers, ISBN: 9781117262451, 1117262456, 2009.
3. V. Venkateswaran, R. Veeraswamy, A.R. Kulandaivelu, Basic Principles of Practical Chemistry, S. Chand & Co., New Delhi, 1997.

Books for References:

1. G. Pass, and H. Sutcliffe, Practical Inorganic Chemistry; Chapman Hall, 1965.
2. W. G. Palmer, Experimental Inorganic Chemistry; Cambridge University Press, 1954.

Web Resources:

1. <http://www.federica.unina.it/agraria/analytical-chemistry/volumetric-analysis/>
2. <https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cy02/>
3. <https://chem.hbcse.tifr.res.in/synthesis-and-analysis-of-an-inorganic-complex/>

Rationale for Nature of the course

This course will enable the students to comprehend the basic knowledge of inorganic estimations through volumetric analysis using EDTA and complex preparation. They will acquire skills through titrimetric methods by connecting the principles of inorganic synthesis

Course outcomes:

At the end of the course, the student will be able to

CLO	CLO Statement	K-level	Weight / Mark
CLO1	Apply the preparative knowledge of inorganic complex	K3	10
CLO2	Demonstrate the basic laboratory techniques of volumetric analysis of given samples.	K2	15
CLO3	Estimate the amount of metal ions in the given solution by complexometric method.	K3	20
CLO4	Interpret analytical data	K4	25
CLO5	Communicate the finding	K3	5

MAPPING WITH PROGRAMME OUTCOMES:

CLO	POs						PSOs					
	1	2	3	4	5	6	1	2	3	4	5	6
CLO1	2	3	1	1	1	2	1	1	2	3	1	1
CLO2	2	3	1	1	1	2	1	1	2	3	1	1
CLO3	2	3	1	1	1	2	1	1	2	3	1	1
CLO4	2	3	1	1	1	2	1	1	2	3	1	1
CLO5	2	3	1	1	1	2	1	1	2	3	1	1

Assessment Scheme**Components of CIA**

Component	Weight / Mark
Internal Test	15
Observation/Record	5
Continuous class assessment	5
Total Marks	25

Name of the course Designer

Dr. M. Boominathan

DEPARTMENT OF CHEMISTRY					CLASS: I M.Sc., Chemistry			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
II	Discipline Elective	25P2CECT3(A)	Green Chemistry	3	5	25	75	100

Nature of course		Skill oriented	√	Employability oriented	√	Entrepreneurship Oriented	

Objectives:

The objective of this course is to make the student to

- Discuss the principles of green chemistry.
- Propose green solutions for chemical energy storage and conversion.
- Explain green solutions for industrial production of petrochemicals, drug molecules and agro compounds.
- Recognise solutions for pollution prevention in industrial chemical and fuel production, automotive industry and shipping industries.
- Identify green solutions for industrial production of surfactants, and inorganic materials.

Unit	Description	Hours	K-level	CLO
I	Introduction to Green Chemistry Need for Green Chemistry. Goals of Green Chemistry. Limitations/ of Green Chemistry. Green Chemistry and Eco-efficiency Environmental protection laws Twelve principles of Green Chemistry with examples. Atom Economy with example of Ibuprofen synthesis. Blended Learning Topic Green Chemistry with examples. Atom Economy with example	15	Up to K2	1
II	Green synthesis-I Designing a Green Synthesis - Choice of starting materials, Choice of reagents: Polymer supported reagents, Choice of catalysts: Biocatalysts and polymer supported catalysts, Choice of solvents. Green Synthesis of Butylated Hydroxy Toluene (BHT), Methyl methacrylate, Paracetamol. Synthesis involving basic principles of Green Chemistry - Organic Synthesis in water – Advantages and examples. Organic Synthesis in super critical CO ₂ -examples. Ionic liquids: properties, types, preparation and examples. Blended Learning Topic Biocatalyst	15	Up to K3	2

III	Green synthesis-II Organic synthesis in solid state – Advantages, Examples for reactions at room temperature, heating and solid support. Oxidation and Reduction reactions. Organic synthesis using green reagents – Examples with Oxygen, Singlet Oxygen, ozone, hydrogen peroxide, dimethyl carbonate.	15	Up to K4	3
IV	Organic synthesis using Green catalysts Phase transfer catalysts – Introduction, Mechanism, types, advantages and applications in organic synthesis. Crown ethers - Introduction, nomenclature, special feature - applications. Biocatalysts-Advantages, biochemical oxidation and reduction-enzyme catalysed processes.	15	Up to K4	4
V	Alternate Energy Processes Microwave assisted organic synthesis – Introduction, Microwave assisted reactions in: water, organic solvents and solid state – Examples – Continuous microwave reactor –basic idea. Ultrasound assisted organic synthesis – Introduction, instrumentation, types of sonochemical reactions with examples. Photo induced organic synthesis – Introduction, Examples for photochemical reactions and industrial applications. Blended Learning Topic Microwave assisted synthesis	15	Up to K4	5

Books for Study:

1. R. Sanghi, M. M. Srivatsava, Green Chemistry: Environment friendly alternatives, 1st ed., Narosa publishing house, 2003.
2. V. K. Ahluwalia, M. Kidwai, New Trends in Green Chemistry, 1st ed., Kluwer academic publishers, 2012.
3. P. T. Anastas, J. C. Warner, Green Chemistry: Theory and Practice, 1st ed., University oxford press, 2005

Books for References:

1. V. K. Ahluwalia and R. Aggarwal, Organic Synthesis: Special Techniques, Narosa Publishing House, New Delhi, 2006.
2. M. Lancaster, Green Chemistry: An Introductory Text, 3rd ed., Royal Society of Chemistry, 2016.
3. F. A. Etzkorn, Green Chemistry: Principles and case studies, 1st ed., Royal Society of Chemistry, 2019.

Web Resources

1. <https://www.epa.gov/greenchemistry>
2. <https://ehs.mit.edu/green-chemistry/>
3. <https://greenchemistry.yale.edu/about/history-green-chemistry>

Blended Learning Resources

1. <https://archive.nptel.ac.in/courses/104/106/104106138/>

NPTEL Course –Organic chemistry-I-**Week 04** NPTEL Course -For **Unit-I-** Green Chemistry with examples. **Unit-II-** Biocatalyst, **Unit-V-** Microwave assisted synthesis

Rationale for Nature of the course

This course will enable the students to know about the principles and techniques of green chemistry and to improve their knowledge in upgrading a conventional chemical synthesis in a green manner.

Activities having direct bearing on Skill development / Employability Entrepreneurship

The basic knowledge gained through this course, students can analyse the ways to improve the given conventional chemical synthesis in to a green synthesis. To achieve this, molecules which are not present in the curriculum will be given for analysis. They can think over the possible ways to synthesize the molecule in a green manner.

Pedagogy

- Chalk-Talk Class room Activities
- Group discussion & Seminar
- Assignment and Quiz through ICT

Course Designer(s):

Dr. S. V. Karthikeyan

Course Schedule

Unit	Topics	Hours	Mode
Unit I	Need for Green Chemistry. Goals of Green Chemistry	4	PPT, Chalk and talk, Group Discussion, Quiz/Seminar, Test
	Limitations/ of Green Chemistry. Green Chemistry and Eco-efficiency	4	
	Environmental protection laws Twelve principles of Green Chemistry with examples	4	
	Atom Economy with example of Ibuprofen synthesis.	3	
Unit II	Designing a Green Synthesis - Choice of starting materials, Choice of reagents: Polymer supported reagents,	4	PPT, Chalk and talk, Group Discussion, Quiz/Seminar, Test
	Choice of catalysts: Biocatalysts and polymer supported catalysts, Choice of solvents. Green Synthesis of Butylated Hydroxy Toluene (BHT), Methyl methacrylate, Paracetamol.	4	
	Synthesis involving basic principles of Green Chemistry - Organic Synthesis in water – Advantages and examples.	4	
	Organic Synthesis in super critical CO ₂ -examples. Ionic liquids: properties, types, preparation and examples.	3	
Unit III	Organic synthesis in solid state – Advantages, Examples for reactions at room temperature, heating and solid support.	5	PPT, Chalk and talk, Group Discussion, Quiz/Seminar, Test
	Oxidation and Reduction reactions.	4	
	Organic synthesis using green reagents – Examples with Oxygen, Singlet Oxygen, ozone, hydrogen peroxide, dimethyl carbonate.	6	
Unit IV	Phase transfer catalysts – Introduction, Mechanism, types, advantages and applications in organic synthesis.	5	PPT, Chalk and talk, Group Discussion, Quiz/Seminar, Test
	Crown ethers - Introduction, nomenclature, special feature - applications	5	
	Biocatalysts-Advantages, biochemical oxidation and reduction-enzyme catalysed processes.	5	
Unit V	Microwave assisted organic synthesis – Introduction, Microwave assisted reactions in: water, organic solvents	4	PPT, Chalk and talk, Assignment
	solid state – Examples – Continuous microwave reactor – basic idea.	4	
	Ultrasound assisted organic synthesis – Introduction, instrumentation, types of sonochemical reactions with examples.	4	
	Photo induced organic synthesis – Introduction, Examples for photochemical reactions and industrial applications.	3	

Course Learning Outcomes:

After successful completion of this course, the student will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Summarize the basic principles need and limitations of green chemistry.	Up to K2
CLO2	Develop organic synthesis using green chemistry principles and methods.	Up to K3
CLO3	Analyse the usage of polymer supported catalysts	Up to K4
CLO4	Examine the applications of PTC and crown ethers for various conversions.	Up to K4
CLO5	Compare the advantages of organic reactions assisted by microwaves, ultrasound and sonication methods.	Up to K4

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	3	3	3	2	2	3
CLO2	3	3	2	3	2	3
CLO3	3	3	2	3	2	3
CLO4	3	3	2	3	2	3
CLO5	3	3	3	3	2	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	2	2	2	2
CLO2	3	3	3	3	3	3
CLO3	3	3	3	3	3	3
CLO4	3	3	3	3	3	3
CLO5	3	3	3	3	3	3

Advance application – 3;

Intermediate level – 2;

Basic level – 1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO1	Up to K2	2	K1 & K1	1	K1	2 (K1 & K1)	1 (K2)
2	CLO2	Up to K3	2	K2 & K3	1	K1	2 (K2 & K2)	1 (K3)
3	CLO3	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1 (K4)
4	CLO4	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1 (K4)
5	CLO5	Up to K4	2	K2 & K3	1	K3	2 (K3 & K3)	1 (K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A & B (No Choice)	Section C (Either /or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated %
K1	6	10	-	16	13.3	35
K2	6	10	10	26	21.7	
K3	6	10	20	36	30	30
K4	2	20	20	42	35	35
Total marks	20	50	50	120	100	100

DEPARTMENT: CHEMISTRY					CLASS: I M.Sc., CHEMISTRY			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
II	Discipline Elective	25P2CECT3	Medicinal Chemistry	3	5	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

Objectives:

The objective of this course is to make the student to

- Study the chemistry behind the development of pharmaceutical materials.
- Gain knowledge on mechanism and action of drugs.
- Understand the need of antibiotics and usage of drugs.
- Familiarize with the mode of action of diabetic agents and treatment of diabetes.
- Identify and apply the action of various antibiotics.

Unit	Description	Hours	K-level	CLO
I	Introduction to receptors: Introduction- Definition of classical binding terms: dose-response curve targets, Agonist, antagonist, partial agonist. affinity, efficacy, potency, LD50, ED50, TD50 tolerance. Receptors, Receptor types, Theories of Drug – receptor interaction, Drug synergism, Drug resistance, physicochemical factors influencing drug action. Blended Learning: Receptors, Receptor types, Theories of Drug – receptor interaction, Drug synergism, Drug resistance, physicochemical factors influencing drug action.	15	Upto K2	1
II	Antibiotics: Introduction, Targets of antibiotics action, classification of antibiotics, enzyme-based mechanism of action, cell wall synthesis inhibitors, β -lactam rings, antibiotics inhibiting protein synthesis. Synthesis and clinical applications of penicillins, cephalosporin. Current trends in antibiotic therapy.	15	Upto K3	2

III	Antihypertensive agents and diuretics: Classification of cardiovascular agents, introduction to hypertension, etiology, types, classification of antihypertensive agents, drug inhibitors of peripheral sympathetic function, central intervention of cardiovascular output. Direct acting arteriolar dilators. classification and mechanism of action of diuretics, Furosemide, Hydrochlorothiazide, Amiloride.	15	Upto K4	3
IV	Antidiabetic Agents Medicinal Chemistry of Antidiabetic Agents Introduction, Types of diabetics, Drugs used for the treatment, chemical classification, Mechanism of action, Treatment of diabetic mellitus. Chemistry of insulin, sulfonyl urea.	15	Upto K4	4
V	Analgesics, Antipyretics and Anti-inflammatory Drugs Introduction, Mechanism of inflammation, classification and mechanism of action and paracetamol, Ibuprofen, Diclofenac, naproxen, indomethacin, phenylbutazone and meperidine.	15	Upto K4	5

Books for Study:

1. Wilson and Gisvold's textbook of organic medicinal and pharmaceutical chemistry,
2. Graham L. Patrick, An Introduction to Medicinal Chemistry, 5th edition, Oxford University Press, 2013. Jayashree Ghosh, A text book of Pharmaceutical Chemistry, S. Chand and Co. Ltd, 1999, 1999 edn.
3. S. Ashutosh Kar, Medicinal Chemistry, Wiley Eastern Limited, New Delhi, 1993, New edn.

Books for References:

1. Foye's Principles of Medicinal Chemistry, Lipincott Williams, Seventh Edition, 2012
2. Burger's Medicinal Chemistry, Drug Discovery and Development, Donald J. Abraham, David P. Rotella, Alfred Burger, Academic press, 2010.
3. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry, John M. Beale Jr and John M. Block, Wolters Kluwer, 2011, 12th edn.
4. P. Parimoo, A Textbook of Medical Chemistry, New Delhi: CBS Publishers. 1995.
5. S. Ramakrishnan, K. G. Prasanna and R. Rajan, Textbook of Medical Biochemistry, Hyderabad: Orient Longman. 3rd edition,

Web Resources:

1. <https://www.ncbi.nlm.nih.gov/books/NBK482447/>
2. <https://training.seer.cancer.gov/treatment/chemotherapy/types.html>
3. <https://www.classcentral.com/course/swayam-medicinal-chemistry-12908>

Blended Learning Resources

[https://archive.nptel.ac.in/courses/104/106/104106106/-](https://archive.nptel.ac.in/courses/104/106/104106106/)

NPTEL Course –Medicinal chemistry-**Week 3 and 4 lecture** NPTEL Course -For Unit-I- Receptors, Receptor types, Theories of Drug – receptor interaction, Drug synergism, Drug resistance, physicochemical factors influencing drug action.

Rationale for Nature of the course

This course will enable the students to comprehend the basic concepts of medicinal chemistry, to study the nature of drugs and mechanism of action of various drugs like antibiotics, antibacterials, Antihypertensive agents and diuretics and diabetic agents, analgesics, antipyretics and Anti-inflammatory Drugs.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Hands-on laboratory training is an essential component of skill development for students in the field of medicinal chemistry and pharmacology. Regulatory affairs workshops are crucial for understanding the legal and procedural framework governing drug approval and marketing. Pharmaceutical marketing projects provide students with an opportunity to develop strategies for promoting drugs based on their unique selling proposition (USP). Drug repurposing offers a lucrative entrepreneurial opportunity by identifying new therapeutic uses for existing drugs.

Pedagogy

- Chalk-Talk class room Activities
- Group Discussion
- Seminar
- Quiz through ICT- Mode

Name of the course Designer

Dr. J. Shanmugapriya

Lecture Schedule

Unit	Descriptions	Hours	Lecture
I	Introduction to receptors: Introduction- Definition of classical binding terms: dose-response curve targets,	4	Chalk& talk, ppt Problem Solving, Quiz, Test
	Agonist, antagonist, partial agonist. affinity, efficacy, potency, LD50, ED50, TD50 tolerance.	4	
	Receptors, Receptor types, Theories of Drug – receptor interaction,	3	
	Drug synergism, Drug resistance, physicochemical factors influencing drug action	4	
II	Antibiotics: Introduction, Targets of antibiotics action	3	Chalk& talk, ppt Problem Solving, Quiz, Test
	classification of antibiotics,enzyme-based mechanism of action,	3	
	Cell wall synthesis inhibitors, β -lactam rings, antibiotics inhibiting protein synthesis	3	
	Synthesis and clinical applications of penicillins, cephalosporin.	3	
	Current trends in antibiotic therapy.	3	
III	Antihypertensive agents and diuretics: Classification of cardiovascular agents	3	Chalk& talk, ppt Problem Solving, Quiz, Test
	Introduction to hypertension, etiology, types, classification of antihypertensive agents	3	
	Drug inhibitors of peripheral sympathetic function, central intervention of cardiovascular output.	3	
	Direct acting arteriolar dilators. classification and mechanism of action of diuretics	3	
	Furosemide, Hydrochlorothiazide, Amiloride	3	
IV	Antidiabetic Agents Medicinal Chemistry of Antidiabetic Agents	3	Chalk& talk, ppt Problem Solving, Quiz, Test
	Introduction, Types of diabetics,	4	
	Drugs used for the treatment, chemical classification,	4	
	Mechanism of action, Treatment of diabetic mellitus, Chemistry of insulin, sulfonyl urea.	4	
V	Analgesics, Antipyretics and Anti-inflammatory Drugs Introduction, Mechanism of inflammation, classification and mechanism of action and paracetamol, Ibuprofen, Diclofenac, naproxen, indomethacin, phenylbutazone and meperidine.	3	Chalk& talk, ppt Problem Solving, Quiz, Assignment
	Classification and mechanism of action and paracetamol,	4	
	Ibuprofen, Diclofenac, naproxen, indomethacin	4	
	Phenylbutazone and meperidine.	4	

COURSE LEARNING OUTCOMES:

At the end of the course, the student will be able to

CLOs	CLO Statement	K-level
CLO1	Outline the importance of receptors	K2
CLO2	Classify different types antibiotics and its mode of action	K3
CLO3	Classify and study mechanism of action of antihypertensive agents and diuretics	K4
CLO4	Familiarize with the mode of action of diabetic agents and treatment of diabetes.	K4
CLO5	Know the mechanism and action of Analgesics, Antipyretics and Anti inflammatory Drugs	K4

Mapping of CLOs and POs

CLO	POs						PSOs					
	1	2	3	4	5	6	1	2	3	4	5	6
CLO1	3	3	3	3	3	3	3	3	3	3	3	3
CLO2	3	3	3	3	3	3	3	3	3	3	3	3
CLO3	3	3	3	3	3	3	3	3	3	3	3	3
CLO4	3	3	3	3	3	3	3	3	3	3	3	3
CLO5	3	3	3	3	3	3	3	3	3	3	3	3
3- Advance Application						2 – Intermediate Level			1 – Basic Level			

Blueprint for Summative Examination
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D(Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO1	Up to K2	2	K1 & K1	1	K1	2 (K1 & K1)	1 (K2)
2	CLO2	Up to K3	2	K2 & K3	1	K1	2 (K2 & K2)	1 (K3)
3	CLO3	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1 (K4)
4	CLO4	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1 (K4)
5	CLO5	Up to K4	2	K2 & K3	1	K3	2 (K3 & K3)	1 (K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A& B (No Choice)	Section C (Either /or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated %
K1	6	10	-	16	13.3	35
K2	6	10	10	26	21.7	
K3	6	10	10	26	21.7	22
K4	2	20	30	52	43.3	43
Total marks	20	50	50	120	100	100

DEPARTMENT: CHEMISTRY					CLASS: I M.Sc., CHEMISTRY			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
II	Core Elective	25P2CECT4 (A)	Bio-inorganic chemistry	3	5	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

Objectives:

The objective of this course is to make the student to

- understand the role of trace elements.
- understand the biological significance of iron, sulphur.
- study the toxicity of metals in medicines.
- acquire knowledge on diagnostic agents.
- discuss on various metalloenzymes properties

Unit	Description	Hours	K-level	CLO
I	Essential trace elements and metalloenzyme : Importance of essential trace elements and Selective transport and storage of metal ions: Ferritin, and Transferrin; Sodium and potassium pump. Metalloenzymes: Zinc enzymes– carboxypeptidase and carbonic anhydrase. Iron enzymes– catalase, and peroxidase. Copper enzymes – superoxide dismutase, and Plastocyanin. Cobalt enzymes – Vitamin- B ₁₂ coenzymes Blended Learning Importance of essential trace elements and Selective transport, Copper enzymes – superoxide dismutase, and Plastocyanin. Cobalt enzymes – Vitamin- B ₁₂ coenzymes	15	Upto K2	1
II	Transport Proteins: Oxygen carriers -Hemoglobin and myoglobin - Structure and oxygenation Bohr Effect. Poisoning effect of CO, NO, CN ⁻ to Myoglobin and Hemoglobin. Biological redox system: Cytochromes– Classification, cytochrome a, b and c. Work function of Cytochrome P-450. Non-heme oxygen carriers – Structure and function of Hemerythrin and hemocyanin. Iron-sulphur proteins – Structure and function of Rubredoxin and Ferredoxin (Fe ₂ S ₂ , Fe ₃ S ₄ , & Fe ₄ S ₄).	15	Upto K3	2

	Blended Learning Non-heme oxygen carriers – Structure and function of Hemerythrin and hemocyanin			
III	Nitrogen fixation and photosynthesis Introduction, types of nitrogen fixing microorganisms symbiotic and asymbiotic bacteria. Nitrogenase enzyme - Metal clusters in nitrogenase: Fe protein and Fe-Mo protein - redox property - Dinitrogen complexes – transition metal complexes of dinitrogen - nitrogen fixation via in-vivo method (biological method) and nitrogen fixation via in-vitro method (Haber-Bosch process). Photosynthesis: structural features and classification of chlorophylls -photosystem-I and photosystem-II and work function using Z diagram – dark and light reactions. Blended Learning Nitrogen fixation- Nitrogenase enzyme - Metal clusters in nitrogenase: Fe protein and Fe-Mo protein- nitrogen fixation via in-vivo method (biological method) and nitrogen fixation via in-vitro method (Haber-Bosch process).	15	Upto K4	30
IV	Metals toxicity, deficiency, and medicine: Metal Toxicity: harmful effect, symptoms and treatment for the toxicity of Hg, Cd, and Pb. Deficiency and excess symptoms of trace elements Zn, Cu, and Co Therapeutic Compounds: Vanadium Based Diabetes Drugs; Platinum Containing Anticancer Agents; Gold based Anti-arthritis; lithium therapy in psychiatric disorder- Chelation therapy for lead, mercury and cadmium- Diagnostic Agents: Technetium Imaging Agents; Gadolinium MRI Imaging Agents.	15	Upto K4	4
V	Metalloenzymes kinetics Enzyme kinetics- Pre-steady state kinetics, free energy of activation. Michaelis - Menton equation - Allosteric Effects – Homo and hetero allosteric regulations- Effect of concentration, pH, temperature - enzyme inhibitors and its types, effect enzyme inhibitors on enzyme reactions.	15	Upto K4	5

Books for Study:

1. Williams,D.R. – Introduction to Bioinorganic chemistry.
2. F.M. Fiabre and D.R. Williams– The Principles of Bioinorganic Chemistry, Royal Society of Chemistry, Monograph for Teachers-31
3. K.F. Purcell and Kotz., Inorganic chemistry, WB Saunders Co., USA.G.N. Mugherjea

Books for References:

1. M. Satake and Y.Mido, Bioinorganic Chemistry- Discovery Publishing House, New Delhi (1996)

2. M.N. Hughes, 1982, The Inorganic Chemistry of Biological processes, II Edition, Wiley London.
3. R.W. Hay, Bio Inorganic Chemistry, Ellis Horwood, 1987.

Web Resources:

1. <https://www.pdfdrive.com/instant-notes-in-inorganic-chemistry-the-instant-notes-chemistry-series-d162097454.html>
2. <https://www.pdfdrive.com/shriver-and-atkins-inorganic-chemistry-5th-edition-d161563417.html>
3. <https://rarediseases.org/rare-diseases/heavy-metal-poisoning/>

Blended Learning link:

UNIT I:

1. Week1: Lecture 2: Metals in Biology: Nature's Selection of Elements in Life
https://onlinecourses.nptel.ac.in/noc25_cy08/unit?unit=17&lesson=19
2. Lecture 5: Metals in Biology: Importance of Cobalt in Coenzyme-B12
https://onlinecourses.nptel.ac.in/noc25_cy08/unit?unit=17&lesson=22
3. Lecture 12: Life with Oxygen: Superoxide Dismutase Activity
https://onlinecourses.nptel.ac.in/noc25_cy08/unit?unit=33&lesson=35

UNIT II

1. Lecture 15: Life with Oxygen: O₂-Carrying Proteins Hemocyanin & Hemerythrin
https://onlinecourses.nptel.ac.in/noc25_cy08/unit?unit=33&lesson=38

UNIT III

1. Lecture 9: Design Principles Used in Chemical Biology: Fixation of Nitrogen from Air
https://onlinecourses.nptel.ac.in/noc25_cy08/unit?unit=25&lesson=29

Rationale for Nature of the course

This course will enable to the students to enrich their knowledge on various area of bioinorganic chemistry and the ways to develop their skill thus it brings employability Skill Development

Activities having direct bearing on Skill development / Employability Entrepreneurship

To enhance skill development and employability related to the outlined content, students may understand the role of trace elements, the biological significance of iron, sulphur. Furthermore; it will provide valuable insights into toxicity of metals & metals in medicines, on diagnostic agents and potential career opportunities

Pedagogy

- Chalk-Talk class room Activities
- Group Discussion
- Seminar
- Quiz through ICT- Mode

Name of the course Designer

Dr. M. Boominathan

Course Schedule

Unit	Descriptions	Hours	Lecture
I	Essential trace elements and metalloenzyme: Importance of essential trace elements and Selective transport and storage of metal ions: Ferritin, and Transferrin; Sodium and potassium pump.	5	Chalk& talk/ppt/ Blended Learning Problem Solving/Quiz/ Test
	Metalloenzymes: Zinc enzymes– carboxypeptidase and carbonic anhydrase. Iron enzymes– catalase, and peroxidase.	5	
	Copper enzymes – superoxide dismutase, and Plastocyanin. Cobalt enzymes – Vitamin-B ₁₂ coenzymes	5	
II	Transport Proteins: Oxygen carriers -Hemoglobin and myoglobin - Structure and oxygenation Bohr Effect. Poisoning effect of CO, NO, CN ⁻ to Myoglobin and Hemoglobin.	5	Chalk& talk/ppt / Blended Learning Problem Solving/Quiz/ Test
	Biological redox system: Cytochromes– Classification, cytochrome a, b and c. Work function of Cytochrome P-450.	5	
	Non-heme oxygen carriers – Structure and function of Hemerythrin and hemocyanin. Iron-sulphur proteins – Structure and function of Rubredoxin and Ferredoxin (Fe ₂ S ₂ , Fe ₃ S ₄ , & Fe ₄ S ₄).	5	
III	Nitrogen fixation and photosynthesis Introduction, types of nitrogen fixing microorganisms symbiotic and asymbiotic bacterias. Nitrogenase enzyme - Metal clusters in nitrogenase: Fe protein and Fe-Mo protein - redox property	5	Chalk& talk/ppt/ Blended Learning Problem Solving/Quiz/ Test
	Dinitrogen complexes – transition metal complexes of dinitrogen - nitrogen fixation via in-vivo method (biological method) and nitrogen fixation via in-vitro method (Haber-Bosch process).	5	
	Photosynthesis: structural features and classification of chlorophylls -photosystem-I and photosystem-II and work function using Z diagram – dark and light reactions.	5	
IV	Metals toxicity, deficiency, and medicine: Metal Toxicity: harmful effect, symptoms and treatment for the toxicity of Hg, Cd, and Pb. Deficiency and excess symptoms of trace elements Zn, Cu, and Co	5	Chalk& talk/ppt Problem Solving/Quiz/ Test
	Therapeutic Compounds: Vanadium Based Diabetes Drugs; Platinum Containing Anticancer Agents; Gold based Anti-arthritis; lithium therapy in psychiatric disorder	5	
	Chelation therapy for lead, mercury and cadmium- Diagnostic Agents: Technetium Imaging Agents; Gadolinium MRI Imaging Agents.	5	
V	Metalloenzymes kinetics		Chalk&

	Enzyme kinetics- Pre-steady state kinetics, free energy of activation.	5	talk/ppt Problem Solving/Quiz/ Assignment
	Michelis - Menton equation - Allosteric Effects – Homo and hetero allosteric regulations	5	
	Effect of concentration, pH, temperature - enzyme inhibitors and its types, effect enzyme inhibitors on enzyme reactions	5	

COURSE OUTCOMES:

At the end of the course, the student will be able to

CLO	CLO Statement	K-level
CLO1	Describe the role of various trace elements in biological system	K2
CLO2	Explain the various biological redox systems in biochemical reactions	K3
CLO3	Examine the redox centres involved in nitrogen fixation and photosynthesis	K4
CLO4	Analysing the toxicity of heavy metals and finding the suitable drugs.	K4
CLO5	Inferring the catalytic and kinetic mechanism of enzymes	K4

Mapping of CLOs and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	2	3	2	3	2	3
CLO2	3	3	2	3	3	2
CLO3	1	3	2	2	2	3
CLO4	3	3	2	2	3	1
CLO5	3	3	2	3	3	3

Mapping with Programme Specific Outcomes:

CLO	PSOs					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	3	3	3	2	2	2
CLO2	3	3	2	3	2	2
CLO3	3	3	2	3	2	2
CLO4	3	3	2	3	2	2
CLO5	3	3	3	3	2	2

Blueprint for Semester Examination
Articulation Mapping-K Levels with Courses Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO1	Up to K2	2	K1 & K1	1	K1	2 (K1 & K1)	1 (K2)
2	CLO2	Up to K3	2	K2 & K3	1	K1	2 (K2 & K2)	1 (K3)
3	CLO3	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1 (K4)
4	CLO4	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1 (K4)
5	CLO5	Up to K4	2	K2 & K3	1	K3	2 (K3 & K3)	1 (K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A& B (No Choice)	Section C (Either /or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated %
K1	6	10	-	16	13.3	35
K2	6	10	10	26	21.7	
K3	6	10	20	36	30	30
K4	2	20	20	42	35	35
Total marks	20	50	50	120	100	100

DEPARTMENT OF CHEMISTRY					CLASS: I M.Sc., Chemistry			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
II	Elective (Generic Elective)	25P2CECT4	MATERIAL SCIENCE	5	5	25	75	100
Nature of course		Skill oriented	√	Employability oriented	√	Entrepreneurship Oriented		

Objectives:

The objective of this course is to make the student to

- Understand the classification and nature of bonding in materials
- Explain various application and properties of material
- Recognize the basis of semiconductors, superconductivity materials and magnets
- Study the synthesis, classification and applications of nanomaterials
- Study the synthesis, classification and applications of nanomaterials

Unit	Description	Hours	K-level	CLO
I	Classification and Structure of Materials Classification of materials: metals, ceramics, polymers and composites. Nature of bonding in materials: metallic, ionic, covalent and mixed bonding; structure of materials: fundamentals of crystallography, symmetry operations, crystal systems, Bravais lattices, unit cells, primitive cells, crystallographic planes and directions; structures of metals, ceramics, polymers, amorphous materials and glasses.	15	Up to K2	1
II	Properties and Applications of Materials Mechanical properties: Mechanical properties of metals, ceramics, polymers and composites at room temperature; stress-strain response (elastic, anelastic and plastic deformation). Electronic properties: free electron theory, Fermi energy, density of states, elements of band theory, semiconductors, Hall effect, dielectric behaviour, piezo- and ferro-electric behaviour. Magnetic properties: Origin of magnetism in materials, para-, dia-, ferro- and ferrimagnetism. Thermal properties: Specific heat, heat conduction, thermal diffusivity, thermal expansion, and thermoelectricity. Optical properties: Refractive index, absorption and transmission of electromagnetic radiation.	15	Up to K3	2

III	Crystal growth methods: (15 Hrs) Nucleation–equilibrium stability and metastable state. Single crystal –Low and high temperature, solution growth– Gel and sol-gel. Crystal growth methods- nucleation– equilibrium stability and metastable state. Single crystal–Low and high temperature, solution growth– Gel and sol-gel. Melt growth - Bridgeman-Stockbarger, Czochralski methods. Flux technique, physical and chemical vapour transport. Lorentz and polarization factor - primary and secondary extinctions.	15	Up to K4	3
IV	Unit IV: Special Materials: (15 Hrs) Soft and hard magnets – Domain theory Hysteresis Loop-Applications. Magneto and giant magneto resistance. Ferro, ferri and antiferromagnetic materials-applications, magnetic parameters for recording applications. Ferro-, Piezo-, and pyro electric materials – properties and applications. Shape memory Alloys-characteristics and applications, Non-linear optics-Second Harmonic Generators, mixing of Laser wavelengths by quartz, ruby and LiNbO ₃ . Blended Learning Superconductivity: Meissner effect, Critical temperature and critical magnetic Field, Type I and II superconductors, BCS theory-Cooper pair, Applications	15	Up to K4	4
V	Materials for Renewable Energy Conversion: Solar Cells: Organic, bilayer, bulk Heterojunction, polymer, perovskite based. Solar energy conversion: lamellar solids and thin films, dye-sensitized photo voltaic cells, coordination compounds anchored onto semiconductor surfaces - Ru(II) and Os(II) polypyridyl complexes. Photochemical activation and splitting of water, CO ₂ and N ₂ . Manganese based photo systems for water- splitting. Complexes of Rh, Ru, Pd and Pt - photochemical generation of hydrogen from alcohol.	15	Up to K4	5

Books for study:

1. S. Mohan and V. Arjunan, Principles of Materials Science, MJP Publishers, 2016.
2. Arumugam, Materials Science, Anuradha Publications, 2007.
3. Giacavazzo et. al., Fundamentals of Crystallography, International Union of Crystallography. Oxford Science Publications, 2010

Books for References:

1. M.G. Arora, Solid State Chemistry, Anmol Publications, New Delhi, 2001.
2. R.K. Puri and V.K. Babbar, Solid State Physics, S Chand and Company Ltd, 2001.
3. C. Kittel, Solid State Physics, John-Wiley and sons, NY, 1966.
4. H.P. Meyers, Introductory Solid State Physics, Viva Books Private Limited, 1998.
5. A.R. West, Solid State Chemistry and Applications, John- Wiley and sons, 1987.

Web Resources

1. <http://xrayweb.chem.ou.edu/notes/symmetry.html>.
2. <http://www.uptti.ac.in/classroocontent/data/Unit%20cell.pdf>.
3. <https://bit.ly/3QyVg2R>

Blended Learning link:

UNIT IV:

Week 2: Type-I and Type-II superconductors, linear response theory, BCS theory, Boundary value problems at high frequencies

<https://archive.nptel.ac.in/courses/115/103/115103108/>

Rationale for Nature of the course

This course will enable the students to know about the classification, properties and bonding nature of materials. Discuss the materials based energy sources

Activities having direct bearing on Skill development / Employability Entrepreneurship

The basic knowledge gained through this course, students can predict the way of special materials, energy source materials, application oriented Materials.

Pedagogy

- Chalk-Talk Class room Activities
- Group discussion & Seminar
- Assignment and Quiz through ICT

Course Designer(s):

Dr. P. Gajendran

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Classification of materials: metals, ceramics, polymers and composites.	4	PPT, Chalk and talk, Group Discussion, Quiz/Seminar, Test
	fundamentals of crystallography, symmetry operations	4	
	crystal systems, Bravais lattices, unit cells, primitive cells, crystallographic planes and directions	4	
	structures of metals, ceramics, polymers, amorphous materials and glasses	3	
Unit II	Properties and Applications of Materials Mechanical properties: Mechanical properties of metals, ceramics, polymers and composites at room temperature; stress-strain response (elastic, anelastic and plastic deformation).	3	PPT, Chalk and talk, Group Discussion, Quiz/Seminar, Test
	Electronic properties: free electron theory, Fermi energy, density of states, elements of band theory, semiconductors, Hall effect, dielectric behaviour, piezo- and ferro-electric behaviour.	3	
	Magnetic properties: Origin of magnetism in materials, para-, dia, ferro- and ferrimagnetism.	3	
	Thermal properties: Specific heat, heat conduction, thermal diffusivity, thermal expansion, and thermoelectricity.	3	
	Optical properties: Refractive index, absorption and transmission of electromagnetic radiation.	3	
Unit III	Crystal growth methods: (15 Hrs) Nucleation–equilibrium stability and metastable state. Single crystal	3	PPT, Chalk and talk, Group Discussion, Quiz/Seminar, Test
	Gel and sol-gel. Crystal growth methods- nucleation–equilibrium stability and metastable state.	3	
	Low and high temperature, solution growth Single crystal–Low and high temperature, solution growth	3	
	Gel and sol-gel. Melt growth - Bridgeman-Stockbarger, Czochralski methods.	3	
	Flux technique, physical and chemical vapour transport. Lorentz and polarization factor - primary and secondary extinctions.	3	
Unit IV	Superconductivity: Meissner effect, Critical temperature and critical magnetic mixing of Laser wavelengths by quartz, ruby and LiNbO ₃ .	3	PPT, Chalk and talk, Group Discussion, Quiz/Seminar, Test
	Type I and II superconductors, BCS theory-Cooper pair, Applications	3	

	Soft and hard magnets – Domain theory Hysteresis Loop-Applications	3	
	Magneto and giant magneto resistance. Ferro, ferri and antiferromagnetic materials-applications, magnetic parameters for recording applications.	2	
	Field, Ferro-, Piezo-, and pyro electric materials – properties and applications. Shape memory	2	
	Alloys-characteristics and applications, Non-linear optics-Second Harmonic Generators,	2	
Unit V	Materials for Renewable Energy Conversion: Solar Cells: Organic, bilayer, bulk heterojunction, polymer	3	PPT, Chalk and talk, Assignment
	perovskite based. Solar energy conversion: lamellar solids and thin films,	3	
	Ru(II) and Os(II) polypyridyl complexes. Photochemical activation and splitting of water, CO ₂ and N ₂ .	3	
	dye-sensitized photo voltaic cells, coordination compounds anchored onto semiconductor surfaces	3	
	Manganese based photo systems for water- splitting. Complexes of Rh, Ru, Pd and Pt - photochemical generation of hydrogen from alcohol. Biginelli reaction, Japp-Klingemann reaction, Bamford-Stevens reaction, Shapiro reaction.	3	

Course Learning Outcomes

After successful completion of this course, the student will be able to

CLO	CLO Statements	K-level
CLO1	Understand and recall the synthesis and characteristics of crystal structures, semiconductors, magnets, nanomaterials and renewable energy materials	K2
CLO2	Integrate and assess the structure of different materials and their properties.	K3
CLO3	Analyze and identify new materials for energy applications.	K4
CLO4	Explain the importance of crystal structures, piezoelectric and pyroelectric materials, nanomaterials, hard and soft magnets, superconductors, solar cells, electrodes, LED uses, structures and synthesis.	K4
CLO5	Design and develop new materials with improved property for energy applications.	K4

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CLO-1	3	3	3	2	2	2
CLO-2	3	3	2	3	2	2
CLO-3	3	3	2	3	2	2
CLO-4	3	3	2	3	2	2
CLO-5	3	3	3	3	2	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	2	2	1	1	1	2
CLO2	2	2	1	1	1	3
CLO3	2	2	1	1	1	3
CLO4	2	2	1	1	1	3
CLO5	2	2	1	1	1	3

Advance application – 3;

Intermediate level – 2;

Basic level – 1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2 (K1 & K1)	1 (K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K1	2 (K2 & K2)	1 (K3)
3	CLO 3	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1 (K4)
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1 (K4)
5	CLO 5	Up to K4	2	K2 & K3	1	K3	2 (K3 & K3)	1 (K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A & B (No Choice)	Section C (Either /or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated %
K1	6	10	-	16	13.3	35
K2	6	10	10	26	21.7	
K3	6	10	20	36	30	30
K4	2	20	20	42	35	35
Total marks	20	50	50	120	100	100

DEPARTMENT: CHEMISTRY					CLASS: I M.Sc., CHEMISTRY			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
II	NME - II	25P2CSEN2	CHEMISTRY BEHIND THE TRADITIONAL MEDICINAL PLANTS	2	2	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	✓

Objectives:

This course enables the students to

- understand the Types of Traditional system of medicine
- aware the medicinal importance of some roots
- recognize the Therapeutic application of flowers
- grasp some common application of leaves in medical treatment
- know uses of fruits in health care treatment.

Unit	Description	Hours	K-level	CLO
I	Introduction to traditional systems of medicine: Ayurveda, siddha Traditional Chinese Medicine, Unani, etc. and their significances.; Advantageous of traditional system of medicine over Allopathic medicine	6	Up to K2	1
II	Roots: Definition and importance of roots in traditional medicine:- Classification of Medicinal Roots based on therapeutic applications. Study of Common Name, Botanical Name, Phytochemical Composition, Medicinal Uses and side effects of Medicinally important roots such as Ginger, Turmeric, Ashwagandha, Licorice, Vetiver, Ginseng, Devil's Claw, Echinacea root, Dandelion root	6	Up to K2	2
III	Flowers: Definition and Role of flowers of as medicine Various Therapeutic uses of Flowers in therapeutic applications. Study of Botanical Name ,Common Name, Phytochemical Composition, therapeutic Uses of some Medicinally Important Flowers such as Hibiscus, Rose, Calendula, Lavender, Chamomil	6	Up to K2	3
IV	Leaves: Definition and importance of Leaves as medicine. Study of Botanical Name, Common Name, Phytochemical Composition, therapeutic Uses and side	6	Up to K2	4

	effects of some Medicinally Important leaves- Neem, Tulsi, Mint, Alo Vera, Moringa, Eucalyptus, Guava, Betel, Fenugreek, Peppermint, Curry Leaves, Oregano Leaf			
V	Fruits: Definition and significance of Fruits in Traditional medicine- Study of Botanical Name, Common Name, Phytochemical Composition, therapeutic Uses and side effects of some fruits-Amla, Pomegranate Papaya, Banana, Jamun, Bitter Melon, Avocado, Citrus Fruits (Oranges, Lemons, Limes, Grapefruit), Pineapple, Berries, Mango, Dates, Fig. and Watermelon	6	Up to K2	5

Books for Study:

1. T. Thirunarayanan, Siddha Medicine: Fundamental Principles and Application
2. Hakim Syed Zillur Rahman, Basics of Unani Medicine, National Council for Promotion of Urdu Language (NCPUL), 2004.

Books for References:

1. Chun-Su Yuan Textbook of Complementary and Alternative Medicine I, CRC Press (a part of the Taylor & Francis Group).2004.
2. Simon Mills and Kerry Bone Principles and Practice of Phytotherapy Churchill Livingstone (Elsevier), 2013.
3. Dr. Suresh Chaturvedi, Essentials of Ayurveda, Chaukhamba Sanskrit Pratishthan, 2003.

Web Resources:

1. <https://www.nccih.nih.gov/>
2. <https://ayush.gov.in/>
3. https://www.nhp.gov.in/ayurveda_mty
4. ichngoforum.org/wp-content/uploads/2018/01/Traditional-Medicine-Final-Web-3.pdf

Rationale for Nature of the course

Many students are able to utilise the beneficial aspects of alternative system of medicine and allopathic system of medicine through the practice of integrative medicine, in which they combine appropriate alternative and allopathic techniques according to the, symptoms, and circumstances and advise of physicians

Activities having direct bearing on Skill development / Employability Entrepreneurship

This course is designed to engage various activities which are directly contribute for skill development, Entrepreneurship and Employability among students. Here are some activities that can have a direct bearing on these aspects like i) Herbal industry visit ii) to identify the Bioactive components in various parts of plants responsible for Medicinal uses. Hence the students will have more chance to acquire knowledge and clear various competitive exams iii) even to launch a start-up company

Pedagogy

- Chalk-Talk class room Activities
- Group Discussion
- Seminar
- Quiz through ICT- Mode

Name of the course Designer

Dr. S. Vidhyasankar

Course Schedule

Unit	Topics	Hours	Mode
I	Introduction to traditional systems of medicine	1	Chalk and talk/PPT/Animated Videos/ quiz/ and Test
	Introduction to Ayurvedic system of medicine	1	
	Introduction to Siddha system of medicine	1	
	Introduction to chine system of medicine	1	
	Introduction to unani system of medicine	1	
	Advantageous of traditional system of medicine over Allopathis medicine	1	
II	Definition and importance of roots in traditional medicine:-	1	Chalk and talk/PPT/Animated Videos/ quiz/Test
	Classification of Medicinal Roots Based on therapeutic applications.	1	
	Botanical Name and Common Name, Phytochemical Composition, Medicinal Use and side effects - Ginger, Turmeric	1	
	Botanical Name and Common Name, Phytochemical Composition, Medicinal Use and side effects Ashwagandha, Licorice	1	
	Botanical Name and Common Name, Phytochemical Composition, Medicinal Use and side effects Vetiver, Ginseng, Devil's root	1	
	Botanical Name and Common Name, Phytochemical Composition, Medicinal Use and side effects Echinacea root, Dandelion root	1	
III	Definition and Role of flowers of as medicine	1	Chalk and talk/PPT/Animated Videos/ quiz/seminar and Test
	Various Therapeutic uses of lowers in therapeutic applications	1	
	Botanical Name and Common Name, Phytochemical Composition, therapeutic l Uses of Hibiscus, Rose, Calendula, Lavender, Chamomil	1	
	Botanical Name and Common Name, Phytochemical Composition, therapeutic l Uses of Rose, Calendula	1	
	Botanical Name and Common Name, Phytochemical Composition, therapeutic l Uses of Lavender	1	
	Botanical Name and Common Name, Phytochemical Composition, therapeutic l Uses of Chamomil	1	
IV	Definition and importance of Leaves in medicine	1	Chalk and talk/PPT/Animated Videos/
	Botanical Name and Common Name, Phytochemical Composition and Therapeutic Uses of various Medicinal Leaves	1	

	Botanical Name and Common Name, Phytochemical Composition and Therapeutic Uses of Neem, Tulsi,	1	quiz/ Test
	Botanical Name and Common Name, Phytochemical Composition and Therapeutic Uses of Mint,Alo-Vera,Moringa,	1	
	Botanical Name and Common Name, Phytochemical Composition and Therapeutic Uses of Eucalyptus, Guava, Betel	1	
	Botanical Name and Common Name, Phytochemical Composition and Therapeutic Uses of Fenugreek, Peppermint, Curry Leaves	1	
V	Definition and significance of Fruits in Traditional medicine-	1	Chalk and talk/PPT/Animated Videos/ quiz/ Assignment
	Botanical Name and Common Name, Phytochemical Composition and Therapeutic Uses of Fruits- Amla, Pomegranate Papaya,	1	
	Botanical Name and Common Name, Phytochemical Composition and Therapeutic Uses of Fruits Banana, Jamun, Bitter Melon,	1	
	Botanical Name and Common Name, Phytochemical Composition and Therapeutic Uses of Fruits Avocado. Citrus Fruits (Oranges, Lemons, Limes,	1	
	Botanical Name and Common Name, Phytochemical Composition and Therapeutic Uses of Fruits Grapefruit),	1	
	Botanical Name and Common Name, Phytochemical Composition and Therapeutic Uses of Fruits Pineapple, Berries, Mango, Dates, Watermelon, Fig	1	

COURSE LEARNING OUTCOMES:

At the end of the course, the student will be able to:

CLO	CLO Statement	K-level
CO1	Understand the various system of medicine	K2
CO2	Get awareness about roots of plants	K2
CO3	Recognize Therapeutic uses of flowers	K2
CO4	Identify various medicinally important leaves	K2
CO5	Classify some important fruits used in traditional system of medicine	K2

Mapping of CLOs and POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	2	1	2	2	2	2
CLO2	1	1	1	1	2	2
CLO3	1	1	1	1	1	1
CLO4	2	1	1	1	1	2
CLO5	2	1	1	1	1	1

Mapping of CLOs and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	2	2	1	1	1	1
CLO2	1	1	1	1	1	2
CLO3	2	2	1	1	1	1
CLO4	1	1	1	1	1	1
CLO5	1	1	1	1	1	1

Advance application -3;

Intermediate level -2;

Basic level-1

Blueprint for Summative Examination
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)
			MCQs		Short Answers		
			No. of Questions	K- Level	No. of Questions	K- Level	
1	CLO 1	Up to K2	1	K1	1	2 (K2 & K2)	1 (K1)
2	CLO 2	Up to K2	1	K1	1	2 (K2 & K2)	1 (K1)
3	CLO 3	Up to K2	1	K1	1	2 (K2 & K2)	1 (K1)
4	CLO 4	Up to K2	1	K1	1	2 (K2 & K2)	1 (K1)
5	CLO 5	Up to K2	1	K1	1	2 (K2 & K2)	1 (K1)
No. of Questions to be asked			5		5		5
No. of Questions to be answered			5		5		3
Marks for each question			2		7		10
Total Marks for each section			10		35		30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either /or)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated %
K1	10	-	50	60	46	46
K2	-	70		70	54	54
Total Marks	10	70	50	130	100	100



DEPARTMENT OF BOTANY

Revised Curriculum

Based on the model curriculum of

TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION (TANSCH)

With elements from

Learning Outcome Based Education framework (LOBE) of UGC

(Choice Based Credit system with Outcome Based Education)

Academic Year 2023-2024 onwards

V and VI semesters (B.Sc. Botany) – Regulation 2023

I and II semesters (M.Sc. Botany) – Regulation 2025



THE MADURA COLLEGE
An Autonomous Institution affiliated to Madurai Kamaraj University
Re-accredited (4th Cycle) with 'A' grade by NAAC
Vidya Nagar, T.P.K. Road, Madurai – 625 011

UG-BOTANY

Vision

Producing Botany students as ambassadors of sustainable development in all spheres of human activity and leaving the earth to the successive generation as intact as possible.

Mission

To sensitize the Botany students to the classification, structure, physiology, ecology, genetics and economic importance of plants

To inculcate the students with an environment that fosters the development of appropriate scientific vocabulary, reasoning skills and effective oral and written communication ability for students.

To create holistic understanding of the allied subjects through interdisciplinary learning.

Programme: B.Sc. Botany	
Duration: 3 years	
Programme Outcomes (POs)	
The B.Sc. Botany programmes designed to achieve the following objectives	
PO1	Apply the knowledge of science and technology fundamentals for findings solution for complex problems.
PO2	To provide up-to-date theoretical knowledge on various forms of plants, their interactions with biotic and abiotic entities in the ecosystem and relevant practical skills.
PO3	To comprehend and interpret various facets of Botany including the importance and judicious utilization and conservation of plant resources.
PO4	To disseminate knowledge on the design and execution of experiments in Botany with emphasis on the operation of relevant sophisticated instruments.
PO5	To promote proficiency in designing the research problems, review of literature, laboratory experiments, data analyses and preparation of reports with professional ethics.
PO6	To enable the students to take up various qualifying examinations concerning Botany and to face the challenges in career opportunities.

Programme Specific Outcomes (PSOs)

PSO1	Implement the concept of science and technology to foster the traditional and modern techniques for solving the complex problems in Plant Biology.
PSO2	Develop the scientific problem-solving skills during experimentation, research projects, analysis and interpretation of data
PSO3	Design scientific experiments independently and to generate useful information to address various issues in Botany.
PSO4	Apply appropriate techniques, resources, and modern ICT tools for understanding plant resources.
PSO5	Demonstrate the contextual knowledge in sustainable exploitation of medicinal, economically important and endangered plants as per the National Biodiversity Act.
PSO6	Communicate proficiently with various stakeholders and society, to comprehend and to write and present reports effectively

EVALUATION (Theory)

Internal (Formative): 25 Marks

External (Summative): 75 Marks

Total: 100 Marks

Continuous Internal Assessment (CIA): (Major & Electives: 25 marks)

S. No.	Components	Marks
1.	Test (Average of two tests conducted for 40 marks and converted into 10 marks)	10
2.	Assignment	05
3.	Seminar	05
3.	Model Making/ / Poster or Chart presentation/Quiz/Documentation/ Case lets/ICT based Assignment/ Mini Project/Attendance	05
Total		25

Question Paper pattern for Theory external examination (Major & Electives: 75 marks)

S. No.	Section	Marks
1.	A. Multiple Choice Question (10x1)	10
2.	B. Short Answer type (5x2)	10
3.	C. Either/or Type (5x5)	25
4.	D. open Choice Type (3 out of 5 questions, 3x10)	30
Total		75

EVALUATION (Practical)

Internal (Formative): 25 Marks

External (Summative): 75 Marks

Total: 100 Marks

Question Paper pattern for Internal /Model practical examination (Major: 25 marks)

S. No.	Components	Marks
1.	Major question (sections/dissections/experiments)	10
2.	Minor Question (sections/dissections/experiments)	05
3.	Spotters	05
4.	Record	05
	Total	25

Question Paper pattern for external practical examination (Major: 75 marks)

S. No.	Components	Marks
1.	Major question (sections/dissections/experiments)	30
2.	Minor Question (sections/dissections/experiments)	20
3.	Spotters	20
4.	Record	05
	Total	75

Internal and External Valuation for U. G Project

Internal (25 Marks)	External (75 Marks)
Guide Evaluation: 1. 10 Marks for students' ability and interest. 2. 10 Marks for regularity and Punctuality. 3. 05 Marks for quality of the work and presentation.	External Evaluation: 1. 25 Marks for Viva-voce 2. 50 Marks for report, presentation, quality of the work (in the presence of HoD, project guide jointly with external examiner).

THE MADURA COLLEGE (AUTONOMOUS), MADURAI - 11

DEPARTMENT OF BOTANY

TANSCHÉ - Curriculum Structure for B.Sc. Botany (Major) to be implemented from June 2023- 2024 onwards

Programme Structure:

Semester I				
Part	Course description	Course Code	Hours	Credits
I	Language – I Tamil / Hindi / Sanskrit	23U1TLAN1 23U1HLAN1 23U1SLAN1	6	3
II	Language – II English	23U1NENG1	6	3
III	Core Course – Plant Diversity I – Algae	23U1CCBT1	5	4
	Core Practical – I	23U1CCBP1	3	3
	Generic Elective – 1 Allied Zoology	23U1CAZT1	4	3
	Generic Elective –1 Allied Zoology Practical	23U1CAZP1	2	1
IV	Skill Enhancement Course (NME1) – Organic farming	23U1BNME1	2	2
	Foundation course (FC)	23U1BFCT1	2	2
Total			30	23
Semester II				
Part	Course description	Course code	Hours	Credits
I	Language - I Tamil / Hindi / Sanskrit	23U2TLAN2 23U2HLAN2 23U2SLAN2	6	3
II	Language – II English	23U2NENG2	6	3
III	Core Course – Plant Diversity II	23U2CCBT2	5	4
	Core Course – Practical – II	23U2CCBP2	3	3
	Generic Elective – 2 Allied Zoology Theory	23U2CAZT2	4	2
	Generic Elective – 2 Allied Zoology Practical	23U2CAZP2	2	1
	Skill Enhancement Course (SEC-2; NME2) – Mushroom cultivation	23U2BNME2	2	2
	SEC – Subject Specific (SEC-3) – Botanical gardening and landscaping	23U2BSEC2	2	2
Total			30	23

Semester III				
Part	Course description	Course code	Hours	Credits
I	Language – I Tamil / Hindi / Sanskrit	23U3TLAN3 23U3HLAN3 23U3SLAN3	6	3
II	Language – II English	23U3NENG3	6	3
III	Core Course –3 Plant Diversity III - Bryophytes and Pteridophytes	23U3BCCT3	4	4
	Core Course – 3 Practical III	23U3BCCP3	3	3
	Allied Elective – 3 – Chemistry paper – III	23U3CGET1	4	4
	Allied Practical – 3	23U3CGEP1	2	1
	Skill Enhancement Course - (SEC-4) – Herbal Technology	23U3BSED4	2	2
	Skill Enhancement Course - (SEC 5) – Entrepreneurial opportunities in Botany	23U3BSED5	2	2
IV	Environmental Studies	23U3EVST1	1	-
Total			30	22
Semester IV				
Part	Course description	Course code	Hours	Credits
I	Language – I Tamil / Hindi / Sanskrit	23U4TLAN4 23U4HLAN4 23U4SLAN4	6	3
II	Language – II English	23U4NENG4	6	3
III	Core Course –4 Plant Diversity IV – Gymnosperms, Palaeobotany and Evolution	23U4BCCT4	4	4
	Core Course – 4 Practical IV	23U4BCCP4	3	3
	Allied Elective – 4 – Chemistry paper – IV	23U4CGET2	4	4
	Allied Practical – 4	23U4CGEP2	2	1
	Skill Enhancement Course (SEC-6) – Fermentation Technology	23U4BSED6	2	2
	Skill Enhancement Course (SEC-7) – Biostatistics	23U4BSED7	2	2
IV	Environmental Studies	23U4EVST2	1	2
	Extension Activity	23U4EXT1	0	1
Total			30	25

Semester-V				
Part	Course description	Course code	Hours	Credits
	Core Course –5-Plant Morphology, Taxonomy and Economic Botany	23U5BCCT5	5	4
	Core Course –6-Plant Anatomy and Embryology	23U5BCCT6	5	4
	Core Course-7-Cell Biology, Genetics and Plant Breeding	23U5BCCT7	5	4
	Core Course – 5-Practical V	23U5BCCP5	3	3
	Discipline Elective Course-I- Computer Application in Botany / Bionanotechnology	23U5BDET1(A) / 23U5BDET1(B)	5	4
	IDC-Bio-Analytical Techniques/ Climate Change	23U5BIDT1(A) / 23U5BIDT1(B)	5	4
	Value Education	23U5VENTI	2	2
	Industrial / Field visit	23U5BINTR	0	2
	Total		30	27
Semester-VI				
Part	Course description	Course code	Hours	Credits
	Core Course –8-Plant Ecology and Phytogeography	23U6BCCT8	6	4
	Core Course –9- Molecular Biology and Plant Biotechnology	23U6BCCT9	6	4
	Core Course –10-Plant Physiology and Biochemistry	23U6BCCT10	6	4
	Core Course – 6-Practical VI	23U6BCCP6	3	3
	Discipline Elective Course-II-Forensic Botany/ Ethnobotany and Pharmacognosy	23U6BDET2 (A) / 23U6BDET2(B)	4	2
	Skill Enhancement Course-Professional Competency Skill - Botany for Competitive Examinations	23U6BSED8	2	2
	Project and Viva voce	23U6BPROV	3	2
	Total		30	21
	Total Hours		180	141

DEPARTMENT OF BOTANY				CLASS: III B.Sc. BOTANY				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/Week	CIA	Ext.	Total
V	Core	23U5BCCT5	Plant Morphology, Taxonomy and Economic Botany	4	5	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	

Objectives:

The students will be able to,

1. Understand the vegetative and reproductive morphology of flowering plants.
2. Apply the basic concepts for classification, nomenclature and identification of plants.
3. Analyse the salient features of selected plant families for identification and economic importance.
4. Recognize the characteristic features of selected plant to know their economic importance.
5. Evaluate the economic importance and beneficial utilization of higher plants.

Unit	Description	Hours	K-level	CLO
I	Morphology of flowering plants: Root system- types and modifications. Shoot system – aerial, sub-aerial underground and root modifications. Leaves – types with examples. Phyllotaxy – types with examples; leaf modifications – phyllode and pitcher. Inflorescences –types with examples, special types – Cyathium and Hypanthodium. Flowers – classification based on position of ovary and sexuality. Floral leaf arrangements - aestivation. Fruits –types with examples.	15	Up to K4	1
II	Principles of classification, nomenclature and identification – Outline, merits and demerits of artificial system – Linnaeus. Natural – Bentham Hooker and Phylogenetic – Engler & Prantl. Salient features of APG-IV classification. Binomial nomenclature, principles of ICN, rules and recommendations – <i>nomina conservanda</i> , typification and author citation. Herbarium technique, Digital herbarium. Local Floras – Flora of Tamil Nadu. Botanical Survey of India and its role in plant taxonomy.	15	Up to K4	2
III	Systematic analysis of selected plant families – I Distribution, vegetative and floral morphology and economic importance of Annonaceae, Nymphaeaceae, Brassicaceae, Portulacaceae, Rutaceae, Myrtaceae, Passifloraceae, Rubiaceae, Apocynaceae and Bignoniaceae.	15	Up to K4	3

IV	Systematic analysis of selected plant families – II Distribution, vegetative and floral morphology and economic importance of Convolvulaceae, Scrophulariaceae, Lamiaceae, Amaranthaceae, Euphorbiaceae, Orchidaceae, Liliaceae, Commelinaceae, Araceae and Poaceae.	15	Up to K4	4
V	Economic botany: Botanical name, family, morphology of useful part and uses of Cereal – Rice and minor millets, Pulses – Green gram and horse gram; Sugar yielding plants – Sugarcane and Beetroot; Vegetable Oil seed – Groundnut and Sunflower; spices and condiments – Cardamom and clove; Essential oil - Eucalyptus and Geranium; Timber yielding plants – Teak and Red sander; Fibre plants - Cotton and Jute.	15	Up to K4	5

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination)	Questions related o the above topics, from various competitive examinations UPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/others to be solved.
Skills acquired from this course	Knowledge, Problem Solving, Analyticalability, Professional Competency, Professional Communication and Transferrable Skill.
Justification for nature of course	This course enhances the better understanding of morphology, classification, identification, nomenclature and economic botany of angiosperms.
Text Book(s)	1. Gurucharan Singh, (2017) Plant systematics – Theorv and Practice. Oxford & IBH Publishing, New Delhi. ISBN: 9781578083510 2. Pullaiah, T. and Karuppusamy, S. (2018) Taxonomy of Angiosperms, 4th revised Ed. Astral International Publishers, New Delhi. ISBN: 9789352220212 3. Sharma, O.P. (2011) Plant Taxonomy, 2nd Edition, Tata-McGraw Hill Pvt. Ltd., New Delhi: ISBN: 9781259081378 4. Subramanyam, N.S. (2009) Modern Plant Taxonomy, Vikas Publishing Pvt. Ltd., New Delhi. ISBN: 9780706993462
Reference Book(s)	1. Gupta, R. (2012) Plant Taxonomy: Past, Present and Future. Teri Publication Pvt. Ltd., New Delhi. ISBN: 9788179933596 2. Tod F, Stuessy, (2009) Plant Taxonomy: The systematic evolution of comparative data. Columbia University Press, London. ISBN: 978-0231147125 3. Singh, D.K., Singh, V. (2009) Taxonomy of Angiosperm, Rastogi publication, New Delhi. ISBN: 978-8171338498 4. Sinha, R.K. (2013) Practical Taxonomy of Angiosperm, IK international publishing house Pvt. Ltd., New Delhi. ISBN: 978-9380578217
Websites and e-Learning resources	https://library.viu.ca/c.php?g=188912&p=1247823 https://www.sil.si.edu/DigitalCollections/tl-2/ https://www.biodiversitylibrary.org/bibliography/48631 https://powo.science.kew.org/

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	recall the plant morphology of Angiosperms.	K1
CO2	review the classification, identification and nomenclature based on recent ICN.	K2
CO3	apply the vegetative and floral morphology, economic importance of selected dicot families.	K3
CO4	relate the vegetative, floral features and economic importance of Monochlamydeae and monocot families.	K4
CO5	recognize the economic potential of selected plants and their useful parts.	K4

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES:

Mapping of Course Outcomes (**CLO**) against Programme Outcomes (**PO**) and Programme Specific Outcomes (**PSOs**) the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1).

CLO	POs						PSOs					
	1	2	3	4	5	6	1	2	3	4	5	6
CLO1	3	3	1	3	2	3	1	2	2	1	2	2
CLO2	3	3	2	2	3	2	3	2	1	2	1	2
CLO3	2	2	1	1	2	1	2	1	3	1	1	1
CLO4	3	3	3	3	3	2	2	3	3	2	2	3
CLO5	3	3	2	3	2	1	3	3	3	2	1	2

Blueprint for Semester Examination

Sl. No	COs	K -Level	Section –A		Section –B		Section C (Either / Choice)	Section D (Open Choice)
			MCQs		Short Answer			
			No. of Questions	K –Level	No. of Questions	K -Level		
1	CO1	Up to K2	2	K1or K2	1	K1	2(K1&K1)	1(K2)
2	CO2	Up to K3	2	K1or K2	1	K1	2(K2&K2)	1(K3)
3	CO3	Up to K3	2	K1or K2	1	K2	2(K3&K3)	1(K3)
4	CO4	Up to K4	2	K1or K2	1	K2	2(K4&K4)	1(K4)
5	CO5	Up to K3	2	K1or K2	1	K2	2(K3&K3)	1(K3)
No. of Question to be asked			10		5		10	5
No. of Question to be answered			10		5		5	3
Mark for each question			1		2		5	10
Total Marks for each section			10		10		25	30

Distribution of Section-wise marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open)	K Levels	Section A (No Choice)	Section B (No Choice)
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF BOTANY				CLASS: III B.Sc. BOTANY				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/Week	CIA	Ext.	Total
V	Core	23U5BCCT6	Plant Anatomy and Embryology	4	5	25	75	100

Nature of Course	Knowledge and Skill	√	Skill Oriented	√	Employability Oriented	√	Entrepreneurship Oriented	

Objectives: The students will be able to,

- Know fundamental concepts of plant anatomy and embryology,
- Understand the internal tissue organization of various plant organs,
- Differentiate normal and abnormal secondary growth,
- Comprehend the structural organization of flowers with relevance to the process of pollination and fertilization and

Unit	Description	Hours	K Level	CLO
I	Plant Anatomy: Tissues - Definition and types. Simple tissue system - parenchyma, collenchyma and sclerenchyma (fibres and sclereids). Complex tissue system - xylem and phloem. Meristem - definition, structure, function and classification. Theories - Apical cell, Histogen and Tunica-Corpus and Korper-Kappe theory.	15	Upto K4	1
II	Primary structure of root and stem (dicot and monocot). Epidermal tissue system - epidermis, cuticle, trichome, bulliform cells, periderm and silica cells. Ground tissue systems - cortex, endodermis, pericycle, pith and medullary rays. Vascular tissue systems - different types of vascular bundles and their arrangement in root and stem.	15	Upto K4	2
III	Secondary thickening of dicot stem and root. Anomalous secondary growth of stem - <i>Boerhaavia</i> , <i>Nyctanthes</i> and <i>Dracaena</i> . Leaf anatomy - dicot (<i>Nerium</i>) and monocot (Grass). Stomatal types. Nodal anatomy and types (uni, tri and multi-lacunar).	15	Upto K4	3
IV	Embryology: Structure of mature anther - Microsporogenesis - male gametophyte. Structure and types of ovules - Megasporogenesis - Development of female gametophyte - monosporic (<i>Polygonum</i>), bisporic (<i>Allium</i>) and tetrasporic (<i>Adoxa</i>) types. Structure of mature embryo sac. Pollination and its types.	15	Upto K4	4
V	Double fertilization and triple fusion. Development of dicot embryo (<i>Capsella</i>). Endosperm and its types - free nuclear, cellular and helobial. Endosperm haustoria. Polyembryony - types, apomixis, parthenogenesis and parthenocarpy. Seed structure and its importance.	15	Upto K4	5

- Know the embryology of following plants.

Books for Study:

1. Bhojwani, S.S and Bhatnagar, S.P. 1994. Embryology of Angiosperms, Vikas publications, New Delhi.
2. Pandey, B.P. 2015. Plant Anatomy. S. Chand Publ. New Delhi.
3. Bhatnagar, S.P., Dantu, P.K and Bhojwani, S.S. 2014. The Embryology of Angiosperms. 6th edition. Vikas Publishing House. Delhi.

Books for Reference:

1. Esau, K. 1985. Anatomy of Seed Plants –John Willey.
2. Cutter, E.G. 1989. Plant Anatomy – Part I – Addison – Wesley Publishing Company.
3. Swamy, B.G.L and Krishnamoorthy. K.V.1990. From Flower to Fruits, Tata McGraw Hill Publishing Co. Ltd.
4. Fahn, A. 1974. Plant Anatomy. Pergmon Press, USA.

Web Resources:

1. <https://egyankosh.ac.in/bitstream/123456789/68174/1/Unit-1.pdf>
2. <https://plantlet.org/anomalous-secondary-growth/>
3. <https://egyankosh.ac.in/bitstream/123456789/16381/1/Unit-1.pdf>

Rationale for the Nature of the Course:

This course integrates foundational knowledge of plant anatomy and embryology, emphasizing the structural and functional organization of plant tissues, organs and reproductive processes. It aims to develop a comprehensive understanding of plant development and adaptations, essential for higher studies and research in botany and allied fields.

Activities having direct bearing on Skill development / Employability / Entrepreneurship:

Hands-on microscopy and dissection activities, along with the study of plant reproductive systems and secondary growth, equip students with skills in tissue analysis and plant anatomy essential for careers in botany, agriculture and pathology, while fostering entrepreneurial opportunities in plant breeding, seed technology and nursery management.

Pedagogy:

Chalk and Talk, Canva Interactive PPT, Educative Video animations, Group discussion, Gamified Quizzes through Quizzes, Learning Management Systems (e-Blogspot / Google site / Google Classroom / CANVAS in structure).

Course Designer:

Dr. S. GNAANA SARASWATHI, Assistant Professor.

Lecture Schedule:

Unit	Topics	Hours	Mode
I	Plant Anatomy: Tissues - Definition and types.	2	Chalk and Talk Canva PPT Educative video animations Google Classroom Google site e-Blog spot Group discussion
	Simple tissue system - parenchyma, collenchyma and sclerenchyma (fibres and sclereids).	3	
	Complex tissue system - xylem and phloem.	3	
	Meristem: definition, structure, function and classification.	3	
	Theories - Apical cell, Histogen and Tunica-Corpus and Korper-Kappe theory.	4	
II	Primary structure of root and stem (dicot and monocot).	5	
	Epidermal tissue system: epidermis, cuticle, trichome, bulliform cells, periderm and silica cells.	3	
	Ground tissue systems: cortex, endodermis, pericycle, pith and medullary rays.	3	
	Vascular tissue systems: different types of vascular bundles and their arrangement in root and stem.	4	
III	Secondary thickening of dicot stem and root.	5	
	Anomalous secondary growth of stem - <i>Boerhaavia</i> , <i>Nyctanthes</i> and <i>Dracaena</i> .	3	
	Leaf - anatomy of dicot (<i>Nerium</i>) and monocot (Grass).	3	
	Stomatal types.	2	
	Nodal anatomy and types (uni, tri and multi-lacunar).	2	
IV	Embryology: Structure of mature anther - Microsporogenesis - male gametophyte.	5	
	Structure and types of ovule - Megasporogenesis - Development of female gametophyte - monosporic (<i>Polygonum</i>), bisporic (<i>Allium</i>) and tetrasporic (<i>Adoxa</i>) types. Structure of mature embryo sac.	8	
	Pollination and its types.	2	
V	Double fertilization and triple fusion.	3	
	Development of dicot embryo (<i>Capsella</i>).	3	
	Endosperm and its types - free nuclear, cellular, helobial, endosperm haustoria.	4	
	Polyembryony - types, apomixis, parthenogenesis and parthenocarp.	3	
	Seed structure and its importance.	2	

Course Learning Outcomes:

CLOs	Course Learning Outcomes	Knowledge level
	On successful completion of the course, the students will be able to	
1	relate to the fundamental concepts of plant anatomy and embryology,	Upto K4
2	describe the internal tissue organization of various plant organs,	Up to K4
3	elucidate the stages of normal and abnormal secondary growth,	Up to K4
4	compare the structural organization of flower in relation to the process of pollination and fertilization and	Up to K4
5	access the various anatomical adaptations in plants.	Up to K4

Mapping with Programme Outcomes and Programme Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	1	3	2	3	1	2	2	2	1	2
CO 2	3	3	2	2	3	2	3	2	3	3	3	2
CO 3	2	2	3	3	1	2	2	1	3	1	2	1
CO 4	3	3	3	3	3	1	2	3	3	3	2	2
CO 5	3	3	2	3	2	3	3	3	3	2	3	3

S-Strong (3)

M-Medium (2)

L-Low(1)

Blueprint for Summative Examination

Sl. No	CLOs	K-Level	Section-A		Section-B		Section-C Either Or Choice	Section-D (Open Choice)
			MCQs		Short Answer			
			No. of Questions	K - level	No. of Questions	K - level		
1	1	Up to K4	2	K1 or K2	1	K1	2(K1&K1)	1 (K2)
2	2	Up to K4	2	K1 or K2	1	K1	2(K2&K2)	1 (K3)
3	3	Up to K4	2	K1 or K2	1	K2	2(K3&K3)	1 (K3)
4	4	Up to K4	2	K1 or K2	1	K2	2(K4&K4)	1 (K4)
5	5	Up to K4	2	K1 or K2	1	K2	2(K3&K3)	1 (K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Mark for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1 – Remembering and recalling facts with specific answers

K2 – Basic understanding of fact and stating main ideas with general answers

K3 – Application oriented – Solving problems

K4 – Examining, analyzing, presentation and make inferences with evidences.

DEPARTMENT OF BOTANY					CLASS: III B.Sc. BOTANY			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
V	Core	23U5BCCT7	Cell Biology, Genetics and Plant Breeding	4	5	25	75	100

Nature of Course	Knowledge and Skill	√	Skill Oriented	√	Employability Oriented	√	Entrepreneurship Oriented	

Objectives: The students will be able to,

- Enable students to gain insights into cell organisation and its functions.
- Familiarize with various cell organelles and their functions.
- Gain knowledge in classical and advanced genetics.
- Learn various plant breeding techniques for crop improvement.

Unit	Description	Hours	K Level	CLO
I	Cell Biology: Cell organisation - Ultra structure of Prokaryotic cell and Eukaryotic cell (Plant cell). Structure, chemistry and functions of Cell wall, Plasma membrane (Fluid-Mosaic model), Cytoskeleton, Ribosomes, Endoplasmic reticulum, Golgi apparatus, Lysosomes and Microbodies. Endocytosis and exocytosis.	15	Upto K4	1
II	Structure and functions of Mitochondria and Chloroplast. Semi genetic autonomy of Mitochondria and Chloroplast. Ultrastructure and functions of Nucleus. Chromosome: Structure, molecular organization of chromatin, Euchromatin, heterochromatin, Polytene and Lampbrush chromosomes, Centromere: types. Cell inclusions: Raphides and Cystolith. Cell cycle, Cell division, Mitosis and Meiosis - Significance.	15	Upto K4	2
III	Genetics: Laws of Mendel, Monohybrid and dihybrid crosses. Incomplete dominance and co-dominance. Multiple alleles: Male sterility in tobacco. Interaction of genes: Complementary genes and epistasis (dominant and recessive). Chromosome theory of linkage, crossing over, recombination and mapping of genes on chromosomes. Sex determination in plants.	15	Upto K4	3
IV	Sex linked inheritance: Haemophilia and colour blindness. Mutation: Types and significance. Chromosomal aberration: Addition, deletion, inversion, duplication and translocation. Extra nuclear inheritance and its significance – Male sterility in corn. Cytoplasmic inheritance: Plastid inheritance in <i>Mirabilis jalapa</i> . Genetics of <i>Neurospora</i> . Population genetics: Hardy-Weinberg law.	15	Upto K4	4
V	Plant Breeding: Principles, plant introduction and acclimatization. Methods of crop improvement: selection (mass, pure line and clonal), hybridization techniques. Heterosis:	15	Upto K4	5

	Interspecific and intergeneric, causes and effects. Mutation in plant breeding, polyploidy: Types and its applications. Breeding for crop improvement in paddy (Disease resistance) and sugarcane.			

Books for Study:

1. Ajoy Paul, (2009). Text book of Cell and Molecular Biology, Books and Allied (P) Ltd Kolkata.
2. Verma P.S. and Agarwal V.K. (2007). Cell Biology, Genetics, Molecular Biology and Evolution, S. Chand and company Ltd, New Delhi.
3. Sinnott, E.W., Dunn, L.L and Dobzhansky, T. 1997. Principles of Genetics, Tata Mc Graw Hill Publishing Co. New Delhi.
4. Ghahal G S and Gosal S S (2002). Principles and Procedures of Plant Breeding. Narosa Publishing House.
5. Gupta, P.K. (2007). Genetics. Rastogi Publication, Meerut, India.

Books for References:

1. Gardner, E.J., Simmons, M.J and Snustad, D. 1991. Principles of Genetics, John Wiley Sons Inc., 8th Edn., New York.
2. Klug, W.S., Cummings, M.R., Spencer, C.A. 2009. Concepts of Genetics. 9th edition. Benjamin Cummings, U.S.A.
3. Strickberger, M.W. 1999. Genetics. Prentice Hall of India Pvt Ltd, New Delhi.
4. Sharma J R (1994). Principles and practices of Plant Breeding. Tata McGraw-Hill Publishers
5. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

Web Resources:

1. <http://www.freebookcentre.net/Biology/Cell-Biology-Books.html>
2. <https://www.biologydiscussion.com/cell>
3. <https://www.us.elsevierhealth.com/medicine/cell-biology>
4. <https://microbenotes.com/category/genetics>
5. <https://www.us.elsevierhealth.com/medicine/genetics>

Rationale for Nature of the Course:

This course will enable the students to know the basis of cellular components, principles of inheritance and plant breeding methods.

Activities having direct bearing on Skill development / Employability / Entrepreneurship:

The skills learned by the students will help them to understand the various cellular organelles and their function, different phases of cell cycle, concept of genetics and various plant breeding methods for crop improvement.

Pedagogy:

Chalk and Talk, PPT, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Labs & Learning Management System.

Course Designer: Dr. N. JANAKIRAMAN, Assistant Professor

Lecture Schedule:

Unit	Topics	Hrs	Mode
Unit I	Cell Biology: Cell organisation - Ultra structure of Prokaryotic cell and Eukaryotic cell (Plant cell).	3	Chalk and Talk, Power Point, Discussion, Seminar, Interaction, Quiz, Video Clippings & Google classroom.
	Structure, chemistry and functions of Cell wall, Plasma membrane (Fluid-Mosaic model), Cytoskeleton, Ribosomes, Endoplasmic reticulum, Golgi apparatus, Lysosomes and Microbodies. Endocytosis and exocytosis.	12	
Unit II	Structure and functions of Mitochondria and Chloroplast. Semi genetic autonomy of Mitochondria and Chloroplast.	3	
	Ultrastructure and functions of Nucleus. Chromosome: Structure, molecular organization of chromatin, Euchromatin, heterochromatin, Polytene and Lampbrush chromosomes, Centromere: types.	7	
	Cell inclusions: Raphides and Cystolith. Cell cycle, Cell division, Mitosis and Meiosis - Significance.	5	
Unit III	Genetics: Laws of Mendel, Monohybrid and dihybrid crosses. Incomplete dominance and co-dominance. Multiple alleles: Male sterility in tobacco.	5	
	Interaction of genes: Complementary genes and epistasis (dominant and recessive).	5	
	Chromosome theory of linkage, crossing over, recombination and mapping of genes on chromosomes. Sex determination in plants.	5	
Unit IV	Sex linked inheritance: Haemophilia and colour blindness. Mutation: Types and significance. Chromosomal aberration: Addition, deletion, inversion, duplication and translocation.	6	
	Extranuclear inheritance and its significance – Male sterility in corn. Cytoplasmic inheritance- Plastid inheritance in <i>Mirabilis jalapa</i> . Genetics of <i>Neurospora</i> .	6	
	Population genetics: Hardy-Weinberg law.	3	
Unit V	Plant Breeding: Principles, plant introduction and acclimatization. Methods of crop improvement: selection (mass, pure line and clonal), hybridization techniques.	6	
	Heterosis: Interspecific and intergeneric, causes and effects. Mutation in plant breeding, polyploidy: Types and its applications.	6	
	Breeding for crop improvement in paddy and sugarcane.	3	

Course Learning Outcomes:

On successful completion of the course, the students will be able to know, understand, apply, analyse and evaluate the

CLOs	Course Learning Outcomes	Knowledge Level
CLO 1	Structure and functions of cells, cellular structures and organelles.	Up to K4
CLO 2	Different phases of cell cycle and their regulation	Up to K4
CLO 3	Laws of inheritance with suitable examples.	Up to K4
CLO 4	Importance of sex-linked inheritance, mutation and population genetics.	Up to K4
CLO 5	Concepts of plant breeding and their role in crop improvement.	Up to K4

Mapping of CLOs with PSOs

#	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CLO 1	1	2	2	1	2	3
CLO 2	2	2	3	2	2	2
CLO 3	2	2	1	2	2	2
CLO 4	2	3	3	2	3	1
CLO 5	1	3	3	1	3	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO 1	3	3	2	3	2	2
CLO 2	3	3	3	2	3	3
CLO 3	2	2	3	3	1	1
CLO 4	3	3	3	3	3	2
CLO 5	3	3	2	2	2	1

Advance application - 3; Intermediate level - 2; Basic level –1

Blue Print for Summative Examinations

Mapping with Course Learning Outcomes (CLOs)

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K Level	No. of Questions	K Level		
1	CLO 1	Up to K2	2	K1 or K2	1	K1	2 (K1 & K1)	1 (K2)
2	CLO 2	Up to K3	2	K1 or K2	1	K1	2 (K2 & K2)	1 (K3)
3	CLO 3	Up to K3	2	K1 or K2	1	K2	2 (K3 & K3)	1 (K3)
4	CLO 4	Up to K4	2	K1 or K2	1	K2	2 (K4 & K4)	1 (K4)
5	CLO 5	Up to K5	2	K1 or K2	1	K2	2 (K3 & K3)	1 (K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - solving problems

K4 - Examining, analyzing, presentation and make inferences with evidence

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF BOTANY					CLASS: III B.Sc. BOTANY			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
V	Core Practical	23U5BCCP5	Practical - V	3	3	25	75	100

Nature of Course	Knowledge and Skill	√	Skill Oriented	√	Employability Oriented	√	Entrepreneurship Oriented	

Objectives: The students will be able to,

1. dissect the vegetative and floral parts of the locally available plants.
2. train students to study the anatomy of plant organs and embryology of plants.
3. identify various cell organelles and understand genetics through problem solving.

Taxonomy of Angiosperms and Economic Botany

1. Observations on the morphology of root and stem modifications, phyllotaxy, types of inflorescence and fruits.
2. Dissection, identification, description and sketching the vegetative and floral parts of the selected locally available plants belonging to families: Annonaceae, Nymphaeaceae, Brassicaceae, Portulacaceae, Rutaceae, Myrtaceae, Passifloraceae, Rubiaceae, Apocynaceae, Bignoniaceae, Convolvulaceae, Scrophulariaceae, Lamiaceae, Amaranthaceae, Euphorbiaceae, Orchidaceae, Liliaceae, Commelinaceae, Araceae and Poaceae.
3. Fifteen (15) Herbarium sheets, field notebook and bonafide record to be submitted for the external examinations.
4. Study the economic products of plants mentioned in the syllabus of economic botany with their special reference to the morphology, botanical name, family and uses.
5. At least two days field trip to any one natural habitat to be conducted for observation, collection and identification of plants from the prescribed botanical families. Field note to be submitted for evaluation.

Anatomy and Embryology

1. Internal structure of dicot and monocot stem.
2. Internal structure of dicot and monocot root.
3. Internal structure of secondary (old) stem and root.
4. Anomalous secondary growth in the stems of *Boerhaavia*, *Nyctanthus* and *Dracaena*.
5. T.S of dicot and monocot leaves.
6. Study of stomatal types.
7. T.S of (young and mature) anther (section from *Datura* or *Cassia* flower).
8. Observation of pollinia.
9. Dissection and display of any two stages of embryo in *Tridax*.

10. Permanent slides: Types of ovules - Anatropous, Orthotropous, Circinotropous, Amphitropous, and Campylotropous. Types of Endosperms - Nuclear, cellular and helobial.

Cell Biology, Genetics and Plant Breeding

1. Study of the photomicrographs of cell organelles.
2. Ergastic substances - starch grains, aleurone grains, crystals - cystolith and raphides.
3. Study the polytene and lamp brush chromosome structure through photographs.
4. Identification of different stages of mitosis by using squash and smear techniques - Onion root tip.
5. Genetic problems: Test cross, back cross and allelic interaction.
6. Multiple alleles problems.
7. Emasculation technique.
8. Test the viability of seeds using Tetrazolium chloride.
9. Genetic models of heterosis.

Rationale for Nature of the Course:

The students acquire profound practical skills in the laboratory with scientific observations in the field of Taxonomy of Angiosperms, Anatomy, Embryology, Cell Biology, Genetics and Plant Breeding thereby enriching a thorough understanding on the field.

Activities having direct bearing on Skill development / Employability / Entrepreneurship:

The course will help the students to develop their skills on plant identification and get entry level jobs in the Botanical Survey of India and other related organizations.

Pedagogy:

Hands on training, field work, dissection, chalk and talk, group discussion, interaction, problem solving, quiz, virtual labs, you tube videos & learning management system (canvas).

Course Designer:

Dr. S. KARUPPUSAMY, Associate Professor

Dr. S. GNAANA SARASWATHI, Assistant Professor

Dr. N. JANAKIRAMAN, Assistant Professor

Lecture Schedule:

S.No.	Description	Hours	Mode
I	Observations on the morphology of root and stem modifications, phyllotaxy, types of inflorescence and fruits. Dissection, identification, description and sketching the vegetative and floral parts of the selected locally available plants belonging to families: Annonaceae, Nymphaeaceae, Brassicaceae, Portulacaceae, Rutaceae, Myrtaceae, Passifloraceae, Rubiaceae, Apocynaceae, Bignoniaceae, Convolvulaceae, Scrophulariaceae, Lamiaceae, Amaranthaceae, Euphorbiaceae, Orchidaceae, Liliaceae, Commelinaceae, Araceae and Poaceae. Fifteen (15) Herbarium sheets, field notebook and bonafide record to be submitted for the external examinations. Study the economic products of plants mentioned in the syllabus of economic botany with their special reference to the morphology, botanical name, family and uses. At least two days field trip to any one natural habitat to be conducted for observation, collection and identification of plants from the prescribed botanical families. Field note to be submitted for evaluation.	15	Plant specimens, Dissection, Microscopic Slides and Problems
	Internal structure of dicot and monocot stem, Internal structure of dicot and monocot root, Internal structure of secondary (old) stem and root, Anomalous secondary growth in the stems of <i>Boerhaavia</i>, <i>Nyctanthus</i> and <i>Dracaena</i>, T.S of dicot and monocot leaves, Study of stomatal types, T.S of (young and mature) anther (section from <i>Datura</i> or <i>Cassia</i> flower), Observation of pollinia, Permanent slides, Types of ovules- Anatropous, Orthotropous, Circinotropous, Amphitropous, Campylotropous, Types of Endosperm - Nuclear, cellular and helobial, Dissection and display of any two stages of embryo in <i>Tridax</i>.	15	
	Study of the photomicrographs of cell organelles, Ergastic substances - starch grains, aleurone grains, crystals - cystolith and raphides, Study the polytene and lamp brush chromosome structure through photographs, Identification of different stages of mitosis by using squash and smear techniques - Onion root tip, Genetic problems: Test cross, back cross and allelic interaction, Multiple alleles problems, Emasculation technique, To test the viability of seeds using Tetrazolium chloride and Genetic models of heterosis.	15	

Course Learning Outcomes:

On successful completion of the course, the students will be able to know, understand, apply and analyse the

CLOs	CLO Statement	Knowledge Level
CLO 1	vegetative and floral parts of locally available plants	Upto K4
CLO 2	economically important plants and their uses	Upto K4
CLO 3	various plant organs and their internal structure by dissection	Upto K4
CLO 4	structure of cell organelles and stages of cell division.	Upto K4
CLO 5	given genetic data to develop genetic map based on the principles of Mendelian inheritance and gene interaction.	Upto K4

Mapping Programme Specific Outcomes with Course Learning Outcomes:

#	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CLO 1	3	2	1	3	3	2
CLO 2	3	3	2	2	2	3
CLO 3	3	3	2	2	1	3
CLO 4	3	2	1	2	1	2
CLO 5	3	2	-	-	-	3

3 - Advance Application; 2 - Intermediate Level; 1 - Basic Level

Mapping Programme Outcomes with Course Learning Outcomes:

#	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CLO 1	3	2	2	2	1	1
CLO 2	3	3	3	3	3	2
CLO 3	3	3	3	3	3	2
CLO 4	2	2	2	2	2	3
CLO 5	1	2	1	1	3	1

3 - Advance Application; 2 - Intermediate Level; 1 - Basic Level

DEPARTMENT OF BOTANY					CLASS: III B.Sc. BOTANY			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
V	Discipline Elective Course - I	23U5BDET1 (A)	Computer Applications in Botany	4	5	25	75	100

Nature of Course	Knowledge and Skill	√	Skill Oriented	√	Employability Oriented	√	Entrepreneurship Oriented	

Objectives: The students will be able to,

1. Increase computational literacy and know the basic components of computer.
2. Search and retrieve information from biological databases to interpret results.
3. Benefit experimental biologists to understand the sequence alignment and analysis.

Unit	Description	Hours	K-level	CLO
I	Computers: Introduction, Components, Hardware (CPU, memory and storage devices), Input and Output devices. Brief account on Software, Network, Internet, Search Engines and Browser. Basic features of MS Word, MS Excel and MS PowerPoint.	15	Upto K4	1
II	Bioinformatics: Overview, Scope and Applications. Biological Databases: Introduction, Importance, Types and Classification. Nucleic acid Databases: INSDC (NCBI, EMBL and DDBJ). Information Retrieval (Entrez and SRS). Protein Sequence Database (UniProt) and Protein Structural Database (PDB).	15	Upto K4	2
III	Scientific Literature Databases (PubMed, PMC and PubChem). Taxonomic Databases (NCBI Taxonomy, IPNI and WFO). Sequence Alignment: Similarity vs Identity, Types of homologous sequences, Scoring schemes, Global and local alignment, Pairwise and multiple sequence alignment.	15	Upto K4	3
IV	Sequence analysis using BLAST. Phylogenetic analysis: Phylogenetic tree; Dendrogram, Cladogram and Phylogram; Monophyletic, Polyphyletic and Paraphyletic clades; Phylogenetic tree of land plants; Methods of Phylogenetic tree construction and Applications.	15	Upto K4	4
V	Generation of QR code for botanicals, SPSS Software, Homology modeling, Protein structure prediction (SWISS-MODEL) and validation tools. Molecular visualization using RasMol. Chemo informatics, Computer aided drug designing and its applications.	15	Upto K4	5

Books for Study:

1. Janakiraman N (2024). Bioinformatics: Methods, Tools and Applications, Scientific Publishers, New Delhi.
2. Prakash S Lohar (2009). Bioinformatics, MJP Publishers, Chennai.
3. Rastogi SC, Mendiratta N and Rastogi P (2019). Bioinformatics Methods and Applications: Genomics, Proteomics and Drug Discovery. 4th Edition, PHI Learning Pvt. Ltd, Delhi.
4. Sharma V, Munjal A and Shanker A (2019). A Text Book of Bioinformatics. 2nd Edition, Rastogi Publications, Meerut, New Delhi.

Books for References:

1. Mani K and Vijayaraj N (2002). Bioinformatics for Beginners. Kalaikathir Achchagam, Coimbatore.
2. Higgs (2005). Bioinformatics and Molecular Evolution, Ane Books India Pvt Ltd.
3. Campbell and Heyer (2006). Discovering Genomics, Proteomics & Bioinformatics, 2nd Edition.

Web Resources:

1. <https://www.biologydiscussion.com>
2. <https://epathshala.nic.in/>
3. <https://epgp.inflibnet.ac.in/>

Rationale for Nature of the Course:

This course will enable the students to know the basic components of computer, how to retrieve biological information from databases, algorithms used in sequence alignment, tools used in sequence analysis and phylogenetic tree construction.

Activities having direct bearing on Skill development / Employability / Entrepreneurship:

The knowledge learned by the students will help them to use computer effectively to extract information from biological databases.

Pedagogy:

Chalk and Talk, Power Point, Group Discussion, Seminar, Interaction, Problem Solving, Softwares, Quiz, Virtual Labs, Video Clippings, Google Classroom & LMS (CANVAS).

Course Designer:

Dr. N. JANAKIRAMAN, Assistant Professor

Lecture Schedule:

Unit	Topics	Hrs	Mode
Unit I	Computers: Introduction, Components, Hardware (CPU, memory and storage devices).	5	Chalk and Talk, Power Point, Discussion, Seminar, Interaction, Quiz, Video Clippings & Google classroom.
	Input and Output devices. Brief account on Software, Network, Internet, Search Engines and Browser.	5	
	Basic features of MS Word, MS Excel and MS PowerPoint.	5	
Unit II	Bioinformatics: Overview, Scope and Applications. Biological Databases: Introduction, Importance, Types and Classification.	5	
	Nucleic acid Databases: INSDC (NCBI, EMBL and DDBJ). Information Retrieval (Entrez and SRS).	5	
	Protein Sequence Database (UniProt) and Protein Structural Database (PDB).	5	
Unit III	Scientific Literature Databases (PubMed, PMC and PubChem).	5	
	Taxonomic Databases (NCBI Taxonomy, IPNI and WFO).	5	
	Sequence Alignment: Similarity vs Identity, Types of homologous sequences, Scoring schemes, Global and local alignment, Pairwise and multiple sequence alignment.	5	
Unit IV	Sequence analysis using BLAST.	5	
	Phylogenetic analysis: Phylogenetic tree; Dendrogram, Cladogram and Phylogram; Monophyletic, Polyphyletic and Paraphyletic clades.	5	
	Phylogenetic tree of land plants; Methods of Phylogenetic tree construction and Applications.	5	
Unit V	Generation of QR code for botanicals, SPSS Software.	5	
	Homology modeling, Protein structure prediction (SWISS-MODEL) and validation tools. Molecular visualization using RasMol.	5	
	Chemo informatics, Computer aided drug designing and its applications.	5	

Course Learning Outcomes:

On successful completion of the course, the students will be able to know, understand, apply, analyse and evaluate the

CLOs	Course Learning Outcomes	Knowledge Level
CLO 1	basic computer literacy and its role in bioinformatics	Up to K4
CLO 2	information from biological databases available on the internet	Up to K4
CLO 3	tools used in bioinformatics for solving biological problems	Up to K4
CLO 4	phylogenetic tree and its applications	Up to K4
CLO 5	elementary prediction of protein structure and drug designing	Up to K4

Mapping of CLOs with PSOs

#	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CLO 1	1	2	2	1	2	3
CLO 2	2	2	3	2	2	2
CLO 3	2	2	1	2	2	2
CLO 4	2	3	3	2	3	1
CLO 5	1	3	3	1	3	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO 1	3	3	2	3	2	2
CLO 2	3	3	3	2	3	3
CLO 3	2	2	3	3	1	1
CLO 4	3	3	3	3	3	2
CLO 5	3	3	2	2	2	1

Advance application - 3; Intermediate level - 2; Basic level –1

Blue Print for Summative Examinations

Mapping with Course Learning Outcomes (CLOs)

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K Level	No. of Questions	K Level		
1	CLO 1	Up to K2	2	K1 or K2	1	K1	2 (K1 & K1)	1 (K2)
2	CLO 2	Up to K3	2	K1 or K2	1	K1	2 (K2& K2)	1 (K3)
3	CLO 3	Up to K3	2	K1 or K2	1	K2	2 (K3 & K3)	1 (K3)
4	CLO 4	Up to K4	2	K1 or K2	1	K2	2 (K4 & K4)	1 (K4)
5	CLO 5	Up to K5	2	K1 or K2	1	K2	2 (K3 & K3)	1 (K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - solving problems

K4 - Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF BOTANY				CLASS: III B.Sc. Botany				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
V	Discipline Elective Course I	23U5BDET1 (B)	Bionanotechnology	4	5	25	75	100

Nature of Course	Knowledge and Skill	√	Skill Oriented	√	Employability Oriented	√	Entrepreneurship Oriented	

Objectives: The students will be able to,

1. Understand the concept, scope and importance of nano science and nanotechnology.
2. Acquire the knowledge on characterization of nano particles and bio-nano materials.
3. Learn the preparation, characterization and therapeutic applications of nano carriers for drug delivery and
4. Comprehend the food and environmental applications of nano biotechnology.

UNIT	CONTENT	CLO	K LEVEL	HOURS
I	Background of Nanoscience: Fundamentals of Bionanoparticles: Production, Size, Surface area, Suspension and Settling, Magnetic and Optical Properties, Biological Transport. Biological nanoparticles production - plants and microbial. Nanoparticles, quantum dots, nanotubes and nanowires.	1	Up to K4	15
II	Techniques to analyze bionanomaterials: Electron Microscopy: Scanning Electron Microscopy (SEM), Transmission Electron microscopy (TEM), Spectroscopy: UV-Vis Spectroscopy, FT-IR Spectroscopy, X-Ray Diffraction (XRD). Biological sample preparation for Electron Microscopy and FT-IR.	2	Up to K4	15
III	Nano carriers for drug delivery: Solid and lipid SNP as drug carriers. Micelles, Micro emulsions, Lipoproteins as pharmaceutical carriers. Nano-capsules: Preparation, Characterization & therapeutic applications. Nanotechnology for cancer research & therapy.	3	Up to K4	15
IV	Nanofertilizers: Nanourea and mixed fertilizers, Nanofertigation - Nanopesticides, Nanoseed Science. Nanotechnology in Precision (smart) farming.	4	Up to K4	15
V	Environmental applications: Nanotechnology for waste reduction and improved energy efficiency, nanotechnology-based water treatment strategies. Health impact of Nanoparticles, safety and toxicological effects. Mapping of the environmental fate of nanomaterials.	5	Up to K4	15

Books for study

1. Taylor and Francis Group (2011). Advances in Nanotechnology and the Environment, Juyoung Kim, CRC Press,
2. Cooper, J. and C. Tass, (2004). Biosensors: A Practical Approach, Oxford University Press.
3. Schmidt, G. (2004). Nanoparticles: From theory to applications, Wiley Weinheim.
4. Niemeyer, C.M. and C.A. Mirkin, (2004) Nanobiotechnology, Concepts, Applications and perspectives, WILEY-VCH, Verlag GmbH & Co,

Books for references

1. K. Raja & M Kannan Subramanian, K S (2020). Textbook on Fundamentals and Applications of Nanotechnology. Tamil Nadu Agricultural University, Daya Publishing House, New Delhi. ISBN: 978-9351249320.
2. Thomas Varghese & K.M (2021). Balakrishna Nanotechnology: An Introduction to Synthesis, Properties and Applications of Nanomaterials. Atlantic Publishers, New Delhi. ISBN: 978-8126916382
3. Choudhary K K (2011). Nanoscience and Nanotechnology. Narosa Publishing House Pvt. Ltd. - New Delhi. ISBN 978-8184875065.
4. Murthy, P. Shankar, Baldev Raj, B B. Rath, James Murdy (2012). Textbook of Nanoscience and Nanotechnology. BS. Orient Blackswan Private Limited - New Delhi. ISBN: 978-8173717383.
5. Vineetha Singh (2011). Nano-biology, Astral Publications, New Delhi.

Web Resources

1. Nanobiology: from physics and engineering to biology - IOPscience
2. Nanotechnology Now - Nanobiology (nanotech-now.com)
3. Nanobiotechnology - Definition and Applications (nanowerk.com)

Rationale for Nature of the Course

Acquired theoretical knowledge on nanoscience, nanomaterials and applications of health, environment, food will help students to get employment in nano-based industries.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Analytical skills gained through theoretical discussions on nanoparticles, nanomaterials and their potential applications of food and fertilizers will help to students to attend issues in crop improvement and nano based agro industries.

Pedagogy

Chalk and Talk, PPT, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Labs & Learning Management System (CANVAS).

Course Designer: Dr. S. SARAVANAN, Assistant Professor.

Course Learning Outcomes: On successful completion of the course, the students will be able to know, understand, apply, analyze the

	CLO Statement	Knowledge Level
CLO -1	Concept, scope and importance of Nanoscience and Nanotechnology.	Up to K4
CLO -2	Techniques to analyze bionanomaterials by SEM, TEM, UV-FTIR and XRD.	Up to K4
CLO -3	Nanocarriers for drug delivery.	Up to K4
CLO -4	Nanotechnology in fertilizers.	Up to K4
CLO -5	Role of nano materials for environmental applications.	Up to K4

Mapping Programme Specific Outcomes with Course Outcomes

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7	PSO-8	PSO-9
CLO-1	-	-	3	2	1	1	2	1	1
CLO-2	-	-	3	2	1	1	2	1	1
CLO-3	-	-	3	2	1	1	2	1	1
CLO-4	-	-	3	2	1	1	2	1	1
CLO-5	-	-	3	2	1	1	2	1	1

3-Advance application, 2- Intermediate level, 1- Basic level

Mapping Programme Outcomes with Course Learning Outcomes

#	PO 1	PO 2	PO 3	PO 4	PO 5
CLO 1	3	3	2	3	1
CLO 2	3	3	3	2	2
CLO 3	3	3	2	2	2
CLO 4	3	3	2	2	2
CLO 5	3	3	3	2	3

3 - Advance Application; 2 - Intermediate Level; 1 - Basic Level

Lesson Plan

Unit	Description	Hrs	Mode
I	a) Nanoscience: Fundamentals of Bionanoparticles: Production, Size, Surface area, Suspension and Settling, Magnetic and Optical Properties, Biological Transport.	5	Chalk and talk PPT, LMS and Group discussion
	b) Biological nanoparticles production - plants and microbial.	5	
	c) Nanoparticles, quantum dots, nanotubes and nanowires.	5	
II	a) Techniques to analyze bionanomaterials: Electron Microscopy: Scanning Electron Microscopy (SEM), Transmission Electron microscopy (TEM). Spectroscopy: UV-Vis Spectroscopy, FT-IR Spectroscopy, X-Ray Diffraction (XRD).	10	Chalk and talk PPT, LMS and Group discussion
	b) Biological sample preparation for Electron Microscopy and FT-IR.	5	
III	a) Nano carriers for drug delivery: Polymeric NP, Micelles, Micro emulsions, Lipoproteins as pharmaceutical carriers.	5	Chalk and talk PPT, LMS and Group discussion
	b) Solid and lipid NP as drug carriers.		
	c) Nano-capsules- Preparation, Characterization & therapeutic applications.	5	
	d) Nano medicine-Biopharmaceuticals. Implantable materials, Devices, Surgical aids, diagnostic tools, Genetic testing, Imaging. Nanotechnology for cancer research & therapy.	5	
IV	a) Nano-fertilizers: Nanourea and mixed fertilizers, Nanofertigation	10	Chalk and talk PPT, LMS and Group discussion
	b) Nanopesticides, Nanoseed Science. Nanotechnology in Precision (smart) farming.	5	
V	a) Environmental applications: Nanotechnology for waste reduction and improved energy efficiency, nanotechnology-based water treatment strategies.	10	Chalk and talk PPT, LMS and Group discussion
	b) Health impact of Nanoparticles, safety and toxicological effects transport of nanomaterials in soil/sediments.	5	
	c) Mapping of the environmental fate of nanomaterials.		
Total		75	

Blue Print for Summative Examinations

Mapping with Course Learning Outcomes (CLOs)

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K Level	No. of Questions	K Level		
1	CLO 1	Up to K2	2	K1 or K2	1	K1	2 (K1 & K1)	1 (K2)
2	CLO 2	Up to K3	2	K1 or K2	1	K1	2 (K2& K2)	1 (K3)
3	CLO 3	Up to K3	2	K1 or K2	1	K2	2 (K3 & K3)	1 (K3)
4	CLO 4	Up to K4	2	K1 or K2	1	K2	2 (K4 & K4)	1 (K4)
5	CLO 5	Up to K5	2	K1 or K2	1	K2	2 (K3 & K3)	1 (K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - solving problems

K4 - Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF BOTANY					CLASS: III B.Sc. BOTANY			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
V	IDC	23U5BIDT1 (A)	Bio-Analytical Techniques	4	5	25	75	100

Nature of Course	Knowledge and Skill	√	Skill Oriented	√	Employability Oriented	√	Entrepreneurship Oriented	

Objectives: The students will be able to,

- Understand the principle, operation and maintenance of various tools/equipment in the laboratory.
- Perform experiments using the laboratory instruments, formulate experiments for project work and evaluate critically the acquisition of data.
- Equip students to collect, analyze and evaluate data generated by their own inquiries in a scientific manner.
- Give an exposure to various forms of field research and data analysis techniques.
- Provide an overview on modern equipment's that they would help students gain confidences to instantly commence research careers and/or start entrepreneurial ventures.

Unit	Description	Hours	K level	CLO
I	Microscopy: Principles and applications. Components, working principle and applications of Light, Compound, Bright field, Dark field, Phase-contrast, Fluorescence, Transmission and Scanning electron microscopes. Microscopic measurements-micrometry, Microscopy drawing: Camera Lucida	15	Upto K4	1
II	Separation techniques: Principles and applications of Paper chromatography, Thin Layer Chromatography (TLC), Ion exchange chromatography, Column chromatography, Gas chromatography - Mass spectrometry (GCMS), High Performance Liquid Chromatography (HPLC). pH Meter: Basic principle, components and operations. Radio-isotopic techniques: Scintillation counter.	15	Upto K4	2
III	Electrophoresis: Components, working principles and applications of Agarose Gel Electrophoresis, Polyacrylamide gel electrophoresis (PAGE), SDS PAGE. Strategy and advantages of 2-Dimentional Electrophoresis. Spectrophotometry: Principle and law of absorption, construction, operation and uses of colorimeter and UV-Visible spectrophotometer	15	Upto K4	3
IV	Centrifugation Technique: Principles and applications, types of centrifuges, Preparative centrifugation: Differential and Density gradient. Cell disruption and fractionation: homogenization media and isolation of mitochondria.	15	Upto K4	4

	Immunological assays: Introduction, agglutination, ELISA and Radioimmunoassay.			
V	Management of laboratory animals: Procurement and maintenance of animals, ethics. Animal husbandry: caging, outdoor and social environment. Anaesthesia and euthanasia. Bleeding, Perfusion and Organ ablations.	15	Upto K4	5

Books for Study:

1. Sharma, V.K. 1991. Techniques in microscopy and cell biology, Tata McGraw Hill, New Delhi.
2. Sawhney, S.K and Randhir Singh. 2000. Introductory practical biochemistry, Narosa Publishing House.
3. Asokan, P. 2001. Basics of analytical biochemistry. Chinna Publications.
4. Bajpai, P.K. 2006. Biological instrumentation and methodology. S. Chand & Company, New Delhi.
5. Palanivelu, P. 2013. Analytical Biochemistry and Separation techniques, 20th century publications, Palkalai nagar, Madurai.

Books for References:

1. Rana, S.V.S. 2009. Biotechniques: Theory and Practice. Rastogi Publications.
2. Zar, J.H. 2012. Biostatistical Analysis. 4th edition. Pearson Publication. U.S.A.
3. Sundar Rao, P.S.S and Richard, J. 2011. Introduction to Biostatistics and research methods, PHI learning Private Ltd., New Delhi.
5. Johansen, D.A. 1940. Plant Micro technique, TATA McGraw Hill Book Co., Ins., New Delhi.
6. Peter Gray. 1964. Handbook of Basic Micro technique. McGraw hill publication, New York.
7. Cooper, T.G. 1991. The Tools of Bio - chemistry, John Wiley & sons, London.
8. Dey, P.M and Harborne, J.B. 2000. Plant Biochemistry Harcourt Asia Pvt. Ltd.
9. Plummer, D.T. 2003. An introduction to practical Biochemistry. 3rd Edn. Tata McGraw Hill Publishing Company Ltd. New Delhi

Web Resources:

1. <https://www.kobo.com/in/en/ebook/bioinstrumentation-1>
2. <https://www.worldcat.org/title/bioinstrumentation/oclc/74848857>
3. <https://www.amazon.in/Bioinstrumentation-M-H-Fulekar-Bhawana-Pandey-ebook/dp/B01JP3M9TW>

Rationale for Nature of the Course:

This course will enable the students to know basic knowledge about the application of Botany to biological techniques and its importance.

Activities having direct bearing on Skill development / Employability / Entrepreneurship:

The skills learned by the students will help them to understand Microscopy, Separation techniques, Radio isotopic techniques, Electrophoresis, Spectrophotometry, Management of laboratory animals.

Pedagogy:

Chalk and Talk, PPT, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Labs & Learning Management System.

Course Designer: R. SARANYA, Assistant Professor

Lecture Schedule:

Unit	Topics	Hrs	Mode
Unit I	Microscopy: Principles and applications. Components, working principle and applications of Light, Compound, Bright field, Dark field, Phase-contrast	7	Chalk and Talk, Power Point, Discussion, Seminar, Interaction, Quiz, Video Clippings & Google classroom.
	Fluorescence, Transmission and Scanning electron microscopes. Microscopic measurements-micrometry, Microscopy drawing: Camera Lucida	8	
Unit II	Separation techniques: Principles and applications of Paper chromatography, Thin Layer Chromatography (TLC), Ion exchange chromatography, Column chromatography, Gas chromatography - Mass spectrometry (GCMS)	8	
	High Performance Liquid Chromatography (HPLC). pH Meter: Basic principle, components and operations. Radioisotopic techniques: Scintillation counter.	7	
Unit III	Electrophoresis: Components, working principles and applications of Agarose Gel Electrophoresis, Polyacrylamide gel electrophoresis (PAGE), SDS PAGE. Strategy and advantages of 2-Dimensional Electrophoresis.	8	
	Spectrophotometry: Principle and law of absorption, construction, operation and uses of colorimeter and UV-Visible spectrophotometer	7	
Unit IV	Centrifugation Technique: Principles and applications, types of centrifuge, Preparative centrifugation: Differential and Density gradient.	7	
	Cell disruption and fractionation: homogenization media and isolation of mitochondria. Immunological assays: Introduction, agglutination, ELISA and Radioimmunoassay.	8	
Unit V	Management of laboratory animals: Laboratory animals, Procurement and ethics. Animal husbandry: caging	8	
	outdoor and social environment. Anesthesia and euthanasia. Bleeding, Perfusion and Organ ablations.	7	

Course Learning Outcomes:

On successful completion of the course, the students will be able to know, understand, apply, analyse the

CLOs	Course Learning Outcomes	Knowledge Level
CLO 1	Principles of Light microscopy, compound microscopy, Fluorescence microscopy and electron microscopy.	Up to K4
CLO 2	Various biological techniques and its importance.	Up to K4
CLO 3	various biological techniques, Electrophoresis, Spectrophotometry and its importance	Up to K4
CLO 4	Significance of different types of chromatography techniques.	Up to K4
CLO 5	Management of laboratory animals and animal husbandry	Up to K4

Mapping of CLOs with PSOs

#	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CLO 1	1	2	2	1	2	3
CLO 2	2	2	3	2	2	2
CLO 3	2	2	1	2	2	2
CLO 4	2	3	3	2	3	1
CLO 5	1	3	3	1	3	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO 1	3	3	2	3	2	2
CLO 2	3	3	3	2	3	3
CLO 3	2	2	3	3	1	1
CLO 4	3	3	3	3	3	2
CLO 5	3	3	2	2	2	1

Advance application - 3; Intermediate level - 2; Basic level – 1

Blue Print for Summative Examinations

Mapping with Course Learning Outcomes (CLOs)

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K Level	No. of Questions	K Level		
1	CLO 1	Up to K2	2	K1 or K2	1	K1	2 (K1 & K1)	1 (K2)
2	CLO 2	Up to K3	2	K1 or K2	1	K1	2 (K2& K2)	1 (K3)
3	CLO 3	Up to K3	2	K1 or K2	1	K2	2 (K3&K3)	1 (K3)
4	CLO 4	Up to K4	2	K1 or K2	1	K2	2 (K4& K4)	1 (K4)
5	CLO 5	Up to K5	2	K1 or K2	1	K2	2 (K3&K3)	1 (K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - solving problems

K4 - Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF BOTANY				Class: III B.Sc. Botany				
Sem	Course type	Subject Code	Course title	Course Hours/ Week	Credits	CIA	Exam	Total
V	IDC	23U5BIDT1 (B)	Climate Change	5	4	25	75	100

Nature of Course	Knowledge and Skill	√	Skill Oriented	√	Employability Oriented	√	Entrepreneurship Oriented	

Objectives: The students will be able to,

1. Demonstrate understanding of the changing climate.
2. Understand the interaction of atmosphere, climate and ecosystem.
3. Examine the technological interventions for mitigating the climate change impacts.
4. Make students awareness of scenario of climate change.

UNIT	CONTENT	CLO	K LEVEL	HOURS
I	Climate change: Introduction, Causes and effect, Components of the earth, a brief account on rain, snow, cyclone, tsunami, flood, earth quake and volcano, drought, wildfires, hurricanes. Acid rain and its effects on plants, animals, microbes and ecosystems.	1	Up to K4	15
II	Components of the atmosphere, the greenhouse gases and effect, Ozone depletion. Greenhouse gas emissions and the causes – electricity generation, transport. Consequences and evidence of climate change, oceans, agriculture, natural vegetation and humans; International efforts on climate change issues.	2	Up to K4	15
III	CO ₂ capture and sequestration methods: Geological storage, Ocean storage, Mineral storage & Leakage. CO ₂ reuse mechanisms - CO ₂ → methanol, CO ₂ → hydrocarbons and CO ₂ → CO → hydrocarbons. CCS projects (Carbon dioxide capture and sequestration). Eutrophication.	3	Up to K4	15
IV	Climate change adaptation and mitigation: strategies for emission reduction - Alternative energy sources and Energy efficiency and conservation. Kyoto protocol, Bali Action Plan (2018), Emission Gap Report (2021) – IET(International Emission Trading), CDMs (Clean Developmental Mechanism) and JI(Joint Implementation).	4	Up to K4	15
V	Carbon credits and carbon economics; UNFCCC (United Nations Frame work for Convention Change) & IPCC (Inter Governmental Pannel on Climate Change), climate change conference- Copenhagen & Mexico. Carbon footprint and ecological footprint	5	Up to K4	15

Books for the Study

1. Robin Moilveen (2010). Fundamentals of weather and climate (2nd Edition), Oxford University Press.
2. David Neelin J (2011). Climate change and climate modeling, Cambridge University press.
3. Rathinasamy, M, Chandramouli S. Phanindra K.B.V.N. Uma Mahesh (2018). Resources and Environmental Engineering II: Climate and Environment.

Book References:

1. Gunderson, LH, Allen CR and Holling (2012). Foundations of Ecological Resilience, Island Press.
2. Thomas E. Lovejoy, Lee Jay Hannah (2006). Climate Change and Biodiversity; Published by Yale University Press.
3. William H. Schlesinger (1997). Biogeochemistry: An Analysis of Global Change. Academic Press, San Diego, CA. 2nd edition. Available at the Bay Tree Bookstore. 4. Global Environmental Change: Research Pathways for the Next Decade, National Research Council, 1999.
4. Parry, ML et al. (2007). Climate change: Impacts, Adaptation and Vulnerability, Cambridge University Press.
5. Patt, A et al. 2009 Assessing Vulnerability to global environmental change: making research useful for adaptation decision making policy, Earth scan London.

Web Resources

1. <https://www.britannica.com/science/climate-change>
2. <https://www.science.org.au/learning/general-audience/science-climate-change/1-what-is-climate-change>
3. https://en.wikipedia.org/wiki/Climate_change
4. <https://www.biologydiscussion.com/biology/environmental-biology-scope-and-its-application/4573>

Rationale for Nature of the Course

Understand how climate change can lead to habitat destruction and how habitat destruction can interact with other aspects of climate change to threaten the survival of some animal species.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

The knowledge acquired by the students will help them to understand the concept of natural greenhouse gases and effect, CO₂ capture and sequestration methods and changing composition of the atmosphere from human population growth & activities

Pedagogy

Chalk and Talk, PPT, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Labs & Learning Management System (CANVAS).

Course Designer: R. SARANYA, Assistant Professor

Lecture Schedule

	Description	Hours	Mode
I	a) Climate change: Introduction,	3	Chalk and talk PPT, LMS and Group discussion
	b) Causes and effect	3	
	c) Components of the earth,	3	
	d) A brief account on rain, snow, cyclone, Tsunami, flood, earth quake and volcano...etc	6	
II	a) Components of the atmosphere, the greenhouse gases and effect,	3	Chalk and talk PPT, LMS and Group discussion
	b) Ozone depletion. Greenhouse gas emissions and the causes	3	
	c) Electricity generation, transport.	3	
	d) Consequences and evidence of climate change.	6	
III	a) CO ₂ capture and sequestration methods: Geological storage,	3	Chalk and talk PPT, LMS and Group discussion
	b) Ocean storage, Mineral storage & Leakage.	3	
	c) CO ₂ reuse mechanisms - CO ₂ → methanol, CO ₂ → hydrocarbons	3	
	d) CO ₂ → CO → hydrocarbons.	4	
	e) CCS projects (Carbon dioxide capture and sequestration).	2	
IV	a) Climate change adaptation and mitigation: strategies for emission reduction	3	Chalk and talk PPT, LMS and Group discussion
	b) Alternative energy sources and Energy efficiency and conservation.	2	
	c) Kyoto protocol, Bali Action Plan (2018),	2	
	d) Emission Gap Report (2021) – IET (International Emission Trading),	2	
	e) CDMs (Clean Developmental Mechanism)	2	
	f) JI (Joint Implementation).	2	
V	a) Climate change adaptation and mitigation:	3	Chalk and talk PPT, LMS and Group discussion
	b) Strategies for emission reduction	3	
	c) Alternative energy sources and Energy efficiency and conservation.	3	
	d) Carbon credits and carbon economics, carbon footprints;	3	
	e) Climate change conference- Copenhagen & Mexico.	3	

Course Learning Outcomes: On successful completion of the course, the students will be able to know, understand, apply, analyses and evaluate

	CLO Statement	Knowledge Level
CLO 1	Climate change: Introduction, Causes and effect, Components of the earth, a brief account on rain, snow, cyclone, tsunami, flood, earthquake and volcano.	Up to K4
CLO 2	Components of the atmosphere, the greenhouse gases and effect, Ozone depletion. Greenhouse gas emissions and the causes – electricity generation, transport. Consequences and evidence of climate change.	Up to K4
CLO 3	CO ₂ capture and sequestration methods: Geological storage, Ocean storage, Mineral storage & Leakage. CO ₂ reuse mechanisms - CO ₂ → methanol, CO ₂ → hydrocarbons and CO ₂ → CO → hydrocarbons. CCS projects (Carbon dioxide capture and sequestration).	Up to K4
CLO 4	Climate change adaptation and mitigation: strategies for emission reduction - Alternative energy sources and Energy efficiency and conservation. Kyoto protocol, Bali Action Plan (2018), Emission Gap Report (2021) – IET (International Emission Trading), CDMs (Clean Developmental Mechanism) and JI (Joint Implementation).	Up to K4
CLO 5	Carbon credits and carbon economics; UNFCCC (United Nations Framework for Convention Change) & IPCC (Inter Governmental Panel on Climate Change), climate change conference- Copenhagen & Mexico.	Up to K4

Mapping programme specific outcomes with course learning outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CLO 1	-	1	-	3	2	-	2	-	3
CLO 2	-	1	2	1	3	2	2	2	3
CLO 3	-	2	3	1	3	1	2	1	2
CLO 4	-	2	1	2	2	1	3	2	2
CLO 5	-	1	-	-	-	1	3	2	2

3- Advance application 2- Intermediate level 1- Basic level

Mapping programme outcome with course learning outcomes

	PO1	PO2	PO3	PO4	PO5
CLO 1	3	2	2	-	2
CLO 2	2	2	2	-	2
CLO 3	3	3	1	1	2
CLO 4	1	1	-	1	-
CLO 5	1	-	3	2	-

3 Advance application 2- Intermediate level 1- Basic level

Blue Print – Model for Internal Examination
Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section – A		Section – B		Section C (Either/ Choice)	Total
			MCQs		Short Answer			
			No. of Questions	K – Level	No. of Questions	K - Level		
1	CLO x	Up to K 2	2	K1&K2	2	K1, K2	1(K1)	
2	CLO y	Up to K 2	1	K1&K2	2	K2	2(K1)	
No. of Question to be asked			3		4		3	14
No. of Question to be answered			2		2		2	10
Mark for each question			2		7		10	
Total Marks for each section			6		14		20	40

K1 - Remembering and recalling facts with specific answers

K2- Basic understanding of fact and stating main ideas with general answers

K3- Application oriented – Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF BOTANY				CLASS: III B.Sc., Botany				
Sem.	Course type	Course code	Course title	Credits	Contact hours/ week	CIA	Ext.	Total
V	Industrial	23U5BINTR	Industrial/ Field visit	2	-	-	-	-

Nature of the course	Skill oriented	√	Employability	√	Entrepreneurship	√

Course Objectives: The course objectives are to,

1. Motivate students to take up internship in research institutions / industry
2. Develop the employability of students and
3. Promote entrepreneurial tendencies among students.

During the second semester vacation, students shall undertake internship for a minimum period of two weeks and submit a report and certificate from the company / industry / institution offering internship.

At the end of the internship, the students will be able to

CLOs	Course Learning Outcomes	K level
CLO 1	Work independently and as a team in mission critical projects in real-time	K4
CLO 2	Develop into a critical thinker and solve every day problems in the industry.	K5
CLO 3	Learn and analyze problems faced by the industry and workforce at large.	K4
CLO 4	Survey the job market / understand entrepreneurial opportunities / research opportunities available to them.	K2
CLO 5	Communicate precisely and accurately with team members and supervisors.	K3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO 1	3	3	3	3	3	3
CLO 2	3	3	3	3	3	3
CLO 3	3	3	3	3	3	3
CLO 4	3	3	3	3	3	3
CLO 5	3	3	3	3	3	3

Advance application –3, Intermediate level –2, Basic level–1

DEPARTMENT OF BOTANY					CLASS: III B.Sc. BOTANY			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours /Week	CIA	Ext	Total
VI	Core	23U6BCCT8	Plant Ecology and Phytogeography	4	6	25	75	100

Nature of Course	Knowledge and Skill	√	Skill Oriented	√	Employability Oriented	√	Entrepreneurship Oriented	

Objectives: The students will be able to,

- Relate to the significance of the biotic and abiotic components.
- Understand the energy flow in ecosystem.
- Level of biodiversity.
- Know implication of pollution on the environment and
- Familiarize with the phytogeography realms.

Unit	Description	Hours	K level	CLO
I	Ecology: Introduction- Autecology and Synecology. Abiotic and biotic factors and their influence on vegetation. Ecosystem: Concept and components, productivity, energy flow, food chain, food web and ecological pyramids. Types of ecosystems –pond, forest and grassland.	15	Up to K4	1
II	Biogeochemical cycles of Carbon, Nitrogen and Phosphorus. Interactions among organisms: Mutualism, commensalism and amensalism. Plant succession – Hydrosere and Xerosere. Ecological adaptations of hydrophytes, xerophytes and halophytes.	20	Up to K4	2
III	Biodiversity: Definition, levels (genetic, species and ecosystem) and values. and Hotspots- Criteria, hotspots of India. Megadiversity nations. Red list categories of IUCN, Causes for the loss of biodiversity. Conservation (In situ and ex situ methods). Biodiversity organizations: NBA, UNEP and WWF.	20	Up to K4	3
IV	Pollution: Causes and consequences of air, water, soil, noise and radiation – Carbon and water foot print. Remedial measures – Disaster management (flood and fire) - Current environmental issues – Global warming, <i>El nino</i> and <i>La nina</i> effects.	15	Up to K4	4
V	Phytogeography: Introduction, realms, continuous and discontinuous distribution, Endemism – types and theories, Continental drift, age and area hypothesis. Phytogeographical regions of India, Vegetation types of India.	20	Up to K4	5

Books for Study:

1. Singh, J.S., Singh, S.P., Gupta, S. 2006. Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi, India.
2. Sharma, P. D. 2010. Ecology and Environment. Rastogi Publications, Meerut, India. 8th ed
3. KrishnaIyer, V.R. 1992. Environmental protection and legal defence. Sterling Publishers Pvt. Ltd.
4. Shukla, R.S and Chandel, P.S. 1990. Plant Ecology, S.Chand & Co. Pvt. Ltd.
5. Krishnamurthy, K.V. 2003. An advanced text book on Biodiversity –Principle and Practice. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi. Sharma, P.D. 2009. Ecology and Environment, Rastogi Publications.

Books for References:

1. Odum, E.P. 2005. Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.
2. Wilkinson, D.M. 2007. Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A.
3. Kumar, H. D. 1990. Modern concepts of Ecology, Vikas Publishing House Pvt. Ltd.,
4. Smith, W. H. 1981. Air pollution and forest: Interactions between air contaminants and forest ecosystems.
5. Vickery, M.L. 1984. Ecology of Tropical plants, John Wiley and Sons.

Web Resources:

1. <https://www.kobo.com/us/en/ebook/plant-ecology-3>.
2. <https://www.worldcat.org/title/plant-ecology/oclc/613206385>
3. https://books.google.co.in/books/about/Plant_Ecology.html?
4. <https://www.kopykitab.com/Plant-Ecology-by-Agrawal-AK-And-Deo-PP>
5. <http://www.freebookcentre.net/Biology/Ecology-Books.html>

Rationale for Nature of the Course:

This course will enable the students to know the basis of biotic and abiotic components, principles of ecosystems, plant distribution and biodiversity conservation.

Activities having direct bearing on Skill development / Employability / Entrepreneurship:

The skills learned by the students will help them to understand the various ecosystems and their function, different phases of ecological adaptation, Biodiversity conservation and Phytogeography.

Pedagogy:

Chalk and Talk, PPT, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Labs & Learning Management System.

Course Designer: Dr. P. JANSIRANI, Assistant Professor

Lecture Schedule:

Unit	Topics	Hrs	Mode
Unit I	Ecology: Introduction- Autecology and Synecology. Abiotic and biotic factors and their influence on vegetation.	7	Chalk and Talk, Power Point, Discussion, Seminar, Interaction, Quiz, Video Clippings & Google classroom.
	Ecosystem: Concept and components, productivity, energy flow, food chain, food web and ecological pyramids. Types of ecosystems –pond, forest and grassland.	8	
Unit II	Biogeochemical cycles of Carbon, Nitrogen and Phosphorus. Interactions among organisms	7	
	Mutualism, commensalism and amensalism. Plant succession – Hydrosere and Xerosere.	7	
	Ecological adaptations of hydrophytes, xerophytes and halophytes	6	
Unit III	Biodiversity: Definition, levels (genetic, species and ecosystem) and values. Causes for the loss of biodiversity.	7	
	Hotspots- Criteria, hotspots of India. Megadiversity nations. Red list categories of IUCN.	6	
	Conservation (In situ and ex situ methods). Biodiversity organizations: NBA, UNEP and WWF.	7	
Unit IV	Pollutions: Causes and consequences of air, water, soil, noise, and radiation	6	
	Carbon and water foot print. Remedial measures.	6	
	Disaster management. Current environmental issues – <i>El nino</i> and <i>La nina</i> effects	3	
Unit V	Introduction, realms, continuous and discontinuous distribution,	6	
	Endemism – types and theories, Continental drift, age and area hypothesis.	7	
	Phytogeographical regions of India, Vegetation types of India.	7	

Course Learning Outcomes:

On successful completion of the course, the students will be able to know, understand, apply, analyse the

CLOs	Course Learning Outcomes	Knowledge Level
CLO 1	Significance of the biotic and abiotic components of the ecosystems and energy flow.	Up to K4
CLO 2	Biogeochemical cycles, interactions and succession of plant community	Up to K4
CLO 3	Implication of pollution on the environment.	Up to K4
CLO 4	Implications of functional and behavioural ecology in natural and man-made areas, biodiversity and conservation.	Up to K4
CLO 5	Mitigation strategies for disaster management and phytogeographical division of India.	Up to K4

Mapping of CLOs with PSOs

#	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CLO 1	1	2	2	1	2	3
CLO 2	2	2	3	2	2	2
CLO 3	2	2	1	2	2	2
CLO 4	2	3	3	2	3	1
CLO 5	1	3	3	1	3	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO 1	3	3	2	3	2	2
CLO 2	3	3	3	2	3	3
CLO 3	2	2	3	3	1	1
CLO 4	3	3	3	3	3	2
CLO 5	3	3	2	2	2	1

Advance application - 3; Intermediate level - 2; Basic level – 1

Blue Print for Summative Examinations

Mapping with Course Learning Outcomes (CLOs)

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K Level	No. of Questions	K Level		
1	CLO 1	Up to K2	2	K1 or K2	1	K1	2(K1&K1)	1 (K2)
2	CLO 2	Up to K3	2	K1 or K2	1	K1	2 (K2&K2)	1 (K3)
3	CLO 3	Up to K3	2	K1 or K2	1	K2	2 (K3&K3)	1 (K3)
4	CLO 4	Up to K4	2	K1 or K2	1	K2	2 (K4& K4)	1 (K4)
5	CLO 5	Up to K5	2	K1 or K2	1	K2	2 (K3&K3)	1 (K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - solving problems

K4 - Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF BOTANY					CLASS: III B.Sc. BOTANY			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours /Week	CIA	Ext	Total
VI	Core	23U6BCCT9	Molecular Biology and Plant Biotechnology	4	6	25	75	100

Nature of Course	Knowledge and Skill	√	Skill-Oriented	√	Employability-Oriented	√	Entrepreneurship-Oriented	

Objectives: The students will be able to,

- Recognize the fundamental concepts of central dogma of molecular biology.
- Study the salient features of gene expression of different levels.
- Develop their competency on different types of plant tissue culture and regeneration pathway.
- Know the types of vectors and evaluate the different methods of gene transfer in plants.

Unit	Description	Hours	K-level	CLO
I	Molecular Biology: Central dogma - DNA as a genetic material (Griffith, Hershey and Chase, Avery et al). DNA - Structure, forms, denaturation and renaturation. RNA structure and types. Replication of DNA in prokaryotes.	18	Upto K4	1
II	Transcription in prokaryotes and eukaryotes. Post transcriptional modification of RNA. Translation in prokaryotes. Genetic code. Gene regulation in Prokaryotes – <i>lac</i> operon. Mutation – mutagens, types. DNA repair mechanism.	18	Upto K4	2
III	Biotechnology: Introduction, history and scope. Multidisciplinary approaches. Vectors - plasmid, bacteriophage and cosmids. Restriction enzymes – types and characteristics. DNA ligase, Gene cloning methods. PCR and its applications. Southern and Northern blotting techniques.	18	Upto K4	3
IV	Plant tissue culture - Introduction, scope and importance, concept of totipotency, aseptic techniques in plant tissue culture. Components of media, sterilization, explant preparation and inoculation. Callus induction and micro propagation. Meristem and protoplast culture. Applications of tissue culture. Synthetic seed technology.	18	Upto K4	4
V	Gene transfer methods - Physical (biolistics and microinjection) Chemical (PEG) and Biological (<i>Agrobacterium</i>). Transgenic plants – Bt cotton, Glyphosate resistant plants, Golden rice and <i>Flavrsavr</i> tomato. Vaccines and their types. Bioremediation of oil spills in ocean.	18	Upto K4	5

Books for Study:

1. Ignacimuthu, S.J. 2003. Plant Biotechnology. Oxford & IBH Publishing, New Delhi.
2. Verma P.S and Agarwal V.K. 2010. Molecular Biology. S Chand Publishers.
3. Bhojwani, S.S and Razdan, M.K. 2004. Plant Tissue Culture, Read Elsevier India Pvt. Ltd.

Books for References:

1. Bernard R Glick and Jack J Pasternak. 2001. Molecular biotechnology-principles and applications of recombinant DNA, (2nd Edition), ASM Press, Washington, D.C.
2. Jogdand, SN. 1997. Gene biotechnology, Himalaya Publishing House, New Delhi.
3. Ernst L. Winnaccker. 2002. From Genes to Clones-introduction to gene technology, VCR Pub., Weintein.
4. James, D Watson et al., 1992. Recombinant DNA (2nd Edition), WH Freeman and Co., New York.
5. Maniatis and Sambrook. 2003. Molecular Cloning- A lab manual Vol. I, II & III, Coldspring Harbor Laboratory Press, New York.

Web Resources

1. <http://www.freebookcentre.net/Biology/BioTechnology-Books.html>
2. https://books.google.co.in/books/about/Introduction_to_Plant_Biotechnology.html?id=RgQLI
3. <https://www.kobo.com/us/en/ebook/plant-biotechnology-1>
4. <https://www.kobo.com/us/en/ebook/plant-biotechnology-1>

Rationale for Nature of the Course:

This course will enable the students to know the basis of genetic materials, molecular biology, principles of various micropropagation techniques and gene transfer methods in plants.

Activities having direct bearing on Skill development / Employability / Entrepreneurship:

The skills learned by the students will help them to understand the DNA, RNA and their replications, genetic engineering methods, plant propagation techniques and scope of biotechnological applications.

Pedagogy:

Chalk and Talk, PPT, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Labs & Learning Management System.

Course Designer: Dr. S. SARAVANAN, Assistant Professor

Lecture Schedule:

Unit	Topics	Hrs	Mode
Unit I	Molecular biology: Central dogma. DNA as a genetic material (Griffith, Hershey and Chase, Avery et al).	8	Chalk and Talk, Power Point, Discussion, Seminar, Interaction, Quiz, Video Clippings & Google classroom.
	DNA - Structure, forms, denaturation and renaturation. RNA structure and types.	7	
	Replication of DNA in prokaryotes.	3	
Unit II	Transcription in prokaryotes and eukaryotes. Post transcriptional modification of RNA.	6	Chalk and Talk, Power Point, Discussion, Seminar, Interaction, Quiz, Video Clippings & Google classroom.
	Translation in prokaryotes. Genetic code. Gene regulation in Prokaryotes – <i>lac</i> operon.	6	
	Mutation – mutagens, types. DNA repair mechanism.	6	
Unit III	Biotechnology: Introduction, history and scope. Multidisciplinary approaches.	5	Chalk and Talk, Discussion, Assignment, Interaction, Quiz, & Google classroom.
	Vectors - plasmid, bacteriophage and cosmids. Restriction enzymes – types and characteristics. DNA ligase, Gene cloning methods.	7	
	PCR and its applications. Southern and Northern blotting techniques.	6	
Unit IV	Plant tissue culture - Introduction, scope and importance, concept of totipotency, aseptic techniques in plant tissue culture.	6	Chalk and Talk, Power Point, Discussion, Seminar, Interaction, Quiz, Video Clippings & Google classroom.
	Components of media, sterilization, explant preparation and inoculation. Callus induction and micropropagation.	6	
	Meristem and protoplast culture. Applications of tissue culture. Synthetic seed technology.	6	
Unit V	Gene transfer methods - Physical (biolistics and microinjection) Chemical (PEG) and Biological (<i>Agrobacterium</i>).	6	Chalk and Talk, Power Point, Discussion, Models, Interaction, Quiz, Video Clippings & Google classroom.
	Transgenic plants – Bt cotton, Glyphosate resistant plants, Golden rice and <i>Flavrsavr</i> tomato.	6	
	Vaccines and their types. Bioremediation of oil spills in ocean.	6	

Course Learning Outcomes: At the end of the course the students will be able to,

CLOs	Course Learning Outcomes	Knowledge Level
CLO 1	understand the concepts of molecular biology, and DNA replication	Up to K4
CLO 2	study the transcription in prokaryotes and eukaryotes	Up to K4
CLO3	comprehend the vectors, restriction enzymes and PCR	Up to K4
CLO4	learn the concept of micropropagation techniques	Up to K4
CLO 5	analyse the applications of biotechnology.	Up to K4

Mapping of CLOs with PSOs

#	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CLO 1	1	2	2	1	2	3
CLO 2	2	2	3	2	2	2
CLO 3	2	2	1	2	2	2
CLO 4	2	3	3	2	3	1
CLO 5	1	3	3	1	3	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO 1	3	3	2	3	2	2
CLO 2	3	3	3	2	3	3
CLO 3	2	2	3	3	1	1
CLO 4	3	3	3	3	3	2
CLO 5	3	3	2	2	2	1

Advance application - 3; Intermediate level - 2; Basic level – 1

Blue Print for Summative Examinations

Mapping with Course Learning Outcomes (CLOs)

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K Level	No. of Questions	K Level		
1	CLO 1	Up to K2	2	K1 or K2	1	K1	2 (K1 & K1)	1 (K2)
2	CLO 2	Up to K3	2	K1 or K2	1	K1	2 (K2& K2)	1 (K3)
3	CLO 3	Up to K3	2	K1 or K2	1	K2	2 (K3&K3)	1 (K3)
4	CLO 4	Up to K4	2	K1 or K2	1	K2	2 (K4& K4)	1 (K4)
5	CLO 5	Up to K5	2	K1 or K2	1	K2	2 (K3&K3)	1 (K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - solving problems

K4 - Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF BOTANY					CLASS: III B.SC			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
VI	core	23U6BCCT10	Plant Physiology and Biochemistry	4	6	25	75	100

Nature of Course	Knowledge and Skill	√	Skill-Oriented	√	Employability-Oriented	√	Entrepreneurship-Oriented	

Objectives: The students will be able to,

- Relate to water relation of plants with respect to various physiological phenomenon.
- Know the pathways of photosynthesis.
- Familiarize with respiration and nitrogen metabolism.
- Know about plant growth regulators.
- Familiarize with structure and function of biomolecules.

Unit	Description	Hours	K-level	CLO
I	Water relations: Properties of water, diffusion, osmosis, imbibition and plasmolysis. Absorption of water by roots – mechanism, active and passive transport. Transpiration – types, mechanisms of stomatal movement: Starch–sugar interconversion and K ⁺ pump theory. Factors affecting transpiration. Ascent of sap.	20	Up toK4	1
II	Mineral transport. Macro and micro nutrients. Translocation of organic solutes: Munch mass flow hypothesis. Photosynthesis: Light reaction- Absorption spectra, PS I, PS II. Non-cyclic and cyclic photophosphorylation. Dark reaction- C3, C4, and CAM pathways.	15	Up toK4	2
III	Respiration: Glycolysis, Oxidative decarboxylation, Krebs cycle, Electron Transport chain. Pentose phosphate pathway. Plant growth regulators: Physiological role of auxins, gibberellins, cytokinins, ethylene and abscisic acid. Photoperiodism. Vernalization. Seed dormancy.	20	Up toK4	3
IV	Plant biochemistry: Structure of atom. Chemical bonds (covalent and electrostatic interactions). Carbohydrates: Classification, structure and physiochemical properties of glucose and starch. Lipids: Classification, structure and properties of triglycerides.	20	Up toK4	4

V	Amino acids: Structure and classification based on R side chain. Proteins: Primary, secondary tertiary, and quaternary organizations. Enzymes- Nomenclature of enzymes. Classification and mechanism of enzyme action. Factors affecting enzyme action.	15	Up toK4	5

Books for study:

1. Verma V.2008. Textbook of plant physiology, Ane's student edition, New Delhi.
2. Pandey, SN and Sinha, BK 1989 Plant physiology, Vikas Publishing House Ltd, New Delhi.
3. Metz E.T 1960 Elements of Biochemistry V.F &S (P) Ltd., Bombay

Books for References

1. Jain V. K 2006 Fundamentals of plant physiology, S, Chand and company Ltd, New Delhi.
2. Noggle and Fritz 1976, Introductory plant Physiology, Prentice Hall, New Delhi.
3. Satyanarayana U and Chakrapani U 1999 Biochemistry Books and Allied (P) Ltd Kolkata.

Web Resources

1. www.plantphys.net
2. https://www.youtube.com/watch?v=RT-w2xHVL_
3. https://www.youtube.com/watch?v=_MHu-A58ys4

Rationale for Nature of the course

Gained theoretical knowledge on plant water relations, metabolism and applications of phytohormones will help students to get employment in agro-based industries.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Analytical skills gained through theoretical discussions on water potential, various metabolic pathways, physiological basis of plant growth and development will help to students to attend issues in crop improvement and agri based industries.

Pedagogy

Chalk and Talk, PPT, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Labs & Learning Management System (CANVAS).

Course Designer:

DR. M. KARPAGA JOTHI, Assistant Professor

Lesson Plan:

Unit	Topics	Hrs	Mode
Unit I	a. Water relations: Properties of water, diffusion, osmosis, imbibition and plasmolysis.	5	Chalk and talk PPT, LMS and Group discussion
	b. Absorption of water by roots – mechanism, active and passive transport.	4	
	c. Transpiration – types, mechanisms of stomatal movement:	5	
	d. Starch–sugar interconversion and K ⁺ pump theory. Factors affecting transpiration. Ascent of sap.	6	
Unit II	a. Mineral transport. Macro and micro nutrients.	4	Chalk and talk PPT, LMS and Group discussion
	b. Translocation of organic solutes: Munch mass flow hypothesis.	5	
	c. Photosynthesis: Light reaction- Absorption spectra, PS I, PS II. Non-cyclic and cyclic photophosphorylation.	3	
	d. Dark reaction- C3, C4, and CAM pathways	3	
Unit III	a. Respiration: Glycolysis, Oxidative decarboxylation, Krebs cycle,	5	Chalk and talk PPT, LMS and Group discussion
	b. Electron Transport chain. Pentose phosphate pathway.	5	
	c. Plant growth regulators: Physiological role of auxins, gibberellins, cytokinins, ethylene and abscisic acid.	5	
	d. Photoperiodism. Vernalization. Seed dormancy	5	
Unit IV	a. Structure of atom. Chemical bonds (covalent and electrostatic interactions).	5	Chalk and talk PPT, LMS and Group discussion
	b. Carbohydrates: Classification, structure and physiochemical properties of glucose and starch.	5	
	c. Lipids: Classification, structure and properties of triglycerides.	5	
Unit V	a. Amino acids- Structure and classification based on R side chain. Proteins:	4	Chalk and talk PPT, LMS and Group discussion
	b. Primary, secondary tertiary, and quaternary organizations.	6	
	c. Enzymes- Nomenclature of enzymes. Classification and mechanism of enzyme action. Factors affecting enzyme action.	5	

Course Learning Outcomes:

On success completion of the course, the students will be able to know, understand, apply and analyse the

CLOs	Course Learning Outcomes	Knowledge Level
CLO–1	Properties of water, water phenomena, mechanisms of water absorption and transpiration	UP TO K4
CLO–2	Significance of nutrients in plants, mechanisms of mineral transport and solute translocation.	UP TO K4
CLO–3	Carbon and nitrogen metabolism	UP TO K4
CLO–4	Role of hormones in many growth and development processes	UP TO K4
CLO–5	Properties and biological role of carbohydrates,	UP TO K4

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7
CLO-1	2	3	3	3	3	3	2
CLO-2	3	3	3	2	3	3	3
CLO-3	3	3`	3	3	3	3	3
CLO-4	3	3	2	3	3	3	3
CLO-5	3	3	3	3	3	2	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5
CLO1	3	3	2	3	2
CLO2	3	3	2	3	3
CLO3	2	2	1	-	2
CLO4	1	-	2	2	1
CLO5	-	1	-	2	-

Advance application– 3; Intermediate level–2; Basic level–1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D(Open Choice)
			MCQs		Short answers			
			No. of Questions	K-Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1&K2	1	K1	2(K1&K1)	1(K2)
2	CLO 2	Up to K3	2	K1&K2	1	K1	2(K2&K2)	1(K3)
3	CLO 3	Up to K3	2	K1&K2	1	K2	2(K3&K3)	1(K3)
4	CLO 4	Up to K4	2	K1&K2	1	K2	2(K4&K4)	1(K4)
5	CLO 5	Up to K3	2	K1&K2	1	K2	2(K3&K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF BOTANY				CLASS: III -B.Sc. Botany				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/ week	CIA	Ext	Total
VI	Core Practical	23U6BCCP6	Major Practical-VI	3	3	25	75	100

(Plant Ecology and Phytogeography, Plant Molecular Biology & Biotechnology, Plant Physiology and Biochemistry)

Nature of Course	Knowledge and Skill	√	Skill-Oriented	√	Employability-Oriented	√	Entrepreneurship-Oriented	

Objectives: The course will enable the students to,

- Study morphological and anatomical adaptations of plants of various habitats.
- Demonstrate techniques of plant tissue culture.
- Familiarize with the structure of DNA and RNA.
- Carryout experiments related with plant physiology.
- Perform biochemistry experiments.

Plant Ecology and Phytogeography

1. Study of morphological and anatomical adaptations of Hydrophytes: *Nymphaea*, *Hydrilla*. Xerophytes: *Nerium*, *Casuarina*. Halophytes : *Rhizophora*.
2. To locate Phyto-geographical regions of India in the India map and hotspots in the world map.
3. Vegetation study – Quadrant and line transect methods.
4. Field trip to the place of ecological interests.

Plant Molecular Biology and Biotechnology

1. Demonstration of Plasmid isolation – Miniprep method.
2. Demonstration of plant DNA extraction.
3. Polymerase Chain Reaction - Demonstration
4. Southern blotting techniques.
5. MS - Media preparation and Explant sterilization.
6. Micropropagation using nodal bud explant– Demonstration.

Plant Physiology and Biochemistry

1. Determination of water potential using potato tuber by Gravimetric / Chardakov methods.
2. Separation of plant pigments by paper chromatography.
3. Effect of monochromatic light on the rate of photosynthesis.
4. Determination of complementary colour of $K_2Cr_2O_7$ & methylene blue.
5. Qualitative test for carbohydrates, proteins and lipids.
6. Physiological set up: Bell jar, Ganong's potometer, Potato osmoscope, and Arc auxanometer.

Rationale for Nature of the Course:

The students acquire profound practical skills in the laboratory with scientific observations in the field of Ecology, Biotechnology, Plant physiology and Biochemistry.

Activities having direct bearing on Skill development / Employability / Entrepreneurship:

This Knowledge and skills acquired by the students will enable them to understand the morphological and anatomical aspects of hydrophytes, xerophytes and halophytes, isolation of plasmid DNA, PCR, blotting and micropropagation techniques, paper chromatography, qualitative estimation of carbohydrates, proteins and lipids.

Pedagogy:

Hands on training, dissection, chalk and talk, power point, group discussion, seminar, interaction, problem solving, quiz, virtual labs, you tube videos & learning management system (canvas).

Course Designer:

Dr. P. JANSIRANI, Assistant Professor,

Dr. M. KAPAGAJOTHI, Assistant Professor and

Dr. S. SARAIVANAN, Assistant Professor.

Course Schedule:

S. No.	Description	Hours	Mode
I	Study of morphological and anatomical adaptations of Hydrophytes: <i>Nymphaea</i> , <i>Hydrilla</i> . Xerophytes: <i>Nerium</i> , <i>Casuarina</i> . Halophytes: <i>Rhizophora</i> . To locate Phyto-geographical regions of India in the India map and hotspots in the world map. Vegetation study – Quadrate and line transect methods.	15	Land specimens, Dissection and Microscopic Slides.
II	Demonstration of Plasmid isolation – Miniprep method. Demonstration of plant DNA extraction. PCR, Southern and Northern blotting techniques. MS - Media preparation and Explant sterilization. Micropropagation using nodal bud explant– Demonstration.	15	Group experiment Group experiments
III	Determination of water potential using potato tuber by Gravimetric/ Chardakov methods. Separation of plant pigments by paper chromatography. Effect of monochromatic light on the rate of photosynthesis. Determination of complementary colour of K ₂ Cr ₂ O ₇ & methylene blue. Qualitative test for carbohydrates, proteins and lipids. Physiological set up: Bell jar, Ganong's potometer, Potato osmoscope, and Arc auxanometer.	15	

DEPARTMENT OF BOTANY					CLASS: III B.Sc. BOTANY			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours /Week	CIA	Ext	Total
VI	Elective	23U6BDET2 (A)	Forensic Botany	2	4	25	75	100
Nature of Course	Knowledge and Skill	√	Skill Oriented	√	Employability Oriented	√	Entrepreneurship Oriented	

Objectives:

The students will be able to,

- Learn the basic knowledge about the application of Botany to Forensic investigations and legal disputes
- Understand palynology, dendrology, plant anatomy, pharmacognosy, molecular biology and toxic compounds from plants that could serve as leads in crime spots.
- Classify the plants from forensic point of view.
- Understand the forensic importance of different parts of plants.
- Develop and identify main morphological and anatomical features of plants, which could be useful for forensic investigations.

Unit	Description	Hours	K level	CLO
I	Introduction, definition, scope and importance of forensic Botany. Forensic tools. Forensic laboratories in India. Sub specialization of forensic studies relation to palynology and plant ecology. Contributions of the forensic botanist in crime scene investigations.	12	Upto K4	1
II	Forensic Limnology: Methods of identification and comparison of various types of planktons and diatoms and their forensic importance. Forensic Mycology: A general account. Fungi as agents of poisoning and hallucinations. Forensic aspects of fibre examinations.	12	Upto K4	2
III	Identification of poisonous properties on human system: <i>Argemone mexicana</i> , <i>Calotropis gigantea</i> , <i>Jatropha curcas</i> , <i>Cleistanthus collinus</i> , <i>Strychnos nux-vomica</i> and <i>Thevetia nerifolia</i> . Effects of drug yielding plants– opium, cannabis, tobacco and <i>Psilocybin</i> mushrooms.	12	Upto K4	3
IV	Collection and preservation of botanical evidences: Botanical samples, outdoor crime scene consideration. DNA analysis: Capillary sequencing, Serology (Blood, saliva and semen).	12	Upto K4	4
V	DNA fingerprinting techniques: Extraction, quantification, amplification and capillary electrophoresis. Detection of maternity and paternity. Use of genetic markers in identification: RFLP, RAPD, SSR and SCAR.	12	Upto K4	5

Books for Study:

1. Coyle, H.M. 2005. Forensic Botany: Principles and Applications to Criminal Casework. CRC Press.
2. James, S.H., Nordby J.J., Bell, S. 2015. Forensic Science: An Introduction to Scientific and Investigative Techniques. CRC Press; 4 editions.
3. David W. Hall, Dr. Jason H. Byrd. 2012. Forensic Botany. Wiley-Blackwell; United Kingdom.

Books for References:

1. Hall, D.W and Byrd, J. 2012. Forensic Botany: a practical guide. Wiley-Blackwell, 1edition.
2. Bock, J.H and Norris, D.O. 2016. Forensic Plant Science, Academic Press.
3. Nicholas Marquez Grant, John Wiley. 2012. Forensic Ecology Handbook. Wiley Backwell.
4. David W. Hall, Jason Byrd. 2012. Forensic Botany: A Practical Guide. Wiley-Blackwell.

Web Resources:

1. <https://www.kobo.com/us/en/ebook/forensic-botany>
2. <https://www.worldcat.org/title/forensic-botany-a-practical-guide/oclc/796086574>
3. https://www.buecher.de/shop/pflanzenoekologie/forensic-botany-ebook-pdf/hall-david-w--byrd-jason/products_products/detail/prod_id/37354547/
4. <https://www.crcpress.com/Forensic-Botany-Principles-and-Applications-to-Criminal-Casework/Miller-Coyle/p/book/9780849315299>
5. <http://docshare02.docshare.tips/files/25818/258183613.pdf>

Rationale for Nature of the Course:

This course will enable the students to know basic knowledge about the application of Botany to Forensic investigations and legal disputes.

Activities having direct bearing on Skill development / Employability / Entrepreneurship:

The skills learned by the students will help them to understand tools, techniques and applications of forensic science using botanical evidences for investigation of crimes.

Pedagogy:

Chalk and Talk, PPT, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Labs & Learning Management System.

Course Designer:

R. SARANYA, Assistant Professor

Lecture Schedule:

Unit	Topics	Hrs	Mode
Unit I	Introduction, definition, scope and importance of forensic Botany. Forensic tools. Forensic laboratories in India.	6	Chalk and Talk, Power Point, Discussion, Seminar, Interaction, Quiz, Video Clippings & Google classroom.
	Sub specialization of forensic studies relation to palynology and plant ecology. Contributions of the forensic botanist in crime scene investigations	6	
Unit II	Forensic Limnology: Methods of identification and comparison of various types of planktons and diatoms and their forensic importance.	6	
	Forensic Mycology: A general account. Fungi as agents of poisoning and hallucinations. Forensic aspects of fibre examinations.	6	
Unit III	Identification of poisonous properties on human system: <i>Argemone mexicana</i> , <i>Calotropis gigantea</i> , <i>Jatropha curcas</i> , <i>Cleistanthus collinus</i> , <i>Strychnos nux-vomica</i>	6	
	Identification of poisonous properties on human system: <i>Thevetia nerifolia</i> . Effects of drug yielding plants– opium, cannabis, tobacco and <i>Psilocybin</i> mushrooms	6	
Unit IV	Collection and preservation of botanical evidences: Botanical samples, outdoor crime scene consideration.	6	
	DNA analysis: Capillary sequencing, Serology (Blood, saliva and semen).	6	
Unit V	DNA fingerprinting techniques: Extraction, quantification, amplification and capillary electrophoresis. Detection of maternity and paternity	6	
	Use of genetic markers in identification: RFLP, RAPD, SSR and SCAR.	6	

Course Learning Outcomes:

On successful completion of the course, the students will be able to know, understand, apply and analyse the

CLOs	Course Learning Outcomes	Knowledge Level
CLO 1	Morphological and anatomical features of plants, which could be useful for forensic investigations.	Up to K4
CLO 2	Forensic importance of different parts of plants.	Up to K4
CLO 3	New methods for the detection of plant poisons used in crime.	Up to K4
CLO 4	Techniques for the collection and preserve of botanical evidences of crime.	Up to K4
CLO 5	Significance of classic and DNA based forensic botany cases.	Up to K4

Mapping of CLOs with PSOs

#	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CLO 1	1	2	2	1	2	3
CLO 2	2	2	3	2	2	2
CLO 3	2	2	1	2	2	2
CLO 4	2	3	3	2	3	1
CLO 5	1	3	3	1	3	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO 1	3	3	2	3	2	2
CLO 2	3	3	3	2	3	3
CLO 3	2	2	3	3	1	1
CLO 4	3	3	3	3	3	2
CLO 5	3	3	2	2	2	1

Advance application - 3; Intermediate level - 2; Basic level – 1

Blue Print for Summative Examinations

Mapping with Course Learning Outcomes (CLOs)

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K Level	No. of Questions	K Level		
1	CLO 1	Up to K2	2	K1 or K2	1	K1	2 (K1 & K1)	1 (K2)
2	CLO 2	Up to K3	2	K1 or K2	1	K1	2 (K2& K2)	1 (K3)
3	CLO 3	Up to K3	2	K1 or K2	1	K2	2 (K3&K3)	1 (K3)
4	CLO 4	Up to K4	2	K1 or K2	1	K2	2 (K4& K4)	1 (K4)
5	CLO 5	Up to K5	2	K1 or K2	1	K2	2 (K3&K3)	1 (K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - solving problems

K4 - Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF BOTANY					CLASS: III B.Sc. BOTANY			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours /Week	CIA	Ext	Total
VI	Elective	23U6BDET2 (B)	Ethnobotany and Pharmacognosy	2	4	25	75	100

Nature of Course	Knowledge and Skill	√	Skill Oriented	√	Employability Oriented	√	Entrepreneurship Oriented	

Objectives:

The course will enable the students to

1. Study the history and importance ethnic knowledge on the uses of herbal plants.
2. Study the details and life style of tribals of Tamil Nadu.
3. Understand the importance and methods of ethnobotanical surveys.
4. Awareness on the commercial significance of traditional knowledge and benefit sharing mechanisms.

UNIT	CONTENT	CLO	K LEVEL	HOURS
I	Ethnobotany - Introduction, scope and objectives, definition, concept, Subdisciplines- ethnoecology, ethnobotany and ethnopharmacology. Method of study; schedule and questionnaire, documentation, Plant collection and documentation	1	Up to K4	12
II	Distribution of ethnic communities in India with special reference to Tamil Nadu (Irulas, Kanis, Paliyars). Ethnobotanical practices- Food plants, medicinal plants and religious plants. Role of ethnobotany in conservation of genetic resources.	2	Up to K4	12
III	Ethnomedicine- Jeevani- discovery and significance. Community medicine, Tribal medicine and folk medicine, Ethno medicinal importance of <i>Piper nigrum</i> , <i>Gloriosa superba</i> and <i>Senna angustifolia</i> . – brief account on traditional knowledge related IPR issues.	3	Up to K4	12
IV	Pharmacognosy ; Scope and its importance, Primary metabolites, Secondary metabolites- alkaloids, terpenoids, phenolics and their functions. Organoleptic evaluation of crude drugs.	4	Up to K4	12
V	Pharmacognosy and its importance in modern medicine, Crude drugs, Classification of drugs; chemical and pharmacological, Major pharmacological groups of plant drugs and their uses.	5	Up to K4	12

Books for the study

1. Gokhale, S. B., Kokate, C. K., and Gokhale, A. (2016). Pharmacognosy. Of traditional Drugs. Nirali Prakashan, 1st Edition. ISBN: 9351642062.
2. Hornok, L. (1992). Cultivation and Processing of Medicinal Plants. Wiley-Blackwell. ISBN: 0471923834.
3. Premendra Singh (2013). MEDICINAL PLANTS: Conservation, Cultivation and Utilization. Daya Publishing House - A division of - Astral International (P) Ltd. ASIN: B00C865V6M.

Books for References

1. Joshi, S.G (2018). Medicinal Plants. Oxford & IBH Publishing C., Pvt., Ltd., New Delhi.
2. Kumar, N (2018). A Textbook of Pharmacognosy. Aitbs Publishers, India.
3. Prajapathi, Purohit, Sharma and Kumar. (2003). A Hand book of Medicinal plants. Agrobios Publications, Jodhpur. Kumar,NC (1993). An Introduction to Medical Botany and Pharmacognosy.
4. Gringauz (2012) Introduction to medicinal chemistry; How Drugs Act & Why. Wiley India. Pvt Ltd. ISBN; 812628567. Publishers & Distributors, 17th ed. Edition. ISBN: 8123925328.
5. Zhang C. L. (2012). Cultivation Techniques of Medicinal Plants. China Agricultural University. ISBN: 7811177773.

Web Resources

1. <https://en.wikipedia.org/pharmacognosy>
2. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5847565>.
3. <https://en.wikipedia.org/wiki/medicinalplant>
4. <https://www.ccras.nic.in/content/medicinal-plants>.

Rationale for Nature of the Course

This course will help students to explore knowledge on traditional medicine followed by tribal people and methods employed in pharmacognosy.

Activities having direct bearing on skill development/ Employability/ Entrepreneurship

The concepts learned by the students related to medicinal properties and their mechanism of action help them to gain a position in pharmaceutical and its related industries.

Course designer;

R. SARANYA, Assistant Professor

Pedagogy

Chalk and talk, PPT, group discussion, Seminar, Interaction, Quiz and learning Management system (CANVAS).

Course Learning Outcomes: On the successful completion of the course the students will be able to

CLO	CLO Statement	Knowledge level
CLO 1	explore importance ethnic knowledge on the uses of herbal plants.	Up to K4
CLO 2	document life style and traditional practices of the above tribes.	Up to K4
CLO 3	gain awareness on the commercial significance of traditional knowledge and benefit sharing mechanisms.	Up to K4
CLO 4	understand the scientific screening of medicinal plant for its purity of drugs and chemical principles	Up to K4
CLO 5	classify drugs and its vital importance in modern medicine,	Up to K4

Mapping programme specific outcomes with course learning outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	3	3	2	3	3	3
CLO2	3	3	3	2	3	2
CLO3	2	2	3	3	2	2
CLO4	2	3	2	3	2	3
CLO5	3	3	3	2	2	3

3- Advance application 2- Intermediate level 1- Basic level

Mapping programme outcome with course learning outcomes

	PO1	PO2	PO3	PO4	PO5
CLO1	3	3	3	3	2
CLO2	3	3	2	3	2
CLO3	3	3	1	1	2
CLO4	2	1	2	1	2
CLO5	3	3	3	2	1

3- Advance application 2- Intermediate level 1- Basic level

Lesson Plan

Unit	Description	Hours	Mode
I	a) Ethnobotany- Introduction, scope and objectives. definition, concept,	3	Blackboard
	b) Subdisciplines ethnoecology, ethnoforestry and ethnopharmacology.	3	Discussion
	c) Method of study; schedule and questionnaire, documentation, Plant collection and documentation	6	Powerpoint
II	a) Distribution of ethnic communities in India with special reference to Tamil Nadu (Irulas, Kanis, Paliyars).	3	Discussion
	b) Ethnobotanical practices- Food plants, medicinal plants and religious plants.	6	Seminar
	c) Role of ethnobotany in conservation of genetic resources.	3	PowerPoint
III	a) Ethnomedicine- Jeevani- discovery and significance. Community medicine,	3	Discussion
	b) Tribal medicine and folk medicine		Seminar
	c) Ethnomedicinal importance of <i>Piper nigrum</i> , <i>Gloriosa superba</i> and <i>Senna angustifolia</i> .	3	Blackboard
	d) Brief account on traditional knowledge related IPR issues.	3	PowerPoint
IV	a) Pharmacognosy; Scope and its importance,		Blackboard
	b) Primary metabolites	3	PowerPoint
	c) Secondary metabolites- alkaloids, terpenoids, phenolics and their functions.	3	Discussion
	d) Organoleptic evaluation of crude drugs	3	Seminar
V	a) Pharmacognosy and its importance in modern medicine, Crude drugs,	3	Blackboard
	b) Classification of drugs; chemical and pharmacological,	3	Blackboard
	c) Major pharmacological groups of plant drugs and their uses.	6	Discussion

Blue Print – Model for External Examination
Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section – A		Section – B		Section C (Either/ Choice)
			MCQs		Short Answer		
			No. of Questions	K – Level	No. of Questions	K – Level	
1	CLO 1	Up to K 2	1	K1	2	K2& K2	1(K1)
2	CLO 2	Up to K 2	1	K1	2	K2& K2	1(K1)
3	CLO 3	Up to K 2	1	K1	2	K2& K2	1(K1)
4	CLO 4	Up to K 2	1	K1	2	K2& K2	1(K1)
5	CLO 5	Up to K 2	1	K1	2	K2& K2	1(K1)
No. of Question to be asked			5		10		5
No. of Question to be answered			5		5		3
Mark for each question			2		7		10
Total Marks for each section			10		35		30

K1 - Remembering and recalling facts with specific answers

K2- Basic understanding of fact and stating main ideas with general answers

K3- Application oriented – Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section- wise marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Total Marks	% of Marks without choice	Consolidated
K1	20	-	50	70	58.33	100%
K2	-	50	-	50	41.67	
Total Marks	20	50	50	120	100.00	100%

DEPARTMENT OF BOTANY					CLASS: III B.Sc. BOTANY			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours /Week	CIA	Ext	Total
VI	SEC	23U6BSED8	Botany For Competitive Examinations	2	2	25	75	100

Nature of Course	Knowledge and Skill	√	Skill-Oriented	√	Employability-Oriented	√	Entrepreneurship-Oriented	

Objectives: the students will be able to,

- Acquire competency in Botany to undertake competitive exams.
- Learn structure, life cycle and economic importance of algae, fungi, lichens, bryophytes, pteridophytes, Gymnosperms and fossils and Geological time scale.
- Understand the morphology, taxonomy and economic importance of angiospermic plants.
- Analyze the concept of ecology, plant communities, pollution types and conservation of natural resources.

Unit	Description	Hours	K-level	CLO
I	Plant world: Five kingdom classification. Outline of Kingdom plantae. General characters and Economic importance of Algae, Fungi and Lichens.	6	Upto K2	1
II	General characters of plant groups: General characters and Economic importance of Bryophytes, Pteridophytes and Gymnosperms. Palaeobotany- Types of fossils, Geological time scale, Fossil beds of Tamil Nadu. Paleobotany- Fossil types. Fossilization methods. Geological Time Scale.	6	Upto K2	2
III	Plant morphology and taxonomy: Root and Stem modification. Inflorescence- raceme, cyme and special types. Pollination types. Taxonomy of Angiosperm: Hierarchy, ICN. Binomial nomenclature and BSI. Herbarium and Major Herbaria of the world. Family characteristics and economic importance of Rutaceae, Asteraceae, Euphorbiaceae, Poaceae. Economic importance of plants: Timber, fibre, oil and medicines.	6	Upto K2	3
IV	Cytology and genetics: Prokaryotic and Eukaryotic cell. Cell organelles with functions. DNA and RNA (Basic concepts). Cell division and its significance. Mendelism – Monohybrid and Dihybrid cross, Sex-linked inheritance, Mutation. Evolution-Origin of life-theories of evolution Darwin, Lamarck and DeVries.	6	Upto K2	4
V	Ecology and biodiversity: Ecosystem: abiotic and biotic components. Energy flow in an ecosystem, Afforestation, Deforestation. Chipko movement, Forest Conservation act. Pollution types and effects (Air, Water and Soil). Biodiversity and Conservation: <i>ex situ</i> and <i>in situ</i> methods. Endangered plants and Red data Book. Rio-Earth summit.	6	Upto K2	5

Books for Study:

1. Pullaiah, T & D, Varalakshmi Narayana, P, Suresh. 2021. Botany for competitive Examinations: (Useful for UPSC-Indian Forest Service, Civil Services, PCS, ASRB CSIR - NET, ICAR-NET and Other Competitive Exams.) Astral Cracker.
2. Mitra, S. 2016. Botany for competitive examinations, Academic Publishers.
3. Mohd Akil Shahezad. 2018. M.C.Qs. in Botany, Library Book House

Books for References:

1. Pandey B.P. (2014). College botany. Vol I, II and III. Chand & Company, New Delhi.
2. Gangulee, H.C., and Kar, A.K (2011). College Botany –I and II. New central book agency, Calcutta.
3. Ganguly A.K., and Kumar. N. C. (1992). General Botany Vol-I and II. Emkay Publications, Delhi.
4. Sharma, P.D. 2017. Ecology and Environment- Rastogi Publication, Meerut.
5. Life Science Books of Theory Practice Study Material for CSIR NET, GATE, SET, TIFR & DBT Module. 2022. Kailash Choudhary. IFAS Publications. India.

Web Resources:

1. <https://www.amazon.in/BOTANY-COMPETITIVE-EXAMINATIONS-SUNIT-MITRA/dp/9383420898>
2. <https://www.amazon.in/Botany-Competitive-Examinations-UPSC-Indian-Competitive/dp/B08VWB64BC>
3. <https://www.ssclatestnews.com/botany-book-pdf-free-download-for-competitive-exams/>
4. <https://sscstudy.com/botany-for-competitive-exams-pdf/>
5. <https://www.amazon.in/Botany-Entrance-Examination-Anupam-Rajak-ebook/dp/B089S1GLMP>

Rationale for Nature of the Course:

This course enables the students to understand the basic concept, structure and functions of various competitive and NET/SET exams.

Activities having direct bearing on Skill development / Employability / Entrepreneurship:

Students are taught analytical skills through group discussions, relevant practices and approach competitive examinations.

Pedagogy:

Chalk and Talk, PPT, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Labs & Learning Management System.

Course Designer: Dr. S. SARAVANAN, Assistant Professor.

Lecture Schedule:

Unit	Topics	Hrs	Mode
Unit I	Five kingdom classification. Outline of Kingdom plantae	2	Chalk and Talk, Power Point, Discussion, Seminar, Interaction, Quiz, Video Clippings & Google classroom.
	General characters and Economic importance of Algae, Fungi and Lichens.	4	
Unit II	General characters and Economic importance of Bryophytes, Pteridophytes and Gymnosperms.	2	
	Palaeobotany- Types of fossils, Geological time scale, Fossil beds of Tamil Nadu. Paleobotany- Fossil types. Fossilization methods. Geological Time Scale.	4	
Unit III	Root and Stem modification. Inflorescence. Pollination types. Hierarchy, ICN. Binomial nomenclature and BSI. Herbarium.	3	
	Family characteristics and economic importance of Rutaceae, Asteraceae, Euphorbiaceae, Poaceae. Economic botany: timber, fibre, oil and medicines.	3	
Unit IV	Cell organelles and functions. DNA and RNA. Cell division and its significance. Mendelism – Monohybrid and Dihybrid cross, Sex-linked inheritance, Mutation.	4	
	Evolution- Origin of life-theories of evolution Darwin, Lamarck and DeVries.	2	
Unit V	Ecosystem: abiotic and biotic components. Energy flow. Afforestation, Deforestation. Chipko movement, Forest Conservation act. Pollution types and effects (Air, Water and Soil).	4	
	Biodiversity and Conservation: <i>ex situ</i> and <i>in situ</i> methods. Endangered plants and Red data Book. Rio-Earth summit.	2	

Course Learning Outcomes: The students will be able to,

CLOs	Course Learning Outcomes	Knowledge Level
CLO 1	know the basic concept, scope and principles of plant kingdom.	Up to K4
CLO 2	comprehend the characteristics of bryophytes and pteridophytes.	Up to K4
CLO 3	analyse the plant morphology and taxonomy	Up to K4
CLO 4	understand the structure of cell organelles and concept of genetic laws.	Up to K4
CLO 5	apply the effective conservation measures.	Up to K4

Mapping of CLOs with PSOs

#	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CLO 1	1	2	2	1	2	3
CLO 2	2	2	3	2	2	2
CLO 3	2	2	1	2	2	2
CLO 4	2	3	3	2	3	1
CLO 5	1	3	3	1	3	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO 1	3	3	2	3	2	2
CLO 2	3	3	3	2	3	3
CLO 3	2	2	3	3	1	1
CLO 4	3	3	3	3	3	2
CLO 5	3	3	2	2	2	1

Advance application - 3; Intermediate level - 2; Basic level - 1

Blue Print – Model for External Examination

Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section – A		Section – B		Section C (Either/ Choice)
			MCQs		Short Answer		
			No. of Questions	K – Level	No. of Questions	K – Level	
1	CLO 1	Up to K 3	6	K3	1	K1	1(K3)
2	CLO 2	Up to K 4	6	K4	1	K2	1(K3)
3	CLO 3	Up to K 4	6	K4	1	K2	1(K2)
4	CLO 4	Up to K 3	6	K3	1	K3	1(K2)
5	CLO 5	Up to K 4	6	K4	1	K3	1(K2)
No. of Question to be asked			30		5		5
No. of Question to be answered			30		3		3
Mark for each question			1		5		10
Total Marks for each section			30		15		30

K1 - Remembering and recalling facts with specific answers

K2- Basic understanding of fact and stating main ideas with general answers

K3- Application oriented – Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section- wise marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Total Marks	% of Marks without choice	Consolidated
K1	20	-	50	70	58.33	100%
K2	-	50	-	50	41.67	
Total Marks	20	50	50	120	100.00	100%

DEPARTMENT OF BOTANY				CLASS: III B. Sc., Botany				
Sem	Course type	Course code	Course title	Credits	Contact hours/ week	CIA	Ext.	Total
VI	Project	23U6BPROV	Project & Viva-voce	2	3	25	75	100

Nature of the course	Skill oriented	√	Employability	√	Entrepreneurship	√

Course Objectives: The course objectives are to,

1. Motivate students to take up research projects in their field of interest.
 2. Promote scientific temper and systematic approach to problem solving and research methodology.
 3. Promote research writing aptitude among students.
- During the sixth semester, students shall undertake a project work and submit the project report.

CLOs	Course Learning Outcomes	K level
CLO 1	Survey scientific literature available and identify gaps in existing studies	K4
CLO 2	Design a scientific study taking practical constraints into account	K4
CLO 3	Perform the scientific study taking practical constraints into account.	K3
CLO 4	Analyze the results.	K4
CLO 5	Communicate the findings based on ethical standards of reporting.	K3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO 1	3	3	3	3	3	3
CLO 2	3	3	3	3	3	3
CLO 3	3	3	3	3	3	3
CLO 4	3	3	3	3	3	3
CLO 5	3	3	3	3	3	3

Advance application –3, Intermediate level –2, Basic level–1

Mapping of CLOs with PSOs

#	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1	3	3	3	3	3
CLO 2	3	3	3	3	3
CLO 3	3	3	3	3	3
CLO 4	3	3	3	3	3
CLO 5	3	3	3	3	3

Advance application –3, Intermediate level –2, Basic level–1



THE MADURA COLLEGE (AUTONOMOUS), MADURAI - 11

DEPARTMENT OF BOTANY

COURSE DESCRIPTION WITH DESCRIPTOR ELEMENTS AND PERCENTAGE OF REVISION

UG-Botany

Course Code	Title of the course	Hours	Credits	Nature of Course (Employability/ Entrepreneurship/Skill Development)			Scope of Focus (Local/National/ Global developmental needs)			Percentage of syllabus Revision/ New
				Empl	Ent	Skill	Local	National	Global	
SEMESTER-I										
23U1CCBT1	Plant Diversity I – Algae	5	4	✓		✓	✓	✓	✓	73.3
23U1CCBP1	Core Practical – I	3	3	✓		✓	✓	✓	✓	33.3
23U1BSED1	Skill Enhancement Course- Organic farming	2	2	✓	✓	✓	✓	✓	✓	New
23U1BFCT1	Foundation course (FC)	2	2	✓		✓	✓	✓	✓	New
SEMESTER-II										
23U2CCBT2	Plant Diversity II	5	4	✓		✓	✓	✓	✓	63.3
23U2CCBP2	Core Practical - II	3	3	✓		✓	✓	✓	✓	16.6
23U2BSED2	Skill Enhancement Course (SEC-2– Mushroom Cultivation	2	2	✓	✓	✓	✓	✓	✓	25
23U2BSED3	Botanical Gardening and Landscaping	2	2	✓	✓	✓	✓	✓	✓	New
SEMESTER-III										
23U3BCCT3	Plant Diversity III - Bryophytes and Pteridophytes	4	4	✓		✓	✓	✓	✓	27.5
23U3BCCP3	Practical III	3	3	✓		✓	✓	✓	✓	15
23U1CAZT1	Generic Elective – 1 Allied Zoology	4	2	✓		✓	✓	✓	✓	77.14
23U1CAZP1	Generic Elective –1 Allied Zoology Practical	2	1	✓		✓	✓	✓	✓	33.3
23U3BSED4	Skill Enhancement Course - (SEC-4) – Herbal Technology	2	2	✓		✓	✓	✓	✓	New
23U3BSED5	Skill Enhancement Course - (SEC 5) – Entrepreneurial opportunities in Botany	2	2	✓	✓	✓	✓	✓	✓	New

SEMESTER-IV										
23U4BCCT4	Plant Diversity IV – Gymnosperms, Palaeobotany and Evolution	4	4	✓		✓	✓	✓	✓	38
23U4BCCP4	Practical IV	3	3	✓		✓	✓	✓	✓	25
23U2CAZT2	Generic Elective – 2 Allied Zoology Theory	4	2	✓		✓	✓	✓	✓	65.7
23U2CAZP2	Generic Elective – 2 Allied Zoology Practical	2	1	✓		✓	✓	✓	✓	33.3
23U4BSED6	Skill Enhancement Course (SEC-6) – Fermentation Technology	2	2	✓		✓	✓	✓	✓	New
23U4BSED7	Skill Enhancement Course (SEC-7) – Biostatistics	2	2	✓		✓	✓	✓	✓	22
SEMESTER-V										
23U5BCCT5	Plant Morphology, Taxonomy and Economic Botany	5	4	✓		✓	✓	✓	✓	33
23U5BCCT6	Plant Anatomy and Embryology	5	4	✓		✓	✓	✓	✓	32
23U5BCCT7	Cell Biology, Genetics and Plant Breeding	5	4	✓		✓	✓	✓	✓	16
23U5BCCP5	Practical- V	3	3	✓		✓	✓	✓	✓	30
23U5BDET1 (A) 23U5BDET1 (B)	Discipline Elective Course-I- Computer Application in Botany / Bionanotechnology	5	4	✓		✓	✓	✓	✓	26
23U5BIDT1 (A) 23U5BIDT1 (B)	IDC-Bio-Analytical Techniques/ Climate Change	5	4	✓		✓	✓	✓	✓	New
SEMESTER-VI										
23U6BCCT8	Plant Ecology and Phytogeography	6	4	✓		✓	✓	✓	✓	30
23U6BCCT9	Molecular Biology and Plant Biotechnology	6	4	✓		✓	✓	✓	✓	47
23U6BCCT10	Plant Physiology and Biochemistry	6	4	✓		✓	✓	✓	✓	28
23U6BCCP6	Practical VI	3	3	✓		✓	✓	✓	✓	24
23U6BDET2 (A) 23U6BDET2 (B)	Discipline Elective Course-II-Forensic Botany/ Ethnobotany and Pharmacognosy	4	2	✓		✓	✓	✓	✓	New
23U6BSED8	Skill Enhancement Course- Professional Competency Skill - Botany for Competitive Examinations	2	2	✓		✓	✓	✓	✓	New



THE MADURA COLLEGE

An Autonomous Institution affiliated to Madurai Kamaraj University
Re-accredited (4th cycle) with 'A' grade by NAAC
Vidya Nagar, T.P.K. Road, Madurai – 625 011

BOTANY DEPARTMENT- POST GRADUATE (P.G)

Vision

- Producing Botany students as ambassadors of sustainable development in all spheres of human activity and leaving the earth to the successive generation as intact as possible.

Mission

- To sensitize the Botany students to the classification, structure, physiology, ecology, genetics and economic importance of plants
- To inculcate the students with an environment that fosters the development of appropriate scientific vocabulary, reasoning skills and effective oral and written communication ability for students
- To create holistic understanding of the allied subjects through interdisciplinary learning.

Programme: M.Sc. Botany	
Duration: 2years	
Programme Outcomes (PO)	
The M.Sc. Botany program is designed to achieve the following objectives	
PO1	To impart knowledge on the fundamental, advanced and emerging concepts in Botany.
PO2	To provide up to date theoretical knowledge on various forms of plants, their interactions with biotic and abiotic entities in the ecosystem and relevant practical skills.
PO3	To comprehend and interpret various facets of Botany including the importance and judicious utilization of plant sources.
PO4	To disseminate knowledge on the design and execution of experiments in Botany with emphasis on the operation of relevant sophisticated instruments.
PO5	To promote proficiency in designing the research problems, review of literature, laboratory experiments, data analyses and preparation of reports with professional ethics.
PO6	To enable the students to take up various qualifying examinations concerning Botany and to face the challenges in career opportunities.

Program Specific Outcomes (PSO)	
On successful completion of the M.Sc. Botany program, the students are expected to	
PSO1	Identify the potency of plant resources in contemporary research and visualize future thrust areas in Botany.
PSO2	Design scientific experiments independently and to generate useful information to address various issues in Botany.
PSO3	Acquire basic knowledge on principles and applications of laboratory instruments and adequate skills to handle them.
PSO4	Carryout scientific experiments independently or in collaboration with inter-disciplinary or multidisciplinary approaches.
PSO5	Awareness on the sustainable utilization of plant / microbial resources following the bioethical norms.
PSO6	Demonstrate proficiency in communicating with various stakeholders like students, teachers, scientists and society.

EVALUATION (Theory)

Internal (Formative): 25 Marks
External (Summative): 75 Marks
Total: 100 Marks

Continuous Internal Assessment (CIA): (Major & Electives: 25 marks)

S. No.	Components	Marks
1.	Test (Average of two tests conducted for 40 marks and converted into 10 marks)	10
2.	Assignment	05
3.	Seminar	05
3.	Model Making/ / Poster or Chart presentation/Quiz/Documentation/ Case lets/ICT based Assignment/ Mini Project/Attendance	05
Total		25

Question Paper pattern for Theory external examination (Major & Electives: 75 marks)

S. No.	Section	Marks
1.	A. Multiple Choice Question (10x1)	10
2.	B. Short Answer type (5x2)	10
3.	C. Either/or Type (5x5)	25
4.	D. open Choice Type (3 out of 5 questions, 3x10)	30
Total		75

EVALUATION (Practical)

Internal (Formative): 25 Marks
External (Summative): 75 Marks
Total: 100 Marks

Question Paper pattern for Internal /Model practical examination (Major: 25 marks)

S. No.	Components	Marks
1.	Major question (sections/dissections/experiments)	10
2.	Minor Question (sections/dissections/experiments)	05
3.	Spotters	05
4.	Record	05
Total		25

Question Paper pattern for external practical examination (Major: 75 marks)

S. No.	Components	Marks
1.	Major question (sections/dissections/experiments)	30
2.	Minor Question (sections/dissections/experiments)	20
3.	Spotters	20
4.	Record	05
Total		75

THE MADURA COLLEGE (AUTONOMOUS), MADURAI - 11

DEPARTMENT OF BOTANY

TANSCH- Curriculum Structure for M.Sc. Botany (Major) to be implemented from June 2025- 2026 onwards

Semester – I					
Part	Course	Subject Code	Course Title	Hours / Week	Credits
A	Core Course - 1 (Theory) (CC1)	25P1BCCT1	Plant diversity- I: Algae, Fungi, Lichens and Bryophytes	6	5
	Core Course - 2 (Theory) (CC2)	25P1BCCT2	Plant diversity- II: Pteridophytes, Gymnosperms and Palaeobotany	6	5
	Core Course - 3 (Practical) (CC3)	25P1BCCP1	Laboratory course- I: Covering Papers I and II	6	4
	Elective Course-I (EC1)	25P1BECT1	Ecology and Conservation Biology	5	3
	Elective Course-II (EC2)	25P1BECT2	Horticulture	5	3
B	Non- Major Elective Course- I	25P1BNME1	Fundamentals of Gardening	2	2
	Total			30	22
Semester – II					
A	Core Course - 4 (Theory) (CC4)	25P2BCCT3	Taxonomy of Angiosperms and Economic Botany	6	5
	Core Course - 5 (Theory) (CC5)	25P2BCCT4	Plant Anatomy, Embryology and of Morphogenesis	6	5
	Core Course – 6 (Practical) (CC6)	25P2BCCP2	Laboratory course- II: Covering Papers III and IV	6	4
	Elective Course-III (EC3)	25P2BECT3	Cell and Molecular Biology	5	3
	Elective Course-IV (EC4)	25P2BECT4	Applied Bioinformatics	5	3
B	Non- Major Elective Course- II	25P2BNME2	Organic Farming	2	2
	Total			30	22

DEPARTMENT OF BOTANY					CLASS: I M.Sc. BOTANY			
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
I	Core-I	25P1BCCT1	Plant Diversity – I: Algae, Fungi, Lichens and Bryophytes	5	6	25	75	100

Nature of Course	Knowledge and Skill	√	Skill Oriented	√	Employability Oriented	√	Entrepreneurship Oriented	

Objectives:

This course will enable the students to,

- Learn about the classification, distinguishing traits, geographic distribution, and reproductive cycle of algae, fungi, lichens and bryophytes.
- Gain knowledge about the ecological and economic importance of algae, fungi, lichens and bryophytes.
- Show interest in the evolutionary origin of plant development.
- Study the biodiversity by describing and explaining the morphology and reproductive processes of algae, fungi, bryophytes.
- Expose the beneficial and harmful aspects of lower plant.

Unit	Description	Hours	K level	CLO
I	ALGAE: Introduction, history, contributions of Indian Phycologist: M.O.P. Iyengar, and V. Krishnamurthy. General characters, classification of algae by F.E. Fritsch (1935-45), habitats, range of thallus organization, pigmentation, Reserve food materials, methods of reproduction and life cycle patterns. Origin and evolution of sex in algae. Structure, reproduction and life cycle of the following genera: <i>Oscillatoria</i> , <i>Ulva</i> , <i>Diatoms</i> , <i>Turbinaria</i> and <i>Gracilaria</i> .	18	Upto K4	1
II	FUNGI: Introduction, history, contributions of Indian Mycologist - C.V. Subramanian. Mode of nutrition. Classification by Alexopoulos and Mims (1979). General characters of major classes: Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina. Structure, reproduction and life cycle of the following genera: <i>Saccharomyces</i> , <i>Rhizopus</i> , <i>Penicillium</i> , <i>Puccinia</i> and <i>Fusarium</i> . Heterothallism, Sexuality and para sexuality and Spore dispersal mechanism.	18	Upto K4	2
III	lichens: Introduction, history, Occurrence and inter-relationship of phycobionts and mycobionts, complex symbiosis and growth forms. Classification by Hale, 1969. Reproduction: Vegetative propagules, Sexual reproduction in	18	Upto K4	3

	Asco, Basidio and Deuterolichens. Structure, reproduction and life cycle of <i>Parmelia</i> and <i>Usnea</i> . Ecology and environmental monitoring of lichens.			
IV	BRYOPHYTES: Introduction, history, occurrence, general characters and classification of Bryophytes by Rothmaler (1951). Structural variations and evolution of gametophytes and sporophytes in Hepaticopsida, Anthoceroopsida and Bryopsida. Structure, reproduction and life cycle of the following genera: <i>Riccia</i> , <i>Anthoceros</i> , <i>Sphagnum</i> and <i>Polytrichum</i> . Chromosomal organization in <i>Spherocarpus</i> . Sex determination in <i>Bryum</i> and <i>Mnium</i> .	18	Upto K4	4
V	ECONOMIC IMPORTANCE: Algae as food and fodder: Single cell protein, Industrial products (Agar-Agar, Carrageenan, Alginic acid, Diatomaceous earth, Iodine, biofertilizers, vitamins biofuel) and Medicinal values. Fungi – Economic importance in baking, brewing and pharmaceutical industries. Nutritional and medicinal values of mushroom. Lichen: Dyes, food flavor, cosmetics and perfumes. Bryophytes: Industry, horticulture and medicine	18	Upto K4	5

Books for Study:

1. Kumar, H.D.1999. Introductory Phycology. Affiliated East-West Press, Delhi.
2. Barsanti, L. and Guadriani, P. 2014. Algae: Anatomy, Biochemistry and Biotechnology, 2nd Edition, CRC Press, ISBN: 1439867321.
3. Sharma, O.P. 2011. Fungi and Allied Microorganisms, Mc Graw Hill, ISBN:9780070700383, 0070700389

Books for References:

1. Sundaralingam, V. 1991. Marine algae. Bishen Singh and Mahendra Pal Singh Publishers, Dehradun.
2. Edward Lee, R. 2018. Phycology, 5th Ed., Cambridge University Press, London.
3. Nash, T.H. 2008. Lichen Biology, Cambridge University press.
4. Johri, R.M., Lata, S. and Tyagi, K. 2012. A Textbook of Bryophyta. Dominant Publishers & Distributors Pvt., Ltd., New Delhi. ISBN: 9789384207335.
5. Alexopoulos, C.J. and Mims, M. 2007. Introductory Mycology. 4th Edition, Wiley Publishers, ISBN: 9780471522294

Web Resources:

1. <https://www.britannica.com/science/algae>
2. <https://en.wikipedia.org/wiki/Bryophyte>
3. <https://www.britannica.com/plant/bryophyte/Ecology-and-habits>
4. <https://www.livescience.com/53618-fungus.html>.
5. http://www.uobabylon.edu.iq/eprints/paper_11_20160_754.pdf

Rationale for Nature of the Course:

This course provides an in-depth understanding of students should be familiar with the basics of algae, fungi, lichens and Bryophytes

Activities having direct bearing on Skill development / Employability / Entrepreneurship:

Demonstration and field visit to areas of mass cultivation of algae and fungi of nutritional, pharmaceutical, industrial and ecosystem restoration interests. Observation of morphology and scientific identification of various lower group of plant species.

Pedagogy:

Chalk and Talk, PPT, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Labs & Learning Management System.

Course Designer: R. SARANYA, Assistant Professor

Lecture Schedule:

Unit	Topics	Hours	Mode
I	a. Introduction to algae	2	
	b. Classification by Fritch	2	
	c. Thallus organization, pigmentation	2	
	d. Reserve food material, methods of reproduction and life cycle patterns.	4	
	e. Origin and evolution of sex in algae.	2	
	f. Structure, reproduction and life cycle of the following genera: <i>Oscillatoria</i> , <i>Ulva</i> , <i>Diatoms</i> , <i>Turbinaria</i> and <i>Gracilaria</i> .	6	
II	a. Introduction, history, contributions of Indian Mycologist - C.V. Subramanian.	3	Chalk and Talk
	b. Mode of nutrition. Classification by Alexopoulos and Mims (1979). General characters of major classes: Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina	2	Canva PPT
	c. Structure, reproduction and life cycle of the following genera:	5	Educative video animations
	d. <i>Saccharomyces</i> , <i>Rhizopus</i> , <i>Penicillium</i> , <i>Puccinia</i> and <i>Fusarium</i> .	5	Google Classroom
	e. Heterothallism, Sexuality and para sexuality and Spore dispersal mechanism.	3	Google site
III	a. Introduction, history, Occurrence and inter-relationship of phycobionts and mycobionts, complex symbiosis and growth forms.	6	CANVAS instructure (LMS) Group discussion
	b. Classification by Hale, 1969.	2	
	c. Reproduction: Vegetative propagules, Sexual reproduction in Asco, Basidio and Deuterolichens.	6	
	d. Structure, reproduction and life cycle of <i>Parmelia</i> and <i>Usnea</i> . Ecology and environmental monitoring of lichens	4	
IV	a. Introduction, history, occurrence, general characters and classification of Bryophytes by Rothmaler (1951).	4	
	b. Structural variations and evolution of gametophytes and sporophytes in Hepaticopsida, Anthocerosopsida and Bryopsida.	6	
	c. Structure, reproduction and life cycle of the following genera: <i>Riccia</i> , <i>Anthoceros</i> , <i>Sphagnum</i> and <i>Polytrichum</i> .	6	
	d) Chromosomal organization in <i>Spherocarpus</i> .	4	
	d. Sex determination in <i>Bryum</i> and <i>Mnium</i>		

V	a. Algae as food and fodder: Single cell protein, Industrial products (Agar-Agar, Carrageenan, Alginic acid, Diatomaceous earth, Iodine, biofertilizers, vitamins biofuel) and Medicinal values.	6	
	b. Fungi – Economic importance in baking, brewing and pharmaceutical industries. Nutritional and medicinal values of mushroom.	6	
	c. Lichen: Dyes, food flavor, cosmetics and perfumes.	2	
	d. Bryophytes: Industry, horticulture and medicine	2	

Course Outcomes: the students will be able to,

COLs	On completion of this course, the students will be able to know, understand, and apply	K-Level
CO1	The vegetative and reproductive morphology; classification and phylogeny of lower algae	K1&K2
CO2	The general characters, classification, phylogeny and lifecycle of fungal genera	K1&K2
CO3	Introduction, history, Occurrence and inter-relationship, reproduction and lifecycle of lichens.	K3
CO4	The salient features, major classes, Structural variations and evolution of gametophytes and sporophytes, Chromosomal organization and Sex determination of bryophytes.	K3&K4
CO5	Economic importance of algae, fungi, lichen and bryophytes.	K4

Mapping of CLOs with PSOs

#	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CLO 1	1	2	2	1	2	3
CLO 2	2	2	3	2	2	2
CLO 3	2	2	1	2	2	2
CLO 4	2	3	3	2	3	1
CLO 5	1	3	3	1	3	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO 1	3	3	2	3	2	2
CLO 2	3	3	3	2	3	3
CLO 3	2	2	3	3	1	1
CLO 4	3	3	3	3	3	2
CLO 5	3	3	2	2	2	1

Advance application - 3; Intermediate level - 2; Basic level –1

Blue Print for Summative Examinations

Mapping with Course Learning Outcomes (CLOs)

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K Level	No. of Questions	K Level		
1	CLO 1	Up to K2	2	K1 or K2	1	K1	2 (K1 & K1)	1 (K2)
2	CLO 2	Up to K3	2	K1 or K2	1	K1	2 (K2& K2)	1 (K3)
3	CLO 3	Up to K3	2	K1 or K2	1	K2	2 (K3&K3)	1 (K3)
4	CLO 4	Up to K4	2	K1 or K2	1	K2	2 (K4& K4)	1 (K4)
5	CLO 5	Up to K5	2	K1 or K2	1	K2	2 (K3&K3)	1 (K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - solving problems

K4 - Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF BOTANY					CLASS: I M.Sc. BOTANY			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
I	Core-II	25P1BCCT2	Plant Diversity II: Pteridophytes, Gymnosperms and Palaeobotany	5	6	25	75	100

Nature of Course	Knowledge and Skill	√	Skill Oriented	√	Employability Oriented	√	Entrepreneurship Oriented	

Objectives: The students will be able to,

- Investigate the classification, distinctive traits, distribution and reproduction and life cycle of the various classes and major types of Pteridophytes and Gymnosperms.
- Identify and characterize diversity of non-flowering plants in order to comprehend the dynamics of diversity to realize the importance of diversity.
- Familiarize the, phylogeny and economic importance of Pteridophytes and Gymnosperms.
- Study and understand the Paleontology of Pteridophytes and Gymnosperms.
- Investigate the concept of fossils and process of fossilization; distinctive characteristics of fossil records of Pteridophytes and Gymnosperms.

Unit	Description	Hours	K level	CLO
I	Pteridophytes: Introduction, distribution, general characters and classification (Sporne, 1954). Morphogenesis: Telome concept. Range of sporophyte, reproduction, evolution of sporophytes and gametophytes. Evolution of spore producing structure. Stelar evolution. Life cycle patterns: homosporous and heterosporous. Apogamy and Apospory. Heterospory and seed habit.	18	Up to K4	1
II	Structure, anatomy, reproduction and life cycle of the following genera: <i>Psilotum</i> , <i>Selaginella</i> , <i>Equisetum</i> , <i>Angiopteris</i> , <i>Ophioglossum</i> , <i>Pteris</i> and <i>Azolla</i> . Economic importance.	18	Up to K4	2
III	Gymnosperms: Introduction, origin, phylogeny, distribution, morphological and anatomical characters, reproduction, polyembryony and classification by Chamberlain (1934).	18	Up to K4	3
IV	Structure, reproduction and life cycle of the following genera: <i>Cycas</i> , <i>Pinus</i> , <i>Cupressus</i> , <i>Araucaria</i> , <i>Podocarpus</i> , <i>Gnetum</i> and <i>Ephedra</i> . Economic importance.	18	Up to K4	4
V	Paleobotany: Geological Time Scale; Radiocarbon dating; Contributions of Birbal Sahni. Gondwana flora of India. Study of fossils in understanding evolution. Fossilization and fossil	18	Up to K4	5

	types. Study of organ genera: <i>Rhynia</i> , <i>Lepidodendron</i> , <i>Cordaites</i> and <i>Lyginopteris</i> . Economic importance of fossils: Fossil pollen analysis, fossil fuels, industrial raw materials and uses.			

Books for Study:

1. Vashishta, P.C. Sinha, A.K and Anil Kumar. 2016. Botany for Degree students. Gymnosperms.
2. S. Chand and Company Ltd., New Delhi.
3. Singh, V., Pande, P.C and Jain, D.K. 2021. A Text Book of Botany. Rastogi Publications, Meerut.
4. Bhatnagar, S.P and Alok Moitra. 2020. Gymnosperms, New Age International (P) Ltd., Publishers, Bengaluru.

Books for References:

1. Johri, R.M, Lata, S, Tyagi, K. 2005. A text book of Gymnosperms, Dominate pub and Distributer, New Delhi.
2. Pandey, S.N and Trivedi, P.S. 2015. A Text Book of Botany Vol. II- 12th edition (Paperback), Vikas Publishing.
3. Arnold A.C. 2005. An Introduction to Paleobotany. Agrobios (India). Jodhpur.
4. Sporne, K.R. 2017. The morphology of Pteridophytes (The structure of Ferns and Allied Plants) (Paperback), Andesite Press.
5. Sporne, K.R. 1967. The Morphology of Gymnosperms. Hutchinson & Co., London.

Web Resources:

1. <https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/>
2. http://www.bsienvi.nic.in/Database/Pteridophytes-in-India_23432.aspx
3. <https://trove.nla.gov.au/work/11471742?q&versionId=46695996>
4. <https://books.google.co.in/books/about/Paleobotany.html?id=HzYUAQAIAAJ>
5. <https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond->

Rationale for Nature of the Course:

This course will enable the students to know the basis of general characters, classification, reproduction and life cycle of Pteridophytes and Gymnosperms.

Activities having direct bearing on Skill development / Employability / Entrepreneurship:

The skills learned by the students will help them to understand the distribution, general characters evolution, classification, phylogeny and economic importance of Pteridophytes and Gymnosperms.

Pedagogy:

Chalk and Talk, PPT, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Labs & Learning Management System.

Course Designer: Dr. N. SARAVANAN, Assistant Professor

Lecture Schedule:

Unit	Topics	Hrs	Mode
Unit I	Pteridophytes: Introduction, distribution, general characters and classification (Sporne, 1954).	6	Chalk and Talk, Power Point, Discussion, Seminar, Interaction, Quiz, Video Clippings & Google classroom.
	Morphogenesis: Telome concept. Range of sporophyte, reproduction, evolution of sporophytes and gametophytes. Evolution of spore producing structure. Stelar evolution.	6	
	Life cycle patterns: homosporous and heterosporous. Apogamy and Apospory. Heterospory and seed habit. Economic importance.	6	
Unit II	Structure, anatomy, reproduction and life cycle of the following genera: Psilotum, Selaginella and Equisetum,	9	
	Structure, anatomy, reproduction and life cycle of the following genera: Angiopteris, Ophioglossum, Pteris and Azolla.	9	
Unit III	Gymnosperms: Introduction, origin, phylogeny, distribution, morphological and anatomical characters.	9	
	Reproduction, polyembryony and classification by Chamberlain (1934).	9	
Unit IV	Structure, reproduction and life cycle of the following genera: <i>Cycas</i> , <i>Pinus</i> , <i>Cupressus</i> and <i>Araucaria</i> .	9	
	Structure, reproduction and life cycle of the following genera: <i>Podocarpus</i> , <i>Gnetum</i> and <i>Ephedra</i> . Economic importance.	9	
Unit V	Paleobotany: Geological Time Scale; Radiocarbon dating; Contributions of Birbal Sahni. Gondwana flora of India.	6	
	Study of fossils in understanding evolution. Fossilization and fossil types.	4	
	Economic importance of fossils: Fossil pollen analysis, fossil fuels, industrial raw materials and uses.	5	
	Study of organ genera: <i>Rhynia</i> , <i>Lepidodendron</i> , <i>Cordaites</i> and <i>Lyginopteris</i> .	3	

Course Learning Outcomes:

CLOs	Course Learning Outcomes The students will be able to	Knowledge Level
CLO 1	Classify the trends in phylogenetic relationship, general characters of Pteridophytes and Gymnosperms.	Up to K4
CLO 2	Identify the morphological/anatomical organization, life history of major types of Pteridophytes and Gymnosperms.	Up to K4
CLO 3	Understand the economic importance of Pteridophytes, Gymnosperms, and fossils.	Up to K4
CLO 4	analyse the evolutionary relationship of Pteridophytes and Gymnosperms.	Up to K4
CLO 5	be aware of various fossil types, fossilization and fossil records of Pteridophytes and Gymnosperms.	Up to K4

Mapping of CLOs with PSOs

#	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CLO 1	1	2	2	1	2	3
CLO 2	2	2	3	2	2	2
CLO 3	2	2	1	2	2	2
CLO 4	2	3	3	2	3	1
CLO 5	1	3	3	1	3	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO 1	3	3	2	3	2	2
CLO 2	3	3	3	2	3	3
CLO 3	2	2	3	3	1	1
CLO 4	3	3	3	3	3	2
CLO 5	3	3	2	2	2	1

Advance application - 3; Intermediate level - 2; Basic level - 1

Summative - Blue - Print - Model

(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D(Open Choice)
			MCQs		Short answers			
			No. of Questions	K Level	No. of Questions	K Level		
1	CLO 1	Up to K 2	2	K1 & K1	1	K1	2 (K1 & K1)	1
2	CLO 2	Up to K 3	2	K2& K3	1	K1	2 (K2& K2)	1
3	CLO 3	Up to K 4	2	K2 & K3	1	K2	2 (K3& K3)	1
4	CLO 4	Up to K 4	2	K3& K4	1	K2	2 (K4 & K4)	1
5	CLO 5	Up to K 4	2	K3& K4	1	K3	2 (K4& K4)	1
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.66	
K3	4	2	10	20	36	30.00	30%
K4	2	-	20	20	42	35.00	35%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF BOTANY				CLASS: I M.Sc. Botany				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/ week	CIA	Ext	Total
I	Core Practical	25P1BCCP1	Major Practical-I	4	6	25	75	100

(Plant Diversity I and Plant Diversity II)

Nature of Course				
Knowledge and skill			√	Employability oriented
Skill oriented			√	Entrepreneurship oriented

Objectives: The course will enable the students to,

- learn the skills and techniques of micro-preparation of vegetative and reproductive parts of thallophytes and non-flowering plant groups,
- comprehend the fundamental concepts and methods used to identify bryophytes, pteridophytes and gymnosperms and
- analyse the vegetation by various sampling methods.

Algae:

1. Study of algae in the field and laboratory of the genera included in theory.
2. Morphology and anatomy of the vegetative and reproductive structures of the following: *Oscillatoria*, *Ulva*, *Diatoms*, *Turbinaria* and *Gracilaria*.
3. Identification of the local algal flora.

Fungi:

1. Study of vegetative and reproductive structures of the following genera: *Saccharomyces*, *Rhizopus*, *Penicillium*, *Puccinia* and *Fusarium*.
2. Isolation and identification of fungi from soil, air and baiting method.
3. Demonstration of mushroom in the laboratory.

Lichens:

1. Study of morphological and reproductive structures of the genera *Parmelia* and *Usnea*.

Bryophytes:

1. Morphology and anatomy of the vegetative and reproductive organs of the following: *Riccia*, *Anthoceros*, *Sphagnum* and *Polytrichum*.

Pteridophytes :

1. Morphology and anatomy of the vegetative and reproductive organs of the following: *Psilotum*, *Selaginella*, *Equisetum*, *Angiopteris*, *Ophioglossum*, *Pteris* and *Azolla*.

Gymnosperms:

1. Morphology and anatomy of the vegetative and reproductive organs of the following: *Cycas*, *Pinus*, *Cupressus*, *Araucaria*, *Podocarpus* and *Gnetum*.

Ecology & Conservation Biology:

1. Determination of quantitative characters of a plant community by random quadrat method (abundance, density, dominance, species diversity and frequency) in grass land.
2. Estimation of above and below ground biomass in a grass land employing quadrat method.
3. To determine the soil moisture, porosity and water holding capacity of soil collected from varying depths at different locations.
4. Determination of pH of soil and water by universal indicator (or) pH meter.
5. Determination of dissolved oxygen in pond water.
6. Estimation of carbonate content in soil.
7. Vegetation mapping of India and world.
8. Field trip to the place of ecological interests.

Rationale for Nature of the course:

The course focus on the practical skills in laboratory on observation and identification of algae, fungi, lichens, bryophytes, pteridophytes, gymnosperms, fossils and vegetation sampling methods.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

This Knowledge and skills acquired by the students will enable them to understand the morphology and anatomy of the vegetative and reproductive organs of bryophytes, pteridophytes and gymnosperms. The various sampling techniques for different ecosystems and determination of soil factors will help them to equip themselves.

Pedagogy

Chalk and Talk, Power Point, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Images, You Tube Videos, Google classroom & LMS (CANVAS).

Course Designers: **Dr. S. Gnaana Saraswathi**, Assistant Professor,

Dr. S. Saravanan, Assistant Professor and

Prof. R. Saranya, Assistant Professor.

Course Schedule

Practical	Description	Hours	Mode
1	Morphology and anatomy of <i>Oscillatoria</i> , <i>Ulva</i> , <i>Diatoms</i> , <i>Turbinaria</i> and <i>Gracilaria</i>	6	Individual Experiments
2	Preparation of culture media and culture of green algae and blue-green algae.	3	Individual Experiments
3	Study of morphological and reproductive structures of <i>Saccharomyces</i> , <i>Rhizopus</i> , <i>Penicillium</i> , <i>Puccinia</i> and <i>Fusarium</i> .	6	Individual Sectioning
4	Isolation and identification of fungi from soil, air and baiting method.	3	Individual Experiments
5	Study of morphological and reproductive structures of the genera <i>Parmelia</i> and <i>Usnea</i>	3	Virtual Images and Group discussion
6	Morphology and anatomy of <i>Riccia</i> , <i>Anthoceros</i> , <i>Sphagnum</i> and <i>Polytrichum</i> .	6	Individual experiments
7	Morphology and anatomy of <i>Psilotum</i> , <i>Selaginella</i> , <i>Equisetum</i> , <i>Angiopteris</i> , <i>Ophioglossum</i> , <i>Pteris</i> and <i>Azolla</i> .	6	Individual experiments
8	Morphology and anatomy of <i>Cycas</i> , <i>Pinus</i> , <i>Cupressus</i> , <i>Araucaria</i> , <i>Podocarpus</i> , <i>Gnetum</i> and <i>Ephedra</i> .	6	Individual experiments
9	Vegetation Sampling methods	4	Individual experiments
10	To determine the soil moisture, porosity and water holding capacity of soil collected from varying depths at different locations.	4	Individual experiments
11	To determine the pH of soil, water and dissolved oxygen in water	2	Individual experiments
12	Estimation of carbonate in soil samples	2	Individual experiments

Course Learning Outcomes:

On successful completion of the course, the students will be able to know, understand, apply and analyse the

CLOs	CLO Statement	Knowledge Level
CLO 1	basic keys to distinguish at species level identification of important algae, fungi and lichens through its structural organizations,	Up to K4
CLO 2	structure of bryophytes, pteridophytes and gymnosperms,	Up to K4
CLO 3	practical skills in thallophytes, pteridophytes and gymnosperms,	Up to K4
CLO 4	importance of structural diversity in the evolution of plant forms and	Up to K4
CLO 5	various soil factors and vegetation sampling.	Up to K4

Mapping Programme Specific Outcomes with Course Learning Outcomes:

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	1	2	2	2	1	2
CLO2	3	2	3	3	3	1
CLO3	3	2	3	1	2	1
CLO4	2	3	3	3	2	2
CLO5	3	3	3	2	3	2

3 - Advance Application; 2 - Intermediate Level; 1 - Basic Level

Mapping Programme Outcomes with Course Learning Outcomes:

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	1	3	2	2
CLO2	3	3	2	2	3	2
CLO3	2	2	3	3	1	1
CLO4	3	3	3	3	3	2
CLO5	3	3	2	3	2	1

3 - Advance Application; 2 - Intermediate Level; 1 - Basic Level

DEPARTMENT OF BOTANY					CLASS: I M.Sc., BOTANY			
Sem	Course Type	Course Code	Course Title	Credits	Contact hours / week	CIA	Ext	Total
I	Major Elective-I	25P1BECT1	Ecology and Conservation Biology	3	5	25	75	100

Nature of Course	Knowledge and Skill	√	Skill Oriented	√	Employability Oriented	√	Entrepreneurship Oriented	

Objectives:

This course will enable the students to,

- Analyse and comprehend the fundamental ideas of plant ecology as a scientific study of environment,
- Study the plant communities and plant succession stages,
- Be aware of the toxicants, causes, impacts and control measures of pollution,
- Study biodiversity management and conservation and
- Enhance the knowledge to protect their environment.

Unit	Description	Hours	K-Level	CLO
I	Ecology – Introduction, history and scope. Basic concepts of population ecology, growth curves, biotic potentials, population dynamics. Regulation of population density. Basics concepts of community, characteristics, composition, structure – physiognomy - growth forms, origin and development, community dynamics. Trends in succession.	15	Up to K4	1
II	Ecosystem Ecology: Introduction – kinds and major types. Functional aspects of ecosystem: Food chain and food web, energy flow and laws of thermodynamics. Productivity - primary, secondary, gross primary and net primary. Resource Ecology: Energy resources - renewable (solar and wind) and non-renewable (coal and natural gas).	15	Up to K4	2
III	Environmental Deterioration: Climate change, Greenhouse effect, global warming, global dimming, El Nino and La Nina, ozone depletion, acid rain and coral bleaching. Eco-restoration. Ecological footprints, carbon footprints. Eco labeling- environmental auditing. Carbon sequestration – definition, types and importance. Toxicology: Environmental toxicants – pesticides, fertilizers, trace elements, heavy metals, radioactive substances and food additives. Teratogens. Dose-response relationship.	15	Up to K4	3
IV	Phytogeography: Phytogeographical Zones-Vegetation types of India and Tamil Nadu distribution: Continuous,	15	Up to K4	4

	Discontinuous and Endemism. Theories of discontinuous distribution: Continental drift, Age and area hypothesis. Geographical Information System (GIS). Principles of remote sensing and its applications. Applications of Drones in GIS.			
V	Biodiversity and Conservation: Definition, types, values and threats to biodiversity. Habitat loss and Fragmentation. Wildlife exploitation. Hot spots. Invasion of exotic species. Man and wild life conflicts. Man and the Biosphere Programme. Animal corridors. Endangered and endemic plant species of India. Red list categories of IUCN. Biotechnology-assisted plant conservation- <i>in situ</i> and <i>ex situ</i> methods. Biodiversity Acts and Policies.	15	Up to K4	5

Books for Study:

1. Krishnamurthy, K.V.2004. An Advanced Text Book of Biodiversity – Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi.
2. Ahuja,V. K.2017. Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.
3. Nithyananda, K.V.2019. Intellectual Property Rights: Protection and Management. India, IN: C engage Learning India Private Limited.
4. Venkataraman M. 2015. An introduction to Intellectual property rights. Create space Independent Pub. North Charleston, USA.
5. Kormondy, E.J. 2017.Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.
6. Gillson, L. 2015. Biodiversity Conservation and Environmental Change, Oxford University Press, Oxford.

Books for Reference:

1. Acquaah, G. 2002. Horticultural Principles and Practices. 2nd Ed. Pearson Education (Singapore) Pvt. Ltd.
2. Ashman, M.A. and Puri, G. 2002. Essentials Soil Science. A clear and concise introduction to soil science. Blackwell Scientific publishers, London.
3. Denisen, E.L. 1979. Principles of Horticulture. MacMillan Publishing Co. Inc. New York.

Web Resources

1. <https://www.intechopen.com/chapters/56171>
2. <https://plato.stanford.edu/entries/biodiversity/>
3. <https://sciencing.com/four-types-biodiversity-8714.html>.
4. <https://www.iaea.org/topics/plant-biodiversity-and-genetic-resources>
5. http://www.bsienviis.nic.in/Database/Status_of_Plant_Diversity_in_India_17566.aspx
6. <https://www.youtube.com/watch?v=qtTLiQoYTyQ>
7. <https://www.youtube.com/watch?v=208B6BtX0Ps>

Rationale for the Nature of the Course:

This course provides an in-depth understanding of environmental challenges and biodiversity conservation, emphasizing the dynamic interactions between organisms and their environments. It equips students with essential knowledge to address global ecological concerns, foster sustainable development and contribute to conservation efforts.

Activities having direct bearing on Skill development / Employability / Entrepreneurship:

Knowledge in GIS, remote sensing and environmental auditing provides a better understanding for careers in ecology, conservation, and environmental management. Knowledge of biodiversity conservation, carbon sequestration, and eco-restoration fosters entrepreneurial opportunities in green technologies, ecological consulting and sustainable resource management.

Pedagogy: Chalk and Talk, Canva Interactive PPT, Educative Videos, Group discussion, Gamified Quizzes through Quizziz, Learning Management Systems (e-Blogspot / Google site / Google Classroom / CANVAS instructure).

Course Designer: Dr. S. GNAANA SARASWATHI, Assistant Professor.

Lecture Schedule:

Unit	Topics	Hours	Mode
I	Population Ecology: Basic concepts, growth curves, biotic potentials, population dynamics. Regulation of population density. Basics concepts of community, characteristic, composition, structure – physiognomy - growth forms, origin and development, community dynamics. Trends in succession.	3	Chalk and Talk
		5	
		4	
		3	
II	Ecosystem and Resource Ecology: Introduction–kinds, major types. functional aspects of ecosystem: Food chain and food web, energy flow, laws of thermodynamics. Productivity–primary and secondary, gross primary and net primary. Resource Ecology: Energy resources; renewable (solar and wind) and non-renewable (coal and natural gas).	3	Canva PPT
		4	
		4	
		4	
III	Environmental Deterioration: Climate change–Greenhouse effect, global warming, global dimming, El Nino, La Nina, ozone depletion, acid rain and coral bleaching. Eco-restoration. Ecological footprints - carbon footprint. Ecolabeling- environmental auditing. Carbon sequestration – definition, types and importance. Toxicology: Environmental toxicants – pesticides, fertilizers, trace elements, heavy metals, radioactive substances and food additives. Teratogens. Dose-response relationship.	4	Educative video animations
		3	
		3	
		5	
IV	Phytogeograph: Phyto geographical Zones–Vegetation types of India and Tamil Nadu. Distribution: Continuous, Discontinuous and Endemism. Theories of discontinuous distribution: Continental drift, Age and area hypothesis. Geographical Information System (GIS). Principles of remote sensing and its applications. Applications of drone in GIS.	4	CANVAS instructure (LMS) Group discussion
		3	
		3	
		5	
V	Biodiversity and Conservation: Definition, types, values and threats to biodiversity. Habitat loss and Fragmentation. Exploitation of wild life. Hot spots. Invasion of exotic species. Man and wild life conflicts. Man and the Biosphere Programme. Endangered and endemic plant species of India. Red list categories of IUCN. Biotechnology assisted plant conservation - <i>in situ</i> and <i>ex situ</i> methods. Biodiversity Acts and Policies.	5	
		5	
		5	

Course Outcomes

CO	On completion of this course, the students will be able to	K-Level
CO1	understand the scope and importance of population ecology, plant communities and ecosystem ecology,	K1&K2
CO2	understand the applied aspect of environmental botany,	K1&K2
CO3	spot the sources and pollution and seek remedies to mitigate and try to rectify them,	K3
CO4	analyze insight into the vegetation types, species interaction and their importance and the factors influencing the environmental conditions and	K3&K4
CO5	recognize different plant communities, categorize plant biomes and identify threatened, endangered plant species and create awareness program in protection of biodiversity.	K4

Mapping with programme outcomes:

CLO	POs						PSOs					
	1	2	3	4	5	6	1	2	3	4	5	6
CLO1	3	3	3	3	2	3	3	2	1	3	2	3
CLO2	3	3	2	3	3	3	2	3	3	3	3	3
CLO3	3	2	3	2	2	2	3	1	1	3	2	2
CLO4	3	3	2	3	3	2	2	2	3	2	3	3
CLO5	3	3	3	3	3	1	3	3	3	3	2	1

Advance application - 3; Intermediate level - 2; Basic level - 1

Blueprint for Internal (CIA) Examination

Articulation Mapping–K Levels with Courses Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section–A		Section B(Either/Choice)	Section C(Open choice)
			Short Answer			
			No. of Questions	K–Level		
1	CLO x	UptoK3	3	1(K1/K2)	2(K2/K3)	1(K2/K3)
2	CLO y	UptoK4	2	1(K1/K2)	2(K3/K4)	1(K3/K4)
No. of Question to be asked			5		2	3
No. of Question to be answered			5		2	2
Mark for each question			2		5	20
Total Marks for each section			10		10	20

Blueprint for External (Semester) Examination
Articulation Mapping–K Levels with Courses Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section–A		Section–B		Section C(Either/Choice)	Section D (Open Choice)
			MCQs		Short Answer			
			No. of Questions	K–Level	No. of Questions	K– Level		
1	CLO1	UptoK2	2	K1&K1	1	K1	2(K1&K1)	K2
2	CLO2	UptoK3	2	K2&K3	1	K1	2(K2&K2)	K3
3	CLO3	UptoK4	2	K2&K3	1	K2	2(K3&K3)	K3
4	CLO4	UptoK4	2	K3&K4	1	K2	2(K4&K4)	K4
5	CLO5	UptoK4	2	K4&K4	1	K3	2(K4&K4)	K4
No. of Question to be Asked			10		5		10	5
No. of Question to be Answered			10		5		5	3
Mark for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of fact and stating main ideas with general answers

K3 - Application oriented–Solving Problems

K4 - Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	%of Marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.66	
K3	4	2	10	20	36	30.00	30%
K4	2	-	20	20	42	35.00	35%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF BOTANY					CLASS: I M. Sc Botany			
Sem	Course type	Course code	Course title	Credits	Contact hours / Week	CIA	Ext	Total
I	Major Elective -II	25P1BECT2	Horticulture	3	5	25	75	100

Nature of Course	Knowledge and Skill	√	Skill Oriented	√	Employability Oriented	√	Entrepreneurship Oriented	

Objectives: The students will be able to,

- Understand the importance and division of horticulture
- Acquire knowledge on plant propagation and fruit crop cultivation.
- Learn about vegetable cultivation and kitchen gardening
- Get to know about landscaping and components of gardens.

Unit	Description	Hours	K-level	CLO
I	Horticulture: Introduction, definitions, history, scope and divisions. Classification of horticultural plants based on habit, life span, climatic requirements and plant parts used for consumption. Soil: Profile and physico-chemical properties. Primary and secondary nutrients and their functions.	15	Up to K4	1
II	Factors Affecting Plant Growth: Biotic and abiotic factors, Fertilizers: organic and Inorganic. Potting Media, Bio inoculants, Methods of fertilizer application. Horticultural tools: Pruning shears, shovel, spade, hedge trimmers, hoe and crow bars.	15	Up to K4	2
III	Plant propagation: Seed viability. Seed dormancy breaking: direct and indirect methods. Seedling production in nurseries and transplantation. Propagation through specialized underground structures: Corm, Tuber, Sucker, Bulb, Bulbils, Rhizome. Vegetative Propagation: Cutting, Layering and Grafting. Training - Pruning and thinning.	15	Up to K4	3
IV	Landscape designing: Principles, components and types of gardens. Garden plants: shrubs and shrubberies, ornamental hedges, edges, flower beds, borders and lawn making. Climbers and creepers. Foliage plants. Succulents and cacti. Ornamental palms, orchids, Topiary. Rockeries and arches. Water garden – Hydroponics. Indoor and outdoor gardening, Hanging baskets. Bonsai plants-Terrace Garden.	15	Up to K4	4
V	Cultivation, harvesting, preservation, storage, value addition, packaging and marketing of Jasmine, Rose, Drumstick, Cucumber, Goose berry and Mango.	15	Up to K4	5

Books for study:

1. Acquaah, G. 2011. Horticulture: Principles and Practices. (4th ed), Pearson Education, London, UK.
2. Janik, J. 1972. Horticultural Science. W.H. Freeman & Company, San Francisco.
3. Kumar, N. 1994. Introduction to Horticulture, Rajalakshmi Publication, India.
4. Manibhushan Rao, K. 2005. Text Book of Horticulture. (2nd ed), Macmillan India Ltd., New Delhi.
5. Sharma, R.R. 2016. Propagation of horticultural crops. Kalyani Publishers, New Delhi.

Books for References

1. Ashman, M.A. and Puri, G. 2002. Essential soil science-A clear and concise introduction to soil science. Blackwell scientific publishers, London.
2. Thomson, L.M. and Troen, F.R. 1975. Soils and soil fertility Tata, McGraw Hill Publication Co. Ltd. New Delhi.
3. Tolanus, S. 2006. Soil fertility, Fertilizer and Integrated Nutrient management. CBS Publication, Delhi, India.

Web Resources

1. <https://www.kobo.com/in/en/ebooks/horticulture>
2. <https://www.gale.com/gardening-and-horticulture>
3. <https://www.iaritoppers.com/p/horticulture-icar-ecourse-pdf-books.html>

Rationale for Nature of the course

Selling of fruit and fruit crops, advisory to several gardens, exporting value added products.

Activities having direct bearing on Skill development / Employability Entrepreneurship

course enables the students to understand and develop various horticultural skill followed in plant propagations.

Pedagogy

Chalk and Talk, PPT, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Labs & Learning Management System (CANVAS).

Course Designer: Dr. M. KARPAGA JOTHI, Assistant Professor

LESSON PLAN:

Unit	TOPICS	Hrs	Mode
I	a) Horticulture: Introduction, definitions, history, scope and divisions.	5	Chalk and talk PPT, LMS and Group discussion
	b) Classification of horticultural plants based on habit, life span, climatic requirements and plant parts used for consumption.	5	
	c) Soil: Profile and physico-chemical properties. Primary and secondary nutrients and their functions.	5	
II	a) Factors Affecting Plant Growth: Biotic and abiotic factors,	5	Chalk and talk PPT, LMS and Group discussion
	b) Fertilizers: organic and Inorganic. Potting Media, Bio inoculants, Methods of fertilizer application.	5	
	c) Horticultural tools: Pruning shears, shovel, spade, hedge trimmers, hoe and crow bars	5	
III	a) Seed viability. Seed dormancy breaking: direct and indirect methods. Seedling production in nurseries and transplantation.	5	Chalk and talk PPT, LMS and Group discussion
	b) Propagation through specialized underground structures: Corm, Tuber, Sucker, Bulb, Bulbils, Rhizome.	5	
	c) Vegetative Propagation: Cutting, Layering and Grafting. Training - Pruning and thinning.	5	
IV	a) Principles, components and types of gardens.	3	Chalk and talk PPT, LMS and Group discussion
	b) Garden plants: shrubs and shrubberies, ornamental hedges, edges, flower beds, borders and lawn making. Climbers and creepers.	4	
	c) Foliage plants. Succulents and cacti. Ornamental palms, orchids, Topiary. Rockeries and arches.	4	
	d) Water garden. Indoor and outdoor gardening, Hanging baskets.	1	
	e) Bonsai plants-Terrace Garden.		
V	Cultivation, harvesting, preservation, storage, value addition, packaging and marketing of Jasmine, Rose, Drumstick, Cucumber, Gooseberry and Mango	15	Chalk and talk PPT, LMS

Course Learning Outcomes:

On successful completion of the course, the students will be able to know, understand, apply and analyse the

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	importance of horticulture and the plant parts used for production and economic development	UP TO K4
CLO-2	demonstrate knowledge of directing plant growth through various techniques.	UP TO K4
CLO-3	apply various methods of plant propagation through plant parts for nursery management and transplantation	UP TO K4
CLO-4	apply and demonstrate skills in flower arrangement, indoor plant cultivation and landscaping and	UP TO K4
CLO-5	apply horticultural skills and knowledge to explore career opportunities in horticulture industry	UP TO K4

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7
CLO-1	2	3	3	3	3	3	2
CLO-2	3	3	3	2	3	3	3
CLO-3	3	3	3	3	3	3	3
CLO-4	3	3	2	3	3	3	3
CLO-5	3	3	3	3	3	2	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5
CLO1	3	3	2	3	2
CLO2	3	3	2	3	3
CLO3	2	2	1	-	2
CLO4	1	-	2	2	1
CLO5	-	1	-	2	-

Advance application- 3;

Intermediate level-2;

Basic level-1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D(Open Choice)
			MCQs		Short answers			
			No. of Questions	K-Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1&K2	1	K1	2(K1&K1)	1(K2)
2	CLO 2	Up to K3	2	K1&K2	1	K1	2(K2&K2)	1(K3)
3	CLO 3	Up to K3	2	K1&K2	1	K2	2(K3&K3)	1(K3)
4	CLO 4	Up to K4	2	K1&K2	1	K2	2(K4&K4)	1(K4)
5	CLO 5	Up to K3	2	K1&K2	1	K2	2(K3&K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF BOTANY					CLASS: I M.Sc., BOTANY			
Sem	Course Type	Course Code	Course Title	Credits	Contact hours / week	CIA	Ext	Total
1	NME-I	25P1BNME1	Fundamentals of Gardening	2	2	25	75	100

Nature of Course	Knowledge and Skill	√	Skill Oriented	√	Employability Oriented	√	Entrepreneurship Oriented	√

Objectives:

The students will be able to,

- Understand the fundamentals of plant cultivation and its significance in home and community gardening,
- Explore various types of gardens and acquire knowledge of garden layouts and essential tools,
- Learn basic plant care practices, including soil preparation, watering, pest control and maintenance techniques,
- Comprehend the structure and function of seeds, causes of seed dormancy and methods for testing seed viability and germination and
- Gain insights into propagation techniques such as cutting, layering, grafting and container gardening, along with compost and manure preparation.

Unit	Description	Hours	K-Level	CLO
I	Gardening: Definition and Importance. Basic essentials for plant growth – water, light and soil. Garden tools and their uses. Principles of garden layout.	6	Up to K2	1
II	Understanding Seeds: Seed – basic structure and functions. Types – monocot and dicot seeds. Basic causes of seed dormancy and methods to break seed dormancy. Seed viability test. Seed storage.	6	Up to K2	2
III	Simple planting methods – introduction, direct seeding and seedling production. Basic Overview of common types of gardens - flower and vegetable.	6	Up to K2	3
IV	Basic Plant Care: Soil preparation for planting. Watering – principles and importance. Simple pest control methods – hand picking and organic sprays. Basic plant maintenance – weeding, manuring and mulching.	6	Up to K2	4
V	Propagation Techniques: Selection of mother plants. Cutting – stem and root; Layering – air layering; Basics of Grafting technique. Plant care - Container gardening. Manure preparation – compost.	6	Up to K2	5

Books for Study:

1. Bose T.K and Mukherjee, D. 1972. Gardening in India, Oxford & IBH Publishing Co., New Delhi.
2. Sandhu, M.K. 1989. Plant Propagation, Wile Eastern Ltd., Bengaluru.
3. Amarjeet Singh Batth. Indian Garden Flowers. 2007. Prakash Books Pvt Ltd. New Delhi

Books for Reference:

1. N.L. Patel, S.L. Chawla, T.R. Ahlawat: Commercial Horticulture, 2016, ASPEE College of Horticulture, Navsari Agricultural University, Navsari 396 450, Gujarat.
2. Prasad S & Kumar U. 2005. Greenhouse Management for Horticultural Crops. 2nd Ed. Agrobios.
3. Don Monty. The Complete Gardener. 2021. Dorling Kindersley Limited, Munich, Germany.

Web Resources:

1. <https://www.kopykitab.com/Nursery-And-Gardening-SEC-by-Prof-C-D-Patil-Dr-G-M-Rane-Dr-S-A-Patil>
2. <https://www.wonderslate.com/nursery-and-gardening-management/ebook-details?siteName=books&bookId=38078&preview=true>
3. https://books.google.co.in/books/about/Nursery_Hindi_Book_Bonsai_Plants_Nursery.html?id=-nfDDwAAQBAJ&redir_esc=y

Rationale for the Nature of the Course:

This course provides foundational knowledge and practical skills in plant cultivation, gardening and propagation techniques, emphasizing sustainable practices essential for personal and professional growth in horticulture.

Activities having direct bearing on Skill development / Employability / Entrepreneurship:

Hands-on training in seed germination, propagation techniques and garden management equips students with skills for careers in horticulture, while promoting entrepreneurship through nursery development, composting and container gardening.

Pedagogy:

Chalk and Talk, Hands on training in the field and Videos.

Course Designer:

Dr. S. GNAANA SARASWATHI, Assistant Professor.

Lecture Schedule

Unit	Topics	Hours	Mode
I	Gardening: Definition and Importance.	1	Chalk and Talk
	Basic essentials for plant growth – water, light and soil.	2	
	Garden tools and their uses. Principles of garden layout.	3	
II	Seed – basic structure and functions.	1	
	Types – monocot and dicot seeds.	2	
	Basic causes of seed dormancy and methods to break seed dormancy.	2	
	Seed viability test. Seed storage.	1	
III	Simple planting methods – introduction, direct seeding and seedling production.	1	
	Basic Overview of common types of gardens.	1	
	Flower and vegetable.	2	
IV	Basic Plant Care: Soil preparation for planting. Watering – principles and importance.	2	
	Simple pest control methods – hand picking and organic sprays.	1	
	Basic plant maintenance – weeding, manuring and mulching.	3	
V	Propagation Techniques: Selection of mother plants.	3	Hands on training Field work
	Cutting – stem and root; Layering – air layering; Basics of Grafting technique.	1	
	Container gardening.	1	
	Manure preparation – compost.	1	

Course outcomes

CO	On completion of this course, the students will be able to	K - Level
CO1	define plant cultivation, identify its importance and understand basic essentials required for growth of plants and the garden tools and its uses in the field,	K2
CO2	understand seed structure, dormancy and viability and conduct seed germination tests effectively and recognize different garden types and apply basic layout principles using appropriate tools.	K4
CO3	work on simple planting methods to develop flower and vegetable garden,	K4
CO4	practice proper plant care techniques like watering, pest control, and soil preparation for healthy plant growth	K3
CO5	work on propagation techniques such as cutting and grafting and understand manure (compost) preparation for sustainable gardening.	K4

Mapping with Programme Outcomes

COs	PO1	PO 2	PO 3	PO 4	PO 5	PO6	PSO 1	PSO 2	PSO 3	PSO 4	PSO5	PSO6
CO1	2	2	1	3	2	1	1	2	2	1	2	1
CO2	2	3	2	2	3	1	3	2	2	2	2	1
CO3	2	2	3	1	1	1	2	1	2	2	1	1
CO4	3	3	2	3	3	1	2	2	2	2	3	1
CO5	3	3	2	3	2	1	3	2	2	3	1	1

S-Strong (3)

M-Medium (2)

L-Low (1)

Blueprint for Formative Examination

Sl. No	CLOs	K-Level	Section-A		Section-B Either Or Choice	Section-C (Open Choice)
			Short Answer			
			No. of Questions	K -level		
1	x	Up to K2	3	K1	2(K2)	1 (K1)
2	Y	Up to K2	2	K1	2(K2)	1 (K1)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Mark for each question			2		5	10
Total Marks for each section			10		10	20

Blueprint for Summative Examination

Sl. No	CLOs	K-Level	Section-A		Section-B Either Or Choice	Section-C (Open Choice)
			Short Answer			
			No. of Questions	K -level		
1	1	Up to K2	1	K1	2(K2)	1 (K1)
2	2	Up to K2	1	K1	2(K2)	1 (K1)
3	3	Up to K2	1	K1	2(K3)	1 (K1)
4	4	Up to K2	1	K1	2(K4)	1 (K1)
5	5	Up to K2	1	K1	2(K3)	1 (K1)
No. of Questions to be asked			5		10	5
No. of Questions to be answered			5		5	3
Mark for each question			2		7	10
Total Marks for each section			10		35	30

K1 – Remembering and recalling facts with specific answers

K2 – Basic understanding of fact and stating main ideas with general answers

DEPARTMENT OF BOTANY				CLASS: I M.Sc. BOTANY				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/Week	CIA	Ext	Total
II	Core-IV	25P2BCCT3	Taxonomy of Angiosperms and Economic Botany	5	6	25	75	100

Nature of Course								
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	✓			

Objectives:

The students will be able to,

- Familiar with basic principles of plant taxonomy and classification.
- Apply the knowledge on modern concepts for plant identification.
- Analyse the salient features, phylogenetic affinity and economic importance of selected Polypetalous plant families.
- Identify the salient features, phylogenetic affinity and economic importance of selected Plant families and
- Analyse the economically important plant groups their utilization

Unit	Description	Hours	K-level	CLO
I	Basic principles of plant taxonomy and classification: Botanical explorations in India, pioneer botanists and their botanical contributions - William Roxburgh, J.D. Hooker, Robert Wight, and J.S. Gamble. Principles of classifications: Outline, merits and demerits, and salient features of artificial system – Linnaeus, natural system – Bentham & Hooker, phylogenetic system – Hutchinson and modern system – APG-IV. Botanical gardens and herbaria of India. Botanical survey of India – organization and its role in plant taxonomy.	18	Up to K4	1
II	Modern trends in taxonomy and nomenclature – Principles and applications of chemotaxonomy, numerical taxonomy, molecular taxonomy and cyber taxonomy. Nomenclature system – history of binomial nomenclature, chronology of codes, principles of ICN, outline of Shenzhen code, author citation, typification, principles of priority, effective and valid publication. Floras – types, e-Floras with special reference to Flora of India. Taxonomic literature – Monographs, journals and virtual herbaria. Modern identification tools – IPNI, POWO and WFO.	18	Up to K4	2
III	Systematic studies of selected plant families I: Salient features, vegetative and floral characters, phylogenetic affinities and economic importance of Magnoliaceae, Menispermaceae, Capparidaceae, Polygalaceae, Zygophyllaceae, Cucurbitaceae, Combretaceae, Onagraceae, Aizoaceae and Apiaceae.	18	Up to K4	3

IV	Systematic studies of selected plant families- II: Salient features, vegetative and floral characters, phylogenetic affinities and economic importance of Asteraceae, Sapotaceae, Solanaceae, Acanthaceae, Verbenaceae, Nyctaginaceae, Loranthaceae, Orchidaceae, Arecaceae and Cyperaceae	18	Up to K4	4
V	Economic botany: Botanical name, family, morphology of useful part and uses of (i) Cereals (rice and wheat); (ii) Pulses (red gram and black gram), (iii) Drug yielding plants (<i>Withania somnifera</i> , <i>Gloriosa superba</i>) (iv) Vegetable oil yielding plants (Groundnut, Sesam); (v) Spices and condiments (nutmeg, cinnamon). (vi) Vegetables (brinjal, ladies finger, bitter guard), (vii) Essential oils (lemon grass and menthol), (viii) Beverages (tea, coffee), (ix) Dye yielding plants (<i>Lawsonia</i> , <i>Punica</i>) (x) Starch yielding plants (potato, cassava).	18	Up to K4	5

Books for study

1. Gurucharan Singh, (2017) Plant systematics – Theory and Practice. Oxford & IBH Publishing, New Delhi. ISBN: 9781578083510
2. Pullaiah, T. and Karuppusamy, S. (2018) Taxonomy of Angiosperms, 4th revised Ed. Astral International Publishers, New Delhi. ISBN: 9789352220212
3. Sharma, O.P. (2011) Plant Taxonomy, 2nd Edition, Tata-McGraw Hill Pvt. Ltd., New Delhi: ISBN: 9781259081378
4. Subramanyam, N.S. (2009) Modern Plant Taxonomy, Vikas Publishing Pvt. Ltd., New Delhi. ISBN: 9780706993462
5. Verma, B.K. (2011) Introduction to Taxonomy of Angiosperms. PHL learning Pvt. Ltd. New Delhi. ISBN: 9788120341142

Books for references

1. Gupta, R. (2012) Plant Taxonomy: Past, Present and Future. Teri Publication Pvt. Ltd., New Delhi. ISBN: 9788179933596
2. Tod F, Stuessy, (2009) Plant Taxonomy: The systematic evolution of comparative data. Columbia University Press, London. ISBN: 978-0231147125
3. Singh, D.K., Singh, V. (2009) Taxonomy of Angiosperm, Rastogi publication, New Delhi. ISBN: 978-8171338498
4. Sinha, R.K. (2013) Practical Taxonomy of Angiosperm, IK international publishing house Pvt. Ltd., New Delhi. ISBN: 978-9380578217
5. Pandey, B.P. (2001) Taxonomy of Angiosperms, S. Chand & Co, New Delhi. ISBN: 978-8121909327

Web resources

1. <https://library.viu.ca/c.php?g=188912&p=1247823>
2. <https://www.sil.si.edu/DigitalCollections/tl-2/>
3. <https://www.biodiversitylibrary.org/bibliography/48631>
4. <https://powo.science.kew.org/>
5. <https://archive.bsi.gov.in/>

Rationale for nature of the course:

Demonstration of principles of plant taxonomy and with equip the knowledge on field identification and authentic naming of plants by systematic practice.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Systematic approach of Angiosperms for classification, identification, nomenclature and utilization of the plant species and provide the information for various sectors of data base managers, plant product utilizers, environmentalists, conservationists and policy makers. Documenting the locally available angiosperm flora for their utility aspects with systematic enumeration

CLOs	CLO Statement	Knowledge Level
Students will be able to know, understand, apply and analyse the		
CLO -1	Classification of angiosperms by various methods of orthodox to modern methods including phylogenetic and cladistic.	Up to K4
CLO -2	Principles of nomenclature, rules of ICN, taxonomic literature for authentic identification of plant species and to resolve the taxonomic problems using evidences of cytology, embryology, phytochemistry and micromolecular support	Up to K4
CLO -3	Economic potential of dicot families with their morphological features.	Up to K4
CLO -4	Economic potential of monocot families with their morphological features.	Up to K4
CLO -5	Economic potential of useful plants and their morphology of useful parts and uses	Up to K4

Mapping Programme Specific Outcomes with Course Outcome:

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	1	1	2	2	2
CLO-2	2	2	2	1	2
CLO-3	1	3	1	2	1
CLO-4	3	3	2	2	2
CLO-5	3	2	3	2	1

3-Advance application, 2- Intermediate level, 1- Basic level

Pedagogy:

Chalk and Talk, PPT, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Labs & Learning Management System (CANVAS).

Lesson plan:

Unit	Description	Hrs	Mode
I	a. Historical account and principles of plant taxonomy.	2	Chalk and talk PPT, LMS and Group discussion
	b. Types of classification and introduction of artificial system.	2	
	c. Natural system of plant classification with its merits and demerits.	2	
	d. Phylogenetic classification (Hutchinson) and its merits and demerits.	2	
	e. Outline of APG-IV classification and its salient features.	1	
	f. Concept of taxonomic hierarchy	4	
	g. Contributions of Indian Botany – Hooker, Wight, Beddome, Gamble and Matthew.		
II	a. Taxonomy relation to morphology, anatomy, palynology, cytology and embryology	5	Chalk and talk PPT, LMS Quiz, Video lectures and Group discussion
	b. Principles and applications of chemotaxonomy, serotaxonomy, molecular taxonomy and DNA barcoding	6	
	c. Molecular markers used in plant taxonomy	2	
	d. Computer applications in plant systematics	2	
	e. Computer language for plant taxonomy-DELTA.	3	
	f. Phylogenetic analysis – Parsimony, PHYLIP and McClade		
III	a. Binomial nomenclature and principles of ICN	2	Chalk and talk PPT, LMS Quiz, Video lectures and Group discussion
	b. Typification, author citation, retention and rejection	4	
	c. Nyms and effective publication	2	
	d. Taxonomic literature – Floras, Monographs and Revisions	4	
	e. Identification keys and Herbarium preparation	3	
	f. Herbarium consultation, POWO, BSI-Archive	2	
	g. Botanical gardens in taxonomic research		
IV	a. Vegetative, floral features and economic importance of dicot families: Magnoliaceae, Capparidaceae and Polygalaceae	4	Chalk and talk PPT, LMS Quiz, Video lectures and Group discussion
	b. Zygophyllaceae, Rhamnaceae, and Sapindaceae	4	
	c. Aizoaceae, Combretaceae, and Myrtaceae	4	
	d. Cucurbitaceae, Asteraceae and Apocynaceae	4	
	e. Convolvulaceae, Bignoniaceae and Verbenaceae	4	

V	a. Vegetative, floral features and economic importance of Nyctaginaceae, Aristolochiaceae and Euphorbiaceae	5	Chalk and talk PPT, LMS Quiz, Video lectures and Group discussion
	b. Loranthaceae, Orchidaceae and Liliaceae	5	
	c. Commelinaceae and Typhaceae	2	
	d. Arecaceae and Poaceae	3	

Course designer: Dr. S. Karuppusamy, Associate Professor

Learning Outcome Based Education (LOBE) &

Assessment Summative Examination – Blue Print

Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2 (K1&K1)	1 (K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K1	2 (K2&K2)	1 (K3)
3	CLO 3	Up to K4	2	K2 & K3	1	K2	2 (K3&K3)	1 (K3)
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2 (K4&K4)	1 (K4)
5	CLO 5	Up to K4	2	K3 & K4	1	K3	2 (K4&K4)	1 (K4)
No. of Questions to be asked			10			5	10	5
No. of Questions to be Answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each section			10			10	25	30

Distribution of Section- wise marks with K Levels in the summative examinations

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.66	
K3	4	2	10	20	36	30.00	30%
K4	2	-	20	20	42	35.00	35%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF BOTANY					CLASS: I M.Sc. BOTANY			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
II	Core-V	25P2BCCT4	Plant Anatomy, Embryology and Morphogenesis	5	6	25	75	100

Nature of Course	Knowledge and Skill	√	Skill Oriented	√	Employability Oriented	√	Entrepreneurship Oriented	

Objectives: The students will be able to,

- Acquaint with structural, functional and biochemical attributes of plant tissues and cell wall
- Deconstruct the strategical secondary thickening in different habits of plants and the basics in micro techniques
- Narrate the critical events in male and female gametogenesis in angiosperms
- Gain knowledge on fertilization and post-fertilization processes and
- Unravel the pattern and components of plant tissue and organ development

Unit	Description	Hours	K level	CLO
I	Anatomy - Meristems: characteristics, classifications, Theories of shoot and root apices, Cytological zonations in shoot apex. Vascular Cambium: Composition and organization, multiplicative and additive divisions. Cell wall: Morphological and physico-chemical characteristics; Plasmodesmata, types of pits, growth of cell wall, formation of intercellular spaces. Xylem: Primary and secondary xylem – tracheary elements; xylem rays and axial parenchyma of angiosperm wood; Phloem: Ultra structure of sieve tube elements and companion cell.	18	Up to K4	1
II	Periderm: Structure, organization and activity of phellogen. Brief account on Polyderm, Rhytidem, wound periderm and protective tissue in monocotyledons. Normal secondary thickening in Dicots; Anomalous secondary growth in Dicots (<i>Amaranthus</i> , <i>Aristolochia</i> , and <i>Bignonia</i>) and arborescent Monocot (<i>Dracaena</i>). Primary thickening in palms. Microtechniques: Methods of microscopic sample preparations, Killing and Fixation, Dehydration and Rehydration, Infiltrations, Embedding, Sectioning, Staining and Mounting.	18	Up to K4	2

III	Embryology - Microsporangium: Structure and development of Anther; structure and types of tapetum. Microsporogenesis. Pollen development and maturation. pollen kit, pollen analysis, pollen storage, pollen sterility and pollen physiology. Structure and growth of pollen tube and Male gametogenesis. Megasporangium: Structure and development of ovule. Megasporesis. Female gametophyte: Ultrastructure of a typical mature embryo sac, Types: Monosporic, Bisporic and Tetrasporic.	18	Up to K4	3
IV	Pollen pistil interaction: pollen recognition and pollen tube guidance in stigma, pollen tube traffic in style and final push of pollen tube to the ovules. Self-incompatibility. Fertilization: Double fertilization and triple fusion; Endosperm: Types, physiological efficiency of endosperm haustoria. Embryogeny in monocot (Grass) and dicot (Crucifer). Polyembryony: Causes, classification and practical applications. Apomixis and its significance.	18	Up to K4	4
V	Morphogenesis: Development of plant body an overview. Components of development: Cell division, division planes and their importance; Cytoskeleton, preprophase band in orienting karyokinesis and cell plate. Vascular differentiation: Xylogenesis and Phloem differentiation. Leaf ontogeny. ABC model of ontogeny of flower. Role of polarity in cell differentiation and symmetry (in stem cuttings, unicellular coenocytes, cellular slime mold, eggs and spores).	18	Up to K4	5

Books for Study:

1. Sharma, P.C. 2017. Text Book of Plant Anatomy. Arjun Publishing House, New Delhi.
2. Pandey, S.N and Ajanta Chandha. 2006. Plant Anatomy and Embryology. Vikas Publishing House Pvt. Ltd, New Delhi.
3. Narayanaswamy, S. 1994. Plant Cell and Tissue Culture. Tata McGraw Hill Ltd. New Delhi.
4. Maheshwari, P. 1963. Recent Advances in Embryology of Angiosperms. Intl. Soc. Plant Morphologists, New Delhi.
5. Bhojwani, S.S. Bhatnagar, S.P and Dantu, P.K. 2015. The Embryology of Angiosperms (6th revised and enlarged edition). Vikas Publishing House, New Delhi.

Books for References:

1. Krishnamurthy, K.V. 1988. Methods in Plant Histochemistry. S. Viswanathan & Co., Madras.
2. Swamy, B.G.L and Krishnamurthy. K.V 1990. From flower to fruits, Tata – McGraw Hill publishing Co Ltd, New Delhi.

3. Pullaiah, T., Lakshminarayana, K and Hanumantha Rao, B. 2006. Text book of Embryology of Angiosperms. Regency Publications, New Delhi.
4. Bierhorst, D.W. 1971. Morphology of Vascular Plants. Macmillan publishers, New York.
5. Crang, R., Lyons-Sobaski, S and Wise, R. 2018. Plant Anatomy: A Concept-Based Approach to the Structure of Seed Plants. Springer International Publishing.
6. Cutler, D. F., Botha, T and Stevenson, D.W. 2008. Plant Anatomy: An Applied Approach. Blackwell Publishing, Malden, USA.
7. Eames, A.J and Mac Daniels, L.H. 2013. Introduction to Plant Anatomy, 3rd Edition. McGraw-Hill Inc., US.

Web Resources:

1. <https://www.ipni.org/>
2. <http://www.theplantlist.org/>
3. https://faculty.etsu.edu/liuc/plant_anatomy_sites.htm
4. http://aryacollegeludhiana.in/E_BOOK/Botany/plant_anatomy.pdf
5. <https://www.uou.ac.in/sites/default/files/slm/BSCBO-202.pdf>
6. http://greenlab.cirad.fr/GLUVED/html/P1_Prelim/Bota/Bota_typo_014.html
7. <https://www.askiitians.com/>

Rationale for Nature of the Course:

Knowledge gained on plant anatomy, embryology and morphogenesis will help the students to get opportunities in wood and paper industries, and crop improvement institutions in the quality assurance, research and development positions

Activities having direct bearing on Skill development / Employability / Entrepreneurship:

Theoretical knowledge on meristems and tissues, cell wall will help students to get employability in wood and paper industries. Knowledge gained like fertilization, development of embryo and polyembryony will gain opportunities in crop improvement, research and development institutions

Pedagogy:

Chalk and Talk, PPT, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Labs & Learning Management System.

Course Designer: Prof. V. Meenakshi Sundaram, Assistant Professor

Lecture Schedule:

Unit	Topics	Hrs	Mode
Unit I	Meristems and Cambium	4	Chalk and Talk, Power Point, Discussion, Seminar, Interaction, Quiz, Video Clippings & Google classroom.
	Cell wall and Plasmodesmata	4	
	Xylem components	4	
	Phloem components	3	
Unit II	Periderm: structure and origin. Other types	2	
	Normal and anomalous secondary thickenings	8	
	Microtechniques	5	
Unit III	Microsporangium development	6	
	Pollen analysis and Microgametogenesis	3	
	Megasporangium and embryo sac development	6	
Unit IV	Pollen pistil interaction	8	
	Fertilization, endosperms and embryo development	4	
	Polyembryony	3	
Unit V	Overview of development, components of development	6	
	Xylogenesis and phloem differentiation, Leaf ontogeny	5	
	Ontogeny of flower; Polarity	4	

Course Learning Outcomes:

CLOs	Course Learning Outcomes	Knowledge Level
On successful completion of this course, the students will be able to know, understand, apply, and analyse the		
CLO 1	structure and functions of meristems, vascular tissues and cell wall components	Up to K4
CLO 2	secondary thickening in plants	Up to K4
CLO 3	micro and mega sporogenesis and gametogenesis	Up to K4
CLO 4	fertilization, embryogenic and polyembryony.	Up to K4
CLO 5	plant development patterns and its regulations	Up to K4

Mapping of CLOs with PSOs

#	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CLO 1	1	2	3	1	2	3
CLO 2	2	2	2	2	2	2
CLO 3	2	2	2	2	2	2
CLO 4	2	1	3	2	1	1
CLO 5	1	1	3	1	1	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO 1	3	3	2	3	2	2
CLO 2	1	2	3	2	3	3
CLO 3	2	2	3	2	3	1
CLO 4	1	2	3	3	3	2
CLO 5	3	3	2	2	3	1

Advance application - 3; Intermediate level - 2; Basic level – 1

Summative - Blue - Print - Model

(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D(Open Choice)
			MCQs		Short answers			
			No. of Questions	K Level	No. of Questions	K Level		
1	CLO 1	Up to K 2	2	K1 & K1	1	K1	2 (K1 & K1)	1
2	CLO 2	Up to K 3	2	K2& K3	1	K1	2 (K2& K2)	1
3	CLO 3	Up to K 4	2	K2 & K3	1	K2	2 (K3& K3)	1
4	CLO 4	Up to K 4	2	K3& K4	1	K2	2 (K4 & K4)	1
5	CLO 5	Up to K 4	2	K3& K4	1	K3	2 (K4& K4)	1
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.66	
K3	4	2	10	20	36	30.00	30%
K4	2	-	20	20	42	35.00	35%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF BOTANY					CLASS: I M.Sc. BOTANY			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours /Week	CIA	Ext	Total
II	Core	25P2BCCP2	Practical II	4	6	25	75	100

(covering papers III and IV)

Nature of Course	Knowledge and Skill	√	Skill Oriented	√	Employability Oriented	√	Entrepreneurship Oriented	

Objectives: The students will be able to,

- train students to observe the distinguishing morphological features of families of angiosperms
- familiarize them with methods of preparations of herbarium, dichotomous key and DNA Bar coding
- develop the skills on micro-preparations, observations and draw anatomical diagrams
- demonstrate micro-techniques and tissue maceration methods

Angiosperm Taxonomy and Economic Botany Practical's

1. Dissection, identification, description and sketching the vegetative and floral parts of the selected locally available plants belonging to families: Magnoliaceae, Menispermaceae, Capparidaceae, Polygalaceae, Zygophyllaceae, Cucurbitaceae, Combretaceae, Onagraceae, Aizoaceae, Apiaceae, Asteraceae, Sapotaceae, Solanaceae, Acanthaceae, Verbenaceae, Nyctaginaceae, Lorantheaceae, Orchidaceae, Arecaceae and Cyperaceae.
2. Identification of binomials using local Floras (Gamble, Matthew, and Pullaiah et al.).
3. Preparation of dichotomous keys for plant identification.
4. Resolving taxonomic problems using, IPNI, GBIF, POWO and BSI-Archive.
5. Practice for construction of molecular barcoding for plant identification
6. Fifteen (15) Herbarium sheets, field notebook and bonafide record to be submitted for the external examinations.
7. Study the economic products of plants mentioned in the syllabus of economic botany with their special reference to the morphology, botanical name, family and uses.
8. At least three days field trip to any one natural habitat to be conducted for observation, collection and identification of plants from the prescribed botanical families. Field note to be submitted for evaluation.

Plant Anatomy and Embryology Practicals

I Micropreparations, Observations and Drawing of

1. Shoot and Root apical meristems
2. Primary structure of dicot stem and root, monocot stem and root (double staining)
3. Dorsiventral and isobilateral leaves
4. Secondary structure of dicot stem and root (double staining)
5. T.S, R.L.S and T.L.S of some woods
6. Anomalous secondary thickening of Dicots (*Amaranthus*, *Aristolochia*, and *Bignonia*) and arborescent Monocot (*Dracaena*)
7. Ditheous and monotheous anthers
8. Pollen morphology

II Demonstration of

1. Tissue maceration – wood.
2. Pollen tube germination

3. Microtechniques
4. Dissection of stages of embryo and endosperms
5. Permanent slide preparations

Books for Study:

1. David F Cutler et al., 2007. Plant Anatomy an Applied Approach, Blackwell Publishing
2. Subramaniam, N.S. 1996. Laboratory Manual of Plant Taxonomy. Vikas Publishing House Pvt. Ltd., New Delhi.
3. Sundara, R. S. 2000. Practical manual of plant anatomy and embryology. Anmol Publ. PVT LTD, New Delhi.
4. Panshin, A. J and C. de Zeeuw. 1980. Textbook of wood technology. Structure, identification and uses of the commercial woods of the United States and Canada. Fourth Edition. New York: McGraw-Hill Book Company.
5. Sharma, H.P. 2009. Plant Embryology: Classical and Experimental, Bombay Popular Prakashan, ISBN-8173199698, 9788173199691.

Books for References:

1. Mann J. Davidson, R.S and J.B. Hobbs, D.V. Banthorpe, J.B. Harborne. 1994. *Natural Products*. Longman Scientific and Technical Essex.
2. Traditional plant medicines as sources of new drugs. P.J Houghton in Pharmacognosy. Trease and Evan's. 16 Ed .2009.
3. Sundara Rajan, S, 2003. Practical Manual of Plant Anatomy and Embryology 1st ed, Anmol Publications, ISBN-812610668.
4. Katherine Esau. 2006. Anatomy of Seed Plants. 2nd edition, John Wiley and Sons.

Web Resources:

1. [http://stem and root apex org.com](http://stemandrootapex.org.com)
2. [http://anatomy of wood.in](http://anatomyofwood.in)
3. [http://plant description org.](http://plantdescription.org)

Rationale for Nature of the Course:

This course will enable the students to know the basis of plant identification, tissue characteristics and stages in plant reproduction.

Activities having direct bearing on Skill development / Employability / Entrepreneurship:

The skills learned by the students will help them to identify the families of angiosperms and understand the structure and functions of tissues, development of embryo and endosperms

Pedagogy:

Chalk and Talk, PPT, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Labs & Learning Management System.

Course Designer: Dr. S. Karuppusamy, Associate Professor and

Prof V. Meenakshi Sundaram, Assistant Professor

Course Learning Outcomes:

On successful completion of the course, the students will be able to know, understand, apply, analyse the

CLOs	Course Learning Outcomes	Knowledge Level
CLO 1	distinguishing characteristics of the families	Up to K4
CLO 2	preparation of herbarium, referring local floras, preparation of dichotomous keys and resolving taxonomic problems	Up to K4
CLO 3	morphological observations of plants of economic importance	Up to K4
CLO 4	micropreparations and observations of plant tissues	Up to K4
CLO 5	demonstration of tissue maceration, pollen germination, embryo and endosperm dissections	Up to K4

Mapping of CLOs with PSOs

#	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CLO 1	2	1	2	2	1	1
CLO 2	2	2	3	2	2	2
CLO 3	1	2	1	2	3	2
CLO 4	2	2	2	2	3	3
CLO 5	1	3	3	1	3	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO 1	2	3	2	2	2	1
CLO 2	3	3	3	2	3	3
CLO 3	2	1	1	3	1	1
CLO 4	3	3	3	3	1	2
CLO 5	3	3	2	2	2	1

Advance application - 3; Intermediate level - 2; Basic level - 1

DEPARTMENT OF BOTANY					CLASS: I M.Sc. BOTANY			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours /Week	CIA	Ext	Total
II	Major Elective-III	25P2BECT3	Cell and Molecular Biology	3	5	25	75	100

Nature of Course	Knowledge and Skill	√	Skill Oriented	√	Employability Oriented	√	Entrepreneurship Oriented	

Objectives:

The students will be able to,

- Impart knowledge on the structure and functions of cellular components
- Acquaint the students with semantic organelles and its multiplicative roles
- Reveal the central dogma of molecular biology
- Explore the expression aspects of genes and
- Understand the regulatory aspects of gene expressions

Unit	Description	Hours	K level	CLO
I	Cell Biology: Cell doctrine. Ultra structure of a typical plant cell. Origin of eukaryotic cells. Structure and functions of Plasma membrane, Vacuole, Endoplasmic reticulum, Peroxisomes, Lysosomes and Golgi complex.	15	Upto K4	1
II	Structure and functions of Chloroplast, Mitochondria and Nucleus. Cell cycle: control system, stages and significance. Meiosis: Phases and evolutionary significance. Signal transduction: signal molecules, receptors, calcium signalling, cAMP and phosphoinositide messengers in plants. Programmed Cell Death.	15	Upto K4	2
III	Molecular Biology - Central dogma. Ultrastructure of chromosome. DNA as the genetic material. Physical and chemical structure of DNA. Alternate structures: A and Z helix. Denaturation and renaturation. C value paradox-cot curve. Structure and significance of mRNA, tRNA, rRNA, siRNA and microRNA. RNA world. DNA replication: semi conservative.	15	Upto K4	3
IV	Typical structure of prokaryotic and eukaryotic genes. Cistron, Muton and recon. Types of gene expression: constitutive and facultative. Transcription in prokaryotes and eukaryotes. Post transcriptional modifications – methyl capping, splicing and poly A tailing. RNA editing. Translation in Prokaryotes: Genetic code and mechanisms. Phenogenesis: One gene one polypeptide hypothesis, Human haemoglobin genetics.	15	Upto K4	4

V	Regulations of gene expression: Levels, Bacterial: Lac and trp operon, Plants: rbcL gene. Post translational processing of proteins: Molecular chaperons in protein folding, Proteolytic cleavage, chemical modifications, Intine splicing. Mutations: Types, Mutagens and mechanisms. DNA Repair mechanisms.	15	Upto K4	5

Books for Study:

1. Ajoy Paul, (2009). Text book of Cell and Molecular Biology, Books and Allied (P) Ltd Kolkata.
2. Verma P.S. and Agarwal V.K. (2007). Cell Biology, Genetics, Molecular Biology and Evolution, S. Chand and company Ltd, New Delhi.
3. Randy Wayne, 2009. Plant Cell Biology, Elsevier, Inc.
4. Sinnott, EW., Dunn, L.L and Dobzhansky, T. 1997. Principles of Genetics, Tata Mc Graw Hill Publishing Co. New Delhi.
5. Gupta, P.K. (2007). Genetics. Rastogi Publication, Meerut, India.
6. David Fried Felder, Molecular Biology

Books for References:

1. Janet Iwasa and Wallace Marshall, 2016. Karp's Cell and Molecular Biology Concepts and Experiments, 8th Edition, Wiley and Sons Inc.
2. Harvey lodish et al. 2008. Molecular Cell biology, Sixth Edition, W.H Freeman and Company, New York.
3. Thomas Pollard et al. 2017, Cell Biology, Third Edition, Elsevier, Philadelphia
4. Gardner, E.J., Simmons, M.J and Snustad, D. 1991. Principles of Genetics, John Wiley Sons Inc., 8th Edn., New York.
5. Klug, W.S., Cummings, M.R., Spencer, C.A. 2009. Concepts of Genetics. 9th edition. Benjamin Cummings, U.S.A.

Web Resources:

1. <http://www.freebookcentre.net/Biology/Cell-Biology-Books.html>
2. <https://www.biologydiscussion.com/cell>
3. <https://www.us.elsevierhealth.com/medicine/cell-biology>
4. <https://microbenotes.com/category/genetics>
5. <https://www.us.elsevierhealth.com/medicine/genetics>
6. <https://libguides.uthsc.edu/genetics/ebooks>

Rationale for Nature of the Course:

Theoretical knowledge gained from this paper will help students to find placements in drug manufacturing industries, transgenic plant production and crop improvement institutions

Activities having direct bearing on Skill development / Employability / Entrepreneurship:

Knowledge on prime cell organelles like nucleus, chloroplast and mitochondria; molecular basis of gene expression and its regulation; mutation and DNA repair mechanisms

Pedagogy:

Chalk and Talk, PPT, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Labs & Learning Management System.

Course Designer:

Prof. V. Meenakshi Sundaram, Assistant Professor

Lecture Schedule

Unit	Topics	Hrs	Mode
Unit I	Cell doctrine. Ultra structure and origin of cell	3	Chalk and Talk, Power Point, Discussion, Seminar, Interaction, Quiz, Video Clippings & Google classroom.
	Structure and functions of cell organelles	12	
Unit II	Structure and functions of Chloroplast, Mitochondria and nucleus.	3	
	Cell division and cell cycle.	7	
	Cell signalling and apoptosis.	5	
Unit III	Central dogma. Ultra structure of chromosome	5	
	Structure of DNA and RNAs	5	
	DNA replication	5	
Unit IV	Typical gene structure	6	
	Transcription and post transcriptional modifications	6	
	Translation and phenogenesis	3	
Unit V	Prokaryotic and eukaryotic gene regulations	6	
	Post translational processing of proteins	6	
	Mutation and DNA repair mechanisms	3	

Course Learning Outcomes:

On successful completion of the course, the students will be able to know, understand, apply, and analyse the

CLOs	Course Learning Outcomes	Knowledge Level
CLO 1	ultra structure of cell organelles and its functions	Up to K4
CLO 2	cell cycle, meiosis and programmed cell death	Up to K4
CLO 3	central dogma, different forms of DNA and RNA, and DNA replication	Up to K4
CLO 4	expression and phenogenesis aspects of genes	Up to K4
CLO 5	regulation of gene expression, mutation and DNA repair mechanisms	Up to K4

Mapping of CLOs with PSOs

#	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CLO 1	1	2	2	1	2	3
CLO 2	2	2	3	2	2	2
CLO 3	2	2	1	2	2	2
CLO 4	2	3	3	2	3	1
CLO 5	1	3	3	1	3	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO 1	3	3	2	3	2	2
CLO 2	3	3	3	2	3	3
CLO 3	2	2	3	3	1	1
CLO 4	3	3	3	3	3	2
CLO 5	3	3	2	2	2	1

Advance application - 3; Intermediate level - 2; Basic level – 1

Blue Print for Summative Examinations
Mapping with Course Learning Outcomes (CLOs)

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K Level	No. of Questions	K Level		
1	CLO 1	Up to K2	2	K1 or K2	1	K1	2 (K1 & K1)	1 (K2)
2	CLO 2	Up to K3	2	K1 or K2	1	K1	2 (K2 & K2)	1 (K3)
3	CLO 3	Up to K3	2	K1 or K2	1	K2	2 (K3 & K3)	1 (K3)
4	CLO 4	Up to K4	2	K1 or K2	1	K2	2 (K4 & K4)	1 (K4)
5	CLO 5	Up to K5	2	K1 or K2	1	K2	2 (K3 & K3)	1 (K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - solving problems

K4 - Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF BOTANY					CLASS: I M.Sc. BOTANY			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours /Week	CIA	Ext	Total
II	Major Elective-IV	25P2BECT4	Applied Bioinformatics	3	5	25	75	100
Nature of Course		Knowledge and Skill	√	Skill Oriented	√	Employability Oriented	√	Entrepreneurship Oriented

Objectives: The students will be able to,

1. Provide an overview on genomics and proteomics.
2. Understand the retrieval of biological data from databases and their applications in life sciences.
3. Create awareness about the importance of various bioinformatics tools in solving biological problems.

Unit	Description	Hours	K-level	CLO
I	Bioinformatics: Introduction, Omics Approach, Genomics: Overview and different areas. Genomes of <i>Arabidopsis</i> , <i>Oryza</i> and human. Genome organization of prokaryotes and eukaryotes (genes and gene related sequences; Intergenic DNA). Genome sequencing: Maxam-Gilbert method, Sanger's dideoxy method and overview of next generation sequencing. DNA barcoding: rbcL and Cytochrome c oxidase sequencing.	15	Upto K4	1
II	Overview of Genomic and cDNA library. Genome editing using CRISPR-Cas9. Proteomics: Overview and applications. Proteome analysis tools (2D PAGE and MALDI-ToF). Biological databases: Classification, Nucleic acid sequence databases (NCBI, EMBL and DDBJ), Protein sequence databases (PIR and SWISS-PROT) and Protein structure databases (PDB, SCOP and CATH).	15	Upto K4	2
III	Literature databases (PubMed and AGRICOLA). Sequence alignment: Scoring schemes and gap penalty; Scoring matrices (PAM and BLOSUM); Global vs local sequence alignment, Dynamic programming (Needleman-Wunsch and Smith-Waterman algorithm), Pairwise and multiple sequence alignments. Sequence analysis: FASTA and BLAST algorithms.	15	Upto K4	3
IV	Phylogenetic analysis: Phylogenetic tree, Methods of tree construction (distance-based and character-based), MEGA. Prediction of protein tertiary structure: Tools, Structure validation and Ramachandran plot. Drug designing: Pharmacokinetics, Pharmacodynamics, <i>In silico</i> drug designing methods: Ligand-based and Structure-based. Molecular docking: AutoDock. Applications of R Programming in Biology.	15	Upto K4	4

V	Intellectual Property Rights: Introduction, Importance and Categories of IPR. Patents: filing procedure, case studies on neem and basmati rice. Copyrights, Trademarks and Geographical Indication. Organisational structure of IP offices in India; IPR: Indian and International Scenario. A brief account on international regimes related to IPR: WIPO, TRIPS and WTO.	15	Upto K4	5

Books for Study:

1. Janakiraman N (2024). Bioinformatics: Methods, Tools and Applications, Scientific Publishers, New Delhi.
2. Jin Xiong (2007). Essential Bioinformatics. Cambridge University Press, UK.
3. Rastogi SC, Mendiratta N and Rastogi P (2019). Bioinformatics Methods and Applications: Genomics, Proteomics and Drug Discovery. 4th Edition, PHI Learning Pvt. Ltd, Delhi.
4. Sharma V, Munjal A and Shanker A (2019). A Text Book of Bioinformatics. 2nd Edition, Rastogi Publications, Meerut, New Delhi.

Books for References:

1. Lesk AM (2002). Introduction to Bioinformatics. 1st Edition, Oxford University Press, Oxford, UK.
2. Higgs (2005). Bioinformatics and Molecular Evolution, Ane Books India Pvt Ltd.
3. Kumar SA, Mohan TCK, Murugan K and Subramaniyan S (2011). General Informatics and Bioinformatics. Ane Books India Pvt Ltd.
4. Mount DW (2001). Bioinformatics - Sequence and Genome Analysis. 1st Edition, Cold Spring Harbor Laboratory Press, New York, USA.
5. Campbell and Heyer (2006). Discovering Genomics, Proteomics & Bioinformatics, 2nd Edition.

Web Resources:

1. <https://epgp.inflibnet.ac.in/>
2. <https://www.sciencedirect.com>
3. <https://epathshala.nic.in/>
4. <https://www.biologydiscussion.com>

Rationale for Nature of the Course:

This course will enable the students to know the omics concepts, various biological databases, determine the gene and protein functions, evolutionary relationships among organisms, predicting the three-dimensional structure of proteins and drug designing.

Activities having direct bearing on Skill development / Employability / Entrepreneurship:

The skills learned by the students will help them to effectively extract information from different databases to solve biological problems and assists them to utilize various online tools for research.

Pedagogy:

Chalk and Talk, Power Point, Group Discussion, Seminar, Interaction, Softwares, Problem Solving, Quiz, Virtual Labs, Video Clippings, Google Classroom & LMS (CANVAS).

Course Designer:

Dr. N. JANAKIRAMAN, Assistant Professor

Lecture Schedule:

Unit	Topics	Hrs	Mode
Unit I	Bioinformatics: Introduction, Omics Approach, Genomics: Overview and different areas. Genomes of <i>Arabidopsis</i> , <i>Oryza</i> and human.	4	Chalk and Talk, Power Point, Discussion, Seminar, Interaction, Quiz, Video Clippings & Google classroom.
	Genome organization of prokaryotes and eukaryotes (genes and gene related sequences; Intergenic DNA).	4	
	Genome sequencing: Maxam-Gilbert method, Sanger's dideoxy method and overview of next generation sequencing. DNA barcoding: rbcL and Cytochrome c oxidase sequencing.	7	
Unit II	Overview of Genomic and cDNA library. Genome editing using CRISPR-Cas9.	4	Chalk and Talk, Power Point, Discussion, Seminar, Interaction, Quiz, Video Clippings & Google classroom.
	Proteomics: Overview and applications. Proteome analysis tools (2D PAGE and MALDI-ToF).	4	
	Biological databases: Classification, Nucleic acid sequence databases (NCBI, EMBL and DDBJ), Protein sequence databases (PIR and SWISS-PROT) and Protein structure databases (PDB, SCOP and CATH).	7	
Unit III	Literature databases (PubMed and AGRICOLA).	3	Chalk and Talk, Power Point, Discussion, Seminar, Interaction, Quiz, Video Clippings & Google classroom.
	Sequence alignment: Scoring schemes and gap penalty; Scoring matrices (PAM and BLOSUM); Global vs local sequence alignment, Dynamic programming (Needleman-Wunsch and Smith-Waterman algorithm), Pairwise and multiple sequence alignments.	7	
	Sequence analysis: FASTA and BLAST algorithms.	5	
Unit IV	Phylogenetic analysis: Phylogenetic tree, Methods of tree construction (distance-based and character-based), MEGA.	5	Chalk and Talk, Power Point, Discussion, Seminar, Interaction, Quiz, Video Clippings & Google classroom.
	Prediction of protein tertiary structure: Tools, Structure validation and Ramachandran plot.	5	
	Drug designing: Pharmacokinetics, Pharmacodynamics, <i>In silico</i> drug designing methods: Ligand-based and Structure-based. Molecular docking: AutoDock. Applications of R Programming in Biology.	5	

Unit V	Intellectual Property Rights: Introduction, Importance and Categories of IPR. Patents: filing procedure, case studies on neem and basmati rice.	5	Chalk and Talk, Power Point, Discussion, Seminar, Interaction, Quiz, Video Clippings
	Copyrights, Trademarks and Geographical Indication. Organisational structure of IP offices in India; IPR: Indian and International Scenario.	5	
	A brief account on international regimes related to IPR: WIPO, TRIPS and WTO.	5	

Course Learning Outcomes:

On successful completion of the course, the students will be able to know, understand, apply, analyse the

CLOs	Course Learning Outcomes	Knowledge Level
CLO 1	genome organization in prokaryotes and eukaryotes	Up to K4
CLO 2	concept of biological databases and the use of different public domain databases of DNA and protein for sequence retrieval	Up to K4
CLO 3	sequence alignment and tools used in sequence analysis	Up to K4
CLO 4	phylogenetic tree construction and protein structure prediction tools	Up to K4
CLO 5	intellectual property rights and their importance in research	Up to K4

Mapping of CLOs with PSOs

#	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CLO 1	1	2	2	3	1	2
CLO 2	3	2	3	2	3	2
CLO 3	2	1	3	3	1	3
CLO 4	2	3	1	3	3	1
CLO 5	3	3	1	3	2	1

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO 1	3	3	1	3	2	3
CLO 2	3	3	2	2	3	2
CLO 3	3	2	3	3	1	2
CLO 4	3	3	3	3	3	1
CLO 5	3	3	2	3	2	2

Advance application - 3; Intermediate level - 2; Basic level –1

Blue Print for Summative Examinations

Mapping with Course Learning Outcomes (CLOs)

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K Level	No. of Questions	K Level		
1	CLO 1	Up to K2	2	K1 or K2	1	K1	2 (K1 & K1)	1 (K2)
2	CLO 2	Up to K3	2	K1 or K2	1	K1	2 (K2 & K2)	1 (K3)
3	CLO 3	Up to K3	2	K1 or K2	1	K2	2 (K3 & K3)	1 (K3)
4	CLO 4	Up to K4	2	K1 or K2	1	K2	2 (K4 & K4)	1 (K4)
5	CLO 5	Up to K5	2	K1 or K2	1	K2	2 (K3 & K3)	1 (K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - solving problems

K4 - Examining, analyzing, presentation and make inferences with evidence

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF BOTANY					CLASS: I M.Sc. BOTANY			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours / Week	CIA	Ext	Total
II	NME-II	25P2BNME2	Organic Farming	2	2	25	75	100

Nature of Course	Knowledge and Skill	√	Skill Oriented	√	Employability Oriented	√	Entrepreneurship Oriented	✓

Objectives: The students will be able to,

- Understand the students about the organic farming.
- Study various aspects of organic farming.
- Know the importance of organic farming in the present scenario and its impact on environment and soil health
- Expose the students to about quality and gardening of organic food.

Unit	Description	Hours	K-level	CLO
I	Organic farming- concept, characteristics, significance, scope of organic farming in India - Principles and types of organic farming. Choice of crops & varieties in organic farming - Organic production methods for cereals, vegetables and fruit crops	6	Up to K4	1
II	Organic farming- Manures- compost, methods of composting - Green manuring, vermicompost and biofertilizer - Organic farming practices for improving soil health.	6	Up to K4	2
III	Indigenous practices of organic farming-role of livestock-cow in organic farming – Panchagavya– Dasagavya– Amirthakaraisal– preparation – properties – general effects on crops.	6	Up to K4	3
IV	Processing, labeling of organic produce - Storage and transport of organic products.	6	Up to K4	4
V	Organic certification: – NPOP guidelines – Certification agencies in India–crop production standards–Quality considerations labelling and accreditation process–marketing and export opportunities–APEDA.	6	Up to K4	5

Books for Study:

1. NIIR Board. 2012. The complete Technology Book on Biofertilizer and organic farming. 2nd Edition. NIIR Project Consultancy Services.
2. Sathe, T.V. 2004. Vermiculture and Organic Farming. Daya publishers.
3. Subba Rao N.S. 2017. Biofertilizers in Agriculture and Forestry. Fourth Edition. Medtech.
4. Vayas,S.C, Vayas, S. and Modi, H.A. 1998. Bio-fertilizers and organic Farming Akta Prakashan, Nadiad.
5. Singh, S M. 2018. Organic Manure: Sources Preparation and Usage in Farming Lands,Siya Publishing House

Books for References:

1. Reddy, S.R. 2019. Fundamentals of Agronomy Kalyani Publications, Uttar Pradesh
2. Tolanur, S. 2018. Fundamentals of Soil Science IInd Edition, CBS Publishers, New Delhi
3. Reddy, S.R. 2017. Principles of Organic Farming Kalyani Publishers, New Delhi
4. Dongarjal, R.P and Zade, S.B. 2019. Insect Ecology and Integrated Pest Management Akinik Publications, New Delhi.
5. Ahmad Mehraban. 2013. The Basis of Organic Fertilizers, LAP LAMBERT Academic Publishing.

Web Resources:

1. <https://www.amazon.in/Healthy-earth-organic-Hari-prasad-ebook/dp/B08L5KFKDV>
2. <https://www.kobo.com/in/en/ebook/organic-farming-for-sustainable-agriculture>
3. <https://www.elsevier.com/books/organic-farming/chandran/978-0-12-813272-2>
4. <https://link.springer.com/book/10.1007/978-3-030-04657-6>
5. <https://www.afrimash.com/product-category/livestocksection/book/organicfarmingebooks/RationaleforNatureof the Course>:

Activities having direct bearing on Skill development / Employability / Entrepreneurship:

Understanding the facts and prospects of agrobiodiversity, organic farming, organic certification, biointensive nutrient management

Pedagogy:

Chalk and Talk, Power Point, Group Discussion, Seminar, Interaction, Soft wares, Problem Solving, Quiz, Virtual Labs, Video Clippings, Google Classroom & LMS (CANVAS).

Course Designer:

Dr. P. JANSIRANI, Assistant Professor

Lecture Schedule:

Unit	Topics	Hrs	Mode
Unit I	Organic farming- concept, characteristics, significance, scope of organic farming in India –	2	Chalk and Talk, PowerPoint, Discussion, Seminar
	Principles and types of organic farming. Choice of crops & varieties in organic farming –	2	
	Organic production methods for cereals, vegetables and fruit crops	2	
Unit II	Organic farming- Manures- compost, methods of composting	2	Chalk and Talk, Power Point, Discussion, Seminar, Interaction, Quiz, Video Clippings & Google classroom.
	Green manuring, vermicompost and biofertilizer	2	
	Organic farming practices for improving soil health.	2	
Unit III	Indigenous practices of organic farming-role of livestock	2	Chalk and Talk, Power Point, Discussion, Seminar, Interaction, Quiz, Video Clippings & Google classroom.
	Cow in organic farming–Panchagavya– Dasagavya	2	
	Amirthakaraaisal–preparation–properties–general effects on crops	2	
Unit IV	Processing, labeling of organic produce	2	Chalk and Talk, Power Point, Discussion, Seminar, Interaction, Quiz, Video Clippings & Google classroom.
	Storage of organic products.	2	
	Transport of organic products	2	
Unit V	Organic certification: NPOP guidelines	2	Chalk and Talk, Power Point, Discussion, Seminar, Interaction, Quiz, Video Clippings & Google classroom.
	Certification agencies in India –crop production standards Quality considerations	2	
	Labelling and accreditation process–marketing and export opportunities–APEDA	2	

Course Learning Outcomes:

On successful completion of the course, the students will be able to know, understand, apply and analyse the

CLOs	Course Learning Outcomes	Knowledge Level
CLO 1	various aspects of organic farming.	Up to K4
CLO 2	organic sources of nutrients, organic waste recycling, manuring methods and crop management	Up to K4
CLO 3	indigenous practices of organic farming and its effects on crops	Up to K4
CLO 4	packaging methods of harvest and develop skills for post-harvest management	Up to K4
CLO 5	quality considerations, marketing and export opportunities of organic farming.	Up to K4

Mapping of CLOs with PSOs

#	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CLO 1	1	2	2	3	1	2
CLO 2	3	2	3	2	3	2
CLO 3	2	1	3	3	1	3
CLO 4	2	3	1	3	3	1
CLO 5	3	3	1	3	2	1

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO 1	3	3	1	3	2	3
CLO 2	3	3	2	2	3	2
CLO 3	3	2	3	3	1	2
CLO 4	3	3	3	3	3	1
CLO 5	3	3	2	3	2	2

Advance application - 3; Inter mediate level - 2; Basic level - 1

Blueprint for Formative Examination

Sl. No	CLOs	K-Level	Section-A		Section-B Either Or Choice	Section-C (Open Choice)
			Short Answer			
			No. of Questions	K -level		
1	x	Up to K2	3	K1	2(K2)	1 (K1)
2	Y	Up to K2	2	K1	2(K2)	1 (K1)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Mark for each question			2		5	10
Total Marks for each section			10		10	20

Blueprint for Summative Examination

Sl. No	CLOs	K-Level	Section-A		Section-B Either Or Choice	Section-C (Open Choice)
			Short Answer			
			No. of Questions	K -level		
1	1	Up to K2	1	K1	2(K2)	1 (K1)
2	2	Up to K2	1	K1	2(K2)	1 (K1)
3	3	Up to K2	1	K1	2(K3)	1 (K1)
4	4	Up to K2	1	K1	2(K4)	1 (K1)
5	5	Up to K2	1	K1	2(K3)	1 (K1)
No. of Questions to be asked			5		10	5
No. of Questions to be answered			5		5	3
Mark for each question			2		7	10
Total Marks for each section			10		35	30

K1 – Remembering and recalling facts with specific answers

K2 – Basic understanding of fact and stating main ideas with general answers



THE MADURA COLLEGE (AUTONOMOUS), MADURAI - 11

DEPARTMENT OF BOTANY

COURSE DESCRIPTION WITH DESCRIPTOR ELEMENTS AND PERCENTAGE OF REVISION

PG-Botany

Course Code	Title of the course	Hours	Credits	Nature of Course (Employability/Entrepreneurship/Skill Development)			Scope of Focus (Local/National/ Global developmental needs			Percentage of syllabus Revision/ New
				Empl.	Ent	Skill	Local	National	Global	
SEMESTER-I										
25P1BCCT1	Plant diversity- I: Algae, Fungi, Lichens and Bryophytes	6	5	✓		✓	✓	✓	✓	30
25P1BCCT2	Plant diversity- II: Pteridophytes, Gymnosperms and Palaeobotany	6	5	✓		✓	✓	✓	✓	32
25P1BCCP1	Laboratory course- I: Covering Papers I and II	6	4	✓		✓	✓	✓	✓	30
25P1BECT1	Ecology and Conservation Biology	5	3	✓		✓	✓	✓	✓	32
25P1BECT2	Horticulture	5	3	✓	✓	✓	✓	✓	✓	31

25P1BNME1	Fundamentals of Gardening	2	2	✓	✓	✓	✓	✓	✓	New
SEMESTER-II										
25P2BCCT3	Taxonomy of Angiosperms and Economic Botany	6	5	✓		✓	✓	✓	✓	38
25P2BCCT4	Plant Anatomy, Embryology and of Morphogenesis	6	5	✓		✓	✓	✓	✓	25
25P2BCCP2	Laboratory course- II: Covering Papers III and IV	6	4	✓		✓	✓	✓	✓	40
25P2BECT3	Cell and Molecular Biology	5	3	✓		✓	✓	✓	✓	23
25P2BECT4	Applied Bioinformatics	5	3	✓		✓	✓	✓	✓	44
25P2BNME2	Organic Farming	2	2	✓	✓	✓	✓	✓	✓	28