



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 3 of 3
(Corrected Copy)

(Syllabi Pages: 1799-2526)



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	88) Dr. L.D. Devasree
70) Dr. S.V. Karthikeyan	89) Dr. B. Latha
71) Prof. S. Vidhyasankar	90) Dr. C. Selvakumar
72) Dr. R. Ramachandran	91) Dr. P. Sivakumar
73) Dr. S. Selvakumar	92) Er. J. Rajendran
74) Dr. P. Prasanna	93) Prof. R. Umasankari
75) Dr. M. Boominathan	94) Dr. T. SreeRamkumar
76) Dr. M. Hasmath Farzana	95) Dr. K. Kathirvel Pandian
77) Dr. J. Shanmugapriya	96) Dr. N. Paneerselvam
78) Prof. S. ChellaPandian	97) Dr. S. Vimal
79) Dr. P. Kannan	98) Dr. K. Vidhya
80) Dr. S. Karuppusamay	99) Dr. S. Suresh Kannan
81) Dr. S. Gnaana Saraswathi	100) Prof. G. Sreedevi
82) Prof. V. Meenakshi Sundaram	101) Dr. M. Revathi
83) Dr. N. Janakiraman	102) Dr. S. Angayarkanni
84) Dr. M. Karpagajothi	103) Prof. K. Rajasaravanakumar
85) Dr. P. Jansi Rani	104) Prof. R. Suguna
86) Dr. S. Saravanan	105) Dr. K. Rajeswari
87) Dr. S. Dinakaran	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.Ramajapandian 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 Rabiyyath 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 ZOOLOGY

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. Zoology) – Regulation 2023

Certificate Course

Credit Distribution for I B.Sc. Zoology

Semester – I				
Part	Course Code	Course description	Credits	Hours
I	23U1TLAN1/ 23U1HLAN1/ 23U1SLAN1	Language - I Tamil / Hindi / Sanskrit	3	6
II	23U1NENG1	Language - II English	3	6
III	23U1ZCCT1	Invertebrata (CC1)	5	5
	23U1ZCCP1	Invertebrata Lab Course (CC2)	3	3
	23U1CGET1	Allied Chemistry-I (EC1)	4	4
	23U1CGEP1	Allied Chemistry Lab Course-I (EC1-P)	1	2
IV	23U1ZFCT1	Applied Zoology	2	2
	23U1ZSED1	Medical Laboratory Techniques	2	2
Semester – II				
Part	Course Code	Course description	Credits	Hours
I	23U2TLAN2/ 23U2HLAN2/ 23U2SLAN2	Language - I Tamil / Hindi / Sanskrit	3	6
II	23U2NENG2	Language - II English	3	6
III	23U2ZCCT2	Chordata (CC3)	5	5
	23U2ZCCP2	Chordata Lab Course (CC4)	3	3
	23U2CGET2	Allied Chemistry -II (EC2)	4	4
	23U2CGEP2	Allied Chemistry Lab Course-II (EC2-P)	1	2
IV	23U2ZSED2	Ornamental fish farming and management	2	2
	23U2ZSED3	Bio-composting for Entrepreneurship	2	2

Credit Distribution for II B.Sc. Zoology

Semester – III				
Part	Course Code	Course description	Credits	Hours
I	23U3TLAN3/ 23U3HLAN3/ 23U3SLAN3	Language - I Tamil / Hindi / Sanskrit	3	6
II	23U3NENG3	Language - II English	3	6
III	23U3ZCCT3	Cell Biology (CC5)	4	4
	23U3ZCCP3	Cell Biology Lab Course (CC6)	3	3
	23U3BGET1	Allied Botany-I (EC1)	4	4
	23U3BGEP1	Allied Botany Lab Course-I (EC1-P)	1	2
IV	23U3ZSED4	Economic Zoology	2	2
	23U3ZSED5	Basic Course in Ornithology	2	2
	23U3ZEVS1	Environmental studies	-	1
			22	30
Semester – IV				
Part	Course Code	Course description	Credits	Hours
I	23U4TLAN4/ 23U4HLAN4/ 23U4SLAN4	Language - I Tamil / Hindi / Sanskrit	3	6
II	23U4NENG4	Language - II English	3	6
III	23U4ZCCT4	Developmental Biology (CC7)	4	4
	23U4ZCCP4	Developmental Biology Lab Course (CC8)	3	3
	23U4BGET2	Allied Botany-II (EC2)	4	4
	23U4BGEP2	Allied Botany Lab Course-II (EC2-P)	1	2
IV	23U4ZSED6	Bioinstrumentation	2	2
	23U4ZSED7	Basics of Marine Biology	2	2
	23U4ZEVS2	Environmental studies	2	1
			24	30

Credit Distribution for III B.Sc. Zoology

Semester – V				
Part	Course Code	Course description	Credits	Hours
III	23U5ZCCT5	Genetics	4	5
	23U5ZCCT6	Evolutionary Biology	4	5
	23U5ZCCT7	Animal Physiology	4	5
	23U5ZCCP5	Lab Course in Physiology, Genetics Evolution and Biodiversity	3	3
	23U5ZDET1	Animal behavior and Reproductive biology	4	5
	23U3ZIDCT	Wildlife Conservation & Management	4	5
	23U5ZVENT1	Value Education	2	2
	23U5ZINTR	Industrial Visit / Internship field visit	2	-
			27	30
Semester – VI				
Part	Course Code	Course description	Credits	Hours
III	23U6ZCCT8	Microbiology	4	6
	23U6ZCCT9	Environmental Biology	4	6
	23U6ZCCT10	Biotechnology	4	6
	23U6ZCCP6	Lab Course- Microbiology, Environmental Biology, Immunology and Biotechnology	3	3
	23U6ZDET2	Immunology	2	4
	23U6ZSED8	Professional Competency Skill	2	2
	23U6ZPROV	Project and Viva	2	3
		Extension	1	-
			22	30

Add-on Courses

Semester	Course Code	Course Title
III	23U3ZAD1	Health Education
IV	23U4ZAD2	Wildlife Conservation

Credit Distribution for I B.Sc. Botany

Semester – I				
Part	Course Code	Course description	Credits	Hours
III	23U1ZGET1	Generic Elective - 1 (Allied Zoology-I) (EC1)	4	4
	23U1ZGEP1	Generic Elective - 1 (Allied Zoology Lab Course-I) (EC1-P)	1	2
Semester – II				
Part	Course Code	Course description	Credits	Hours
IV	23U2ZGET2	Generic Elective - 2 (Allied Zoology -II) (EC2)	4	4
	23U2ZGEP2	Generic Elective - 2 (Allied Zoology Lab Course-II) (EC2-P)	1	2

Credit Distribution for II B.Sc. Chemistry

Semester – III				
Part	Course Code	Course description	Credits	Hours
III	23U3ZGET1	Generic Elective - 1 (Allied Zoology-I) (EC1)	4	4
	23U3ZGEP1	Generic Elective - 1 (Allied Zoology Lab Course-I) (EC1-P)	1	2
Semester – IV				
Part	Course Code	Course description	Credits	Hours
IV	23U4ZGET2	Generic Elective - 2 (Allied Zoology -II) (EC2)	4	4
	23U4ZGEP2	Generic Elective - 2 (Allied Zoology Lab Course-II) (EC2-P)	1	2

Certificate Course

Semester	Course Code	Course Title
Even		Fish Breeding Technology

DEPARTMENT OF ZOOLOGY				CLASS: III B.Sc. Zoology				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
V	CORE	23U5ZCCT5	GENETICS	4	5	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	

Course Objectives

By the end of the course, students will be able:

1. To understand the structure and functions of nucleic acids in the cell.
2. To know the causes and effects of mutations.
3. To comprehend the importance of genetic variation in evolution.
4. To know about the harmful effects of genetic variations in humans, their cumulative effect in human population and the molecular basis of variations.

Unit	Description	Hours	K-level	CLO
I	Mendelian Genetics and Inheritance: Mendelian genetics: Mendelian experiments, laws of Mendel, Monohybrid, Dihybrid, back and test cross; Interaction of genes: Incomplete dominance, co dominance, complementary genes, supplementary genes, lethal genes. Inheritance: Polygenic inheritance- skin colour; multiple alleles- ABO blood groups; extra chromosomal inheritance- kappa particles; sex linked inheritance – eye colour in Drosophila, colour blindness and hemophilia in man.	15	Up to K2	1
II	Linkage and Crossing Over: Linkage: Linked genes, complete and incomplete linkage. Crossing over: molecular mechanisms of crossing over, kinds of crossing over, models of recombination. Chromosome mapping: inference and coincidence, haploid mapping, somatic cell hybridization.	15	Up to K3	2
III	Cytogenetics: Variation in chromosome number and structure: position effect, types. Molecular basis of mutation, Mutational hotspots. Agents causing mutation - radiation and chemicals. Detection of mutation - ClB method and muller-5 method.	15	Up to K3	3

IV	Human and Microbial Genetics: Human genetics: Karyotype and ideogram; sex determination - Barr body technique; chromosomal abnormalities in humans, Pedigree analysis; diagnosis of genetic abnormalities; Eugenics, Euphenics and Euthenics. Bacterial genetics: Conjugation, transformation and transduction.	15	Up to K4	4
V	Molecular Genetics: Insertion elements, transposable elements, retroelements; operon model, lac operon, tryptophan operon and feedback mechanism. Gene regulation in Eukaryotes.	15	Up to K4	5

Books for Study:

1. David E Sadava, 1993. Cell Biology - Organelle Structure and Function, Jones Bartlett Publishers.
2. Gupta G. K., 2013. Genetics Classical to Modern, Rastogi publishers, Meerut.
3. Lewin B., 2008. Genes IX, Jones and Bartlett publishers.
4. Veer Bala Rastogi., 2019. Text Book of Genetics, Medtech.
5. Verma P.S and Agarwal V.K., 2006. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S. Chand & Company Ltd.
6. Verma P. S. and V. K. Agarwal., 2018. Genetics, S. Chand & Company Pvt Ltd.

Books for References:

1. Cooper, Geoffrey M., 2018. The cell: A Molecular Approach, Eighth Edition, Oxford University Press.
2. De Robertis, E. D. P and E.M.F Robertis, 2017. Cell and Molecular Biology 8th Edition, LWW..
3. Dobzhansky T., 1982. Genetics and The Origin of Species, Columbia University.
4. Fletcher H and Hickey I., 2015. Genetics, IV Edition. GS, Taylor and Francis Group, New York and London.
5. Gardner, Anne. 2009. Human Genetics, Scion Publishing Ltd.
6. Klug, W. S., Cummings, M. R., Spencer, C. A., 2012. Concepts of Genetics. X Edition. Benjamin Cummings.
7. Lodish, Harvey, Arnold Berk et al., 2007. Molecular cell biology. 6th edition, W. H. Freeman.
8. Russel, Peter J. 2013. I Genetics: A Molecular Approach, Pearson.
9. Strickberger M. W., 1995. Genetics, Prentice Hall India Learning P. Ltd.

Web Resources

1. <https://go.nature.com/2XE8V1q>
2. <https://bit.ly/3zoTt6B>
3. <https://bit.ly/2XAm7oa>
4. <https://bit.ly/2XEbhxi>
5. <https://bit.ly/3AB4bso>
6. <https://bit.ly/39pZSE4>
7. <https://www.genome.gov/genetics-glossary/Sex-Linked>
8. <https://www.vedantu.com/biology/mutagens>

Rationale for Nature of the course

This course will enable the students to comprehend the knowledge on basic concepts on Mendelian Genetics and Inheritance. Students will learn the significance of Linkage, Crossing over and Cytogenetics. Students will also acquire knowledge on human genetics, microbial genetics and molecular genetics.

Activities having direct bearing on Skill development / Employability /Entrepreneurship

The acquired knowledge on Inheritance, Human genetics, Cytogenetics, Microbial genetics and Molecular genetics will help the students for developing the skills in genetics which further paves the way for their employability.

Pedagogy

Chalk and Talk, PPT, group discussion, seminar, interaction, quiz, tutorial and virtual labs.

Course Designer:

Dr. L.D. Devasree

Course Schedule (75 hours)

Unit	Topics	Hrs	Mode
Unit I	Mendelian genetics: Mendelian experiments, laws of Mendel, Monohybrid, Dihybrid, back and test cross;	3	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Interaction of genes: Incomplete dominance, co-dominance, complementary genes, supplementary genes, lethal genes.	4	
	Inheritance: Polygenic inheritance- skin colour; multiple alleles- ABO blood groups; inheritance – eye colour in rabbit	4	
	extra chromosomal inheritance- kappa particles; sex linked inheritance – eye colour in Drosophila, colour blindness and hemophilia in man.	4	
Unit II	Linkage: Linked genes, complete and incomplete linkage.	2	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Crossing over: molecular mechanisms of crossing over	2	
	Kinds of crossing over	2	
	Models of recombination.	3	
	Chromosome mapping: inference and coincidence	3	
	Haploid mapping, somatic cell hybridization	3	
Unit III	Variation in chromosome number and structure: position effect, types	3	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Molecular basis of mutation, Mutational hotspots	3	
	Agents causing mutation - radiation and chemicals.	3	
	Detection of mutation - CLB method	3	
	Muller-5 method	3	
Unit IV	Human genetics: Karyotype and ideogram; sex determination - Barr body technique	3	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Chromosomal abnormalities in humans, Pedigree analysis	4	
	Diagnosis of genetic abnormalities; Eugenics, Euphenics and Euthenics.	4	
	Bacterial genetics: Conjugation, transformation and transduction	4	
Unit V	Insertion elements, transposable elements, retroelements	4	Chalk and talk, ppt, group discussion, quiz, seminar & Assignment
	operon model, lac operon	3	
	tryptophan operon.	2	
	feedback mechanism	2	
	Gene regulation in Eukaryotes.	4	

Course Learning Outcomes:

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

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Explain the basis of inheritance and expression of genes.	Up to K2
CLO-2	Interpret the types, mechanism and significance of linkage & crossing over	Up to K3
CLO-3	Illustrate the causes of variations in genetic material and identify the effect in a population using different techniques.	Up to K3
CLO-4	Examine the role of genetics in human and microbial organisms.	Up to K4
CLO-5	Analyse the factors which contribute to changes in gene expression and gene regulation in Eukaryotes.	Up to K4

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

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

Advance application– 3;

Intermediate level–2;

Basic level–1

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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 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 K4	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	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 ZOOLOGY				CLASS: III B.Sc. Zoology				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
V	CORE	23U5ZCCT6	EVOLUTIONARY BIOLOGY	4	5	25	75	100
Nature of Course								
Skill Oriented		✓	Employability Oriented		Entrepreneurship Oriented			

Course Objectives

By the end of the course, students will be able:

1. To learn fundamentals of evolutionary biology, history of evolutionary thoughts and theories of evolution.
2. To explain the forces and mechanism of evolution.
3. To identify various types of evidences to understand the animal evolution in a broader perspective.
4. To evaluate the trends in evolution of higher forms though inspecting fossils of man and horse.
5. To compile the modern methods and practice for the improvement of human race with an ethical perspective.

Unit	Description	Hours	K-level	CLO
I	Fundamentals and History of Evolution: Inorganic and organic evolution - History of evolutionary thought, Primordial earth and primeval atmosphere, Chemical origin of life: Synthesis of organic molecules, Urey-Miller experiment, Origin of prokaryotes and eukaryotes	15	Up to K2	1
II	Theories of Evolution: Lamarckism - Neo Lamarckism - Darwinism - Neo Darwinism and modern synthetic theory - DeVrie's Mutation theory – modern concepts of mutation – Mutation and their role in evolution-Animal colouration and Mimicry.	15	Up to K3	2
III	Mechanism of Evolution: Isolating mechanisms – geographical, pre-zygotic and post zygotic mechanism. Modes of speciation (allopatric, peripatric, parapatric and sympatric) Hybridization is an evolutionary catalyst-Adaptive radiation in reptiles and mammals-Convergence and parallelism.	15	Up to K3	3
IV	Evidences for Evolution: Morphological, physiological and biochemical, embryological, Taxonomical and geographical evidences-Palaeontological evidences-evolutionary genomics. Geological timescale– Nature of fossils- Dating of fossils- carbon dating.	15	Up to K4	4
V	Evolution of Higher forms: Patterns and origin of Higher categories- Evolution of man and fossil records of horse. Cultural evolution of man, Population genetics and evolution: gene pool, gene frequency and genotype frequency; Hardy-Weinberg law of equilibrium. Factors affecting Hardy-Weinberg equilibrium.	15	Up to K4	5

Books for Study:

1. Ridley, M., 2004. Evolution. III Edition. Blackwell Publishing.
2. Lull, R.S. 2010. Organic evolution., The Macmillan, New York.
3. Minkoff, E.C. 1983. Evolutionary biology. Reading, MA: Addison-Wesley Publishing Company
4. Sober, E. 1994. Conceptual issues in evolutionary biology. Cambridge, MA: MIT Press.
5. Rastogi, V.B. 1991. Organic Evolution. Kedar Nath Ram Nath Publications, Meerut, Uttar Pradesh, India.
6. Strickerberger, M.W. 1996. Evolution. Jones & Bartlett, USA
7. Colbert, E.H. Morales, M. and Minkoff, E.C. 2011. Colbert's Evolution of The Vertebrates: A History of the Backboned Animals Through Time, Wiley, India.

Books for References:

1. Burns, G.W. 1972. The Science of Genetics. An Introduction to Heredity. Mac Millan Publ. Co. Inc.
2. Gardner, E.F. 1975. Principles of Genetics. John Wiley & Sons, Inc. New York.
3. Harth and Jones, E.W. 1998. Genetics—Principles and Analysis. Jones and Bar Hett Publ. Boston.
4. Levine, L. 1969. Biology of the Gene. Toppan.
5. Pedder, J. 1972. Genetics as a Basic Guide. W. Norton & Company, Inc.
6. Rastogi, V.B. 1991. A Text Book of Genetics. Kedar Nath Ram Nath Publications, Meerut, Uttar Pradesh, India.
7. White, M.J.D. 1973. Animal Cytology and Evolution. Cambridge Univ Press.

Web Resources

1. <https://bit.ly/3nPD09m>
2. <https://bit.ly/3CHOdgL>
3. <https://bit.ly/2XvcCXl>
4. <https://bit.ly/2XAL1Vh>
5. <https://bit.ly/3zoU9Jl>

Rationale for Nature of the course:

This course will help the students to comprehend the knowledge on history of evolutionary thoughts, theories of evolution, and forces and mechanism of evolution. Students will also acquire knowledge on the evidences for understanding the mechanism of evolution. They also get enlightened about the evolution of higher forms through studying of fossils. The knowledge acquired on the modern methods and practice for the improvement of human race will help the students to understand the human genetics in an ethical perspective.

Activities having direct bearing on Skill development / Employability

The acquired knowledge on evolution of earth and animals will help the students for developing the skills on methods for studying evolution of animals and human. The mastered knowledge on paleontology and improvement of human race with evolutionary perspective will further pave the way for their employability.

Pedagogy

Chalk and Talk, PPT, group discussion, seminar, interaction, quiz, tutorial and virtual labs.

Course Designer: Dr. R. Eswaran

Course Schedule (75 hours)

Unit	Topics	Hrs	Mode
Unit I	Fundamentals and History of Evolution : Inorganic and organic evolution - History of evolutionary thought	4	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Primordial earth and primeval atmosphere	3	
	Chemical origin of life: Synthesis of organic molecules	3	
	Urey-Miller experiment	2	
	Origin of prokaryotes and eukaryotes	3	
Unit II	Theories of Evolution: Lamarckism - Neo Lamarckism	3	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Darwinism - Neo Darwinism and modern synthetic theory	3	
	DeVrie's Mutation theory – modern concepts of mutation –	4	
	Mutation and their role in evolution	2	
	Animal colouration and Mimicry	3	
Unit III	Mechanism of Evolution: Isolating mechanisms – geographical, pre-zygotic and post zygotic mechanism	3	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Modes of speciation - allopatric, peripatric, parapatric and sympatric	2	
	Hybridization is an evolutionary catalyst	2	
	Adaptive radiation in reptiles and mammals	4	
	Convergence and parallelism	4	
Unit IV	Evidences for Evolution: Morphological, physiological evidences	3	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Biochemical, embryological evidences	3	
	Taxonomical and geographical evidences- Paleontological evidences–evolutionary genomics	3	
	Geological timescale	3	
	Nature of fossils- Dating of fossils- carbon dating	3	
Unit V	Evolution of Higher forms: Patterns and origin of Higher categories	3	Chalk and talk, ppt, group discussion, quiz, seminar & Assignment
	Evolution of man and fossil records of horse	3	
	Cultural evolution of man, Population genetics and evolution: gene pool	3	
	Gene frequency and genotype frequency, Hardy-Weinberg law of equilibrium	3	
	Factors affecting Hardy-Weinberg equilibrium	3	

Course Learning Outcomes:

On successful completion of the course, the students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Demonstrate the primordial earth and history of evolutionary thoughts.	Up to K2
CLO-2	Make use of evolutionary theories to understand evolution of animals.	Up to K3
CLO-3	Identify mechanisms of evolution through Isolating mechanisms, Modes of speciation, Hybridization and Adaptive Radiation	Up to K3
CLO-4	Examine the Morphological, physiological, biochemical, embryological, Taxonomical and geographical evidences- Palaeontological evidences for the evolution of animals	Up to K4
CLO-5	Analyze the fossil records of man and horse for understanding the evolution of higher categories of animals, and to examine the importance of Hardy-Weinberg equilibrium.	Up to K4

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

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

Advance application- 3;

Intermediate level-2;

Basic level-1

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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 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 K4	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	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 ZOOLOGY				CLASS: III B.Sc. Zoology				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/ week	CIA	Ext	Total
V	CORE	23U5ZCCT7	ANIMAL PHYSIOLOGY	4	5	25	75	100
Nature of Course								
Skill Oriented		✓	Employability Oriented		✓	Entrepreneurship Oriented		

Course Objectives

By the end of the course, students will be able:

1. To familiarizing students with the principles and basic facts of Animal Physiology
2. To give students an insight about the molecular and cellular basis of physiological function in animals.
3. To give an idea about the regulation of organ system functions and homeostasis.
4. To make the students aware about how the structural functional relationships and its synchronization with the molecular signals.

Unit	Description	Hours	K-level	CLO
I	Nutrition & Respiration Nutrition: Digestion and absorption of carbohydrates, proteins and lipids. Minerals, Vitamins and their deficiency. Hormonal control of digestion. Respiration: Mechanism of respiration - oxygen transport, Bohr's effect and Carbon dioxide transport.	15	Up to K2	1
II	Circulation & Excretion Blood- composition and functions, Types of blood pigments in lower and higher organisms. Mechanism of clotting. Types of Hearts- Heart beat and its regulation in human system. Pace maker – Cardiac cycle – ECG - Pulse and blood pressure. Excretory system: Nephron structure, Mechanism of urine formation. Excretory products. Osmoregulation in freshwater and marine fishes.	15	Up to K3	2
III	Muscle and Nervous system. Types of muscles – Ultrastructure, striated muscle, cardiac and smooth muscle. Muscle contraction & properties. Neurons– structure & types - Transmission of Impulse, Synaptic junction and Neurotransmitters. Reflex action. Nerve disorders – epilepsy, Alzheimer's disease, Parkinson's disease.	15	Up to K4	4
IV	Sense Organs Structure of eye, physiology of vision, visual pigments, photo chemistry of vision - Eye defects – myopia, hyperopia, presbyopia, astigmatism, cataract - Structure of ear and mechanism of hearing - Hearing impairments- deafness, labyrinthine disease	15	Up to K4	4

V	Endocrinology and Reproductive Physiology Endocrine glands, hormones, actions and disorders in man – Pituitary, Thyroid, Pancreas, Adrenal and Gonads. Feedback mechanism, Puberty, Adolescence, pregnancy, parturition, lactation and birth control methods in human system.	15	Up to K4	5

Books for Study:

1. Agarwal R A., Anil K Srivastava., Kaushal Kumar.,1978. Animal Physiology and Biochemistry, S. Chand & Co. Ltd., New Delhi Publishing., 377 pp.
2. Ambika Shanmugam, 2001. Fundamentals of Biochemistry for Medical students, Karthik Offset Printers, Chennai, 590pp
3. Berry A.K.1998. A text book of Animal Physiology and Biochemistry. Emkay Publications, New Delhi, 320 pp.
4. Parameswaran, Ananta Krishnan and Ananta Subramanian, 1975. Outlines of Animal Physiology, S. Viswanathan (Printers & Publishers) Pvt. Ltd., 329 pp
5. Verma P.S., Tyagi B.S & Agarwal V.K., 2010. Animal Physiology, S. Chand & Co. Ltd., New Delhi Publishing. 417 pp.

Books for references:

1. Guyton, A.C. and Hall, J.B., 2011. Text Book of Medical Physiology,
2. 9th Edition, W.B. Sanders Company, Prism Books (Pvt.) Ltd., Bangalore., 1064 pp.
3. Ganong, W.F., 2019. Review of Medical Physiology, McGraw Hill, New Delhi., 340 pp.
4. Hill, W.R., Wyse, G.A and Anderson, M. 2016. Animal Physiology (4thedn).
5. Sinauer Associates is an imprint of Oxford University Press; USA, 828 pp.
6. Hoar, W.S. 1983. General and Comparative Physiology. Prentice Hall of India, New Delhi, 928 pp.
7. Prosser C.L., 1985. Comparative Animal Physiology, Satish Book Enterprise, Agra - 282 003, 966 pp.
8. Sarada Subrahmanyam, Madhavan Kutty, K., & Singh H.D., 2018. Text Book of
9. Human Physiology, S. Chand & Co, New Delhi.
10. Singh, H.R and Kumar, N. 2017. Animal physiology and biochemistry, Vishal publishing company, Jalandhar, 864

Web Resources

1. <https://microbenotes.com/category/biochemistry/>
2. <https://www.stem.org.uk/resources/collection/3931/animal-physiology>
3. <https://animalphys4e.sinauer.com>
4. <https://nptel.ac.in/courses/102/104/102104042>
5. <https://biochem.oregonstate.edu>

Rationale for nature of the course

This course will enable the students to comprehend the knowledge o the basic concepts of Animal Physiology. Students will learn the molecular and cellular basis of physiological and cellular functions of Animal system.

Activities having direct bearing on skill development / employability entrepreneurship

Acquired knowledge on Animal Physiology will help the students for developing skills and clarity in the physiological and functions of the Animal and human system. It provides the fundamental knowledge for the discovery of drug.

Pedagogy

Chalk and Talk, PPT, group discussion, seminar, interaction, quiz, tutorial and virtual labs.

Course Designer: Dr. B. Latha.

COURSE SCHEDULE (75 HOURS)

Unit	Topics	Hrs	Mode
Unit I	Nutrition: Digestion and absorption of carbohydrates, proteins and lipids.	4	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Minerals, Vitamins and their deficiency.	3	
	Hormonal control of digestion.	4	
	Respiration: Mechanism of respiration -oxygen transport.	2	
	Bohr's effect and Carbon dioxide transport.	2	
Unit II	Circulation & Excretion	2	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Blood- composition and functions,		
	Types of blood pigments in lower and higher organisms.	2	
	Mechanism of clotting.	2	
	Types of Hearts- Heart beat and its regulation in human system.	2	
	Pace maker – Cardiac cycle – ECG - Pulse and blood pressure.	2	
	Excretory system: Nephron structure, Mechanism of urine formation	2	
	Excretory products.	1	
Unit III	Osmoregulation in freshwater and marine fishes	2	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Muscle and Nervous system.		
	Types of muscles – Ultrastructure, striated muscle, cardiac and smooth muscle.	4	
	Muscle contraction & properties.		
	Neurons– structure & types - Transmission of Impulse,	4	
	Synaptic junction and Neurotransmitters. .	2	
Unit IV	Reflex action. Nerve disorders – epilepsy,	2	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Alzheimer's disease, Parkinson's disease	3	
	Sense Organs	4	
	Structure of eye, physiology of vision, visual pigments, photo chemistry of vision - Eye defects –myopia, hyperopia, presbyopia, astigmatism, cataract -	4	
	Structure of ear and mechanism of hearing -	4	
Unit V	Hearing impairments- deafness, labyrinthine disease	3	Chalk and talk, ppt, group discussion, quiz, seminar & Assignment
	Endocrinology		
	Endocrine glands, hormones, actions and disorders in man – Pituitary,	6	
	Thyroid, Pancreas, Adrenal and Gonads.	6	
	Feedback mechanism, Puberty,	3	
Unit V	Adolescence, pregnancy, parturition, lactation and	2	Chalk and talk, ppt, group discussion, quiz, seminar & Assignment
	birth control methods in human system	2	

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 basic concepts, structures, mechanism of digestion and respiration.	Up to K2
CLO-2	Describe the process of, Blood circulation, clotting mechanism, excretion and osmoregulation.	Up to K3
CLO-3	Apply the knowledge to learn about the muscles, and Nervous system	Up to K3
CLO-4	Analyse the importance of vision and hearing.	Up to K4
CLO-5	Examine the clinical implications of endocrinology and Reproductive Physiology.	Up to K4

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

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

Advance application- 3;

Intermediate level-2;

Basic level-1

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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 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 K4	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	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 ZOOLOGY				CLASS: III B.Sc. Zoology				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
V	CORE PRACTICAL	23U5ZCCP5	Lab Course in Physiology, Genetics Evolution and Biodiversity	3	3	25	75	100
Nature of Course								
Skill Oriented		✓	Employability Oriented		✓	Entrepreneurship Oriented		

Course Objectives

By the end of the course, students will be able:

1. To demonstrate the physiological process and the biomolecules involved.
2. To analyze the techniques used and to verify the principles of genetics
3. To identify evolutionary evidences to understand the process of animal evolution
4. To understand the methods used for the biodiversity and conservation
5. To get field exposure and the knowledge on latest developments in the field of genetics, evolutionary biology, Animal Physiology and wildlife conservation.

Unit	Description	Hours	K-level	CLO
I	Digestive Enzymes: Counting of cockroach haemocytes using haemocytometer. Amylase activity in relation to temperature in human saliva. Oxygen consumption of fish in relation to body weight. Qualitative analysis of Nitrogenous waste products- ammonia, urea and uric acid. Sphygmomanometer, Kymograph and ECG.	9	Upto K4	1
II	Mounting of Polytene chromosomes- Verification of Mendelian monohybrid experiment using beads- Fingerprints in human population. Twins, Mendelian traits in man, Sickle cell anemia, Klinefelter's syndrome, Turner and Down syndrome	9	Upto K4	2
III	Study on types of fossils-Evolutionary importance of <i>Peripatus</i> and <i>Limulus</i> -Problems on Hardy-weinberg Law. Darwin's Finches, <i>Archaeopteryx</i> , Vestigial organ in man	9	Upto K4	3
IV	Study of arthropods of water and soil samples. Collection, isolation, identification and mounting of marine and freshwater plankton. Study of sandy shore fauna-Study of rocky shore fauna. River Conservation. Pitfall trap, Light trap, Red data book, Ecological pyramids	9	Upto K4	4
V	Field Visit : Institutional visits, Visit to waste water treatment plant, Vermicompost plant. Visit to ecosystem and archaeologically important sites.	9	Upto K4	5

Books for Study:

1. Widmaier, E.P., Raff, H. and Strang, K.T. 2008. Vander's Human Physiology, XI Edition., McGraw Hill., 770PP.
2. Bishop, M.L., Fody, E.P., Schoeff, L.E. 2010. Clinical Chemistry: Principles, Procedure, correlations. Wolters Kluwer, India, 298PP.
3. Burtis, C.A. and Ashwood, E.R. 2008. Tietz textbook of Fundamentals of clinical Chemistry and molecular diagnostics, Elsevier, Philadelphia.
4. Tortora G.J. & Derrickson B., 2016. Principles of Anatomy and Physiology, John Wiley and Sons, Inc. 1232 PP.
5. Agarwal R.A., Anil K. Srivastava., Kaushal Kumar., 1978. Animal Physiology and Biochemistry, S. Chand & Co. Ltd., New Delhi Publishing., 377PP.
6. Abhijit Dutta, 2009. Experimental biology: A Laboratory Science, Narosa, New Delhi.
7. Michael, P., 1984. Ecological Methods for field visit and laboratory investigation. Tata McGraw Hill, New Delhi.
8. APHA, 1992. Standard Methods for the examination of water and wastewater, American Public Health association, Washington D.C.

Books for References:

1. Hoar, W.S. 1983. General and Comparative Physiology. Prentice Hall of India, New Delhi., 928 PP.
2. Prosser C.L., 1985. Comparative Animal Physiology, Satish Book Enterprise, Agra-282003, 966PP.
3. Wood, D.W., 1968. Principles of Animal Physiology, Edward Arnold Ltd, London., 342 PP.
4. Guyton, A.C. and Hall, J.B., 2011. Text Book of Medical Physiology, 9th Edition, W.B. Saunders Company, Prism Books (Pvt.) Ltd., Bangalore., 1064PP.
5. Wilson, J.A. 1984, Principles of Animal Physiology, Macmillan Publishing., 426 PP.
6. Eugenia, 2008. Environmental Biotechnology and cleavers Bioprocesses, London.
7. Ramesh, R & M, Anbu 1996. Chemical methods for environmental Analysis of water and sediment. Macmillan India Limited, Chennai.
8. Sinha, J., Chatterjee, A.K. & Chattopadhyay, P. 2011. *Advanced Practical Zoology*, Books and Allied (P) Ltd. Kolkata, India.

Web Resources

1. <https://www.youtube.com/watch?v=ZXRckDpJM7Y>
2. https://www.medicinenet.com/alp_test/article.htm
3. <https://vlab.amrita.edu/?sub=3&brch=63>
4. <https://www.asbmb.org/education/online-teaching/online-lab-work>
5. <https://open.umn.edu/opentextbooks/textbooks/687>
6. <https://bit.ly/3lO29yP>

Rationale for Nature of the course

This course will help the students to acquire skills on the methods to study genetics, evolutionary biology, Animal Physiology and wildlife conservation. They also get the enriched field knowledge on the latest developments in the above said field. The knowledge acquired on the modern methods and practice will help them for their higher studies, research and other areas of applications.

Activities having direct bearing on Skill development / Employability

The practical knowledge acquired by learn-by-doing method individually and as a group will help them for their skill development. The problem solving methods and discussion on the specific topics through minor experiments and spotters will also enrich the skills of students.

Pedagogy

Practicals, Chalk and Talk, PPT, group discussion, interaction, tutorial and virtual labs.

Course Designer: Dr. R. Eswaran

Course Schedule (45 hours)

Cycle	Topics	Hrs	Mode
1	Digestive Enzymes: Counting of cockroach haemocytes using haemocytometer./ Amylase activity in relation to temperature in human saliva.	3	Practicals, observation and discussion
2	Oxygen consumption of fish in relation to body weight	3	
3	qualitative analysis of Nitrogenous waste products- Ammonia, urea and uric acid. Sphygmomanometer, Kymograph, ECG	3	
4	Mounting of Polytene chromosomes, Fingerprints in human population	3	
5	Verification of Mendelian monohybrid experiment using beads	3	
6	Twins, Mendelian traits in man, Sickle cell anemia, Klinefelter's syndrome, Turner and Down syndrome	3	
7	Study on types of fossils- Evolutionary importance of <i>Peripatus</i> and <i>Limulus</i>	3	
8	Problems on Hardy-Weinberg Law	3	
9	Darwing Finches, <i>Archaeopteryx</i> , Vestigial organ in man	3	Practicals, observation and discussion, Field and institutional Visits
10	Study of arthropods of water / soil samples	3	
11	Collection, isolation, identification and mounting of marine and freshwater plankton	3	
12	Study of sandy shore fauna-Study of rocky shore fauna	3	
13	River conservation	3	
14	Pitfall trap, Light trap, Red data book, Ecological pyramids	3	
15	Field Visit /Institutional visits*	3	

*Field Visit /Institutional visits will be arranged in a convenient date

Course Learning Outcomes:

On successful completion of the course, the students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Discuss the Physiological process and biomolecules involve in the physiological activity	Up to K2
CLO-2	Verify the principles of genetics and the techniques used for the genetical study	Up to K3
CLO-3	Determine the evolutionary evidences to understand the process of evolution	Up to K3
CLO-4	Analyze the methods and techniques involved for the biodiversity and conservation.	Up to K4
CLO-5	Explore the knowledge on latest developments in the field of genetics, evolutionary biology, Animal Physiology and wildlife conservation.	Up to K4

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

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

Advance application– 3;

Intermediate level–2;

Basic level–1

DEPARTMENT OF ZOOLOGY				CLASS: III B.Sc. Zoology				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
V	CORE	23U5ZDET1	Animal behavior and Reproductive biology	4	5	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented		Entrepreneurship Oriented	

Course Objectives

By the end of the course, students will be able:

1. To understand the biological properties of animal behavior, with an evolutionary and ecological emphasis.
2. To compare innate and learned behavior and differentiate between various mating system and impart the knowledge social behavior and social systems; and animal personality
3. To enable students to learn about the female reproductive system and regulation of its function and enable students to comprehend about fertilization, pregnancy, parturition and lactation.
4. To equip students with knowledge on causes of infertility, reproductive health, assisted reproductive technology and associated ethical issues

Unit	Description	Hours	K-level	CLO
I	Evolution and Social Behaviour: Sexual selection, Altruism- Types of Altruism, Sexual strategy and social organization- (monogamy, Polygamy), Visual adaptations to unfavourable environments. Animal and the Environment: Homeostasis and Behaviour:- Thermoregulatory Behaviour, Foraging Behaviour, Animal Learning:- Types of animal Learning (Classical Conditioning, Trial and Error Learning) Conditioning and Learning:- Types of Conditioning, Decision-Making and Adaptation	15	Up to K2	1
II	Understanding Complex Behaviour, Decision making behaviour in Animals; Factors Influencing Decision-Making in Animals, Complex behaviour of honey bees - "waggle dance", non-verbal communication in humans, mental images, Intelligence, tool use and culture. Chronobiology: Biological rhythms-circadian, tidal, lunar, circannual, Dysfunction of biological Clock	15	Up to K3	2
III	Male and Female Reproductive Systems: Male Reproductive system-Testis, Spermatogenesis, Cellular function; Sperm transportation in male tract; Andropause.	15	Up to K3	3

	Female Reproductive system- Ovary, oogenesis, and its hormonal regulation; Reproductive cycles and their regulation, changes in the female tract; Menopause.			
IV	Gamete Transport, Fertilization, Gestation, and Reproductive Health Ovum transport in the fallopian tubes; Sperm transport in the female tract, Fertilization; Hormonal control of implantation; Hormonal regulation of gestation. pregnancy diagnosis (urine test, HCG), foeto – maternal relationship; Lactation and its regulation Infertility in male and female: causes, diagnosis and management; Sexually transmitted Infections- Human Papillomavirus (HPV) and Gonorrhea. syphilis	15	Up to K4	4
V	Modern Reproductive Technology: Sperm banks, frozen embryos, Stem Cell banks, in vitro fertilization, test tube baby, ET, EFT, IUT, ZIFT, GIFT, ICSI, PROST; ethical issues related to ART; Surrogate motherhood; Fetal Loss and Birth Defects ; (cleft lip)	15	Up to K4	5

Books for Study:

1. Ghosh, S.K. 2004 *Animal Behaviour* Kalyani Publishers,
2. Singh, B. D. ,2002 *Evolutionary Biology*, S. Chand & Company.
3. Verma P.S. and Agarwal, V.K. 2004 *Ecology of Animal Behaviour*, S. Chand & Company.
4. Ghosh S. K., 2012. *Biological Rhythms and Chronotherapy*, Oxford University Press.
5. Gopalan, V. R. 2013. *Chronobiology: Understanding Biological Clocks*, Cambridge University Press.
6. Jain, V.K., 2009. *Human Physiology: Reproductive System* S. Chand & Company.
7. Jain, V.K., 2009. *Medical Physiology*, Elsevier India,
8. David McFarland, 1985. *Animal Behaviour*, Longman Scientific & Technical, UK.576pp.
9. Harjindra Singh,1990. *Text Book of Animal Behaviour*, Anomol Publication, 293pp.
10. Hoshang S. Gundevia and Hare Govind Singh, 1996. *Animal Behaviour*, S. Chand & Co, 280pp.
11. Shukla, J. P 2010, *Fundamentals of Animal Behaviour*, Atlantic, 587pp.
12. . Vinod Kumar, 2002. *Biological Rhythms*. Narosa Publishing House, Delhi.

Books for References:

1. Cassan, A. 2005. *Human reproduction and Development (Inside the Human Body)*. New York: Chelsea Clubhouse
2. Gardner, D. K.2006. *In vitro Fertilization: A Practical Approach*. CRC Press.
3. Guyton and Hall,2018. *Essentials of Human Physiology* ,Elsevier, 2018
4. Rajan, K.S. *Cognitive Science:2009. A Philosophical Introduction*, Sage Publications,
5. Kumar S. 2012., *Human and Animal Communication*, Alfred Publishing.

6. Michael D. Breed and Janice Moore, 2012. Animal Behaviour, Academic Press, USA, 359pp
7. Aubrey Manning and Martin Stamp Dawkins, 2012. An Introduction to Animal Behaviour, 6th Edition, Cambridge University Press, UK. 458pp.
8. Davis E. Davis, 1970. Integral Animal Behaviour, Mac Millan Company, London, 118pp.
9. Jay, C. Dunlap, Jennifer, J. Loros, Patricia J. De Coursey (ed). 2004. Chronobiology Biological time Keeping, Sinauer Associates Inc, Publishers, Sunderland, MA.
10. Johnson, M. H. 2018. Essential Reproduction. New Jersey: Wiley-Blackwell.
11. Jones, R.E. 2013. Human Reproductive Biology. Amsterdam :Elsevier.
12. Neill, Jimmy D. ed 2006. Knobil and Neill's Physiology of Reproduction. Volume I. Third edn. Elsevier Academic Press.
13. Pinon, R. 2003. Biology of Human Reproduction. California: University Science Books

Web Resources

1. <https://www.ncbs.res.in/content/animal-behaviour>
2. <https://bit.ly/3i6wUxR>
3. <https://www.behaviour.univie.ac.at/>
4. <https://www.ru.nl/bsi/>

Rationale for Nature of the course

The course provides a comprehensive understanding of evolutionary and social behavior, animal perception, and cognitive learning, offering students insights into complex behavioral patterns that can inform careers in research, psychology, and behavioral sciences.

The exploration of ethical issues surrounding assisted reproductive technologies, non-verbal communication, and decision-making behavior fosters critical thinking and prepares students for entrepreneurial opportunities in the medical, research, and ethical consulting sectors.

Activities having direct bearing on Skill development / Employability Entrepreneurship

The acquired knowledge on age-associated physiological changes in the reproductive tract will help the students for developing the skills Knowledge of reproductive technology, infertility treatments, and ethical considerations can provide an entrepreneurial edge in medical fields, encouraging the development of clinics, health services, or consultancy businesses focusing on reproductive health. which further paves the way for their employability.

Pedagogy

Chalk and Talk, PPT, group discussion, seminar, interaction, quiz, tutorial and virtual labs.

Course Designer: Dr. P. Sivakumar

Course Schedule (75 hours)

Unit	Topics	Hrs	Mode
Unit I	Sexual selection, Decision-Making and Adaptation	2	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Altruism- Types of Altruism	2	
	Sexual strategy and social organization- (monogamy, Polygamy)	2	
	Visual adaptations to unfavorable environments.	2	
	Homeostasis and Behaviour - Thermoregulatory Behaviour, Foraging Behaviour	2	
	Types of animal Learning (Classical Conditioning, Trial and Error Learning	2	
	Types of Conditioning, Decision-Making and Adaptation	3	
Unit II	Decision making behaviour in Animals	2	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Factors Influencing Decision-Making in Animals	3	
	Complex behaviour of honey bees - "waggle dance"	2	
	non-verbal communication in humans, mental images, Intelligence, tool use and culture.	3	
	Chronobiology: Biological rhythms-circadian, tidal, lunar, circannual	3	
	Dysfunction of biological Clock	2	
Unit III	Male Reproductive system-Testis	2	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Spermatogenesis	2	
	Cellular function; Sperm transportation in male tract; Andropause.	3	
	Female Reproductive system- Ovary	2	
	Oogenesis, and its hormonal regulation	2	
	Reproductive cycles and their regulation,	2	
	changes in the female tract; Menopause.	2	
Unit IV	Ovum transport in the fallopian tubes; Sperm transport in the female tract	2	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Fertilization; Hormonal control of implantation; Hormonal regulation of gestation.	3	
	pregnancy diagnosis (urine test, HCG), foeto – maternal relationship	4	
	Lactation and its regulation Infertility in male and female: causes, diagnosis and management	3	
	Sexually transmitted Infections- Human Papillomavirus (HPV) and Gonorrhea. Syphilis.	3	

Unit V	Sperm banks, frozen embryos, Stem Cell banks	2	Chalk and talk, ppt, group discussion, quiz, seminar & Assignment
	in vitro fertilization, test tube baby	2	
	ET, EFT, IUT, ZIFT, GIFT, ICSI, PROST	5	
	ethical issues related to ART	2	
	Surrogate motherhood	2	
	Fetal Loss and Birth Defect (cleft lip)	2	

Course Learning Outcomes:

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

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Recall and understand the genetic basis and evolutionary history of animal behaviour.	Up to K3
CLO-2	Describe and identify innate, learned and cognitive behavior	Up to K3
CLO-3	Discuss structural and functional aspect of male and female reproductive system.	Up to K3
CLO-4	Analyse the role of hormones and hormonal regulations in reproductive health	Up to K4
CLO-5	Examine the different modern assisted reproductive techniques and its ethical issues related to ART.	Up to K4

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

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

Advance application- 3;

Intermediate level-2;

Basic level-1

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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 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 K4	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	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 ZOOLOGY				CLASS: III B.Sc. Zoology				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
V	IDC	23U5ZIDCT	WILDLIFE CONSERVATION AND MANAGEMENT	4	5	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	

Course Objectives

By the end of the course, students will be able:

1. To understand and discuss the importance of wildlife, its values, modern concepts in wildlife management, and relevant conservation policies.
2. To assess and instill strong foundations on wildlife policies and be familiar with a variety of laws and regulations.
3. To analyse and design appropriate approaches to turn conflict into tolerance and coexistence, with an emphasis on the human dimensions of human-wildlife interactions.
4. To evaluate and integrate all the related areas like Fundamentals in Ecology, Forestry, Natural Resource Conservation approaches and develop the role PVA models for protection of Endangered species.
5. To explain the advanced scientific basis for wildlife management and discuss National and International Efforts for successful wildlife conservation.

Unit	Description	Hours	K-level	CLO
I	Biodiversity Extinction and Conservation Approaches: Identification and prioritization of Ecologically sensitive area (ESA). Coarse filter and fine filter approaches. Regional and National approaches for biodiversity conservation (Tribes in Periyar Tiger Reserve and Gujar at Chilla Wildlife Sanctuary).	15	Up to K2	1
II	Theory and Analysis of Conservation of Populations: Stochastic perturbations - Environmental, Demographic, spatial and genetic stochasticity. Population viability analysis-conceptual foundation, uses of PVA models. Management Decisions for small populations using PVA models. Minimum viable populations & recovery strategies for threatened species (Gangetic Dolphin).	15	Up to K3	2
III	National and International Efforts for Conservation: International agreements for conserving marine life, Convention on wetlands of International Importance (Ramsar convention), Conservation of Natural Resources. Overview of conservation of Forest & Grassland resources. CITES, IUCN, CBD, National Forest Policy, 1988, National Wildlife Action Plan 2017-2031, Wildlife Protection Act 1972, National and State Biodiversity Action Plans and other Forests and Environmental Acts.	15	Up to K3	3

IV	Wildlife in India: Wildlife wealth of India & threatened wildlife, Reasons for wildlife depletion in India, Wildlife conservation approaches and limitations. Wild life Habitat: Characteristic, Fauna and Adaptation with special reference to Tropical Forest. Protected Area concept: National Parks, Sanctuaries and Biosphere Reserves, cores and Buffers, Nodes and corridors. Community Reserve and conservation Reserves.	15	Up to K4	4
V	Management of Wildlife: Distribution, status. Habitat utilization pattern, threats to survival of Slender Loris, Musk deer, Great Indian Bustard, Olive Ridley turtle. Wildlife Trade & legislation, Assessment, documentation, Prevention of trade, Wild life laws and ethics.	15	Up to K4	5

Books for Study:

1. Robinson, W.L. and Eric, G. Bolen, 1984. Wildlife Ecology and Management, Maxmillan Publishing Company, New York, p 478.
2. Aaron, N.M. 1973 Wildlife ecology, W.H. Freeman Co. San Francisco, U.S.A.
3. Dasmann, R. F, 1964. Wildlife Biology, John Wiley & Sons, New York, p 231.
4. Justice Kuldeep Singh 1998. Handbook of Environment, Forest and Wildlife Protection Laws in India, Natraj Publishers, Dehradun.
5. Hosetti, B.B. 1997 Concepts in Wildlife Management, Daya Publishing House, Delhi.
6. Sutherland, W.J 2000. The conservation handbook: Research, Management and Policy. Blackwell Science.
7. Caughley, G and Sinclair, A.R.E. 1994 Wildlife ecology and management. Blackwell Science.
8. Woodroffe R, Thirgood, S. and Rabinowitz A. 2005. People and Wildlife, Conflict or Co existence? Cambridge University.
9. Sinha, P.C. 1998. Wildlife and Forest Conservation, Anmol Publishing Pvt. Ltd., New Delhi.
10. Singh, S.K. 2005. Text Book of Wildlife Management. IBDC, Lucknow.

Books for References:

1. Gilas, R.H Jr.(ed.), 1984. Wildlife Management Techniques, 3rd ed. The Wildlife Society, Washington D.C., Nataraj Publishers, Dehra Dun, p 547.
2. Rodgers, W.A, 1991. Techniques for Wildlife Census in India - A Field Manual: Technical Manual - T M - 2. WII.
3. Saharia, V.B. 1982. Wildlife of India, Natraj Publishers, Dehra Dun.
4. Goutam Kumar Saha and Subhendu Mazumdar, 2017. Wildlife Biology: An Indian Prospective, PHI Publisher, Delhi.
5. Katwal/Banerjee, 2002. Biodiversity conservation in managed and protected areas, Agrobios, India.
6. Gopal, Rajesh, 1992. Fundamentals of Wildlife Management, Justice Home, Allahabad, India.

7. Sharma, B.D, 1999. Indian Wildlife Resources Ecology and Development, Daya Publishing House, Delhi.
8. Stephen, H.B. and V.B. Saharia,1995. Wildlife research and management. Asian and American Approaches, Oxford University Press, Delhi.
9. Negi, S.S. 1993. Biodiversity and its conservation in India, Indus Publishing Co., New Delhi.
10. Moulton, M. P. & J. Sanderson, 1997. Wildlife Issues in a Changing World. St. Lucie Press.

Web Resources

1. <https://bit.ly/39oPj44>
2. <https://bit.ly/3lHdEYJ>
3. <https://bit.ly/3CwBCfY>
4. <https://bit.ly/3EDYr3a>
5. <https://bit.ly/3tVtG4U>

Rationale for Nature of the course

This course will enable the students to comprehend the knowledge on wildlife conservation and management. Students will learn the conservation approaches and significance of biodiversity. Students will also acquire knowledge on biodiversity, national and international efforts for conservation and wildlife management.

Activities having direct bearing on Skill development / Employability Entrepreneurship

The acquired knowledge on wildlife conservation and management will help the students for developing the skills in approaches and efforts of conservation, Indian wildlife and wildlife management which further paves the way for their higher studies.

Pedagogy

Chalk and Talk, PPT, group discussion, seminar, interaction, quiz, tutorial and virtual labs.

Course Designer: Dr. C. Selvakumar

Course Schedule (75 hours)

Unit	Topics	Hrs	Mode
Unit I	Perspectives and Expressions.	3	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Identification Ecologically sensitive area.	2	
	Prioritization of Ecologically sensitive area.	2	
	Coarse filter approaches.	2	
	Fine filter approaches.	2	
	Regional approaches for biodiversity conservation.	1	
	National approaches for biodiversity conservation (Tribes in Periyar Tiger Reserve and Gujar at Chilla Wildlife Sanctuary).	3	
Unit II	Stochastic perturbations - Environmental, Demographic, spatial and genetic stochasticity	4	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Population viability analysis-conceptual foundation	3	
	Uses of PVA models.	2	
	Management Decisions for small populations using PVA models.	2	
	Minimum viable populations	2	
	Recovery strategies for threatened species (Gangetic Dolphin).	2	
Unit III	International agreements for conserving marine life	2	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Convention on wetlands of International Importance (Ramsar convention)	2	
	Conservation of Natural Resources.	2	
	Overview of conservation of Forest & Grassland resources.	2	
	CITES, IUCN, CBD National Forest Policy, 1988	3	
	National Wildlife Action Plan 2017-2031	1	
	Wildlife Protection Act 1972,	1	
	National and State Biodiversity Action Plans and other Forests and Environmental Acts.	2	
Unit IV	Wildlife wealth of India & threatened wildlife	2	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Reasons for wildlife depletion in India	1	
	Wildlife conservation approaches and limitations	2	
	Wild life Habitat: Characteristic, Fauna and	3	

	Adaptation with special reference to Tropical Forest		
	Protected Area concept: National Parks, Sanctuaries and Biosphere Reserves, cores and Buffers	4	
	Nodes and corridors	1	
	Community Reserve and conservation Reserves.	2	
Unit V	Management of Wildlife: Distribution, status.	2	Chalk and talk, ppt, group discussion, quiz, seminar & Assignment
	Habitat utilization pattern,	2	
	Threats to survival of Slender Loris, Musk deer, Great Indian Bustard, Olive Ridley turtle.	4	
	Wildlife Trade & legislation	2	
	Assessment, documentation, Prevention of trade	3	
	Wild life laws and ethics	2	

Course Learning Outcomes:

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

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Understand and recall the importance of wildlife, extinction and Conservation Approaches of wildlife.	Up to K2
CLO-2	Explain the theory and analysis of conservation of populations and role Population Viability Analysis (PVA) models	Up to K3
CLO-3	Integrate and assess the National and International approaches for biodiversity conservation.	Up to K3
CLO-4	Analyze and differentiate threats to wildlife, various action plans, conservation strategies on wildlife of India to turn conflict into tolerance and coexistence.	Up to K4
CLO-5	Construct and simulate National and International strategies for Conservation, Wild life laws and ethics.	Up to K4

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

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

Advance application– 3;

Intermediate level–2;

Basic level–1

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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 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 K4	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	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 ZOOLOGY					CLASS: III B.Sc.,			
Sem.	Course type	Course code	Course title	Credits	Contact hours/ week	CIA	Ext	Total
V	Internship	23U5ZINTR	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 ZOOLOGY				CLASS: III B.Sc. Zoology				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
VI	CORE	23U6ZCCT8	MICROBIOLOGY	4	6	25	75	100
Nature of Course								
Skill Oriented		✓	Employability Oriented		✓	Entrepreneurship Oriented		

Course Objectives

By the end of the course, students will be able:

1. To become familiar with the concepts of history and scope of Microbiology.
2. To understand the structure and working mechanism of microbial cells.
3. To learn the manipulation techniques of microbes, staining methodologies and safety disposals.
4. To encourage and motivate the students and make them to grasp and implement the biological significance, beneficiary aspects in the current research and medical field.

Unit	Description	Hours	K-level	CLO
I	Introduction to microbiology History and Scope of microbiology. Contribution of Leeuwenhoek- Edward Jenner, Louis Pasteur, Robert Koch, Alexander Fleming, Subba Rao, Sambhu Nath De. Evolution of Microbial diversity. Systematic position: Five kingdom classification of Whittaker. Control of Microorganisms. Types of Microscopes: Fluorescent and Confocal.	18	Up to K2	1
II	Introduction to Bacteriology & Microbial techniques Classification of bacteria, Structure of bacteria, Nucleoid, Plasmid, bacterial respiration, Nutritional types, Bacterial growth, growth rate, growth curve, Preparation of culture medium, Culture techniques- Batch culture and Continuous culture, culture of <i>E.coli</i> - Plate culture, Differential culture, Isolation and purification Techniques of Pure culture - Streak plate method, pour plate method and spread plate method, Types of staining- simple staining and gram staining. Economic importance of bacteria.	18	Up to K3	2
III	Introduction to Mycology General characteristics and outline classification of fungi, Morphology of some common fungi. Penicillium, Rhizopus and Aspergillus. Economic importance of fungi. Yeasts: General Characteristics and outline classification of yeasts - Lichens and Mycorrhiza.	18	Up to K3	3

IV	Introduction to Virology Virus Structure and Classification. Virus Entry and Viral Pathogenesis. DNA Viruses: Adeno viruses, Herpes viruses and Poxviruses. Positive-strand RNA Viruses: Picorna viruses, Corona virus and Dengue virus. Negative-strand RNA Viruses: Paramyxo viruses and Filo viruses. Bacterial Viruses - Virions, Viroids, Prions,	18	Up to K4	4
V	Medical Microbiology- Causative organisms, Mode of transmission, pathogenicity, symptoms and prevention, control and treatment. Bacterial Diseases - Diphtheria, Typhoid fever, Tuberculosis and Cholera - Viral Diseases- small pox, measles, common cold, Rabies. Fungal diseases -Dandruff and candidiasis.	18	Up to K4	5

Books for Study:

1. Aneja K.R., Experiments in Microbiology, plant pathology, Tissue culture and Mushroom Cultivation, New Age International, New Delhi.
2. Arumugam, N, Mani, A., Narayanan, L.M., Fatima,D. & Selvaraj, A.M 2015.
3. Atlas R.M., Microbiology – fundamentals and applications, Macmillan Publishing Company, New York.
4. Dubey, R.C.& Maheswari, D. K,2013, A textbook of Microbiology, S. Chand Publications, New Delhi.
5. Ravindra Nath, Fundamentals of Biology Courses for Biotechnology, - Vol.1, Special Bangalore University edition, Kalayani Publishers.
6. Greenwood D, Richard CD, John S and Peuther F (1992). Medical Microbiology, 16th edition. ELBS, Churchill.

Reference Books

1. Alexopoulos C. J.and Mims, C. W., Introductory Mycology, New Age International, New Delhi.
2. Benson Harold J, Microbiological Applications, WCB McGraw – Hill, New York.
3. Brock T.D. and Madigan M.T., Biology of Microorganisms, Prentice Hall of India Private Limited.
4. Collins CH, Patricia M, and Lyne JM (1995). Collins and Lynes Microbiological Methods 7th edition. Grange, Butter Worth, Oxford
5. Cappucino JG and Sherman N (1996). Microbiology, A Laboratory Manual 4th edition. Benjamin Cumings Inc. California.
6. Thomas M. Bell, 1965. An Introduction to General Virology, William Heinemann Medical books, London
7. Stanier R.Y., Ingraham J.L., General Microbiology, Prentice Hall of India Private Limited, New Delhi.
8. Salle A.J., Fundamental Principles of Bacteriology, Tata McGraw – Hill Publishing

Company Limited, New Delhi.

9. Pelczar J. Chan E.C.S. and Krieg N.R., Microbiology, McGraw Hill Book Company, New York.

Rationale for Nature of the course

This course will enable the students to grasp the theories concepts, scope of Microbiology, significance of microbe, Synthesis of enzymes, mechanism of enzyme action, drugs and impart knowledge in food preservation

Activities having direct bearing on Skill development / Employability Entrepreneurship

Embedding knowledge on the basic and advanced concepts of Microbiology adorns the overall understanding and which creates the interest in doing research activities in this field and provide Job opportunities in medical industries.

Course Designer: Dr. B. Latha

Course Schedule (90 hours)

Unit	Topics	Hrs	Mode
Unit I	History and Scope of microbiology.	2	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Contribution of Leeuwenhoek- Edward Jenner, Louis Pasteur, Robert Koch, Alexander Fleming, Subba Rao, Sambhu Nath De.	4	
	Evolution of Microbial diversity. Systematic position:	4	
	Five kingdom classification of Whittaker.	2	
	Control of Microorganisms.	3	
	Types of Microscopes: Fluorescent and Confocal.	3	
Unit II	Classification of bacteria,	2	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Structure of bacteria, Nucleoid, Plasmid	3	
	bacterial respiration, Nutritional types, Bacterial growth, growth rate, growth curve	3	
	Preparation of culture medium, Culture techniques- Batch culture and Continuous culture, culture of <i>E. coli</i> - Plate culture, Differential culture	2	
	Isolation and purification Techniques of Pure culture - Streak plate method, pour plate method and spread plate method,	4	
	Types of staining- simple staining and gram staining.	2	
	Economic importance of bacteria	2	
Unit III	General characteristics and outline classification of fungi	4	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Morphology of some common fungi. Penicillium	4	
	Rhizopus and Aspergillus	2	
	Economic importance of fungi	2	
	Yeasts: General Characteristics and outline classification of yeasts	3	
	Lichens and Mycorrhiza	3	
Unit IV	Virus Structure and Classification.	3	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Virus Entry and Viral Pathogenesis.	3	
	DNA Viruses: Adeno viruses, Herpes viruses, Poxviruses	3	
	Positive-strand RNA Viruses: Picorna viruses, Corona virus, Dengue virus	3	
	Negative-strand RNA Viruses: Paramyxo viruses, Filo viruses	3	
	Bacterial Viruses - Virions, Viroids, Prions	3	

Unit V	Causative organisms, Mode of transmission, pathogenicity, symptoms and prevention, control and treatment. Bacterial Diseases - Diphtheria, Typhoid fever, Tuberculosis and Cholera	6	Chalk and talk, ppt, group discussion, quiz, seminar & Assignment
	Causative organisms, Mode of transmission, pathogenicity, symptoms and prevention, control and treatment. Viral Diseases- small pox, measles, common cold, Rabies.	6	
	Causative organisms, Mode of transmission, pathogenicity, symptoms and prevention, control and treatment. Fungal diseases -Dandruff and candidiasis.	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 history, concepts, and working of various microscopes and their applications.	Up to K2
CLO-2	Apply the knowledge in preparing and maintaining the cultures and purification techniques.	Up to K3
CLO-3	Analyze the characteristics, classification and importance of Fungi and Yeasts.	Up to K3
CLO-4	Examine the medical significance of viruses, including their RNA and DNA types, and classification.	Up to K4
CLO-5	Analyze the pathogenicity of causative organisms, including the mode of transmission, pathogenic mechanisms, symptoms, and methods of prevention, control, and treatment for bacterial, fungal and viral infections.	Up to K5

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

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

Advance application– 3;

Intermediate level–2;

Basic level–1

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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 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 K4	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	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 ZOOLOGY				CLASS: III B.Sc. Zoology				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
VI	CORE	23U6ZCCT9	ENVIRONMENTAL BIOLOGY	4	6	25	75	100
Nature of Course								
Skill Oriented		✓	Employability Oriented		Entrepreneurship Oriented			

Course Objectives

By the end of the course, students will be able:

1. To understand the structure and functions of the ecosystem.
2. To Compare innate and learned behavior and differentiate between various mating systems
3. To explain the relationship between biotic and abiotic factors in an ecosystem.
4. To know the causes and effects of climate change and habitat loss.
5. To bring awareness about the impact of socio-economic development on the environment and the solutions put forward by the government to reduce environmental damage.

Unit	Description	Hours	K-level	CLO
I	Ecosystem: Concept of an ecosystem-Structure and function of an ecosystem- Producers, consumers and decomposers, Food chain, food webs, and ecological pyramids. Energy flow in the ecosystem-Ecological succession. Introduction, types, characteristic features, structure and function of the following ecosystem: Forest ecosystem, Aquatic ecosystems (ponds).	18	Up to K2	1
II	Population Ecology And Biological Cycles: Structure and distribution – Growth curves - Groups, natality, Mortality - Density indices, factors affecting population growth. Population regulation and human population control. Complete and incomplete biogeochemical cycles - Sedimentary cycle.	18	Up to K3	2
III	Environmental Stresses and Management: Global climatic pattern, global warming- Greenhouse effect. Atmospheric ozone, acid rain and nitrogen deposition. Uptake, biotransformation, elimination and accumulation of toxicants. Factors influencing bioaccumulation from food and trophic transfer. Biodegradation and bioremediation of chemicals	18	Up to K3	3
IV	Environmental Pollution: Definition- cause, effects and control measures of: -Air pollution - Water pollution -Soil pollution - Thermal pollution -Nuclear hazards.	18	Up to K4	4
V	Biodiversity Conservation: Biodiversity crisis – habitat degradation, poaching of wild life. - political causes of loss of biodiversity. - In situ and ex situ conservation of biodiversity -Hot spots of Biodiversity. Green peace movement - Chipko Movement - Role of government agencies: Central and State Pollution Control Boards - Ministry of Environment and Forests- National Biodiversity Authority.	18	Up to K4	5

Books for Study:

- 1) Matthew R. Fisher, 2018. Environmental Biology. Open Oregon Educational Resources. James Madison University.
- 2) Asthana, D.K. and Meera, A. 2009. A text book of environmental studies, S. Chand, New Delhi
- 3) Sanyal, K. Kundu, M. and Rana, S. 2009. Ecology and environment, Books and allied, Kolkata.
- 4) Grant, W.E. and Swannack, T.M., 2008, Ecological Modelling, Blackwell.

Books for References:

- 1) Odum E.P.1983. Basic Ecology, Saunders, New York
- 2) Wilkinson, D.M., 2007, Fundamental Processes in Ecology: An Earth system Approach, Oxford University Press, UK.
- 3) Saha, T.K. 2010. Ecology and Environmental biology, Books and Allied, Kolkata.

Web Resources

1. <https://bit.ly/2VYWOM5>
2. <https://bit.ly/2VZQFiT>
3. <https://bit.ly/3kqdXYA>
4. <https://bit.ly/39rvvgt>

Rationale for Nature of the course

The course provides a comprehensive understanding of ecosystems, emphasizing their structure, function, and the intricate relationships between producers, consumers, and decomposers, as well as energy flow, ecological succession, and biodiversity conservation. It explores population dynamics, biological cycles, and environmental stresses, including pollution and climate change, to highlight their impact on ecological balance and human well-being. Additionally, the course integrates management strategies such as bioremediation, biodiversity conservation, and environmental policies, equipping students with the knowledge to address contemporary environmental challenges effectively.

Activities having direct bearing on Skill development / Employability Entrepreneurship

The course equips students with practical skills in environmental monitoring, pollution control, and biodiversity conservation, which are essential for careers in environmental consultancy, sustainability management, and ecological research. Additionally, the curriculum promotes entrepreneurship by encouraging sustainable business practices, such as eco-friendly agriculture, waste management solutions, and conservation-based enterprises, fostering innovation in environmental sustainability.

Pedagogy

Chalk and Talk, PPT, group discussion, seminar, interaction, quiz, tutorial and virtual labs.

Course Designer: Dr. P. Sivakumar

Course Schedule (90 hours)

Unit	Topics	Hrs	Mode
Unit I	Ecosystem: Concept of an ecosystem-Structure and function of an ecosystem- Producers, consumers and decomposers,	4	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Food chain, food webs, and ecological pyramids.	3	
	Energy flow in the ecosystem-Ecological succession.	4	
	Introduction, types, characteristic features, structure and function of the following ecosystem: Forest ecosystem,	4	
	Aquatic ecosystems (ponds).	3	
Unit II	Population And Biological Cycles : Structure and distribution Population Ecology And Biological Cycles: Structure and distribution	4	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Growth curves - Groups, natality, Mortality -Density indices,	4	
	factors affecting population growth. Population regulation and human population control.	6	
	Complete and incomplete biogeochemical cycles - Sedimentary cycle.	4	
Unit III	Environmental Stresses and Management: Global climatic pattern,	3	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	global warming- Greenhouse effect. Atmospheric ozone, acid rain and nitrogen deposition.	4	
	Uptake, biotransformation, elimination and accumulation of toxicants.	4	
	Factors influencing bioaccumulation from food and trophic transfer.	4	
	Biodegradation and bioremediation of chemicals	3	
Unit IV	Environmental Pollution: Definition- cause, effects and control measures of: -Air pollution.	3	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Water pollution	5	
	Soil pollution	5	
	Thermal pollution	2	
	Nuclear hazards	3	
Unit V	Biodiversity Conservation: Biodiversity crisis – habitat degradation, poaching of wild life. -	4	Chalk and talk, ppt, group discussion, quiz, seminar & Assignment
	Political causes of loss of biodiversity	3	
	In situ and ex situ conservation of biodiversity	3	
	Hot spots of Biodiversity.	2	
	Green peace movement - Chipko Movement	2	
	Role of government agencies: Central and State Pollution Control Boards Ministry of Environment and Forests- National Biodiversity Authority.	4	

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 fundamental structure and functions of the ecosystem	Up to K3
CLO-2	Assess the inter-relationship between organisms and between biotic and abiotic factors in an ecosystem	Up to K3
CLO-3	Evaluate the impact of human population growth and socio-economic development on the structure and function of the ecosystem	Up to K3
CLO-4	Analyze the types of pollution, its impact in the ecosystem and its control measures.	Up to K4
CLO-5	Examine the loss of biodiversity and role of Central and State government agencies in biodiversity conservation.	Up to K4

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

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

Advance application– 3;

Intermediate level–2;

Basic level–1

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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 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 K4	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	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 ZOOLOGY				CLASS: III B.Sc. Zoology				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
VI	CORE	23U6ZCCT10	BIOTECHNOLOGY	4	6	25	75	100
Nature of Course								
Skill Oriented		✓	Employability Oriented		✓	Entrepreneurship Oriented		

Course Objectives

By the end of the course, students will be able:

1. To understand the fundamentals of Biotechnology and Biotechnological techniques.
2. To impart the skills required to explain the protocols for genetically manipulating cells and produce transgenic animals.
3. To encourage the use of the apt molecular techniques to evaluate and analyze animal traits and diseases at the genomic level and employ methods for easy taxonomical identification and classification for biodiversity and environmental studies.
4. To study methods of transgenesis and to consider their use in improving animal husbandry and animal health.
5. To motivate students to review the ethics and speculate on the environmental implications of animal biotechnological methods

Unit	Description	Hours	K-level	CLO
I	Fundamentals of Biotechnology: r-DNA technology: Restriction Enzymes; Vectors – pBR322, Phage lambda, Cosmid, HAC, BAC, YAC; Gene cloning: steps in cloning, selection of clones – chromogenic substrate, antibiotics. Animal cell culture: Basic requirements and techniques of cell culture, natural and synthetic culture media, primary culture and cell lines; Stem cells: types, culture and applications.	18	Up to K2	1
II	Techniques in Animal Biotechnology: Isolation and purification: DNA; Blotting techniques: Methods of different types of blotting; DNA sequencing: Sanger method, DNA chips, microarray; PCR: principle, types and application; Gene library: screening with probes; Site directed mutagenesis: principle and application; Gene transfer in animal cells: transfection, viral mediated, electroporation, biolistic, direct DNA injection.	18	Up to K3	2
III	Transgenic Animal Technology: Transgenesis: Concept, transgenes, transgenic animal models - sheep; Applications of transgenesis: Transgenic animals (fishes), transgenic live stocks, and animals as bioreactors.	18	Up to K3	3

IV	Animal Biotech and Health Care: Medical biotechnology- recombinant vaccines (hepatitis B), hormones – (insulin) DNA and diagnostic systems: (tuberculosis, AIDS), genetic diseases (Sickle cell anemia). Gene therapy: Ex-vivo and in-vivo, CRISPR gene editing. Molecular markers: RFLP, RAPD. DNA fingerprinting and application.	18	Up to K4	4
V	Applications and Ethics: Industrial biotechnology: Basic concepts of fermentation, bioreactor design, production of ethanol, vitamin (B12) and streptomycin; Ethics: Recent issues in animal biotechnology, Socio ethical problem and ethical implication.	18	Up to K4	5

Books for Study:

1. Singh B. D., 2015. Biotechnology: Expanding horizon, Kalyani publishers.
2. Sasidhara, R., 2015. Animal biotechnology, MJP publishers.
3. Dubey R. C., 2014. A text Book of Biotechnology, S. Chand & Co Ltd, Ram Nagar, New Delhi.
4. Dubey S. K., Bandana Ghosh, 2012. Fish biotechnology, Wisdom Press.
5. Dubey R.C., 2014. Advanced Biotechnology, S. Chand Publication.
6. Ruby, R.C., 2012. A text book of biotechnology, S. Chand Company, New Delhi.
7. Samba Murthy K., Ashutosh Kar., 2009. Pharmaceutical Biotechnology, New Age International (P) Ltd.
8. Ramdoss P., 2009. Animal Biotechnology- Recent concepts and developments, MJP publishers.
9. Satyanarayana U., 2008. Biotechnology, Books and Allied, Kolkata.
10. Ignacimuthu, S., 2008. Basic Biotechnology, Tata McGraw hill, New Delhi.
11. Rastogi S. C., 2007. Biotechnology: Principles and applications, Alpha Science publishers.
12. Ranga, M.M., 2003. Animal biotechnology, Agrobios, New Delhi.

Books for References:

1. Veer Bala Rastogi, 2016. Principles of Molecular biology, Medtech, Maine, USA.
2. Michael Crichton, 2014. Essentials of Biotechnology, Medtech, Maine, USA.
3. Godbey W.T., 2014. An Introduction to Biotechnology, Academic press, New York, USA.
4. Peters, P., 2009. Biotechnology – A guide to genetic engineering, WMC brown publisher, UK.
5. Ramawat, K.G and Shailey Goyal, 2009. Comprehensive biotechnology, S.Chand company, New Delhi, India.
6. Primrose S.B., R. M. Twyman and R. W. Old, 2001. Principles of gene manipulation, Wiley- Blackwell, UK.

7. Primrose S. B., 2001. Molecular Biotechnology, Panima Publishing Corporation, New Delhi, India.
8. Hames B.D. and Higgins S.J. 1995. Gene Probes: A Practical Approach, Oxford University Press, UK.

Web Resources

1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3612824/>
2. <https://www.isaaa.org/resources/publications/pocketk/40/default.asp>
3. <https://www.ncbi.nlm.nih.gov/books/NBK207574/>
4. <https://iopscience.iop.org/article/10.1088/1755-1315/492/1/012035/pdf>
5. <https://go.nature.com/3zAZmO9>

Rationale for Nature of the course

This course will enable the students to comprehend the knowledge on fundamentals and various Techniques of biotechnology. Students will learn the Animal cell culture, Techniques in Animal Biotechnology, Transgenic Animal Technology, Gene therapy and Molecular markers. Students will also acquire knowledge on applications of biotechnology and Ethics.

Activities having direct bearing on Skill development / Employability Entrepreneurship

The acquired knowledge on recent molecular techniques and their applications will help the students for developing the skills in biotechnology, which further paves the way for their employability and higher studies.

Pedagogy

Chalk and Talk, PPT, group discussion, seminar, interaction, quiz, tutorial and virtual labs.

Course Designer: Dr. C. Selvakumar

Course Schedule (90 hours)

Unit	Topics	Hrs	Mode
Unit I	r-DNA technology: Enzymes	3	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Vectors – pBR322, Phage lambda, Cosmid, HAC, BAC, YAC	2	
	Host cells	3	
	Gene cloning: steps in cloning, selection of clones – chromogenic substrate, antibiotics	2	
	Animal cell culture: Basic requirements and techniques of cell culture	4	
	Natural and synthetic culture media, primary culture and cell lines	1	
	Stem cells: types, culture and applications	3	
Unit II	Isolation and purification: DNA and mRNA	3	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Blotting techniques: Methods of different types of blotting	3	
	DNA sequencing: Sanger method, DNA chips, microarray	3	
	PCR: principle, types and application	2	
	Gene library: screening with probes	2	
	Site directed mutagenesis: principle and application	2	
	Gene transfer in animal cells: transfection, liposomal, viral mediated, electroporation, biolistic, direct DNA injection	3	
Unit III	Concept of Transgenesis	2	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Transgenes	2	
	Transgenic animal models - knock out mice, sheep	2	
	Applications of transgenesis	2	
	Molecular farming	3	
	Transgenic fishes	2	
	Transgenic live stocks	3	
	Animals as bioreactors.	2	
Unit IV	Monoclonal antibodies	2	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	recombinant vaccines –hepatitis B	2	
	hormones – insulin.	2	
	DNA diagnostic systems: tuberculosis, AIDS, genetic diseases	3	
	Gene therapy: Ex vivo and in vivo, role in cancer treatment	3	
	CRISPR gene editing	2	
	Molecular markers: RFLP, RAPD, DNA fingerprinting and application	4	

Unit V	Mapping of human genome, applications & ethics	4	Chalk and talk, ppt, group discussion, quiz, seminar & Assignment
	Bioreactors- Basic concepts of fermentation	2	
	Bioreactor design	2	
	Production of ethanol, vitamin (B12) and streptomycin	3	
	Ethics: Socio ethical problem	2	
	Recent trends in animal biotechnology	3	
	Ethical implications	2	

Course Learning Outcomes:

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

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Describe the methodologies for handling animal cells based on their diverse characteristics and identify the correct biotechnological tools to obtain the desired products from the cells.	Up to K2
CLO-2	Develop and explain the various techniques in Animal Biotechnology.	Up to K3
CLO-3	Explain the protocols for genetically manipulating cells and produce transgenic animals and choose the correct methods of transgenesis and to consider their use in improving animal husbandry nationally and globally.	Up to K3
CLO-4	Select the apt molecular techniques to evaluate and analyze animal traits and human diseases at the genomic level.	Up to K4
CLO-5	Speculate on the environmental implications of animal biotechnological methods and design responsible, ethical solutions to livestock production and health issues.	Up to K4

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

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

Advance application- 3;

Intermediate level-2;

Basic level-1

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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 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 K4	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	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 ZOOLOGY				CLASS: III B.Sc. Zoology				
Sem	Course Type	Course Code	CourseTitle	Credits	Contact Hours/week	CIA	Ext	Total
VI	CORE PRACTICAL	23U6ZCCP6	Lab Course in Microbiology, Environmental Biology Immunology and Biotechnology	3	3	25	75	100
Nature of Course								
Skill Oriented		✓	Employability Oriented		✓	Entrepreneurship Oriented		

Course Objectives

By the end of the course, students will be able:

1. To understand the techniques related to microbial culture and staining methods of microbiology
2. To analyze and measure the water quality parameters and environmental factors
3. To examine lymphoid organs, blood grouping and techniques of immunology.
4. To determine the DNA and RNA in an animal tissues.
5. To get field exposure and the knowledge on latest developments in the field of Microbiology, Environmental Biology Immunology and Biotechnology.

Unit	Description	Hours	K-level	CLO
I	Culture media preparation- Pure culture methods (Demo), Motility of bacteria- Hanging drop method, Simple staining and Gram staining of Bacteria Bacterial growth curve, Rabies virus, <i>Penicilium chrysogenum</i>	9	Upto K4	1
II	Estimation of dissolved oxygen and carbon dioxide, Measurement of water transparency using Secchi' disc- Mounting of freshwater planktons Hygrometer, Rain gauge, pH meter	9	Upto K4	2
III	Lymphoid organs in Chick (Demo)– ABO Blood grouping-Total WBC and RBC using Haemocytometer. Estimation of Haemoglobin - Immunodiffusion test (Demo). Bone marrow, Thymus Spleen, Lymph nodes, Tonsil, Double immunodiffusion.	9	Up to K4	3
IV	Isolation of DNA from animal tissue (Demo). Qualitative analysis of DNA –Electrophoresis. PCR, EcoR1, PAGE, Bacteriophage	9	Upto K4	4
V	Field Visit : Institutional visits, Visit to Biotechnology industry, Microbiological laboratory, Industrial or polluted area important sites.	9	Upto K4	5

Books for Study:

1. Surya Nandan Meena, Milind Naik, 2019. *Advances in Biological Science Research: A Practical Approach*, Academic Press, New York, USA.
2. Michael Perlin, William Becker's son, Adarsh Gopinath, 2017. *Cell Genetics and Molecular Biology: A Lab Manual (First Edition)*, Cognella Inc., USA.
3. Saxena., Baunthiyal M., Ravi I., 2015. *Laboratory Manual of Microbiology, Biochemistry and Molecular Biology*, Scientific Publishers, India.
4. Bansal M.P., 2013. *Molecular Biology and Biotechnology: basic experimental protocols*, The Energy and Resources Institute (TERI), New Delhi, India.
5. Chaitanya K.V., 2013. *Cell and molecular biology: A Lab Manual*, Phi Learning Pvt. Ltd., New Delhi, India.
6. Sinha, J., Chatterjee, A.K. & Chattopadhyay, P. 2011. *Advanced Practical Zoology*, Books and Allied (P) Ltd. Kolkata, India.
7. Michael, P., 1984. *Ecological Methods for field visit and laboratory investigation*. Tata McGraw Hill, New Delhi.

Books for References:

1. Andreas Hofmann, Samuel Clokie, 2018. *Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology*, Cambridge University Press, UK.
2. Sarah Stauffer, Aaron Gardner, Wilko Duprez, Dewi Ayu Kencana Ungu, Philip Wismer, 2018. *Labster Virtual Lab Experiments: Basic Genetics*, Springer Publishers, NY, USA.
3. Leonard Davis, Mark Dibner, James Battey, 2012. *Basic Methods in Molecular Biology*, Elsevier Science Publishing Co., NY, USA.
4. Robert F. Schleif, Pieter C. Wensink, 2012. *Practical Methods in Molecular Biology*, Springer-Verlag, NY, USA.
5. Ian Freshney R., 2010. *Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications*, John Wiley & Sons, USA.

Web Resources

1. <https://www.jove.com/>
2. <https://vlab.amrita.edu/?sub=3&brch=77>
3. <http://cbii-au.vlabs.ac.in/>
4. https://media.hhmi.org/biointeractive/vlabs/transgenic_fly/index.html
5. <https://www.ibiology.org/biology-techniques/>

Rationale for Nature of the course

This course will help the students to acquire skills on the methods to study Microbiology, Environmental Biology Immunology and Biotechnology. They also get the enriched field knowledge on the latest developments in the above said field. The knowledge acquired on the modern methods and practice will help them for their higher studies, research and other areas of applications.

Activities having direct bearing on Skill development / Employability

The practical knowledge acquired by learn-by-doing method individually and as a group will help them for their skill development. The problem solving methods and discussion on the specific topics through minor experiments and spotters will also enrich the skills of students.

Pedagogy

Practicals, Chalk and Talk, PPT, group discussion, interaction, tutorial and virtual labs.

Course Designer: Dr. R. Eswaran

Course Schedule (45 hours)

Cycle	Topics	Hrs	Mode
1	Culture media preparation-Pure culture methods	3	Practicals, observation and discussion
2	Hanging drop method	3	
3	Simple staining and Gram staining of Bacteria	3	
4	Whittaker's Five kingdom, <i>E. coli</i> , Bacterial growth curve, Rabies virus, <i>Penicillium Chrysogenum</i>	3	
5	Quantitative measurement of Alkalinity / Hardness	3	
6	Measurement of water transparency using Sacchis' disc	3	
7	Mounting of freshwater planktons Hygrometer, Rain gauge, pH meter	3	
8	Lymphoid organs in Chick	3	
9	ABO Blood grouping-Total WBC and RBC.	3	Practicals, observation and discussion, Field and institutional Visits
10	Estimation of Haemoglobin - Immunodiffusion test.	3	
11	Bone marrow, Spleen, Secondary lymphoid organs, double immunodiffusion	3	
12	Isolation of DNA / RNA from animal or plant tissue	3	
13	Determination of the purity of isolated DNA and RNA samples by UV spectrophotometry / Quantitative estimation of DNA by Spectrophotometry	3	
14	PCR, EcoR1, Ligase, PAGE, Bacteriophage	3	
15	Field Visit /Institutional visits*	3	

*Field Visit /Institutional visits will be arranged based on convenience

Course Learning Outcomes:

On successful completion of the course, the students will be able

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Demonstrate the methods of culture media preparation, pure culture and other select techniques of microbiology	Up to K2
CLO-2	Estimate water quality parameters and environmental factors	Up to K3
CLO-3	Determine lymphoid organs, blood grouping and techniques of immunology	Up to K3
CLO-4	Analyze and estimate the DNA and RNA in a plant or animal tissues	Up to K4
CLO-5	Explore the knowledge on latest developments in the field of Microbiology, Environmental Biology Immunology and Biotechnology.	Up to K4

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

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

Advance application– 3;

Intermediate level–2;

Basic level–1

DEPARTMENT OF ZOOLOGY				CLASS: III B.Sc. Zoology				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
VI	DEC	23U6ZDET2	IMMUNOLOGY	2	4	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	

Course Objectives

By the end of the course, students will be able:

1. To understand the fundamentals of immunology in protection against disease and also the key principles of antigen- antibody reaction in the immune system.
2. To list basic mechanisms that regulate immune responses, describe the main steps in the generation of cells and organs of the immune system.
3. To describe the basic mechanisms that provide innate immunity and antigen processing and presentation.
4. To differentiate B and T cell receptors, organs, and microenvironments of the Immune System.
5. To promote critical thinking and provide students with knowledge on how the immune system works building on their previous knowledge from biochemistry, genetics and cell biology.

Unit	Description	Hours	K-level	CLO
I	Immune Cells and Organs: Overview of Immune System - Organs of the Immune system: Primary lymphoid organs - Thymus and bone marrow; Secondary Lymphoid organs - Lymph nodes and spleen; Lymphatic tissues - Peyer's patches and MALT, GALT and CALT. Haemopoiesis. Cells of the immune system - T and B-lymphocytes, macrophages. Neutrophils, eosinophils, and basophils -Mast cells and dendritic cells.	12	Up to K2	1
II	Innate and Adaptive Immunity: Innate Immunity; Physical and mechanical, biochemical, cellular and genetic factors. Adaptive immunity – Humoral and Cell mediated. General Properties of Cytokines and Chemokines. Major Histocompatibility Complex (MHC): Structure and functions of MHC Class I & II molecules.	12	Up to K3	2
III	Antigen and Antibodies: Antigens- Antigenicity and immunogenicity: Properties -foreignness, molecular size, heterogeneity. Antibodies: Structure, types and	12	Up to K3	3

	function of Immunoglobulins. Complement system: Classical pathway and Alternative pathway.			
IV	Immunopathology: Hypersensitivity: Type I, II, III and IV. Autoimmunity: Organ specific autoimmune diseases-Hashimoto's thyroiditis and Goodpasture's syndrome, Systemic autoimmune diseases- Systemic Lupus Erythematosus and Rheumatoid Arthritis. Immunity against infectious diseases-viral (influenza), bacterial (tuberculosis) and parasitic (malaria).	12	Up to K4	4
V	Immunological Techniques: Antigen-Antibody interactions: - Specificity of Ag-Ab reactions, binding sites of Ag and Ab, binding forces of Ab and Ab, avidity bonus effect and cross reaction Agglutination reaction. Detection of Ag-Ab reaction, -Precipitation- Sign of radial immunodiffusion and Agglutination- ABO blood typing, hybridoma technology- production of monoclonal antibodies and its applications. Vaccines: Types uses- Immunization schedule for children.	12	Up to K4	5

Books for Study:

1. Kuby, J, Punt, J, Stranford, S, Jones, Pand Owen, J, 2018. Immunology, 8th Edition, W.H. Freeman Publishing, New York, 944 pp.
2. Roitt, M, Peter J. Delves, Seamus J. Martin and Dennis R. Burton, 2017. Essential Immunology, 13th Edition, Wiley-Blackwell Publishing, USA, 576 pp.
3. Coleman, R.M., 2014. Fundamental Immunology, 2nd Edition, Published by Mc. Graw Hill Education India, 357 pp.
4. Raj Khanna, 2011. Immunology, Oxford University press, New Delhi. 428 pp.
5. Rao. C.V. 2011. Immunology, Narosa Publishing House, New Dehli, 426 pp.

Books for References:

1. Abul A. Andrew, Lichtman. H, Shiv. P, 2014. Cellular and Molecular Immunology, 8th Edition, Published by W.B. Saunders, 544 PP.
2. Chapel. H, Haeney. M, Misbah. S, and Snowden. N, 2006. Essentials of Clinical Immunology, 5th Edition. Blackwell Publishing, 368 PP.
3. William R. Clark, 1985. The Experimental Foundations of Modern Immunology, Published by Johns Hopkins University Press, New York. 326 PP.
4. Kenneth Murphy & Casey Weaver, 2016. Janeway's Immunology, Garland Science publishers, 924 pp.

Web Resources

1. <https://www.aaaai.org/>
2. <https://www.bsaci.org/>
3. <https://www.immunology.org/>
4. <https://nptel.ac.in/courses/102/103/102103038/>
5. <https://microbenotes.com/category/immunology/>

Rationale for Nature of the course

This course will enable the students to comprehend the knowledge on basic concepts of immunology. Students will learn the significance of immune cells, organs, immunity and immunoglobulins. Students will also acquire knowledge on MHC, hypersensitivity, autoimmune diseases and get enlightened on various techniques employed in immunology.

Activities having direct bearing on Skill development / Employability Entrepreneurship

The acquired knowledge on basic concepts in immunology, its significance and various techniques will help the students for developing the skills in clinical diagnosis, which further paves the way for their employability.

Pedagogy

Chalk and Talk, PPT, group discussion, seminar, interaction, quiz, tutorial and virtual labs.

Course Designer: Dr. L. D. Devasree

Course Schedule (60 hours)

Unit	Topics	Hrs	Mode
Unit I	Overview of Immune System - Organs of the Immune system: Primary lymphoid organs - Thymus and bone marrow	2	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Secondary Lymphoid organs - Lymph nodes and spleen	3	
	Lymphatic tissues - Peyer's patches and MALT, GALT and CALT.	3	
	Haemopoiesis. Cells of the immune system - T and B-lymphocytes, macrophages. Neutrophils, eosinophils, and basophils -Mast cells and dendritic cells.	4	
Unit II	Innate Immunity; Physical and mechanical, biochemical, cellular and genetic factors.	3	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Adaptive immunity – Humoral and Cell mediated.	3	
	General Properties of Cytokines and Chemokines.	2	
	Major Histocompatibility Complex (MHC): Structure and functions of MHC Class I & II molecules.	4	
Unit III	Antigens- Antigenicity and immunogenicity: Properties - foreignness, molecular size, heterogeneity.	3	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Antibodies: Structure, types and function of Immunoglobulins.	3	
	Complement system: Classical pathway	3	
	Alternative pathway.	3	
Unit IV	Hypersensitivity: Type I, II, III and IV.	3	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Autoimmunity: Organ specific autoimmune diseases- Hashimoto's thyroiditis and Goodpasture's syndrome	2	
	Systemic autoimmune diseases- Systemic Lupus Erythematosus and Rheumatoid Arthritis.	3	
	Immunity against infectious diseases–viral (influenza)	2	
	Bacterial (tuberculosis) and parasitic (malaria).	2	
Unit V	Antigen-Antibody interactions: - Specificity of Ag-Ab reactions, binding sites of Ag and Ab,	1	Chalk and talk, ppt, group discussion, quiz, seminar & Assignment
	Binding forces of Ab and Ab, avidity bonus effect and cross reaction.	2	
	Agglutination reaction. Detection of Ag-Ab reaction, Precipitation- Sign of radial immunodiffusion and Agglutination- ABO blood typing	3	
	hybridoma technology-	1	
	Production of monoclonal antibodies and its applications.	2	
	Vaccines: Types, uses- Immunization schedule for children	3	

Course Learning Outcomes:

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

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Recall the general concepts of immune system, hematopoiesis, organs and cells of immune system.	Up to K2
CLO-2	Classify and explain types of immunity, state the significance of anatomical barriers and major histocompatibility.	Up to K3
CLO-3	Differentiate the biological characteristics of antigen, antibodies and analyze the role of complement in immune response.	Up to K3
CLO-4	Compare the mechanism of various types of hypersensitivity reactions, assess the different types of autoimmune diseases and identify immune responses against infectious diseases.	Up to K4
CLO-5	Examine the nature of antigen and antibody interaction in various immunological assays, clinical diagnosis and efficacy of different types of vaccines.	Up to K4

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

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

Advance application– 3;

Intermediate level–2;

Basic level–1

BLUE PRINT FOR EXTERNAL
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 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 K4	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	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 ZOOLOGY				CLASS: III B.Sc. Zoology				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
VI	SED	23U6ZSED8	PROFESSIONAL COMPETENCY SKILL	2	2	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	

Course Objectives

By the end of the course, students will be able:

1. To understand the taxonomic skills required to identification of organisms.
2. To analyze the concepts, features and applications of bioinformatics.
3. To impart the methods of biological data collection, organization and presentation of data and methods for interpretation and conclusion of data.
4. To study the thesis or project preparation and writing.
5. To motivate students to prepare the entrance examinations and research institutions.

Unit	Description	Hours	K-level	CLO
I	Taxonomy and its importance: Importance of Taxonomy. Identification using Taxonomic key, Simple dichotomous key, Bracket Key, Nomenclature: Synonyms and Homonyms, Meaning of Authors name in brackets, types (Holotype, Paratype, Syntype) and its importance.	6	Up to K2	1
II	Bioinformatics: Definitions, Applications of Bioinformatics, Features of biological Databases, Protein databases (PDB, SWISS-PROT), DNA databases (Gen Bank, BOLD). Sequence alignment: BLAST, FASTA. Molecular docking – drug designing.	6	Up to K3	2
III	Biostatistics: Types of data (Primary and secondary data), Methods of collecting Primary and secondary data, Measurement of Central tendency (mean) for individual, discrete and frequency series, Measures of dispersion (standard deviation), Chi-square test, Pearson's Correlation coefficient.	6	Up to K3	3
IV	Thesis or Project Preparation and Writing: Research gap / selecting a topic / hypothesis, Parts of thesis/report, scientific meeting, References, Bibliography, reference manager, plagiarism.	6	Up to K4	4

V	Higher study avenues in Zoology: CUET, NET, GATE, ICAR, Exam conducted by IISc, IISER other organizations. Institutions: ZSI, WII, IARI, IFGTB, ICFRE. NBFGR, CSIR.	6	Up to K4	5

Books for Study

1. Banerjee, P. 2014. *Introduction to Bioinformatics*, S. Chand and Company Pvt. Limited, New Chennai.
2. Gurumani, N. 2004. *An introduction to Biostatistics*. MJP publishers. Chennai
3. Hepsyba, S.G.H. & Hemalatha, C.R. 2009. *Basic Bioinformatics*, MJP Publishers, Delhi.
4. Lesk, A.M. 2007. *Introduction to Bioinformatics*, Oxford University Press, New Delhi.
5. Narendran, T.C. 2006. *An Introduction to Taxonomy: 1-80* (Published by the Director, Zoological Survey of India, Kolkata).
6. Ramakrishnan, P. 1996. *Biostatistics*, Saras Publications, Nagercoil.

Books for References

1. Sokal, R.J. and Rohlf, S.J. 1981, *Introduction to Biostatistics*, W.H. Freeman, London.
2. Mittal, C. 2003, *Fundamentals of Information Technology*, Pragathi Prakasam, Meerut.
3. Zar, J.H. 2011. *Biostatistical Analysis*, Pearson Education Inc. New Delhi.
4. Murthy, C.S.V. 2004, *Bioinformatics*, Himalaya Publishing House, New Delhi.

Web Resources

1. https://cdn1.sph.harvard.edu/wp-content/uploads/sites/565/2019/09/HST190_Lecture_1.pdf
2. <https://www.aminotes.com/2017/10/biostatistics-study-materials.html>
3. <https://microbenotes.com/category/bioinformatics/>
4. <https://www.biologydiscussion.com/biodiversity/bioinformatics/notes-on-bioinformatics-genetics/38224>

Rationale for Nature of the course

This course will enable the students to understand the methodology used in the biostatistics and bioinformatics. Students will learn the principle involved in taxonomy. Students will also acquire knowledge on the data collection methods, basic and inferential statistical methods used for the biological research and thesis writing. They also get enlightened on the various entrance examinations on the bioinformatics and biological databases.

Activities having direct bearing on Skill development/Employability/Entrepreneurship

The acquired knowledge on the principles and methods used in the taxonomy, biostatistics, bioinformatics and entrance examinations will help the students to improve their skills, which further paves the way for their higher studies and employability.

Pedagogy

Chalk and Talk, PPT, group discussion, seminar, interaction, quiz, tutorial and virtual labs.

Course Designer: Dr. C. Selvakumar.

Course Schedule (30 hours)

Unit	Topics	Hrs	Mode
Unit I	Importance of Taxonomy	1	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Identification using Taxonomic key, Simple dichotomous key, Bracket Key, Indented key.	2	
	Nomenclature: Synonyms and Homonyms	1	
	Meaning of Authors name in brackets	1	
	Type and its importance.	1	
Unit II	Definitions and Applications of Bioinformatics	2	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Features of biological Databases	1	
	Protein databases (PDB, SWISS-PROT), DNA databases (GenBank, BOLD)	1	
	Sequence alignment: BLAST & FASTA	1	
	Molecular docking – drug designing	1	
Unit III	Types of data (Primary and secondary data)	1	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Methods of collection of Primary and secondary data	1	
	Measurement of Central tendency (mean) for individual, discrete and frequency series)	2	
	Measures of dispersion (standard deviation), Chi-square test, Pearson Correlation coefficient.	2	
Unit IV	Research gap / selecting a topic / hypothesis	2	Chalk and talk, ppt, group discussion, quiz, seminar & Test
	Parts of thesis/report, scientific meeting	2	
	References, Bibliography, Reference manager, plagiarism.	2	
Unit V	CUET, CSIR – NET, IISc, IISER, GATE/ICAR.	2	Chalk and talk, ppt, group discussion, quiz, seminar & Assignment
	ZSI, WII,	2	
	IARI, IFGTB, ICFRE.	2	

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 taxonomic skills to identify the organisms	Up to K2
CLO–2	Evaluate the role of role of bioinformatics to the modern biological research	Up to K3
CLO–3	Apply the statistical methods and knowledge for data collection and presentation	Up to K3
CLO–4	Examine the thesis or project preparation and writing skills.	Up to K4
CLO–5	Analyze the various examinations and research institutions in India	Up to K4

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

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

Advance application– 3;

Intermediate level–2;

Basic level–1

BLUE PRINT FOR EXTERNAL
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 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 K4	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 zChoice)	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 ZOOLOGY				CLASS III B.Sc.				
Sem.	Course type	Course code	Course title	Credits	Contact hours/ week	CIA	Ext.	Total
VI	Project	23U6ZPROV	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

Advance application–3, Intermediate level –2, Basic level–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	

Advance application–3, Intermediate level –2, Basic level–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)

DEPARTMENT OF ZOOLOGY			CLASS: B.Sc./B.Com./M.Sc.			
Semester	Course Type	Course Title	Contact Hours/week	CIA	Ext	Total
Even	Certificate Course	FISH BREEDING TECHNOLOGY	2	50	50	100

Course Objectives

1. To understand the need and scope of aquaculture.
2. To study the economically important aquarium fishes, culture practices and management.
3. To acquire knowledge about life feed culture, artificial feed formulation and technique on aquaculture practices.
4. To create awareness and motivates students to become entrepreneurs.
5. To encourage students for self-employment.

Unit	Description	Hours
I	Introduction to Ornamental Fishes. Basics of aquaculture - Definition and Scope. History of Aquaculture: National Scenario. Ornamental Fisheries - New Dimensions in Aquaculture Entrepreneurship, Setting up of an Aquarium.	6
II	Construction of Aquarium Construction, settings, and maintenance of aquarium, Aquarium, and Aquarium Accessories. Water quality maintenance: pH, Oxygen, Hardness, Salinity and Chlorine.	6
III	Indigenous and Exotic ornamental fishes: Basic knowledge of the Native (<i>Devario aequipinnatus</i> , <i>Devario rerio</i> , <i>Barilius gatensis</i> , <i>Dawkinsia tambraparaniei</i> and Exotic (Gold fish, Mollies, Guppy, beta fish) ornamental fishes.	6
IV	Breeding and Rearing of Egg layers and Livebearers: Breeding of ornamental fish / Major carp- egg layer species (<i>Devario rerio/Labeo rohita</i>) and Livebearer species (Mollies). Preparation spawning in and aquarium/ Breeding hapa early embryonic development, larval development and post embryonic development. Nursery management.	6
V	Fish pathology and Live feed culture: Common Aquarium Fish Diseases - Parasitic diseases- <i>Lernae</i> , <i>Ligula</i> , Bacterial diseases- Fin Rot Viral diseases- Carp pox, Protozoan diseases- Velvet disease. Live Feed Culture (<i>Artemia salina</i> , <i>Daphania</i> , <i>Vinegar eel</i> , <i>Tubifex</i>) for Tropical Ornamental Fish. Use of probiotics in aquaculture.	6

Reference Books

1. Zade, S.B., Khune, C.J., Sitre, S.R., and Tijare, R.V. 2011. *Principles of Aquaculture*, Himalaya Publishing House, Mumbai.
2. Tharadevi, C.S. and Jayashree, K.V. 2009, *Home Aquarium*, Saras Publication.
3. Kamleshwar Pandey and Shukla, J.P. 2012. *Fish and Fisheries*, Rastogi Publication, Meerut.

Course Designer

Dr. P. Sivakumar



DEPARTMENT OF COMPUTER SCIENCE

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. Computer Science) – Regulation 2023



The Madura College, Madurai – 625 011
Department of Computer Science
PROGRAMME STRUCTURE – B.Sc. Computer Science

Sem	Course category	Course code	Title of the Course	Hours	Credits
I	Language - I	23U1TLAN1	Language - I Tamil / Hindi / Sanskrit	6	3
	Language - II	23U1NENG1	Language - II English	6	3
	Core	23U1_CCT1	Core Theory -1 C Programming	5	5
	Core - Practical	23U1_CCP1	Core Practical -1 C Programming Lab	3	3
	Allied / GEC	23U1_GET1(P)	Allied Theory -1 Numerical Methods	6	5
	Foundation Course	23U1_FCT1	Problem-Solving Techniques	2	2
	SEC	23U1_SED1	Introduction to HTML	2	2
II	Language - I	23U2TLAN2	Language - I Tamil / Hindi / Sanskrit	6	3
	Language - II	23U2NENG2	Language - II English	6	3
	Core	23U2_CCT2	Core Theory -2 Data Structures and Algorithms	5	5
	Core - Practical	23U2_CCP2	Core Practical -2 Data Structures and Algorithms Lab.	3	3
	Allied /GEC	23U2_GET2(P)	Allied Theory -2 Graph Theory and its Applications	6	4
	SEC	23U2_SED2	Fundamentals of Information Technology	2	2
	SEC	23U2_SED3	Foundation course (FC) Office Automation	2	2
	Part V	23U2YRC1/NC C/NSS		---	---
III	Language - I	23U3TLAN3/	Language - I Tamil / Hindi / Sanskrit	6	3
	Language - II	23U3NENG3	Language - II English	6	3
	Core	23U3_CCT3	Core Theory -5 Python Programming	5	4
	Core - Practical	23U3_CCP3	Core Practical -3 Python Programming Lab	3	3
	Allied / GEC	23U3_GET1	Elective course -3 (Generic/Discipline specific) Digital Logic Fundamentals	5	5
	SEC	23U3_SED4	Skill Enhancement Course SEC-4 Web Designing	2	2
	SEC	23U3_SED5	Skill Enhancement Course SEC-5 Multimedia systems	2	2

IV	Language - I	23U4TLAN4	Language - I Tamil / Hindi / Sanskrit	6	3
	Language - II	23U4NENG4	Language - II English	6	3
	Core	23U4_CCT4	Core Theory -6 Computer Networks	4	4
	Core - Practical	23U4_CCP4	Core Practical -4 Web Designing Lab.	3	3
	Allied / GEC	23U4_GET2	Elective course -4 (Generic/Discipline specific) Resource Management Techniques	6	5
	Allied - Practical	23U4_GEP2			
	SEC	23U4_SED6	SEC-6 PHP Programming	2	2
	SEC	23U4_SED7	SEC-7 Software testing	2	2
	EVS	23U4EVST1	Environmental Studies EVS -2	2	2
	Part V	23U4YRC2/NC C/NSS		0	1
V	Core	23U5_CCT5	Java Programming	5	4
	Core	23U5_CCT6	Database Management Systems	5	4
	Core	23U5_CCT7	Software Engineering	5	4
	Core - Practical	23U5_CCP5	DBMS Lab	3	3
	Discipline Elective	23U5_DET1(A)	Introduction to Data Science	5	4
		23U5_DET1(B)	IoT and its Applications		
	IDC / MDC	23U5_MDCT	E-Commerce Applications & Management	5	4
	Value Education	23U5VENT1	Value Education	2	2
	Industrial Visit/ Internship Field Visit	23U5_INTR	Industrial Visit / Internship Field Visit	0	2
VI	Core	23U6_CCT8	Dot Net Programming	6	4
	Core	23U6_CCT9	Data Mining and Data Warehouse	6	4
	Core	23U6_CCT10	Open source Technology	6	4
	Core - Practical	23U6_CCP6	Dot Net Programming Lab	3	3
	Discipline Elective	23U6_DET2(A)	Cloud Computing	4	2
		23U6_DET2(B)	Cryptography		
	SEC-PC	23U6_SED8	Professional Competency Skill Enhancement Course	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



The Madura College, Madurai – 625 011

Department of Computer Science

COURSE DESCRIPTION WITH DESCRIPTOR ELEMENTS AND PERCENTAGE OF REVISION

(Kindly note: Only courses offered by the department need to be mentioned here)

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	
23U1TLAN1	Language - I Tamil / Hindi / Sanskrit	6	3							
23U1NENG1	Language - II English	6	3							
23U1_CCT1	Core Theory -1 C Programming	5	5	√	√	√			√	20%
23U1_CCP1	Core Practical -1 C Programming Lab	3	3	√	√	√		√	√	30%
23U1_GET1(P)	Allied Theory -1 Numerical Methods	6	5							
23U1_FCT1	Problem-Solving Techniques	2	2	√	√	√			√	New
23U1_SED1	Introduction to HTML	2	2	√	√	√		√	√	New
23U2TLAN2	Language - I Tamil / Hindi / Sanskrit	6	3							
23U2NENG2	Language - II English	6	3							
23U2_CCT2	Core Theory -2 Data Structures and Algorithms	5	5	√		√			√	25%
23U2_CCP2	Core Practical -2 Data Structures and Algorithms Lab.	3	3	√		√			√	70%
23U2_GET2(P)	Allied Theory -2 Graph Theory and its Applications	6	4	√					√	New
23U2_SED2	Fundamentals of Information Technology	2	2	√		√		√	√	New
23U2_SED3	Foundation course (FC)	2	2	√	√	√		√	√	40%

	Office Automation									
23U2YRC1/NCC/NSS		---	---							
23U3TLAN3/	Language - I Tamil / Hindi / Sanskrit	6	3							
23U3NENG3	Language - II English	6	3							
23U3_CCT3	Core Theory -5 Python Programming	5	4	√		√			√	70%
23U3_CCP3	Core Practical -3 Python Programming Lab	3	3	√		√			√	New
23U3_GET1	Elective course -3 (Generic/Discipline specific) Digital Logic Fundamentals	5	5	√		√			√	30%
23U3_SED4	Skill Enhancement Course SEC-4 Web Designing	2	2	√	√	√			√	32%
23U3_SED5	Skill Enhancement Course SEC-5 Multimedia systems	2	2	√	√			√		No Change
23U4TLAN4	Language - I Tamil / Hindi / Sanskrit	6	3							
23U4NENG4	Language - II English	6	3							
23U4_CCT4	Core Theory -6 Computer Networks	4	4	√		√			√	No Change
23U4_CCP4	Core Practical -4 Web Designing Lab.	3	3	√	√	√			√	New
23U4_GET2	Elective course -4 (Generic/Discipline specific) Resource Management Techniques	6	5	√	√				√	No Change
23U4_SED6	SEC-6 PHP Programming	2	2	√	√	√			√	New
23U4_SED7	SEC-7 Software testing	2	2	√	√	√			√	New
23U4EVST1	Environmental Studies EVS - 2	2	2		√	√		√	√	No Change
23U4YRC2/NCC/NSS		0	1							
23U5_CCT5	Java Programming	5	4	√		√			√	25%
23U5_CCT6	Database Management	5	4	√	√	√		√	√	New

	Systems									
23U5_CCT7	Software Engineering	5	4	√	√			√	√	No Change
23U5_CCP5	DBMS Lab	3	3	√		√		√	√	New
23U5_DET1(A)	Introduction to Data Science	5	4	√	√	√			√	New
23U5_DET1(B)	IoT and its Applications			√	√	√	√	√	√	New
23U5_MDCT	E-Commerce Applications & Management	5	4	√	√		√	√	√	No Change
23U5VENT1	Value Education	2	2							
23U5_INTR	Industrial Visit / Internship Field Visit	0	2	√	√		√	√		New
23U6_CCT8	Dot Net Programming	6	4	√	√	√		√	√	New
23U6_CCT9	Data Mining and Data Warehouse	6	4	√	√		√	√	√	No Change
23U6_CCT10	Open source Technology	6	4		√	√	√	√	√	No Change
23U6_CCP6	Dot Net Programming Lab	3	3	√		√		√	√	New
23U6_DET2(A)	Cloud Computing	4	2	√	√		√	√	√	New
23U6_DET2(B)	Cryptography					√	√	√	√	New
23U6_SED8	Professional Competency Skill Enhancement Course	2	2	√		√		√	√	New
23U6_PROV	Project and Viva-voce	3	2	√	√	√	√	√	√	New

Language I – Tamil / Hindi / Sanskrit

SEC – Skill Enhancement Course

SEC-PC – Professional Competency Skill Enhancement Course

MDC – Multidisciplinary Course

Language II : English

GEC – Generic Elective Course

IDC – Interdisciplinary Course

The Madura College, Madurai – 625 011
Department of Computer Science

Multi-disciplinary Course:

A multi-disciplinary approach has been introduced in the revised modern curriculum with the OBE pattern as it is considered an important challenging technique. Computer science department faculty members collaborate with mathematics and commerce and will handle the curriculum which is framed as an integrated one with the components of Computers, commerce, and mathematics. Computer-related content is a prime area and remaining things will be the integrated components of both maths and commerce. The integrated content can be very beneficial to student learners. This scheme will be offered during the final year (Vth semester) of B.Sc. Computer science degree.

Evaluation Pattern Theory subjects:

	Components	Marks	Total Marks
Internal [Formative]	Test	10	25
	Assignment	5	
	Attendance/Quiz	5	
	Quiz / Documentation / Case lets / ICT-based assignments / Mini Projects	5	
External [Summative]		75	75
Total Marks			100

Question Paper pattern for External examination - Theory (75 marks)

Section		Marks
A	Multiple Choice Questions (10 X 1 mark)	10
B	Short Answer questions (5 X 2 marks)	10
C	Either or Choice questions (5 X 5 marks)	25
D	Open Choice questions – 3 out of 5 (3 X 10 Marks)	30
	Total	75

Practical Subjects:

A candidate has to prepare an Algorithm / Procedure for the questions given during the external practical examination. The following list of parameters is taken into account for the evaluation.

Total Marks: 100 (Internal: 40 marks, External: 60 Marks)

Parameters:

For Internal Marks:

- i. Average of two tests: ----- 25
- ii. Record Note Work: ----- 10
- iii. Seminar / Quiz: ----- 5
- Total: 40 marks**

For External Marks:

i. Aim, Procedure /	
Algorithm& Program: -----	15
ii. Coding & Compilation :-----	10
iii. Debugging :-----	15
iv. Results : -----	10
v. Viva: -----	10
Total:	60 marks

Add-on courses**Evaluation pattern for Add-on courses:**

Internal evaluation	: 50 % marks
External evaluation	: 50 %marks

Continuous Internal Assessment components	Marks
Assignment (3nos) / mini project)	20 %
Paper presentation/seminar	15 %
Quiz	15 %
Total	50%

External examination duration: 2 hours

Question paper pattern

Part-A	Multiple choice type	10 x 1 = 10 marks
Part- B	Descriptive type [4 out of 7]	4 x 10 = 40 marks

Project Work:

The combined team effort will be considered as a project and must be undertaken by all students either individually or in pairs. Project work may be offered during the final semester. It should be conducted in the department's computer laboratory under the supervision of faculty guides.

The following list of parameters is taken into account for the evaluation of Project work and Viva-voce.
Total Marks: 100 (Internal: 25 marks, External: 75 Marks)

Parameters:**For Internal Marks: (25 marks)**

Two review meetings : 2 x 15	= 30 Marks (Converted into 15 marks)
Overall Performance :	= 20 Marks (Converted into 10 marks)
Total marks	= 50 marks

For External Marks: (75 marks)

Project Report	: = 20 Marks
Project Demo &Presentation	: = 30 Marks
Viva-Voce	: = 25 Marks

THE MADURA COLLEGE (Autonomous)
Department of Computer Science
Curriculum Structure **V Semester**

Part	Sub. Code	Course description	Hours	Credits
Core-Theory -V	23U5DCCT5	Java Programming	5	4
Core-Theory – VI	23U5DCCT6	Database Management Systems	5	4
Core-Theory- VII	23U5DCCT7	Software Engineering	5	4
Core-Practical -V	23U5DCCP5	DBMS Lab	3	3
Discipline Elective-I	23U5DDET3(A)	Introduction to Data Science	5	4
	23U5DDET3(B)	IoT and its Applications		
MDC (Multidisciplinary course)	23U5DMDCT	E-Commerce Applications & Management	5	4
Value Education	23U5VENT1	Value Education	2	2
	23U5DINTR	Industrial Visit / Internship Field Visit	--	2
		Total	30	27

VI Semester

Part		Course description	Hours	Credits
Core-Theory	23U6DCCT8	Dot Net Programming	5	4
Core-Theory	23U6DCCT9	Data Mining and Data Warehouse	5	4
Core-Theory	23U6DCCT10	Open source Technology	5	4
Core-Practical	23U6DCCP6	Dot Net Programming Lab	3	3
Discipline Elective-II	23U6DDET4(A)	Cloud Computing	4	2
	23U6DDET4(B)	Cryptography		
SEC-PC	23U6_SED8	Professional Competency Skill Development Course	2	2
Project & Viva-voce	23U6DPROV	Project and Viva-voce	3	2
		Total	30	21

SEMESTER V

DEPARTMENT OF COMPUTER SCIENCE				CLASS: III B.Sc. Computer Science				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
V	Core		Java Programming	4	5	25	75	100

Nature of course					
Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

COURSE OBJECTIVES:

This course is designed to:

- To provide fundamental knowledge of object-oriented programming
- To equip the student with programming knowledge in Core Java from the basics up.
- To enable the students to use AWT controls, Event Handling, and Swing for GUI.

UNITS	Contents	Total Hours: 75 hrs.	K-Level	CLO
I	Introduction: Review of Object Oriented concepts – History of Java – Java buzzwords - JVM architecture - Datatypes - Variables - Scope and lifetime of variables - arrays - operators – control statements - type conversion and casting - Simple Java program - constructors - methods - Static block - Static Data – Static Method String and String Buffer Classes.	15	Upto K2	CLO1
II	Inheritance: Basic concepts - Types of inheritance - Member access rules - Usage of this and Super key word - Method Overloading - Method overriding - Abstract classes - Dynamic method dispatch - Usage of final keyword. Packages: Definition- Access Protection -Importing Packages. Interfaces: Definition– Implementation– Extending Interfaces. Exception Handling: <i>try – catch- throw - throws – finally</i> – Built- inexceptions - Creating own Exception classes.	15	Upto K3	CLO2

III	Multithreaded Programming: Thread Class - Runnable interface –Synchronization–Using synchronizedmethods– Using synchronized statement- InterthreadCommunication –Deadlock. I/O Streams: Concepts of streams - Stream classes- Byte and Character stream - Reading console Input and Writing Console output - File Handling.	15	Upto K4	CLO3
IV	AWT Controls: The AWT class hierarchy - user interface components- Labels - Button - Text Components - Check Box - Check Box Group - Choice - List Box - Panels – Scroll Pane - Menu - Scroll Bar. Working with Frame class - Colour - Fonts and layout managers. Event Handling: Events - Event sources - Event Listeners - Event Delegation Model (EDM) - Handling Mouse and Keyboard Events - Adapter classes - Inner classes	15	Upto K3	CLO4
V	Swing: Introduction to Swing - Hierarchy of swing components. Containers - Top level containers - JFrame - JWindow - JDialog - JPanel - JButton - JToggleButton - JCheckBox - JRadioButton - JLabel, JtextField - JTextArea - JList - JComboBox - JScrollPane.	15	Upto K3	CLO5
	Total	75		

Text Books

1. Herbert Schildt, The Complete Reference, Tata McGraw Hill, New Delhi, 7th Edition, 2010
2. Gary Cornell, Core Java 2 Volume I – Fundamentals, Addison Wesley, 1999

Books for Reference

1. Head First Java, O’Rielly Publications,
2. Y. Daniel Liang, Introduction to Java Programming, 7th Edition, Pearson Education India, **2010**

Web Resources

1. <https://javabeginnerstutorial.com/core-java-tutorial>
2. <http://docs.oracle.com/javase/tutorial/>
3. <https://www.coursera.org/>

Rationale for Nature of the course:

JAVA programming includes concepts such as class, object and inheritance etc. It enhances the coding structure and thus it making it more reliable. Nowadays, java is the best choice for scientific and other processing.

Activities having direct bearing on Skill development / Employability /Entrepreneurship

- Seminar
- Assignment preparation
- Presentation with ICT tools
- Live- demonstrations with program sample segments.

Pedagogy:

The teaching methods includes Chalk and talk, PowerPoint, demonstrations and assignments.

Lecture schedule:

Unit	Topics	Hrs	Mode
Unit I	Introduction: Review of Object Oriented concepts – History of Java – Java buzzwords -	3	Chalk and talk and assignment
	JVM architecture - Datatypes - Variables - Scope and lifetime of variables - arrays - operators	4	
	control statements - type conversion and casting - simple java program - constructors - methods	4	
	Static block - Static Data – Static Method String and String Buffer Classes.	4	
Unit II	Inheritance: Basic concepts - Types of inheritance - Member access rules - Usage of this and Super keyword - Method Overloading - Method overriding	4	Chalk and talk, Group discussion
	Abstract classes - Dynamic method dispatch - Usage of final keyword.	4	
	Packages: Definition- Access Protection -Importing Packages. Interfaces: Definition–Implementation–Extending Interfaces.	4	
	Exception Handling: <i>try – catch- throw - throws – finally</i> – Built-in exceptions - Creating own Exception classes.	3	
Unit III	Multithreaded Programming: Thread Class - Runnable interface –Synchronization–Using synchronized methods–	5	Chalk and talk, Quiz and assignment
	Using synchronized statement- Inter thread Communication –Deadlock.	5	
	I/O Streams: Concepts of streams - Stream classes- Byte and Character stream - Reading console Input and Writing Console output - File Handling.	5	
Unit IV	AWT Controls: The AWT class hierarchy - user interface components- Labels - Button - Text Components -	5	PPT, Chalk and talk, Quiz and assignment
	Check Box - Check Box Group - Choice - List Box - Panels – Scroll Pane - Menu - Scroll Bar. Working with Frame class - Colour - Fonts and layout managers.	5	

	Event Handling: Events - Event sources - Event Listeners - Event Delegation Model (EDM) - Handling Mouse and Keyboard Events - Adapter classes - Inner classes	5	
Unit V	Swing: Introduction to Swing - Hierarchy of swing components. Containers - Top level containers	5	PPT, Chalk and talk, Quiz and assignment
	JFrame - JWindow - JDialog - JPanel - JButton - JToggleButton - JCheckBox	5	
	- - JRadioButton - JLabel, JtextField - JtextArea - JList - JComboBox - JScrollPane.	5	

Learning Outcome Based Education & Assessment (LOBE)

Blue Print – JAVA Programming

Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

BLUE PRINT FOR INTERNAL ASSESSMENT – I

S. No.	CLOs	K-Level	Section A		Section B (Either / or Choice)	Section C (Open Choice)
			No. of Questions	K-Level		
1.	CLO 1	Up to K 2	2	K1 & K2	2 (K1&K1)	1(K2)
2.	CLO 2	Up to K 3	3	K1 & K2	2 (K2&K2)	2(K3)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each Question			2		5	10
Total Marks for each Section			10		10	20

BLUE PRINT FOR INTERNAL ASSESSMENT – II

S. No.	CLOs	K-Level	Section A		Section B (Either / or Choice)	Section C (Open Choice)
			No. of Questions	K-Level		
1.	CLO 3	Up to K 3	2	K1 & K2	2	1(K4)
2.	CLO 4	Up to K 4	3	K1 & K2	2	2(K3)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each Question			2		5	10
Total Marks for each Section			10		10	20

Learning Outcome Based Education & Assessment (LOBE)

Blue Print – JAVA Programming

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 K-2	2	K1 & K2	1	K1	2 (K1&K1)	1(K2)
2	CLO 2	Up to K-3	2	K1 & K2	1	K2	2 (K2&K2)	1(K3)
3	CLO 3	Up to K-3	2	K1 & K2	1	K2	2 (K3&K3)	1(K4)
4	CLO 4	Up to K-3	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
5	CLO 5	Up to K-4	2	K1 & K2	1	K2	2 (K4&K4)	1(K3)
No. of Questions to be			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 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%

Distribution of Unit-wise questions with K Levels

Section A	Section B	Section C	Section D
2 Questions for each Unit (K1 & K2 Level)	1 Question from each Unit (K1 & K2 Level)	2 Questions from Unit-I (K1 Level)	1Question from Unit-I (K2 Level)
		2 Questions from Unit-II (K3 Level)	1Question from Unit-II (K3 Level)
		2 Questions from Unit-III (K3 Level)	1Question from Unit-III (K4 Level)
		2 Questions from Unit-IV (K2 Level)	1Question from Unit-IV (K3 Level)
		2 Questions from Unit-V (K4 Level)	1Question from Unit-V (K3 Level)

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 interferences with evidences

COURSE OUTCOMES:

On the completion of the course the students will be able to

CLOs	COURSE OUTCOME	Knowledge Level (basis of Bloom's Taxonomy)
CO-1	Understand the basic Object Oriented concepts, Implement the basic constructs of Core Java	Up to K2
CO-2	Implement inheritance, packages, interfaces and exception handling	Up to K3
CO-3	Implement multi-threading and IO Streams	Up to K4
CO-4	Implement AWT and event handling	Up to K3
CO-5	Use swing to create GUI	Up to K3

MAPPING OF COs WITH PSOs:

Course Outcomes	PSO 1 (Knowledge Base)	PSO 2 (Problem Analysis & Investigation)	PSO 3 (Communication Skills & Design)	PSO 4 (Individual and Team Work)	PSO 5 (Professionalism Ethics and equity)	PSO 6 (Life Long Learning)
CO-1	3	1	1	2	1	1
CO-2	2	3	2	1	1	1
CO-3	2	3	1	1	1	2
CO-4	3	2	2	1	2	1
CO-5	2	2	2	3	2	1

3- Advanced Application

2- Intermediate

1- Introductory

MAPPING OF CLOs WITH POs:

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

1- Basic Level

2-Intermediate Level

3-Advanced Level

DEPARTMENT OF COMPUTER SCIENCE				CLASS: III B.Sc. Computer Science				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
V	Core		Database Management System	4	5	25	75	100

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

COURSE OBJECTIVES:

This course is designed to:

- Understand the various basic concepts of Data Base Systems
- Design database schema considering normalization and relationships within a database.
- Learn to design Database operations and implement them using PL/SQL Programs

UNIT	Contents	Total Hours: 75 Hrs	K-Level	CLO
I	Database Concepts: Database Systems - Data vs Information - Introducing the database -File system - Problems with file system – Database systems. Data models - Importance - Basic Building Blocks - Business rules - Evolution of Data models - Degrees of Data Abstraction	15	Upto K2	CLO1
II	Design Concepts: Relational database model - logical view of data-keys -Integrity rules - relational set operators - data dictionary and the system catalog - relationships -data redundancy revisited -indexes - codd's rules. Entity relationship model - ER diagram	15	Upto K3	CLO2
III	Normalization of Database Tables: Database tables and Normalization – The Need for Normalization –The Normalization Process – Higher level Normal Form. Introduction to SQL: Data Definition Commands – Data Manipulation Commands – SELECT Queries – Additional Data Definition Commands – Additional SELECT Query Keywords – Joining Database Tables.	15	Upto K4	CLO3

IV	Advanced SQL: Relational SET Operators: UNION – UNION ALL – INTERSECT – MINUS. SQL Join Operators: Cross Join – Natural Join – Join USING Clause – JOIN ON Clause – Outer Join. Sub Queries and Correlated Queries: WHERE – IN – HAVING – ANY and ALL – FROM. SQL Functions: Date and Time Function – Numeric Function – String Function – Conversion Function	15	Upto K3	CLO4
V	PL/SQL: A Programming Language: History – Fundamentals – Block Structure – Comments – Data Types – Other Data Types – Variable Declaration – Assignment operation – Arithmetic operators. Control Structures and Embedded SQL: Control Structures – Nested Blocks – SQL in PL/SQL – Data Manipulation – Transaction Control statements. PL/SQL Cursors and Exceptions: Cursors – Implicit Cursors, Explicit Cursors and Attributes – Cursor FOR loops – SELECT...FOR UPDATE – WHERE CURRENT OF clause – Cursor with Parameters – Cursor Variables – Exceptions – Types of Exceptions.	15	Upto K3	CLO5
	Total	75		

Text Books

1. Coronel, Morris, Rob, "Database Systems, Design, Implementation and Management", Ninth Edition
2. Nilesh Shah, "Database Systems Using Oracle", 2nd edition, Pearson Education India, 2016

Books for Reference

1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, "Database System Concepts", McGraw Hill International Publication, VI Edition
2. Shio Kumar Singh, "Database Systems", Pearson publications, II Edition

Web Resources

Web resources from NDL Library, E-content from open-source libraries

Rationale for the Nature of the Course:

The database management system is the most widely used database system in the world. As this is popular and used in many areas, learning this technology will help to get a good job position in the organization and help to compete with others and stand in the market at the top. Database Management System stores data in the form of tables. DBMS provides Data Safety, fault tolerance, accessing, and easily managing the data.

Activities having a direct bearing on Skill development / Employability /Entrepreneurship

- Seminar
- Assignment preparation
- Presentation with ICT tools
- Live- demonstrations with program sample segments.

Pedagogy:

The teaching methods include Chalk and talk, PowerPoint, demonstrations, and assignments.

Lecture schedule:

Units	Topics	Hrs	Mode
I	Introduction: Database System Applications-DBMS Vs. File System - View of Data-Data Model Database Languages	3	Chalk and talk and assignment
	Database users and Administrators -Transaction Management - Database System Structure - Application Architecture	4	
	Data Models: Basic Concepts - Constraint- Keys- ER Diagram -Weak Entity -	4	
	Extended ER Features - UML; Relational Model: Structure of Relational Databases - Relational Algebra - Views.	4	
II	SQL: Background-Basic Structure-Set Operation-	4	Chalk and talk, Group discussion
	Aggregate Function-Null Values-Nested Sub Queries	4	
	Views - Modification of the Database – Data Definition Language	4	
	- Embedded SQL - Dynamic SQL.	3	
III	Advance SQL : Integrity and Security: Domain - Constraint	5	Chalk and talk, Quiz and assignment
	- assertions - Triggers - Security and Authorization -	5	
	Referential Integrity Authorization in SQL - Encryption and Authentication.	5	
IV	Relational Database Design: First Normal Form -	3	PPT, Chalk and talk, Quiz and assignment
	Pitfalls in Relational Database Design-Functional Dependencies (Second Normal Form)	5	
	Boyce-Codd Normal form - Third Normal Form -	4	
V	- Fourth Normal Form - Overall Database Design Process.	3	PPT, Chalk and talk, Quiz and assignment
	Transaction Management: Transaction concepts - States - Serializability. Lock based concurrency control:	5	
	Locks - Granting - Two-Phase Locking protocol. Time stamp based protocol:	5	
	Timestamps - Timestamp ordering protocol - Dead lock handling.	5	

Learning Outcome Based Education & Assessment (LOBE)
Blue Print – Database Management System
Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)
BLUE PRINT FOR INTERNAL ASSESSMENT – I

S. No.	CLOs	K-Level	Section A		Section B (Either / or Choice)	Section C (Open Choice)
			No. of Questions	K-Level		
1.	CLO 1	Up to K 2	2	K1 & K2	2 (K1&K1)	1(K2)
2.	CLO 2	Up to K 3	3	K1 & K2	2 (K2&K2)	2(K3)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each Question			2		5	10
Total Marks for each Section			10		10	20

BLUE PRINT FOR INTERNAL ASSESSMENT – II

S. No.	CLOs	K-Level	Section A		Section B (Either / or Choice)	Section C (Open Choice)
			No. of Questions	K-Level		
1.	CLO 3	Up to K 3	2	K1 & K2	2	1(K4)
2.	CLO 4	Up to K 4	3	K1 & K2	2	2(K3)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each Question			2		5	10
Total Marks for each Section			10		10	20

Learning Outcome Based Education & Assessment (LOBE)

Blue Print – Database Management systems

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 K-2	2	K1 & K2	1	K1	2 (K1&K1)	1(K2)
2	CLO 2	Up to K-3	2	K1 & K2	1	K2	2 (K2&K2)	1(K3)
3	CLO 3	Up to K-3	2	K1 & K2	1	K2	2 (K3&K3)	1(K3)
4	CLO 4	Up to K-3	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
5	CLO 5	Up to K-4	2	K1 & K2	1	K2	2 (K4&K4)	1(K4)
No. of Questions to be			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 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%

Distribution of Unit-wise questions with K Levels

Section A	Section B	Section C	Section D
2 Questions for each Unit (K1 & K2 Level)	1 Question from each Unit (K1 & K2 Level)	2 Questions from Unit-I (K1 Level)	1Question from Unit-I (K2 Level)
		2 Questions from Unit-II (K3 Level)	1Question from Unit-II (K3 Level)
		2 Questions from Unit-III (K3 Level)	1Question from Unit-III (K4 Level)
		2 Questions from Unit-IV (K2 Level)	1Question from Unit-IV (K3 Level)
		2 Questions from Unit-V (K4 Level)	1Question from Unit-V (K3 Level)

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 interferences with evidences

COURSE LEARNING OUTCOMES:

On the completion of the course the students will be able to

CLOs	COURSE LEARNING OUTCOME	Knowledge Level (basis of Bloom's Taxonomy)
CO1	Understand the various basic concepts of Data Base Systems. Difference between file system and DBMS and compare various data models.	Upto K2
CO2	Define the integrity constraints. Understand the basic concepts of the Relational Data Model and entity-relationship Model.	Upto K3
CO3	Design database schema considering normalization and relationships within a database. Understand and construct databases using Structured Query Language. Attain a good practical skill in managing and retrieving data using Data Manipulation Language (DML)	Upto K4
CO4	Classify the different functions and various join operations and enhance the knowledge of handling multiple tables.	Upto K3
CO5	Learn to design Database operations and implement them using PL/SQL programs. Learn the basics of PL/SQL and develop programs using Cursors, Exceptions	Upto K3

MAPPING OF CLOs WITH PSOs:

Course Outcomes	PSO 1 (Knowledge Base)	PSO 2 (Problem Analysis & Investigation)	PSO 3 (Communication Skills & Design)	PSO 4 (Individual and Team Work)	PSO 5 (Professionalism Ethics and equity)	PSO 6 (Life Long Learning)
CLO-1	3	1	1	2	1	1
CLO-2	1	2	3	1	1	1
CLO-3	2	1	1	1	1	2
CLO-4	2	1	1	1	2	1
CLO-5	2	2	2	3	2	1

3- Advanced Application

2- Intermediate

1- Introductory

MAPPING OF CLOs WITH POs:

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

1- Basic Level

2-Intermediate Level

3-Advanced Level

DEPARTMENT OF COMPUTER SCIENCE				CLASS: III B.Sc. Computer Science				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
V	Core		Software Engineering	4	5	25	75	100

Nature of course					
Skill oriented		Employability oriented	✓	Entrepreneurship Oriented	✓

COURSE OBJECTIVES:

This course is designed to:

- Gain basic knowledge of analysis and design of systems
- Model a reliable and cost effective software system
- Perform testing at various levels

UNIT	Contents	Total Hours: 75 Hrs	K- Level	CLO
I	Introduction: The software engineering discipline, programs vs. software products, why study software engineering, the emergence of software engineering, Notable changes in software development practices, computer systems engineering. Software Life Cycle Models: Why use a life cycle model, Classical waterfall model, iterative waterfall model, prototyping model, evolutionary model, spiral model, or comparison of different life cycle models	15	Upto K2	CLO1
II	Requirements Analysis and Specification: Requirements gathering and analysis, Software requirements specification (SRS) Software Design: Good software design, cohesion and coupling, neat arrangement, software design approaches, objectoriented vs. function-oriented design	15	Upto K3	CLO2

III	Function-Oriented Software Design: Overview of SA/SD methodology, structured analysis, data flow diagrams (DFD's), structured design, detailed design. User-Interface design: Characteristics of a good interface; basic concepts; types of user interfaces; component based GUI development, a user interface methodology.	15	Upto K3	CLO3
IV	Coding and Testing: Coding; code review; testing; testing in the large vs testing in the small; unit testing; black-box testing; white-box testing; debugging; program analysis tools; integration testing; system testing; some general issues associated with testing. Software Reliability and Quality Management: Software reliability; statistical testing; software quality; software quality management system; SEI capability maturity model; personal software process.	15	Upto K4	CLO4
V	Computer Aided Software Engineering: CASE and its scope; CASE environment; CASE support in software life cycle; other characteristics of CASE tools; towards second generation CASE tool; architecture of a CASE environment. Software Maintenance: Characteristic of software maintenance; software reverse engineering; software maintenance process models; estimation of maintenance cost.	15	Upto K3	CLO5
	Total	75		

Text Book

Rajib Mall, Fundamentals of Software Engineering, Fifth Edition, Prentice-Hall of India, 2018

Books for Reference

1. Richard Fairley, Software Engineering Concepts, Tata McGraw-Hill Publishing Company Ltd, Edition 1997
2. Roger S. Pressman, Software Engineering, Seventh Edition, McGraw-Hill
3. James A. Senn, Analysis & Design of Information Systems, Second Edition, McGraw-Hill International Editions.

Web Resources

Web resources from NDL Library, E-content from open-source libraries

Rationale for the Nature of the Course:

Software engineering is important because specific software is needed in almost every industry, in every business, and for every function. It becomes more important as time goes on – if something breaks within your application portfolio, a quick, efficient, and effective fix needs to happen as soon as possible.

Activities having direct bearing on Skill development / Employability /Entrepreneurship

- Seminar
- Assignment preparation
- Presentation with ICT tools
- Live- demonstrations with program sample segments.

Pedagogy:

The teaching methods include Chalk and talk, PowerPoint, demonstrations, and assignments.

Lecture schedule:

Units	Topics	Hrs	Mode
I	Introduction - Software Engineering Discipline - Evolution and Impact - Programs Vs Software Products. -	3	Chalk and talk and assignment
	Software Life Cycle Models: Use of a Life Cycle Models - Classical Waterfall Model -Iterative Waterfall Model - Prototyping Model - Evolutionary Model - Spiral Model.	4	
	Software Project Management: Responsibilities of a Software Project Manager - Project Planning	4	
	Metrics for Project Size Estimation - Project Estimation Techniques -Risk Management.	4	
II	Requirements Analysis and Specification: Requirements Gathering and Analysis -	4	Chalk and talk, Group discussion
	Software Requirements Specification (SRS) - Formal System Development Techniques.	4	
	Software Design: Characteristics of a Good Software Design - Cohesion and Coupling	4	
	Neat Arrangement - Software Design Approaches.	3	
III	Function-Oriented Software Design: Overview of SA/SD Methodology -Structured Analysis -	5	Chalk and talk, Quiz and assignment
	Data Flow Diagrams (DFDs).Object Modelling Using UML: Overview of Object-Oriented Concepts - UML Diagrams -	5	
	Use Case Model -Class Diagrams - Interaction Diagrams - Activity Diagrams - State Chart Diagram.	5	
IV	User Interface Design: Characteristics of a Good User Interface - Basic Concepts - Types of User Interfaces -	5	PPT, Chalk and talk, Quiz and assignment
	Component-Based GUI Development; Coding and Testing: Coding -	5	
	Testing - UNIT Testing - Black-Box Testing -White-Box Testing - Debugging -Integration Testing - System Testing.	5	
V	Software Reliability and Quality Management: Software Reliability - Statistical Testing -Software Quality - Software Quality Management System - ISO 9000	5	PPT, Chalk and talk, Quiz and assignment
	Computer Aided Software Engineering: CASE Environment - CASE support in Software Life Cycle - Characteristics of CASE Tools - Architecture of a CASE Environment.	5	
	. Software Maintenance: Characteristics of Software Maintenance - Software Reverse Engineering - Software Maintenance Process Models - Estimation of Maintenance Cost. Software Reuse: Issues in any Reuse Program - Reuse Approach.	5	

Learning Outcome Based Education & Assessment (LOBE)
Blue Print – Software Engineering
Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)
BLUE PRINT FOR INTERNAL ASSESSMENT – I

S. No.	CLOs	K-Level	Section A		Section B (Either / or Choice)	Section C (Open Choice)
			No. of Questions	K-Level		
1.	CLO 1	Up to K 2	2	K1 & K2	2 (K1&K1)	1(K2)
2.	CLO 2	Up to K 3	3	K1 & K2	2 (K2&K2)	2(K3)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each Question			2		5	10
Total Marks for each Section			10		10	20

BLUE PRINT FOR INTERNAL ASSESSMENT – II

S. No.	CLOs	K-Level	Section A		Section B (Either / or Choice)	Section C (Open Choice)
			No. of Questions	K-Level		
1.	CLO 3	Up to K 3	2	K1 & K2	2 (K3&K3)	1(K4)
2.	CLO 4	Up to K 4	3	K1 & K2	2 (K3&K3)	2(K3)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each Question			2		5	10
Total Marks for each Section			10		10	20

Learning Outcome Based Education & Assessment (LOBE)

Blue Print – Software engineering

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 K-2	2	K1 & K2	1	K1	2 (K1&K1)	1(K2)
2	CLO 2	Up to K-3	2	K1 & K2	1	K2	2 (K2&K2)	1(K3)
3	CLO 3	Up to K-3	2	K1 & K2	1	K2	2 (K3&K3)	1(K3)
4	CLO 4	Up to K-3	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
5	CLO 5	Up to K-4	2	K1 & K2	1	K2	2 (K4&K4)	1(K4)
No. of Questions to be			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 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%

Distribution of Unit-wise questions with K Levels

Section A	Section B	Section C	Section D
2 Questions for each Unit (K1 & K2 Level)	1 Question from each Unit (K1 & K2 Level)	2 Questions from Unit-I (K1 Level)	1Question from Unit-I (K2 Level)
		2 Questions from Unit-II (K3 Level)	1Question from Unit-II (K3 Level)
		2 Questions from Unit-III (K3 Level)	1Question from Unit-III (K4 Level)
		2 Questions from Unit-IV (K2 Level)	1Question from Unit-IV (K3 Level)
		2 Questions from Unit-V (K4 Level)	1Question from Unit-V (K3 Level)

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 interferences with evidences

COURSE LEARNING OUTCOMES:

Upon the completion of the course, the students will be able to

CLOs	COURSE LEARNING OUTCOME	Knowledge Level (basis of Bloom's Taxonomy)
CLO-1	Understand principles and practices of software engineering	Up to K2
CLO-2	Identify software models for different nature of projects	Up to K3
CLO-3	Familiarize tools for software design process. Understand the concepts of process planning and scheduling	Up to K3
CLO-4	Develop strategies for testing.	Up to K4
CLO-5	Understand the concepts of Software Reliability and Quality Management	Up to K3

MAPPING OF CLOs WITH PSOs:

Course Outcomes	PSO 1 (Knowledge Base)	PSO 2 (Problem Analysis & Investigation)	PSO 3 (Communication Skills & Design)	PSO 4 (Individual and Team Work)	PSO 5 (Professionalism Ethics and equity)	PSO 6 (Life Long Learning)
CLO-1	3	1	1	2	1	1
CLO-2	1	2	3	1	1	1
CLO-3	2	1	1	1	1	2
CLO-4	2	1	1	1	2	1
CLO-5	2	2	2	3	2	1

3- Advanced Application

2- Intermediate

1- Introductory

MAPPING OF CLOs WITH POs:

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

1- Basic Level

2-Intermediate Level

3-Advanced Level

DEPARTMENT OF COMPUTER SCIENCE				CLASS: III B.Sc. Computer Science				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
V	Core		Database Management System Lab	4	3	25	75	100

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

COURSE OBJECTIVES:

This course is designed to:

- enable the students to learn the designing of data base systems
- understand the concepts of database management systems, design simple Database models
- To learn and understand to write queries using SQL, PL/SQL.

List of Exercises:

I. SQL

1. DDLCOMMANDS
2. DMLCOMMANDS
3. TCLCOMMANDS

II. PL/SQL

4. FIBONACCI SERIES
5. FACTORIAL
6. STRING REVERSE
7. SUM OF SERIES
8. TRIGGER

III. CURSOR

9. STUDENT MARK ANALYSIS USING CURSOR

IV. APPLICATION

10. LIBRARY MANAGERMENTSYSTEM

11. STUDENT MARK ANALYSIS

Rationale for the nature of the course:

The purpose of PL/SQL is to combine database language and procedural programming language. We have included this lab for those (beginner to intermediate) who are familiar with SQL and Oracle. Exercises are designed to enhance your ability to write well-structured PL/SQL programs. Hope, these exercises help you to improve your PL/SQL query skills.

Activities having a direct bearing on Skill development / Employability /Entrepreneurship:

- Practicing to solve the problem by writing programs.
- Writing algorithms for various programs for solving.
- Hands-on training.

COURSE LEARNING OUTCOMES:

Upon the completion of the course, the students will be able to

CLOs	COURSE OUTCOME	Knowledge Level (basis of Bloom's Taxonomy)
CLO-1	Design database schema with normalization and relationships between the tables	Up to K2
CLO-2	Write SQL queries to user specifications	Up to K4
CLO-3	Develop triggers, and procedures in PL/SQL programs in Oracle.	Up to K3
CLO-4	Prepare the report with various options described in the database using queries.	Up to K4
CLO-5	Develop programs with various business-related applications.	Up to K3

MAPPING OF CLOs WITH PSOs:

Course Outcomes	PSO 1 (Knowledge Base)	PSO 2 (Problem Analysis & Investigation)	PSO 3 (Communication Skills & Design)	PSO 4 (Individual and Team Work)	PSO 5 (Professionalism Ethics and equity)	PSO 6 (Life Long Learning)
CLO-1	3	1	2	1	1	1
CLO-2	2	3	2	1	1	1
CLO-3	2	2	2	1	1	2
CLO-4	2	2	2	1	1	1
CLO-5	2	1	2	3	2	1

3- Advanced Application

2- Intermediate

1- Introductory

MAPPING OF CLOs WITH POs:

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

1- Basic Level

2-Intermediate Level

3-Advanced Level

DEPARTMENT OF COMPUTER SCIENCE				CLASS: III B.Sc. Computer Science				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
V	Major Elective		Introduction to Data Science	4	5	25	75	100

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

COURSE OBJECTIVES:

This course is designed to:

- Learn about the basics of Data Science and Big Data
- Learn about various algorithms in data science
- Learn about the Hadoop framework

UNIT	Contents	Total Hours: 75 Hrs	K-Level	CLO
I	Introduction: Benefits and uses – Facts of data – Data science process – Big data ecosystem and data science	15	Upto K2	CLO1
II	The Data science process: Overview – research goals - retrieving data - transformation – Exploratory Data Analysis – Model building .	15	Upto K3	CLO2
III	Algorithms : Machine learning algorithms – Modeling process – Types – Supervised – Unsupervised - Semi-supervised	15	Upto K3	CLO3
IV	Introduction to Hadoop : Hadoop framework – Spark – replacing MapReduce– NoSQL – ACID – CAP – BASE – types	15	Upto K4	CLO4
V	Case Study: Prediction of Disease - Setting research goals - Data retrieval – preparation - exploration - Disease profiling - presentation and automation	15	Upto K3	CLO5
	Total	75		

Text Book

1. Davy Cielen, Arno D. B. Meysman, Mohamed Ali, “Introducing Data Science”, manning publications 2016

Books for Reference

1. Roger Peng, “The Art of Data Science”, lulu.com 2016.
2. Murtaza Haider, “Getting Started with Data Science – Making Sense of Data with Analytics”, IBM press, E-book.
3. Davy Cielen, Arno D.B. Meysman, Mohamed Ali, “Introducing Data Science: Big Data, Machine Learning, and More, Using Python Tools”, Dreamtech Press 2016.
4. Annalyn Ng, Kenneth Soo, “Numsense! Data Science for the Layman: No Math Added”, 2017, 1st Edition.
5. Cathy O’Neil, Rachel Schutt, “Doing Data Science Straight Talk from the Frontline”, O’Reilly Media 2013.
6. Lillian Pierson, “Data Science for Dummies”, 2017 II Edition

Web Resources

1. <https://www.w3schools.com/datascience/>
2. https://en.wikipedia.org/wiki/Data_science
3. <http://www.cmap.polytechnique.fr/~lepenec/en/post/references/refs/>

Rationale for the Nature of the Course:

Data science enables businesses to process huge amounts of structured and unstructured big data to detect patterns. Always the concepts of data science will increase efficiencies, manage costs, and boost their market advantage. It makes sense of the data through a variety of statistical techniques.

Activities having a direct bearing on Skill development / Employability /Entrepreneurship

- Seminar
- Assignment preparation
- Presentation with ICT tools
- Live- demonstrations with program sample segments.

Pedagogy:

The teaching methods include Chalk and talk, PowerPoint, demonstrations and assignments.

Lecture schedule:

Units	Topics	Hrs	Mode
I	Introduction: Benefits and uses – Facts of data	5	Chalk and talk and assignment
	– Data science process	5	
	– Big data ecosystem and data science	5	
II	The Data science process: Overview – research goals	5	Chalk and talk, Group discussion
	retrieving data - transformation	5	
	- – Exploratory Data Analysis – Model building.	5	
III	Algorithms : Machine learning algorithms – Modeling process	5	Chalk and talk, Quiz and assignment
	– Types – Supervised – Unsupervised	5	
	- Semi-supervised	5	
IV	Introduction to Hadoop : Hadoop framework – Spark	5	PPT, Chalk and talk, Quiz and assignment
	– replacing MapReduce– NoSQL – ACID	5	
	– CAP – BASE – types	5	
V	Case Study: Prediction of Disease - Setting research goals	5	PPT, Chalk and talk, Quiz and assignment
	- Data retrieval – preparation - exploration	5	
	- Disease profiling - presentation and automation	5	

Learning Outcome Based Education & Assessment (LOBE)

Blue Print – Introduction to Data Science

Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

BLUE PRINT FOR INTERNAL ASSESSMENT – I

S. No.	CLOs	K-Level	Section A		Section B (Either/or Choice)	Section C (Open Choice)
			No. of Questions	K-Level		
1.	CLO 1	Up to K 2	2	K1 & K2	2 (K1&K1)	1(K2)
2.	CLO 2	Up to K 3	3	K1 & K2	2 (K2&K2)	2(K3)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each Question			2		5	10
Total Marks for each Section			10		10	20

BLUE PRINT FOR INTERNAL ASSESSMENT – II

S. No.	CLOs	K-Level	Section A		Section B (Either / or Choice)	Section C (Open Choice)
			No. of Questions	K-Level		
1.	CLO 3	Up to K 3	2	K1 & K2	2	1(K4)
2.	CLO 4	Up to K 4	3	K1 & K2	2	2(K3)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each Question			2		5	10
Total Marks for each Section			10		10	20

Learning Outcome Based Education & Assessment (LOBE)

Blue Print – Introduction to Data Science

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 K-2	2	K1 & K2	1	K1	2 (K1&K1)	1(K2)
2	CLO 2	Up to K-3	2	K1 & K2	1	K2	2 (K2&K2)	1(K3)
3	CLO 3	Up to K-3	2	K1 & K2	1	K2	2 (K3&K3)	1(K3)
4	CLO 4	Up to K-3	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
5	CLO 5	Up to K-4	2	K1 & K2	1	K2	2 (K4&K4)	1(K4)
No. of Questions to be			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 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%

Distribution of Unit-wise questions with K Levels

Section A	Section B	Section C	Section D
2 Questions for each Unit (K1 & K2 Level)	1 Question from each Unit (K1 & K2 Level)	2 Questions from Unit-I (K1 Level)	1Question from Unit-I (K2 Level)
		2 Questions from Unit-II (K3 Level)	1Question from Unit-II (K3 Level)
		2 Questions from Unit-III (K3 Level)	1Question from Unit-III (K4 Level)
		2 Questions from Unit-IV (K2 Level)	1Question from Unit-IV (K3 Level)
		2 Questions from Unit-V (K4 Level)	1Question from Unit-V (K3 Level)

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 interferences with evidences

COURSE LEARNING OUTCOMES:

On the completion of the course the students will be able to

CLOs	COURSE LEARNING OUTCOME	Knowledge Level (basis of Bloom's Taxonomy)
CLO-1	Understand the basics in Data Science and Big data.	Upto K2
CLO-2	Understand overview and building process in Data Science.	Upto K3
CLO-3	Understand various Algorithms in Data Science.	Upto K3
CLO-4	Understand the Hadoop Framework in Data Science.	Upto K4
CLO-5	A case study in Data Science.	Upto K3

MAPPING OF CLOs WITH PSOs:

Course Outcomes	PSO 1 (Knowledge Base)	PSO 2 (Problem Analysis & Investigation)	PSO 3 (Communication Skills & Design)	PSO 4 (Individual and Team Work)	PSO 5 (Professionalism Ethics and equity)	PSO 6 (Life Long Learning)
CLO-1	3	1	1	2	1	1
CLO-2	1	2	3	1	1	1
CLO-3	2	1	1	1	1	2
CLO-4	2	1	1	1	2	1
CLO-5	2	2	2	3	2	1

3- Advanced Application

2- Intermediate

1- Introductory

MAPPING OF CLOs WITH POs:

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

1- Basic Level

2-Intermediate Level

3-Advanced Level

DEPARTMENT OF COMPUTER SCIENCE				CLASS: III B.Sc. Computer Science				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
V	Elective		Internet of Things and its Applications	4	5	25	75	100
Nature of course								
Skill oriented		✓	Employability oriented	✓	Entrepreneurship Oriented		✓	

COURSE OBJECTIVES

This course is designed to:

- Design IoT Applications in different domains
- Implement basic IoT Applications on embedded systems
- Gain knowledge on Industrial IoT

UNIT	Topics	Total Hours: 75 Hrs	K-Level	CLO
I	IoT& Web Technology, The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.	15	K2	CLO1
II	M2M to IoT – A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.	15	K3	CLO2
III	IoT Architecture -State of the Art – Introduction, State of the Architecture. Reference Model- Introduction. Functional View, Information View, Deployment and Operational View, and Other Relevant architectural views	15	K3	CLO4
IV	IoT Applications for Value Creations Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management	15	K4	CLO4

V	Internet of Things Privacy, Security and Governance Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Project Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security	15	K3	CLO5
Total		75		

Text Book

Vijay Madiseti and Arshdeep Bahga, “Internet of Things: (A Hands-on Approach)”, Universities Press (INDIA) Private Limited 2014, 1st Edition.

Books for Reference

1. Michael Miller, “The Internet of Things: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities Are Changing the World”, kindle version.
2. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, Apress Publications 2013, 1st Edition,.
3. Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice" 4..Cuno Pfister, “Getting Started with the Internet of Things”, O’Reilly Media 2011

Web Resources

1. <https://www.simplilearn.com>
2. <https://www.javatpoint.com>
3. <https://www.w3schools.com>

Rationale for the Nature of the Course:

Internet of Things provides easy access to information from anywhere at any time on any device. IoT apps support the collection of the right kind and right amount of data that assists the making of the right decision as per personal preferences. IoT aims to automate processes, reduce manual interventions, and enable smarter operations.

Activities having a direct bearing on Skill development / Employability /Entrepreneurship

- Seminar
- Assignment preparation
- Presentation with ICT tools
- Live- demonstrations with program sample segments.

Pedagogy:

The teaching methods include Chalk and talk, PowerPoint, demonstrations and assignments.

Lecture schedule:

Units	Topics	Hrs	Mode
I	IoT& Web Technology, The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision,	5	Chalk and talk and assignment
	IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes,	5	
	Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.	5	
II	M2M to IoT – A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An Emerging Industrial Structure for IoT,	5	Chalk and talk, Group discussion
	The international driven global value chain and global information monopolies. M2M to IoT-An Architectural	5	
	Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.	5	
III	IoT Architecture -State of the Art – Introduction, Stat of the art, Architecture. Reference Model- Introduction	5	Chalk and talk, Quiz and assignment
	Reference Model and architecture, IoT reference Model, IoT Reference Architecture- Introduction	5	
	Functional View, Information View, Deployment and Operational View, and Other Relevant architectural views	5	
IV	IoT Applications for Value Creations Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT,	5	PPT, Chalk and talk, Quiz and assignment
	Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization,	5	
	IoT for Retailing Industry, IoT For Oil and GasIndustry, Opinions on IoT Application and Value for Industry, Home Management	5	
V	Internet of Things Privacy, Security and Governanc Introduction, Overview of Governance	5	PPT, Chalk and talk, Quiz and assignment
	, Privacy an Security Issues, Contribution from FP7 Project Security, Privacy, and Trust in IoT-	5	
	Data Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT i Smart Cities, Security	5	

Learning Outcome Based Education & Assessment (LOBE)
Blue Print – Internet of Things and its applications
Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)
BLUE PRINT FOR INTERNAL ASSESSMENT – I

S. No.	CLOs	K-Level	Section A		Section B (Either/or Choice)	Section C (Open Choice)
			No. of Questions	K-Level		
1.	CLO 1	Up to K 2	2	K1 & K2	2 (K1&K1)	1(K2)
2.	CLO 2	Up to K 3	3	K1 & K2	2 (K2&K2)	2(K3)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each Question			2		5	10
Total Marks for each Section			10		10	20

BLUE PRINT FOR INTERNAL ASSESSMENT – II

S. No.	CLOs	K-Level	Section A		Section B (Either / or Choice)	Section C (Open Choice)
			No. of Questions	K-Level		
1.	CLO 3	Up to K 3	2	K1 & K2	2	1(K4)
2.	CLO 4	Up to K 4	3	K1 & K2	2	2(K3)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each Question			2		5	10
Total Marks for each Section			10		10	20

Learning Outcome Based Education & Assessment (LOBE)
Blue Print – Internet of Things and its applications
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 K-2	2	K1 & K2	1	K1	2 (K1&K1)	1(K2)
2	CLO 2	Up to K-3	2	K1 & K2	1	K2	2 (K2&K2)	1(K3)
3	CLO 3	Up to K-3	2	K1 & K2	1	K2	2 (K3&K3)	1(K3)
4	CLO 4	Up to K-3	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
5	CLO 5	Up to K-4	2	K1 & K2	1	K2	2 (K4&K4)	1(K4)
No. of Questions to be			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 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%

Distribution of Unit-wise questions with K Levels

Section A	Section B	Section C	Section D
2 Questions for each Unit (K1 & K2 Level)	1 Question from each Unit (K1 & K2 Level)	2 Questions from Unit-I (K1 Level)	1Question from Unit-I (K2 Level)
		2 Questions from Unit-II (K3 Level)	1Question from Unit-II (K3 Level)
		2 Questions from Unit-III (K3 Level)	1Question from Unit-III (K4 Level)
		2 Questions from Unit-IV (K2 Level)	1Question from Unit-IV (K3 Level)
		2 Questions from Unit-V (K4 Level)	1Question from Unit-V (K3 Level)

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 interferences with evidences

COURSE LEARNING OUTCOMES:

On the completion of the course the students will be able to

CLOs	COURSE LEARNING OUTCOME	Knowledge Level (basis of Bloom's Taxonomy)
CLO-1	Understand the basics of IoT.	Upto K2
CLO-2	Understand the overview of IoT architecture and the Industrial structure of IoT.	Upto K3
CLO-3	Understand the smart applications and application areas of IoT	Upto K3
CLO-4	Understand the Industrial applications and home management of IoT.	Upto K4
CLO-5	Explore the security and issues of IoT	Upto K3

MAPPING OF CLOs WITH PSOs:

Course Outcomes	PSO 1 (Knowledge Base)	PSO 2 (Problem Analysis & Investigation)	PSO 3 (Communication Skills & Design)	PSO 4 (Individual and Team Work)	PSO 5 (Professionalism Ethics and equity)	PSO 6 (Life Long Learning)
CLO-1	3	1	1	2	1	1
CLO-2	1	2	3	1	1	1
CLO-3	2	1	1	1	1	2
CLO-4	2	1	1	1	2	1
CLO-5	2	2	2	3	2	1

3- Advanced Application

2- Intermediate

1- Introductory

MAPPING OF CLOs WITH POs:

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

1- Basic Level

2-Intermediate Level

3-Advanced Level

DEPARTMENT OF COMPUTER SCIENCE				CLASS: III B.Sc. Computer Science				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
V	Multi-disciplinary		E-Commerce Applications & Management	4	5	25	75	100

Nature of course					
Skill oriented		Employability oriented	✓	Entrepreneurship Oriented	✓

COURSE OBJECTIVES :

This course is designed to

- Understand the concept of E-commerce and its types
- Study the various online payment and marketing management on Web
- Understand various E-business Strategies.

Units	CONTENTS	Total Hours: 60	K-Level	CLO
I	History of E-commerce and Indian Business Context: E-Commerce -Emergence of the Internet - Emergence of the WWW - Advantages of E-Commerce -Transition to E-Commerce in India - The Internet and India - E-transition Challenges for Indian Corporate.	10 hrs	Up to K2	1
II	Business Models for E-commerce: Business Model - E-business Models Based on the Relationship of Transaction Parties - E-business Models Based on the Relationship of Transaction Types.	10 hrs	Up to K2	2
III	Enabling Technologies of the World Wide Web: World Wide Web - Internet Client-Server Applications - Networks and Internets - Software Agents -Internet Standards and Specifications - ISP. E-Marketing : Traditional Marketing - Identifying Web Presence Goals - Online Marketing - E-advertising	10 hrs	Up to K2	3
IV	Management concepts in Technology: 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 – MBE – TQM – BEP.	15 hrs	Up to K2	4

V	Decision Analysis: Decision making under conditions of certainty-Uncertainty- Decision making under conditions of Risk-Expected value criterion- Expected Opportunity Loss(EOL) criterion-Expected Value of Perfect Information(EVPI)-Expected Profit with Perfect Information(EPPI)	15 hrs	Up to K2	5

Books for Study:

1. P.T.Joseph, "E-Commerce - An Indian Perspective", 4th Edition, PHI Learning, 2012. (for Units 1 ,2 and 3)
2. L.M. Prasad, ***Principles and Practice of Management***, Sixth Edition, Sultan Chand & Sons, New Delhi (For Unit 4)
3. P.K.Gupta, D.S.Hira, "Problems in Operation Research", S. Chand & Company LTD., New Delhi 1991. (For Unit 5)

Books for Reference :

1. David Whiteley, "E-Commerce Strategy, Technologies and Applications", 1st Edition, Tata Mc-Graw-Hill, 2001.
2. Kamallesh K Bajaj and Debjani Nag, "E-Commerce - The cutting edge of Business", 2nd Edition, Tata McGraw-Hill Education, 2005.
3. R.N. Gupta, ***Principles of Management***, S. Chand & Company Pvt. Ltd. New Delhi.
4. Dinkar Pagare, ***Business Management***, Sultan Chand & Sons, New Delhi.
5. Kanti Swarup, P.K Gupta, Man Mohan, "Operations Research", Sultan Chand & Sons, New Delhi 1977.

Web resources:

1. https://www.tutorialspoint.com/e_commerce/index.htm
2. <https://blog.templatetoaster.com/what-is-ecommerce/>

Rationale for Nature of the course:

E-commerce has simplified sales and marketing as salespeople can complete sales online, saving time, increasing revenue and enhancing efficiency. Execution of online business transactions that are fast and cost effective. E-Commerce in education is not confined to students only, teachers can also benefit themselves through this medium.

Activities having direct bearing on Skill development / Employability /Entrepreneurship

- Seminar
- Assignment preparation
- Presentation with ICT tools
- Live- demonstrations.

Pedagogy:

The teaching methods includes Chalk and talk, PowerPoint, demonstrations and assignments.

Lecture schedule:

Units	Topics	Hrs	Mode
I	History of E-commerce and Indian Business Context: E-Commerce -Emergence of the Internet - -	3	Chalk and talk and assignment
	Emergence of the WWW - Advantages of E-Commerce - Transition to E-Commerce in India	4	
	The Internet and India - E-transition Challenges for Indian Corporate.	3	
II	Business Models for E-commerce: Business Model -	3	Chalk and talk, Group discussion
	- E-business Models Based on the Relationship of Transaction Types.	3	
	E-business Models Based on the Relationship of Transaction Parties	4	
III	Enabling Technologies of the World Wide Web: World Wide Web - Internet Client-Server Applications	3	Chalk and talk, Quiz and assignment
	Networks and Internets - Software Agents -Internet Standards and Specifications - ISP	4	
	-E-Marketing : Traditional Marketing - Identifying Web Presence Goals - Online Marketing - E-advertising	3	
IV	Management–Meaning-Definition– Features – Levels of Management – Principles of Management – Functions of Management. Planning – Steps in planning–MBO.	5	PPT, Chalk and talk, Quiz and assignment
	Organization–Meaning–Types of Organization Structure– Centralization and Decentralization - Delegation of Authority. Staffing – Recruitment – Selection Process.	5	
	Motivation – Maslow Theory. Leadership – Leadership Styles. Control – Meaning – Steps in control – Techniques – Budget – MBE – TQM – BEP.	5	
V	Decision making under conditions of certainty- Uncertainty-Decision making under conditions of Risk	5	PPT, Chalk and talk, Quiz and assignment
	Expected value criterion- Expected Opportunity Loss(EOL) criterion-	5	
	Expected Value of Perfect Information (EVPI)-Expected Profit with Perfect Information(EPPI)	5	

Continuous Internal Assessment (CIA): 25 Marks

Components	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)
Blue Print – E-Commerce Applications & Management
Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)
BLUE PRINT FOR INTERNAL ASSESSMENT – I

S. No.	CLOs	K-Level	Section A		Section B (Either / or Choice)	Section C (Open Choice)
			No. of Questions	K-Level		
1.	CLO 1	Up to K 2	2	K1 & K2	2 (K1&K1)	1(K2)
2.	CLO 2	Up to K 3	3	K1 & K2	2 (K2&K2)	2(K3)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each Question			2		5	10
Total Marks for each Section			10		10	20

BLUE PRINT FOR INTERNAL ASSESSMENT – II

S. No.	CLOs	K-Level	Section A		Section B (Either / or Choice)	Section C (Open Choice)
			No. of Questions	K-Level		
1.	CLO 3	Up to K 3	2	K1 & K2	2	1(K4)
2.	CLO 4	Up to K 4	3	K1 & K2	2	2(K3)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each Question			2		5	10
Total Marks for each Section			10		10	20

Learning Outcome Based Education & Assessment (LOBE)
Blue Print – E-Commerce Applications & Management
Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

S. No.	CLOs	K-Level	Section A		Section B (Either / or Choice)		Section C (Open Choice)
			Short Answers				
			No. of Questions	K-Level	No. of Questions	K-Level	
1	CLO 1	Up to K-2	1	K1	1	K2 & K2	1(K2)
2	CLO 2	Up to K-2	1	K2	1	K2 & K2	1(K2)
3	CLO 3	Up to K-2	1	K2	1	K2 & K2	1(K2)
4	CLO 4	Up to K-2	1	K1	1	K2 & K2	1(K2)
5	CLO 5	Up to K-2	1	K2	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

K3 – Application oriented – Solving Problems

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	---	---	10	7.69	8
K2	---	70	50	120	92.31	92
Total Marks	10	70	50	130	100.00	100%

COURSE LEARNING OUTCOMES:

On the completion of the course the students will be able to

CLOs	COURSE LEARNING OUTCOME	Knowledge Level (basis of Bloom's Taxonomy)
CLO-1	Understand the basic idea and evolution of e-commerce	K1,K2
CLO-2	Understand the various business models for ecommerce and their relationships	K1, K2
CLO-3	Identify the technologies of the ecommerce activities and their goals	K1, K2
CLO-4	Analyse the online commercial and management activities	K1, K2
CLO-5	Understand the information systems and decision making on various applications of e-commerce.	K1, K2

MAPPING OF CLOs WITH PSO:

Course Outcomes	PSO 1 (Knowledge Base)	PSO 2 (Problem Analysis & Investigation)	PSO 3 (Communication Skills & Design)	PSO 4 (Individual and Team Work)	PSO 5 (Professionalism Ethics and equity)	PSO 6 (Life Long Learning)
CLO-1	3	1	1	2	1	1
CLO-2	1	2	3	1	1	1
CLO-3	2	1	1	1	1	2
CLO-4	2	1	1	1	2	1
CLO-5	2	2	2	3	2	1

3- Advanced Application

2- Intermediate

1- Introductory

MAPPING OF CLOs WITH POs:

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

1- Basic Level

2-Intermediate Level

3-Advanced Level

SEMESTER - VI

DEPARTMENT OF COMPUTER SCIENCE				CLASS: III B.Sc. Computer Science				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
VI	Core		.Net Programming	4	5	25	75	100

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

COURSE OBJECTIVES :

This course is designed to

- Identify and Understand the goals and objectives of the .NET Framework and ASP.NET
- Develop ASP.NET Web Applications using Standard Controls
- Handle SQL Server Database using ADO.NET

UNIT	Contents	No. of Hours	K-Level	CLO
I	Overview of .NET framework: Common Language Runtime (CLR), Framework Class Library- C# Fundamentals: Primitive types and Variables – Operators - Conditional statements -Looping statements – Creating and using Objects – Arrays – String operations.	15	K2	CLO1
II	Introduction to ASP.NET - IDE-Languages supported Components -Working with Web Forms – Web form standard controls: Properties and its events – HTML controls -List Controls: Properties and its events.	15	K3	CLO2
III	Rich Controls: Properties and its events – validation controls: Properties and its events– File Stream classes - File Modes – File Share – Reading and Writing to files – Creating, Moving, Copying and Deleting files – File uploading.	15	K3	CLO3
IV	ADO.NET Overview – Database Connections – Commands – Data Reader - Data Adapter - Data Sets - Data Controls and its Properties – Data Binding	15	K4	CLO4

V	Grid View control: Deleting, editing, Sorting, and Paging. XML classes – Web form to manipulate XML files - Website Security - Authentication - Authorization – Creating a Web application.	15	K3	CLO5
Total		75		

Text Books

1. SvetlinNakov, VeselinKolev & Co, Fundamentals of Computer Programming with C#, Faber publication,2019.
2. Mathew, Mac Donald, The Complete Reference ASP.NET, Tata McGraw-Hill,2015.

Books for Reference

1. Herbert Schildt, The Complete Reference C#.NET, TataMcGraw-Hill,2017.
2. Kogent Learning Solutions, C# 2012 Programming Covers .NET 4.5 Black Book, Dreamtechpres,2013.
3. Anne Boehm, Joel Murach, Murach's C# 2015, Mike Murach& Associates Inc.2016.
4. DenielleOtey, Michael Otey, ADO.NET: The Complete reference, McGrawHill,2008.
5. Matthew MacDonald, Beginning ASP.NET 4 in C# 2010,APRESS,2010.

Web Resources

1. <https://www.geeksforgeeks.org/introduction-to-net-framework/>
2. <https://www.javatpoint.com/net-framework>

Rationale for Nature of the course:

.NET Programming has assumed tremendous importance in the past decade and has been widely used across many industries towards solving their problems. Working knowledge of ASP.NET has become indispensable with regard to development of feature rich web applications catering to varied needs of the industry.

Activities having direct bearing on Skill development / Employability /Entrepreneurship

- Seminar
- Assignment preparation
- Presentation with ICT tools
- Live- demonstrations with program sample segments.

Pedagogy:

The teaching methods includes Chalk and talk, PowerPoint, demonstrations and assignments.

Lecture schedule:

Units	Topics	Hrs	Mode
I	Overview of .NET framework: Common Language Runtime (CLR), Framework Class Library-	4	Chalk and talk and assignment
	C# Fundamentals: Primitive types and Variables – Operators - Conditional statements -	4	
	Looping statements – Creating and using Objects	4	
	– Arrays – String operations.	3	
II	Introduction to ASP.NET - IDE-Languages supported Components -	4	Chalk and talk, Group discussion
	Working with Web Forms –	4	
	Web form standard controls: Properties and its events	4	
	HTML controls -List Controls: Properties and its events.	3	
III	Rich Controls: Properties and its events – validation controls: Properties and its events	5	Chalk and talk, Quiz and assignment
	– File Stream classes - File Modes – File Share – Reading and Writing to files –	5	
	Creating, Moving, Copying and Deleting files – File uploading.	5	
IV	ADO.NET Overview – Database Connections – Commands	5	PPT, Chalk and talk, Quiz and assignment
	Data Reader - Data Adapter	5	
	- Data Sets - Data Controls and its Properties – Data Binding	5	
V	Grid View control: Deleting, editing, Sorting, and Paging. XML classes	5	PPT, Chalk and talk, Quiz and assignment
	– Web form to manipulate XML files - Website Security -	5	
	Authentication - Authorization – Creating a Web application.	5	

Learning Outcome Based Education & Assessment (LOBE)
Blue Print – .Net Programming
Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)
BLUE PRINT FOR INTERNAL ASSESSMENT – I

S. No.	CLOs	K-Level	Section A		Section B (Either / or Choice)	Section C (Open Choice)
			No. of Questions	K-Level		
1.	CLO 1	Up to K 2	2	K1 & K2	2 (K1&K1)	1(K2)
2.	CLO 2	Up to K 3	3	K1 & K2	2 (K2&K2)	2(K3)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each Question			2		5	10
Total Marks for each Section			10		10	20

BLUE PRINT FOR INTERNAL ASSESSMENT – II

S. No.	CLOs	K-Level	Section A		Section B (Either / or Choice)	Section C (Open Choice)
			No. of Questions	K-Level		
1.	CLO 3	Up to K 3	2	K1 & K2	2	1(K4)
2.	CLO 4	Up to K 4	3	K1 & K2	2	2(K3)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each Question			2		5	10
Total Marks for each Section			10		10	20

Learning Outcome Based Education & Assessment (LOBE)

Blue Print – .NET Programming

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 K-2	2	K1 & K2	1	K1	2 (K1&K1)	1(K2)
2	CLO 2	Up to K-3	2	K1 & K2	1	K2	2 (K2&K2)	1(K3)
3	CLO 3	Up to K-3	2	K1 & K2	1	K2	2 (K3&K3)	1(K3)
4	CLO 4	Up to K-3	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
5	CLO 5	Up to K-4	2	K1 & K2	1	K2	2 (K4&K4)	1(K4)
No. of Questions to be			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 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%

Distribution of Unit-wise questions with K Levels

Section A	Section B	Section C	Section D
2 Questions for each Unit (K1 & K2 Level)	1 Question from each Unit (K1 & K2 Level)	2 Questions from Unit-I (K1 Level)	1Question from Unit-I (K2 Level)
		2 Questions from Unit-II (K3 Level)	1Question from Unit-II (K3 Level)
		2 Questions from Unit-III (K3 Level)	1Question from Unit-III (K4 Level)
		2 Questions from Unit-IV (K2 Level)	1Question from Unit-IV (K3 Level)
		2 Questions from Unit-V (K4 Level)	1Question from Unit-V (K3 Level)

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 interferences with evidences

COURSE LEARNING OUTCOMES:

On the completion of the course the students will be able to

CLOs	COURSE LEARNING OUTCOME	Knowledge Level (basis of Bloom's Taxonomy)
1	Develop working knowledge of C# programming constructs and the .NET Framework	Upto K2
2	To develop a software to solve real-world problems using ASP.NET	Upto K3
3	To Work On Various Controls Files	Upto K3
4	To create a web application using Microsoft ADO.NET.	Upto K4
5	To develop web applications using XML	Upto K3

MAPPING OF CLOs WITH PSOs:

Course Outcomes	PSO 1 (Knowledge Base)	PSO 2 (Problem Analysis & Investigation)	PSO 3 (Communication Skills & Design)	PSO 4 (Individual and Team Work)	PSO 5 (Professionalism Ethics and equity)	PSO 6 (Life Long Learning)
CLO-1	3	1	1	2	1	1
CLO-2	1	2	3	1	1	1
CLO-3	2	1	1	1	1	2
CLO-4	2	1	1	1	2	1
CLO-5	2	2	2	3	2	1

3- Advanced Application

2- Intermediate

1- Introductory

MAPPING OF CLOs WITH POs:

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

1- Basic Level

2-Intermediate Level

3-Advanced Level

DEPARTMENT OF COMPUTER SCIENCE				CLASS: III B.Sc. Computer Science				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
VI	Core		Data Mining and Warehouse	4	5	25	75	100

Nature of course					
Skill oriented		Employability oriented	✓	Entrepreneurship Oriented	✓

COURSE OBJECTIVES :

This course is designed to

- Provide knowledge on Data Mining and Warehousing concepts and techniques
- Study the basic concepts of Data Mining Architecture
- Study about association, classification, and clustering principles

UNIT	Contents	No. of Hours	K-Level	CLO
I	Introduction: Data mining – Functionalities – Classification – Introduction to Data Warehousing – Data Preprocessing: Preprocessing the Data – Data cleaning – Data Integration and Transformation – Data Reduction	15	K2	CLO1
II	Data Mining, Primitives, Languages and System Architecture: Data Mining – Primitives – Data Mining Query Language, Architecture of Data mining Systems. Concept Description, Characterization and Comparison: Concept Description, Data Generalization and Summarization, Analytical Characterization, Mining Class Comparison – Statistical Measures.	15	K3	CLO2
III	Mining Association Rules: Basic Concepts – Single Dimensional Boolean Association Rules From Transaction Databases, Multilevel Association Rules from transaction databases – Multi dimension Association Rules from Relational Database and Data Warehouses.	15	K3	CLO3
IV	Classification and Prediction: Introduction – Issues – Decision Tree Induction – Bayesian Classification – Classification of Back Propagation. Classification based on Concepts from Association Rule Mining – Other Methods. Prediction – Introduction – Classifier Accuracy	15	K4	CLO4

V	Cluster Analysis: Introduction – Types of Data in Cluster Analysis, Partitioning Methods – Hierarchical Methods-Density Based Methods – GRID Based Method – Model based Clustering Method	15	K3	CLO5
	Total	75		

Text Book

1. Han and M. Kamber, “Data Mining Concepts and Techniques”, 2001, Harcourt India Pvt. Ltd, New Delhi.

Books for Reference

1. K.P. Soman, ShyamDiwakar, V. Ajay “Insight into Data Mining Theory and Practice “;Prentice Hall of India Pvt. Ltd, New Delhi
2. Parteek Bhatia, ‘Data Mining and Data Warehousing: Principles and Practical Techniques’, Cambridge University Press, 2019

Web Resources

1. <https://www.topcoder.com/thrive/articles/data-warehousing-and-data-mining#:~:text=Data%20warehousing%20is%20a%20method,compiled%20in%20the%20data%20warehouse.>
2. <https://www.javatpoint.com/data-mining-cluster-vs-data-warehousing>
3. <https://www.tutorialspoint.com/Data-Warehousing-and-Data-Mining>

Rationale for Nature of the course:

Data mining improves the speed and efficiency of accessing various data sets and makes it easier for decision making. Data mining is considered for process of extracting useful data from very big set of data.

Activities having direct bearing on Skill development / Employability /Entrepreneurship

- Seminar
- Assignment preparation
- Presentation with ICT tools
- Live- demonstrations.

Pedagogy:

The teaching methods includes Chalk and talk, PowerPoint, demonstrations and assignments.

Lecture schedule:

Units	Topics	Hrs	Mode
I	Introduction: Data mining – Functionalities – Classification – Introduction to Data Warehousing–	5	Chalk and talk and assignment
	– Data Pre-processing : Pre-processing the Data – Data cleaning	5	
	Data Integration and Transformation – Data Reduction	5	
II	Data Mining, Primitives, Languages and System Architecture: Data Mining –Primitives –	5	Chalk and talk, Group discussion
	Data Mining Query Language, Architecture of Data mining Systems. Concept Description, Characterization and Comparison: Concept	5	
	Description, Data Generalization and Summarization, Analytical Characterization, Mining Class Comparison – Statistical Measures.	5	
III	Mining Association Rules: Basic Concepts – Single Dimensional Boolean	5	Chalk and talk, Quiz and assignment
	Association Rules From Transaction Databases, Multilevel Association Rules from transaction databases	5	
	Multi dimension Association Rules from Relational Database and Data Warehouses.	5	
IV	Classification and Prediction: Introduction – Issues – Decision Tree Induction –	5	PPT, Chalk and talk, Quiz and assignment
	Bayesian Classification – Classification of Back Propagation.	5	
	Classification based on Concepts from Association Rule Mining – Other Methods. Prediction – Introduction – Classifier Accuracy.	5	
V	Cluster Analysis: Introduction – Types of Data in Cluster Analysis,	5	PPT, Chalk and talk, Quiz and assignment
	Petitioning Methods – Hierarchical Methods-Density Based Methods	5	
	– GRID Based Method – Model based Clustering Method	5	

Learning Outcome Based Education & Assessment (LOBE)
Blue Print – Data mining and data warehouse
Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)
BLUE PRINT FOR INTERNAL ASSESSMENT – I

S. No.	CLOs	K-Level	Section A		Section B (Either / or Choice)	Section C (Open Choice)
			No. of Questions	K-Level		
1.	CLO 1	Up to K 2	2	K1 & K2	2 (K1&K1)	1(K2)
2.	CLO 2	Up to K 3	3	K1 & K2	2 (K2&K2)	2(K3)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each Question			2		5	10
Total Marks for each Section			10		10	20

BLUE PRINT FOR INTERNAL ASSESSMENT – II

S. No.	CLOs	K-Level	Section A		Section B (Either / or Choice)	Section C (Open Choice)
			No. of Questions	K-Level		
1.	CLO 3	Up to K 3	2	K1 & K2	2	1(K4)
2.	CLO 4	Up to K 4	3	K1 & K2	2	2(K3)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each Question			2		5	10
Total Marks for each Section			10		10	20

Learning Outcome Based Education & Assessment (LOBE)

Blue Print – Data mining and data warehouse

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 K-2	2	K1 & K2	1	K1	2 (K1&K1)	1(K2)
2	CLO 2	Up to K-3	2	K1 & K2	1	K2	2 (K2&K2)	1(K3)
3	CLO 3	Up to K-4	2	K1 & K2	1	K2	2 (K3&K3)	1(K4)
4	CLO 4	Up to K-3	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
5	CLO 5	Up to K-4	2	K1 & K2	1	K2	2 (K4&K4)	1(K3)
No. of Questions to be			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 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%

Distribution of Unit-wise questions with K Levels

Section A	Section B	Section C	Section D
2 Questions for each Unit (K1 & K2 Level)	1 Question from each Unit (K1 & K2 Level)	2 Questions from Unit-I (K1 Level)	1Question from Unit-I (K2 Level)
		2 Questions from Unit-II (K3 Level)	1Question from Unit-II (K3 Level)
		2 Questions from Unit-III (K3 Level)	1Question from Unit-III (K4 Level)
		2 Questions from Unit-IV (K2 Level)	1Question from Unit-IV (K3 Level)
		2 Questions from Unit-V (K4 Level)	1Question from Unit-V (K3 Level)

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 interferences with evidences

COURSE LEARNING OUTCOMES:

On the completion of the course the students will be able to

CLOs	COURSE LEARNING OUTCOME	Knowledge Level (basis of Bloom's Taxonomy)
CLO-1	Identify the scope and necessity of Data Mining and Warehousing	Up to K2
CLO-2	Understand data quality and methods and techniques for pre-processing of data	Up to K3
CLO-3	Analyse the patterns that can be discovered by classification and clustering	Up to K3
CLO-4	Understand data mining techniques clustering and association rule mining	Up to K4
CLO-5	Identify complex cluster data analysis methods	Up to K3

MAPPING OF CLOs WITH PSOs:

Course Outcomes	PSO 1 (Knowledge Base)	PSO 2 (Problem Analysis & Investigation)	PSO 3 (Communication Skills & Design)	PSO 4 (Individual and Team Work)	PSO 5 (Professionalism Ethics and equity)	PSO 6 (Life Long Learning)
CLO-1	3	1	1	2	1	1
CLO-2	2	3	2	1	1	1
CLO-3	2	3	1	1	1	2
CLO-4	3	2	2	1	2	1
CLO-5	2	2	2	3	2	1

3- Advanced Application

2- Intermediate

1- Introductory

MAPPING OF CLOs WITH POs:

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

1- Basic Level

2-Intermediate Level

3-Advanced Level

DEPARTMENT OF COMPUTER SCIENCE				CLASS: III B.Sc. Computer Science				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/ week	CIA	Ext	Total
VI	Core		Open Source Technology	4	5	25	75	100

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

COURSE OBJECTIVES :

This course is designed

- Introduces Open Source methodologies.
- To make the students to gain experience using open source tools, languages and frameworks to prepare for careers in software development.

Units	CONTENTS	Total Hours: 75	K-Level	CLO
I	Introduction : Open Source, Free Software, Free Software vs. Open Source software, Public Domain Software, FOSS does not mean no cost. History : BSD, The Free Software Foundation and the GNU Project.	15 hrs	Up to K2	1
II	Open Source History, Initiatives, Principle and methodologies. Philosophy : Software Freedom, Open Source Development Model Licences and Patents: What Is A License, Important FOSS Licenses (Apache, BSD, GPL, LGPL), copyrights and copylefts, Patents Economics of FOSS : Zero Marginal Cost, Income-generation opportunities, Problems with traditional commercial software, Internationalization	15 hrs	Up to K3	2
III	Community Building: Importance of Communities in Open Source MovementJBoss Community- Starting and Maintaining an Open Source Project - Open Source Hardware	15 hrs	Up to K3	3
IV	Apache HTTP Server and its flavours- WAMP server (Windows, Apache, MySQL, PHP)- Apache, MySQL, PHP, JAVA as development platform.	15 hrs	Up to K3	4
V	Open source vs. closed source Open source government, Open source ethics. Social and Financial impacts of open source technology, Shared software, Shared source.	15 hrs	Up to K4	5

Books for Study:

1. Sumitabha Das “Unix Concepts and Applications, Tata McGraw Hill Education 006
2. The Official Ubuntu Book, 8th Edition
3. Kailash Vadera, Bhavyesh Gandhi, “Open Source Technology”, University Science press, ker

Books for Reference :

1. Paul Kavanagh, “Open Source Software: Implementation and Management”, Elsevier Digital Press
2. The Linux Documentation Project : <http://www.tldp.org>
3. Docker Project Home : <http://www.docker.com>

Web resources:

1. https://www.tutorialspoint.com/basics_of_computers/basics_of_computers_open_source_software.htm
2. <https://ittutorials.net/open-source/>
3. <https://training.linuxfoundation.org/training/beginners-guide-open-source-software-development/>

Rationale for Nature of the course:

Open-source software may be developed in a collaborative public manner. Open-source software is a prominent example of open collaboration, meaning any capable user is able to participate online in development, making the number of possible contributors indefinite. The ability to examine the code facilitates public trust in the software. Open source code can be used for studying and allows capable end users to adapt software to their personal needs

Activities having direct bearing on Skill development / Employability /Entrepreneurship

- Seminar
- Assignment preparation
- Presentation with ICT tools
- Live- demonstrations.

Pedagogy:

The teaching methods includes Chalk and talk, PowerPoint, demonstrations and assignments.

Lecture schedule:

Units	Topics	Hrs	Mode
I	Introduction : Open Source, Free Software, Free Software vs. Open Source software,	5	Chalk and talk and assignment
	Public Domain Software, FOSS does not mean no cost.	5	
	History : BSD, The Free Software Foundation and the GNU Project.	5	
II	Open Source History, Initiatives, Principle and methodologies. Philosophy : Software Freedom, Open Source Development	4	Chalk and talk, Group discussion
	Model Licences and Patents: What Is A License, Important FOSS Licenses (Apache, BSD,GPL, LGPL),	4	
	copyrights and copyleft, Patents Economics of FOSS : Zero Marginal Cost, Income-generation opportunities,	4	
	Problems with traditional commercial software, Internationalization	3	
III	Community Building: Importance of Communities in Open Source -	5	Chalk and talk, Quiz and assignment
	MovementJBoss Community- Starting and Maintaining an Open Source Project	5	
	Open Source Hardware	5	
IV	Apache HTTP Server and its flavors- WAMP server (Windows, Apache, MySQL, PHP)-	5	PPT, Chalk and talk, Quiz and assignment
	Apache, MySQL,	5	
	PHP, JAVA as development platform.	5	
V	Open source vs. closed source Open source government, Open source ethics.	5	PPT, Chalk and talk, Quiz and assignment
	Social and Financial impacts of open source technology,	5	
	Shared software, Shared source.	5	

Learning Outcome Based Education & Assessment (LOBE)**Blue Print – Open Source Technology****Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)****BLUE PRINT FOR INTERNAL ASSESSMENT – I**

S. No.	CLOs	K-Level	Section A		Section B (Either / or Choice)	Section C (Open Choice)
			No. of Questions	K-Level		
1.	CLO 1	Up to K 2	2	K1 & K2	2 (K1&K1)	1(K2)
2.	CLO 2	Up to K 3	3	K1 & K2	2 (K2&K2)	2(K3)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each Question			2		5	10
Total Marks for each Section			10		10	20

BLUE PRINT FOR INTERNAL ASSESSMENT – II

S. No.	CLOs	K-Level	Section A		Section B (Either / or Choice)	Section C (Open Choice)
			No. of Questions	K-Level		
1.	CLO 3	Up to K 3	2	K1 & K2	2	1(K4)
2.	CLO 4	Up to K 4	3	K1 & K2	2	2(K3)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each Question			2		5	10
Total Marks for each Section			10		10	20

Learning Outcome Based Education & Assessment (LOBE)

Blue Print – Open Source Technology

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 K-2	2	K1 & K2	1	K1	2 (K1&K1)	1(K2)
2	CLO 2	Up to K-3	2	K1 & K2	1	K2	2 (K2&K2)	1(K3)
3	CLO 3	Up to K-4	2	K1 & K2	1	K2	2 (K3&K3)	1(K4)
4	CLO 4	Up to K-3	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
5	CLO 5	Up to K-4	2	K1 & K2	1	K2	2 (K4&K4)	1(K3)
No. of Questions to be			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 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%

Distribution of Unit-wise questions with K Levels

Section A	Section B	Section C	Section D
2 Questions for each Unit (K1 & K2 Level)	1 Question from each Unit (K1 & K2 Level)	2 Questions from Unit-I (K1 Level)	1Question from Unit-I (K2 Level)
		2 Questions from Unit-II (K3 Level)	1Question from Unit-II (K3 Level)
		2 Questions from Unit-III (K3 Level)	1Question from Unit-III (K4 Level)
		2 Questions from Unit-IV (K2 Level)	1Question from Unit-IV (K3 Level)
		2 Questions from Unit-V (K4 Level)	1Question from Unit-V (K3 Level)

COURSE LEARNING OUTCOMES:

On the completion of the course the students will be able to

CLOs	COURSE LEARNING OUTCOME	Knowledge Level (basis of Bloom's Taxonomy)
CLO-1	Understand the concepts of Open Source, Free Software, Free Software vs. Open Source software, Public Domain Software,	Up to K2
CLO-2	Describe the Open Source History, Initiatives, Principle and methodologies.	Up to K3
CLO-3	Identify maintenance of open source project methods	Up to K3
CLO-4	Understand the procedures of Apache and WAMP server interfacing	Up to K4
CLO-5	Analyse the procedures for shared software and shared sources	Up to K3

MAPPING OF CLOs WITH PSOs:

Course Outcomes	PSO 1 (Knowledge Base)	PSO 2 (Problem Analysis & Investigation)	PSO 3 (Communication Skills & Design)	PSO 4 (Individual and Team Work)	PSO 5 (Professionalism Ethics and equity)	PSO 6 (Life Long Learning)
CLO-1	3	1	1	2	1	1
CLO-2	2	3	2	1	1	1
CLO-3	2	3	1	1	1	2
CLO-4	3	2	2	1	2	1
CLO-5	2	2	2	3	2	1

3- Advanced Application

2- Intermediate

1- Introductory

MAPPING OF CLOs WITH POs:

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

1- Basic Level

2-Intermediate Level

3-Advanced Level

DEPARTMENT OF COMPUTER SCIENCE				CLASS: III B.Sc. Computer Science				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/ week	CIA	Ext	Total
VI	Core Practical		.NET Programming Lab	3	3	25	75	100

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

COURSE OBJECTIVES :

This course is designed to

- Develop ASP.NET Web Application using standard controls
- Implement file handling in ASP.NET
- Create rich database applications using ADO.NET

List of Exercises

1. Create an exposure of Web applications and tools
2. Implement the Html Controls
3. Implement the Server Controls
4. Web application using Web controls.
5. Web application using List controls.
6. Web Page design using Rich control. Validate user input using Validation controls. Working with File concepts.
7. Web application using Data Controls.
8. Data binding with Web controls
9. Data binding with Data Controls.
10. 10 Database application to perform insert, update and delete operations.
11. 11.Database application using Data Controls to perform insert, delete, edit, paging and sorting operation.
12. Implement the Xml classes.
13. Implement Authentication – Authorization.
14. Ticket reservation using ASP.NET controls.
15. Online examination using ASP.NET controls

Rationale for the nature of the course:

ASP.NET has become an indispensable tool for development of feature rich web applications and the course aims to introduce the techniques and practices of ASP.NET

Activities having direct bearing on Skill development / Employability /Entrepreneurship

- Lab tutorial class
- Algorithm preparation
- Live- demonstrations.

COURSE LEARNING OUTCOMES:

On the completion of the course the students will be able to

CLOs	COURSE LEARNING OUTCOME	Knowledge Level (basis of Bloom's Taxonomy)
CO1	To create web applications and implement various controls	Upto K4
CO2	Create web pages in Rich control.	Upto K4
CO3	Develop knowledge about file handling operations	Upto K4
CO4	An ability to design XML classes	Upto K4
CO5	To develop a software to solve real-world problems using ASP.NET	Upto K4

MAPPING OF CLOs WITH PSOs:

Course Outcomes	PSO 1 (Knowledge Base)	PSO 2 (Problem Analysis & Investigation)	PSO 3 (Communication Skills & Design)	PSO 4 (Individual and Team Work)	PSO 5 (Professionalism Ethics and equity)	PSO 6 (Life Long Learning)
CLO-1	3	1	1	2	1	1
CLO-2	2	3	2	1	1	1
CLO-3	2	3	1	1	1	2
CLO-4	3	2	2	1	2	1
CLO-5	2	2	2	3	2	1

3- Advanced Application

2- Intermediate

1- Introductory

MAPPING OF CLOs WITH POs:

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

1- Basic Level

2-Intermediate Level

3-Advanced Level

DEPARTMENT OF COMPUTER SCIENCE				CLASS: III B.Sc. Computer Science				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
VI	Elective		Cloud Computing	2	4	25	75	100

Nature of course					
Skill oriented		Employability oriented	✓	Entrepreneurship Oriented	✓

COURSE OBJECTIVES :

This course is designed to

- Learn various cloud service types and technologies in cloud computing
- Learn Cloud Architecture and application design
- Learn various aspects of application design and security

UNIT	Contents	No. of Hours	K-Level	CLO
I	Introduction to Cloud Computing: Definition of Cloud Computing – Characteristics of Cloud Computing – Cloud Models – Cloud Service Examples – Cloud-based Services and Applications. Cloud Concepts and Technologies: Virtualization – Load balancing – Scalability and Elasticity – Deployment – Replication – Monitoring – Software Defined Networking – Network Function Virtualization – MapReduce – Identity and Access Management – Service Level Agreements – Billing.	12	K2	CLO1
II	Cloud Services Compute Services: Amazon Elastic Computer Cloud - Google Compute Engine - Windows Azure Virtual Machines Storage Services: Amazon Simple Storage Service - Google Cloud Storage - Windows Azure Storage Database Services: Amazon Relational Data Store - Amazon Dynamo DB - Google Cloud SQL - Google Cloud Data Store - Windows Azure SQL Database - Windows Azure Table Service Application Services: Application Runtimes and Frameworks - Queuing Services - Email Services - Notification Services - Media Services Content Delivery Services: Amazon CloudFront -	12	K3	CLO2

	Windows Azure Content Delivery Network Analytics Services: Amazon Elastic MapReduce - Google MapReduce Service - Google BigQuery - Windows Azure HDInsight Deployment and Management Services: Amazon Elastic Beanstalk - Amazon CloudFormation Identity and Access Management Services: Amazon Identity and Access Management - Windows Azure Active Directory Open Source Private Cloud Software: CloudStack – Eucalyptus - OpenStack			
III	Cloud Application Design: Introduction – Design Consideration for Cloud Applications – Scalability – Reliability and Availability – Security – Maintenance and Upgradation – Performance – Reference Architectures for Cloud Applications – Cloud Application Design Methodologies: Service Oriented Architecture (SOA), Cloud Component Model, IaaS, PaaS and SaaS Services for Cloud Applications, Model View Controller (MVC), RESTful Web Services – Data Storage Approaches: Relational Approach (SQL), Non-Relational Approach (NoSQL).	12	K3	CLO3
IV	Cloud Application Benchmarking and Tuning: Introduction to Benchmarking – Steps in Benchmarking – Workload Characteristics – Application Performance Metrics – Design Consideration for Benchmarking Methodology – Benchmarking Tools and Types of Tests – Deployment Prototyping. Cloud Security: Introduction – CSA Cloud Security Architecture – Authentication (SSO) – Authorization – Identity and Access Management – Data Security: Securing data at rest, securing data in motion – Key Management – Auditing.	12	K4	CLO4
V	Case Studies: Cloud Computing for Healthcare – Cloud Computing for Energy Systems - Cloud Computing for Transportation Systems - Cloud Computing for Manufacturing Industry - Cloud Computing for Education.	12	K3	CLO5
	Total	60		

Text Book

ArshdeepBahga, Vijay Madiseti, Cloud Computing – A Hands On Approach, Universities Press (India) Pvt. Ltd., 2018

Books for Reference

1. Anthony T Velte, Toby J Velte, Robert Elsenpeter, Cloud Computing: A Practical Approach, Tata McGraw-Hill, 2013.
2. Barrie Sosinsky, Cloud Computing Bible, Wiley India Pvt. Ltd., 2013.
3. David Crookes, Cloud Computing in Easy Steps, Tata McGraw Hill, 2015.
4. Dr. Kumar Saurabh, Cloud Computing, Wiley India, Second Edition 2012.

Web Resources

1. https://en.wikipedia.org/wiki/Cloud_computing
2. https://link.springer.com/chapter/10.1007/978-3-030-34957-8_7
3. <https://webobjects.cdw.com/webobjects/media/pdf/solutions/cloud-computing/121838-CDW-Cloud-Computing-Reference-Guide.pdf>

Rationale for the Nature of the Course:

Cloud computing makes data backup, disaster recovery, and business continuity easier and less expensive because data can be mirrored at multiple redundant sites on the cloud provider's network. Cloud infrastructure involves the hardware and software components required for the proper deployment of a cloud computing model.

Activities having a direct bearing on Skill development / Employability /Entrepreneurship

- Seminar
- Assignment preparation
- Presentation with ICT tools
- Live- demonstrations.

Pedagogy:

The teaching methods include Chalk and talk, PowerPoint, demonstrations and assignments.

Lecture schedule:

Units	Topics	Hrs	Mode
I	Introduction to Cloud Computing: Definition of Cloud Computing – Characteristics of Cloud Computing – Cloud Models – Cloud Service Examples – Cloud-based Services and Applications.	4	Chalk and talk and assignment
	Cloud Concepts and Technologies: Virtualization – Load balancing – Scalability and Elasticity – Deployment – Replication – Monitoring –	4	
	Software Defined Networking – Network Function Virtualization – MapReduce – Identity and Access Management – Service Level Agreements – Billing.	4	
II	Cloud Services Compute Services: Amazon Elastic Computer Cloud - Google Compute Engine - Windows Azure Virtual Machines . Storage Services: Amazon Simple Storage Service - Google Cloud Storage - Windows Azure Storage Database Services: Amazon Relational Data Store - Amazon Dynamo DB - Google Cloud SQL - Google Cloud Data Store - Windows Azure SQL Database - Windows Azure Table Service	4	Chalk and talk, Group discussion
	Application Services: Application Runtimes and Frameworks - Queuing Services - Email Services - Notification Services - Media Services Content Delivery Services: Amazon CloudFront - Windows Azure Content Delivery Network Analytics Services: Amazon Elastic MapReduce - Google MapReduce Service - Google BigQuery - Windows Azure HDInsight	4	
	Deployment and Management Services: Amazon Elastic Beanstalk - Amazon CloudFormation Identity and Access Management Services: Amazon Identity and Access Management -	4	
	Windows Azure Active Directory Open Source Private Cloud Software: CloudStack – Eucalyptus - OpenStack	4	
III	Cloud Application Design: Introduction – Design Consideration for Cloud Applications – Scalability –	4	Chalk and talk, Quiz and assignment
	Reliability and Availability – Security – Maintenance and Upgradation – Performance – Reference Architectures for Cloud Applications –	4	
	Cloud Application Design Methodologies: Service Oriented Architecture (SOA), Cloud Component Model, IaaS, PaaS and SaaS Services for Cloud Applications, Model View Controller (MVC), RESTful Web Services – Data Storage Approaches: Relational Approach (SQL), Non-Relational Approach (NoSQL).	4	

IV	Cloud Application Benchmarking and Tuning: Introduction to Benchmarking – Steps in Benchmarking – Workload Characteristics – Application Performance Metrics –	4	PPT, Chalk and talk, Quiz and assignment
	Design Consideration for Benchmarking Methodology – Benchmarking Tools and Types of Tests – Deployment Prototyping.	4	
	Cloud Security: Introduction – CSA Cloud Security Architecture – Authentication (SSO) – Authorization – Identity and Access Management – Data Security : Securing data at rest, securing data in motion – Key Management – Auditing.	4	
V	Case Studies: Cloud Computing for Healthcare –	4	PPT, Chalk and talk, Quiz and assignment
	Cloud Computing for Energy Systems - Cloud Computing for Transportation Systems -	4	
	Cloud Computing for Manufacturing Industry - Cloud Computing for Education.	4	

Learning Outcome Based Education & Assessment (LOBE)

Blue Print – Cloud Computing

Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

BLUE PRINT FOR INTERNAL ASSESSMENT – I

S. No.	CLOs	K-Level	Section A		Section B (Either / or Choice)	Section C (Open Choice)
			No. of Questions	K-Level		
1.	CLO 1	Up to K 2	2	K1 & K2	2 (K1&K1)	1(K2)
2.	CLO 2	Up to K 3	3	K1 & K2	2 (K2&K2)	2(K3)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each Question			2		5	10
Total Marks for each Section			10		10	20

BLUE PRINT FOR INTERNAL ASSESSMENT – II

S. No.	CLOs	K-Level	Section A		Section B (Either / or Choice)	Section C (Open Choice)
			No. of Questions	K-Level		
1.	CLO 3	Up to K 3	2	K1 & K2	2 (K3&K3)	1(K4)
2.	CLO 4	Up to K 4	3	K1 & K2	2 (K3&K3)	2(K3)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each Question			2		5	10
Total Marks for each Section			10		10	20

Learning Outcome Based Education & Assessment (LOBE)

Blue Print – Cloud Computing

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 K-2	2	K1 & K2	1	K1	2 (K1&K1)	1(K2)
2	CLO 2	Up to K-3	2	K1 & K2	1	K2	2 (K2&K2)	1(K3)
3	CLO 3	Up to K-4	2	K1 & K2	1	K2	2 (K3&K3)	1(K4)
4	CLO 4	Up to K-3	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
5	CLO 5	Up to K-4	2	K1 & K2	1	K2	2 (K4&K4)	1(K3)
No. of Questions to be			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 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%

Distribution of Unit-wise questions with K Levels

Section A	Section B	Section C	Section D
2 Questions for each Unit (K1 & K2 Level)	1 Question from each Unit (K1 & K2 Level)	2 Questions from Unit-I (K1 Level)	1Question from Unit-I (K2 Level)
		2 Questions from Unit-II (K3 Level)	1Question from Unit-II (K3 Level)
		2 Questions from Unit-III (K3 Level)	1Question from Unit-III (K4 Level)
		2 Questions from Unit-IV (K2 Level)	1Question from Unit-IV (K3 Level)
		2 Questions from Unit-V (K4 Level)	1Question from Unit-V (K3 Level)

COURSE LEARNING OUTCOMES:

On the completion of the course the students will be able to

CLOs	COURSE LEARNING OUTCOME	Knowledge Level (basis of Bloom's Taxonomy)
CO 1	Understand the fundamental concepts and Technologies in Cloud Computing.	Upto K2
CO 2	Able to understand various cloud service types and their uses and pitfalls.	Upto K3
CO 3	Able to understand Cloud Architecture and Application design.	Upto K3
CO 4	Understand the various aspects of application design, benchmarking, and security in the Cloud.	Upto K4
CO 5	Understand various Case Studies in Cloud Computing.	Upto K3

MAPPING OF CLOs WITH PSOs:

Course Outcomes	PSO 1 (Knowledge Base)	PSO 2 (Problem Analysis & Investigation)	PSO 3 (Communication Skills & Design)	PSO 4 (Individual and Team Work)	PSO 5 (Professionalism Ethics and equity)	PSO 6 (Life Long Learning)
CLO-1	3	1	1	2	1	1
CLO-2	2	3	2	1	1	1
CLO-3	2	3	1	1	1	2
CLO-4	3	2	2	1	2	1
CLO-5	2	2	2	3	2	1

3- Advanced Application

2- Intermediate

1- Introductory

MAPPING OF CLOs WITH POs:

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

1- Basic Level

2-Intermediate Level

3-Advanced Level

DEPARTMENT OF COMPUTER SCIENCE				CLASS: III B.Sc. Computer Science				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
VI	Elective		Cryptography	2	4	25	75	100

Nature of course								
Skill oriented	✓	✓	Employability oriented		Entrepreneurship Oriented			

COURSE OBJECTIVES :

This course is designed to

- Understand the fundamentals of cryptography
- Acquire knowledge on standard algorithms used to provide confidentiality, integrity, and authenticity
- Understand the various key distribution and management schemes

UNIT	Contents	No. Of. Hours	K-Level	CLO
I	Introduction: The OSI security Architecture – Security Attacks – Security Mechanisms – Security Services – A model for network Security.	12	Upto K2	CLO1
II	Classical Encryption Techniques: Symmetric cipher model – Substitution Techniques: Caesar Cipher – Monoalphabetic cipher – Play fair cipher – Poly Alphabetic Cipher – Transposition techniques – Stenography	12	Upto K3	CLO2
III	Block Cipher and DES: Block Cipher Principles – DES – The Strength of DES – RSA: The RSA algorithm.	12	Upto K3	CLO3
IV	Network Security Practices: IP Security overview - IP Security architecture – Authentication Header. Web Security: SecureSocketLayer and Transport Layer Security – Secure Electronic Transaction.	12	Upto K4	CLO4
V	Intruders – Malicious software – Firewalls.	12	Upto K3	CLO5
TOTAL HOURS		60		

Textbook

William Stallings, “Cryptography and Network Security Principles and Practices”.

Books for Reference

1. Behrouz A. Foruzan, “Cryptography and Network Security”, Tata McGraw-Hill, 2007.
2. Atul Kahate, “Cryptography and Network Security”, Second Edition, 2003, TMH.
3. 3 M.V. Arun Kumar, “Network Security”, 2011, First Edition, USP.

Web Resources

1. <https://www.tutorialspoint.com/cryptography/>
2. <https://gpgtools.tenderapp.com/kb/how-to/introduction-to-cryptography>

Rationale for the Nature of the Course:

Cryptography ensures confidentiality by encrypting sent messages using an algorithm with a key only known to the sender and recipient. Cryptography allows the information to remain secure and enables parties to send and receive complex messages. Cryptography can ensure the confidentiality and integrity of both data in transit as well as the data remains.

Activities having a direct bearing on Skill development / Employability / Entrepreneurship

- Seminar
- Assignment preparation
- Presentation with ICT tools
- Live- demonstrations.

Pedagogy:

The teaching methods include Chalk and talk, PowerPoint, demonstrations and assignments.

Lecture schedule:

Units	Topics	Hrs	Mode
I	Introduction: The OSI security Architecture – Security Attacks –	4	Chalk and talk and assignment
	Security Mechanisms – Security Services	4	
	– A model for network Security.	4	
II	Classical Encryption Techniques: Symmetric cipher model – Substitution Techniques: Caesar Cipher –	4	Chalk and talk, Group discussion
	Monoalphabetic cipher – Play fair cipher –	4	
	Poly Alphabetic Cipher – Transposition techniques – Stenography	4	
III	Block Cipher and DES: Block Cipher Principles –	4	Chalk and talk, Quiz and assignment
	DES – The Strength of DES –	4	
	RSA: The RSA algorithm.	4	
IV	Network Security Practices: IP Security overview	4	PPT, Chalk and talk, Quiz and assignment
	- IP Security architecture – Authentication Header.	4	
	Web Security: SecureSocketLayer and Transport Layer Security – Secure Electronic Transaction.	4	
V	Intruders –	4	PPT, Chalk and talk, Quiz and assignment
	Malicious software	4	
	– Firewalls.	4	

Learning Outcome Based Education & Assessment (LOBE)
Blue Print – Cryptography
Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)
BLUE PRINT FOR INTERNAL ASSESSMENT – I

S. No.	CLOs	K-Level	Section A		Section B (Either / or Choice)	Section C (Open Choice)
			No. of Questions	K-Level		
1.	CLO 1	Up to K 2	2	K1 & K2	2 (K1&K1)	1(K2)
2.	CLO 2	Up to K 3	3	K1 & K2	2 (K2&K2)	2(K3)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each Question			2		5	10
Total Marks for each Section			10		10	20

BLUE PRINT FOR INTERNAL ASSESSMENT – II

S. No.	CLOs	K-Level	Section A		Section B (Either / or Choice)	Section C (Open Choice)
			No. of Questions	K-Level		
1.	CLO 3	Up to K 3	2	K1 & K2	2 (K3&K3)	1(K4)
2.	CLO 4	Up to K 4	3	K1 & K2	2 (K3&K3)	2(K3)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each Question			2		5	10
Total Marks for each Section			10		10	20

Learning Outcome Based Education & Assessment (LOBE)
Blue Print – Cryptography
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 K-2	2	K1 & K2	1	K1	2 (K1&K1)	1(K2)
2	CLO 2	Up to K-3	2	K1 & K2	1	K2	2 (K2&K2)	1(K3)
3	CLO 3	Up to K-4	2	K1 & K2	1	K2	2 (K3&K3)	1(K4)
4	CLO 4	Up to K-3	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
5	CLO 5	Up to K-4	2	K1 & K2	1	K2	2 (K4&K4)	1(K3)
No. of Questions to be			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 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%

Distribution of Unit-wise questions with K Levels

Section A	Section B	Section C	Section D
2 Questions for each Unit (K1 & K2 Level)	1 Question from each Unit (K1 & K2 Level)	2 Questions from Unit-I (K1 Level)	1Question from Unit-I (K2 Level)
		2 Questions from Unit-II (K3 Level)	1Question from Unit-II (K3 Level)
		2 Questions from Unit-III (K3 Level)	1Question from Unit-III (K4 Level)
		2 Questions from Unit-IV (K2 Level)	1Question from Unit-IV (K3 Level)
		2 Questions from Unit-V (K4 Level)	1Question from Unit-V (K3 Level)

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 interferences with evidences

COURSE LEARNING OUTCOMES:

On the completion of the course the students will be able to

CLOs	COURSE LEARNING OUTCOME	Knowledge Level (basis of Bloom's Taxonomy)
CO 1	Understand the fundamental concepts and Technologies in Cloud Computing.	Upto K2
CO 2	Able to understand various cloud service types and their uses and pitfalls.	Upto K3
CO 3	Able to understand Cloud Architecture and Application design.	Upto K3
CO 4	Understand the various aspects of application design, benchmarking, and security in the Cloud.	Upto K4
CO 5	Understand various Case Studies in Cloud Computing.	Upto K3

MAPPING OF CLOs WITH PSOs:

Course Outcomes	PSO 1 (Knowledge Base)	PSO 2 (Problem Analysis & Investigation)	PSO 3 (Communication Skills & Design)	PSO 4 (Individual and Team Work)	PSO 5 (Professionalism Ethics and equity)	PSO 6 (Life Long Learning)
CLO-1	3	1	1	2	1	1
CLO-2	2	3	2	1	1	1
CLO-3	2	3	1	1	1	2
CLO-4	3	2	2	1	2	1
CLO-5	2	2	2	3	2	1

3- Advanced Application

2- Intermediate

1- Introductory

MAPPING OF CLOs WITH POs:

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

1- Basic Level

2-Intermediate Level

3-Advanced Level

DEPARTMENT OF COMPUTER SCIENCE				CLASS: III B.Sc. Computer Science				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/ week	CIA	Ext	Total
VI			Professional Competency	2	2	25	75	100

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

COURSE OBJECTIVES:

This course is designed to:

- communicative competence among the Students.
- enhance the learner's soft skills by giving adequate exposure in LSRW and sub skills.
- enable learners to put the life skills into practice with confidence.

UNIT	Contents	No. of Hours	K-Level	CLO
I	KNOW THYSELF / UNDERSTANDING SELF: Introduction to Soft skills-Self discovery-Developing positive attitude-Improving perceptions- Forming values.	6	K2	CLO1
II	INTERPERSONAL SKILLS/ UNDERSTANDING OTHERS: Developing interpersonal relationship-Team building-group dynamics-Net working- Improved work relationship	6	K3	CLO2
III	COMMUNICATION SKILLS / COMMUNICATION WITH OTHERS: Art of listening –Art of reading –Art of speaking –Art of writing-Art of writing e-mails e mail etiquette.	6	K3	CLO3
IV	CORPORATE SKILLS / WORKING WITH OTHERS Oral Presentation – Memos- Note taking - Note making and preparing Minutes- Reports, Proposals, Abstracts - Technical Writing.	6	K4	CLO4
V	SELLING SELF / JOB HUNTING Writing resume/cv-interview skills-Group discussion-Mock interview-Mock GD – Goal setting - Career planning	6	K3	CLO5
	Total	30		

Books for Reference

1. N. Krishnasamy, Manju Dhariwel and Lalitha Krishnasamy(2015). Mastering Communication Skills and Soft Skills – Bloomburg.
2. Meena.K and V.Ayothi (2013) A Book on Development of Soft Skills (Soft Skills : A Road Map to Success), P.R. Publishers & Distributors,
3. Meera Banerjee and Krishna Mohan: Developing Communication Skills, Trinity Publishers-(Lakshmi Publications.
4. Alex K. (2012) Soft Skills – Know Yourself & Know the World, S.Chand & Company LTD, Ram Nagar, New Delhi- 110 055.

Web Resources

1. https://www.kngac.ac.in/elearning-portal/ec/admin/contents/5_18K5SSD_2020101606570516.pdf
2. <https://www.osou.ac.in/eresources/Soft-Skills-ccs04.pdf>

Rationale for the Nature of the Course:

Getting a job in the IT industry requires one to acquire and hone a host of skills not just technical. The course provides an overview of the other skills required to develop one's professional competency for a successful career in the IT industry.

Activities having a direct bearing on Skill development / Employability /Entrepreneurship

- Seminar
- Assignment preparation
- Presentation with ICT tools
- Live- demonstrations.

Pedagogy:

The teaching methods include Chalk and talk, PowerPoint, demonstrations and assignments.

Lecture schedule:

Units	Topics	Hrs	Mode
I	Introduction to Soft skills-Self discovery-Developing positive attitude	3	Chalk and talk and assignment
	Improving perceptions- Forming values	3	
II	Developing interpersonal relationship-Team building-group dynamics	3	Chalk and talk, Group discussion
	Net working- Improved work relationship	3	
III	Art of listening –Art of reading –Art of speaking	3	Chalk and talk, Quiz and assignment
	Art of writing-Art of writing e-mails e mail etiquette.	3	
IV	Oral Presentation – Memos- Note taking - Note making and preparing Minutes	3	PPT, Chalk and talk, Quiz and assignment
	Reports, Proposals, Abstracts - Technical Writing.	3	
V	Writing resume/cv-interview skills-Group discussion	3	PPT, Chalk and talk, Quiz and assignment
	Mock interview-Mock GD – Goal setting - Career planning	3	

Learning Outcome Based Education & Assessment (LOBE)
Blue Print – Cryptography
Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)
BLUE PRINT FOR INTERNAL ASSESSMENT – I

S. No.	CLOs	K-Level	Section A		Section B (Either / or Choice)	Section C (Open Choice)
			No. of Questions	K-Level		
1.	CLO 1	Up to K 2	2	K1 & K2	2 (K1&K1)	1(K2)
2.	CLO 2	Up to K 3	3	K1 & K2	2 (K2&K2)	2(K3)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each Question			2		5	10
Total Marks for each Section			10		10	20

BLUE PRINT FOR INTERNAL ASSESSMENT – II

S. No.	CLOs	K-Level	Section A		Section B (Either / or Choice)	Section C (Open Choice)
			No. of Questions	K-Level		
1.	CLO 3	Up to K 3	2	K1 & K2	2	1(K4)
2.	CLO 4	Up to K 4	3	K1 & K2	2	2(K3)
No. of Questions to be asked			5		4	3
No. of Questions to be answered			5		2	2
Marks for each Question			2		5	10
Total Marks for each Section			10		10	20

Learning Outcome Based Education & Assessment (LOBE)

Blue Print – Cryptography

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 K-2	2	K1 & K2	1	K1	2 (K1&K1)	1(K2)
2	CLO 2	Up to K-3	2	K1 & K2	1	K2	2 (K2&K2)	1(K3)
3	CLO 3	Up to K-4	2	K1 & K2	1	K2	2 (K3&K3)	1(K4)
4	CLO 4	Up to K-3	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
5	CLO 5	Up to K-4	2	K1 & K2	1	K2	2 (K4&K4)	1(K3)
No. of Questions to be			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 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%

Distribution of Unit-wise questions with K Levels

Section A	Section B	Section C	Section D
2 Questions for each Unit (K1 & K2 Level)	1 Question from each Unit (K1 & K2 Level)	2 Questions from Unit-I (K1 Level)	1Question from Unit-I (K2 Level)
		2 Questions from Unit-II (K3 Level)	1Question from Unit-II (K3 Level)
		2 Questions from Unit-III (K3 Level)	1Question from Unit-III (K4 Level)
		2 Questions from Unit-IV (K2 Level)	1Question from Unit-IV (K3 Level)
		2 Questions from Unit-V (K4 Level)	1Question from Unit-V (K3 Level)

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 interferences with evidences

COURSE LEARNING OUTCOMES:

On the completion of the course the students will be able to

CLOs	COURSE LEARNING OUTCOME	Knowledge Level (basis of Bloom's Taxonomy)
CO 1	Develop listening, speaking, reading and writing skills in English.	Upto K2
CO 2	Promote communicative ability in both spoken and written form of the language	Upto K3
CO 3	Enhance soft skills and engage in a range of communicative tasks and activities	Upto K3
CO 4	Develop interpersonal skills to maintain human relationship	Upto K4
CO 5	Develop corporate skills to promote leadership qualities and team spirit.	Upto K3

MAPPING OF CLOs WITH PSOs:

Course Outcomes	PSO 1 (Knowledge Base)	PSO 2 (Problem Analysis & Investigation)	PSO 3 (Communication Skills & Design)	PSO 4 (Individual and Team Work)	PSO 5 (Professionalism Ethics and equity)	PSO 6 (Life Long Learning)
CLO-1	3	1	1	2	1	1
CLO-2	2	3	2	1	1	1
CLO-3	2	3	1	1	1	2
CLO-4	3	2	2	1	2	1
CLO-5	2	2	2	3	2	1

3- Advanced Application

2- Intermediate

1- Introductory

MAPPING OF CLOs WITH POs:

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

1- Basic Level

2-Intermediate Level

3-Advanced Level

PG & RESEARCH DEPARTMENT OF COMMERCE				CLASS:III B.Com (FMA)				
Sem	Course type	Course code	Course title	Credits	Contact hours/ Week	CIA	Ext	Total
V	DSE	23U5XDET3 (A)	Python for Data Analytics	4	5	25	75	100

Nature of course					
Skill oriented		Employability oriented		Entrepreneurship Oriented	

Objectives:

- To Understand fundamental programming concepts of Python programming and its Libraries
- To study basic programming concepts and packages for data analysis, modeling, and visualization in python language.
- To study about structure and LOOP
- To comprehend the Basics of NumPy Arrays
- To gain inputs in Data structure, plotting & visualisation

Unit	Description	Hours	K-level	CLO
I	Computer systems – Python Programming Language Computational Thinking – Python Data Types: Expressions, Operator, Variables, and Assignments – Strings – Lists – Objects & Classes – Python standard library.	15	Upto K2	CLO1
II	Imperative programming: Python modules – Built-in-function: print function –eval function – user-defined function & assignments -parameter passing.	15	Upto K3	CLO2
III	Text Data, Files & Exceptions: Strings, revisited – formatted output – files – errors & Exceptions – Execution control Structures: decision control & the IF statement. For LOOP & Iteration Patterns – two-dimensional list- while loop – more loop patterns – additional iteration control statements – Container and Randomness: Dictionaries – other built-in container types – character encodings & strings – module random. Namespaces – encapsulation in functions – global vs. local namespaces exceptional flow control – modules as namespaces.	15	Upto K3	CLO3
IV	NumPy Basics :Array and Vectorized Computation – A Multidimensional Array Object – Data Processing using Arrays,File Input and Output with Arrays – Linear Algebra – Random Number Generation.	15	Upto K4	CLO4

V	Pandas – Data Structure – Essential Functionality – Handling Missing Data – Hierarchical Indexing – Data loading, Storage and File formats- Data wrangling- Plotting and Visualization -Time Series – Financial and Economic Data applications.	15	Upto K3	CLO5

Books for study:

1. Wes McKinney, Python for Data Analysis, O'Reilly Media, Inc., 1005 Gravenstein Highway North, Sebastopol.
2. Kenneth A. Lambert – Fundamentals of Python First Programs - Cengage ,New Delhi
3. ChSatyanarayana, M Radhika Mani, BN Jagadesh - Python Programming- Cengage, New Delhi.

Books for References:

1. J. M. Weiming, Mastering Python for Finance. Birmingham, England: Packt Publishing.
2. Ljubomir Periodic, “Introduction to Computing Using Python: An Application Development Focus”, John Wiley & Sons,2012
2. Shymala Devi, Python Programming, Vijay Nicole Imprints, Chennai
3. Wesley J. Chun, “Core Python Programming”, Pearson Education.

Web Resources

1. https://onlinecourses.nptel.ac.in/noc20_cs46/preview
2. <https://bedford-computing.co.uk/learning/wp-content/uploads/2015/10/Python-for-Data-Analysis.pdf>

Course Designers: Er. J. Rajendran, Head & Associate Professor of Computer Science

Rationale for the Nature of the Course:

Python is easy to learn and understand and has a simple syntax. It has a vast collection of libraries for numerical computation and data manipulation. One of the most significant benefits of data analytics is that it takes speculation out of critical business decisions. It helps the company's decision-makers identify the trends and make better business decisions.

Activities having a direct bearing on Skill development

- Seminar
- Assignment preparation
- Presentation with ICT tools
- Live- demonstrations.

Pedagogy: Chalk & Talk, Assignments, Test, Quiz

Course Schedule

Unit	Topics	Hrs	Mode
I	Computer systems – Python Programming Language Computational Thinking – Python Data Types: Expressions, Operator, Variables, and Assignments	7	Chalk and Talk, PPTs, Quiz / Seminar, & Test
	Strings – Lists – Objects & Classes – Python standard library.	8	
II	Imperative programming: Python modules – Built-in-function: print function	7	Chalk and Talk, PPTs, Quiz / Seminar, & Test
	Eval function – user-defined function & assignments -parameter passing.	8	
III	Text Data, Files & Exceptions: Strings, revisited – formatted output – files – errors & Exceptions – Execution control Structures: decision control & the IF statement. For LOOP & Iteration Patterns	7	Chalk and Talk, PPTs, Quiz / Seminar, & Test
	Two-dimensional list- while loop – more loop patterns – additional iteration control statements – Container and Randomness: Dictionaries – other built-in container types – character encodings & strings – module random. Namespaces – encapsulation in functions – global vs. local namespaces exceptional flow control – modules as namespaces.	8	
IV	NumPy Basics :Array and Vectorized Computation – A Multidimensional Array Object	7	Chalk and Talk, PPTs, Quiz / Seminar, & Test
	Data Processing using Arrays, File Input and Output with Arrays – Linear Algebra – Random Number Generation.	8	
V	Pandas – Data Structure – Essential Functionality – Handling Missing Data – Hierarchical Indexing – Data loading, Storage and File formats	7	Chalk and Talk, PPTs, Quiz / Seminar, & Assignment
	Data wrangling- Plotting and Visualization -Time Series – Financial and Economic Data applications.	8	

Course Learning Outcomes:

CLOs	At the end of the course, the student will be able to:	K Level
CLO–1	Demonstrate the understanding of basic programming terminologies and packages of python language.	Upto K2
CLO–2	Will gain knowledge on concepts and packages for data analysis, modeling, and visualization in python language.	Upto K3
CLO–3	In depth understanding about structure and LOOP	Upto K3
CLO–4	Analyze the time series data to design an optimized investment plan.	Upto K4
CLO–5	Demonstrate financial and Economic	Upto K3

PG & RESEARCH DEPARTMENT OF COMMERCE				CLASS:III B.Com (FMA)				
Sem	Course type	Course code	Course title	Credits	Contact hours/ Week	CIA	Ext	Total
VI	DSE	23U6XDET2 (B)	Basics of R programming for Analytics	2	4	25	75	100

Nature of course					
Skill oriented		Employability oriented		Entrepreneurship Oriented	

Objectives:

- To analyze data using the statistical tool R.
- To create vectors, lists, matrices, arrays and data frames using R.
- To draw charts and graphs using R.
- To automate data analysis, working collaboratively and openly on code.
- To know how to generate dynamic documents.

Unit	Description	Hours	K-level	CLO
I	Introduction Features of R – How to install and run R – Comments in R – Reserved words – Identifiers – Constants – Variables – Operators (Arithmetic, Relational, Logical, Assignment, Miscellaneous Operators) – Operator Precedence – Strings.	12	Upto K2	CLO1
II	Basic Data Types, Vectors, Lists and Matrices Basic Data Types (Numeric, Integer, Complex, Logical, Character) – Creating, combining vectors – Accessing Vector Elements – Modifying Vectors – Deleting Vectors- Vector arithmetic and Recycling – Vector Element Sorting – Reading Vectors – Creating Lists –Accessing List elements – Updating List Elements –Merging Lists – List to Vector conversion – Creating matrices – Accessing Matrix Elements – Matrix Arithmetic – Matrix Manipulation – Matrix Operations.	12	Upto K3	CLO2
III	Arrays, Factors and Data Frames Creating Arrays – Accessing Array Elements – Array Element Manipulation – Array Arithmetic – Creating factors – Accessing Factor Components – Modifying factors – Creating Data Frames – Accessing Data Frames Components – Modifying Data Frames –Aggregating Data – Sorting Data – Merging Data – Reshaping data – Sub-setting data – Data Type Conversion	12	Upto K3	CLO3

IV	Flow Control & Functions Decision making (using if statement - if...else statement - Nested If...Else statement - if else function - Switch statement) – Loops (for loop – while Loop – repeat Loop) – Loop Control statements – break statement – next statement – Function definition and Function Calling – Function without arguments – Built-in functions (Mathematical functions – Character functions – statistical functions – date and time functions – other functions – Recursive function)	12	Upto K4	CLO4
V	Charts & Graphs Bar charts (Plotting bars vertically and horizontally – Plotting categorical data – Grouped bar chart – Stacked bar chart) – Histogram (Simple histogram – Histogram with labels, breaks and density lines) – Line graphs (Simple line graph & Graphs with Multiple lines) – Pie charts (Simple Pie chart – Pie chart with slice percentages – 3D Pie charts)	12	Upto K3	CLO5

Books for study:

1. W. N. Venables, D. M. Smith, An Introduction to R, R Core Team, 2018.
2. John Verzani, simple R – Using R for Introductory Statistics, CRC Press, Taylor & Francis Group, 2005.
3. Mark Gardener, “Beginning R - The Statistical Programming Language”, John Wiley & Sons.
4. Wickham, H. & Golemund, G. (2018). for Data Science. O’Reilly: New York

Books for References:

1. Beginner’s guide for Data Analysis using R Programming by Dr.Jeeva Jose.
2. P. Dalgaard. Introductory Statistics with R, 2nd Edition. Springer 2008.
3. Dunlop, Dorothy D., and Ajit C. Tamhane. Statistics and data analysis: from elementary to intermediate. Prentice Hall, 2000.
4. Norman Matloff, “The Art of R Programming- A Tour of Statistical Software Design”.

Web Resources

1. <https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf>
2. <http://r4ds.had.co.nz>
3. [http://google-styleguide.googlecode.com/svn/trunk/ Rguide.xml](http://google-styleguide.googlecode.com/svn/trunk/Rguide.xml)

Course Designers: Er. J. Rajendran, Head & Associate Professor

Rationale for the Nature of the Course:

In general, Analytics and statistical engines using R programming provide deeper, more accurate insights for the business. R programming constructs can be used to develop very specific, in-depth analyses. R can help with querying big data and is used by many industry leaders to leverage big data across the business.

Activities having a direct bearing on Skill development

- Seminar
- Assignment preparation
- Presentation with ICT tools
- Live- demonstrations.

Pedagogy: Chalk & Talk, Assignments, Test, Quiz

Course Schedule

Unit	Topics	Hrs	Mode
I	Introduction Features of R – How to install and run R – Comments in R – Reserved words – Identifiers – Constants	6	Chalk and Talk, PPTs, Quiz / Seminar, & Test
	Variables – Operators (Arithmetic, Relational, Logical, Assignment, Miscellaneous Operators) – Operator Precedence – Strings.	6	
II	Basic Data Types, Vectors, Lists and Matrices Basic Data Types (Numeric, Integer, Complex, Logical, Character) – Creating, combining vectors – Accessing Vector Elements – Modifying Vectors – Deleting Vectors- Vector arithmetic and Recycling – Vector Element Sorting	6	Chalk and Talk, PPTs, Quiz / Seminar, & Test
	Reading Vectors – Creating Lists – Accessing List elements – Updating List Elements – Merging Lists – List to Vector conversion – Creating matrices – Accessing Matrix Elements – Matrix Arithmetic – Matrix Manipulation – Matrix Operations.	6	
III	Arrays, Factors and Data Frames Creating Arrays – Accessing Array Elements – Array Element Manipulation – Array Arithmetic – Creating factors – Accessing Factor Components – Modifying factors – Creating Data Frames	6	Chalk and Talk, PPTs, Quiz / Seminar, & Test
	Accessing Data Frames Components – Modifying Data Frames – Aggregating Data – Sorting Data – Merging Data – Reshaping data – Sub-setting data – Data Type Conversion	6	
IV	Flow Control & Functions Decision making (using if statement - if...else statement - Nested If...Else statement - if else function - Switch statement) – Loops (for loop – while Loop – repeat Loop) – Loop Control statements – break statement – next statement	6	Chalk and Talk, PPTs, Quiz / Seminar, & Test
	Function definition and Function Calling – Function without arguments – Built-in functions (Mathematical functions – Character functions – statistical functions – date and time functions – other functions – Recursive function)	6	
V	Charts & Graphs Bar charts (Plotting bars vertically and horizontally – Plotting categorical data – Grouped bar chart – Stacked bar chart) – Histogram (Simple histogram)	6	Chalk and Talk, PPTs, Quiz / Seminar, & Assignment
	Histogram with labels, breaks and density lines) – Line graphs (Simple line graph & Graphs with Multiple lines) – Pie charts (Simple Pie chart – Pie chart with slice percentages – 3D Pie charts)	6	

Course Learning Outcomes:

CLOs	At the end of the course, the student will be able to:	K Level
CLO-1	On the successful completion of the course, the students will be able to: Analyze data using the statistical tool R.	Upto K2
CLO-2	Create vectors, lists, matrices, arrays and data frames using R.	Upto K3
CLO-3	Design and implement the program using data frame, list to provide the solution for various problem.	Upto K3
CLO-4	Ability to apply statistical techniques using R Programming for decision making.	Upto K4
CLO-5	Study about factors and tables and to solve statistical problems.	Upto K3

Class		I B.Com (CA)						
Title of the Course		Programming in C and Lab						
TANSICHE Course type		Core 2						
Course Category		Core 2						
Nature of Course		Skill Development						
Category	Core	Year	I	Credits	3	Course Code		
		Semester	I					
Instructional Hours per week		Lecture	Tutorial		Practical		Total	
		4					4	
Marks		CIA			Semester		Total	
		25			75		100	
Pre-requisite(s)		Should have studied Commerce in higher secondary						
Objectives of the Course		1. Describe the core syntax and semantics of C programming language. 2. Discover the need for working with the strings and functions. 3. Illustrate the process of structuring the data using matrix, struct.						
Course Outline		Unit I Introduction to C Language:C Language Introduction-Features of C Language-Benefits of C over other languages-Compilation of C Program-First Program in CPre-processor in CPre-processor directives					12hrs	
		Unit II Variables, Data Types & Operators:Variables and Keywords in C-Scope rules in C-Data Types in C-Operators & Its Types-Typecasting in C					12hrs	
		Unit III Control Flow Statements:Decision Making Statements-Switch Statement in C-C Loops & Control Structure Practice problems-Continue Statement , Break Statement Array & String Handling in C:Arrays in C-Strings in C					12hrs	
		Unit IV Multidimensional Arrays in C-String functions in C- Practice problems Functions in C:Function Prototype-Parameter Passing Techniques in C-Storage Classes in C-Recursion Concept -Functions in CPractice problems					12hrs	
		Unit V Pointers, Structures, and Unions:Pointers in C-Structures- Union - Enumeration (or enum) in C- Pointer vs Array in C – C application programs (Sorting, Matrix manipulations, student’s mark list preparation)					12hrs	

Extended Professional Component	• Creative Presentation • Assignment • Web based case studies
Skills acquired from this course	Write programs related to character array
Justification for nature of course	
Text Book(s)	1. E. Balaguruswamy, "Programming in ANSI C", 8th Edition, 2019, McGraw Hill Education, ISBN:978-93-5316-513-0. 2. Pradip Dey, Manas Ghosh, "Programming in C", 2nd Edition, 2018, Oxford University, Press, ISBN: 978-01-9949-147-6. 3. Kernighan B.W and Dennis M. Ritchie, "The C Programming Language", 2nd Edition, 2015, Pearson Education India, ISBN: 978-93-3254-944-9.
Reference Book(s)	1. Yashavant P. Kanetkar, "Let Us C", 16th Edition, 2019, BPB Publications, ISBN: 978- 93-8728-449-4. 2. Jacqueline A Jones and Keith Harrow, "Problem Solving with C", Pearson Education, ISBN: 978-93-325-3800-9. 3. Dr. Guruprasad Nagraj, "C Programming for Problem Solving", Himalaya Publishing House. ISBN-978-93-5299-361-1.
Websites and e-Learning resources	1. http://elearning.vtu.ac.in/econtent/courses/video/BS/14CPL16.html 2. https://nptel.ac.in/courses/106/105/106105171/

C Programming Lab	
Learning Objectives: (for teachers: what they have to do in the class/lab/field) • Understand problem statements and identify appropriate solutions. • Demonstrate the use of IDE and C Compiler. • Develop programs using C Programming Language.	
Course Outcomes: (for students: To know what they are going to learn) CO1: Apply the concept of Control Structures to solve any given problem. CO2: Apply the concept of single and multi-dimensional arrays to solve problems related to searching, sorting and matrix operations. CO3: Apply the concept of Strings for writing programs related to character array. CO4: Write programs using concept of user defined and recursive functions. CO5: Apply concept of structures to write programs.	

List of Programs

1. Write a C program to find roots of a Quadratic equation.
2. Write a C program to find the total no. of digits and the sum of individual digits of a positive integer.
3. Write a C program to generate the Fibonacci sequence of first N numbers.
4. Write a C program to sum the series $S=1 - x + (x^2/2!) - (x^3/3!) + \dots - (x^n/n!)$
5. Write a C program to arrange the elements of an integer array using Bubble Sort algorithm.
6. Write a C program to input two matrices and perform matrix multiplication on them
7. Write a C program to check whether the given string is palindrome or not without using Library functions.
8. Write a C program to count the number of lines, words and characters in a given text.
9. Write a C program to generate Prime numbers in a given range using user defined function.
10. Write a C program to find factorial of a given number using recursive function.
11. Write a C program to maintain a record of n student details using an array of structures with four fields - Roll number, Name, Marks and Grade. Calculate the Grade according to the following conditions.

Marks Grade

≥ 80 A

≥ 60 B

≥ 50 C

≥ 40 D

< 40 E

Print the details of the student, given the student Roll number as input.

Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC –CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from the course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Text Books:

E. Balaguruswamy, "Programming in ANSI C", 8th Edition, 2019, McGraw Hill Education, ISBN:978-93-5316-513-0.

Reference Books:

1. Pradip Dey, Manas Ghosh, "Programming in C", 2nd Edition, 2018, Oxford University Press, ISBN: 978-01-9949-147-6.
2. Kernighan B.W and Dennis M. Ritchie, "The C Programming Language", 2nd Edition, 2015, Pearson Education India, ISBN: 978-93-3254-944-9.
3. Yashavant P. Kanetkar, "Let Us C", 16th Edition, 2019, BPB Publications, ISBN: 978-93-8728-449-4.
4. Jacqueline A Jones and Keith Harrow, "Problem Solving with C", Pearson Education. ISBN: 978-93-325-3800-9.
5. Dr. Guruprasad Nagraj, "C Programming for Problem Solving", Himalaya Publishing House. ISBN-978-93-5299-361-1.

Weblinks and Video Lectures (e-Resources):

1. <http://elearning.vtu.ac.in/econtent/courses/video/BS/14CPL16.html>
2. <https://nptel.ac.in/courses/106/105/106105171/>

COURSE LEARNING OUTCOME

CLOs	At the end of the course, the student will be able to	K-level
CLO 1	Apply the concept of Control Structures to solve any given problem.	K2
CLO 2	Apply the concept of single and multi-dimensional arrays to solve problems related to searching, sorting and matrix operations.	K3
CLO 3	Apply the concept of Strings for writing programs related to character array.	K3
CLO 4	Write programs using concept of user defined and recursive functions.	K4
CLO 5	Apply concept of structures to write programs.	K3

Class		I B.Com (CA)					
Title of the Course		PYTHON PROGRAMMING AND LAB					
TANSICHE Course type		Core 2					
Course Category		Core 2					
Nature of Course		Skill Development					
Category	Core	Year	I	Credits	3	Course Code	
		Semester	I				
Instructional Hours per week		Lecture	Tutorial		Practical		Total
		4					4
Marks		CIA			Semester		Total
		25			75		100
Pre-requisite(s)		Should have studied Commerce in higher secondary					
Objectives of the Course		1.Describe the core syntax and semantics of Python programming language. 2. Discover the need for working with the strings and functions 3. Illustrate the process of structuring the data using lists, dictionaries, tuples and sets. 4. Understand the usage of packages and Dictionaries					
Course Outline		Unit I Introduction: Computer algorithms-Computer Hardware-Computer Software-Python programming language - Literals - Variables and Identifiers - Operators - Expressions and Data types, Input / output					12hrs
		Unit II Control Structures: Boolean Expressions - Selection Control - If Statement- Indentation in Python- Multi-Way Selection -- Iterative Control- While Statement- Infinite loops- Definite vs. Indefinite Loops- Boolean Flag. String, List and Dictionary, Manipulations Building blocks of python programs,Understanding and using ranges.					12 hrs
		Unit III Functions: Program Routines- Defining Functions- More on Functions: Calling Value-Returning Functions- Calling Non-Value-Returning Functions- Parameter Passing - Keyword Arguments in Python - Default Arguments in Python-Variable Scope. Recursion: Recursive Functions					12hrs
		Unit IV Objects and their use: Software Objects - Turtle Graphics – Turtle attributes-Modular Design: Modules - Top-Down Design - Python Modules -					12hrs

	Unit V Dictionaries and Sets: Dictionary type in Python - Set Data type. Text Files: Opening, reading and writing text files – Exception Handling	12 hrs
Extended Professional Component	• Creative Presentation • Assignment • Web based case studies	
Skills acquired from this course	Represent compound data using Python lists, tuples, dictionaries etc.	
Justification for nature of course		
Text Book(s)	1. Charles Dierbach, “Introduction to Computer Science using Python - A computational Problem-solving Focus”, Wiley India Edition, 2015. 2. Wesley J. Chun, “Core Python Applications Programming”, 3rd Edition , Pearson Education, 2016 3. Mark Lutz, “Learning Python Powerful Object Oriented Programming”, O’reilly Media 2018, 5th Edition	
Reference Book(s)	1. Timothy A. Budd, “Exploring Python”, Tata MCGraw Hill Education Private Limited 2011, 1 st Edition. 2. John Zelle, “Python Programming: An Introduction to Computer Science”, Second edition, Course Technology Cengage Learning Publications, 2013, ISBN 978- 1590282410 3. Michel Dawson, “Python Programming for Absolute Beginners” , Third Edition, Course Technology Cengage Learning Publications, 2013, ISBN 978-1435455009	
Websites and e-Learning resources	https://onlinecourses.swayam2.ac.in/cec22_cs20/preview	

Python Programming Lab

Learning Objectives: (for teachers: what they have to do in the class/lab/field)

- Acquire programming skills in core Python.
- Acquire Object-oriented programming skills in Python.
- Develop the skill of designing graphical-user interfaces (GUI) in Python.
- Develop the ability to write database applications in Python.
- Acquire Python programming skills to move into specific branches

Course Outcomes: (for students: To know what they are going to learn)

CO1: To understand the problem solving approaches

CO2: To learn the basic programming constructs in Python

CO3: To practice various computing strategies for Python-based solutions to real world problems

CO4: To use Python data structures - lists, tuples, dictionaries.

List of Programs

1. Program to convert the given temperature from Fahrenheit to Celsius and vice versa depending upon user's choice.
2. Write a Python program to construct the following pattern, using a nested loop

```
  *
 **
***
****
*****
****
***
**
*
```

3. Program to calculate total marks, percentage and grade of a student. Marks obtained in each of the five subjects are to be input by user. Assign grades according to the following criteria:

Grade A: Percentage ≥ 80

Grade B: Percentage ≥ 70 and < 80

Grade C: Percentage ≥ 60 and < 70 Grade D: Percentage ≥ 40 and < 60

Grade E: Percentage < 40

4. Program, to find the area of rectangle, square, circle and triangle by accepting suitable input parameters from user.
5. Write a Python script that prints prime numbers less than 20.
6. Program to find factorial of the given number using recursive function.
7. Write a Python program to count the number of even and odd numbers from array of N numbers.
8. Write a Python class to reverse a string word by word.
9. Read a file content and copy only the contents at odd lines into a new file.
10. Create a Turtle graphics window with specific size.

Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC –CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from the course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Learning Resources:**• Recommended Texts**

1. Charles Dierbach, “Introduction to Computer Science using Python - A computational Problem-solving Focus”, Wiley India Edition, 2015.
2. Wesley J. Chun, “Core Python Applications Programming”, 3rd Edition , Pearson Education, 2016

• Reference Books

1. Mark Lutz, “Learning Python Powerful Object Oriented Programming”, O’reilly Media 2018, 5th Edition.
2. Timothy A. Budd, “Exploring Python”, Tata McGraw Hill Education Private Limited 2011, 1 st Edition.
3. John Zelle, “Python Programming: An Introduction to Computer Science”, Second edition, Course Technology Cengage Learning Publications, 2013, ISBN 978-1590282410
4. Michel Dawson, “Python Programming for Absolute Beginners” , Third Edition, Course Technology Cengage Learning Publications, 2013, ISBN 978-1435455009

COURSE LEARNING OUTCOME

CLOs	At the end of the course, the student will be able to	K-level
CLO 1	Develop and execute simple Python programs	K2
CLO 2	Write simple Python programs using conditionals and looping for solving problems	K3
CLO 3	Decompose a Python program into functions	K3
CLO 4	Represent compound data using Python lists, tuples, dictionaries etc.	K4
CLO 5	Apply concept of structures to write programs.	K3

Class		I B.Com (CA)						
Title of the Course		OFFICE AUTOMATION AND LAB						
TANSICHE Course type		Core 2						
Course Category		Core 2						
Nature of Course		Skill Development						
Category	Core	Year	I	Credits	3	Course Code		
		Semester	II					
Instructional Hours per week		Lecture	Tutorial		Practical		Total	
		4					4	
Marks		CIA			Semester		Total	
		25			75		100	
Pre-requisite(s)		Should have studied Commerce in higher secondary						
Objectives of the Course		1. The major objective in introducing the Computer Skills course is to impart training for students in Microsoft Office which has different components like MS Word, MS Excel and Power point. 2. The course is highly practice oriented rather than regular class room teaching 3. To acquire knowledge on editor, spread sheet and presentation software						
Course Outline		Unit I Introductory concepts: Hardware and Software - Memory unit – CPU-Input Devices: Key board, Mouse, and Scanner. Output devices: Monitor, Printer. Introduction to Operating Systems - Introduction to Programming Languages.						12hrs
		Unit II Word Processing: File menu operations - Editing text – tools, formatting, bullets, and numbering - Spell Checker - Document formatting – Paragraph alignment, indentation, headers and footers, printing – Preview, options, merge.						12 hrs
		Unit III Spreadsheets: Excel – opening, entering text and data, formatting, navigating; Formulas – entering, handling and copying						12hrs
		Unit IV Charts – creating, formatting, and printing, analysis tables, preparation of financial statements, introduction to data analytics.						12hrs

	Unit V Powerpoint: Introduction to Powerpoint - Features – Understanding slide typecasting & viewing slides – creating slide shows. Applying special objects – including objects & pictures – Slide transition – Animation effects, audio inclusion, timers.	12 hrs
Extended Professional Component	• Creative Presentation • Assignment • Web based case studies	
Skills acquired from this course	Understand and create a presentation using PowerPoint tool	
Justification for nature of course		
Text Book(s)	Peter Norton, “Introduction to Computers” –Tata McGraw-Hill.	
Reference Book(s)	Jennifer Ackerman Kettel, Guy Hat-Davis, Curt Simmons, “Microsoft 2003”, Tata McGraw- Hill.	
Websites and e-Learning resources	Web content from NDL / SWAYAM or opensource web resources	

Office Automation Lab	
Learning Objectives: (for teachers: what they have to do in the class/lab/field) • Office tools course would enable the students in crafting professional word documents, excel spread sheets, power point presentations using the Microsoft suite of office tools. • To familiarize the students in preparation of documents and presentations with office automation tools.	
Course Outcomes: (for students: To know what they are going to learn) CO1: to perform documentation CO2: to perform accounting operations CO3: to perform presentation skills	

List of Programs

Word

Word Orientation : The instructor needs to give an overview of Microsoft word & Importance of MS Word as word Processor, Details of the four tasks and features that would be covered Using word – Accessing, overview of toolbars, saving files, Using help and resources, rulers, format painter.

Task 1 : Using word to create project certificate. Features to be covered:-Formatting Fonts in word, Drop Cap in word, Applying Text effects, Using Character Spacing, Borders and Colors, Inserting Header and Footer, Using Date and Time option in Word.

Task 2 : Creating project abstract Features to be covered:-Formatting Styles, Inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check , Track Changes.

Task 3 : Creating a Newsletter : Features to be covered:- Table of Content, Newspaper columns, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes and Paragraphs

Excel

Excel Orientation :The instructor needs to tell the importance of MS Excel as a Spreadsheet tool, give the details of the four tasks and features that would be covered Excel – Accessing, overview of toolbars, saving excel files, Using help and resources {Comdex Information Technology course tool kit Vikas }

Task1: Creating a Scheduler - Features to be covered: Gridlines, Format Cells, Summation, auto fill, Formatting Text

Task 2 : Calculations - Features to be covered:- Cell Referencing, Formulae in excel – average, standard deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function, LOOKUP/VLOOKUP

Task 3 : Performance Analysis - Features to be covered:- Split cells, freeze panes, group and outline, Sorting, Boolean and logical operators, Conditional formatting

MS Power Point

Task1 :Students will be working on basic power point utilities and tools which help them create basic power point presentation. Topic covered includes :- PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows

Task 2 :This session helps students in making their presentations interactive. Topics covered includes: Hyperlinks, Inserting –Images, Clip Art, Audio, Video, Objects, Tables and Charts

Task 3 :Concentrating on the in and out of Microsoft power point. Helps them learn best practices in designing and preparing power point presentation. Topics covered includes :- Master Layouts (slide, template, and notes), Types of views (basic, presentation, slide slotter, notes etc), Inserting – Background, textures, Design Templates, Hidden slides.Auto content wizard, Slide Transition, Custom Animation, Auto Rehearsing

Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC –CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from the course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
1. Comdex Information Technology course tool kit Vikas Gupta, WILEY Dreamtech,2005 2. The Complete Computer upgrade and repair book,3rd edition Cheryl A Schmidt, WILEY Dreamtech 3. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education. 4. PC Hardware and A + Handbook – Kate J. Chas PHI (Microsoft)	

COURSE LEARNING OUTCOME

CLOs	At the end of the course, the student will be able to	K-level
CLO 1	Understand the basics of computer systems and its components.	K2
CLO 2	Understand and apply the basic concepts of a word processing package.	K3
CLO 3	Understand and apply the basic concepts of electronic spreadsheet software.	K3
CLO 4	Understand and apply the basic concepts of database management system.	K4
CLO 5	Understand and create a presentation using PowerPoint tool.	K3

Class		I B.Com (CA)						
Title of the Course		PROGRAMMING IN C++ AND LAB						
TANSICHE Course type		Core 2						
Course Category		Core 2						
Nature of Course		Skill Development						
Category	Core	Year	I	Credits	3	Course Code		
		Semester	II					
Instructional Hours per week		Lecture	Tutorial		Practical		Total	
		4					4	
Marks		CIA			Semester		Total	
		25			75		100	
Pre-requisite(s)		Should have studied Commerce in higher secondary						
Objectives of the Course		1 To engender an appreciation for the need and characteristics of Object-orientation. 2. To impart knowledge of the C++ language grammar in order to design and implement programming solutions to simple problems by applying Object-oriented thinking.						
Course Outline		Unit I Object Oriented Programming Concepts: Complexity in software - The need for object-orientation – Abstraction – Encapsulation – Modularity – Hierarchy. Basic Elements of C++: Classes – Objects – Data members and member functions – private and public access specifiers - Static members - Constructors – Singleton class - Destructors						12hrs
		Unit II Friend Functions and Friend Classes - Array of objects – Pointer to objects - this pointer – References – Dynamic memory allocation - Namespaces. Function Overloading: Overloading a function - Default arguments – Overloading Constructors. Operator Overloading: Overloading an operator as a member function – Overloading an operator as a friend function						12 hrs
		Unit III Overloading the operators [], (), -> and comma operators – Conversion Functions. Inheritance: Types of inheritance – protected access specifier –Virtual Base Class – Base class and derived class constructors. Run-time Polymorphism: Virtual Functions						12hrs

	Unit IV Function overriding - Pure virtual function – Abstract base class. Templates: Function templates – Overloading a function template – Class templates.	12hrs
	Unit V Exception Handling: Exceptions – try, catch, throw – Rethrowing an exception – Restricting exceptions - Handling exceptions in derived classes - terminate(), abort(), unexpected(), set_terminate(). I/O Streams: Formatted I/O with ios class functions - Manipulators – Creating own manipulator – Overloading << and >> operators.	12 hrs
Extended Professional Component	• Creative Presentation • Assignment • Web based case studies	
Skills acquired from this course	Write programs implementing File and Stream I/O.	
Justification for nature of course		
Text Book(s)	1. Herbert Schildt, <i>C++ - The Complete Reference</i> , Third Edition, TMH, 1999. 2. Grady Booch, <i>Object Oriented Analysis and Design</i> , Pearson Education, 2008. (For Unit I)	
Reference Book(s)	1. Bjarne Stroustrup, <i>The C++ Programming Language</i> , Addison Wesley, 2000 2. J. P. Cohoon and J. W. Davidson, <i>C++ Program Design – An Introduction to Programming and Object-Oriented Design</i> , Second Edition, McGraw Hill, 1999. 3. C. J. Lippman, <i>C++ Primer</i> , Third Edition, Addison Wesley, 2000.	

Object Oriented Programming with C++	
Learning Objectives: (for teachers: what they have to do in the class/lab/field) • Design classes for the given problems. • Write programs in C++. • Code, debug and execute a C++ program to solve the given problems using an IDE.	
Course Outcomes: (for students: To know what they are going to learn) CO1: Design and create classes.Implement Stream I/O as appropriate. CO2: Design appropriate data members and member functions. CO3: Implement functions, friend functions, static members, constructors and compile-time polymorphism. CO4: Implement inheritance, run-time polymorphism and destructors. CO5: Implement templates and exceptions. Use STL class library.Implement File I/O.	

List of Programs

1. 1. Write a class to represent a complex number which has member functions to do the following
 - a. Set and show the value of the complex number
 - b. Add, subtract and multiply two complex numbers
 - c. Multiplying the complex number with a scalar value
2. Write a Point class that represents a 2-d point in a plane. Write member functions to
 - a. Set and show the value of a point
 - b. Find the distance between two points
 - c. Check whether two points are equal or not
4. Design and implement a class to represent a Solid object.
 - a. Apart from data members to represent dimensions, use a data member to specify the type of solid.
 - b. Use functions to calculate volume and surface area for different solids.
5. Design a class representing time in hh:mm:ss. Write functions to
 - a. Set and show the time
 - b. Find the difference between two time objects
 - c. Adding a given duration to a time
 - d. Conversion of the time object to seconds
6. Design a 3x3 matrix class and demonstrate the following:
 - a. Addition and multiplication of two matrices using operator overloading
 - b. Maintaining a count of the number of matrix object created
7. Design a class called cString to represent a string data type. Create a data member in the class to represent a string using an array of size 100. Write the following functionality as member functions:
 - a. Copy Constructor
 - b. Concatenate two strings
 - c. Find the length of the string
 - d. Reversing a string
 - e. Comparing two strings
8. Design a class called cString to represent a string data type. Create a data member in the class to represent a string whose size is dynamically allocated. Write the following as member functions:
 - a. Copy Constructor
 - b. Destructor
 - c. Concatenate two strings
 - d. Find the length of the string
 - e. Reversing a string
 - f. Comparing two strings

Extended Professional Component

Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC –CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)

Skills acquired from the Course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Learning Resources: Recommended Texts 1. Herbert Schildt, <i>C++ - The Complete Reference</i>, Third Edition, TMH, 1999. 2. Grady Booch, <i>Object Oriented Analysis and Design</i>, Pearson Education, 2008. (For Unit I) Reference Books 1. Bjarne Stroustrup, <i>The C++ Programming Language</i>, Addison Wesley, 2000. 2. J. P. Cohoon and J. W. Davidson, <i>C++ Program Design – An Introduction to Programming and Object-Oriented Design</i>, Second Edition, McGraw Hill, 1999. C. J. Lippman, <i>C++ Primer</i> , Third Edition, Addison Wesley, 2000.	

COURSE LEARNING OUTCOME

CLOs	At the end of the course, the student will be able to	K-level
CLO 1	Explain the various basic concepts of Object-orientation.	K2
CLO 2	Write programs to implement static binding	K3
CLO 3	Write programs to implement inheritance and dynamic binding	K3
CLO 4	Write programs to implement templates and exception handling and learn how to use STL class library.	K4
CLO 5	Write programs implementing File and Stream I/O.	K3



DEPARTMENT OF INFORMATION TECHNOLOGY

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)

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

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

I and II semesters (B.Sc. Computer Science with Artificial Intelligence) – Regulation 2025

Curriculum Structure for B.Sc. Information Technology

Part	Course Description	Course Code	Course Title	Contact hours/ week	Credits
SEMESTER I					
I	Lang – I	23U1TLAN1/ 23U1HLAN1/ 23U1SLAN1	Tamil-I/ Sanskrit-I/ Hindi-I	6	3
II	English – I	23U1NENG1	English –I	6	3
III	Core – I	23U1FCCT1	Programming in C	5	5
	Core Practical – I	23U1FCCP1	C Programming Lab	3	3
	Generic Elective – I	23U1SGET1	Statistical Methods and its Application - I	6	5
IV	Foundation Course – I	23U1FFCT1	Fundamentals of Computers	2	2
	Skilled – I	23U1FSED1	Office Automation	2	2
	Total			30	23
SEMESTER II					
I	Lang – II	23U2TLAN2 / 23U2HLAN2 / 23U2SLAN2	Tamil-II/ Sanskrit-II/ Hindi-II	6	3
II	English – II	23U2NENG2	English-II	6	3
III	Core – II	23U2FCCT2	JAVA Programming	5	5
	Core Practical – II	23U2FCCP2	JAVA Programming Lab	3	3
	Generic Elective – II	23U2SGET2	Statistical Methods and its Application - II	6	5
IV	Skilled – II	23U2FSED2	Problem Solving Techniques	2	2
	Skilled – III	23U2FSED3	Fundamentals of Information Technology	2	2
V	PART – V	23U2YRC/N SS/NCC		-	-
	Total			30	23
SEMESTER III					
I	Lang – III	23U3TLAN3/ 23U3HLAN3/ 23U3SLAN3	Tamil-III/ Sanskrit-III/ Hindi-III	6	3
II	English – III	23U3NENG3	English –III	6	3

III	Core – III	23U3FCCT3	Relational Database Management System	4	4
	Core Practical – III	23U3FCCP3	Relational Database Management System Lab	3	3
	Generic Elective – III	23U3KGET1	Financial Accounting	6	5
IV	Skilled – IV	23U3FSED4	Multimedia Systems	2	2
	Skill – V	23U3FSED5	Digital Logic Fundamentals	2	2
	EVS	23U4EVST1	Environmental Studies	1	-
	Total			30	22
SEMESTER IV					
I	Lang – IV	23U4TLAN4/ 23U4HLAN4/ 23U4SLAN4	Tamil-IV/ Sanskrit-IV/ Hindi-IV	6	3
II	English – IV	23U4NENG4	English-IV	6	3
III	Core – IV	23U4FCCT4	Dot Net Programming	4	4
	Core Practical – IV	23U4FCCP4	Dot Net Programming Lab	3	3
	Generic Elective – IV	23U4KGET2	Cost & Management Accounting	6	5
IV	Skilled – VI	23U4FSED6	Advanced Excel	2	2
	Skilled – VII	23U4FSED7	Introduction to HTML	2	2
	EVS	23U4EVST1	Environmental Studies	1	2
V	PART – V	23U4YRC/NS S/NCC		-	1
	Total			30	25
Part	Course Description	Course Code	Course Title	Contact hours/ week	Credits
SEMESTER V					
III	Core – V	23U5FCCT5	PHP Scripting	5	4
	Core – VI	23U5FCCT6	Data Structures and Algorithms	5	4
	Core – VII	23U5FCCT7	Software Engineering	5	4
	Core Practical – V	23U5FCCP5	PHP Scripting Lab	3	3
	Discipline Elective – I	23U5FDET1	Data Mining / Computer Architecture	5	4
	Discipline Elective – IDC	23U5FIDCT	Biometrics	5	4
IV	Value Education	23U5VENT1	Value Education	2	2
	Internship / Industrial Activity	23U5FINTR	Internship	-	2
	Total			30	27

SEMESTER VI					
III	Core – VIII	23U6FCCT8	Python Programming	6	4
	Core – IX	23U6FCCT9	Data Communication and Networking	6	4
	Core – X	23U6FCCT10	Operating System	6	4
	Core Practical – VI	23U6FCCP6	Python Programming Lab	3	3
	Discipline Elective – II	23U6FDET2	Computational Intelligence / Internet of Things	4	2
IV	Professional Competency Skill	23U6FSED8	Verbal and Non-Verbal Reasoning	2	2
	Project & Viva-Voce	23U6FPROV	Project & Viva-Voce	3	2
	Total			30	21

VALUE ADDED COURSES

Course Description	Course Code	Course Title	Contact hours/ week	Credits
Add-On – I	23U3FAD1	Multimedia Tools	2	2
Add-On – II	23U5FAD2	R Programming	2	2
Certificate Course – I	23FC01	Web Designing Tools	2	2
Certificate Course – II	23FC02	PC Hardware & Troubleshooting	2	2
Self Study Course		Quantitative Aptitude	-	2

DEPARTMENT OF INFORMATION TECHNOLOGY					CLASS: III B.Sc. (IT)			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours/Week	CIA	Ext.	Total
V	Core - V	23U5FCCT5	PHP Scripting	4	5	25	75	100
Nature of the Course:								
Skill oriented		✓	Employability oriented		✓	Entrepreneurship Oriented		

Objectives:

- To acquire knowledge in PHP programming and its Lexical Structure.
- To familiarize the concept of Functions, Arrays and Strings
- To understand the concepts of web techniques and cookies, session.
- To be familiar with File Concepts and implementing MySQL Database.
- To learn the concept of jQuery fundamentals.

Unit	Description	Hrs.	K-Level	CLO
I	Introduction to PHP: Language Basics: Lexical Structure – Data Types – Variables - Expressions and Operators – Flow – Control statements – Embedding PHP in Web Pages.	15	K2	CLO 1
II	Functions: Defining a function – Variable Scope - Function Parameters. Strings: Encoding and Escaping – Comparing Strings – Manipulating and Searching Strings. Arrays: Single and Multidimensional Arrays – Traversing Arrays – Sorting.	15	K3	CLO 2
III	Classes and Objects: Declaring a class - Introspection – Serialization. Web Techniques: HTML Basics, variables Processing Forms – Setting Response Headers. Maintaining State: Cookies and Session -Graphics.	15	K4	CLO 3
IV	Working with files: Working with files: the concept of resource-recognizing newline characters, end of file character-opening and closing a file-reading from a file-writing a string to a file-moving the file pointer-reading directory contents. Working with MySQL Database: Select data from a single table – Select data from multiple tables - Performing DML operations.	15	K3	CLO 4

V	jQuery Fundamentals: Requirements of jQuery- JavaScript Premier – jQuery Core – DOM Selection and Manipulation – Event Handling – HTML Forms and Data – jQuery with PHP.	15	K4	CLO 5

Books for Study:

1. Kevin Tatroe, Peter MacIntyre, Rasmus Lerdorf, “ Programming PHP”, Third Edition, O’Reilly Publications.
Unit I: 2.
Unit II: 3,4,5.
Unit III: 6,7
2. W.Jason Gilmore, “Beginning Php and Mysql” , Fourth Edition, Springer publishers.
Unit IV:10,29,30
3. Cesar Otero, Rob Lorsen (2012), “Professional jQuery”, John Wiley Sons & Inc.
Unit V :2,3,4,5,6

Books for References:

1. W. Jason Gilmore (2010), “Beginning PHP & MySQL”, Apress.
2. Larry Ullman (2008), “PHP 6 and MySQL 5”, Pearson Education.
3. Michale C. Glass (2004), “Beginning PHP, Apache, MySQL Web Development”, Wiley DreamTech Press.
4. Robin Nixon (2013), “Learning PHP, MySQL, JavaScript & CSS”, O’Reilly, 2nd Edition.
Jack Franlin (2013), “Beginning jQuery”, Apress, Springer Science

Web Resources:

1. <https://www.javatpoint.com/php-functions>
2. https://www.tutorialspoint.com/php/php_classes_and_objects.htm
3. https://www.w3schools.com/php/php_mysql_connect.asp
4. <https://www.javatpoint.com/what-is-jquery>

Rationale for Nature of the Course:

- Server Side Scripting Language used to create Open source, Powerful, Efficient, dynamic and Interactive Webpages.

Activities having direct bearing on Skill development / Employability:

- Practice to write programs, Bug fixing and to design dynamic webpages.

Pedagogy:

- Chalk and talk, PPT, Assignment, Seminar, Group discussion, Test and Quiz.

Course Designer:

- Ms. R.Tamilselvi

Course Schedule:

Unit	Topics	Hrs	Mode
Unit I	Introduction to PHP: Language Basics: Lexical Structure – Data Types – Variables.	7	Lecture, Quiz, PPT, Test, Seminar
	Expressions and Operators – Flow – Control statements – Embedding PHP in Web Pages.	8	
Unit II	Functions: Defining a function – Variable Scope - Function Parameters – Strings: Encoding and Escaping – Comparing Strings – Manipulating and Searching Strings.	7	Lecture, Quiz, PPT, Test, Seminar
	Arrays: Single and Multidimensional Arrays – Traversing Arrays – Sorting.	8	
Unit III	Classes and Objects: Declaring a class - Introspection – Serialization. Web Techniques: HTML Basics, variables Processing Forms – Setting Response Headers.	8	Lecture, Quiz, PPT, Test, Seminar
	Maintaining State: Cookies and Session-Graphics.	7	
Unit IV	Working with files: Working with files: the concept of resource-recognizing newline characters, end of file character-opening and closing a file-reading from a file-writing a string to a file-moving the file pointer-reading directory contents.	8	Lecture, Quiz, PPT, Test, Seminar
	Working with MySQL Database: Select data from a single table – Select data from multiple tables - Performing DML operations.	7	
Unit V	jQuery Fundamentals: Requirements of jQuery-JavaScript Premier – jQuery Core – DOM Selection and Manipulation.	7	Lecture, Quiz, Assignment, Seminar
	Event Handling – HTML Forms and Data – jQuery with PHP.	8	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Describe the Expressions, Variable, Data types and Operators.	K2
CLO-2	Make use of Control structures and Arrays for developing the code.	K3
CLO-3	Focus on web techniques and cookies & session.	K4
CLO-4	Apply the concepts of files and MySQL database connectivity.	K3
CLO-5	Analyze the requirements of jQuery fundamentals.	K4

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

Mapping of CLOs with POs:

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

Advance application- 3; Intermediate level-2; Basic level-1

Summative - Blue – Print – Model for PHP Scripting
(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(K3&K3)	1(K3)
3	CLO 3	Up to K4	2	K1 & K2	1	K2	2(K2&K2)	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	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	100%

DEPARTMENT OF INFORMATION TECHNOLOGY					CLASS: III B.Sc. (IT)			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours/ Week	CIA	Ext.	Total
V	Core - VI	23U5FCCT6	Data Structures and Algorithms	4	5	25	75	100
Nature of the Course:								
Skill oriented		✓	Employability oriented			Entrepreneurship Oriented		

Objectives:

- To demonstrate various methods of organizing data.
- To get familiarity with the concepts of trees and its variants.
- To develop the program using linked lists, trees and graphs.
- To implement operations like searching and sorting using divide and conquer technique.
- To apply a greedy technique to solve a specific problem.

Unit	Description	Hrs.	K-Level	CLO
I	Stacks, Queues and Linked List: The Stack & Queue abstract data type– Evaluation of Expressions. Linked Lists: Singly Linked Lists –Double Linked List - Circular list- Linked Stacks and Queues – Polynomials.	15	K2	CLO 1
II	Trees: Basic Terminology – Binary Trees- Properties - Representations - Binary Tree Traversal – Additional Binary tree operations-Threaded Binary Trees - Binary Search Tree.	15	K4	CLO 2
III	Graphs: Definitions and Representations – Elementary Graph Operations-Minimum Cost Spanning Trees – Shortest Path and Transitive Closure – Activity Networks.	15	K3	CLO 3
IV	Introduction: Space complexity – Time Complexity – Asymptotic Notation. Divide and Conquer: The General Method – Binary Search – Finding the Maximum and Minimum – Merge Sort – Quick Sort – Selection Sort.	15	K3	CLO 4

V	The Greedy Method: The General Method – Knapsack problem- job sequencing with deadlines- Optimal storage on tapes-optimal merge patterns-single source shortest path.	15	K4	CLO 5

Books for Study:

1. Ellis Horowitz, Sartaj Sahni & Dinesh Mehta, “Fundamentals of Data structures in C++” ,2nd Edition,Universities Press 2008.
Unit I: 1.2- 1.4, 2.3, 2.5, 3.2, 3.3, 3.6, 4.1, 4.4, 4.6, 4.7.
Unit II: 5.1.1, 5.2, 5.3.1- 5.3.4, 5.4, 5.5, 5.7.
Unit III: 6.1- 6.5.
2. Ellis Horowitz , Sartaj Sahni & Sanguthevar Rajasekaran(2007),“Fundamentals Of Computer Algorithms”, 2nd Edition, Universities Press.
Unit IV: 1.3.1-1.3.3 , 3.1 – 3.6.
Unit V: 4.1 – 4.4, 4.6 – 4.8.

Books for References:

1. Yedidyah langsam, Moshe J.Augenstein and Aaron, “Data structures using C “, PHI.
2. Seymour Lipschutz(2006) , “Data Structures”, TataMcGrawhill.
3. Jean Paul Tremblay and Paul G Sorenson(1991), “An Introduction to Data structure with Application”,THM, II Edition.

Web Resources:

1. <https://www.geeksforgeeks.org/data-structures/>
2. https://www.tutorialspoint.com/data_structures_algorithms/greedy_algorithms.htm
3. <https://www.javatpoint.com/divide-and-conquer-introduction>

Rationale for Nature of the Course:

- Helps the students in developing logic and structured programs and to storing and organizing data in a particular way in a computer

Activities having direct bearing on Skill development:

- Give practices to conduct seminar and group discussion and preparing assignments.

Pedagogy:

- Chalk and talk, PPT, Assignment, Seminar, Group discussion, Test and Quiz.

Course Designer:

- Ms. R. Lakshapriya

Course Schedule:

Unit	Topics	Hrs	Mode
Unit I	The Stack abstract data type – The Queue abstract data type Evaluation of Expressions.	8	Lecture, seminar PPT, Test and Quiz.
	Linked List – Singly – Double – Circular linked list.	7	
Unit II	Basic Terminology – Binary Trees- Properties – Representations Binary Tree Traversal.	8	Lecture, seminar PPT, Test and Quiz.
	Additional Binary tree operations-Threaded Binary Trees – Binary Search Trees.	7	
Unit III	Graphs Definitions and Representations – Elementary Graph operations.	8	Lecture, seminar Group Discussion, Test and Quiz.
	Minimum Cost Spanning Trees – Shortest Path and Transitive Closure – Activity Networks.	7	
Unit IV	Introduction: Space complexity – Time Complexity – Asymptotic Notation. Divide and Conquer Binary Search Finding the Maximum and Minimum.	8	Lecture, seminar, Group Discussion PPT, Test and Quiz.
	Merge Sort – Quick Sort – Selection Sort.	7	
Unit V	The Greedy Method Introduction - Knapsack problem - job sequencing with deadlines.	8	Lecture, Test, Quiz, Assignment and Seminar.
	Optimal storage on tapes-optimal merge patterns - single source shortest path..	7	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Describe how stacks, queues and linked structures are represented in memory and their applications.	K2
CLO-2	Analyze of various applications using Tree operations.	K4
CLO-3	Demonstrate the representation of Graph and its variants.	K3
CLO-4	Use divide and conquer algorithms to implement sorting & searching.	K3
CLO-5	Discuss the computational efficiency of the greedy method for solving real time problems.	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	3	2	3	1
CLO-3	3	3	3	3	1
CLO-4	3	3	3	3	1
CLO-5	3	3	3	3	1

Mapping of CLOs with POs:

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

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 K4	2	K1 & K2	1	K1	2 (K3 & K3)	1(K4)
3	CLO 3	Up to K3	2	K1 & K2	1	K2	2 (K2 & K2)	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(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			10		10		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	100%

DEPARTMENT OF INFORMATION TECHNOLOGY					CLASS: III B.Sc. (IT)			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours/Week	CIA	Ext.	Total
V	Core VII	23U5FCCT7	Software Engineering	4	5	25	75	100
Nature of the Course:								
Skill oriented	✓	Employability oriented		✓	Entrepreneurship Oriented			

Objectives:

- To impart knowledge in Software Engineering and its models.
- To understand the concept of Software Requirements Analysis and Specifications.
- To gain knowledge in Software Cost Estimation and Design Strategy.
- To make aware of Software Testing and its Terminologies.
- To familiar with the concept of Software Reliability and Maintenance.

Course Content

Unit	Description	Hrs.	K-Level	CLO
I	Introduction to Software Engineering: Definition - The changing nature of software - Software Myths - Terminologies - Role of Management in Software Development. Software Life Cycle Models: The Waterfall Model - Increment Process Model - Evolutionary Process Model - The Unified Process.	15	K3	CLO 1
II	Software Requirements Analysis and Specifications: Requirements Engineering - Type of Requirements - Feasibility Studies - Requirements Elicitation - Requirements Analysis - Requirements Documentation - Requirements Validation.	15	K2	CLO 2
III	Software Project Planning: Size Estimation - Cost Estimation - The Constructive Cost Model (COCOMO) - COCOMO II - The Putnam Resource Allocation Model - Software Risk Management Software Design: Definition - Modularity - Strategy of Design - Function Oriented Design.	15	K3	CLO 3
IV	Software Testing: A Strategic Approach to Software Testing - Terminologies - Functional Testing - Structural Testing - Levels of Testing - Validation Testing - Testing Tools.	15	K4	CLO 4
V	Software Reliability: Basic Concepts - Software Quality - McCall Software Quality Model - Boehm Software Quality Model - Capability Maturity Model. Software Maintenance: Definition - Process - Models - Configuration Management -Documentation.	15	K3	CLO 5

Book for Study:

1. K.K Agarwal, Yogesh Singh (2009), “Software Engineering”, 3rd Edition, New Age International Publishers
Unit I: 1.2 – 1.6, 2.2 – 2.5.
Unit II: 3
Unit III: 4.1, 4.2, 4.4 – 4.7, 5
Unit IV: 8.1 – 8.6, 8.8
Unit V: 7.1, 7.2, 7.4, 9.1 - 9.3, 9.8, 9.9)

Books for References:

1. Roger S. Pressman, “Software Engineering – A Practioners Approach”, 5th Edition, Tata McGraw Hill Publication.
2. Panaj Jalote(2005), “An Integrated Approach to Software Engineering”, 3rd Edition, Narosa Publication.
3. Thomas T. Baker, “Writing Software Documentation- A task oriented approach”, Second Edition, Pearson Education.
4. Rajib Mall, “Fundamentals of Software Engineering”, Second Edition, Prentice Hall.

Web Resources:

1. http://www.tutorialspoint.com/software_engineering
2. <http://www.nada.kth.se/lectures/>
3. <http://www2.latech.edu/>

Rationale for Nature of the Course:

- Apply the principles of software engineering to design, development, maintenance, testing, and evaluation of software in IT sector.

Activities having direct bearing on Skill development / Employability:

- Case studies for requirement specifications and cost estimation and practice to perform testing and Bug fixing.

Pedagogy:

- Chalk and talk, PPT, Assignment, Seminar, Group discussion, Test and Quiz.

Course Designer:

- Ms. S. Sasikala

Course Schedule:

Unit	Topics	Hrs	Mode
Unit I	Introduction to Software Engineering: Definition - The changing nature of software - Software Myths - Terminologies - Role of Management in Software Development.	8	Lecture, Quiz, PPT, Test, Seminar
	Software Life Cycle Models: The Waterfall Model - Increment Process Model - Evolutionary Process Model - The Unified Process.	7	
Unit II	Software Requirements Analysis and Specifications: Requirements Engineering - Type of Requirements - Feasibility Studies.	8	Lecture, Quiz, PPT, Test, Seminar
	Requirements Elicitation - Requirements Analysis - Requirements Documentation - Requirements Validation.	7	
Unit III	Software Project Planning: Size Estimation - Cost Estimation - The Constructive Cost Model (COCOMO) - COCOMO II - The Putnam Resource Allocation Model.	8	Lecture, Quiz, PPT, Test, Seminar
	Software Risk Management - Software Design: Definition - Modularity - Strategy of Design - Function Oriented Design.	7	
Unit IV	Software Testing: A Strategic Approach to Software Testing - Terminologies - Functional Testing.	8	Lecture, Quiz, PPT, Test, Seminar
	Structural Testing - Levels of Testing - Validation Testing - Testing Tools.	7	
Unit V	Software Reliability: Basic Concepts - Software Quality - McCall Software Quality Model - Boehm Software Quality Model - Capability Maturity Model.	8	Lecture, Quiz, Assignment, Seminar
	Software Maintenance: Definition - Process - Models - Configuration Management -Documentation.	7	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Identify basic terminologies involved in the entire software developmental life cycle.	K3
CLO-2	Discuss on suitable models, techniques and tools for the development of a software product.	K2
CLO-3	Apply software engineering perspective through requirements analysis, software design and construction, verification, and validation to develop solutions to modern problems.	K3
CLO-4	Analyze different process, cost, quality models and testing techniques.	K4
CLO-5	Estimate the project cost using suitable cost estimation models, rate the software risks and evaluate management strategies for effective software development.	K3

Mapping of CLOs with PSOs:

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

Mapping of CLOs with POs:

#	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	1	1	1	1	1	2
CLO-2	2	1	2	3	2	2
CLO-3	2	3	2	3	2	2
CLO-4	3	3	2	3	2	2
CLO-5	1	3	2	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	CLO 1	Up to K3	2	K1& K2	1	K2	2 (K3 & K3)	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 (K2 & K2)	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	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			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	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	100%

DEPARTMENT OF INFORMATION TECHNOLOGY					CLASS: III B.Sc. (IT)			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours/Week	CIA	Ext .	Total
V	Core Practical - V	23U5FCCP5	PHP Scripting Lab	3	3	25	75	100
Nature of the Course:								
Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented				

Objectives:

- To acquire knowledge in PHP programming and its Lexical Structure.
- To familiarize the concept of Functions, Arrays and Strings
- To understand the concepts of web techniques and cookies, session.
- To be familiar with File Concepts and implementing MySQL Database.
- To learn the concept of jQuery fundamentals.

Unit	Description	Hrs.	K-Level	CLO
I	1. Write a PHP program to print the table of a number. 2. Write a PHP program to find if the given number is leap year or not. 3. Write a PHP program to print Fibonacci Series. 4. Write a PHP program to find Age calculator program. 5. Write a PHP program to print Star Triangle pattern. 6. Write a PHP program to print Number pattern. 7. Write a PHP program to print Continuous character pattern.	9	K2	CLO 1
II	8. Write a PHP Program to sort the Numbers in Ascending Order. 9. Write a PHP program to implement Include Function. 10. Write a PHP program to implement User Defined Function. 11. Write a PHP Program to implement String Handling Function.	9	K3	CLO 2
III	12. Write a PHP program to check whether the given string is palindrome or not using Form Elements 13. Write a PHP program for counting the visiting page using cookie. 14. Write a PHP page for login system using session.	9	K4	CLO 3

IV	15. Write a PHP Program to print personal details using File. 16. Write a PHP program to perform File Operations. 17. Write a PHP Code to make database Connection, Create Database, Create Table in MySQL. 18. Write a php program for login page with SQL connection.	9	K3	CLO 4
V	19. Write a PHP program to create jQuery event handling methods. 20. Write a PHP program to design a webpage using form controls.	9	K4	CLO 5

Books for Study:

1. Kevin Tatroe, Peter MacIntyre, Rasmus Lerdorf, “ Programming PHP”, Third Edition, O’Reilly Publications.
2. Joel Murach, Ray Harris (2010), “PHP and MySQL”, Shroff Publishers & Distributors.
3. Cesar Otero, Rob Lorsen (2012), “Professional jQuery”, John Wiley Sons & Inc.

Books for References:

1. W. Jason Gilmore (2010), “Beginning PHP & MySql”, Apress.
2. Larry Ullman (2008), “PHP 6 and MySQL 5”, Pearson Education.
3. Michale C. Glass (2004), “Beginning PHP, Apache, MySQL Web Development”, Wiley DreamTech Press.

Web Resources:

1. <https://www.geeksforgeeks.org/php-introduction/>
2. <https://www.javatpoint.com/php-functions>
3. https://www.tutorialspoint.com/php/php_classes_and_objects.htm

Rationale for Nature of the Course:

- Server Side Scripting Language used to create Open source, Powerful, Efficient, dynamic and Interactive Webpages.

Activities having direct bearing on Skill development / Employability:

- Practice to write programs
- Bug fixing and to design dynamic webpages.

Pedagogy:

- Demo and Practical session.

Course Designer:

- Ms. R.Tamilselvi

Course Schedule:

Unit	Description	Hrs.	Mode
I	1. Write a PHP program to print the table of a number.	4	Demo & Practical Session
	2. Write a PHP program to find if the given number is leap year or not.		
	3. Write a PHP program to print Fibonacci Series.		
	4. Write a PHP program to find Age calculator program.	5	
	5. Write a PHP program to print Star Triangle pattern.		
	6. Write a PHP program to print Number pattern.		
	7. Write a PHP program to print Continuous character pattern.		
II	8. Write a PHP Program to sort the Numbers in Ascending Order.	4	Demo & Practical Session
	9. Write a PHP program to implement Include Function.	5	
	10. Write a PHP program to implement User Defined Function.		
	11. Write a PHP Program to implement String Handling function.		
III	12. Write a PHP program to check whether the given string is palindrome or not using Form Elements	4	Demo & Practical Session
	13. Write a PHP program for counting the visiting page using cookie.		
	14. Write a PHP page for login system using session.	5	
IV	15. Write a PHP Program to print personal details using File.	4	Demo & Practical Session
	16. Write a PHP program to perform File Operations.	5	
	17. Write a PHP Code to make database Connection, Create Database, Create Table in MySQL.		
	18. Write a PHP program for login page with SQL connection.		
V	19. Write a PHP program to create jQuery event handling methods.	4	Demo & Practical Session
	20. Write a PHP program to design a webpage using form controls.	5	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Describe the Expressions, Variable, Data types and Operators.	K2
CLO-2	Make use of Control structures and Arrays for developing the code.	K3
CLO-3	Focus on web techniques and cookies & session.	K4
CLO-4	Apply the concepts of files and MySQL database connectivity.	K3
CLO-5	Analyze the requirements of jQuery fundamentals.	K4

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

Mapping of CLOs with POs:

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

Advance application- 3; Intermediate level-2; Basic level-1

DEPARTMENT OF INFORMATION TECHNOLOGY					CLASS: III B.Sc. (IT)			
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/Week	CIA	Ext.	Total
V	Discipline Elective - I	23U5FDET1	Data Mining	4	5	25	75	100
Nature of the Course:								
Skill oriented	✓	Employability oriented			Entrepreneurship Oriented			

Objectives:

- To understand the basic data mining task and techniques.
- To characterize the various patterns of association rule techniques.
- To impart the knowledge on classification models and algorithms.
- To familiarize the clustering algorithm for specific problem.
- To develop skills for solving practical problems in Data Visualization.

Unit	Description	Hrs.	K-Level	CLO
I	Introduction: Data Mining – Kinds of Data and Patterns to be Mined – Technologies used – Kinds of Applications are Targeted - Major Issues – Data objects and Attribute types – Basic statistical descriptions of Data. Data Preprocessing: Data Cleaning – Data Integration - Data Reduction - Data Transformation.	15	K2	CLO 1
II	Association Rules Mining: Introduction – Frequent Itemset Mining Methods: Apriori Algorithm - Generating Association Rules from Frequent Itemsets - Improving the efficiency of Apriori - A Pattern – Growth Approach for mining Frequent Itemsets - Pattern Evaluation Methods.	15	K4	CLO 2
III	Classification: Introduction – Basic concepts – Logistic regression - Decision tree induction – Bayesian classification, Rule-based classification - Model Evaluation and selection.	15	K3	CLO 3
IV	Cluster Analysis: Introduction - Requirements for Cluster Analysis - Partitioning Methods: The K-Means method. Hierarchical Method: Agglomerative method. Density based methods: DBSCAN. Evaluation of Clustering: Determining the Number of Clusters – Measuring Clustering Quality.	15	K3	CLO 4
V	Outlier Detection: Outliers and Outlier Analysis – Outlier Detection Methods. Data Visualization: Pixel-oriented visualization – Geometric Projection visualization technique -Icon-based - Hierarchical visualization - Visualizing complex data and relations.	15	K4	CLO 5

Book for Study:

1. Jiawei Han, Micheline Kamber, Jian Pei, “Data Mining concepts and techniques”, 3rd Edition, Elsevier publication, 2012.
Unit-I: 1.2 – 1.7, 2.1, 2.2, 3.1-3.5.
Unit-II: 6.1-6.3.
Unit-III: 8.1-8.5.
Unit-IV: 10.1-10.4, 10.6.
Unit-V: 12.1, 12.2, 2.3

Books for References:

1. Ian H. Witten and Eibe Frank, “Data Mining: Practical Machine Learning Tools and Techniques”, Second Edition, Morgan Kaufmann.
2. Arun K Pujari, “Data Mining Techniques”, 10 impressions, University Press, 2008.
3. Daniel T. Larose, Chantal D. Larose, "Data mining and Predictive analytics" Second Ed., Wiley Publication, 2015.
4. G.K. Gupta, “Introduction to Data mining with case studies”, 2nd Edition, PHI Private limited, New Delhi, 2011.

Web Resources:

1. https://www.tutorialspoint.com/data_mining/index.htm
2. https://www.ceom.ou.edu/media/docs/upload/Pang-Ning_Tan_Michael_Steinbach_Vipin_Kumar_-_Introduction_to_Data_Mining-Pe_NRDk4fi.pdf
3. https://books.google.co.in/books/about/Data_Mining_Concepts_and_Techniques.html

Rationale for Nature of the Course:

- Data Mining improves the speed and efficiency of accessing various data sets and makes it easier for decision making.
- Helps to develop logic and structured data mining algorithms to solve different real time applications.

Activities having direct bearing on Skill development:

- Give practices to conduct seminar and group discussion and preparing assignments.

Pedagogy:

- Chalk and talk, PPT, Assignment, Seminar, Group discussion, Test and Quiz.

Course Designer:

- Ms. K.Imaya

Course Schedule:

Unit	Topics	Hrs	Mode
Unit I	Introduction: Data Mining – Kinds of Data and Patterns to be Mined – Technologies used –Kinds of Applications are Targeted - Major Issues –Data objects and Attribute types – Basic statistical Descriptions of Data.	8	Lecture, Quiz, PPT, Test, Seminar
	Data Preprocessing: Data Cleaning – Data Integration - Data Reduction - Data Transformation.	7	
Unit II	Association Rules Mining: Introduction – Frequent Itemset Mining Methods: Apriori Algorithm-Generating Association Rules from Frequent Itemsets.	8	Lecture, Quiz, PPT, Test, Seminar
	Improving the efficiency of Apriori-A Pattern –Growth Approach for mining Frequent Itemsets-Pattern Evaluation Methods.	7	
Unit III	Classification: Introduction –Basic concepts – Logistic regression - Decision tree induction.	8	Lecture, Quiz, PPT, Test, Seminar
	Bayesian classification, Rule-based classification-Model Evaluation and selection.	7	
Unit IV	Cluster Analysis: Introduction-Requirements for Cluster Analysis - Partitioning Methods: The K-Means method - Hierarchical Method: Agglomerative method.	8	Lecture, Quiz, PPT, Test, Seminar
	Density based methods: DBSCAN-Evaluation of Clustering: Determining the Number of Clusters – Measuring Clustering Quality.	7	
Unit V	Outlier Detection: Outliers and Outlier Analysis – Outlier Detection Methods - Data Visualization: Pixel-oriented visualization.	8	Lecture, Quiz, Assignment, Seminar
	Geometric Projection visualization technique-Icon-based-Hierarchical visualization-Visualizing complex data and relations.	7	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Describe the key processes of data mining and knowledge discovery process.	K2
CLO-2	Analyze the frequent pattern and correlation techniques to solve real time problems.	K4
CLO-3	Make use of various methods of Classification Algorithms.	K3
CLO-4	Apply clustering techniques to solve problems in a mathematical way.	K3
CLO-5	Recommend appropriate data models for data mining techniques to solve real world problems.	K4

Mapping of CLOs with PSOs:

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

Mapping of CLOs with POs:

#	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	2	2	2	2	2	2
CLO-2	2	3	3	3	3	2
CLO-3	2	3	3	3	3	3
CLO-4	2	3	3	3	2	2
CLO-5	2	2	2	2	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	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	K1	2(K3&K3)	1(K4)
3	CLO 3	Up to K3	2	K1 & K2	1	K2	2(K2&K2)	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(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	100%

DEPARTMENT OF INFORMATION TECHNOLOGY					CLASS: III B.Sc(IT)			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours/Week	CIA	Ext.	Total
V	Discipline Elective - I	23U5FDET1	Computer Architecture	4	5	25	75	100
Nature of the Course:								
Skill oriented	✓	Employability oriented			Entrepreneurship Oriented			

Objectives:

- To understand the basic concepts of Registers and Micro programmed Control.
- To know the importance of Register Organization and Addressing Modes.
- To analyze the essentials of Pipelining and Arithmetic Operations.
- To familiarize the concept of I/O Organization.
- To observe the efficiency of the Memory Organization.

Unit	Description	Hrs.	K-Level	CLO
I	Introduction to Registers and Micro Operations: Register Transfer and Micro Operations: Register Transfer Language-Register Transfer-Bus and Memory Transfer-Arithmetic Micro Operations-Logic Operations-Shift Micro Operations. Micro Programmed Control: Control Memory – Address Sequencing-Design of Control Unit.	15	K2	CLO 1
II	Register Organization: Central Processing Unit: General Register Organization-Stack Organization –Instruction Formats-Addressing Modes-Data Transfer and Manipulation-Program Control.	15	K3	CLO 2
III	Pipeline and Vector Processing: Parallel Processing – Pipelining -Arithmetic Pipeline - Instruction Pipeline. Computer Arithmetic: Introduction - Addition and Subtraction - Multiplication Algorithms - Division Algorithms.	15	K4	CLO 3
IV	Input Output Organization: Input Output Interface-Asynchronous Data Transfer-Modes of Transfer-Priority Interrupt -Direct Memory Access –Input Output Processor.	15	K3	CLO 4
V	Memory Organization : Memory Hierarchy –Main Memory-Auxiliary Memory-Associative Memory- Cache Memory-Virtual Memory. Multi Processors: Characteristics of Multi Processor-Interconnection Structures.	15	K3	CLO 5

Book for Study:

1. M. Morris Mano, “Computer System Architecture”, Third Edition Revised, Pearson Publications.
Unit I: 5.1-5.6, 8.1, 8.2, 8.4.
Unit II: 9.2, 9.5-9.7.
Unit III: 10.1-10.4, 11.1-11.4.
Unit IV: 12.2-12.7.
Unit V: 13.1-13.6, 14.1-14.2.

Books for References:

1. A.P Godse , Dr. D.A Godse, “Computer System Architecture ”, Technical Publications.
2. William Stallings, “Computer Organization and Architecture (Designing for Performance)” Ninth Edition, Pearson Publications.
3. John D Carpinelli, “Computer System Organization and Architecture”, Pearson Publications.

Web Resources:

1. <https://www.studytonight.com/computer-architecture>
2. <https://www.geeksforgeeks.org/computer-organization-and-architecture-tutorials/>
3. <https://www.tutorialspoint.com/computer-system-architecture>
4. <https://www.elprocus.com/computer-architecture>

Rationale for Nature of the Course:

- Provides insights into how hardware and software interact to perform computations.
- Provides the skills to design processors, microcontrollers and other embedded systems.

Activities having direct bearing on Skill development:

- Computer Architecture bridges the gap between Electronics, Computer Science and Engineering. This Knowledge is Applicable in diverse fields, including Robotics, Networking and Data Centres.
- By Enhancing Both Theoretical knowledge and Practical Skills, Preparing individuals for Careers in Hardware design, System Optimization and Software-Hardware integration. The build a Foundation for innovation in fields like AI, IOT, and high performance computing.

Pedagogy:

- Chalk and Talk, PPT, Assignment, Seminar, Group discussion, Test and Quiz.

Course Designer:

- Ms. D. Geetharamani

Course Schedule:

Unit	Topics	Hrs	Mode
Unit I	Introduction to Registers and Micro Operations: Register Transfer and Micro Operations: Register Transfer Language-Register Transfer-Bus and Memory Transfer.	7	Lecture, Quiz, PPT, Test, Seminar
	Arithmetic Micro Operations-Logic Operations-Shift Micro Operations . Micro programmed Control : Control Memory – Address Sequencing-Design of Control Unit.	8	
Unit II	Register Organization: Central Processing Unit: General Register Organisation-Stack Organisation-Instruction Formats.	7	Lecture, Quiz, PPT, Test, Seminar
	Addressing Modes-Data Transfer and Manipulation-Program Control.	8	
Unit III	Pipeline and Vector Processing: Parallel Processing-Pipelining-Arithmetic Pipeline-Instruction Pipeline.	7	Lecture, Quiz, PPT, Test, Seminar
	Computer Arithmetic: Introduction - Addition and Subtraction - Multiplication Algorithms-Division Algorithms.	8	
Unit IV	Input Output Organization: Input Output Interface-Asynchronous Data Transfer-Modes of Transfer.	7	Lecture, Quiz, PPT, Test, Seminar
	Priority Interrupt-Direct Memory access –Input Output Processor.	8	
Unit V	Memory Organization: Memory Hierarchy –Main Memory-Auxiliary Memory-Associative Memory- Cache Memory-Virtual Memory.	7	Lecture, Quiz, Assignment, Seminar
	Multi Processors: Characteristics of Multi Processor-Interconnection Structures.	8	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Express the effectiveness of Registers and Micro Operations.	K2
CLO-2	Organize Stack, Instruction Formats and Addressing Modes.	K3
CLO-3	Apply Parallel Processing in Real Time Applications.	K4
CLO-4	Identify various Modes of Transfer and Interrupts.	K3
CLO-5	Collect the Significance of Memory and Multiprocessors.	K3

Mapping of CLOs with PSOs:

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

Mapping of CLOs with POs:

#	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	2	2	3	1	3	2
CLO-2	3	3	2	1	2	2
CLO-3	2	2	3	1	2	2
CLO-4	2	3	3	1	3	2
CLO-5	3	3	3	1	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 K2	2	K1 &K2	1	K1	2(K1&K1)	1(K2)
2	CLO 2	Up to K3	2	K1 &K2	1	K2	2(K3&K3)	1(K3)
3	CLO 3	Up to K4	2	K1 &K2	1	K2	2(K4&K4)	1(K4)
4	CLO 4	Up to K3	2	K1 &K2	1	K1	2(K2&K2)	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			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	100%

DEPARTMENT OF INFORMATION TECHNOLOGY					CLASS: III B.Sc. (IT)			
Sem .	Course Type	Course Code	Course Title	Credits	Contact Hours/Week	CIA	Ext.	Total
V	Discipline Elective - IDC	23U5IDCT	Biometrics	4	5	25	75	100
Nature of the Course:								
Skill Oriented		✓	Employability Oriented		✓	Entrepreneurship Oriented		✓

Objectives:

- To identify the various biometric technologies.
- To understand various biometric recognition.
- To develop simple applications for privacy.
- To understand the basic concepts of fingerprints and morphology.
- To impart knowledge in Biological Biometrics.

Unit	Description	Hrs .	K-Level	CLO
I	Introduction: What is Biometrics, History, Types of biometric Traits, General architecture of biometric systems, Basic working of biometric matching, Applications of biometrics, Biometrics versus traditional authentication methods. Face Biometrics: Introduction, Background of Face Recognition, Design of Face Recognition System, Face Detection in Video Sequences, Challenges in Face Biometrics, Advantages and Disadvantages.	15	K2	CLO 1
II	Retina and Iris Biometrics: Introduction, Performance of Biometrics, Design of Retina Biometrics, Design of Iris Recognition System, Applications of Iris Biometrics, Advantages and Disadvantages. Vein and Fingerprint Biometrics: Introduction, Biometrics Using Vein Pattern of Palm, Fingerprint Biometrics, Fingerprint Recognition System, Fingerprint Indexing, Advantages and Disadvantages.	15	K2	CLO 2
III	Privacy Enhancement Using Biometrics: Introduction, Privacy Concerns Associated with Biometric Deployments, Identity and Privacy, Privacy Concerns, Biometrics with Privacy Enhancement, Soft Biometrics. Multimodal Biometrics: Introduction to Multimodal Biometrics, Basic Architecture of Multimodal Biometrics, Multimodal Biometrics Using Face and Ear, Characteristics and Advantages of Multimodal Biometrics.	15	K2	CLO 3

IV	Fingerprints: Dermatoglyphics, history, morphology, types, biological basis of fingerprints Comparison of a Single Fingerprint, classification, friction ridge skin, ridge formation and characteristics. Fundamental principles of fingerprinting. Dermatoglyphics in medicine.	15	K2	CLO 4
V	Biological biometric: Blood group, types, Structure of DNA, chromosome, DNA finger printing -method and uses, Biometrics in Forensic Identification , ethics and concerns of biometric data collection.	15	K2	CLO 5

Books for Study:

1. G.R Sinha and Sandeep B. Patil(2013),” Biometrics: Concepts and Applications”, Wiley.
Unit-I: 1, 2.
Unit-II: 4, 5.
Unit-III: 7, 8.6-8.9.
2. Laurie O.Rabinson, John K.Laub, Eric H.Holder, “The Fingerprint”, U S Department of Justice
Unit-IV, V

Books for References:

1. Ruud M. Bolle, Sharath Pankanti, Nalinik.Ratha, Andrew W.Senior, Jonathan H. Connell(2009) “Guide to Biometrics”, Springer.
2. Anil k. Jain, Arun A. Ross, Karthik Nandakumar,” Introduction to Biometrics”.

Web Resources:

1. <https://www.tutorialspoint.com/biometrics/index.htm>
2. <https://www.javatpoint.com/biometrics-tutorial>
3. <https://www.Biometrics in Forensic Identification: Applications and Challenges – DocsLib>

Rationale for Nature of the Course:

- Explore the various current and future applications of Biometrics in business and government sectors.
- Explore the expected trends and future use of Biometrics.

Activities having direct bearing on Skill development / Employability / Entrepreneurship:

- By having group discussions and interactive session at regular basis on Biometrics concepts.
- Potentially be Setting up for a wider array of Career Opportunities.

Pedagogy:

- Lecture, PPT, Assignment, Seminar, Group Discussion, Test and Quiz.

Course Designers:

- Ms. K.R.Ramadevi.
- Dr.N.Kamala Dhasan.

Course Schedule:

Unit	Topics	Hrs	Mode
Unit I	Introduction: What is Biometrics, History, Types of biometric Traits, General architecture of biometric systems, Basic working of biometric matching, Applications of biometrics, Biometrics versus traditional authentication methods.	8	Lecture, PPT, Seminar, Quiz, Test
	Face Biometrics: Introduction, Background of Face Recognition, Design of Face Recognition System, Face Detection in Video Sequences, Challenges in Face Biometrics, Advantages and Disadvantages.	7	
Unit II	Retina and Iris Biometrics: Introduction, Performance of Biometrics, Design of Retina Biometrics, Design of Iris Recognition System, Applications of Iris Biometrics, Advantages and Disadvantages.	8	Lecture, PPT, Seminar, Quiz, Test
	Vein and Fingerprint Biometrics: Introduction, Biometrics Using Vein Pattern of Palm, Fingerprint Biometrics, Fingerprint Recognition System, Fingerprint Indexing, Advantages and Disadvantages.	7	
Unit III	Privacy Enhancement Using Biometrics: Introduction, Privacy Concerns Associated with Biometric Deployments, Identity and Privacy, Privacy Concerns, Biometrics with Privacy Enhancement, Soft Biometrics.	8	Lecture, PPT, Seminar, Group Discussion, Quiz, Test
	Multimodal Biometrics: Introduction to Multimodal Biometrics, Basic Architecture of Multimodal Biometrics, Multimodal Biometrics Using Face and Ear, Characteristics and Advantages of Multimodal Biometrics.	7	
Unit IV	Fingerprints: Dermatoglyphics, history, morphology, types, biological basis of fingerprints Comparison of a Single Fingerprint, classification.	8	Lecture, PPT, Seminar, Quiz, Test
	Friction ridge skin, ridge formation and characteristics. Fundamental principles of fingerprinting. Dermatoglyphics in medicine.	7	
Unit V	Biological biometric: Blood group, types, Structure of DNA, chromosome, DNA finger printing -method and uses.	10	Lecture, PPT, Seminar, Quiz, Assignment
	Biometrics in Forensic Identification, ethics and concerns of biometric data collection.	5	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	To understand the basic concepts and the functionality of the Biometrics, Face Biometrics, Types, Architecture and Applications.	K2
CLO-2	To know the concepts Retina and Iris Biometrics and Vein and Fingerprint Biometrics.	K2
CLO-3	To analyse the Privacy Enhancement and Multimodal Biometrics.	K2
CLO-4	To understand the basic concepts of fingerprints and morphology.	K2
CLO-5	To impart knowledge in Biological Biometrics	K2

Mapping of CLOs with PSOs:

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

Mapping of CLOs with POs:

#	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	3	2	1	2	3	1
CLO-2	3	2	1	2	3	2
CLO-3	3	3	2	2	3	2
CLO-4	3	3	3	3	3	2
CLO-5	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))

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	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

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	10	-	-	10	7.69	8%
K2		70	50	120	92.31	92%
Total Marks	10	70	50	130	100	100%

DEPARTMENT OF INFORMATION TECHNOLOGY					CLASS: III B.Sc. (IT)			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours/Week	CIA	Ext.	Total
V	Internship / Industrial Activity	23U5FINTR	Internship	2	-	-	-	-
Nature of the Course:								
Skill oriented		✓	Employability oriented		✓	Entrepreneurship Oriented		✓

Objectives:

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

During the duration of the programme, students shall be allowed for Internship / Industrial visit.

This programme includes preparation and submission of work diary and report of visit along with certificates (if any).

Course Learning Outcomes:

On the completion of the Internship, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Focus on practical understanding of industry operations and insights into the potential career paths	K4
CLO-2	Apply theoretical knowledge to real-world scenarios	K3
CLO-3	Analyse with current technologies and observe workplace practices	K4
CLO-4	Connect with awareness of recent trends	K4
CLO-5	Apply critical thinking skills through interaction with industry professionals	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	3
CLO-3	3	3	3	3	3
CLO-4	3	3	3	3	3
CLO-5	3	3	3	3	3

Mapping of CLOs with POs

#	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	3	3	2	3	2	2
CLO-2	3	2	3	3	3	3
CLO-3	3	3	2	2	2	2
CLO-4	2	3	3	2	3	3
CLO-5	3	2	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 INFORMATION TECHNOLOGY					CLASS: III B.Sc. (IT)			
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/Week	CIA	Ext	Total
VI	Core - VIII	23U6FCCT8	Python Programming	4	6	25	75	100
Nature of the Course:								
Skill Oriented	✓	Employability Oriented			✓	Entrepreneurship Oriented		

Objectives:

- To understand the basic concepts in Python programming.
- To understand the concepts of specialized data types.
- To impart knowledge on various functions and modules.
- To inculcate the concept of Class and Inheritance.
- To impart the knowledge on file and database concepts.

Unit	Description	Hrs.	K-Level	CLO
I	Basics of Python Programming: History of Python-Features of Python — Built-in Data Types - Output Statements — Comments — Indentation — Operators — Type conversions. Python Arrays: Defining and Processing Arrays — Array methods. Control Statements: Selection/Conditional Branching statements: if, if-else, nested if and if-elif-else statements. Iterative Statements: while loop, for loop, else suite in loop and nested loops. Jump Statements: break, continue and pass statements.	18	K2	CLO 1
II	Lists: Creating a list - Access values in List - Updating values in Lists - Nested lists - Basic list operations - List Methods. Tuples: Creating, Accessing, Updating and Deleting Elements in a tuple – Nested tuples – Difference between lists and tuples. Dictionaries: Creating, Accessing, Updating and Deleting Elements in a Dictionary – Dictionary Functions and Methods - Difference between Lists and Dictionaries. Sets - Creating a Set.	18	K3	CLO 2
III	Functions: Function Definition – Function Call – Variable Scope and its Lifetime-Return Statement. Function Arguments: Required Arguments, Keyword Arguments, Default Arguments and Variable Length Arguments - Lambda Functions - Recursion. Python Strings: String operations- Immutable Strings - Built-in String Methods and Functions - String Comparison. Modules: import statement- The Python module – dir() function – Modules and Namespace – Defining our own modules. Packages in Python.	18	K3	CLO 3

IV	Classes and Objects: Defining Classes - Creating Objects -Class Method and self Argument - The _init_() method - Class Variables - Object Variables - The _del_() method - Public and Private Data Members - Built-in Class Attributes. Inheritance: Polymorphism - Method Overriding - Types of Inheritance.	18	K4	CLO 4
V	Python File Handling: Types of files in Python - Opening and Closing files. Reading and Writing files: write() and writelines() methods - append() method – read() and readlines() methods – with keyword – Splitting words – File methods - File Positions - Renaming and deleting files. Database Programming: SQL Database	18	K4	CLO 5

Books for Study:

1. Reema Thareja, “Python Programming using problem solving approach”, First Edition, 2017, Oxford University Press.
Unit-I: 3,4.
Unit-II: 5.1to 5.7,5.10,5.11,5.12.
Unit-III: 8.2.1 to 8.2.6, 8.4.1 to 8.4.6,8.5, 8.6.1 to 8.6.7.
Unit-IV:9.1 to 9.6,9.8,9.12,10.1,10.2,10.3.
Unit-V: 7.1 to 7.7.
2. Mark Summerfield “Programming in Python 3: A Complete Introduction to the Python Language”, 2018 second edition, Pearson Education.
Unit-V:12.

Books for References:

1. Dr.R Nageswara Rao, “Core Python Programming”, First Edition, 2017, Dreamtech Publishers.
2. Vamsi Kurama, “Python Programming: A Modern Approach”, Pearson Education.
3. Mark Lutz, ”Learning Python”, Orielly

Web Resources:

1. <https://www.programiz.com/python-programming>
2. <https://www.guru99.com/python-tutorials.html>

Rationale for Nature of the Course:

- Python is a world-famous simple, powerful and general-purpose computer language.
- This is an open-source language. It is called a high-level language, dynamic language, graphical user interface language, object-oriented language, interpreter language.
- Python language can easily create complicated programs and easy to write a program.

Activities having direct bearing on Skill development / Employability:

- Give practices to conduct seminar and group discussion and preparing assignments.

Pedagogy:

- Chalk and talk, PPT, Assignment, Seminar, Group discussion, Test and Quiz.

Course Designer:

- Ms. S. Brindha

Course Schedule:

Unit	Topics	Hrs	Mode
Unit I	Basics of Python Programming: History of Python-Features of Python - Built-in Data Types - Output Statements - Comments – Indentation – Operators – Type conversions. Python Arrays: Defining and Processing Arrays – Array methods.	9	Lecture, Quiz, PPT, Test, Seminar
	Control Statements: Selection/Conditional Branching statements: if, if-else, nested if and if-elif-else statements. Iterative Statements: while loop, for loop, else suite in loop and nested loops. Jump Statements: break, continue and pass statements.	9	
Unit II	Lists: Creating a list - Access values in List - Updating values in Lists - Nested lists - Basic list operations - List Methods. Tuples: Creating, Accessing, Updating and Deleting Elements in a tuple – Nested tuples – Difference between lists and tuples.	9	Lecture, Quiz, PPT, Test, Seminar
	Dictionaries: Creating, Accessing, Updating and Deleting Elements in a Dictionary – Dictionary Functions and Methods - Difference between Lists and Dictionaries. Sets - Creating a Set.	9	
Unit III	Functions: Function Definition – Function Call – Variable Scope and its Lifetime-Return Statement. Function Arguments: Required Arguments, Keyword Arguments, Default Arguments and Variable Length Arguments - Lambda Functions - Recursion.	9	Lecture, Quiz, PPT, Test, Seminar
	Python Strings: String operations- Immutable Strings - Built-in String Methods and Functions - String Comparison. Modules: import statement- The Python module – dir() function – Modules and Namespace – Defining our own modules. Packages in Python.	9	
Unit IV	Classes and Objects: Defining Classes - Creating Objects - Class Method and self Argument - The _init_() method - Class Variables - Object Variables - The _del_() method - Public and Private Data Members - Built-in Class Attributes	9	Lecture, Quiz, PPT, Test, Seminar
	Inheritance: Polymorphism - Method Overriding - Types of Inheritance.	9	
Unit V	Python File Handling: Types of files in Python - Opening and Closing files. Reading and Writing files: write() and writelines() methods - append() method – read() and readlines() methods – with keyword – Splitting words	9	Lecture, Quiz, Assignment, Seminar
	File methods - File Positions - Renaming and deleting files. Database Programming: SQL Database.	9	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Outline the basic concepts in python programming.	K2
CLO-2	Apply various data types and identify its usage.	K3
CLO-3	Construct programs using loops, functions and Modules in python for processing the data.	K3
CLO-4	Analyze the basic concepts and techniques of class and inheritance in python.	K4
CLO-5	Devise the coding by implementing Files and Database Concepts.	K4

Mapping of CLOs with PSOs:

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

Mapping of CLOs with POs:

#	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	2	2	1	2	2	1
CLO-2	2	3	2	2	2	2
CLO-3	2	3	3	2	1	1
CLO-4	2	3	3	2	2	2
CLO-5	2	2	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 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 K3	2	K1 & K2	1	K2	2(K2&K2)	1(K3)
4	CLO 4	Up to K4	2	K1 & K2	1	K2	2(K3&K3)	1(K4)
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	25	16%
Total Marks	10	10	50	50	120	100	100%

DEPARTMENT OF INFORMATION TECHNOLOGY					CLASS: III B.Sc. (IT)			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours/Week	CIA	Ext.	Total
VI	Core - IX	23U6FCCT9	Data Communication And Networking	4	6	25	75	100
Nature of the Course:								
Skill oriented	✓	Employability oriented			Entrepreneurship Oriented			

Objectives:

- To impart the knowledge in data communications and Network Models.
- To analyze the performance of analog and digital signals.
- To understand Error Detecting and Correcting Mechanisms.
- To familiar with the concept of wired and wireless LANs.
- To understand the network layer protocols.

Unit	Description	Hrs.	K-Level	CLO
I	Introduction: Data Communication-Networks: Distributed Processing-Network Criteria Physical Structures –Network Models-Categories of Network-Internetwork - The Internet Protocols and Standards – Network Models: Layers in the OSI Model - TCP/IP Protocol Suite.	18	K2	CLO 1
II	Data and Signals: Analog and Digital Data - Analog and Digital Signals – Performance. Digital Transmission: Transmission Modes. Multiplexing: FDM – WDM - Synchronous TDM -Statistical TDM. Transmission Media: Guided media - Unguided Media.	18	K3	CLO 2
III	Switching: Circuit Switched Networks - Datagram Networks-Virtual Circuit Network - Error Detection and Correction: Introduction - Block Coding - Linear Block Codes - Cyclic Codes: Cyclic Redundancy Check - Checksum. Data Link Control: Framing - Flow Control and Error Control - Noiseless Channel: Stop-and-wait Protocol.	18	K3	CLO 3
IV	Wired LANs: Standard Ethernet-GIGABIT Ethernet. Wireless LAN: Bluetooth Connecting LANs: Connecting Devices: Passive Hubs – Repeaters - Active Hubs – Bridges – Two Layer Switches-Routers-Three layer Switches-Gateway. Network Layer: Internet Protocol: IPv4 –Ipv6-Transition from IPv4 to IPv6.	18	K4	CLO 4

V	Network Layer: Delivery, Forwarding and Routing- Unicast Routing Protocols: Distance Vector Routing-Link state routing. Future & Current Trends in Computer Networks: 5G Network: Salient Features-Technology-Applications-Advanced Features-Advantages & Disadvantages - Applications-WiFi - WiMax Lifi- Lifi vs Wifi.	18	K4	CLO 5

Book for Study:

1. Behrouz and Forouzan (2006), “Data Communication and Networking”, 4th Edition, TMH.
Unit-I: 1, 2.
Unit-II: 3, 4, 6, 7.
Unit-III: 8, 10, 11.
Unit-IV: 13, 14, 15, 20.
Unit-V: 22

Books for References:

1. Jean Walrand (1998), “Communication Networks”, Second Edition, Tata McGraw Hill.
2. William Stallings, “Data and Computer Communication”, Sixth Edition, Pearson Education, 2000
3. Andrew S. Tanenbaum, “Computer Networks”, PHI, Fourth Ed., 2003.

Web Resources:

1. http://www.tutorialspoint.com/data_communication_computer_network/
2. http://www.slideshare.net/zafar_ayub/data-communication-and-network-11903853
3. <http://www.freetechbooks.com/data-communication-and-networks-f31.html>

Rationale for Nature of the Course:

- To allow the exchange of data between devices, which facilitates communication and the sharing of information
- Devices are connected through transmission mediums like cables or wireless devices.

Activities having direct bearing on Skill development:

- Give practices to conduct seminar and group discussion and preparing assignments.

Pedagogy:

- Chalk and talk, PPT, Assignment, Seminar, Group discussion, Test and Quiz.

Course Designer:

- Ms. K.Vairameenakshi

Course Schedule:

Unit	Topics	Hrs	Mode
Unit I	Introduction: Data Communication-Networks: Distributed Processing-Network Criteria Physical Structures–Network Models.	9	Lecture Quiz, PPT Test, Seminar
	Categories of Network- Internetwork - The Internet Protocols and Standards. Network Models: Layers in the OSI Model - TCP/IP Protocol Suite.	9	
Unit II	Data and Signals: Analog and Digital Data - Analog and Digital Signals – Performance. Digital Transmission: Transmission Modes.	9	Lecture Quiz, PPT Test, Seminar
	– Multiplexing: FDM – WDM - Synchronous TDM - Statistical TDM - Transmission Media: Guided media - Unguided Media.	9	
Unit III	Switching: Circuit Switched Networks - Datagram Networks-Virtual Circuit Network. Error Detection and Correction: Introduction - Block Coding - Linear Block Codes.	9	Lecture Quiz, PPT Test, Seminar
	Cyclic Codes: Cyclic Redundancy Check - Checksum. Data Link Control: Framing - Flow Control and Error Control - Noiseless Channel: Stop-and-wait Protocol.	9	
Unit IV	Wired LANs: Standard Ethernet-GIGABIT Ethernet-Wireless LAN: Bluetooth Connecting LANs: Connecting Devices: Passive Hubs-Repeaters-Active Hubs-Bridges	9	Lecture Quiz, PPT Test, Seminar
	Two Layer Switches-Routers-Three layer Switches- Gateway-Network Layer: Internet Protocol: IPv4 –Ipv6-Transition from IPv4 to IPv6.	9	
Unit V	Network Layer: Delivery, Forwarding and Routing-Unicast Routing Protocols: Distance Vector Routing-Link state routing.	9	Lecture, Quiz, Seminar, Assignment
	Future & Current Trends in Computer Networks: 5G Network: Salient Features - Technology-Applications-Advanced Features - Advantages & Disadvantages-Applications-WiFi – WiMax Lifi - Lifi vs Wifi.	9	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Describe the fundamental concepts of computer networks and its application areas.	K2
CLO-2	Apply the concept of Analog and Digital Signals.	K3
CLO-3	Identify the various error detections and corrections techniques.	K3
CLO-4	Analyze the importance of wire and wireless LAN and Network Layer	K4
CLO-5	Analyze the concept of Network layer Operation and 5G Technology.	K4

Mapping of CLOs with PSOs:

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

Mapping of CLOs with POs:

#	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	3	2	1	1	1	1
CLO-2	3	3	2	2	2	2
CLO-3	3	3	2	2	1	2
CLO-4	3	3	2	2	1	2
CLO-5	3	3	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	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 K3	2	K1& K2	1	K2	2(K3&K3)	1(K3)
4	CLO 4	Up to K4	2	K1& K2	1	K2	2(K2&K2)	1(K4)
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	100%

DEPARTMENT OF INFORMATION TECHNOLOGY					CLASS: III B.Sc. (IT)			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours/Week	CIA	Ext.	Total
VI	Core - X	23U6FCCT10	Operating System	4	6	25	75	100
Nature of the Course:								
Skill oriented		✓	Employability oriented			Entrepreneurship Oriented		

Objectives:

- To know the basic concepts of Operating System and Process Management.
- To impart the knowledge of scheduling algorithms and process synchronization.
- To understand the concepts of Deadlock and its methods.
- To familiarize with the concept of Storage Management and virtual memory.
- To understand the concepts of File System Interface and Shell Programming.

Unit	Description	Hrs.	K-Level	CLO
I	Introduction: Definition of Operating System – OS Structures: OS Services – System Calls – Virtual Machines – Process Management: Process Concepts – Process Scheduling – Operating on Process – Co-operating Processes – Inter-process Communication.	18	K2	CLO 1
II	CPU Scheduling: Basic Concepts - Scheduling Criteria - Scheduling Algorithms - Process Synchronization: The Critical Section Problem - Semaphores - Classical Problems of Synchronization - Critical Regions.	18	K3	CLO 2
III	Deadlocks: System Model - Deadlock characterization – Methods for Handling Deadlocks - Deadlock Prevention - Deadlock avoidance - Deadlock Detection - Recovery from Deadlock.	18	K3	CLO 3
IV	Storage management: Memory management - Swapping – Contiguous Memory allocation. Paging – Segmentation – Segmentation with Paging – Virtual memory: Demand paging - Page replacement – Thrashing. Mass-Storage Structure: Disk Structure - Disk scheduling.	18	K4	CLO 4

V	File-System Interface: File Concept-File Attributes-File Operations – Access Methods: Sequential Access – Direct Access –Directory Structure - Single-Level Directory- Two – Level Directory-Tree-Structured Directories- Introducing Shell Programming – Linux General Purpose Commands-Process Oriented Commands – Communication Oriented Commands.	18	K4	CLO 5

Books for Study:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne (2012), “Operating System Concepts”, 9th edition, Wiley Student Edition.
Unit-I: 1.1, 1.4, 2.1, 2.3, 2.4, 3.1, 3.3, 3.4.
Unit-II: 6.1, 6.2, 6.3, 5.2, 5.6, 5.7.
Unit-III: 7.1-7.7.
Unit-IV: 8.1-8.6, 9.2, 9.4, 9.6, 10.2, 10.4.
2. B.Mohamed Ibrahim, (2005), “Linux Practical Approach”, Firewall Media.
Unit-V: 11.1, 11.2, 11.3

Books for References:

1. Milan Milenkovic (2003), “Operating System Concepts and Design”, McGraw Hill.
2. Andrew S. Tanenbaum, (2001),”Modern Operating Systems”, 2nd Edition, Prentice Hall of India.
3. Deitel & Deitel (2008), “Operating systems”, 3rd edition, Pearson Education, India.

Web Resources:

1. <https://www.geeksforgeeks.org/different-approaches-or-structures-of-operating-systems/>
2. <https://www.javatpoint.com/cpu-scheduling-algorithms-in-operating-systems>
3. <https://www.tutorialspoint.com/process-deadlocks-in-operating-system>

Rationale for Nature of the Course:

- Purpose of having an operating system is to manage the device's hardware and software resources and provides the necessary common services & interfaces for installed programs to run.

Activities having direct bearing on Skill development:

- To enhance system-level understanding, that is crucial in many real-world applications.

Pedagogy:

- Chalk and talk, PPT, Assignment, Seminar, Group discussion, Test and Quiz.

Course Designer:

- Ms. R.Tamilselvi

Course Schedule:

Unit	Topics	Hrs	Mode
Unit I	Introduction: Definition of Operating System –OS Structures: OS Services – System Calls – Virtual Machines.	9	Lecture, Quiz, PPT, Test, Seminar
	Process Management: Process Concepts – Process Scheduling – Operating on Process – Co-operating Processes – Inter-process Communication.	9	
Unit II	CPU Scheduling: Basic Concepts - Scheduling Criteria - Scheduling Algorithms.	9	Lecture, Quiz, PPT, Test, Seminar
	Process Synchronization: The Critical Section Problem - Semaphores - Classical Problems of Synchronization - Critical Regions.	9	
Unit III	Deadlocks: System Model - Deadlock characterization – Methods for Handling Deadlocks Deadlock Prevention.	9	Lecture, Quiz, PPT, Test, Seminar
	Deadlock avoidance- Deadlock Detection - Recovery from Deadlock.	9	
Unit IV	Storage management: Memory management - Swapping – Contiguous Memory allocation. Paging – Segmentation – Segmentation with Paging.	9	Lecture, Quiz, PPT, Test, Seminar
	Virtual memory: Demand paging - Page replacement – Thrashing. Mass-Storage Structure: Disk Structure- Disk scheduling.	9	
Unit V	File-System Interface: File Concept-File Attributes-File Operations – Access Methods: Sequential Access – Direct Access.	9	Lecture, Quiz, Assignment, Seminar
	Directory Structure: Single-Level Directory- Two –Level Directory-Tree-Structured Directories- Introducing Shell Programming – Linux General Purpose Commands-Process Oriented Commands – Communication Oriented Commands.	9	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Describe the basic concept of Operating System processes.	K2
CLO-2	Identify the significance of scheduling algorithms and process Synchronization.	K3
CLO-3	Apply the deadlock handling Mechanisms.	K3
CLO-4	Analyze the various Memory Management Techniques.	K4
CLO-5	Focus the concepts file system interface and shell programming.	K4

Mapping of CLOs with PSOs:

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

Mapping of CLOs with POs:

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

Advance application- 3; Intermediate level-2; Basic level-1

Blue Print for Summative Examination – Operating System
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& 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	K2	2(K4&K4)	1(K3)
5	CLO 5	Up to K4	2	K1& K2	1	K1	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	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	100%

DEPARTMENT OF INFORMATION TECHNOLOGY					CLASS: III B.Sc. (IT)			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hrs/Week	CIA	Ext.	Total
VI	Core Practical - VI	23U6FCCP6	Python Programming Lab	3	3	25	75	100
Nature of the Course:								
Skill Oriented	✓	Employability Oriented		✓	Entrepreneurship Oriented		✓	

Objectives:

- To understand the basic concepts in Python programming.
- To understand the concepts of specialized data types.
- To impart knowledge on various functions and modules.
- To inculcate the concept of Class and Inheritance.
- To impart the knowledge on file and database concepts.

Unit	Description	Hrs.	K-Level	CLO
I	1. Write a Python program that calculates the area of a circle based on the radius entered by the user. 2. Write a Python program that accepts the user's first and last name and prints them in reverse order with a space between them. 3. Write a Python program to construct the any pattern, using a nested for loop. 4. Write a Python program that prints all the numbers from 0 to 6 except 3 and 6. Note : Use 'continue' statement. 5. Write a Python program that iterates the integers from 1 to 50. For multiples of three print "Fizz" instead of the number and for multiples of five print "Buzz". For numbers that are multiples of three and five, print "FizzBuzz".	9	K2	CLO 1

II	6. Write a Python Program to perform append, insert, pop, reverse, sort methods in list. 7. Write a Python program to add two matrices (using nested lists) 8. Write a Python program to perform repetition, membership, maximum and minimum operations in Tuple. 9. Write a Python program to perform union, intersection, difference, symmetric difference and enumerate operation in Sets. 10. Create a menu driven Python program with a dictionary for words and their meanings. Write functions to add a new entry, search for a particular word and retrieve meaning, for given meaning find words with the same meaning, remove an entry, display all words sorted alphabetically.	9	K3	CLO 2
III	11. Write a Python function to multiply all the numbers in a list. 12. Write a Python program to sort a list of tuples using Lambda. 13. Write a Python function that accepts a string and counts the number of upper and lower case letters. 14. Write a Python function to create and print a list where the values are the squares of numbers between 1 and 30 15. Write a Python program to multiply two integers without using the * operator.	9	K3	CLO 3
IV	16. Write a python program that has a class person storing name, DOB. The program should subtract DOB from current date to find whether the person is eligible to vote or not. 17. Write a Python program that has classes such as student, course and department. Enroll a student in a course of a particular department. (Use inheritance) 18. Write a Python program that overloads the + operator to add two objects of class Matrix.	9	K4	CLO 4
V	19. Write a Python program to read data from a file and calculate the percentage of vowels and consonants in the file. 20. Write a Python program to create a file and display its contents. 21. Write a Python program to create student database in MySQL, insert, update and display the records.	9	K4	CLO 5

Books for Study:

1. Reema Thareja, “Python Programming using problem solving approach”, First Edition, 2017, Oxford University Press.
2. Mark Summerfield “Programming in Python 3: A Complete Introduction to the Python Language”, 2018 second edition, Pearson Education..

Books for References:

1. Dr.R Nageswara Rao, “Core Python Programming”, First Edition, 2017, Dreamtech Publishers.
2. Vamsi Kurama, “Python Programming: A Modern Approach”, Pearson Education.
3. Mark Lutz, ”Learning Python”, Orielly

Web Resources:

1. <https://www.programiz.com/python-programming>
2. <https://www.guru99.com/python-tutorials.html>

Rationale for Nature of the Course:

- Python is a world-famous simple, powerful and general-purpose computer language.
- This is an open-source language. It is called a high-level language, dynamic language, graphical user interface language, object-oriented language, interpreter language.
- Python language can easily create complicated programs and easy to write a program.

Activities having direct bearing on Skill development / Employability / Entrepreneurship:

- Give practices to conduct seminar and group discussion and preparing assignments.

Pedagogy:

- Demonstration , Practical Session

Course Designer:

- Ms. S. Brindha

Course Schedule:

Unit	Topics	Hrs	Mode
Unit I	1. Write a Python program that calculates the area of a circle based on the radius entered by the user. 2. Write a Python program that accepts the user's first and last name and prints them in reverse order with a space between them. 3. Write a Python program to construct the any pattern, using a nested for loop.	4	Demo & Practical Session
	4. Write a Python program that prints all the numbers from 0 to 6 except 3 and 6. Note: Use 'continue' statement. 5. Write a Python program that iterates the integers from 1 to 50. For multiples of three print "Fizz" instead of the number and for multiples of five print "Buzz". For numbers that are multiples of three and five, print "FizzBuzz".	5	
Unit II	6. Write a Python Program to perform append, insert, pop, reverse, sort methods in list. 7. Write a Python program to add two matrices (using nested lists) 8. Write a Python program to perform repetition, membership, maximum and minimum operations in Tuple.	4	Demo & Practical Session
	9. Write a Python program to perform union, intersection, difference, symmetric difference and enumerate operation in Sets. 10. Create a menu driven Python program with a dictionary for words and their meanings. Write functions to add a new entry, search for a particular word and retrieve meaning, for given meaning find words with the same meaning, remove an entry, display all words sorted alphabetically	5	
Unit III	11. Write a Python function to multiply all the numbers in a list. 12. Write a Python program to sort a list of tuples using Lambda. 13. Write a Python function that accepts a string and counts the number of upper and lower case letters.	4	Demo & Practical Session
	14. Write a Python function to create and print a list where the values are the squares of numbers between 1 and 30 15. Write a Python program to multiply two integers without using the * operator.	5	

Unit IV	16. Write a python program that has a class person storing name, DOB. The program should subtract DOB from current date to find whether the person is eligible to vote or not.	6	Demo & Practical Session
	17. Write a Python program that has classes such as student, course and department. Enroll a student in a course of a particular department. (Use inheritance)		
	18. Write a Python program that overloads the + operator to add two objects of class Matrix	3	
Unit V	19. Write a Python program to read data from a file and calculate the percentage of vowels and consonants in the file.	3	Demo & Practical Session
	20. Write a Python program to create a file and display its contents.		
	21. Write a Python program to create student database in MySQL, insert, update and display the records.	6	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Outline the basic concepts in python programming.	K2
CLO-2	Apply various data types and identify its usage.	K3
CLO-3	Construct programs using loops, functions and Modules in python for processing the data.	K3
CLO-4	Analyze the basic concepts and techniques of class and inheritance in python.	K4
CLO-5	Devise the coding by implementing Files and Database Concepts.	K4

Mapping of CLOs with PSOs:

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

Mapping of CLOs with POs:

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

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

DEPARTMENT OF INFORMATION TECHNOLOGY					CLASS: III B.Sc. (IT)			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hrs/Week	CIA	Ext.	Total
VI	Discipline Elective - II	23U6FDET2	Computational Intelligence	2	4	25	75	100
Nature of the Course:								
Skill oriented	✓	Employability oriented			Entrepreneurship Oriented			

Objectives:

- To understand the basics of Fuzzy Sets.
- To study about the Fuzzy logic systems.
- To understand and apply the concepts of Neural Network and its functions.
- To understand the concepts of Artificial Neural Network.
- To study about the Genetic Algorithm.

Unit	Description	Hrs .	K-Level	CLO
I	Fuzzy Set Theory: Fuzzy Vs Crisp – Crisp Sets – Fuzzy Sets – Fuzzy Relations.	12	K2	CLO 1
II	Fuzzy Systems: Crisp Logic- Predicate Logic – Fuzzy Logic – Fuzzy Rule based systems – Defuzzification.	12	K3	CLO 2
III	Neural Networks: Basic Concepts of Neural Networks - Human Brain – Model of Artificial Neuron - Neural Network Architectures – Characteristics of Neural Networks. Backpropagation Networks: Architecture of Backpropagation Networks - Backpropagation Learning.	12	K4	CLO 3
IV	Artificial Neural Networks: Fundamental Concepts – Basic Models of Artificial Neural Networks – Important Terminologies of ANNs – McCulloch-Pitts Neuron – Linear Separability – Hebb Network.	12	K3	CLO 4
V	Genetic Algorithm: Introduction – Biological Background – Genetic Algorithm Vs Traditional Algorithm – Basic Terminologies in Genetic Algorithm – Simple GA – General Genetic Algorithm – Operators in Genetic Algorithm.	12	K3	CLO 5

Books for Study:

1. S. Rajasekaran, G. A. Vijayalakshmi, “Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications”, PHI.
Unit-I: 6.
Unit-II: 7
Unit-III: 2.1 - 2.5, 3.1, 3.2
2. S.N. Sivanandam and S.N. Deepa, “Principles of Soft Computing”, 2nd Edition, Wiley India Pvt. Ltd.
Unit-IV: 2.
Unit-V: 15.1, 15.2, 15.5 – 15.9

Books for References:

1. F. Martin, Mc neill, and Ellen Thro, “Fuzzy Logic: A Practical approach”, AP Professional, 2000. Chin Teng Lin, C. S. George Lee,” Neuro-Fuzzy Systems”, PHI.
2. Chin Teng Lin, C. S. George Lee,” Neuro-Fuzzy Systems”, PHI.
3. Simon S. Haykn, “Neural Networks: A Comprehensive Foundation”, Macmillen, 1994.

Web Resources:

1. <https://www.javatpoint.com/fuzzy-logic>
2. <https://www.youtube.com/watch?v=HXfJpuAqMb8>
3. <https://www.geeksforgeeks.org/fuzzy-logic-introduction/>

Rationale for Nature of the Course:

- It helps to analyse & create flexible information processing of humans such as sensing, understanding, learning, & thinking.
- It is a field of study that seeks to understand, explain and predict intelligent behaviour.

Activities having direct bearing on Skill development:

- Give practices to conduct seminar and group discussion and preparing assignments.
- By developing a strong foundation in computer science, artificial intelligence.

Pedagogy:

- Chalk and talk, PPT, Assignment, Seminar, Group discussion, Test and Quiz.

Course Designer:

- Ms. S. Rajalakshmi

Course Schedule:

Unit	Topics	Hrs	Mode
Unit I	Fuzzy Set Theory: Fuzzy Vs Crisp – Crisp Sets.	6	Lecture, Quiz, PPT, Test, Seminar
	Fuzzy Sets – Fuzzy Relations.	6	
Unit II	Fuzzy Systems: Crisp Logic- Predicate Logic – Fuzzy Logic.	6	Lecture, Quiz, PPT, Test, Seminar
	Fuzzy Rule based systems – Defuzzification	6	
Unit III	Neural Networks: Basic Concepts of Neural Networks - Human Brain – Model of Artificial Neuron - Neural Network Architectures.	6	Lecture, Quiz, PPT, Test, Seminar
	Characteristics of Neural Networks. Backpropagation Networks: Architecture of Backpropagation Networks - Backpropagation Learning.	6	
Unit IV	Artificial Neural Networks: Fundamental Concepts – Basic Models of Artificial Neural Networks – Important Terminologies of ANNs.	6	Lecture, Quiz, PPT, Test, Seminar
	McCulloch-Pitts Neuron – Linear Separability – Hebb Network.	6	
Unit V	Genetic Algorithm: Introduction – Biological Background – Genetic Algorithm Vs Traditional Algorithm – Basic Terminologies in Genetic Algorithm.	6	Lecture, Quiz, Assignment, Seminar
	Simple GA – General Genetic Algorithm – Operators in Genetic Algorithm.	6	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Describe the fundamentals of Fuzzy sets and relations.	K2
CLO-2	Apply the fuzzy logic in rule based systems and find the significance of defuzzification techniques.	K3
CLO-3	Infer the concepts of Neural Network and analyze and apply the learning techniques.	K4
CLO-4	Identify the significance of the artificial neural networks and its applications.	K3
CLO-5	Apply the concept of Genetic Algorithm and Analyze the optimization problems using GAs.	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	3	2	3	2	3
CLO-3	3	2	3	2	3
CLO-4	3	3	3	2	3
CLO-5	3	3	3	2	3

Mapping of CLOs with POs:

#	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	3	3	2	3	2	2
CLO-2	3	3	3	3	3	2
CLO-3	3	3	3	2	2	3
CLO-4	3	3	3	3	3	3
CLO-5	3	3	3	3	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	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(K4)
4	CLO 4	Up to K3	2	K1 & K2	1	K2	2(K2&K2)	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			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	100%

DEPARTMENT OF INFORMATION TECHNOLOGY					CLASS: III B.Sc. (IT)			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hrs/Week	CIA	Ext.	Total
VI	Discipline Elective - II	23U6FDET2	Internet of Things	2	4	25	75	100
Nature of the Course:								
Skill oriented	✓	Employability oriented		✓	Entrepreneurship Oriented			

Objectives:

- To impart the knowledge in Smart Technology.
- To understand the usage of smart appliances.
- To familiar with the concept of Smart Cars and Air Craft.
- To enhance the knowledge in better working through technology.
- To learn about the privacy and security issues in IoT.

Unit	Description	Hrs.	K-Level	CLO
I	Introduction Smart connectivity: Welcome to the Internet of Things – Welcome to the Future – What Is the Internet of Things? – What Kinds of Things can be Connected to the Internet of Things? – What do all those connected things do? Smart Technology: How the Internet of Things Works – Understanding the IoT – Building the IoT – Understanding Smart Devices – Understanding Network Connections – Examining Wireless Technologies.	12	K2	CLO 1
II	Smart TVs: Viewing in a Connected World – What Exactly is Smart TV? – Considering Smart TV Operating Systems – Examining a typical Smart TV – Exploring Smart TV Set-Top Devices - How to choose a smart TV or Device – Integrating Smart TVs into the Internet of Things – Smart TVs and You. Smart Appliances: From Remote Control Ovens to Talking Refrigerators – Understanding Smart Applications Smart Applications and You.	12	K3	CLO 2
III	Smart Cars: Connecting on the Road – Smart Cars Today and Tomorrow – Cars That Drive Themselves. Smart Aircraft: Invasion of the Drones – What Drones Are and What They Aren't – How Drones Are Used Today? – The Future of Drone Aircraft – Regulating Drone Aircraft – Fly the Scary Skies – Other Smart Aircraft Technologies – Smart Aircraft and you.	12	K3	CLO 3

IV	Smart Businesses: Better Working Through Technology – Smart Office – Smart Stores – Smart Inventory Management – Smart Businesses and You. Smart Cities: Everyone’s Connected – Understanding the Smart City – Smart Infrastructure – Smart Roads and Traffic Management Smart Public Lighting – Smart Utilities – Smart Grid – Smart Cities and You.	12	K3	CLO 4
V	Smart World: The Global Internet of Everything – Scaling the IoT Globally – Connecting Cities, States and Countries – The Rural IoT – The Agricultural IoT – The Environmental IoT – Battling Climate Change – Impediments to the Global IoT – The Smart World and You. Smart Problems: Big Brother is Watching You – Privacy Issues – Security Issues – Big Data Issues – Autonomy and Control Issues – Smart Machine Issues – Smart Problems and You.	12	K4	CLO 5

Book for Study:

1. Michael Miller, “The Internet of Things: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities Are Changing the World”, Que Publishing.

Unit-I: 1, 2.

Unit-II: 3, 4.

Unit-III: 5, 8, 9.

Unit-IV: 12, 13.

Unit-V: 14, 15

Books for References:

1. Vijay Madisetti and Arshdeep Bahga, “Internet of Things: (A Hands-on Approach)”, Universities Press (INDIA) Private Limited 2014, 1st Edition.
2. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, Apress Publications 2013, First Edition,
3. Waltenegus Dargie, Christian Poel labauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice", Wiley Publications.

Web Resources:

1. <https://www.ibm.com/think/topics/internet-of-things>
2. <https://www.astronics.com/smart-aircraft-system>
3. <https://innovate.ieee.org/innovation-spotlight/addressing-the-iot-challenges-of-smart-cities>

Rationale for Nature of the Course:

- Devices with sensors, processing ability, software and other technologies that connect and exchange data with other devices and systems over the Internet or other communication networks.

Activities having direct bearing on Skill development / Employability:

- To developing and monitoring multiple devices.
- To promote collaborative learning and team work spirit through multi-disciplinary projects and diverse professional activities.

Pedagogy:

- Chalk and talk, PPT, Assignment, Seminar, Group discussion, Test and Quiz.

Course Designer:

- Mr. N.Radha Krishnan

Course Schedule:

Unit	Topics	Hrs	Mode
Unit I	Introduction Smart connectivity: Welcome to the Internet of Things – Welcome to the Future – What Is the Internet of Things? – What Kinds of Things can be Connected to the Internet of Things? – What do all those connected things do?	6	Lecture, Quiz, PPT, Test, Seminar
	Smart Technology: How the Internet of Things Works – Understanding the IoT – Building the IoT – Understanding Smart Devices – Understanding Network Connections – Examining Wireless Technologies.	6	
Unit II	Smart TVs: Viewing in a Connected World – What Exactly is Smart TV? – Considering Smart TV Operating Systems – Examining a typical Smart TV – Exploring Smart TV Set-Top Devices - How to choose a smart TV or Device – Integrating Smart TVs into the Internet of Things – Smart TVs and You.	6	Lecture, Quiz, PPT, Test, Seminar
	Smart Appliances: From Remote Control Ovens to Talking Refrigerators – Understanding Smart Applications Smart Applications and You.	6	
Unit III	Smart Cars: Connecting on the Road – Smart Cars Today and Tomorrow – Cars That Drive Themselves.	6	Lecture, Quiz, PPT, Test, Seminar
	Smart Aircraft: Invasion of the Drones – What Drones Are and What They Aren't – How Drones Are Used Today? – The Future of Drone Aircraft – Regulating Drone Aircraft – Fly the Scary Skies – Other Smart Aircraft Technologies – Smart Aircraft and you.	6	
Unit IV	Smart Businesses: Better Working Through Technology – Smart Office – Smart Stores – Smart Inventory Management – Smart Businesses and You.	6	Lecture, Quiz, PPT, Test, Seminar
	Smart Cities: Everyone's Connected – Understanding the Smart City – Smart Infrastructure – Smart Roads and Traffic Management Smart Public Lighting – Smart Utilities – Smart Grid – Smart Cities and You.	6	

Unit V	Smart World: The Global Internet of Everything – Scaling the IoT Globally – Connecting Cities, States and Countries – The Rural IoT – The Agricultural IoT – The Environmental IoT – Battling Climate Change – Impediments to the Global IoT – The Smart World and You.	6	Lecture, Quiz, Assignment, Seminar
	Smart Problems: Big Brother is Watching You – Privacy Issues – Security Issues – Big Data Issues – Autonomy and Control Issues – Smart Machine Issues – Smart Problems and You.	6	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Describe the smart connectivity and smart devices.	K2
CLO-2	Collect the use of smart TV and appliances.	K3
CLO-3	Identify the benefits of smart care and aircraft.	K3
CLO-4	Use the technologies in the business and cites.	K3
CLO-5	Analyze the issues in the real time usage.	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	2	3	2
CLO-3	3	3	3	3	2
CLO-4	3	3	3	3	3
CLO-5	3	3	3	2	3

Mapping of CLOs with POs:

#	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	3	3	2	1	2	3
CLO-2	3	3	1	1	3	3
CLO-3	3	3	2	3	2	3
CLO-4	3	3	2	3	3	3
CLO-5	3	3	2	1	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	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			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	100

DEPARTMENT OF INFORMATION TECHNOLOGY					CLASS: III B.Sc. (IT)			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hrs/Week	CIA	Ext .	Total
VI	Professional Competency Skill	23U6FSED8	Verbal and Non-Verbal Reasoning	2	2	25	75	100
Nature of the Course:								
Skill Oriented		✓	Employability Oriented		✓	Entrepreneurship Oriented		

Objectives:

- To enhance and practice the knowledge in the basic level of Verbal Reasoning.
- To improve and practice the knowledge in the moderate level of Verbal Reasoning.
- To enrich and practice the knowledge in the advanced level of Verbal Reasoning.
- To impart the knowledge in Logical Reasoning.
- To enrich and practice the knowledge in Non-Verbal Reasoning.

Unit	Description	Hrs.	K-Level	CLO
I	Coding And Decoding – Puzzle Test – Sequential Output Tracing – Direction Sense Test.	6	K4	CLO 1
II	Logical Venn Diagrams – Number Ranking and Time Sequence Test – Arithmetical Reasoning – Data Sufficiency.	6	K4	CLO 2
III	Decision Making – Assertion and Reason – Situation Reaction Test – Verification of the Truth of the Statement.	6	K4	CLO 3
IV	Logic – Statement-Arguments – Statement-Assumptions – Statement-Conclusions – Theme Detection.	6	K4	CLO 4
V	Analytical Reasoning – Completion of Incomplete Pattern – Figure Matrix – Construction of Squares and Triangles.	6	K4	CLO 5

Book for Study:

1. A Modern Approach to Verbal and Non-Verbal Reasoning – R.S. Aggarwal – S. Chand & Company Limited 2018.

Unit I: Part I - Section I – 4, 6, 7 & 8.

Unit II: Part I - Section I – 9, 11, 14 & 16.

Unit III: Part I - Section I – 17 to 20.

Unit IV: Part I - Section II – 1, 2, 3, 5 & 7.

Unit V: Part II – 4, 8, 9 & 16.

Books for References:

1. A New Approach to Reasoning - Verbal, Non-verbal and Analytical – BS Sijwali & Indu Sijwali – Arihant Publications 2021.
2. Reasoning for Competitive Examinations – Nishit K Sinha – Pearson Publications 2019.

Web Resources:

1. <https://www.indiabix.com/verbal-reasoning/venn-diagrams/>
2. <https://www.geeksforgeeks.org/statement-and-assumption/>
3. <https://www.geeksforgeeks.org/analytical-reasoning-non-verbal-reasoning/>

Rationale for Nature of the Course:

- It helps to analyse & create, flexible information processing such as understanding, learning, thinking & finding solutions.
- It helps to clear first level scrutiny of several recruitments.

Activities having direct bearing on Skill development / Employability:

- Through the practices like seminar, group discussion and assignments.
- Through the multiple Mock Test at regular intervals.

Pedagogy:

- Chalk and talk, PPT, Assignment, Seminar, Group discussion, Quiz and Test.

Course Designer:

- Mr. K. RajaSaravanaKumar

Course Schedule:

Unit	Topics	Hrs	Mode
Unit I	Coding And Decoding – Puzzle Test.	3	Lecture, Quiz, PPT, Test, Seminar
	Sequential Output Tracing – Direction Sense Test.	3	
Unit II	Logical Venn Diagrams – Number Ranking and Time Sequence Test.	3	Lecture, Quiz, PPT, Test, Seminar
	Arithmetical Reasoning – Data Sufficiency.	3	
Unit III	Decision Making – Assertion and Reason.	3	Lecture, Quiz, PPT, Test, Seminar
	Situation Reaction Test – Verification of the Truth of the Statement.	3	
Unit IV	Logic – Statement-Arguments – Statement-Assumptions.	3	Lecture, Quiz, PPT, Test, Seminar
	Statement-Conclusions – Theme Detection.	3	
Unit V	Analytical Reasoning – Completion of Incomplete Pattern.	3	Lecture, Quiz, Assignment, Seminar
	Figure Matrix – Construction of Squares and Triangles.	3	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Understand and practice the basic level of Verbal Reasoning.	K4
CLO-2	Apply logics to solve moderate level of Verbal Reasoning.	K4
CLO-3	Analyze various techniques in Assertions and Reasoning.	K4
CLO-4	Identify the importance of Assumptions.	K4
CLO-5	Utilize Analytical Reasoning to complete the patterns.	K4

Mapping of CLOs with PSOs:

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

Mapping of CLOs with POs:

#	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	3	3	2	3	2	2
CLO-2	3	3	3	3	3	2
CLO-3	3	3	3	2	2	3
CLO-4	3	3	3	3	3	3
CLO-5	3	3	3	3	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 (Open Choice)	Section C (Open Choice)
			MCQs			
			No. of Questions	K-Level		
1	CLO 1	Up to K4	6	K3 & K4	1 (K1)	1 (K2)
2	CLO 2	Up to K4	6	K3 & K4	1 (K2)	1 (K3)
3	CLO 3	Up to K4	6	K3 & K4	1 (K1)	1 (K2)
4	CLO 4	Up to K4	6	K3 & K4	1 (K2)	1 (K3)
5	CLO 5	Up to K4	6	K3 & K4	1 (K2)	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 (No Choice)	Section C (Either/or)	Total Marks	% of Marks with choice	Consolidated
K1	-	10	-	10	9.52	43%
K2	-	15	20	35	33.33	
K3	15	-	30	45	42.85	43%
K4	15	-	-	15	14.28	14%
Total Marks	30	25	50	105	100	100%

DEPARTMENT OF INFORMATION TECHNOLOGY					CLASS: III B.Sc. (IT)			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours/Week	CIA	Ext.	Total
VI	Project	23U6FPROV	Project & Viva Voce	2	3	25	75	100
Nature of the Course:								
Skill oriented		✓	Employability oriented		✓	Entrepreneurship Oriented		✓

Objectives:

- To motivate students in research methodology
- To develop scientific temper and systematic approach to problem solving and research methodology.
- To promote the experimental and analytical knowledge
- To recommend research writing skill 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 students will be able to:

CLOs	Course Learning Outcomes	Knowledge 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	Experiment the scientific study with 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 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

Mapping of CLOs with POs:

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

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

Internal & External Valuation for Project

Internal	External
25 Marks	75 Marks
<u>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. (Project will be evaluated by Guide with External Examiner in the presence of HOD/Coordinator)



The Madura College (Autonomous), Madurai – 625 011

Department of Information Technology

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	
V	23U5FCCT5	PHP Scripting	5	4	✓		✓			✓	51.2%
	23U5FCCT6	Data Structures and Algorithms	5	4			✓			✓	No Change
	23U5FCCT7	Software Engineering	5	4	✓		✓			✓	67.2%
	23U5FCCP5	PHP Scripting Lab	3	3	✓		✓			✓	51.4%
	23U5FDET1	Data Mining	5	4			✓			✓	73.5%
	23U5FDET1	Computer Architecture	5	4			✓	✓			No Change
	23U5FIDCT	Biometrics	5	4	✓	✓	✓			✓	New Paper
VI	23U6FCCT8	Python Programming	6	4	✓		✓			✓	26.8%
	23U6FCCT9	Data Communication and Networking	6	4			✓			✓	39.1%
	23U6FCCT10	Operating System	6	4			✓	✓			6.7%
	23U6FCCP6	Python Programming Lab	3	3	✓	✓	✓			✓	95.2%
	23U6FDET2	Computational Intelligence	4	2			✓			✓	New Paper
	23U6FDET2	Internet of Things	4	2	✓		✓			✓	New Paper
	23U6FSED8	Verbal and Non-Verbal Reasoning	2	2	✓		✓			✓	New Paper
	23U6FPROV	Project & Viva-Voce	3	2	✓		✓			✓	New Paper



THE MADURA COLLEGE (Autonomous)

PG DEPARTMENT OF COMPUTER SCIENCE

**Curriculum based on
TAMIL NADU STATE COUNCIL FOR HIGHER EDUCATION
(TANSCHÉ)
(Choice Based Credit System with Outcome Based Education)**

Academic Year 2025-2026 onwards

M.Sc. Computer Science

I and II Semesters

VISION

To disseminate quality education in Computer science and related fields to the students make them fit and have strong foundation to compete the challenges in the Computer world.

MISSION

- To implement appropriate and relevant educational programs through quality teaching and learning methods.
- To explore the skills of the students through student centric activities based on Hands on training.
- To create a learning environment for enhancing their innovated ideas, problem solving skills, leadership qualities and team spirit.
- To produce skilled graduates with a creative mind-set who can recognize a computational problem either in IT industry or society, and develop effective solutions

PROGRAMME EDUCATIONAL OBJECTIVES (PEOS):

After successful completion of the programme, the students will be able to

#	DESCRIPTION
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 OUTCOMES (POS):

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

#	GRADUATE ATTRIBUTES	DESCRIPTION
PO-1	Ethical Value	Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities.
PO-2	Decision Making	Foster analytical and critical thinking abilities for data-based decision-making.
PO-3	Problem Solving	Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context.
PO-4	Communication	Ability to develop communication, managerial and interpersonal skills.

PO-5	Employability	Inculcate contemporary business practices to enhance employability skills in the competitive environment.
PO-6	Individual and Team Leadership	Capability to lead themselves and the team to achieve organizational goals.

PROGRAMME SPECIFIC OUTCOMES Aligned with Graduate Attributes:

#	GRADUATE ATTRIBUTES	DESCRIPTION
PSO-1	Placement	To prepare the students who will demonstrate respectful engagement with others' ideas, behaviours, 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.
PSO-3	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.
PSO-4	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 for Admission

A candidate must have passed their B.Sc. (CS/IT)/ BCA with Mathematics in +2 or any other examination approved by Madurai Kamaraj University as equivalent.

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.

EVALUATION PATTERN

THEORY		
Internal(Formative)	25 Marks	
	Components of Internal Assessment	Marks
	Test	10
	Assignment	5
	Quiz	5
	Seminar	5
External (Summative)	75 Marks	

PRACTICAL		
Internal (Formative)	25 Marks	
	Components of Internal Assessment	Marks
	Test	10
	Continuous observation	10
	Record	5
External (Summative)	75 Marks	

I. TEST

ASSESSMENT RUBRICS

#	Timeline
1	36 th day
2	72 nd day
Retest	On genuine reasons / medical grounds (with prior permission)

Assessment Strategy

- Objective.
- Subjective.

Assessment of the learning level attained by the students against mapped Course / Programme Outcomes.

Rubrics:**Section –A (Short Answer)**

Criteria	Performance Marks	
	2	1
Assessment	The answer is relevant, Correct and complete	The answer is relevant but incomplete

Section –B (Paragraph Answer)

Criteria	Performance Marks				
	5	4	3	2	1
Assessment	The answer is relevant, answered at the appropriate K-level, conclusion Or result drawn correctly.	The answer is relevant, answered at the appropriate K-level, arguments are correct but conclusion/ result is inconclusive or incorrect.	The answer is relevant, Answered at The appropriate K-level, arguments are correct but incomplete And inconclusive	The answer is relevant with few correct and few incorrect and inconclusive arguments	The answer is relevant but arguments are incorrect and inconclusive.

Section –C

Criteria	Performance Marks					
	10	8-9	6-7	4-5	2-3	1
Assessment	The answer is correct and conclusive. The result is drawn correctly	The answer is correct and complete. The result is incorrect or inconclusive	The answer is mostly correct, most key points are correct but the result is incorrect or inconclusive	The answer is partly correct. A few key points are correct. Inference is drawn Incorrectly or inconclusively	The answer is incomplete. Most key points are incorrect.	The answer is irrelevant

**Question paper pattern for test component of Internal Assessment
(Duration 1 ½ hours)**

Pattern	No. of Questions	Marks per Question	Total Marks
Section–A (Short Answer - No choice)	5	2	10
Section–B (Paragraph type - Either-or)	2	5	10
Section–C (Open Choice - Two questions to be answered out of Three Questions)	2	10	20
Total Marks			40

Blue Print for Test Component of CIA

Pattern	Section–A (Short Answer)	Section–B (Either- Or)	Section–C (Open Choice)
CLO X	2 / 3*	1*	1 / 2*
CLO Y	2 / 3*	1*	1 / 2*

***K-levels can be decided by the course teacher ensuring proper distribution across K-levels.**

Assessment methodology and weight:

Weight: 10 marks.

Calculated Metric = Average of two tests.

II. SEMINAR

Timeline
Spread over the entire semester from days 20 to 80

Assessment Strategy

Rubric:

Component	3	2	1
Presentation	-	Presentation was done with ICT tools and the tools were Appropriate for the content.	Usage of ICT tools was inadequate.
Content	Content was presented clearly and concisely, key points were answered well and arguments were established very well.	Content was relevant, key points were presented but inferences were ineffectively drawn or questions answered inadequately.	Content was presented but key points were not articulated effectively

Weight : 5 marks

III. ASSIGNMENT:

#	Timeline
1	30 th day
2	70 th day

Assessment Strategy

Rubric:

Component	2	1
Timely submission	-	The assignment is Submitted on time
Content	-	Content is relevant and Complete in all respects
Originality	-	Content is written in own words with paraphrasing
Library and Information resources Usage	Library and N-list resources are used and the resources used are cited appropriately and adequately	Information resource usage (or) usage of other resources are inadequate or not properly referenced

Assessment methodology and weight**Weight :** 5 marks**Assessment outcome :** Best one score to be considered.**IV. QUIZ**

#	Timeline
1	18 th day
2	48 th day
3	78 th day

(Or)

#	Timeline
1	40 th day
2	80 th day

Assessment strategy

- Objective

Assessment methodology and**weight Weight:** 5 Marks.**Assessment outcome :** Average of test 2 out of 3 quizzes (or) best one of 2 quizzes.

Curriculum Structure for M.Sc. Computer Science

Part	Course Description	Course Code	Course Title	Contact Hours/ Week	Credits
SEMESTER I					
A	Core – I	25P1DCCT1	Analysis & Design of Algorithms	6	5
	Core – II	25P1DCCT2	Cloud Computing	6	5
	Core Practical – I	25P1DCCP1	Algorithms And Cloud Computing Lab	6	4
	Discipline Elective – I	25P1DECT1	Advanced Computer Networks / Soft Computing	5	3
	Discipline Elective – II	25P1DECT2	Advanced Computer Organization and Architecture / Web Application Development	5	3
B	NME – I	25P1DSEN1	Office Automation	2	2
	Total			30	22
SEMESTER II					
A	Core – III	25P2DCCT3	Advanced Java Programming	6	5
	Core – IV	25P2DCCT4	Data Mining And Warehousing	6	5
	Core Practical – II	25P2DCCP2	Advanced Java & Data Mining Tools Lab	6	4
	Discipline Elective – III	25P2DECT3	Advanced Software Engineering/ Scripting Languages	5	3
	Discipline Elective – IV	25P2DECT4	Artificial Intelligence & Machine Learning / Blockchain Technology	5	3
B	NME – II	25P2DSEN2	Advanced Excel Techniques	2	2
	Total			30	22

PG DEPARTMENT OF COMPUTER SCIENCE					CLASS: I M.Sc. (CS)			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours/Week	CIA	Ext.	Total
I	Core – I	25P1DCCT1	Analysis & Design of Algorithms	5	6	25	75	100
Nature of the Course:								
Skill oriented		✓	Employability oriented		✓	Entrepreneurship Oriented		

Objectives:

- To understand the algorithmic procedure to determine the computational complexity of algorithms.
- To learn about the searching and sorting algorithms.
- To devise an efficient approach to solving problems by Greedy method.
- To learn effective problem solving in computing applications using Dynamic Programming.
- To understand about Backtracking algorithms.

Unit	Description	Hrs.	K-Level	CLO
I	Introduction: Algorithm Definition and Specification - Space complexity - Time Complexity - Asymptotic Notations - Elementary Data Structure: Stacks and Queues - Binary Tree – Binary Search Tree – Heap - Heap sort - Graph.	18	K2	CLO1
II	Basic Traversal and Search Techniques: Techniques for Binary Trees - Techniques for Graphs. Divide and Conquer: General Method - Binary Search - Merge Sort - Quick Sort.	18	K4	CLO2
III	The Greedy Method: General Method – Knapsack Problem – Minimum Cost Spanning Tree - Single Source Shortest Path.	18	K3	CLO3
IV	Dynamic Programming: General Method – Multistage Graphs – All Pair Shortest Path - Optimal Binary Search Trees - 0/1 Knapsacks - Traveling Salesman Problem - Flow Shop Scheduling.	18	K3	CLO4
V	Backtracking: General Method – 8-Queens Problem – Sum of Subsets – Graph Coloring - Hamiltonian Cycles. Branch And Bound: The Method - Traveling Salesperson.	18	K4	CLO5

Book for study:

1. Ellis Horowitz, “Computer Algorithms”, Galgotia Publications.

Unit-I: 1, 2

Unit-II: 6, 3

Unit-III: 4

Unit-IV: 5

Unit-V: 7, 8

Books for References:

1. V.Aho, Hopcroft, Ullman “Data structures and Algorithms”
2. S.E. Goodman, ST. Hedetniem “Introduction to design and Analysis of Algorithms” - TMH.

Web Resources:

1. https://www.tutorialspoint.com/design_and_analysis_of_algorithms/index.htm
2. <https://www.javatpoint.com/daa-tutorial>
3. <https://jainakshay781.files.wordpress.com/2017/12/horowitz-and-sahani-fundamentals-of-computer-algorithms-2nd-edition.pdf>

Rationale for Nature of the Course:

- The process of designing algorithms to solve problems in computer science and information technology. It also involves analyzing the complexity of these algorithms.

Activities having direct bearing on Skill development / Employability:

- To Practice coding and Analyze, Algorithm.

Pedagogy:

- Chalk and talk, PPT, Assignment, Seminar, Group discussion, Test and Quiz.

Course Designer:

- Mrs. K. Vairameenakshi

Course Schedule:

Unit	Topics	Hrs	Mode
Unit I	Introduction: Algorithm Definition and Specification – Space complexity -Time Complexity -Asymptotic Notations.	9	Lecture, Quiz, PPT, Test, Seminar
	Elementary Data Structure: Stacks and Queues - Binary Tree – Binary Search Tree – Heap - Heap sort - Graph.	9	
Unit II	Basic Traversal and Search Techniques: Techniques for Binary Trees - Techniques for Graphs.	9	Lecture, Quiz, PPT, Test, Seminar
	Divide and Conquer: General Method - Binary Search - Merge Sort - Quick Sort.	9	
Unit III	The Greedy Method: General Method – Knapsack Problem	9	Lecture, Quiz, PPT, Test, Seminar
	Minimum Cost Spanning Tree - Single Source Shortest Path.	9	
Unit IV	Dynamic Programming: General Method – Multistage Graphs – All Pair Shortest Path - Optimal Binary Search Trees.	9	Lecture, Quiz, PPT, Test, Seminar
	0/1 Knapsacks - Traveling Salesman Problem - Flow Shop Scheduling.	9	
Unit V	Backtracking: General Method – 8-Queens Problem – Sum of Subsets – Graph Coloring.	9	Lecture, Quiz, Seminar, Assignment
	Hamiltonian Cycles. Branch And Bound: The Method - Traveling Salesperson.	9	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO–1	Explain about algorithms and determines their time complexity.	K2
CLO–2	Examine specific search and sort algorithms using divide and conquer technique.	K4
CLO–3	Apply Greedy method and its algorithm.	K3
CLO–4	Identify graph using dynamic programming techniques.	K3
CLO–5	Illustrate the concept of the backtracking & branch bound technique.	K4

Mapping of CLOs with PSOs:

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

Mapping of CLOs with POs:

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

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 K4	2	K1 & K2	1	K1	2(K4&K4)	1(K3)
3	CLO 3	Up to K3	2	K1 & K2	1	K2	2(K2&K2)	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(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	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	100%

PG DEPARTMENT OF COMPUTER SCIENCE					CLASS: I M.Sc. (CS)			
Sem .	Course Type	Course Code	Course Title	Credits	Contact Hours/Week	CIA	Ext .	Total
I	Core-II	25P1DCCT2	Cloud Computing	5	6	25	75	100
Nature of the Course:								
Skill oriented		✓	Employability oriented		✓	Entrepreneurship Oriented		✓

Objectives:

- To Understand the Fundamentals and Essential of Cloud Computing.
- To Learn about Web based Calendars for Scheduling, Collaborating on Group Projects and Events.
- To focus on the importance of Cloud Computing driven Commercial Systems and Applications.
- To Expose the Students to Frontier areas of Cloud Computing and Information Systems Web Services.
- To acquire knowledge about Online File Storage and Sharing Services.

Unit	Description	Hrs	K-Level	CLO
I	Introduction -Cloud Computing: Introduction – From Collaboration to the Cloud – Working of Cloud Computing – pros and cons- Benefits - Developing Cloud Services - Types of Cloud Service Development- Discovering Cloud Services.	18	K2	CLO 1
II	Cloud Computing For Everyone: Centralizing Email Communications - Cloud Computing for Community-Collaborating on Schedules - Collaborating on Group Projects and Events – Cloud Computing for Corporation - Mapping Schedules - Managing Projects.	18	K3	CLO 2
III	Using Cloud Services: Collaborating on Calendars Schedules and Task Management - Exploring Online Calendar Applications - Online Scheduling- Online Planning and Task Management- Collaborating on Event Management - Collaborating on Word Processing- Spreadsheets and Databases.	18	K3	CLO 3
IV	Outside the Cloud: Evaluating Web Mail Services - Evaluating Instant Messaging - Evaluating Web Conference Tools - Creating Groups on Social Networks - Evaluating Online Groupware - Collaborating via Blogs and Wikis.	18	K4	CLO 4

V	Storing and Sharing: Understanding Cloud Storage- Evaluating Online File Storage- Exploring Online Book Marking Services- Exploring Online Photo Editing Applications- Exploring Photo Sharing Communities-Controlling it with Web Based Desktops.	18	K4	CLO 5

Book for Study:

1. Michael Miller, “Cloud Computing”, Pearson Education, New Delhi, 2009.

Unit I: 1, 2, 3

Unit II: 4, 5, 6

Unit III: 7, 8, 11, 12, 13

Unit IV: 18, 19, 20

Unit V: 15, 16, 17

Books for References:

1. Anthony T.Velte, “Cloud Computing A Practical Approach”, 1st Edition, Tata McGraw Hill Education Private Limited, 2009.
2. Cloud Computing – Sandeep Bhowmic, Cambridge University Press, 2017.

Web Resources:

1. <https://nptel.ac.in/courses/106/105/106105167/>
2. https://www.tutorialspoint.com/cloud_computing/index.htm
3. <https://www.javatpoint.com/cloud-computing-tutorial>

Rationale for Nature of the Course:

- Studying Cloud Computing fosters the ability to design solutions for Real World challenges such as Scaling Applications and Securing data.
- Many Emerging Technologies, such as AI, IOT, Big Data Analytics, rely on Cloud Platforms.

Activities having direct bearing on Skill development / Employability/ Entrepreneurship:

- Knowledge of Cloud Computing Empowers Entrepreneurs to build Scalable, Cloud-Native Businesses.
- Cloud Computing Knowledge is applicable in various industries, including Healthcare, Finance, Education, E-commerce and Entertainment.

Pedagogy:

- Chalk and Talk, PPT, Assignment, Seminar, Group Discussion, Test and Quiz.

Course Designer:

- Mrs. D. Geetharamani

Course Schedule:

Unit	Topics	Hrs	Mode
Unit I	Introduction - Cloud Computing: Introduction - From Collaboration to the Cloud - Working of Cloud Computing - pros and cons - Benefits.	9	Lecture, Quiz, PPT, Test, Seminar
	Developing Cloud Services - Types of Cloud Service Development- Discovering Cloud Services.	9	
Unit II	Cloud Computing For Everyone: Centralizing Email Communications - Cloud Computing for Community -Collaborating on Schedules.	9	Lecture, Quiz, PPT, Test, Seminar
	Collaborating on Group Projects and Events – Cloud Computing for Corporation - Mapping Schedules - Managing Projects.	9	
Unit III	Using Cloud Services: Collaborating on Calendars, Schedules and Task Management - Exploring Online Calendar Applications - Online Scheduling - Online Planning and Task Management.	9	Lecture, Quiz, PPT, Test, Seminar
	Collaborating on Event Management - Collaborating on Word Processing- Spreadsheets and Databases	9	
Unit IV	Outside the Cloud: Evaluating Web Mail Services- Evaluating Instant Messaging- Evaluating Web Conference Tools.	9	Lecture, Quiz, PPT, Test, Seminar
	Creating Groups on Social Networks- Evaluating Online Groupware- Collaborating via Blogs and Wikis.	9	
Unit V	Storing and Sharing: Understanding Cloud Storage- Evaluating Online File Storage - Exploring Online Book Marking Services.	9	Lecture, Quiz, Assignment, Seminar
	Exploring Online Photo Editing Applications- Exploring Photo Sharing Communities-Controlling it with Web Based Desktops.	9	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Explain the Core Concepts of Cloud Computing Paradigm.	K2
CLO-2	Apply the Fundamental Concepts in Data Enters to Understand the Tradeoffs in Power , Efficiency and Cost.	K3
CLO-3	Make Use of Different Cloud Services and determine their Significance.	K3
CLO-4	Analyze Existing Software development Strategies as applied to Web Design Compare and Contrast Web based Client – Server Models.	K4
CLO-5	Identify Resource Management Fundamentals and Outline their Role in Managing Infrastructure in Cloud Computing.	K4

Mapping of CLOs with PSOs:

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

Mapping of CLOs with POs:

#	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	3	2	2	2	3	3
CLO-2	3	2	1	2	3	3
CLO-3	3	1	1	2	3	3
CLO-4	3	2	1	2	3	3
CLO-5	3	2	1	2	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	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 K3	2	K1 & K2	1	K2	2(K2&K2)	1(K3)
4	CLO 4	Up to K4	2	K1 & K2	1	K2	2(K4&K4)	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			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)	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	100%

PG DEPARTMENT OF COMPUTER SCIENCE					CLASS: I M.Sc. (CS)			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours/Week	CIA	Ext.	Total
I	Core Practical – I	25P1DCCP1	Algorithms and Cloud Computing Lab	4	6	25	75	100
Nature of the Course:								
Skill oriented		✓	Employability oriented		✓	Entrepreneurship Oriented		

Objectives:

- To implement basic data structures.
- To develop programs based on the applications of the data structures using various techniques.
- To understand the applications of various algorithms.
- To Learn the Design and Development Process involved in Creating a Cloud based Applications.
- To Focus on the importance of Cloud Computing driven Commercial Systems and Applications and thereby developing Web Applications in Cloud.

Unit	Description	Hrs.	K-Level	CLO
I	1. Write a program to solve the tower of Hanoi using recursion. 2. Write a program to perform various operations on stack using linked list. 3. Write a program to perform various operation in circular queue.	18	K2	CLO 1
II	4. Write a program to traverse through binary search tree using traversals. 5. Write a program to sort an array of an elements using quick sort. 6. Write a program to solve number of elements in ascending order using heap sort.	18	K4	CLO 2
III	7. Write a program to solve the knapsack problem using greedy method 8. Write a program to solve the Prims Algorithm using Minimum Cost Spanning Tree. 9. Write a program to solve the Kruskal Algorithm using Minimum Cost Spanning Tree. 10. Write a program to solve the Breadth First Search Using graph. 11. Write a program to solve the Depth First Search Using graph. 12. Write a program to place the 8 queens on an 8X8 matrix so that no two queens attack each other.	18	K3	CLO 3

IV	13. Launch a Linux Virtual Machine 14. Implementation of Para-Virtualization using VM Ware's workstation. 15. Working and Installation of Google App Engine. 16. Use GAE(Google App Engine) to Launch the Web Applications	18	K3	CLO 4
V	17. To Host a Static Website. 18. Exploring a Google Cloud for Storage, Sharing data, Manager Calendar -To do List, Document Editing Tools. 19. Working with Google Drive to make a Spreadsheet and Notes 20. To Connect Amazon Red shift with S3 (Amazon Simple Storage Service) bucket	18	K4	CLO 5

Book(s) for Study:

1. Ellis Horowitz, "Computer Algorithms", Galgotia Publications.
2. Michael Miller "Cloud Computing", Pearson Education, New Delhi, 2009.

Books for References:

1. Annathy Levith "Introduction to the Design and Analysis of Algorithm", Pearson Education Asia 2003.
2. Anthony T.Velte, 1st Edition, "Cloud Computing A Practical Approach", Tata McGraw Hill Education Private Limited, 2009

Web Resources:

- https://www.tutorialspoint.com/object_oriented_analysis_design/ooad_object_oriented_analysis
- https://www.tutorialspoint.com/cloud_computing/index.htm
- <https://www.javatpoint.com/cloud-computing-tutorial>

Rationale for Nature of the Course:

- Helping the students in developing logic and structured programs and to storing and organizing data in a particular way in a computer.
- Many emerging Technologies, such as AI, IOT, Big data analytics, rely on Cloud Platforms.

Activities having direct bearing on Skill development / Employability:

- To Practice coding and Analyze Algorithms.

Pedagogy:

- Chalk and talk, PPT, Assignment, Seminar, Group discussion, Test and Quiz.

Course Designers:

- Ms. K. Vairameenakshi
- Ms. D. Geetharamani

Course Schedule:

Unit	Topics	Hrs	Mode
Unit I	Write a program to solve the tower of Hanoi using recursion. Write a program to traverse through binary search tree using traversals.	9	Demo & Practical Session
	Write a program to perform various operations on stack using linked list.	9	
Unit II	Write a program to perform various operation in circular queue. Write a program to sort an array of an elements using quick sort.	9	Demo & Practical Session
	Write a program to solve number of elements in ascending order using heap sort.	9	
Unit III	Write a program to solve the knapsack problem using greedy method Write a program to solve the Prim's Algorithm using Minimum Cost Spanning Tree. Write a program to solve the Kruskal Algorithm using Minimum Cost Spanning Tree.	9	Demo & Practical Session
	Write a program to solve the Breadth First Search Using graph. Write a program to solve the Depth First Search Using graph. Write a program to place the 8 queens on an 8X8 matrix so that no two queens attack each other.	9	
Unit IV	Launch a Linux Virtual Machine Implementation of Para-Virtualization using VM Ware's workstation.	9	Demo & Practical Session
	Working and Installation of Google App Engine. Use GAE(Google App Engine) to Launch the Web Applications.	9	
Unit V	To Host a Static Website. Exploring a Google Cloud for Storage, Sharing data, Manager Calendar -To do List, Document Editing Tools.	9	Demo & Practical Session
	Working with Google Drive to make a Spreadsheet and Notes To Connect Amazon Red shift with S3 (Amazon Simple Storage Service) bucket	9	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Explain about algorithms and determines their time complexity.	K2
CLO-2	Examine specific search and sort algorithms using divide and conquer technique.	K4
CLO-3	Apply Greedy method and its algorithm.	K3
CLO-4	Make Use of existing software development strategies as applied to web design compare and contrast web based client/server models.	K3
CLO-5	Analyze different Cloud services and determine their significance.	K4

Mapping of CLOs with PSOs:

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

Mapping of CLOs with POs:

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

Advance application- 3; Intermediate level-2; Basic level-1

PG DEPARTMENT OF COMPUTER SCIENCE					CLASS: I M.Sc. (CS)			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours/Week	CIA	Ext.	Total
I	Discipline Elective – I	25P1DECT1	Advanced Computer Networks	3	5	25	75	100
Nature of the Course:								
Skill oriented	✓	Employability oriented			Entrepreneurship Oriented			

Objectives:

- To understand the general principles of data communication layer and function of Physical layer
- To familiarize the transmission media, flow control and error detection and correction.
- To acquire the knowledge of the basic protocols involved in wired and wireless communication process.
- To gain core knowledge of network layer routing protocols and IP addressing.
- To motivate the need for network security practices in organizational units.

Unit	Description	Hrs.	K-Level	CLO
I	Introduction: Data Communication - Networks - Network Types - Standards and Administration. Network Models: Protocol Layering - TCP/IP Protocol Suite - The OSI Model. Physical Layer: Data Signals - Periodic Analog Signals - Digital Signals - Transmission Impairment - Data Rate Limits – Performance.	15	K2	CLO 1
II	Multiplexing - Spread Spectrum. Switching: Introduction - Circuit - Switched Networks - Packet Switching - Structure of a Switch. Data - Link Layer: Introduction - Link Layer Addressing. Error Detection & Correction: Introduction - Block Coding - Cyclic Codes - CheckSum - Forward Error Correction.	15	K3	CLO 2
III	Wired LANs: Ethernet: Ethernet Protocol - Standard Ethernet Wireless LANs: Introduction - IEEE 80.11 Projects - Bluetooth Other Wireless Networks: WiMAX - Cellular Telephony - Satellite Networks. Connecting Devices. Network Layer: Introduction to Network Layer - Network - Layer Services - Packet Switching - Network - Layer Performance - IPV4 Addresses - Forwarding of IP Packets.	15	K3	CLO 3
IV	Network - Layer Protocol: Internet Protocol (IP) - ICMPv4 - Mobile IP. Next Generation IP: IPv6 Addressing - The IPv6 Protocol - The ICMPv6 Protocol - Transition from IPv4 to Ipv6. Transport Layer: Introduction - Transport - Layer Protocols. Transport - Layer Protocols: Introduction - User Datagram Protocol - Transmission Control Protocol.	15	K4	CLO 4

V	Cryptography and Network Security: Introduction to Cryptography – Security Attacks – Security Services. Symmetric and Asymmetric-key: Digital Signatures and Authentication Protocol. Web Security: Secure Socket Layer Secure Electronic Transaction. System Security - Intruders and Viruses – Firewalls – Password Security.	15	K4	CLO 5

Book(s) for Study:

- Behrouz A.Forouzan – “Data Communications and Networking”, 5E Tata McGraw Hill Education (India) Private Limited.
Unit– I: 1.1- 1.5., 2.1- 2.3., 3.1- 3.6.
Unit–II: 6.1, 6.2, 8.1- 8.4, 9.1, 9.2, 10.1- 10.5.
Unit–III: 13.1, 13.2., 15.1, 15.2., 16.1 - 16.3, 17.1, 18.1- 18.5.
Unit–IV: 19.1- 19.3., 22.1- 22.4., 24.1- 24.3.
- William Stallings, “Cryptography and Network Security”, PHI/Pearson Education.7th edition
Unit -V:1,3,13,14,15,19

Books for References:

- A.S.Tanenbaum, 2011, Computer Networks, Fifth Edition, Pearson Education. Inc.
- B.Frouzan, 1998, Introduction to Data Communication in Networking, Tata McGraw Hill Education (India) Private Limited.
- Larry L. Peterson and Bruce S. Davie, 2007, Computer Networks – A Systems Approach, 4th Edition, Publisher: Elsevier Science.

Web Resources:

- <http://peasonhighered.com/tanenbaum>
- https://www.tutorialspoint.com/data_communication_computer_network/index.htm
- <https://www.studytonight.com/computernetworks>

Rationale for Nature of the Course:

- To allow multiple processes to send and receive the data over the network without interfering with other processes.

Activities having direct bearing on Skill development / Employability:

- Practice to present seminar and paper presentation regarding various network techniques.
- Practice to implement cryptographic techniques in their academic project.

Pedagogy:

- Lecture, PPT, Assignment, Seminar, Group discussion and **Test**.

Course Designer:

- Ms. S. Brindha**

Course Schedule:

Unit	Topics	Hrs	Mode
Unit I	Data Communication - Networks - Network Types - Standards and Administration. Network Models: Protocol Layering - TCP/IP Protocol Suite	8	Lecture, Quiz, PPT, Seminar, Test
	Physical Layer: Data Signals - Periodic Analog Signals - Digital Signals - Transmission Impairment - Data Rate Limits – Performance.	7	
Unit II	Multiplexing - Spread Spectrum. Switching: Introduction - Circuit - Switched Networks - Packet Switching - Structure of a Switch.	8	Lecture, Quiz, PPT, Seminar, Test
	Data - Link Layer: Introduction - Link Layer Addressing. Error Detection & Correction: Introduction - Block Coding - Cyclic Codes - CheckSum - Forward Error Correction..	7	
Unit III	Wired LANs: Ethernet: Ethernet Protocol - Standard Ethernet Wireless LANs: Introduction - IEEE 80.11 Projects - Bluetooth Other Wireless Networks: WiMAX - Cellular Telephony - Satellite Networks. Connecting Devices. Other Wireless Networks: WiMAX - Cellular Telephony - Satellite Networks. Connecting Devices.	8	Lecture, Quiz, PPT, Seminar, Test
	Network Layer: Introduction to Network Layer - Network - Layer Services - Packet Switching - Network - Layer Performance - IPV4 Addresses - Forwarding of IP Packets.	7	
Unit IV	Network - Layer Protocol: Internet Protocol (IP) - ICMPv4 - Mobile IP. Next Generation IP: IPv6 Addressing - The IPv6 Protocol - The ICMPv6 Protocol - Transition from IPv4 to Ipv6. Transport Layer: Introduction - Transport - Layer Protocols.	8	Lecture, Quiz, PPT, Seminar, Test
	Transport - Layer Protocols: Introduction - User Datagram Protocol - Transmission Control Protocol.	7	
Unit V	Cryptography and Network Security: Introduction to Cryptography – Security Attacks – Security Services. Authentication Protocol.	8	Lecture, Quiz, Seminar, Assignment
	Symmetric and Asymmetric-key: Digital Signatures and Authentication Protocol. Web Security: Secure Socket Layer Secure Electronic Transaction. System Security - Intruders and Viruses – Firewalls – Password Security.	7	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Describe the functions of each layer in OSI and TCP/IP model.	K2
CLO-2	Differentiate various Switching techniques and Apply the concept of different Error Detection and Correction methods.	K3
CLO-3	Analyze the design principles of wired and wireless communication media.	K3
CLO-4	Understand the various Transport layer protocols and also differentiate IPV4 and IPV6 Protocols.	K4
CLO-5	Focus on current network authentication applications, network security and their vulnerabilities that are exploited by intentional and unintentional attacks.	K4

Mapping of CLOs with PSOs:

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

Mapping of CLOs with POs:

#	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	2	2	2	1	1	1
CLO-2	2	2	2	1	2	1
CLO-3	2	2	2	2	2	2
CLO-4	2	2	1	2	2	1
CLO-5	2	2	1	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 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(K3&K3)	1(K4)
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	100%

PG DEPARTMENT OF COMPUTER SCIENCE					CLASS: I M.Sc. (CS)			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours/Week	CIA	Ext.	Total
I	Discipline Elective – I	25P1DECT1	Soft Computing	3	5	25	75	100
Nature of the Course:								
Skill oriented		✓	Employability oriented			Entrepreneurship Oriented		

Objectives:

- To identify and understand the basics of AI and Soft Computing.
- To study about the Fuzzy logic systems.
- To understand and apply the concepts of Neural Network and its functions.
- To study about the Genetic Algorithm.
- To understand the emerging areas Computational Intelligence.

Unit	Description	Hrs.	K-Level	CLO
I	Introduction: Artificial Intelligence – a brief Review - Pitfalls of the Traditional AI - Computational Intelligence - an Emergence of a New Computational Paradigm - Computational Intelligence - a Formal Definition - Soft computing - Definitions - Fundamental Elements of Soft Computing - Computational Learning Theory - Synergism in Soft computing.	15	K2	CLO 1
II	Fuzzy Sets and Relations: Conventional Sets - Fuzzy Sets - Membership Functions - Continuous and Discrete Membership Functions - Typical Membership Functions - Operations on Fuzzy Sets - Basic Concepts Associated with Fuzzy Sets - Extension Principle of Fuzzy Sets - Fuzzy Relations - Projection of Fuzzy Relations.	15	K4	CLO 2
III	Machine Learning Using Neural Nets: Biological Neural Networks - Artificial Neural Networks - Principles of Learning in a Neural Net - Stability and Convergence - Three Important Theorems for Stability Analysis of Neural Dynamics. Supervised Neural Learning Algorithms: Introduction -McCulloch-Pitts Model - The Perceptron Learning Model. Unsupervised Neural Learning Algorithms: Introduction - Discrete Hopfield Network - Continuous Hopfield Neural Net.	15	K4	CLO 3
IV	Introduction to Generic Algorithms: Working Cycle of a Generic Algorithm - Binary –Coded GA - GA-Parameters Setting - Constraints Handling in GA – Advantages and disadvantages of Generic Algorithms. Applications of Soft Computing.	15	K3	CLO 4

V	Evolutionary Computing: Evolutionary Algorithm – Swarm Intelligence – Evolutionary Strategies - Evolutionary Programming – Advantages of Evolutionary Computation. Swarm Intelligence: Overview – Particle Swarm Optimization: Functioning of Particle Swarm Optimization.	15	K3	CLO 5

Books for Study:

1. Amit Konar, “Computational Intelligence Principles, Techniques and Applications”, Springer, 2007.
Unit-I: 1.
Unit-II: 5.
Unit-III: 7, 8.1-8.3, 9.1, 9.2.1,9.2.2.
2. Dilip K.Pratihar, ”Soft Computing, Fundamentals and Applications”, Narosa Publishing House, Chennai, 2015.
Unit-IV: 3, 14
3. Saroj Kaushik, Sunitha Tiwari, “Soft Computing Fundamentals, Techniques and Applications”, 1st edition, TMH.
Unit-V: 11, 13

Books for References:

1. D. E. Goldberg, “Genetic Algorithms in Search, Optimization, and Machine Learning”, Addison-Wesley, Reading, 1989.
2. K.H. Lee, “First Course on Fuzzy Theory and Applications”, Springer, 2005.
3. Andries P. Engelbrecht, “Computational Intelligence: An Introduction”, John Wiley and Sons, 2007.

Web Resources:

1. https://www.cet.edu.in/noticefiles/274_soft%20computing%20LECTURE%20NOTES.pdf
2. <https://towardsdatascience.com/perceptron-learning-algorithm-d5db0deab975>
3. <https://marketbrew.ai/how-particle-swarm-optimization-works-a-step-by-step-guide>

Rationale for Nature of the Course:

- To develop intelligent machines to provide solutions to real world problems, which are not modelled or too difficult to model mathematically.
- To solve real-world problems by providing approximate results that conventional and analytical model cannot solve.

Activities having direct bearing on Skill development:

- Discussing different viewpoints to come up with innovative solution
- Using real-world examples to learn how to think critically

Pedagogy:

- Chalk and talk, PPT, Assignment, Seminar, Group discussion, Test and Quiz.

Course Designer:

- Ms. S. Rajalakshmi

Course Schedule:

Unit	Topics	Hrs	Mode
Unit I	Introduction: Artificial Intelligence – a brief Review - Pitfalls of the Traditional AI - Computational Intelligence- an Emergence of a New Computational Paradigm - Computational Intelligence- a Formal Definition.	9	Lecture, Quiz, Test, Seminar
	Soft computing - Definitions - Fundamental Elements of Soft Computing - Computational Learning Theory - Synergism in Soft computing.	6	
Unit II	Fuzzy Sets And Relations: Conventional Sets - Fuzzy Sets - Membership Functions - Continuous and Discrete Membership Functions - Typical Membership Functions - Operations on Fuzzy Sets - Basic Concepts Associated with Fuzzy Sets - Extension Principle of Fuzzy Sets - Fuzzy Relations - Projection of Fuzzy Relations.	9	Lecture, PPT, Quiz, Test, Group Discussion, Seminar
	Fuzzy Pattern Recognition: Introduction - The Fuzzy C-Means Clustering Algorithm - Image Segmentation Using Fuzzy C-Means Clustering Algorithm.	6	
Unit III	Machine Learning Using Neural Nets: Biological Neural Networks - Artificial Neural Networks - Principles of Learning in a Neural Net - Stability and Convergence - Three Important Theorems for Stability Analysis of Neural Dynamics.	9	Lecture, PPT, Quiz, Test, Seminar
	Supervised Neural Learning Algorithms: Introduction - McCulloch-Pitts Model - The Perceptron Learning Model. Unsupervised Neural Learning Algorithms: Introduction - Discrete Hopfield Network - Continuous Hopfield Neural Net.	6	
Unit IV	Introduction To Generic Algorithms: Working Cycle of a Generic Algorithm - Binary –Coded GA - GA-Parameters Setting - Constraints Handling in GA.	9	Lecture, PPT, Quiz, Test, Seminar
	Advantages and disadvantages of Generic Algorithms - Combination of local and Global Optimum Search Algorithms.	6	
Unit V	Evolutionary Computing: Evolutionary Algorithm – Swarm Intelligence – Evolutionary Strategies - Evolutionary Programming – Advantages of Evolutionary Computation.	9	Lecture, Quiz, Assignment, Seminar
	Swarm Intelligence: Overview – Particle Swarm Optimization: Functioning of Particle Swarm Optimization.	6	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Remember the fundamentals of Soft Computing.	K2
CLO-2	Review Fuzzy Logic and its relations.	K4
CLO-3	Test for possibility theory in Neural Networks.	K4
CLO-4	Classify various Genetic Algorithms.	K3
CLO-5	Analyze the performance of Evolutionary Computing	K3

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	3	3	2	3
CLO-3	3	3	3	2	3
CLO-4	3	3	2	2	3
CLO-5	3	3	2	2	3

Mapping of CLOs with POs:

#	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	3	2	2	2	2	3
CLO-2	3	3	3	2	3	3
CLO-3	3	3	3	2	3	3
CLO-4	3	3	2	2	2	3
CLO-5	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		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(K3&K3)	1(K4)
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 K3	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			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	100%

PG DEPARTMENT OF COMPUTER SCIENCE					CLASS: I M.Sc. (CS)			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours/Week	CIA	Ext.	Total
I	Discipline Elective – II	25P1DECT2	Advanced Computer Organization and Architecture	3	5	25	75	100
Nature of the Course:								
Skill oriented		✓	Employability oriented			Entrepreneurship Oriented		

Objectives:

- To impart knowledge on functions of computer.
- To learn the working principle of CPU with pipelining.
- To understand memory concepts, arithmetic operations and the importance of I/O system.
- To know the importance of parallel computing models and properties of networks.
- To understand the performance of multi core processors.

Unit	Description	Hrs.	K-Level	CLO
I	Basic Structure of Computers: Basic operational concepts – Bus structures – Software. Machine Instructions and Programs: Memory operations - Instructions and instruction sequencing– Addressing modes – Basic Input / Output operations – Stacks and Queues – Subroutines.	15	K2	CLO 1
II	Basic Processing Unit & Pipelining: Fundamental concepts – Execution of a complete instruction - Multiple bus organization - Hardwired control - Micro programmed control. Pipelining: Basic concepts - Data hazards - Instruction hazards - Influence on instruction sets.	15	K4	CLO 2
III	Memory System & Arithmetic: Basic concepts – Semiconductor RAM – Cache memories - Virtual memory. Arithmetic: Addition & Subtraction of signed numbers – Multiplication of positive numbers – Signed operand multiplication. I/O Organization: Accessing I/O devices –Interrupts – Direct Memory Access.	15	K3	CLO 3
IV	Parallel Computer Models: The state of computing - Multiprocessors and Multicomputers – Multivector and SIMD computers. Program and Network properties: Conditions of parallelism – Program Partitioning and scheduling – Program flow mechanism - System interconnect architectures	15	K3	CLO 4
V	Multiprocessors and Multicomputers: Multiprocessor System interconnects – Message Passing Mechanisms. Scalable, Multithreaded, and Dataflow Architectures: Principles of Multithreading, Fine-Grain Multicomputers.	15	K4	CLO 5

Book(s) for Study:

1. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, “Computer Organization” Fifth Edition, Tata McGraw Hill, 2002.
Unit I - 1.3, 1.4, 1.5, 2.3, 2.4, 2.5, 2.7, 2.8, 2.9
Unit II - 7.1 - 7.5, 8.1 - 8.4
Unit III - 5.1, 5.2, 5.5, 5.7, 6.1, 6.3, 6.4, 4.1, 4.2, 4.4
2. Kai Hwang, Naresh Jotwani, “Advanced Computer Architecture – Parallelism, Scalability and Programmability”, second edition, TMH, New Delhi.
Unit IV – 1.1 – 1.3, 2.1 – 2.4
Unit V – 7.1, 7.4, 9.2, 9.3

Books for References:

1. David A. Patterson and John L. Hennessy, “Computer Architecture – A Quantitative Approach”, Sixth Edition, Morgan Kaufmann Publishers, Elsevier.
2. William Stallings, “Computer Organization and Architecture – Designing for Performance”, Sixth Edition, Pearson Education, 2003.
3. John P. Hayes, “Computer Architecture and Organization”, Third Edition, Tata McGraw Hill, 1998.

Web Resources:

1. <http://list.zju.edu.cn/kaibu/comparch/>
2. <https://www.slideshare.net>
3. <https://cseweb.ucsd.edu/classes/wi14/cse141/pdf/>

Rationale for Nature of the Course:

- Emphasizes the data flow, timing analysis, and memory hierarchy, trade off between execution cycles, hardware requirements/cost and software that must be made in order to produce good system design.
- An overview of computer architecture, which stresses the underlying design principles and the impact of these principles on computer performance. General topics include design methodology, processor design, control design, memory organization, system organization, and parallel processing.

Activities having direct bearing on Skill development:

- Assignment, Programming, Research and Presentation activities helps students understand, analyze and design computer architecture preparing them for career in hardware design.

Pedagogy:

- Chalk and talk, PPT, Assignment, Seminar, Group discussion, Test and Quiz.

Course Designer:

- Ms. R. Lakshapriya

Course Schedule:

Unit	Topics	Hrs	Mode
Unit I	Basic Structure of Computers: Basic operational concepts – Bus structures – Software.	8	Lecture, seminar PPT, Test and Quiz.
	Machine Instructions and Programs: Memory operations - Instructions and instruction sequencing– Addressing modes – Basic Input / Output operations – Stacks and Queues – Subroutines.	7	
Unit II	Basic Processing Unit & Pipelining: Fundamental concepts – Execution of a complete instruction – Multiple bus organization – Hardwired control.	8	Lecture, seminar PPT, Test and Quiz.
	Micro programmed control. Pipelining: Basic concepts – Data hazards – Instruction hazards – Influence on instruction sets.	7	
Unit III	Memory System & Arithmetic: Basic concepts – Semiconductor RAM – Cache memories - Virtual memory. Arithmetic: Addition & Subtraction of signed numbers – Multiplication of positive numbers – Signed operand multiplication.	8	Lecture, seminar Group Discussion, Test and Quiz.
	I/O Organization: Accessing I/O devices –Interrupts – Direct Memory Access.	7	
Unit IV	Parallel Computer Models: The state of computing - Multiprocessors and Multicomputers – Multivector and SIMD computers.	8	Lecture, seminar, Group Discussion PPT, Test and Quiz.
	Program and Network properties: Conditions of parallelism – Program Partitioning and scheduling – Program flow mechanism - system interconnect architectures.	7	
Unit V	Multiprocessors and Multicomputers: Multiprocessor System interconnects – Message Passing Mechanisms.	8	Lecture, Quiz, Assignment and Seminar.
	Scalable, Multithreaded, and Dataflow Architectures: Principles of Multithreading, Fine-Grain Multicomputers.	7	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Explain basic operational concepts and identify the use of various Addressing Modes.	K2
CLO-2	Focus on types of controls used in instruction execution and inspect the principle of Pipelining.	K4
CLO-3	Classify various memory organizations and focus on Arithmetic Operations and Interrupt techniques to access I/O devices.	K3
CLO-4	Utilize different types of parallelism and interconnect architectures.	K3
CLO-5	Assess the use of multithreading and parallel processing software.	K4

Mapping of CLOs with PSOs:

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

Mapping of CLOs with POs:

#	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	1	1	3	2	2	1
CLO-2	1	1	3	2	2	2
CLO-3	1	2	3	2	2	2
CLO-4	1	1	3	2	2	2
CLO-5	1	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	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	K1	2 (K3 & K3)	1(K4)
3	CLO 3	Up to K3	2	K1 & K2	1	K2	2 (K2 & K2)	1(K3)
4	CLO 4	Up toK3	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			10		10		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	100%

PG DEPARTMENT OF COMPUTER SCIENCE					CLASS: I M.Sc. (CS)			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hrs/Week	CIA	Ext.	Total
I	Discipline Elective – II	25P1DECT2	Web Application Development	3	5	25	75	100
Nature of the Course:								
Skill oriented	✓	Employability oriented		✓	Entrepreneurship Oriented			✓

Objectives:

- To understand the various concepts of JavaScript.
- To learn the Document Object Model.
- To summarize managing web page styles using JavaScript and CSS.
- To create interactive applications using functions in PHP.
- To learn and use open source database management system MySQL.

Unit	Description	Hrs.	K-Level	CLO
I	Getting Started with JavaScript: What is JavaScript? Why JavaScript? Writing your first JavaScript program – Working with Variables – Creating Arrays – Accessing Array Elements –Types of Operators – Loops and Branches.	15	K2	CLO 1
II	Using Function Terminology : Writing Functions – Returning Values – Passing and Using Arguments – Function Scope –Creating Objects – Retrieving and Setting Object Properties –Deleting Objects – Working with Methods – The Navigator Object – The Window object’s methods – Manipulating Documents with the DOM.	15	K3	CLO 2
III	Using Events in JavaScript : Understanding HTML Forms – Working with Form Object – Working with CSS and Graphics.	15	K4	CLO 3
IV	Basic development Concepts: Creating first PHP Scripts – Using Variable and Operators - Storing Data in variable - Understanding Data Types - Using Constants - Writing Simple Conditional Statements - Repeating Action with Loops – Working with String and Numeric Functions - Storing Data in Arrays - Working with Dates and Times. Creating User-Defined Functions - Creating Classes – Using Advanced OOP Concepts. Working with Files and Directories: Reading Files- Writing Files Processing Directories.	15	K3	CLO 4
V	Introducing Database and SQL: Using MySQL - Adding and Modifying Data Handling Errors – Using SQLite Extension and PDO Extension. Introduction to XML - Simple XML and DOM Extension.	15	K4	CLO 5

Books for Study:

1. Chris Minnick and Eva Holland, “Coding with JavaScript for Dummies”, John Wiley & Sons, Inc., 2015.
Unit-I: 1-6
Unit-II: 7-10
Unit-III: 11-13
2. VikramVaswani, “PHP A Beginner’s Guide”, Tata McGraw-Hill.
Unit-IV: 1-6
Unit-V: 7, 8

Books for References:

1. Ralph Moseley and M. T. Savaliya, “Developing Web Applications”, Wiley-India Private Limited, 2011.
2. Steven Holzner,” The PHP Complete Reference”, Tata McGraw-Hill Edition.

Web Resources:

1. <https://javascript.info/>
2. https://www.w3schools.com/js/js_events.asp
3. <https://www.tutorialspoint.com/php/index.htm>

Rationale for Nature of the Course:

- Fostering creativity in designing functional and user-friendly web applications.
- Build scalable, secure and user-centric solutions in today’s technology-driven landscape.

Activities having direct bearing on Skill Oriented/Employability/Entrepreneurship:

- Practice to write programs and bug fixing.
- Practice to design a dynamic web page.

Pedagogy:

- Chalk and talk, PPT, Assignment, Seminar, Group discussion, Test and Quiz.

Course Designer:

- Mr. M. Ashok Kumar

Course Schedule:

Unit	Topics	Hrs	Mode
Unit I	Getting Started with JavaScript: What is JavaScript? Why JavaScript? Writing your first JavaScript program – Working with Variables – Creating Arrays – Accessing Array Elements.	8	Lecture, Seminar, PPT, Test and Quiz.
	Types of Operators – Loops and Branches.	7	
Unit II	Using Function Terminology – Writing Functions – Returning Values – Passing and Using Arguments – Function Scope – Creating Objects – Retrieving and Setting Object Properties – Deleting Objects.	8	Lecture, Seminar, Test and Quiz.
	Working with Methods – The Navigator Object – The Window object's methods – Manipulating Documents with the DOM.	7	
Unit III	Using Events in JavaScript – Understanding HTML Forms – Working with Form Object.	8	Lecture, Seminar, Assignment, Test and Quiz.
	Working with CSS and Graphics.	7	
Unit IV	Basic development Concepts – Creating first PHP Scripts – Using Variable and Operators – Storing Data in variable – Understanding Data types – Using Constants – Writing Simple Conditional Statements – Repeating Action with Loops – Working with String and Numeric Functions – Storing Data in Arrays.	8	Lecture, Seminar, Group discussion, Test and Quiz.
	Working with Dates and Times User-Defined Functions – Creating Classes – Using Advanced OOP Concepts. Working with Files and Directories: Reading Files- Writing Files Processing Directories.	7	
Unit V	Introducing Database and SQL- Using MySQL- Adding and Modifying Data Handling Errors.	8	Lecture, Quiz and Seminar.
	Using SQLite Extension and PDO Extension. Introduction XML - Simple XML and DOM Extension.	7	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Describe and utilize JavaScript programming concepts such as variables, arrays, conditions, and loops.	K2
CLO-2	Build and deploy JavaScript code to solve practical web design problems.	K3
CLO-3	Analyze how to script forms and to handle web page events.	K4
CLO-4	Construct PHP script to create dynamic web applications.	K3
CLO-5	Illustrate SQL commands to database development environment.	K4

Mapping of CLOs with PSOs:

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

Mapping of CLOs with POs:

#	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	3	3	1	1	2	3
CLO-2	3	3	3	1	2	3
CLO-3	3	3	2	2	2	3
CLO-4	3	3	2	2	3	3
CLO-5	3	3	2	1	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	CLO 1	Up to K2	2	K1&K2	1	K1	2(K1&K1)	1(K2)
2	CLO2	Up to K3	2	K1&K2	1	K1	2(K2&K2)	1(K3)
3	CLO 3	Up to K4	2	K1&K2	1	K2	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	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	100%

PG DEPARTMENT OF COMPUTER SCIENCE					CLASS: I M.Sc. (CS)			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours/Week	CIA	Ext.	Total
I	NME-I	25P1DSEN1	Office Automation	2	2	25	75	100
Nature of the Course:								
Skill oriented	✓	Employability oriented			✓	Entrepreneurship Oriented		

Objectives:

- To become familiar with formatting and enhancing the document.
- To enable the user to create the professional documents.
- To create presentations that includes text, animation and transitions.
- To construct formulas using built-in functions in Excel.
- To learn the manipulation of data with Ms-Access.

Unit	Description	Hrs.	K-Level	CLO
I	Exploring the Interface and Formatting Elements: An Overview of the Interface Feature – Creating Documents – Setting the Printing Options – Formatting Text, Styles and Paragraphs.	6	K2	CLO 1
II	Creating Lists and Constructing Advanced Tables: Constructing a List Automatically – Constructing a List Manually – Modifying a Bulleted or Numbered List – Creating Tables – Editing and Formatting Tables – Converting a Table to Text – Creating Professional Documents: Creating a Basic Form – Inserting and Modifying Section Breaks– Inserting a Header and Footer– Inserting Page Numbers.	6	K2	CLO 2
III	PowerPoint: The PowerPoint Interface and Presentation Options: Creating Presentation Templates – Setting Slide Size– Changing Slide Orientation– Adding Tags to a Presentation– Saving Presentations in different formats – Formatting Slides: Setting up Slides and Applying Layouts – Add Headers and Footers to Slides – Applying and Modifying Themes –Sending an Object forward or backward – Grouping Objects– Inserting Audio and Video– Photo Albums, Sections and Show Tools: Inserting Text –Inserting Pictures in black and white – Adding Animation Effects – Applying Effect Options – Previewing Animations– Working with Transitions - Creating a Custom Slide Show.	6	K2	CLO 3

IV	Excel: Formatting, Manipulating, and Presenting Data Visually: Identifying rows, columns and cells – Workbooks and Worksheets – Name Box and Formula Bar – Status Bar – Constructing and Formatting an Excel Worksheet – Working with Worksheets and Sheet tabs – Applying Formulas and Functions: Learning Basic Formula Operations – Learning Excel Functions– Defining a named range.	6	K2	CLO 4
V	Access: Database Organization and Setting Relationships: Introduction to Access and the settings options – Constructing tables and manipulating data – Building relationships - Defining the primary key , join type and referential integrity.	6	K2	CLO 5

Book for Study:

1. Linda Foulkes, “Learn Microsoft Office 2019”, Packt Publishing, 2020.
Unit-I: 1.
Unit-II: 2, 3.
Unit-III: 5, 6, 7.
Unit-IV: 8, 9.
Unit-V: 13.

Books for References:

1. Jennifer Ackerman Kettel, Guy Hat-Davis, Curt Simmons,” Microsoft 2003”, Tata McGraw-Hill.
2. Content Development Group, “Working with MS Office 2000”, Tata McGraw-Hill Publishing Company Limited.

Web Resources:

1. <https://www.javatpoint.com/ms-word-tutorial>
2. <http://www.guru99.com/inroduction-to-microsoft-excel.html>
3. https://www.quackit.com/microsoft_access/tutorial/

Rationale for Nature of the Course:

- It is used to digitally create, store, manipulate rely office information and data needed for accumulation basic tasks and goals.

Activities having direct bearing on Skill development / Employability:

- To give enough practices on data management with interaction and demonstration.
- To develop formal letters and presentation of designs.

Pedagogy:

- Chalk and talk, PPT, Assignment, Seminar, Group discussion, Test and Quiz.

Course Designer:

- Ms. S.Saranya

Course Schedule:

Unit	Topics	Hrs	Mode
Unit I	Exploring the Interface and Formatting Elements: An Overview of the Interface Feature – Creating Documents – Setting the Printing Options.	3	Lecture, PPT, Test and Quiz.
	Formatting Text, Styles and Paragraphs.	3	
Unit II	Creating Lists and Constructing Advanced Tables: Constructing a List Automatically – Constructing a List Manually – Modifying a Bulleted or Numbered List – Creating Tables – Editing and Formatting Tables – Converting a Table to Text.	3	Lecture, PPT, Assignment, Test and Quiz.
	Creating Professional Documents: Creating a Basic Form –Inserting and Modifying Section Breaks– Inserting a Header and Footer– Inserting Page Numbers.	3	
Unit III	PowerPoint: The PowerPoint Interface and Presentation Options: Creating Presentation Templates – Setting Slide Size–Changing Slide Orientation– Adding Tags to a Presentation– Saving Presentations in different formats – Formatting Slides: Setting up Slides and Applying Layouts – Add Headers and Footers to Slides – Applying and Modifying Themes –Sending an Object forward or backward – Grouping Objects– Inserting Audio and Video.	3	Lecture, Test and Quiz.
	Photo Albums, Sections and Show Tools: Inserting Text –Inserting Pictures in black and white – Adding Animation Effects – Applying Effect Options – Previewing Animations– Working with Transitions - Creating a Custom Slide Show.	3	
Unit IV	Excel: Formatting, Manipulating, and Presenting Data Visually: Identifying rows, columns and cells – Workbooks and Worksheets – Name Box and Formula Bar – Status Bar – Constructing and Formatting an Excel Worksheet – Working with Worksheets and Sheet tabs.	3	Lecture, Group discussion, Test and Quiz.
	Applying Formulas and Functions: Learning Basic Formula Operations – Learning Excel Functions– Defining a named range.	3	
Unit V	Access: Database Organization and Setting Relationships: Introduction to Access and the settings options – Constructing tables and manipulating data.	3	Lecture, Quiz and Seminar.
	Building relationships - Defining the primary key, join type and referential integrity.	3	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Trace the steps to format and enhance the document using Ms-Word.	K2
CLO-2	Describe how to create document using Microsoft Word.	K2
CLO-3	Demonstrate basic objects and design elements to presentations.	K2
CLO-4	Demonstrate worksheets and organize data in Microsoft Excel.	K2
CLO-5	Examine database concepts and explore the Ms-Access environment.	K2

Mapping of CLOs with PSOs:

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

Mapping of CLOs with POs:

#	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	1	1	1	2	1	1
CLO-2	1	1	2	2	3	3
CLO-3	2	3	2	2	2	2
CLO-4	2	2	2	2	3	3
CLO-5	2	3	2	2	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 (Open Choice)
			Short Answers		(Either/ or Choice)		
			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		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

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 with choice	Consolidated
K1	10	-	50	60	46.15	100
K2	-	70	-	70	53.85	
Total Marks	10	70	50	130	100	100%

PG DEPARTMENT OF COMPUTER SCIENCE					CLASS: I M.Sc. (CS)			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours/Week	CIA	Ext.	Total
II	Core-III	25P2DCCT3	Advanced Java Programming	5	6	25	75	100
Nature of the Course:								
Skill oriented	✓	Employability oriented			✓	Entrepreneurship Oriented		

Objectives:

- To impart knowledge in threading and networking.
- To implement the distributed object model using RMI.
- To create the communication with Relational Databases.
- To create dynamic web pages using Servlet and JSP
- To learn about JAR files and the creation of GUI using Swing Classes.

Unit	Description	Hrs .	K-Level	CLO
I	Unit I: BASICS OF JAVA: Java Basics Review: Components and event handling – Threading concepts–Networking features – Media techniques.	18	K2	CLO 1
II	Unit II: REMOTE METHOD INVOCATION: Remote Method Invocation - Distributed Application Architecture- Creating stubs and skeletons - Defining Remote objects - Remote Object Activation – Object Serialization - Java Spaces	18	K4	CLO 2
III	Unit III: DATABASE: Java in Databases - JDBC principles – database access – Interacting - database search – Creating multimedia databases – Database support in web applications.	18	K3	CLO 3
IV	Unit IV: SERVLETS: Java Servlets: Java Servlet and CGI programming - A simple java Servlet - Anatomy of a java Servlet – Reading data from a Client - Reading http request header - sending data to a client and writing the http response header - working with cookies. Java Server Pages: JSP Overview – Installation - JSP tags -Components of a JSP page – Expressions – Scriptlets –Directives – Declarations - A complete example.	18	K3	CLO 4
V	Unit V: ADVANCED TECHNIQUES: JAR file format creation – Internationalization – Swing Programming –Advanced java	18	K4	CLO 5

Books for Study:

1. Jamie Jaworski, "Java Unleashed", SAMS Techmedia Publications, 1999.
Unit-I: 20, 21, 22, 23, 30, , Web Resource: 4
Unit-III: 43, 44, 45, 46
2. Campione, Walrath and Huml, "The Java Tutorial", Addison Wesley, 1999
Unit-I: 3, 8
3. "Java the Complete Reference", Herbert Schildt, McGraw Hill Education, 9th Edition, New York, 2017
Unit-I: 24, 25
Unit-II: 30
Unit IV: 38
Unit V: 31, 32, 33
4. "Servlet & JSP" – A Tutorial, Budi Kurniawan Second Edition, Brainy Software Publications.
Unit-IV: 4, 5, 7, 14, 16, 23, Web Resource: 4

Books for References:

1. A Jim Keogh, "The Complete Reference J2EE", Tata Mc Graw Hill Publishing Company Ltd, 2010.
2. David Sawyer McFarland, "Java Script And J Query-The Missing Manual", Oreilly Publications, 3rd Edition, 2011.
3. Deitel and Deitel, "Java How to Program ", Third Edition, PHI/ Pearson Education Asia.

Web Resources:

1. <https://www.javatpoint.com/servlet-tutorial>
2. <https://www.tutorialspoint.com/java/index.htm>
3. https://onlinecourses.nptel.ac.in/noc19_cs84/preview
4. <https://www.studocu.com/in/document/periyar-university/bcom-computer-applications/advanced-java-programming-notes/98632831>

Rationale for Nature of the Course:

- Develop wide variety of applications including web applications, software and game development, Network programming, GUI, Scientific and Numeric applications.

Activities on Skill Development / Employability:

- By providing practice to write coding and present seminars in relevant topics.
- Practice to develop Games, Apps and dynamic Web pages.

Pedagogy:

- Chalk and talk, PPT, Assignment, Seminar, Group discussion, Test and Quiz.

Course Designer:

- Ms. S. Sasikala

Course Schedule:

Unit	Topics	Hrs	Mode
Unit I	Java Basics Review: Components and event handling –Threading concepts.	9	Lecture, Group Discussion, Seminar, Test, Quiz
	Networking features – Media techniques.	9	
Unit II	Remote Method Invocation-Distributed Application Architecture- Creating stubs and skeletons Defining Remote objects.	9	Lecture, Seminar, Test, PPT, Quiz
	Remote Object Activation-Object Serialization-Java Spaces.	9	
Unit III	Java in Databases-JDBC principles–database access-Interacting-database search.	9	Lecture, Seminar, Test, Quiz
	Creating multimedia databases – Database support in web applications.	9	
Unit IV	Java Servlets: Java Servlet and CGI programming- A simple java Servlet-Anatomy of a java Servlet-Reading data from a client-Reading http request header-sending data to a client and writing the http response header-working with cookies.	9	Lecture, Group discussion, Seminar, Test, & Quiz
	Java Server Pages: JSP Overview-Installation-JSP tags-Components of a JSP page - Expressions Scriptlets -Directives-Declarations-A complete example.	9	
Unit V	JAR files format creation–Internationalization.	9	Lecture, PPT, Seminar, Assignment
	Swing Programming–Advanced java.	9	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Illustrate the concept of Event handling, Networking features.	K2
CLO-2	Focus on the concept of Distributed object model using RMI.	K4
CLO-3	Develop the program to create communication with database using JDBC.	K3
CLO-4	Build the dynamic web pages using Servlet and JSP.	K3
CLO-5	Discover the JAR files and Swing components.	K4

Mapping of CLOs with PSOs:

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

Mapping of CLOs with POs:

#	PO-1	PO-2	PO-3	PO-4	PO-5	PO-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

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 K4	2	K1& K2	1	K2	2(K3&K3)	1(K4)
3	CLO 3	Up to K3	2	K1& K2	1	K1	2(K2&K2)	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(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 - Level	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 Mark s	10	10	50	50	120	100	100%

PG DEPARTMENT OF COMPUTER SCIENCE					CLASS: I M.Sc. (CS)			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours/Week	CIA	Ext .	Total
II	Core-IV	25P2DCCT4	Data Mining and Warehousing	5	6	25	75	100
Nature of the Course:								
Skill oriented		✓	Employability oriented		✓	Entrepreneurship Oriented		

Objectives:

- To learn the concepts of mining task, classification, clustering and data warehousing.
- To develop skill of using data mining tasks to solve practical problems.
- To apply clustering to develop decision-making skills.
- To be familiar with the concepts of data warehouse and online analytical processing
- To utilize Weka tools to develop datamining applications.

Unit	Description	Hrs.	K-Level	CLO
I	Introduction: Basic data mining tasks – data mining versus knowledge discovery in databases – data mining issues – data mining metrics – social implications of data mining – data mining from a database perspective. Data Mining Techniques: Introduction – a statistical perspective on data mining – similarity measures – decision trees – neural networks – genetic algorithms.	18	K2	CLO 1
II	Classification: Introduction – Statistical-based algorithms - distance-based algorithms - decision tree-based algorithms - neural network – based algorithms – rule-based algorithms – combining techniques.	18	K4	CLO 2
III	Clustering: Introduction – Similarity and Distance Measures – Outliers – Hierarchical Algorithms – Partitional Algorithms. Association Rules: Introduction - large item sets - basic algorithms – parallel & distributed algorithms – comparing approaches - incremental rules – advanced association rules techniques – measuring the quality of rules.	18	K3	CLO 3
IV	Data Warehousing: Introduction - characteristics of a data warehouse – data marts – other aspects of data mart. Online Analytical Processing: Introduction – OLTP & OLAP systems - Data modelling – star schema for multidimensional view – data modelling – multifact star schema or snow flake schema – OLAP TOOLS – State of the market – OLAP TOOLS and the internet.	18	K3	CLO 4
V	The Weka Data Mining Workbench: Introduction to Weka. The Explorer: Getting Started – Exploring the Explorer – Filtering Algorithms - Clustering Algorithm – Association-Rule Learners – Attribute Selection.	18	K4	CLO 5

Books for Study:

1. Margaret H. Dunham, "Data Mining: Introductory and Advanced Topics", Pearson education, 2003.
Unit-I: 1.1-1.6, 3.1-3.6
Unit-II: 4.1-4.7
Unit-III: 5.1-5.5, 6.1-6.8
2. C.S.R. Prabhu, "Data Warehousing Concepts, Techniques, Products and Applications", PHI, Second Edition.
Unit-IV: 1, 2
3. Ian H. Witten, Eibe Frank, Mark A. Hall, "Data Mining: Practical Machine Learning Tools and Techniques", Third Edition, Morgan Kaufmann Publishers.
Unit V: 10.1, 11.1, 11.2, 11.3, 11.6, 11.7, 11.8.

Books for References:

1. ArunK.Pujari, "DataMiningTechniques",UniversitiesPress(India)Pvt.Ltd.,2003
2. AlexBerson,StephenJ.Smith,"DataWarehousing,DataMiningandOLAP",TMCH, 2001
3. Jiawei Han & Micheline Kamber, "Data Mining Concepts & Techniques", 2001, Academic press.

Web Resources:

1. <https://www.javatpoint.com/data-warehouse>.
2. <https://www.geeksforgeeks.org/basic-concept-classification-data-mining/>
3. https://www.tutorialspoint.com/data_mining/dm_cluster_analysis.htm

Rationale for Nature of the Course:

- Datamining integrate different technologies like statistics, association rules and database systems tow extracting worthwhile information from raw data in huge volume.
- Data warehousing provide a centralize repository to store large amounts of data in various business.

Activities having direct bearing on Skill development / Employability:

- To analysis the datamining techniques using statistical perspective.
- To implement OLAP in multidimensional analysis of business information and support the capability for complex estimation, trend analysis and sophisticated data modelling.

Pedagogy:

- Chalk and talk, PPT, Assignment, Seminar, Group discussion, Test and Quiz.

Course Designer:

- Mr. N.Radha Krishnan

Course Schedule:

Unit	Topics	Hrs	Mode
Unit I	Introduction: Basic data mining tasks – data mining versus knowledge discovery in databases – data mining issues – data mining metrics – social implications of data mining – data mining from a database perspective.	9	Lecture, PPT, Test and Quiz.
	Data Mining Techniques: Introduction – A Statistical Perspective On Data Mining – Similarity Measures – Decision Trees – Neural Networks – Genetic Algorithms.	9	
Unit II	Classification: Introduction – Statistical–Based Algorithms - Distance–Based Algorithms.	9	Lecture, PPT, Assignment, Test and Quiz.
	Decision Tree–Based Algorithms - Neural Network – Based Algorithms – Rule–Based Algorithms – Combining Techniques.	9	
Unit III	Clustering: Introduction – Similarity and Distance Measures –Outliers – Hierarchical Algorithms – Partitional Algorithms	8	Lecture, Test and Quiz.
	Association Rules: Introduction - large item sets - basic algorithms – parallel & distributed algorithms – comparing approaches - incremental rules – advanced association rules techniques – measuring the quality of rules	10	
Unit IV	Data Warehousing: Introduction - characteristics of a data warehouse – data marts – other aspects of data mart.	6	Lecture, Group discussion, Seminar, Test and Quiz.
	Online Analytical Processing: Introduction – OLTP & OLAP systems - Data modelling – star schema for multidimensional view – data modelling – multifactstar schema or snow flake schema – OLAP TOOLS – State of the market – OLAP TOOLS and the internet.	12	
Unit V	The Weka Data Mining Workbench: Introduction to Weka.	3	Lecture, Quiz and Seminar.
	The Explorer: Getting Started – Exploring the Explorer – Filtering Algorithms - Clustering Algorithm – Association–Rule Learners – Attribute Selection.	15	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Illustrate the datamining techniques with statistical perspective models	K2
CLO-2	Analyze the classification with various algorithms.	K4
CLO-3	Examine the association rules for the inventory controls	K3
CLO-4	Use OLAP for the business intelligence, reporting and forecasting.	K3
CLO-5	Focus on the tools to explore the data analysis.	K4

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	3
CLO-4	3	2	2	2	3
CLO-5	3	2	2	2	3

Mapping of CLOs with POs:

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

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 K4	2	K1&K2	1	K2	2(K4&K4)	1(K3)
3	CLO 3	Up to K3	2	K1&K2	1	K1	2(K2&K2)	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(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, 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	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	100%

PG DEPARTMENT OF COMPUTER SCIENCE					CLASS: I M.Sc. (CS)			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours/Week	CIA	Ext.	Total
II	Core Practical – II	25P2DCCP2	Advanced Java & Data mining Tools Lab	4	6	50	50	100
Nature of the Course:								
Skill oriented		✓	Employability oriented		✓	Entrepreneurship Oriented		

Objectives:

- To impart knowledge in threading, networking and the AWT.
- To implement the distributed object model using RMI.
- To create the communicate with Relational Databases.
- To understand & write programs using the DM algorithms using WEKA tool.
- To apply statistical interpretations for the solutions WEKA tool.

Unit	Description	Hrs.	K-Level	CLO
I	1. Display a welcome message using Servlet. 2. Design a Purchase Order form using Html form and Servlet. 3. Develop a program for calculating the percentage of marks of a student using JSP. 4. Design a Purchase Order form using Html form and JSP. 5. Prepare an Employee pay slip using JSP.	18	K2	CLO 1
II	6. Write a program using JDBC for creating a table, Inserting, deleting records and list out the records. 7. Write a program using Java servlet to handle form data. 8. Write a simple Servlet program to create table of all the header site receives along with their associated values. 9. Write a program in JSP by using session object.	18	K4	CLO 2
III	10. Write a program to build a simple Client Server application using RMI. 11. Create an applet for a calculator application. 12. Program to send a text message to another system and receive the text message from the system (use socket programming).	18	K3	CLO 3
IV	13. To demonstrate pre-processing on dataset student.arff using WEKA tool. 14. To demonstrate association rule process on dataset test.arff using apriori algorithm.	18	K3	CLO 4

V	15. To demonstrate classification rule process on dataset employee.arff using j48 algorithm. 16. To demonstrate clustering rule process on dataset student.arff using simple K - means algorithm.	18	K4	CLO 5

Books for Study:

1. Jamie Jaworski, "Java Unleashed", SAMS Techmedia Publications, 1999.
2. Campione, Walrath and Huml, "The Java Tutorial", Addison Wesley, 1999
3. "Java the Complete Reference", Herbert Schildt, McGraw Hill Education, 9th Edition, New York, 2017 "Servlet & JSP" – A Tutorial, Budi Kurniawan Second Edition, Brainy Software Publications.

Books for References:

1. A Jim Keogh, "The Complete Reference J2EE", Tata Mc Graw Hill Publishing Company Ltd, 2010.
2. David Sawyer McFarland, "Java Script And J Query-The Missing Manual", O'Reilly Publications, 3rd Edition, 2011.
3. Deitel and Deitel, "Java How to Program", Third Edition, PHI/ Pearson Education Asia.
4. Arun K. Pujari, "Data Mining Techniques", Universities Press (India) Pvt. Ltd
5. Alex Berson, Stephen J. Smith, "Data Warehousing, Data Mining and OLAP", TMCH, 2001.
6. Jiawei Han & Micheline Kamber, "Data Mining Concept & Techniques". Academic press.

Web Resources:

1. <https://www.javatpoint.com/servlet-tutorial>
2. <https://www.tutorialspoint.com/java/index.htm>
3. https://onlinecourses.nptel.ac.in/noc19_cs84/preview
4. <https://www.studocu.com/in/document/periyar-university/bcom-computer-applications/advanced-java-programming-notes/98632831>

Rationale for Nature of the Course:

- Develop wide variety of applications including web applications, software and game development, Network programming, GUI, Scientific and Numeric applications.

Activities on Skill Development / Employability:

- By providing practice to write coding and present seminars in relevant topics.
- Practice to develop Games, Apps and dynamic Web pages.

Pedagogy:

- Demo and Practical Session.

Course Designer:

- Ms. S. Sasikala
- Mr. N. Radha Krishnan

Course Schedule:

Unit	Topics	Hrs	Mode
Unit I	1. Display a welcome message using Servlet. 2. Design a Purchase Order form using Html form and Servlet. 3. Develop a program for calculating the percentage of marks of a student using JSP.	10	Demo & Practical Session
	4. Design a Purchase Order form using Html form and JSP. 5. Prepare a Employee pay slip using JSP.	8	
Unit II	6. Write a program using JDBC for creating a table, Inserting, deleting records and list out the records. 7. Write a program using Java servlet to handle form data.	10	Demo & Practical Session
	8. Write a simple Servlet program to create table of all the header si t receives along with their associated values. 9. Write a program in JSP by using session object.	8	
Unit III	10. Write a program to build a simple Client Server application using RMI. 11. Create an applet for a calculator application.	10	Demo & Practical Session
	12. Program to send a text message to another system and receive the text message from the system (use socket programming).	8	
Unit IV	13. To demonstrate pre-processing on dataset student.arff using WEKA tool.	10	Demo & Practical Session
	14. To Demonstrate association rule process on dataset test.arff using apriori algorithm.	8	
Unit V	15. To demonstrate classification rule process on dataset employee.arff using j48 algorithm.	10	Demo & Practical Session
	16. To demonstrate clustering rule process on dataset student.arff using simple K - means algorithm.	8	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Understand and implement the concepts of Java using HTML forms, JSP & JAR.	K2
CLO-2	Devise the concepts of JDBC and RMI.	K4
CLO-3	Examine the functions of Association rules, Clustering techniques using R.	K3
CLO-4	Apply data mining techniques like classification, prediction using WEKA Tool.	K3
CLO-5	Classify different visualizations techniques using WEKA tool.	K4

Mapping of CLOs with PSOs:

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

Mapping of CLOs with POs:

#	PO-1	PO-2	PO-3	PO-4	PO-5	PO-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

PG DEPARTMENT OF COMPUTER SCIENCE					CLASS: I M.Sc. (CS)			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours/Week	CIA	Ext.	Total
II	Discipline Elective-III	25P2DECT3	Advanced Software Engineering	3	5	25	75	100
Nature of the Course:								
Skill oriented		✓	Employability oriented			Entrepreneurship Oriented		

Objectives:

- To impart the knowledge of Software Development Process.
- To learn the concept of Software Requirements Analysis and Specification.
- To understand the concept of Software Project Management and Estimation techniques.
- To familiar various Design techniques and IEEE recommended practice.
- To focus on Software Testing and Maintenance for process improvement.

Unit	Description	Hrs.	K-Level	CLO
I	Introduction: The Problem Domain – Software Engineering Challenges - Software Engineering Approach – Software Processes: Software Process – Characteristics of a Software Process – Software Development Process Models – Other software processes.	15	K2	CLO 1
II	Software Requirements Analysis and Specification: Requirement engineering – Type of Requirements – Feasibility Studies – Requirements Elicitation – Requirement Analysis – Requirement Documentation – Requirement Validation – Requirement Management – SRS - Formal System Specification – Axiomatic Specification – Algebraic Specification. Case study: Student Result management system. Software Quality Management – Software Quality, Software Quality Management System, ISO 9000, SEI CMM.	15	K3	CLO 2
III	Software Project Management: Responsibilities of a software project manager – Project planning – Metrics for Project size estimation – Project Estimation Techniques – Empirical Estimation Techniques – COCOMO – Halstead's software science – Staffing level estimation – Scheduling – Organization and Team Structures – Staffing – Risk management – Software Configuration Management – Miscellaneous Plan.	15	K4	CLO 3
IV	Software Design: Outcome of a Design process – Characteristics of a good software design – Cohesion and coupling - Strategy of Design – Function Oriented Design – Object Oriented Design - Detailed Design - IEEE Recommended Practice for Software Design Descriptions.	15	K3	CLO 4

V	Software Testing: A Strategic approach to software testing – Terminologies – Functional testing– Structural testing – Levels of testing – Validation testing - Regression testing – Art of Debugging– Testing tools – Metrics - Reliability Estimation. Software Maintenance - Maintenance Process - Reverse Engineering – Software Re-engineering - Configuration Management Activities.	15	K4	CLO 5

Books for Study:

1. Pankaj Jalote, “An Integrated Approach to Software Engineering”, 3rd Edition, Narosa Publishing House, Delhi.
Unit-I: 1.1,1.2,1.3, 2.1 - 2.4
2. Rajib Mall, “Fundamentals of Software Engineering”, 3rd Edition, PHI Publication.
Unit-II: 4.1-4.5, 11.2-11.6
Unit-III: 3.1-3.15
Unit-IV: 5.1-5.3, 5.5
Unit-V: 13, 3.14
3. R.S.Pressman, “A Practitioners Approach – Software Engineering”, 8th Edition McGraw Hill.
Unit-V: 22.1, 22.3, 22.7, 22.9, 23.3, 23.6, 26.6

Books for References:

1. K. K. Aggarwal and Yogesh Singh, “Software Engineering”, 3rd Edition, New Age International Publishers.
2. Carlo Ghezzi, M.Jarayeri, D.Manodrioli, “Fundamentals of Software Engineering”, PHI Publication.

Web Resources:

1. <https://www.javatpoint.com/software-engineering-tutorial>
2. <https://www.geeksforgeeks.org/software-engineering/>
3. https://www.tutorialspoint.com/software_engineering/index.htm

Rationale for Nature of the Course:

- Apply the principles of software engineering to design, development, maintenance, testing, and evaluation of software in IT sector.

Activities having direct bearing on Skill development:

- Give practices to conduct seminar and group discussion and preparing assignments.

Pedagogy:

- Chalk and talk, PPT, Assignment, Seminar, Group discussion, Test and Quiz.

Course Designer:

- Ms. K .Imaya

Course Schedule:

Unit	Topics	Hrs	Mode
Unit I	Introduction: The Problem Domain – Software Engineering Challenges - Software Engineering Approach.	8	Lecture, Quiz, PPT, Test, Seminar
	Software Processes: Software Process – Characteristics of a Software Process – Software Development Process Models – Other software processes.	7	
Unit II	Software Requirements Analysis and Specification: Requirement engineering – Type of Requirements – Feasibility Studies – Requirements Elicitation – Requirement Analysis – Requirement Documentation – Requirement Validation – Requirement Management – SRS - Formal System Specification – Axiomatic Specification – Algebraic Specification.	8	Lecture, Quiz, PPT, Test, Seminar
	Case study: Student Result management system. Software Quality Management –Software Quality, Software Quality Management System, ISO 9000, SEI CMM.	7	
Unit III	Software Project Management: Responsibilities of a software project manager – Project planning – Metrics for Project size estimation – Project Estimation Techniques – Empirical Estimation Techniques – COCOMO.	8	Lecture, Quiz, PPT, Test, Seminar
	Halstead's software science – Staffing level estimation – Scheduling– Organization and Team Structures – Staffing – Risk management – Software Configuration Management – Miscellaneous Plan.	7	
Unit IV	Software Design: Outcome of a Design process – Characteristics of a good software design – Cohesion and coupling - Strategy of Design.	8	Lecture, Quiz, PPT, Test, Seminar
	Function Oriented Design – Object Oriented Design - Detailed Design - IEEE Recommended Practice for Software Design Descriptions.	7	
Unit V	Software Testing: A Strategic approach to software testing – Terminologies – Functional testing– Structural testing – Levels of testing – Validation testing - Regression testing – Art of Debugging– Testing tools – Metrics - Reliability Estimation.	8	Lecture, Quiz, Assignment, Seminar
	Software Maintenance - Maintenance Process - Reverse Engineering – Software Re-engineering - Configuration Management Activities.	7	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Describe the knowledge of Software Engineering Process.	K2
CLO-2	Apply the concept of Software Requirements Analysis and Specification.	K3
CLO-3	Analyze the concept of Software Project Management techniques.	K4
CLO-4	Make use of various Design techniques and IEEE recommended practice.	K3
CLO-5	Focus on Software Testing and Maintenance for process improvement.	K4

Mapping of CLOs with PSOs:

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

Mapping of CLOs with POs:

#	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	2	2	1	2	1	2
CLO-2	2	3	3	3	2	3
CLO-3	2	3	3	3	2	2
CLO-4	2	2	2	3	1	3
CLO-5	2	2	3	3	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	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 K4	2	K1& K2	1	K2	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	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	100%

PG DEPARTMENT OF COMPUTER SCIENCE					CLASS: I M.Sc. (CS)			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours/Week	CIA	Ext.	Total
II	Discipline Elective-III	25P2DECT3	Scripting Languages	3	5	25	75	100
Nature of the Course:								
Skill oriented	✓	Employability oriented		✓	Entrepreneurship Oriented			

Objectives:

- To learn the various concepts of JavaScript.
- To summarize managing web page styles using JavaScript and CSS.
- To create interactive applications using Node.js.
- To learn how to deploy Node.js applications to production environments.
- To impart the knowledge of creating user interfaces.

Unit	Description	Hrs	K-Level	CLO
I	Introduction: What is JavaScript? Why JavaScript? Writing your first JavaScript program – Working with Variables – Creating Arrays – Accessing Array Elements–Types of Operators –Loops and Branches-Writing Functions–Returning Values–Passing and Using Arguments–Function Scope–Creating Objects–Retrieving and Setting Object Properties.	15	K2	CLO 1
II	Working with Methods: The Navigator Object–The Window object’s methods–Manipulating Documents with the DOM. Using Events in JavaScript–Understanding HTML Forms–Working with Form Object–Working with CSS and Graphics.	15	K3	CLO 2
III	Getting started with Node.js: npm–Web Apps with Express–File system I/O–Exporting and Consuming Modules–package.json.	15	K4	CLO 3
IV	Callback to Promise–Exception handling–http–Using Streams–Deploying Node.js applications in production–File upload–Mongodb integration–Simple REST based CRUD API. The User Interface: The Importance of the User Interface.	15	K3	CLO 4
V	The User Interface Design Process -Understanding How People Interact with Computers. Develop System Menus and Navigation Schemes: Structures of Menus-Functions of Menus-Content of Menus-Formatting of Menus.	15	K4	CLO 5

Books for Study:

1. Chris Minnick and Eva Holland, “Coding with JavaScript for Dummies”, John Wiley & Sons, Inc., 2015.
Unit-I: 1-8
Unit-II: 9-13
2. “Node.js Notes for Professionals”, GoalKicker.com.
Unit-III: 1-5, 10
Unit-IV: 14, 16, 20-22, 26, 28, 30
3. Wilbert O. Galitz, “The Essential Guide to User Interface Design, An Introduction to GUI Design Principles and Techniques”, third edition, Wiley Publishing, Inc.
Unit-IV: 1
Unit-V: 2 (Part-2)

Books for References:

1. Sandro Pasquali, “Mastering Node.js”, Packt Publishing, 2013.
2. David Flanagan, “JavaScript: The Definitive Guide”, Sixth Edition, O’Reilly Media, Inc, 2011.

Web Resources:

1. <https://javascript.info/>
2. <https://www.tutorialspoint.com/nodejs/index.htm>
3. <https://www.geeksforgeeks.org/user-experience-or-ux-design/>

Rationale for Nature of the Course:

- Fostering creativity in designing functional and user-friendly web applications.
- Build scalable, secure network applications and real-time web applications.

Activities having direct bearing on Skill / Employability:

- Practice to write server-side code.
- Practice to design a dynamic web page.

Pedagogy:

- Chalk and talk, PPT, Assignment, Seminar, Group discussion, Test and Quiz.

Course Designer(s):

- Mr. M. Ashok Kumar

Course Schedule:

Unit	Topics	Hrs	Mode
Unit I	What is JavaScript? Why JavaScript? Writing your first JavaScript program – Working with Variables – Creating Arrays – Accessing Array Elements–Types of Operators – Loops and Branches.	8	Lecture, Seminar, PPT, Test and Quiz.
	Writing Functions–Returning Values–Passing and Using Arguments–Function Scope–Creating Objects–Retrieving and Setting Object Properties.	7	
Unit II	Working with Methods–The Navigator Object–The Window object’s methods–Manipulating Documents with the DOM.	8	Lecture, Seminar, PPT, Test and Quiz.
	Using Events in JavaScript–Understanding HTML Forms–Working with Form Object–Working with CSS and Graphics.	7	
Unit III	Getting started with Node.js–npm–Web Apps with Express.	8	Lecture, Seminar, Test, Quiz.
	FileSystem I/O–Exporting and Consuming Modules–package.json.	7	
Unit IV	Callback to Promise–Exception handling–http–Using Streams–Deploying Node.js applications in production–File upload–Mongodb integration–Simple REST based CRUD API.	8	Lecture, Seminar, Group discussion, Test, Quiz.
	The User Interface:The Importance of the User Interface.	7	
Unit V	The User Interface Design Process -Understanding How People Interact with Computers.	8	Lecture, Seminar, Quiz, Assignment.
	Develop System Menus and Navigation Schemes: Structures of Menus-Functions of Menus-Content of Menus-Formatting of Menus.	7	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Describe and utilize JavaScript programming concepts such as variables, arrays, conditions, and loops.	K2
CLO-2	Build and deploy JavaScript code to solve practical web design problems.	K3
CLO-3	Analyze how to build real-world applications with Node.js.	K4
CLO-4	Create and manage MongoDB databases.	K3
CLO-5	Illustrate the fundamental concepts and techniques in designing UI.	K4

Mapping of CLOs with PSOs:

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

Mapping of CLOs with POs:

#	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	3	3	1	1	2	3
CLO-2	3	3	3	1	2	3
CLO-3	3	3	2	2	2	3
CLO-4	3	3	2	2	3	3
CLO-5	3	3	2	1	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	CLO 1	Up to K2	2	K1&K2	1	K1	2(K1&K1)	1(K2)
2	CLO2	Up to K3	2	K1&K2	1	K1	2(K2&K2)	1(K3)
3	CLO 3	Up to K4	2	K1&K2	1	K2	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	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	100%

PG DEPARTMENT OF COMPUTER SCIENCE					CLASS: I M.Sc. (CS)			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours/Week	CIA	Ext.	Total
II	Discipline Elective -IV	25P2DECT4	Artificial Intelligence & Machine Learning	3	5	25	75	100
Nature of the Course:								
Skill oriented		✓	Employability oriented		✓	Entrepreneurship Oriented		

Objectives:

- To understand the various concepts of AI Techniques.
- To learn the methods of solving problems using Artificial Intelligence.
- To provide knowledge on concepts of Representations and Predicate Logic.
- To impart knowledge in Machine learning with respect to Data mining, Bigdata and Cloud.
- To study the Applications and Impact of Machine learning.

Unit	Description	Hrs.	K-Level	CLO
I	Introduction: AI Problems - AI techniques - Criteria for success. Problems, Problem Spaces, Search: State space search - Production Systems - Problem Characteristics - Issues in design of Search.	15	K2	CLO 1
II	Heuristic Search techniques: Generate and Test - Hill Climbing - Best-First, Problem Reduction, Constraint Satisfaction, Means-end analysis. Knowledge representation issues: Representations and mappings - Approaches to Knowledge representations - Issues in Knowledge representations - Frame Problem.	15	K3	CLO 2
III	Using Predicate logic: Representing simple facts in logic - Representing Instance and ISA relationships - Computable functions and predicates - Resolution - Natural deduction. Representing knowledge using rules: Procedural Vs. Declarative knowledge - Logic programming – Forward Vs. Backward reasoning – Matching - Control knowledge.	15	K4	CLO 3
IV	Understanding Machine Learning: What Is Machine Learning? - Defining BigData - BigData in Context with Machine Learning - The Importance of the Hybrid Cloud -Leveraging the Power of Machine Learning - The Roles of Statistics and Data Mining with Machine Learning - Putting Machine Learning in Context - Approaches to Machine Learning.	15	K3	CLO 4

V	Looking Inside Machine Learning: The Impact of Machine Learning on Applications - Data Preparation - The Machine Learning Cycle.	15	K4	CLO 5

Books for Study:

1. Elaine Rich, Kevin Knight and Shivashankar B. Nair, "Artificial Intelligence", 3rd edition, TMH.
Unit I: 1, 2
Unit II: 3, 4
Unit III: 5, 6
2. Judith Hurwitz, Daniel Kirsch, "Machine Learning For Dummies" ®, IBM Limited Edition.
Unit IV: 1
Unit V: 3

Books for References:

1. George Fluger," Artificial Intelligence", 4th Edition, Pearson Education Publ, 2002.
2. Vinod Chandra S.S, Anand Hareendran S, "Artificial Intelligence and Machine Learning", First Edition, Year-2014

Web Resources:

1. <https://www.javatpoint.com/artificial-intelligence-tutorial>
2. <https://nptel.ac.in/courses/106/105/106105077/>
3. <https://www.datacamp.com/blog/machine-learning-lifecycle-explained>

Rationale for Nature of the Course:

- It is a new, emerging field which consists of a set of tools and techniques used to automate tasks, improve decision-making and optimize processes.
- It is a fast growing discipline and is full of rigorous practical analysis.

Activities having direct bearing on Skill development / Employability:

- Demonstrating technical skills, competency in AI & ML.
- Promoting collaborative learning and team work spirit through multi-disciplinary projects and diverse professional activities.

Pedagogy:

- Chalk and talk, PPT, Assignment, Seminar, Group discussion, Test and Quiz.

Course Designer:

- Ms. S.Saranya

Course Schedule:

Unit	Topics	Hrs	Mode
Unit I	Introduction: AI Problems - AI techniques - Criteria for success.	8	Lecture, PPT, Test and Quiz.
	Problems, Problem Spaces, Search: State space search - Production Systems - Problem Characteristics - Issues in design of Search.	7	
Unit II	Heuristic Search techniques: Generate and Test - Hill Climbing- Best-First, Problem Reduction, Constraint Satisfaction, Means-end analysis.	8	Lecture, PPT, Test and Quiz.
	Knowledge representation issues: Representations and mappings -Approaches to Knowledge representations -Issues in Knowledge representations - Frame Problem.	7	
Unit III	Using Predicate logic: Representing simple facts in logic - Representing Instance and ISA relationships - Computable functions and predicates - Resolution - Natural deduction.	8	Lecture, Test and Quiz.
	Representing knowledge using rules: Procedural Vs. Declarative knowledge- Logic programming –Forward Vs. Backward reasoning -Matching-Control knowledge.	7	
Unit IV	Understanding Machine Learning: What Is Machine Learning?-Defining BigData- BigData in Context with Machine Learning-The Importance of the Hybrid Cloud.	8	Lecture, Group discussion, Seminar, Test and Quiz.
	Leveraging the Power of Machine Learning-The Roles of Statistics and Data Mining with Machine Learning-Putting Machine Learning in Context-Approaches to Machine Learning.	7	
Unit V	Looking Inside Machine Learning: The Impact of Machine Learning on Applications.	8	Lecture, Assignment, Quiz and Seminar.
	Data Preparation -The Machine Learning Cycle.	7	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Summarize different AI problems, characteristics and state space representation.	K2
CLO-2	Apply heuristic, uninformed and informed search strategies for solving AI problems.	K3
CLO-3	Examine AI problem solving approaches to predicate logic and uncertainty.	K4
CLO-4	Apply the machine learning concepts in real life problems.	K3
CLO-5	Analyze the impact of machine learning on applications.	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	2	3	2
CLO-3	3	3	3	3	2
CLO-4	3	3	3	3	3
CLO-5	3	3	3	2	3

Mapping of CLOs with POs:

#	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	3	3	2	1	2	3
CLO-2	3	3	1	1	3	3
CLO-3	3	3	2	3	2	3
CLO-4	3	3	2	3	3	3
CLO-5	3	3	2	1	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	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 K4	2	K1&K2	1	K2	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	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	100%

PG DEPARTMENT OF COMPUTER SCIENCE					CLASS: I M.Sc. (CS)			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours/Week	CIA	Ext.	Total
II	Discipline Elective - IV	25P2DECT4	Blockchain Technology	3	5	25	75	100
Nature of the Course:								
Skill oriented		✓	Employability oriented		✓	Entrepreneurship Oriented		✓

Objectives:

- To understand the fundamentals of Blockchain and its application.
- To learn security features and its significance.
- To acquire knowledge on Cryptocurrency and bitcoin protocols.
- To know the impact of cryptocurrency regulation on financial stability.
- To identify opportunities & challenges posed by Blockchain.

Unit	Description	Hrs .	K-Level	CLO
I	Introduction: Introduction to Blockchain - The Big Picture of the Industry – Size, Growth, Structure, Players. Bitcoin Versus Crypto Currencies Versus Blockchain - Distributed Ledger Technology (DLT). Strategic Analysis of the Space – Blockchain Platforms, Regulators, Application Providers. The Major Application: Currency, Identity, Chain of Custody.	15	K2	CLO1
II	Network and Security: Advantage Over Conventional Distributed Database, Blockchain Network, Mining Mechanism, Distributed Consensus, Blockchain 1.0, 2.0 And 3.0 – Transition, Advancements and Features. Privacy, Security Issues in Blockchain.	15	K4	CLO2
III	Cryptocurrency: Cryptocurrency - History, Distributed Ledger, Bitcoin Protocols - Symmetric-Key Cryptography - Public-Key Cryptography - Digital Signatures - High and Low Trust Societies. Types of Trust Model: Peer-To-Peer, Leviathan, And Intermediary. Application of Cryptography to Blockchain.	15	K3	CLO3
IV	Cryptocurrency Regulation: Cryptocurrency Regulation - Stakeholders, Roots of Bit Coin, Legal Views - Exchange of Cryptocurrency - Black Market - Global Economy. Crypto Economics – Assets, Supply And Demand, Inflation and Deflation – Regulation.	15	K3	CLO4

V	Challenges in Blockchain: Opportunities and Challenges In Blockchain – Application Of Blockchain: Industry 4.0 – Machine to Machine Communication – Data Management In Industry4.0 – Future Prospects. Blockchain In Health 4.0 – Blockchain Properties - Healthcare Costs - Healthcare Quality - Healthcare Value - Challenges for Using Blockchain for Healthcare Data.	15	K4	CLO5

Books for Study:

1. Mastering Bitcoin: Unlocking Digital Crypto currencies, Antonopoulos.
Unit-1: 1
Unit-III: 4
2. Arvindan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction”, 2016, Princeton University Press.
Unit-II: 5
Unit-IV: 7
3. Mastering Blockchain, Imran Bashir, 2017 Fourth Edition, Packt Publications
Unit-V: 11,12

Books for References:

1. Bitcoin: A Peer-to-Peer Electronic Cash System –Satoshi Nakamoto.
2. Blockchain Technology for Industry 4.0 -Rodrigoda Rosa Righi, Antonio Marcos Alberti, Madhusudan Singh -Springer 2020.

Web Resources:

1. <https://www.tutorialspoint.com/biometrics/index.htm>
2. <https://www.tutorialspoint.com/blockchain/index.htm>
3. <https://www.investopedia.com/terms/b/blockchain.asp>

Rationale for Nature of the Course:

- Helps in the verification and traceability of multistep transactions.
- Provide secure transactions, reduce compliance costs, and speed up data transfer processing.

Activities having direct bearing on Skill development / Employability /Entrepreneurship:

- By having group discussions and interactive session at regular basis on cryptography concepts.
- Deploying a model of smart contracts.

Pedagogy:

- Chalk and talk, PPT, Assignment, Seminar, Group discussion, Test and Quiz.

Course Designer:

- Ms. K.R.Ramadevi

Course Schedule:

Unit	Topics	Hrs	Mode
Unit I	Introduction: Introduction to Blockchain - The Big Picture of the Industry – Size, Growth, Structure, Players. Bitcoin Versus Crypto Currencies Versus Blockchain - Distributed Ledger Technology (DLT).	8	Lecture, PPT, Quiz, Test, Seminar
	Strategic Analysis of the Space – Blockchain Platforms, Regulators, Application Providers. The Major Application: Currency, Identity, Chain of Custody.	7	
Unit II	Network And Security: Advantage Over Conventional Distributed Database, Blockchain Network, Mining Mechanism, Distributed Consensus.	8	Lecture, PPT, Quiz, Test, Seminar
	Blockchain 1.0, 2.0 And 3.0 – Transition, Advancements and Features. Privacy, Security Issues in Blockchain.	7	
Unit III	Cryptocurrency: Cryptocurrency - History, Distributed Ledger, Bitcoin Protocols -Symmetric-Key Cryptography - Public-Key Cryptography.	8	Lecture, PPT, Quiz, Test, Seminar
	Digital Signatures -High and Low Trust Societies - Types of Trust Model: Peer-To-Peer, Leviathan, And Intermediary. Application Of Cryptography to Blockchain.	7	
Unit IV	Cryptocurrency Regulation: Cryptocurrency Regulation-Stakeholders, Roots Of Bit Coin, Legal Views-Exchange of Cryptocurrency.	8	Lecture, Group Discussion, Quiz, Test, Seminar
	Black Market-Global Economy. Crypto Economics–Assets, Supply And Demand, Inflation and Deflation – Regulation.	7	
Unit V	Challenges In Blockchain: Opportunities and Challenges In Blockchain – Application Of Blockchain: Industry 4.0 – Machine to Machine Communication.	8	Lecture, Group Discussion Quiz, Seminar, Assignment
	Data Management in Industry4.0–Future Prospects. Blockchain In Health 4.0 – Blockchain Properties - Healthcare Costs - Healthcare Quality - Healthcare Value - Challenges for Using Blockchain For Healthcare Data.	7	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Demonstrate blockchain technology and cryptocurrency.	K2
CLO-2	Analyze the mining mechanism in blockchain.	K4
CLO-3	Apply and identify security measures and various types of services that allow people to trade and transact with bitcoins.	K3
CLO-4	Identify the impact of cryptocurrency regulation on financial stability, markets and innovation.	K3
CLO-5	Analyze Blockchain in healthcare industry.	K4

Mapping of CLOs with PSOs:

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

Mapping of CLOs with POs:

#	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	2	1	2	1	3	3
CLO-2	3	2	3	2	3	2
CLO-3	3	2	3	2	2	2
CLO-4	2	1	3	2	3	2
CLO-5	2	2	2	1	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	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	K1	2(K3&K3)	1(K4)
3	CLO 3	Up to K3	2	K1 & K2	1	K2	2(K2&K2)	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(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		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 (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	10	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%

PG DEPARTMENT OF COMPUTER SCIENCE					CLASS: I M.Sc. (CS)			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours/Week	CIA	Ext.	Total
II	NME-II	25P2DSEN2	Advanced Excel Techniques	2	2	25	75	100
Nature of the Course:								
Skill Oriented		✓	Employability Oriented	✓	Entrepreneurship Oriented			

Objectives:

- To handle large amounts of data.
- To filtering, sorting, and grouping data or subsets of data.
- To create pivot tables to consolidate data from multiple files.
- To aggregate numeric data and summarise into categories and subcategories.
- To presenting data in the form of charts and graphs.

Unit	Description	Hrs.	K-Level	CLO
I	Basics of Excel - Customizing Common Options - Absolute And Relative Cells - Protecting and Un-Protecting Worksheets and Cells - Working With Functions - Logical Functions - Data Validations - Specifying a Valid Range of Values - Specifying A List of Valid Values - Specifying Custom Validations Based on Formula - Working with Templates Designing The Structure of A Template.	6	K2	CLO 1
II	Sorting and Filtering Data - Sorting Tables - Multiple-Level Sorting - Custom Sorting - Filtering Data for Selected View - Advanced Filter Options - Working with Reports - Creating Subtotals - Multiple-Level Subtotal. More Functions. Date And Time Functions - Text Functions - Database Functions - Formatting Using Auto Formatting Option for Worksheets - Using Conditional Formatting Option for Rows, Columns and Cells.	6	K2	CLO 2
III	Creating Pivot Tables Formatting and Customizing Pivot Tables - Advanced Options of Pivot Tables - Pivot Charts - Consolidating Data from Multiple Sheets and Files Using Pivot Tables - Data Consolidation Feature To Consolidate Data - Show Value As % Of Row, % Of Column, Running Total, Compare With Specific Field - Viewing Subtotal Under Pivot	6	K2	CLO 3
IV	Whatif Analysis - Data Tables - Lookup and Reference Functions - Vlookup with Exact Match, Approximate Match - Nested Vlookup With Exact Match - Vlookup With Tables, Dynamic Ranges - Using Vlookup To Consolidate Data From Multiple Sheets.	6	K2	CLO 4

V	Charts - Formatting Charts - 3D Graphs - Bar and Line Chart Together - Secondary Axis In Graphs - Sharing Charts With Powerpoint / MS Word, Dynamically - New Features Of Excel Sparklines, Inline Charts, Data Charts.	6	K2	CLO 5

Books for Study:

- Excel 2019 All-in-One for Dummies – 2018- Greg Harvey.
Unit-I: 1, 2.
Unit-II: book 3-1, 2.
Unit IV: 7
- Microsoft Excel 2019 Pivot Table Data Crunching-2019, Bill Jelen and Michael Alexander.
Unit III: 1, 2, 5
- Excel 2010 Advanced – Stephen Moffat, The Mouse training Company & Ventus Publishing ApS – 2011.
Unit II: 3
Unit IV: 1
Unit V: 4

Books for References:

- Excel: Quick start Guide from Beginner to Expert (Excel, Microsoft Office7 by William Fischer.
- Advanced Excel Essentials -Jordan Gold meier.
- Excel 2016 Bible-John Walkenbach.

Web Resources:

- <https://www.ablebits.com/office-addins-blog/data-validation-excel/>
- <https://www.exceldemy.com/excel-consolidate-multiple-worksheets-into-one-pivottable/>
- <https://www.ablebits.com/office-addins-blog/vlookup-multiple-sheets-excel-examples/>

Rationale for Nature of the Course:

- Help to manage, analyze, and interpret data with ease.
- Prepare to harness Excel's full potential and make impactful data-driven decisions.

Activities having direct bearing on Skill development / Employability:

- By having group discussions and interactive session at regular basis on the core concepts of the course.
- Implementing a model of real-time sample problems on Excel application.

Pedagogy:

- Chalk and talk, PPT, Assignment, Seminar, Group discussion, Test and Quiz.

Course Designer:

- Mr. K. RajaSaravnaKumar

Course Schedule:

Unit	Topics	Hrs	Mode
Unit I	Basics of Excel - Customizing Common Options - Absolute And Relative Cells - Protecting and Un-Protecting Worksheets and Cells - Working With Functions - Logical Functions - Data Validations.	3	Lecture, PPT, Quiz, Test, Seminar
	Specifying a Valid Range of Values - Specifying A List of Valid Values - Specifying Custom Validations Based on Formula - Working with Templates Designing The Structure of A Template.	3	
Unit II	Sorting and Filtering Data - Sorting Tables - Multiple-Level Sorting - Custom Sorting - Filtering Data for Selected View - Advanced Filter Options - Working with Reports - Creating Subtotals - Multiple-Level Subtotal. More Functions.	3	Lecture, PPT, Quiz, Test, Seminar
	Date And Time Functions - Text Functions - Database Functions - Formatting Using Auto Formatting Option for Worksheets - Using Conditional Formatting Option for Rows, Columns and Cells.	3	
Unit III	Creating Pivot Tables Formatting and Customizing Pivot Tables - Advanced Options of Pivot Tables - Pivot Charts - Consolidating Data from Multiple Sheets and Files Using Pivot Tables.	3	Lecture, PPT, Quiz, Test, Seminar
	Data Consolidation Feature To Consolidate Data - Show Value As % Of Row, % Of Column, Running Total, Compare With Specific Field - Viewing Subtotal Under Pivot.	3	
Unit IV	Whatif Analysis - Data Tables - Lookup and Reference Functions - Vlookup with Exact Match, Approximate Match - Nested Vlookup With Exact Match.	3	Lecture, Group Discussion, Quiz, Test, Seminar
	Vlookup With Tables, Dynamic Ranges - Using Vlookup To Consolidate Data From Multiple Sheets.	3	
Unit V	Charts - Formatting Charts - 3D Graphs - Bar and Line Chart Together - Secondary Axis In Graphs - Sharing Charts With Powerpoint / MS Word, Dynamically.	3	Lecture, Group Discussion Seminar, Quiz, Assignment
	New Features Of Excel Sparklines, Inline Charts, Data Charts.	3	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Understand in handling the large amounts of data.	K2
CLO-2	Demonstrate Filtering, sorting, and grouping data or subsets of data.	K2
CLO-3	Describe pivot tables to consolidate data from multiple files.	K2
CLO-4	Aggregate numeric data and summarise into categories and subcategories.	K2
CLO-5	Representing data in the form of charts and graphs.	K2

Mapping of CLOs with PSOs:

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

Mapping of CLOs with POs:

#	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	2	1	2	1	3	3
CLO-2	3	2	3	2	3	2
CLO-3	3	2	3	2	2	2
CLO-4	2	1	3	2	3	2
CLO-5	2	2	2	1	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 (Open Choice)
			Short Answers		(Either/ or Choice)		
			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		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

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 with choice	Consolidated
K1	10	-	50	60	46.15	100
K2	-	70	-	70	53.85	
Total Marks	10	70	50	130	100	100%



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	25P1DCCT1	Analysis & Design of Algorithms	6	5	✓		✓			✓	No Revision
	25P1DCCT2	Cloud Computing	6	5	✓	✓	✓			✓	No Revision
	25P1DCCP1	Algorithm and Cloud Computing Lab	6	4	✓		✓			✓	33.3%
	25P1DECT1	Advanced Computer Networks	5	3			✓		✓		New Paper
		Soft Computing	5	3			✓			✓	New Paper
	25P1DECT2	Advanced Computer Organization and Architecture	5	3			✓	✓			New Paper
		Web Application Development	5	3	✓	✓	✓			✓	60%
	25P1DSEN1	Office Automation	2	2	✓		✓			✓	New Paper
II	25P2DCCT3	Advanced Java Programming	6	5	✓		✓			✓	No Revision
	25P2DCCT4	Data Mining And Warehousing	6	5	✓		✓			✓	20%
	25P2DCCP2	Advanced Java & Data Mining Tools Lab	6	4	✓		✓			✓	40%
	25P2DECT3	Advanced Software Engineering	5	3			✓		✓		No Revision
		Scripting Languages	5	3	✓		✓			✓	New Paper
	25P2DECT4	Artificial Intelligence & Machine Learning	5	3	✓		✓			✓	No Revision
		Blockchain Technology	5	3	✓	✓	✓			✓	No Revision
	25P2DSEN2	Advanced Excel Techniques	2	2	✓		✓		✓		New Paper

Emp- Employability; Ent- Entrepreneurship; Skill- Skill Development



THE MADURA COLLEGE (Autonomous)

DEPARTMENT OF INFORMATION TECHNOLOGY

**Curriculum based on
TAMIL NADU STATE COUNCIL FOR HIGHER EDUCATION (TANSCHÉ)
(Choice Based Credit System with Outcome Based Education)**

Academic Year 2025-2026 onwards

**B.Sc. Computer Science with Artificial Intelligence
I and II Semesters**

VISION

To Produce quality human resources in the field of Computer Science with Artificial Intelligence, staying at the forefront of the technological advancements, and make the students to address the complex challenges in diverse domains to meet IT industry requirements.

MISSION

- To provide quality education to the students so as to equip them with strong fundamental concepts, critical thinking, programming, and problem-solving skills by providing hands-on experience, professional ethics, and leadership qualities to serve the Society.
- To produce highly qualified and motivated students through a rigorous curriculum of theory and applications.
- To produce successful students with personal & professional responsibilities and commitment to lifelong learning.

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 teamwork 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 OUTCOMES (Defined by TANSCHÉ)

PO–1: Disciplinary Knowledge: Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate programme of study.

PO–2: 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.

PO–3: 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.

PO-4: 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.

PO-5: 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.

PO-6: 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-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives.

PROGRAMME-SPECIFIC OUTCOMES (PSOs)

Aligned with Graduate Attributes

#	Programme-Specific Outcome	Graduate Attributes
PSO-1	To prepare the students who will demonstrate respectful engagement with ideas, behaviours and beliefs which apply diverse frames to decisions and actions.	Disciplinary Knowledge
PSO-2	Understand, formulate, develop programming model with logical approaches to address issues arising in social science, business and other contexts.	Critical Thinking
PSO-3	Acquire good knowledge and understanding to solve specific theoretical and applied problems in advanced areas of Computer science and Industrial statistics.	Problem Solving & Scientific Reasoning
PSO-4	Develop a range of generic skills helpful in employment, internships & societal activities.	Analytical Reasoning
PSO-5	Get adequate exposure to global and local concerns that provides platform for further exploration into multi-dimensional aspects of computing sciences.	Self-directed & Lifelong Learning

ELIGIBILITY FOR ADMISSION

A candidate must have passed their 10+2 in Science stream with Mathematics, Physics, Chemistry, and Computer Science/Biology as their core subjects, conducted by the State Board of School Examinations, Government of Tamil Nadu, CBSE & ICSE or any other examination approved by Madurai Kamaraj University as equivalent.

DURATION OF THE COURSE

The students shall undergo prescribed course of study for the period of three academic years under CBCS semester pattern with Outcome Based education.

Medium of Instruction: English

System: Choice Based Credit System with Outcome Based Model.

EVALUATION PATTERN

THEORY		
Internal(Formative)	25 Marks	
	Components of Internal Assessment	Marks
	Test	10
	Assignment	5
	Quiz	5
	Seminar / Attendance	5
External (Summative)	75marks	

PRACTICAL		
Internal (Formative)	25 Marks	
	Components of Internal Assessment	Marks
	Test	10
	Continuous observation	10
	Record	5
External (Summative)	75 marks	

ASSESSMENT RUBRICS

I. TEST

#	Timeline
1	36 th day
2	72 nd day
Retest	On genuine reasons / medical grounds (with prior permission)

Assessment Strategy

- Objective.
- Subjective.

Assessment of the learning level attained by the students against mapped Course / Programme Outcomes.

Rubrics:**Section –A (Short Answer)**

Criteria	Performance Marks	
	2	1
Assessment	The answer is relevant, Correct and complete	The answer is relevant but incomplete

Section –B (Paragraph Answer)

Criteria	Performance Marks				
	5	4	3	2	1
Assessment	The answer is relevant, answered at the appropriate K-level, conclusion Or result drawn correctly.	The answer is relevant, answered at the appropriate K-level, arguments are correct but conclusion/ result is inconclusive or incorrect.	The answer is relevant, Answered at The appropriate K-level, arguments are correct but incomplete And inconclusive	The answer is relevant with few correct and few incorrect and inconclusive arguments	The answer is relevant but arguments are incorrect and inconclusive.

Section –C

Criteria	Performance Marks					
	10	8-9	6-7	4-5	2-3	1
Assessment	The answer is correct and conclusive. The result is drawn correctly	The answer is correct and complete. The result is incorrect or inconclusive	The answer is mostly correct, most key points are correct but the result is incorrect or inconclusive	The answer is partly correct. A few key points are correct. Inference is drawn Incorrectly or inconclusively	The answer is incomplete. Most key points are incorrect.	The answer is irrelevant

Question paper pattern for test component of Internal Assessment (Duration 1 ½ hours)

Pattern	No. of Questions	Marks per Question	Total Marks
Section–A (Short Answer - No choice)	5	2	10
Section–B (Paragraph type - Either-or)	2	5	10
Section–C (Open Choice - Two questions to be answered out of Three Questions)	2	10	20
Total Marks			40

Blue Print for Test Component of CIA

Pattern	Section–A (Short Answer)	Section–B (Either- Or)	Section–C (Open Choice)
CLO X	2 / 3*	1*	1 / 2*
CLO Y	2 / 3*	1*	1 / 2*

***K-levels can be decided by the course teacher ensuring proper distribution across K-levels.**

Assessment methodology and weight:

Weight:10 marks.

Calculated Metric = Average of two tests.

II. SEMINAR

Timeline
Spread over the entire semester from days 20 to 80

Assessment Strategy

Rubric:

Component	3	2	1
Presentation	-	Presentation was done with ICT tools and the tools were Appropriate for the content.	Usage of ICT tools was inadequate.
Content	Content was presented clearly and concisely, key points were answered well and arguments were established very well.	Content was relevant, key points were presented but inferences were ineffectively drawn or questions answered inadequately.	Content was presented but key points were not articulated effectively

Weight : 5 marks

III. ASSIGNMENT:

#	Timeline
1	30 th day
2	70 th day

Assessment Strategy Rubric:

Component	2	1
Timely submission	-	The assignment is Submitted on time
Content	-	Content is relevant and Complete in all respects
Originality	-	Content is written in own words with paraphrasing
Library and Information resources usage	Library and N-list resources are used and the resources used are cited appropriately and adequately	Information resource usage (or) usage of other resources are inadequate or not properly referenced

Assessment methodology and weight Weight : 5 marks

Assessment outcome : Best one score to be considered.

IV. QUIZ

#	Timeline
1	18 th day
2	48 th day
3	78 th day

(Or)

#	Timeline
1	40 th day
2	80 th day

Assessment strategy

- Objective

Assessment methodology and weight Weight: 5 Marks.

Assessment outcome : Average of test 2 out of 3 quizzes (or) best one of 2 quizzes.

V. ATTENDANCE

#	Timeline*
1	33 rd day
2	63 rd day
3	83 rd day

- Attendance to be verified at the intervals specified.

Assessment Strategy

Rubric:

Criteria	Performance Marks				
	5	4	3	2	1
Attendance	>90%	80-89%	70-79%	60-69%	<59%

Weight: 5 Marks.

Curriculum Structure

Part	Course Description	Course Code	Course Title	Contact hours/ week	Credits
SEMESTER I					
I	Lang – I	23U1TLAN1/ 23U1HLAN1/ 23U1SLAN1	Tamil - I/ Sanskrit - I/ Hindi - I	6	3
II	English – I	23U1NENG1	English - I	6	3
III	Core – I	25U1QCCT1	Programming in C	5	5
	Core Practical – I	25U1QCCP1	Programming in C Lab	3	3
	Generic Elective – I	25U1MGET1	Numerical Methods	6	5
IV	Foundation Course –I	25U1QFCT1	Problem Solving Techniques	2	2
	Skilled - I	25U1QSED1	Fundamentals of Computers	2	2
	Total			30	23
SEMESTER II					
I	Lang - II	23U2TLAN2/ 23U2HLAN2/ 23U2SLAN2	Tamil - II/ Sanskrit - II/ Hindi - II	6	3
II	English - II	23U2NENG2	English - II	6	3
III	Core - II	25U2QCCT2	Object Oriented Programming With C++	5	5
	Core Practical - II	25U2QCCP2	Object Oriented Programming With C++ Lab	3	3
	Generic Elective - II	25U2MGET2	Graph Theory and its Applications	6	5
IV	Skilled - II	25U2QSED2	Database Design Using MS Access	2	2
	Skilled - III	25U2QSED3	Office Automation	2	2
V	PART V		NCC1/ NSS1/ YRC1	-	-
	Total			30	23

DEPARTMENT OF COMPUTER SCIENCE WITH ARTIFICIAL INTELLIGENCE					CLASS: I B.Sc. (CS with AI)			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hrs./Week	CIA	Ext.	Total
I	Core-I	25U1QCCT1	Programming in C	5	5	25	75	100
Nature of the Course:								
Skill oriented		✓	Employability oriented		✓	Entrepreneurship Oriented		

Objectives:

- To familiarize the students with the basics of C.
- To inculcate the concepts of Decision Making, Looping and Arrays.
- To improve the programming skills by using Functions.
- To learn the concept of Files and Pointers.
- To acquire Knowledge on Structures and Union.

Unit	Description	Hrs.	K-Level	CLO
I	Overview of C: History of C- Importance of C- Basic Structure of C Programs-Executing a C Program- Constants, Variables and Data types - Operators and Expressions - Managing Input and Output Operations.	15	K2	CLO 1
II	Decision Making and Branching: Decision Making and Looping - Arrays - Character Arrays and Strings.	15	K4	CLO 2
III	User Defined Functions: Elements of User Defined Functions- Definition of Functions- Return Values and their Types- Function Call- Function Declaration- Categories of Functions- Nesting of Functions-Recursion.	15	K3	CLO 3
IV	Pointers: Understanding Pointers - Accessing the Address of a Variable - Declaring Pointer Variables - Initialization of Pointer Variables - Accessing a Variable through its Pointer - Pointer Expressions - Pointer and Arrays - Pointers and Character Strings - Array of Pointers - File Management in C.	15	K4	CLO 4
V	Structures and Unions: Introduction- Defining a Structure - Declaring Structure Variables - Accessing Structure Members - Structure Initialization - Arrays of Structures - Arrays within Structures – Unions - Size of Structures.	15	K3	CLO 5

Book for study:

1. E. Balaguruswamy, “Programming in ANSI C”, Fifth Edition, Tata McGraw Hill Publications, 2010. Unit-I: 1.1, 1.2, 1.8, 1.9, 1.10, 2, 3, 4.
Unit-II: 5, 6, 7, 8.
Unit-III: 9.
Unit-IV: 10.
Unit-V: 11, 12.

Books for References:

1. Robert W. Sebesta, “Concepts of Programming Languages”, Fourth Edition, Addison Wesley, 2012
2. Ashok Kamthane, (2009), —Programming with ANSI & Turbo C, Pearson Education
3. Byron Gottfried, (2010), —Programming with C, Schaums Outline Series, Tata McGraw Hill Publications.

Web Resources:

1. <http://www.tutorialspoint.com/cprogramming/>
2. <http://www.cprogramming.com/>
3. <http://www.programmingsimplified.com/c-program-examples>
4. <http://www.programiz.com/c-programming>
5. <http://www.cs.cf.ac.uk/Dave/C/CE.html>
6. <http://fresh2refresh.com/c-programming/c-function/>

Rationale for Nature of the Course:

- C is an imperative procedural language. It provides constructs that map efficiently to typical machine instructions.

Activities having direct bearing on Skill development / Employability:

- Practice to write Programs, assignments.
- Debugging.

Pedagogy:

- Chalk and talk, PPT, Assignment, Seminar, Group discussion, Test and Quiz.

Course Designer:

- Ms. S. Brindha

Course Schedule:

Unit	Topics	Hrs	Mode
Unit I	Overview of C: History of C- Importance of C- Basic Structure of C Programs-Executing a C Program- Constants, Variables.	7	Lecture, Quiz, PPT, Test, Seminar
	Data types - Operators and Expressions - Managing Input and Output Operations.	8	
Unit II	Decision Making and Looping.	7	Lecture, PPT, Quiz, Test, Seminar
	Arrays - Character Arrays and Strings.	8	
Unit III	User Defined Functions: Elements of User Defined Functions- Definition of Functions- Return Values and their Types.	7	Lecture, Quiz, PPT, Test, Seminar
	Function Call- Function Declaration- Categories of Functions- Nesting of Functions-Recursion.	8	
Unit IV	Pointers: Understanding Pointers - Accessing the Address of a Variable - Declaring Pointer Variables - Initialization of Pointer Variables.	7	Lecture, Quiz, Group Discussion, Test, Seminar
	Accessing a Variable through its Pointer - Pointer Expressions - Pointer and Arrays - Pointers and Character Strings - Array of Pointers - File Management in C.	8	
Unit V	Structures and Unions: Introduction- Defining a Structure- Declaring Structure Variables Accessing Structure Members.	7	Lecture, Quiz, Assignment, Seminar
	Structure Initialization- Arrays of Structures- Arrays within Structures- Unions- Size of Structures.	8	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Outline the fundamental concepts of C programming languages, and its features.	K2
CLO-2	Inspect the importance of Decision making, Looping and Array Concepts.	K4
CLO-3	Construct the Programs by making use of Functions.	K3
CLO-4	Devise coding by applying Pointers and Files.	K4
CLO-5	Compute programs by using Structures and Unions.	K3

Mapping of CLOs with PSOs:

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

Mapping of CLOs with POs:

#	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	3	1	1	1	1	1
CLO-2	3	3	3	1	3	3
CLO-3	3	2	2	3	3	2
CLO-4	3	3	2	3	3	3
CLO-5	3	3	3	1	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	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	K1	2(K4&K4)	1(K3)
3	CLO 3	Up to K3	2	K1 & K2	1	K2	2(K2&K2)	1(K3)
4	CLO 4	Up to K4	2	K1 & K2	1	K2	2(K3&K3)	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	100%

DEPARTMENT OF COMPUTER SCIENCE WITH ARTIFICIAL INTELLIGENCE					CLASS: I B.Sc. (CS with AI)			
Sem .	Course Type	Course Code	Course Title	Credits	Contact Hrs./Week	CIA	Ext .	Total
I	Core Practical-I	25U1QCCP1	Programming in C Lab	3	3	25	75	100
Nature of the Course:								
Skill oriented		✓	Employability oriented		✓	Entrepreneurship Oriented		

Objectives:

- To provide exposure for problem solving through C programming.
- To train the basic concepts of the C Programming language.
- To apply different concepts of C language to solve the problem.
- To inculcate the concept of Files and Pointers.
- To practice the usage of Structures and Union.

Unit	Description	Hrs.	K-Level	CLO
I	1. Write a C program to compute the perimeter and area of a circle with a given radius. 2. Write a C program that accepts two integers and find the maximum number using conditional operator. 3. Write a program that converts Centigrade to Fahrenheit. 4. Write a C program to implement arithmetic operators.	9	K2	CLO 1
II	5. Write a C program to read temperature in centigrade and display a suitable message according to the temperature state below: Temp < 0 then Freezing weather Temp 0-10 then Very Cold weather Temp 10-20 then Cold weather Temp 20-30 then Normal in Temp Temp 30-40 then Its Hot Temp >=40 then Its Very Hot 6. Write a C program to find and print the first 10 Fibonacci numbers using a while loop	9	K4	CLO 2

	7. Write a C program that prompts the user to input a series of integers until the user stops by entering 0 using a do-while loop. Calculate and print the sum of all positive integers entered. 8. Write a program in C to display the cube of the number up to an integer. 9. Write a program in C to count the total number of elements in an array. 10. Write a program in C to count the total number of alphabets, digits and special characters in a string.			
III	11. Write a program in C to find the square of any number using the function. 12. Write a program in C to check whether a number is a prime number or not using the function. 13. Write a program in C to check Armstrong and Perfect numbers using the function. 14. Write a program in C to find the sum of digits of a number using recursion	9	K3	CLO 3
IV	15. Write a program in C to add two numbers using pointers. 16. Write a program in C to find the maximum number between two numbers using a pointer. 17. Write a program in C to store n elements in an array and print the elements using a pointer. 18. Write a program in C to count the number of words and characters in a file.	9	K4	CLO 4
V	19. Create a structure called "Student" with members name, age, and total marks. Write a C program to input data for two students, display their information, and find the average of total marks. 20. Create a structure named "Employee" to store employee details such as employee ID, name, and salary. Write a program to input data for three employees, find the highest salary employee, and display their information.	9	K3	CLO 5

Book for study:

1. E. Balaguruswamy, “Programming in ANSI C”, Fifth Edition, Tata McGraw Hill Publications, 2010.

Books for References:

1. Robert W. Sebesta, “Concepts of Programming Languages”, Fourth Edition, Addison Wesley, 2012.
2. Ashok Kamthane, (2009), —Programming with ANSI & Turbo C, Pearson Education
3. Byron Gottfried, (2010), —Programming with C, Schaums Outline Series, Tata McGraw Hill Publications

Web Resources:

1. <http://www.programmingsimplified.com/c-program-examples>
2. <http://www.programiz.com/c-programming>
3. <http://www.cs.cf.ac.uk/Dave/C/CE.html>
4. <https://www.w3resource.com/c-programming-exercises/>

Rationale for Nature of the Course:

- C is an imperative procedural language. It provides constructs that map efficiently to typical machine instructions.

Activities having direct bearing on Skill development / Employability:

- Practice to write programs. Helps to develop the problem solving and logical reasoning skills.

Pedagogy:

- Demo and Practical Session.

Course Designer:

- Ms. S. Brindha

Course Schedule:

Unit	Topics	Hrs	Mode
Unit I	1. Write a C program to compute the perimeter and area of a circle with a given radius. 2. Write a C program that accepts two integers and find the maximum number using conditional operator.	4	Demo & Practical Session.
	3. Write a program that converts Centigrade to Fahrenheit. 4. Write a C program to implement arithmetic operators.	5	
Unit II	5. Write a C program to read temperature in centigrade and display a suitable message according to the temperature state below: Temp < 0 then Freezing weather Temp 0-10 then Very Cold weather Temp 10-20 then Cold weather Temp 20-30 then Normal in Temp Temp 30-40 then Its Hot Temp >=40 then Its Very Hot. 6. Write a C program to find and print the first 10 Fibonacci numbers using a while loop 7. Write a C program that prompts the user to input a series of integers until the user stops by entering 0 using a do-while loop. Calculate and print the sum of all positive integers entered.	5	Demo & Practical Session
	8. Write a program in C to display the cube of the number up to an integer. 9. Write a program in C to count the total number of elements in an array. 10. Write a program in C to count the total number of alphabets, digits and special characters in a string.	4	
Unit III	11. Write a program in C to find the square of any number using the function. 12. Write a program in C to check whether a number is a prime number or not using the function.	5	Demo & Practical Session
	13. Write a program in C to check Armstrong and Perfect numbers using the function. 14. Write a program in C to find the sum of digits of a number using recursion.	4	
Unit IV	15. Write a program in C to add two numbers using pointers. 16. Write a program in C to find the maximum number between two numbers using a pointer.	5	Demo & Practical Session
	17. Write a program in C to store n elements in an array and print the elements using a pointer. 18. Write a program in C to count the number of words and characters in a file.	4	

Unit V	19. Create a structure called "Student" with members name, age, and total marks. Write a C program to input data for two students, display their information, and find the average of total marks.	5	Demo & Practical Session
	20. Create a structure named "Employee" to store employee details such as employee ID, name, and salary. Write a program to input data for three employees, find the highest salary employee, and display their information.	4	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Outline the concepts of C programming languages, and its features.	K2
CLO-2	Inspect the importance of Decision making, Looping and Array Concepts	K4
CLO-3	Constructs the Programs by making use of Functions.	K3
CLO-4	Devise coding by applying Pointers and Files	K4
CLO-5	Compute programs by using Structures and Unions	K3

Mapping of CLOs with PSOs:

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

Mapping of CLOs with POs:

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

Advance application- 3; Intermediate level-2; Basic level-1

DEPARTMENT OF COMPUTER SCIENCE WITH ARTIFICIAL INTELLIGENCE					CLASS: I B.Sc. (CS with AI)			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hrs./ Week	CIA	Ext.	Total
I	Foundation Course - I	25U1QFCT1	Problem Solving Techniques	2	2	25	75	100
Nature of the Course:								
Skill oriented		✓	Employability oriented			Entrepreneurship Oriented		

Objectives:

- To understand the concepts of algorithms and programs, and to know of the basic problem solving strategies.
- To learn the concepts of mathematical function.
- To gain knowledge in factoring methods.
- To impart the basic concepts of array techniques.
- To acquire knowledge in text processing and recursive algorithms.

Unit	Description	Hrs.	K-Level	CLO
I	Introduction: Notion of algorithms and programs – Requirements for solving problems by computer – The problem solving aspect - Problem definition phase, Getting started on a problem, The use of specific examples, Similarities among problems, Working backwards from the solution – General problem-solving strategies - Problem solving using top-down design – Implementation of algorithms – The concept of Recursion.	6	K2	CLO 1
II	Fundamental Algorithms : Exchanging the values of two variables – Counting - Summation of a set of numbers - Factorial computation - Fibonacci Series generation - Reversing the digits of an integer – Base Conversion.	6	K3	CLO 2
III	Factoring Methods : Finding the square root of a number – The smallest divisor of an integer – Greatest common divisor of two integers - Generating prime numbers – Computing the prime factors of an integer – Raising a number to a large power – Computing the <i>n</i> th Fibonacci number.	6	K3	CLO 3

IV	Array Techniques: Array order reversal – Array counting – Finding the maximum number in a set - Removal of duplicates from an ordered array - Partitioning an array – Finding the k^{th} smallest element.	6	K4	CLO 4
V	Text Processing and Pattern Searching: Text line length adjustment – Left and right justification of text – Keyword searching in text – Text line editing – Linear pattern search. Recursive algorithms: Towers of Hanoi – Permutation generation.	6	K4	CLO 5

Book for study:

1. R.G. Dromey, “How to Solve it by Computer”, Pearson India, 2007.
Unit-I: 1.1 to 1.4.
Unit-II: 2.1 to 2.8.
Unit-III: 3.1 to 3.8.
Unit-IV: 4.1 to 4.7.
Unit V: 6.1 to 6.5, 8.3, 8.6

Books for References:

1. George Polya, Jeremy Kilpatrick, “The Stanford Mathematics Problem Book: With Hints and Solutions”, Dover Publications, 2009 (Kindle Edition 2013).
2. Greg W. Scragg, “Problem Solving with Computers”, Jones & Bartlett 1st edition, 1996.

Web Resources:

1. <https://www.tutorialspoint.com/problem-solving-steps-techniques-and-best-practices>
2. https://www.brainkart.com/article/Fundamentals-of-Algorithmic-Problem-Solving_7992/
3. https://germanna.edu/sites/default/files/2022-03/Factoring_Methods.pdf
4. <https://www.geeksforgeeks.org/problem-solving-arrays/>
5. <https://www.geeksforgeeks.org/pattern-searching/>

Rationale for Nature of the Course:

- Knowledge, Problem Solving, Analytical ability, Professional Competency.

Activities having direct bearing on Skill development:

- Giving practice to solve problems, conducting Group Discussion, providing case studies.

Pedagogy:

- Chalk and Talk, PPT, Assignment, Seminar, Group discussion, Test and Quiz.

Course Designer:

- Ms. R.TamilSelvi

Course Schedule:

Unit	Topics	Hrs	Mode
Unit I	Introduction: Notion of algorithms and programs – Requirements for solving problems by computer – The problem solving aspect - Problem definition phase, Getting started on a problem.	3	Lecture, Quiz, PPT, Test, Seminar
	The use of specific examples, Similarities among problems, Working backwards from the solution – General problem-solving strategies - Problem solving using top-down design – Implementation of algorithms – The concept of Recursion.	3	
Unit II	Fundamental Algorithms: Exchanging the values of two variables – Counting - Summation of a set of numbers - Factorial computation.	3	Lecture, Quiz, PPT, Test, Seminar
	Fibonacci Series generation - Reversing the digits of an integer – Base Conversion.	3	
Unit III	Factoring Methods: Finding the square root of a number – The smallest divisor of an integer – Greatest common divisor of two integers - Generating prime numbers.	3	Lecture, Quiz, PPT, Test, Seminar
	Computing the prime factors of an integer – Raising a number to a large power – Computing the n th Fibonacci number.	3	
Unit IV	Array Techniques: Array order reversal – Array counting – Finding the maximum number in a set - Removal of duplicates from an ordered array.	3	Lecture, Quiz, Group Discussion, Test, Seminar
	Partitioning an array – Finding the k^{th} smallest element.	3	
Unit V	Text Processing and Pattern Searching: Text line length adjustment – Left and right justification of text – Keyword searching in text – Text line editing – Linear pattern search.	4	Lecture, Quiz, Assignment, Seminar
	Recursive algorithms: Towers of Hanoi – Permutation generation.	2	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Explain the basic concepts of problem solving aspect.	K2
CLO-2	Utilize the fundamental concepts to solve the real life problems.	K3
CLO-3	Make use of the various mathematical functions.	K3
CLO-4	Differentiate various array functions.	K4
CLO-5	Analyze the significance of text and its patterns.	K4

Mapping of CLOs with PSOs:

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

Mapping of CLOs with POs:

#	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	3	2	2	1	1	3
CLO-2	3	2	2	2	1	3
CLO-3	3	3	2	3	1	3
CLO-4	3	3	3	3	2	3
CLO-5	3	3	3	2	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	CLO 1	Up to K2	2	K1 & K2	1	K2	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 K3	2	K1 & K2	1	K2	2(K2&K2)	1(K3)
4	CLO 4	Up to K4	2	K1 & K2	1	K2	2(K4&K4)	1(K3)
5	CLO 5	Up to K4	2	K1 & K2	1	K1	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	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	100%

DEPARTMENT OF COMPUTER SCIENCE WITH ARTIFICIAL INTELLIGENCE					CLASS: I B.Sc. (CS with AI)			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hrs/Week	CIA	Ext.	Total
I	Skilled - I	25U1QSED1	Fundamentals of Computers	2	2	25	75	100
Nature of the Course:								
Skill oriented		✓	Employability oriented			Entrepreneurship oriented		

Objectives:

- To understand the basic computer organization.
- To impart knowledge in computer software and languages.
- To learn about processor and memory.
- To acquire the concepts of Operating System.
- To gain knowledge of internet with e-commerce.

Unit	Description	Hrs.	K-Level	CLO
I	Introduction to Computers: Data Processing-Characteristic features of Computers-Computer generations. Basic computer organization: Input Unit-Output unit-Storage unit-Types of storage. Number system: Decimal, Octal, Binary, Hexadecimal number system. Input and Devices.	6	K2	CLO 1
II	Computer Software: Types of Software - System Architecture Computer Languages: Machine Language - Assembly Language - High Level Language - Object Oriented Languages.	6	K3	CLO 2
III	Processor and Memory: Memory Structure - Processor Speed - Types of processor - Main Memory. Secondary storage devices: Classification of commonly used secondary storage devices (Sequential Access Devices, Direct Access Devices).	6	K3	CLO 3
IV	Operating System: Functions, Measuring System Performance, Assemblers, Compilers and Interpreters. Batch Processing, Multiprogramming, Multi-Tasking, Multiprocessing, Time Sharing, DOS, Windows, Unix/Linux.	6	K4	CLO 4
V	Internet: Introduction to Internet and Intranet – Services of Internet - Domain Name – URL – Browser – Types of Browsers – Search Engine - E-Mail – Basic Components of E-Mail – How to send group mail. E-Commerce: Digital Signature – Digital Currency – Online shopping and transaction.	6	K4	CLO 5

Book for study:

1. Pradeep K.Sinha and Priti Sinha, 2004, “Computer Fundamentals”, Sixth Edition, BPB Publications.

Unit-I: 1, 2,3,4

Unit-II: 10, 12

Unit-III: 7,8

Unit-IV: 14

Unit-V: 18

Books for References:

1. C.S.V. Murthy, 2009, “Fundamentals of Computers”, Third Edition, Himalaya Publishing House.
2. Bhardwaj Sushil Puneet Kumar, “Fundamental of Information Technology”
3. S. K Bansal, “Fundamental of Information Technology”.

Web Resources:

1. <https://www.geeksforgeeks.org/computer-organization-basic-computer-instructions/>
2. <https://www.vedantu.com/coding-for-kids/computer-languages>
3. <https://www.javatpoint.com/secondary-storage-devices-in-computer-organization>
4. <https://www.geeksforgeeks.org/introduction-of-operating-system-set-1/>
5. <https://www.geeksforgeeks.org/e-commerce/>

Rationale for Nature of the Course:

- It helps people understand how computers work and how to use them effectively.

Activities having direct bearing on Skill development:

- Group Discussion, Case Studies and Assignment.

Pedagogy:

- Chalk and Talk, PPT, Assignment, Seminar, Group discussion, Test and Quiz.

Course Designer:

- Ms. R.TamilSelvi

Course Schedule:

Unit	Topics	Hrs	Mode
Unit I	Introduction to Computers: Data Processing-Characteristic features of Computers-Computer generations. Basic computer organization: Input unit-Output unit-Storage unit-Types of storage.	3	Lecture, Quiz, PPT, Test, Seminar
	Number system: Decimal, Octal, Binary, Hexadecimal number system. Input and Devices.	3	
Unit II	Computer Software: Types of Software - System Architecture.	2	Lecture, Quiz, PPT, Test, Seminar
	Computer Languages: Machine Language - Assembly Language - High Level Language - Object Oriented Languages.	4	
Unit III	Processor and Memory : Memory structure-Processor speed-Types of processor - Main Memory.	3	Lecture, Quiz, PPT, Test, Seminar
	Secondary storage devices: Classification of commonly used secondary storage devices(Sequential Access Devices, Direct Access Devices.	3	
Unit IV	Operating System: Functions, Measuring System Performance, Assemblers, Compilers and Interpreters.	3	Lecture, Quiz, Group Discussion, Test, Seminar
	Batch Processing, Multiprogramming, Multi-Tasking, Multiprocessing, Time Sharing, DOS, Windows, Unix/Linux.	3	
Unit V	Internet: Introduction to Internet and Intranet, Services of Internet - Domain Name, URL , Browser, Types of Browsers, Search Engine - E-Mail, Basic Components of E-Mail, How to send group mail.	3	Lecture, Quiz, Assignment, Seminar
	E-Commerce: Digital Signature, Digital Currency, Online shopping and transaction.	3	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Outline the basic computer organization.	K2
CLO2	Identify the computer language and its types.	K3
CLO3	Classify the different types of secondary storage devices.	K3
CLO4	Categorize the multiprocessing and multitasking.	K4
CLO5	Connect to Internet with E-commerce.	K4

Mapping of CLOs with PSOs:

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

Mapping of CLOs with POs:

#	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	3	1	1	1	1	2
CLO-2	3	2	2	2	1	2
CLO-3	3	3	3	2	2	2
CLO-4	3	3	3	3	2	2
CLO-5	3	2	2	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	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 K3	2	K1 & K2	1	K2	2(K2&K2)	1(K3)
4	CLO 4	Up to K4	2	K1 & K2	1	K2	2(K4&K4)	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			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	100%

DEPARTMENT OF COMPUTER SCIENCE WITH ARTIFICIAL INTELLIGENCE					CLASS: I B.Sc. (CS with AI)			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hrs/Week	CIA	Ext.	Total
II	Core-II	25U2QCCT2	Object Oriented Programming With C++	5	5	25	75	100
Nature of the Course:								
Skill oriented		✓	Employability oriented		✓	Entrepreneurship Oriented		

Objectives:

- To understand the principles of Object Oriented Programming.
- To learn how to write inline functions for efficiency and performance.
- To learn how to implement types of Constructors and Overloading.
- To understand and develop a program using various type of Inheritance.
- To create & process data in files and know about exception handling.

Unit	Description	Hrs.	K-Level	CLO
I	Principles of Object Oriented Programming: Object Oriented Programming Paradigm – Basic Concepts of Object Oriented Programming – Benefits of Object Oriented Programming –Object Oriented Languages – Applications of Object Oriented Programming – Beginning with C++. Token Expressions & Control Structures: Tokens– Keywords – Identifiers and Constants – Data Types – Type Compatibility – Variables – Operators – Implicit Conversions – Operator Precedence – Control Structures.	15	K2	CLO 1
II	Functions in C++ and Classes & Objects: The Main Function– Function Prototyping – Call by Reference – Return by Reference – Inline Functions – Function Overloading – Friend and Virtual Functions – Specifying a class – Member Functions – Arrays within a class – Static Member Functions – Arrays of Objects –Friendly Functions.	15	K4	CLO 2
III	Constructors & Destructors, Operator Overloading: Constructors – Parameterized Constructors – Copy Constructors – Dynamic Constructors – Destructors – Defining Operator Overloading – Overloading Operators – Rules for Overloading Operators – Type Conversions.	15	K3	CLO 3

IV	Inheritance: Defining Derived Classes – Single Inheritance – Multilevel Inheritance – Multiple Inheritance – Hierarchical Inheritance – Hybrid Inheritance. Pointers, Virtual Functions & Polymorphism: Pointers– Pointers to Objects–this pointer–Pointer to Derived Classes–Virtual Functions.	15	K3	CLO 4
V	Working with Files, Exception handling: Classes for File Stream Operations–Opening and Closing a File–File Modes, Input Output Operations, Updating a File–Basics of Exception Handling–Exception Handling Mechanism–Throwing Mechanism–Catching Mechanism–Specifying Exceptions.	15	K4	CLO 5

Book for study:

1. E. Balagurusamy, “Object-Oriented Programming with C++”, 8th Edition, TMH.
Unit-I: 1, 2.
Unit-II: 3.
Unit-III: 4, 5.
Unit-IV: 6, 7, 8.
Unit-V: 9, 11, 13.

Books for References:

1. Sourav Sahay, “Object Oriented Programming with C++”, 2nd Edition, Oxford University Press, 2017.
2. Reema Thareja, “Object Oriented Programming with C++”, 1st Edition, Oxford University Press, 2015.
3. Rumbaugh, “Object Oriented Design”, Pearson publication.

Web Resources:

1. <https://www.geeksforgeeks.org/cpp-tutorial/>
2. <https://www.programiz.com/cpp-programming/constructors>
3. https://www.tutorialspoint.com/cplusplus/cpp_exceptions_handling.htm

Rationale for Nature of the Course:

- Set of user defined types makes a program more concise.
- It makes many sorts of code analysis feasible.
- Supports different ways of programming like procedural, object oriented, functional.

Activities having direct bearing on Skill development / Employability:

- Practice to write programs. Helps to develop the problem solving and logical reasoning skills.
- Learn how to design and implement classes and objects.

Pedagogy:

- Chalk and talk, PPT, Assignment, Seminar, Group discussion, Test and Quiz.

Course Designer:

- Ms. S. Saranya.

Course Schedule:

Unit	Topics	Hrs	Mode
Unit I	Principles of Object Oriented Programming: Object Oriented Programming Paradigm – Basic Concepts of Object Oriented Programming – Benefits of Object Oriented Programming –Object Oriented Languages – Applications of Object Oriented Programming – Beginning with C++.	6	Lecture, Seminar, Quiz, PPT and Test.
	Token Expressions & Control Structures: Tokens– Keywords – Identifiers and Constants – Data Types – Type Compatibility – Variables – Operators – Implicit Conversions – Operator Precedence – Control Structures.	9	
Unit II	Functions in C++ and Classes & Objects: The Main Function– Function Prototyping – Call by Reference – Return by Reference – Inline Functions – Function Overloading – Friend and Virtual Functions.	7	Lecture, Quiz, Test and Seminar.
	Specifying a class – Member Functions – Arrays within a class – Static Member Functions – Arrays of Objects –Friendly Functions	8	
Unit III	Constructors & Destructors, Operator Overloading: Constructors – Parameterized Constructors – Copy Constructors – Dynamic Constructors – Destructors.	8	Lecture, Quiz, PPT, Test and Seminar.
	Defining Operator Overloading – Overloading Operators – Rules for Overloading Operators – Type Conversions.	7	
Unit IV	Inheritance: Defining Derived Classes – Single Inheritance – Multilevel Inheritance – Multiple Inheritance – Hierarchical Inheritance – Hybrid Inheritance.	8	Lecture, Quiz, PPT, Test and Seminar.
	Pointers, Virtual Functions & Polymorphism: Pointers– Pointers to Objects–this pointer–Pointer to Derived Classes–Virtual Functions.	7	
Unit V	Working with Files, Exception handling: Classes for File Stream Operations–Opening and Closing a File–File Modes, Input Output Operations, Updating a File.	8	Lecture, Quiz, Assignment, Seminar.
	Basics of Exception Handling– Exception Handling Mechanism– Throwing Mechanism–Catching Mechanism–Specifying Exceptions.	7	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Understand and apply object-oriented features.	K2
CLO-2	Analyze how to implement the concept of functions and classes.	K4
CLO-3	Identify the types of constructors.	K3
CLO-4	Determine the use of object oriented features such as inheritance to develop C++ programs for complex problems.	K3
CLO-5	Examine the usage of File concepts in C++ coding.	K4

Mapping of CLOs with PSOs:

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

Mapping of CLOs with POs:

#	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	3	2	3	3	3	3
CLO-2	3	2	3	3	3	3
CLO-3	3	2	3	3	3	3
CLO-4	3	2	3	3	3	3
CLO-5	3	2	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	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	K1	2 (K3&K3)	1(K4)
3	CLO 3	Up to K3	2	K1 & K2	1	K2	2 (K2&K2)	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(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	100%

DEPARTMENT OF COMPUTER SCIENCE WITH ARTIFICIAL INTELLIGENCE					CLASS: I B.Sc. (CS with AI)			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hrs/ Week	CIA	Ext .	Total
II	Core Practical-II	25U2QCCP2	Object Oriented Programming With C++ Lab	3	3	25	75	100
Nature of the Course:								
Skill oriented	✓	Employability oriented		✓	Entrepreneurship Oriented			

Objectives:

- To understand the principles of Object Oriented Programming.
- To learn how to write inline functions for efficiency and performance.
- To learn how to implement types of Constructors and Overloading.
- To understand and develop a program using any type of Inheritance.
- To create & process data in files and know about exception handling.

Unit	Description	Hrs.	K-Level	CLO
I	1. Write a Program to find Simple Interest and Compound Interest. 2. Write a Program to generate Fibonacci series. 3. Write a Program to find greatest of three numbers. 4. Write a program to convert the temperature in Fahrenheit to Celsius and vice-a-verse. 5. Write a Program to demonstrate the working of following Loops: While, Do While, For, If-Else, Switch.	9	K2	CLO 1
II	6. Write a Program to show Function Overloading. 7. Write a Program to create a class and access member function of a class. 8. Write a Program to display elements of an array. 9. Write a Program to calculate Sum and Average of an array. 10. Write a Program to sort elements of an array using Bubble sort. 11. Write a Program to add and subtract two matrices. 12. Write a Program to calculate square and cube of a number using inline functions.	9	K4	CLO 2

III	13. Write a Program to create constructor with arguments and pass the arguments to constructor. 14. Write a Program to create object and release them using destructor. 15. Write a Program to perform addition, subtraction, multiplication of two objects using operator keyword.	9	K3	CLO 3
IV	16. Write a Program to derive single and multiple inheritances. 17. Write a Program to implementation of Virtual Function. 18. Write a Program to use pointer for both base and derived classes and call the member function. Use virtual keyword.	9	K3	CLO 4
V	19. Write a Program to write text in a file. Read the text from the file from EOF. Display the contents in reverse order. 20. Write a Program to find the factorial of a number. Throw multiple exceptions and define multiple catch statements to handle exceptions.	9	K4	CLO 5

Book for study:

1. E. Balagurusamy, “Object-oriented programming with C++”, 8th Edition, TMH.

Books for References:

1. Herbert Schildt, “The complete reference C++”, 4th Edition, McGraw Hill.
2. Richard Grimes, “Beginning C++ Programming”, Packt Publishing 2017.
3. Rumbaugh,” Object Oriented Design”, Pearson publication.

Web Resources:

1. <https://www.geeksforgeeks.org/cpp-tutorial/>
2. <https://www.programiz.com/cpp-programming/constructors>
3. https://www.tutorialspoint.com/cplusplus/cpp_exceptions_handling.htm

Rationale for Nature of the Course:

- Set of user defined types makes a program more concise.
- It makes many sorts of code analysis feasible.
- Supports different ways of programming like procedural, object oriented functional.

Activities having direct bearing on Skill development / Employability:

- Practice to write programs. Helps to develop the problem solving and logical reasoning skills.
- To design and implement classes and objects.

Pedagogy:

- Demo and Practical Session

Course Designer:

- Ms. S. Saranya

Course Schedule:

Unit	Topics	Hrs	Mode
Unit I	1. Write a Program to find Simple Interest and Compound Interest. 2. Write a Program to generate Fibonacci series. 3. Write a Program to find greatest of three numbers.	5	Demo and Practical Session
	4. Write a program to convert the temperature in Fahrenheit to Celsius and vice-a-verse. 5. Write a Program to demonstrate the working of following Loops: While, Do While, For, If-Else, Switch.	4	
Unit II	6. Write a Program to show Function Overloading. 7. Write a Program to create a class and access member function of a class. 8. Write a Program to display elements of an array. 9. Write a Program to calculate Sum and Average of an array.	5	Demo and Practical Session
	10. Write a Program to sort elements of an array using Bubble sort. 11. Write a Program to add and subtract two matrices. 12. Write a Program to calculate square and cube of a number using inline functions.	4	
Unit III	13. Write a Program to create constructor with arguments and pass the arguments to constructor. 14. Write a Program to create object and release them using destructor.	5	Demo and Practical Session
	15. Write a Program to perform addition, subtraction, multiplication of two objects using operator keyword	4	
Unit IV	16. Write a Program to derive single and multiple inheritances. 17. Write a Program to implementation of Virtual Function.	5	Demo and Practical Session
	18. Write a Program to use pointer for both base and derived classes and call the member function. Use virtual keyword.	4	
Unit V	19. Write a Program write text in a file. Read the text from the file from EOF. Display the contents in reverse order.	5	Demo and Practical Session
	20. Write a Program to find the factorial of a number. Throw multiple exceptions and define multiple catch statements to handle exceptions.	4	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Understand and apply object-oriented features.	K2
CLO-2	Analyze how to implement the concept of functions and classes.	K4
CLO-3	Identify the types of constructors.	K3
CLO-4	Determine the use of object oriented features such as inheritance to develop C++ programs for complex problems.	K3
CLO-5	Examine the usage of File concepts in C++ coding.	K4

Mapping of CLOs with PSOs:

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

Mapping of CLOs with POs:

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

Advance application- 3; Intermediate level-2; Basic level-1

DEPARTMENT OF COMPUTER SCIENCE WITH ARTIFICIAL INTELLIGENCE					CLASS: I B.Sc. (CS with AI)			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours/ Week	CIA	Ext .	Total
II	Skilled-II	25U2QSED2	Database Design using MS Access	2	2	25	75	100
Nature of the Course:								
Skill oriented		✓	Employability oriented		✓	Entrepreneurship Oriented		

Objectives:

- To identify and understand the basics of Database Terminology.
- To study about the creation of tables.
- To understand and apply the concepts of keys in a table.
- To understand the concepts of Queries to access the database.
- To study about the usage of operators and expressions used in queries.

Unit	Description	Hrs.	K-Level	CLO
I	An introduction to Database Development: The Database Terminology of Access – Relational Databases – Access Database Objects – A Five-Step Design Method. Getting Started with Access: How to Create a Blank Database – The Access 2019 Interface – The Ribbon – Quick Access Toolbar.	6	K2	CLO 1
II	Creating Access Tables: Table types - Creating a New Table – Changing a Table Design – Understanding Field Properties.	6	K3	CLO 2
III	Keys: Setting the Primary Key – Indexing Access Tables - Printing a Table Design – Saving the completed Table – Manipulating Tables - Adding records to a Database Table. Understanding Table Relationships: Building Bulletproof Databases – Table Relationships	6	K3	CLO 3
IV	Selecting Data with Queries: Introducing Queries – Creating a Query – Working with Query Fields – Adding Criteria to Queries - Displaying the Recordset – Saving a Query – Creating Multi-table Queries - Working with the Table Pane – Creating and Working with Query Joins.	6	K4	CLO 4

V	Using Operators and Expressions in Access: Introducing Operators – Using Operators and Expressions in Queries – Entering Single Value Field Criteria – Using Multiple Criteria in a Query – Entering Criteria in Multiple Fields.	6	K4	CLO 5

Book for study:

1. Michael. R. Groh, “Microsoft Access 2019 Bible”, Wiley Publishing Inc.
Unit-I: 1, 2
Unit-II: 3
Unit-III: 3, 4
Unit-IV - 8
Unit-V - 9

Books for References:

1. Arvin Meyer, Douglas J. Steele, “Access Solutions Tips, Tricks and Secrets from Microsoft Access MVPs”.
2. Jeff Conrad, John L. Viescas, “Microsoft Access 2010 Inside Out”, 1 st edition, The Microsoft Press Store, 2010.
3. Ken Bluttman, Wayne S Freeze, “Access Data Analysis Cookbook”, O’Reilly Media Inc, 2007.

Web Resources:

1. <https://www.pdfdrive.com/download-ms-access-tutorial-pdf-versione33405612.html>
2. <https://www.youtube.com/watch?v=57jBdK3YVJo>
3. https://www.tutorialspoint.com/ms_access/index.htm
4. <https://www.youtube.com/watch?v=1XTXv1V3-ag><https://www.guru99.com/msaccess-tutorial.html>

Rationale for Nature of the Course:

- Helps to track and record data regularly, and then display, export, or print subsets of that data.
- Provides structure for data, such as controlling what types of data can be entered and how data in one table is related to data in other tables.

Activities having direct bearing on Skill development / Employability:

- For building a database without writing code or being a database expert.
- Data Entry Operations
- Knowledge Processing Operations

Pedagogy:

- Chalk and talk, PPT, Assignment, Seminar, Group discussion, Test and Quiz.

Course Designer:

- Ms. S. Rajalakshmi

Course Schedule:

Unit	Topics	Hrs	Mode
Unit I	An introduction to Database Development: The Database Terminology of Access – Relational Databases – Access Database Objects – A Five-Step Design Method.	3	Lecture, Quiz, PPT, Test, Seminar
	Getting Started with Access: How to Create a Blank Database – The Access 2019 Interface – The Ribbon – Quick Access Toolbar.	3	
Unit II	Creating Access Tables: Table types - Creating a New Table.	3	Lecture, Quiz, PPT, Test, Seminar
	Changing a Table Design – Understanding Field Properties.	3	
Unit III	Keys: Setting the Primary Key – Indexing Access Tables - Printing a Table Design – Saving the completed Table – Manipulating Tables - Adding records to a Database Table.	3	Lecture, Quiz, PPT, Test, Seminar
	Understanding Table Relationships: Building Bulletproof Databases – Table Relationships.	3	
Unit IV	Selecting Data with Queries: Introducing Queries – Creating a Query – Working with Query Fields – Adding Criteria to Queries - Displaying the Recordset – Saving a Query.	3	Lecture, Quiz, Group Discussion, Test, Seminar
	Creating Multi-table Queries - Working with the Table Pane – Creating and Working with Query Joins.	3	
Unit V	Using Operators and Expressions in Access: Introducing Operators – Using Operators and Expressions in Queries.	3	Lecture, Quiz, Assignment, Seminar
	Entering Single Value Field Criteria – Using Multiple Criteria in a Query – Entering Criteria in Multiple Fields.	3	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Understand the basics of database concepts.	K2
CLO-2	Determine the significance of Tables.	K3
CLO-3	Identify the importance of usage of keys.	K3
CLO-4	Correlate different types of queries.	K4
CLO-5	Classify various criteria types to access the database.	K4

Mapping of CLOs with PSOs:

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

Mapping of CLOs with POs:

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

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(K3&K3)	1(K3)
3	CLO 3	Up to K3	2	K1 & K2	1	K2	2(K2&K2)	1(K3)
4	CLO 4	Up to K4	2	K1 & K2	1	K2	2(K3&K3)	1(K4)
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	100%

DEPARTMENT OF COMPUTER SCIENCE WITH ARTIFICIAL INTELLIGENCE					CLASS: I B.Sc. (CS with AI)			
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hrs/Week	CIA	Ext.	Total
II	Skilled-III	25U2QSED3	Office Automation	2	2	25	75	100
Nature of the Course:								
Skill oriented		✓	Employability oriented		✓	Entrepreneurship Oriented		

Objectives:

- To create, edit and formatting a text and adding images.
- To impart the knowledge on mail merge and also sharing documents in real time.
- To know the basic concepts of creating data, sorting and generate chart.
- To apply formulas and functions to perform calculations and data analysis.
- To design and deliver effective presentations using PowerPoint.

Unit	Description	Hrs.	K-Level	CLO
I	MS Word: An Overview of the interface features - Creating the Documents setting the printing option - Formatting text, styles and paragraphs. Google Docs: Getting started – Building Documents - adding images & Graphics.	6	K2	CLO 1
II	MS Word: Creating Lists and constructing advanced tables technical requirements – creating Professional documents: Performing mail merge - constructing Forms - customizing page layouts. Google Docs: Tables and charts - Sharing & Collaborating – Managing the Documents.	6	K3	CLO 2
III	MS Excel: Formulating, Manipulating and Presenting Data Visually Technical requirements: Introducing the interface and setting option - Constructing and formatting an excel worksheet - working with worksheets and sheet tabs - sorting and filtering data - setting print options - Creating chart based on worksheet data. Google Sheet: Getting started - Building Spreadsheets -Adding Chart.	6	K3	CLO 3

IV	MS Excel: Applying formulas and functions: Constructing a formula - using the function library - applying name and ranges in a formula - Analyzing and organizing data technical requirements: Creating and managing pivot tables and pivot Charts. Google Sheet: Formulas and Functions - Data Analysis – Data Validation - Sharing & Collaborating – Managing the Documents.	6	K4	CLO 4
V	PowerPoint: The PowerPoint Interface and Presentation Options Technical requirements - Introduction and new features - saving presentations in different forms - setting print options and layouts - using view and Zoom options - Formatting, Tables, Charts and Graphic Element - creating and modifying photo albums - Applying animations and transitions -using hyperlinks, actions and commands.	6	K4	CLO 5

Books for study:

1. Linda Foulkes “Learn Microsoft office 2019” Packet publishing.
Book1:
Unit-I - 1
Unit-II - 3,4
Unit-III - 8
Unit-IV - 9
Unit-V - 6,7
2. Kelvin Wilson Understanding Google Docs The Step-by-step Guide to Understanding the Fundamentals of Google Docs.
Book2:
Unit-1 – 1,2,3
Unit-2 – 4,5,6
3. Kelvin Wilson Understanding Google Sheet The Step-by-step Guide to Understanding the Fundamentals of Google Sheet.
Book3:
Unit-3 - 1,2,4
Unit-4 - 3,5,6,7,8

Books for References:

1. Jennifer Ackerman Kettle, guy Hat-Davis, Curt Simmons, "Microsoft 2003", Tata McGraw Hill.
2. Grija.D, Rashmi M, "Office Automation", Himalaya Publishing House.

Web Resources:

1. <https://www.udemy.com/course/office-automation-certificate-course/>
2. <https://www.javatpoint.com/automation-tools>
3. <https://www.javatpoint.com/microsoft-access>
4. <https://www.geeksforgeeks.org/introduction-to-microsoft-powerpoint/>

Rationale for Nature of the Course:

- By automating routine process like scheduling document management, and data entry, business can boost efficiency reduce human errors, and free up time for more strategic work.
- Automated technology offers many conveniences, including in the workplace.
- It makes sense to adopt computerized tools for efficiency.

Activities having direct bearing on Skill development / Employability:

- To increase efficiency
- Formal Letter Writing
- Resume Writing
- Presentation Design
- Data Processing Operations

Pedagogy:

- Chalk and talk, PPT, Assignment, Seminar, Group discussion, Test and Quiz.

Course Designer:

- Ms. K. Vairameenakshi

Course Schedule:

Unit	Topics	Hrs	Mode
Unit I	MS Word: An Overview of the interface features -Creating the Documents setting the printing option-	3	Lecture, Quiz, PPT, Test, Seminar
	Formatting text, styles, and paragraphs. Google Docs: Getting started – Building Documents - adding images & Graphics.	3	
Unit II	MS Word: Creating Lists and constructing advanced tables technical requirements – creating Professional documents: Performing mail merge - constructing Forms - customizing page layouts.	3	Lecture, Quiz, PPT, Test, Seminar
	Google Docs: Tables and charts - Sharing & Collaborating – Managing the Documents.	3	
Unit III	MS Excel: Formulating, Manipulating and Presenting Data Visually Technical requirements : Introducing the interface and setting option - Constructing and formatting an excel worksheet.	3	Lecture, Quiz, PPT, Test, Seminar
	working with worksheets and sheet tabs-sorting and filtering data-setting print options - Creating chart based on worksheet data. Google Sheet: Getting started-Building Spreadsheets - Adding Chart	3	
Unit IV	MS Excel: Applying formulas and functions: Constructing a formula - using the function library -applying name and ranges in a formula - Analyzing and organizing data technical requirements: Creating and managing pivot tables and pivot Charts-	3	Lecture, Quiz, Group Discussion, Test, Seminar
	Google Sheet: Formulas and Functions - Data Analysis –Data Validation - Sharing & Collaborating – Managing the Documents	3	
Unit V	PowerPoint: The PowerPoint Interface and Presentation Options Technical requirements- Introduction and new features - saving presentations in different forms.	3	Lecture, Quiz, Assignment, Seminar
	setting print options and layouts-using view and Zoom options - Formatting, Tables, Charts and Graphic Element - creating and modifying photo albums - Applying animations and transitions - using hyperlinks, actions and commands.	3	

Course Learning Outcomes:

On the Completion of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Describe about the basic concepts of word and Google Docs.	K2
CLO-2	Construct the tables and implementing mail merge.	K3
CLO-3	Identify the various formatting and sorting a text and adding spread sheet in Google Sheet.	K3
CLO-4	Discover various formulas and managing the pivot table and also analysing, validating and sharing data in google sheet.	K4
CLO-5	Focus on the creating presentation, modifying photo albums and applying animation and hyperlinks.	K4

Mapping of CLOs with PSOs:

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

Mapping of CLOs with POs:

#	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	3	1	1	1	1	1
CLO-2	3	3	3	1	3	3
CLO-3	3	2	2	3	2	2
CLO-4	3	3	3	3	3	3
CLO-5	3	3	3	1	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	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 K3	2	K1 & K2	1	K2	2(K2&K2)	1(K3)
4	CLO 4	Up to K4	2	K1 & K2	1	K2	2(K3&K3)	1(K4)
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, 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	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	100%



The Madura College (Autonomous), Madurai – 625 011
Department of Computer Science with Artificial Intelligence

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	25U1QCCT1	Programming in C	5	5	✓		✓			✓	New Paper
	25U1QCCP1	Programming in C Lab	3	3	✓		✓			✓	New Paper
	25U1QFCT1	Problem Solving Techniques	2	2			✓	✓			New Paper
	25U1QSED1	Fundamentals of Computers	2	2			✓	✓			New Paper
II	25U2QCCT2	Object Oriented Programming with C++	5	5	✓		✓			✓	New Paper
	25U2QCCP2	Object Oriented Programming with C++ Lab	3	3	✓		✓			✓	New Paper
	25U2QSED2	Database Design Using MS Access	2	2	✓		✓		✓		New Paper
	25U2QSED3	Office Automation	2	2	✓		✓		✓		New Paper



DEPARTMENT OF MICROBIOLOGY

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. Microbiology) – Regulation 2023

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

Department of Microbiology
The Madura College
Madurai
B.Sc., Microbiology

Semester	Part	Subject code	Course	Title of the Course	H	C
I	Part I	23U1TLAN1/ 23U1HLAN1/ 23U1SLAN1	Language -I	Tamil / Hindi / Sanskrit	6	3
	Part II	23U1NENG1	Language – II	English	6	3
	Part III	23U1RCCT1	Core Theory I	Fundamentals of Microbiology and Microbial Diversity	5	5
		23U1RCCP1	Core Practical I	Major Practical - I	3	3
		23U1LGET1	Allied Theory -I	Basic and clinical biochemistry	4	4
		23U1LGEP1	Allied Practical – I	Allied Practical - 1	2	1
	Part IV	23U1RSED1	Skill Enhancement Course SEC – I	Social and Preventive Medicine	2	2
		23U1RFCT1	Foundation Course - I	Introduction to Microbial World	2	2
					30	23

Semester	Part	Subject code	Course	Title of the Course	H	C
II	Part I	23U2TLAN2/ 23U2HLAN2/ 23U2SLAN2	Language -I	Tamil / Hindi / Sanskrit	6	3
	Part II	23U2NENG2	Language – II	English	6	3
	Part III	23U2RCCT2	Core Theory – II	Microbial Physiology and Metabolism	5	5
		23U2RCCP2	Core Practical – II	Major Practical - II	3	3
		23U2LGET2	Allied Theory – II	Clinical Laboratory Technology	4	4
		23U2LGEP2	Allied Practical – II	Allied Practical - II	2	1
	Part IV	23U2RSED2	Skill Enhancement Course SEC – II	Nutrition & Health Hygiene	2	2
		23U2RSED3	Skill Enhancement Course -SEC-III	Sericulture	2	2
	Part V	23U2YRC1/NSS/NCC				
					30	23

Department of Microbiology
The Madura College
Madurai
B.Sc., Microbiology

Semester	Part	Subject code	Course	Title of the Course	H	C
III	Part I	23U3TLAN3/ 23U3HLAN3/ 23U3SLAN3	Language -I	Tamil / Hindi / Sanskrit	6	3
	Part II	23U3NENG3	Language – II	English	6	3
	Part III	23U3RCCT3	Core Theory – III	Molecular biology and Microbial genetics	4	4
		23U3RCCP3	Core Practical – III	Major Practical - III	3	3
		23U3CGET1	Allied Theory - III	Bioinstrumentation	4	4
		23U3CGEP1	Allied Practical – III	Allied Practical I	2	1
	Part IV	23U3RSED4	Skill Enhancement Course SEC – IV	Organic farming and biofertilizer technology	2	2
		23U3RSED5	Skill Enhancement Course -SEC-V	Aquaculture	2	2
		23U3EVST1		EVS	1	-
					30	22

Semester	Part	Subject code	Course	Title of the Course	H	C
IV	Part I	23U4TLAN4/ 23U4HLAN4/ 23U4SLAN4	Language -I	Tamil / Hindi / Sanskrit	6	3
	Part II	23U4NENG4	Language – II	English	6	3
	Part III	23U4RCCT4	Core Theory – IV	Immunology and Immuno technology	4	4
		23U4RCCP4	Core Practical – IV	Major Practical - IV	3	3
		23U4CGET2	Allied Theory –IV	Food processing technology	4	4
		23U4CGEP2	Allied Practical IV	Allied Practical III	2	1
	Part IV	23U4RSED6	Skill Enhancement Course SEC – VI	Vaccine technology	2	2
		23U4RSED7	Skill Enhancement Course SEC- VII	Apiculture	2	2
		23U4EVST2		EVS	1	2
	Part V	23U4YRC2/NS S/NCC	YRC/NSS/NCCC		-	1
					30	25

Department of Microbiology
The Madura College
Madurai
B.Sc., Microbiology

Semester	Subject code	Course	Title of the Course	H	C
V	23U5RCCT5	Core Theory - V	Bacteriology and Mycology	5	4
	23U5RCCT6	Core Theory - VI	Virology and Parasitology	5	4
	23U5RCCT7	Core Theory - VII	Recombinant DNA Technology	5	4
	23U5RCCP5	Core Practical- V	Major Practical - V	3	3
	23U5RDET1	Discipline Elective Course - I	Biosafety & Bioethics	5	4
	23U5RIDCT	IDC	Bioeconomics	5	4
	23U5VENT1	Value Education		2	2
	23U5RINTR	Internship/ Industrial visit/ Field visit		-	2
				30	27

Semester	Subject code	Course	Title of the Course	H	C
VI	23U6RCCT8	Core Theory – VIII	Environmental And Agriculture Microbiology	6	4
	23U6RCCT9	Core Theory – IX	Food, Dairy and Probiotic Microbiology	6	4
	23U6RCCT10	Core Theory - X	Pharmaceutical Microbiology	6	4
	23U6RCCP6	Core Practical- VI	Major Practical - VI	3	3
	23U6RDET2	Discipline Elective Course - II	Entrepreneurship And Bio-Business	4	2
	23U6RSED8	Skill Enhancement Course (Professional Competency Skill)	Microbial Quality Control and Testing	2	2
	23U6RPROV	Project and Viva	Project	3	2
				30	21

Add-on and Self-Study Papers for B.Sc., Microbiology

Semester	Subject code	Course	Title of the Course	H	C
III	23U3RADD1	Add-on I	Biostatistics and Bioinformatics	2	2
IV	23U4RSST1	Self- Study	Bioenergy	-	2
V	23U5RADD2	Add-on II	Introduction to Medical Coding	2	2

Allied Microbiology Papers for B.Sc., Biotechnology

Semester	Subject code	Course	Title of the Course	H	C
III	23U3RGET1	Allied Theory -I	Fundamentals of Microbiology	4	4
	23U3RGEP1	Allied Practical I	Allied Practical I	2	1
IV	23U4RGET2	Allied Theory -II	Bioinformatics and Biostatistics	4	4
	23U4RGEP2	Allied Practical II	Allied Practical II	2	1

Credit Distribution for UG MICROBIOLOGY

S.No	Part	Course Details	Credit
1	III	Core(15x4)	60
2		Elective Generic/ Discipline Specific Elective (8x3=24)	24
3	I & II	Language & English (Lang - 4x3=12 Eng - 4x3=12)	24
4	IV	NME(2x2)	4
5		EVS(1x2)	2
6		Value Education(1x2)	2
7		Extension Activity(1x1)	1
8		Ability Enhancement [AECC]- Soft Skill(4x2=8)	8
		Skill Enhancement Course [4 Courses x 2 credits =8 credits]	
		SEC-4 – 1 Credit	9
		Summer internship/ Industrial training (2x1=2 credits)	2
		Foundation course	2
		Professional Competency Skill	2
9.	V	YRC/NSS/NCC	1
			141

Programme	B.Sc. MICROBIOLOGY
Programme code:	23UGMB
Duration:	3 years [UG]
Programme Outcomes	PO1: Disciplinary Knowledge: Acquire detailed knowledge and expertise in all the disciplines of the subject. PO2: Communication skills: Able to communicate scientific information, concepts, experiments and significance. PO3: Ethical value: Apply knowledge on ethical and legal based issues PO4: Analytical reasoning: Familiarize to collect, analyze and interpret scientific data. PO5: Contribution to society: Solve public issues concerned with public health and safety for the welfare of the society.
Programme Specific Outcome	PSO-1: Placement Prepare the students in all disciplines like agriculture, industry-medical, pharma, dairy, hotel, food and food processing, immunologicals, cosmetics, vermitechnology and water treatment for effective and respectful placement. PSO-2: Entrepreneur To create effective entrepreneur by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations.

	PSO-3: Research and Development Design and implement HR systems that comply with good laboratory practices, following ethical values, leading the organization towards growth and development. . PSO-4: Contribution to society To contribute to the development of society and produce microbiological products, by collaborating with stake holders, related to the betterment of environment and mankind at the national and global level. PSO-5: Ethical and Legal issues To identify, understanding and resolve ethical and legal issues related to Microbiology

DEPARTMENT OF MICROBIOLOGY					CLASS: III B.Sc., Microbiology			
Sem	Course type	Course code	Course title	Credits	Contact hours/ Week	CIA	Ext	Total
V	Core Theory - V	23U5RCCT5	BACTERIOLOGY AND MYCOLOGY	4	5	25	75	100
Nature of Course								
Skill Oriented		✓	Employability Oriented		✓	Entrepreneurship Oriented		

Objectives:

- Understand the role of normal flora and pathogenic microbes of various diseases and clinical microbiological techniques.
- Basic knowledge about Gram positive pathogenic bacteria and their epidemiology
- Acquire knowledge about Gram negative pathogenic bacteria and nosocomial infections
- Comprehensive knowledge about medically important, its classification and its significance
- Gain knowledge about the general characteristics and mode of action of various antibacterial agents

Unit	Description	Hours	K-level	CLO
I	History and classification of medically important microbes, Koch's postulates-A brief account on the normal microbial flora of the healthy human body – Host-pathogen interactions: Definitions of infection, invasion, primary and opportunistic pathogens, pathogenicity, virulence, toxigenicity, carriers, endemic, epidemic, pandemic diseases and epidemiology – putative virulence factors of human pathogens –infectious disease cycle. Collection and transport of clinical specimens for bacterial and fungal infections.	15	K2	CLO 1
II	Medically important gram positive infections - causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention and treatment of the following bacterial diseases (a) Streptococcal infections (<i>Streptococcus pyogenes</i> , <i>Streptococcus faecalis</i>), (b) Staphylococcal infections (<i>Staphylococcus aureus</i>), (c) Tetanus (<i>Clostridium tetani</i>) (d) Diphtheria (<i>Corynebacterium diphtheriae</i>) (e) Anthrax (<i>Bacillus anthracis</i>) (f) Tuberculosis (<i>Mycobacterium tuberculosis</i>), (g) Leprosy (<i>Mycobacterium leprae</i>).	15	K3	CLO 2

III	Medically important gram-negative infections - causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention, and treatment of the following bacterial diseases (a) Meningitis (<i>Streptococcus pneumoniae</i> , <i>Neisseria meningitidis</i>) (b) Typhoid (<i>Salmonella typhi</i> , <i>Salmonella paratyphi</i>) (c) Cholera (<i>Vibrio cholerae</i>) (d) Bacillary dysentery (<i>Shigella dysenteriae</i>); Sexually Transmitted disease (Syphilis - <i>Treponema pallidum</i> . Gonorrhoea - <i>Neisseria gonorrhoeae</i>); Nosocomial infections – definition, importance, and their control (<i>Pseudomonas aeruginosa</i>).	15	K3	CLO 3
IV	Medically important fungi - Classification of medically important fungi; Superficial mycoses: <i>Pityriasis versicolor</i> ; <i>Tinea nigra</i> ; Piedra. Cutaneous mycoses: <i>Microsporum</i> spps., <i>Trichophyton</i> spps., and <i>Epidermophyton floccosum</i> . Subcutaneous mycoses: Chromoblastomycosis; Sporotrichosis; Systemic Mycoses - Blastomycosis; Histoplasmosis; Opportunistic Infections -Candidiasis; Cryptococcosis; Zygomycosis; Mycotoxins: Aflatoxin	15	K3	CLO 4
V	Antimicrobial agents -General characteristics and mode of action of Antibacterial agents: Modes of action with an example for each: Inhibitor of nucleic acid synthesis; Inhibitor of cell wall synthesis; Inhibitor of cell membrane function; Inhibitor of protein synthesis; Inhibitor of metabolism Antifungal agents: Mechanism of action of Amphotericin B, Griseofulvin.	15	K4	CLO 5

Books for Study:

1. Greenwood, D., Slack, R.B. and Peutherer, J.F. (2012) Medical Microbiology, 18th Edition. Churchill Livingstone, London.
2. Ananthanarayanan, R. and JayaramPanicker C.K. (2020) Text book of Microbiology. Orient Longman, Hyderabad.
3. JagdishChander (2018). Textbook of Medical Mycology, 4th edition, Jaypee brothers medical publishers.

Books for References:

1. Gerhardt, P., Murray, R.G., Wood, W.A. and Krieg, N.R. (Editions) (1994) Methods for General and Molecular Bacteriology. ASM Press, Washington, DC.
2. Kevin Kavanagh, (2018). Fungi Biology and Applications 3rd Edition. Wiley Blackwell publishers.
3. C.J. Alexopoulos, C.W. Mims, M. Blackwell, (2007). Introductory Mycology, 4th edition. Wiley publishers.

Web Resources

1. <http://textbookofbacteriology.net/nd>
2. <https://microbiologysociety.org/members-outreach-resources/links.html>
3. <http://mycology.cornell.edu/fteach.html>

Rationale for Nature of the course

This course provides detailed insight on general characteristics, lifecycle, ecology of different members of each group of medically significant bacteria and fungi.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Bacteriology and Mycology gives knowledge to the microbiologists to use specimens from humans, animals, and plants to detect and prevent disease. They identify pathogenic microbes that cause disease and distinguish them from normal flora and environmental organisms

Pedagogy

Chalk and talk PPT, Group discussion , Seminar, Quiz

Course Designer(s):

Dr. K.Rajeswari

Lecture Schedule

Unit	Topics	Hrs	Mode
Unit I	History and classification of medically important microbes, Koch's postulates-	3	Chalk and talk PPT
	A brief account on the normal microbial flora of the healthy human body – Host-pathogen interactions:	3	
	Definitions of infection, invasion, primary and opportunistic pathogens, pathogenicity, virulence, toxigenicity, carriers, endemic, epidemic, pandemic diseases	3	
	Epidemiology – putative virulence factors of human pathogens –infectious disease cycle.	3	
	Collection and transport of clinical specimens for bacterial and fungal infections.	3	
Unit II	Medically important gram positive infections - Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention and treatment of the following bacterial diseases (a) Streptococcal infections (<i>Streptococcus pyogenes</i> , <i>Streptococcus faecalis</i>), (b) Staphylococcal infections (<i>Staphylococcus aureus</i>),	4	Chalk and talk PPT
	Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention and treatment of the following bacterial diseases: (c) Tetanus (<i>Clostridium tetani</i>) (d) Diphtheria (<i>Corynebacterium diphtheriae</i>)	4	
	Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention and treatment of the following bacterial diseases: (e) Anthrax (<i>Bacillus anthracis</i>) (f) Tuberculosis (<i>Mycobacterium tuberculosis</i>),	4	
	Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention and treatment of the following bacterial diseases: (g) Leprosy (<i>Mycobacterium leprae</i>).	3	

Unit III	Medically important Gram-Negative infections - Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention, and treatment of the following bacterial diseases (a) Meningitis (<i>Streptococcus pneumoniae</i> , <i>Neisseria meningitidis</i>)	3	Chalk and talk PPT, Group discussion
	Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention, and treatment of the following bacterial diseases (b) typhoid (<i>Salmonella typhi</i> , <i>Salmonella paratyphi</i>)	3	
	Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention, and treatment of the following bacterial diseases (c) Cholera (<i>Vibrio cholerae</i>)	3	
	Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention, and treatment of the following bacterial diseases (d) bacillary dysentery (<i>Shigella dysenteriae</i>); Sexually Transmitted disease (syphilis – <i>Treponema pallidum</i> . Gonorrhoea - <i>Neisseria gonorrhoeae</i>);	3	
	Nosocomial infections – definition, importance, and their control (<i>Pseudomonas aeruginosa</i>).	3	
Unit IV	Medically important Fungi - Classification of medically important fungi; Subcutaneous mycoses: Chromoblastomycosis; Sporotrichosis;	3	Chalk and talk PPT, Group discussion
	Superficial mycoses: <i>Pityriasis versicolor</i> ; <i>Tinea nigra</i> ; Piedra.	3	
	Cutaneous mycoses: <i>Microsporum spp.</i> , <i>Trichophyton spp.</i> , and <i>Epidermophyton floccosum</i> .	3	
	Systemic Mycoses - Blastomycosis; Histoplasmosis;	3	
	Opportunistic Infections -Candidiasis; Cryptococcosis; Zygomycosis; Mycotoxins: Aflatoxin	3	
Unit V	Antimicrobial agents -General characteristics and mode of action of Antibacterial agents:	3	Chalk and talk PPT, Quiz, Seminar
	Modes of action with an example for each: Inhibitor of nucleic acid synthesis;	3	
	Inhibitor of cell wall synthesis; Inhibitor of cell membrane function;	3	
	Inhibitor of protein synthesis;	3	
	Inhibitor of metabolism Antifungal agents: Mechanism of action of Amphotericin B, Griseofulvin.	3	

Course Learning Outcomes:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Understand the importance of normal flora of human body and acquire knowledge on the process of infectious disease.	K2
CLO-2	Explain the various bacterial pathological events during the progression of an infectious disease, and apply the underlying mechanisms of spread of disease and its control.	K3
CLO-3	Compile a list of disease-causing bacteria and compare their modes of infection, symptoms, diagnosis and treatment.	K3
CLO-4	Comprehend human-fungal interaction, which can be applied to obtain in-depth knowledge on fungal diseases and the mechanism behind the disease process.	K3
CLO-5	Explain the types of mycoses caused in humans and categorize the modes of infection, pathogenesis, and treatment with introduction to mycotoxins.	K4

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5
CLO1	2	1	2	2	2
CLO2	1	1	2	3	3
CLO3	1	2	2	2	3
CLO4	1	2	2	2	3
CLO5	1	2	1	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	CLO 1	Up to K-2	2	K1 & K2	1	K2	2 (K2&K2)	1(K2)
2	CLO 2	Up to K-3	2	K1 & K2	1	K2	2 (K3&K3)	1(K3)
3	CLO 3	Up to K-3	2	K1 & K2	1	K3	2 (K3&K3)	1(K3)
4	CLO 4	Up to K-3	2	K1 & K2	1	K3	2 (K3&K3)	1(K3)
5	CLO 5	Up to K-4	2	K1 & K2	1	K4	2 (K2&K2)	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, 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	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 MICROBIOLOGY					CLASS: III B.Sc., Microbiology			
Sem.	Course type	Course code	Course title	Credits	Contact hours/ Week	CIA	Ext	Total
V	Core Theory - VI	23U5RCCT6	VIROLOGY AND PARASITOLOGY	4	5	25	75	100
Nature of Course								
Skill Oriented		✓	Employability Oriented		✓	Entrepreneurship Oriented		

Objectives:

- To gain knowledge on properties and classification of viruses and collection of relevant clinical samples for diagnosing viral infections.
- To understand pathogenic microorganisms of viruses and the mechanisms by which they cause disease in the human body.
- To gain knowledge about reemerging viral infections and develop diagnostic skills, including the use and interpretation of laboratory test in the diagnosis of infectious diseases.
- Understand the types of parasites causing infections in the intestine.
- To develop skills in the diagnosis of parasitic infections.

Unit	Description	Hours	K-level	CLO
I	General Properties, replication and Classification of viruses (Baltimore classification), Cultivation of viruses- in animals, embryonated eggs and tissue culture, Virus purification assays - collection and transport of clinical specimens for viral infections.	15	K2	CLO 1
II	Viral diseases with reference to symptoms, pathogenesis, transmission, prophylaxis and control – Arboviruses (Flavi virus), Picorna viruses (Polio virus and Rhinovirus), Hepatitis viruses (HAV, HBV, HCV, HDV, HEV), Rabies virus, Orthomyoviruses (Influenza virus) and Paramyxoviruses (Mumps and Measles virus), Pox viruses (Variola, Vaccinia), Herpes viruses (Herpes simplex, Varicella zoster), Adeno viruses, Rota viruses and HIV viruses. Oncogenic viruses (Human Papilloma virus): Introduction, characteristics of transformed cells, mechanism of viral oncogenesis and clinical manifestations.	15	K3	CLO 2

III	Emerging and reemerging viral infections (SARS, Swine flu, Ebola, Dengue, Chikungunya- and Corona) – causes, spread and preventive measures. Detection of viruses in clinical specimens – Serological and Molecular diagnosis of virus infections – Antiviral agents, Interferons and Viral Vaccines, Immunization schedules.	15	K3	CLO 3
IV	General introduction to Medical Parasitology, Classification of medically important parasites. Morphology, life cycle, pathogenesis, clinical features, laboratory diagnosis, prevention and treatment of diseases caused by the following organisms: <i>Entameoba histolytica</i> , flagellates (<i>Giardia lamblia</i> , <i>Leishmania donovani</i>), Sporozoa- <i>Plasmodium</i> spp.	15	K3	CLO 4
V	Introduction to Helminthes, Platyhelminthe – <i>Taenia solium</i> ; <i>Fasciola hepatica</i> ; <i>Paragonimus westermani</i> ; <i>Schistosoma haematobium</i> – Nematelminthes – <i>Ascaris lumbricoides</i> <i>Ankylostoma duodenale</i> ; <i>Enterobius vermicularis</i> ; <i>Trichuris trichiura</i> ; <i>Trichinella spiralis</i> ; <i>Wuchereria bancrofti</i> ; <i>Dracanculus medinensis</i> . Collection, transport and examination of specimen Laboratory techniques in parasitology Examination of faeces for ova and cyst by direct wet mount and iodine wet mount, Concentration methods (Floatation and Sedimentation techniques), Examination of blood for parasites. Cultivation of parasites.	15	K4	CLO 5

Books for Study:

1. S., Rajan (2007). Medical microbiology, MJP publisher.
2. Jeyaram Paniker, C.K. (2006). Text Book of Parasitology Jay Pee Brothers, NewDelhi.
3. Arora D.R. and Arora B. (2002). Medical Parasitology, 1st Edition CBS Publishers & Distributors, New Delhi.

Books for References:

1. Jawetz, E., Melnick, J.L. and Adelberg, E.A. (2000). Review of Medical Microbiology, 19thEdition. Lange Medical Publications, U.S.A.

2. Ananthanarayan, R. and Jeyaram Paniker, C.K. (2009). Text Book of Microbiology, 8th Edition. Orient Longman, Chennai.
3. Conrat HF, Kimball PC and Levy JA. (1988). Virology. II edition. Prentice Hall, Englewood Cliff, New Jersey.

Web Resources

1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4047123/>
2. <https://www.ncbi.nlm.nih.gov/pubmed/21722309>
3. <https://www.sciencedirect.com/science/article/pii/S2211753919300193>

Rationale for Nature of the Course

Virology and Parasitology are crucial disciplines in the field of microbiology, focusing on the study of viruses and parasites that cause diseases in humans, animals, and plants. The rapid emergence and re-emergence of viral and parasitic diseases, such as COVID-19, Ebola, and malaria, pose significant threats to global health, economies, and societies.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Students will learn to isolate and characterize organisms using various techniques, such as PCR, ELISA, and electron microscopy. These activities will help students develop essential skills in laboratory research, critical thinking, communication, entrepreneurship, and problem-solving, making them more employable and competitive

Pedagogy

The pedagogical approach for this course will be student-centered, interactive, and inquiry-based. The following teaching-learning methods will be employed like Lectures, Laboratory Sessions and Case Studies and Group Work

Course Designer(s):

Dr. P.N. Rajarajan

Lecture Schedule

Unit	Topics	Hrs	Mode
Unit I	General Properties, replication and Classification of viruses (Baltimore classification),	5	Chalk and talk, PPT
	Cultivation of viruses- in animals, embryonated eggs and tissue culture,	5	
	Virus purification assays - collection and transport of clinical specimens for viral infections.	5	
Unit II	Viral diseases with reference to symptoms, pathogenesis, transmission, prophylaxis and control – Arboviruses (Flavi virus Oncogenic viruses (Human Papilloma virus):	6	Chalk and talk, PPT
	Picorna viruses (Polio virus and Rhinovirusx Orthomyoviruses (Influenza virus) and Paramyxoviruses (Mumps and Measles virus),	3	
	Pox viruses (Variola, Vaccinia), Herpes viruses (Herpes simplex, Varicella zoster), Adeno viruses, Rota viruses and HIV viruses.	3	
	Introduction, characteristics of transformed cells, mechanism of viral oncogenesis and clinical manifestations.	3	
Unit III	Emerging and reemerging viral infections (SARS, Swine flu, Ebola, Dengue, Chikungunya- and Corona) – causes, spread and preventive measures.	5	Chalk and talk, PPT
	Detection of viruses in clinical specimens – Serological and Molecular diagnosis of virus infections –	5	
	Antiviral agents, Interferons and Viral Vaccines, Immunization schedules.	5	
Unit IV	General introduction to Medical Parasitology, Classification of medically important parasites. Morphology, life cycle, pathogenesis, clinical features, laboratory diagnosis, prevention and treatment of diseases causes of: <i>Entameoba histolytica</i> ,	5	Chalk and talk, PPT, Quiz
	Morphology, life cycle, pathogenesis, clinical features, laboratory diagnosis, prevention and treatment of diseases causes of flagellates (<i>Giardia lamblia</i> , <i>Leishmaniadonovani</i>),	5	
	Morphology, life cycle, pathogenesis, clinical features, laboratory diagnosis, prevention and treatment of diseases causes of Sporozoa- <i>Plasmodium</i> spps.	5	

Unit V	Introduction to Helminthes, Platyhelminthe – <i>Taenia solium</i> ; <i>Fasciola hepatica</i> ; <i>Paragonimus westermani</i> ; <i>Schistosoma haematobium</i> –	5	Chalk and talk, PPT, Seminar, Quiz
	Nemathelminthes – <i>Ascaris lumbricoides</i> <i>Ankylostoma duodenale</i> ; <i>Enterobius vermicularis</i> ; <i>Trichuris trichiura</i> ; <i>Trichinella spiralis</i> ; <i>Wuchereria bancrofti</i> ; <i>Dracanculus medinensis</i> .	4	
	Collection, transport and examination of specimen Laboratory techniques in parasitology Examination of faeces for ova and cyst by direct wet mount and iodine wet mount,	3	
	Concentration methods (Floatation and Sedimentation techniques), Examination of blood for parasites. Cultivation of parasites.	3	

Course Learning Outcomes:

CLOs	Course Learning Outcomes	Knowledge Level
CLO–1	Understand the structure and properties of viruses, cultivation methods and diagnosis of viral diseases.	K2
CLO–2	Knowledge of basic and general concepts of causation of disease by the pathogenic microorganisms and various parameters of assessment of their severity and the methods of diagnosis.	K3
CLO–3	Insights to treatment options of viral diseases.	K3
CLO–4	Knowledge about the importance of protozoans in the intestine.	K3
CLO–5	Knowledge of Nematodes as infectious agent	K4

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5
CLO1	2	2	1	1	2
CLO2	1	3	3	2	3
CLO3	2	2	1	2	2
CLO4	2	1	2	2	2
CLO5	2	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	No. of Questions	K- Level		
1	CLO 1	Up to K-2	2	K1 & K2	1	K2	2 (K2&K2)	1(K2)
2	CLO 2	Up to K-3	2	K1 & K2	1	K2	2 (K3&K3)	1(K3)
3	CLO 3	Up to K-3	2	K1 & K2	1	K3	2 (K3&K3)	1(K3)
4	CLO 4	Up to K-3	2	K1 & K2	1	K3	2 (K3&K3)	1(K3)
5	CLO 5	Up to K-4	2	K1 & K2	1	K4	2 (K2&K2)	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, 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	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 MICROBIOLOGY					CLASS: III B.Sc., Microbiology			
Sem	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
V	Core Theory - VII	23U5RCCT7	RECOMBINANT DNA TECHNOLOGY	4	5	25	75	100
Nature of Course								
Skill Oriented		✓	Employability Oriented	✓	Entrepreneurship Oriented			

Objectives:

- Understand the principles of rDNA technology.
- Illustrate the molecular tools employed in gene cloning.
- Discuss the importance of various molecular techniques and their importance in Biotechnology.
- Acquire knowledge about the concepts of tissue culture methods and transgenic organisms.
- Examine recent trends in genetic engineering and its application in human welfare.

Unit	Description	Hours	K-level	CLO
I	Milestones in rDNA Technology Gene Manipulation-Steps involved in Gene Cloning. Isolation of Chromosomal and Plasmid DNA. Restriction endonuclease - Discovery, Types, Mode of action-Application of Ligase ,DNA Polymerase, DNA Modifying enzymes and Topoisomerases .Use of Linkers and Adapters.	15	K2	CLO 1
II	Artificial Gene Transfer methods- Calcium Chloride Induction, Electroporation, Microinjection, Biolistic method, Liposome and Viral-mediated delivery. Cloning vectors –Properties and Applications - Plasmid Based Vectors- Natural Vectors- pSC101 and pMB1.Artificial Vectors- pBR322 and pUC. Phage Based Vectors- Lambda phage. Hybrid Vectors, Phagemid, Cosmid, BAC and YAC. Screening of Recombinants. Genomic DNA and cDNA library-Construction and Screening.	15	K3	CLO 2
III	Molecular Tools- PCR- Types. Gel Electrophoresis- AGE and PAGE Blotting Techniques-Southern, Western &Northern. DNA sequencing methods-Sanger's and Automated method. Recent Trends in Genetic Engineering- Targeted Genome Editing- ZFNs, TALENs, CRISPRs. Gene Targeting-Knock-in &Knock-outs. DNA Finger Printing.	15	K3	CLO 3

IV	Plant Biotechnology – Media, Growth Regulators and Equipment for Plant Tissue Culture-Explant Culture-Micropropagation- Callus and Protoplast Culture-Production of Bio-Active Secondary Metabolites by Plant Tissue Culture - Agrobacterium and Crown Gall Tumors, TiPlasmid and RiPlasmid-Animal Biotechnology-Principles of Animal Cell Culture, Media and Equipment for Animal Cell Culture – Primary and Secondary Cultures- Cell Lines- Types, Establishment and Maintenance of Cell Lines.	15	K3	CLO 4
V	Applications of Genetic Engineering - Transgenic Animals – Mice and Sheep-Recombinant Cytokines and their use in the Treatment of Animal infections- Monoclonal Antibodies in Therapy- Vaccines and their Applications in Animal Infections - Human Gene Therapy-Germline and Somatic Cell Therapy- <i>Ex-vivo</i> Gene Therapy-SCID (Severe Combined Immuno Deficiency) – <i>In-vivo</i> Gene Therapy- CFTR (Cystic Fibrosis Transmembrane Regulator) – Vectors in Gene Therapy-Viral and Non-Viral Vectors. Transgenic Plants– BtCotton, BtCorn, Round Readysoybean, Flavr Savr Tomato and Golden Rice.	15	K4	CLO 5

Books for Study:

1. Brown T.A.(2016). Gene Cloning and DNA Analysis. 7th Edition. John Wiley and Jones, Ltd.
2. Dale J. W., Schantz M.V. and Plant N. (2012). From Gene to Genomes – Concepts and Applications of DNA Technology. 3rd Edition. John Wileys and Sons Ltd.
3. Keya Chaudhuri (2013). Recombinant DNA technology. The Energy and Resources Institute

Books for References:

1. Maloy S. R., Cronan J.E. Jr. and Freifelder D.(2011). Microbial Genetics. 2nd Edition. Narosa Publishing Home Pvt Ltd.
2. Glick B. R. and Patten C.L(2018). Molecular Biotechnology – Principles and Applications of Recombinant DNA. 5th Edition. ASM Press.

3. Synder L., Peters J. E., Henkin T.M. and Champness W. (2013). Molecular Genetics of Bacteria, 4th Edition. ASM Press Washington-D.C. ASM Press.

Web Resources

1. <https://www.britannica.com/recombinant-DNA-technology>
2. <https://www.byjus.com/recombinant-dna-technology>
3. <https://www.le.ac.uk/recombinant-dna-and-genetic-techniques>

Rationale for Nature of the course

The aim of this course is to provide an introduction to recombinant DNA technology. It helps the students to understand the principle of molecular methods in cloning have been used to develop techniques in recombinant DNA technology.

Activities having direct bearing on Skill development / Employability Entrepreneurship

To familiarize the student with the basic concepts in genetic engineering – enzymes, cloning vehicles, gene libraries, analysis and expression of the cloned gene in host cell. At the end of the course the student will have enough background of recombinant DNA technology essential for taking up projects in the field of Biotechnology.

Pedagogy

Chalk and talk, PPT, Group Discussion, Seminar

Course Designer(s):

Mrs. N. Sumathy

Lecture Schedule

Unit	Topics	Hrs	Mode
Unit I	Milestones in rDNA Technology Gene Manipulation-Steps involved in Gene Cloning.	4	Chalk and Talk
	Isolation of Chromosomal and Plasmid DNA.	3	
	Restriction endonuclease - Discovery, Types, Mode of action-	4	
	Application of Ligase ,DNA Polymerase, DNA Modifying enzymes and Topoisomerases .Use of Linkers and Adapters.	4	
Unit II	Artificial Gene Transfer methods- Calcium Chloride Induction, Electroporation, Microinjection, Biolistic method, Liposome and Viral-mediated delivery.	4	Chalk and Talk, PPT
	Cloning vectors –Properties and Applications - Plasmid Based Vectors- Natural Vectors-pSC101 and pMB1.	4	
	Artificial Vectors- pBR322 and pUC.Phage Based Vectors- Lambda phage.	3	
	Hybrid Vectors, Phagemid, Cosmid, BAC and YAC.Screening of Recombinants. Genomic DNA and cDNA library-Construction and Screening.	4	
Unit III	Molecular Tools- PCR- Types. Gel Electrophoresis- AGE and PAGE	4	Chalk and Talk,PPT,Quiz
	Blotting Techniques-Southern, Western &Northern. DNA sequencing methods-Sanger's and Automated method.	4	
	Recent Trends in Genetic Engineering- Targeted Genome Editing- ZFNs,TALENs,CRISPRs.	4	
	Gene Targeting-Knock-in &Knock-outs. DNA Finger Printing.	3	
Unit IV	Plant Biotechnology – Media, Growth Regulators and Equipment for Plant Tissue Culture-Explant Culture-Micropropagation- Callus and Protoplast	4	Chalk and Talk, PPT, Quiz, Seminar
	Culture-Production of Bio-Active Secondary Metabolites by Plant Tissue Culture -Agrobacterium and Crown Gall Tumors,	4	
	TiPlasmid and RiPlasmid-Animal Biotechnology-Principles of Animal Cell Culture,	3	
	Media and Equipment for Animal Cell Culture – Primary and Secondary Cultures- Cell Lines- Types,Establishment and Maintenance of Cell Lines.	4	

Unit V	Applications of Genetic Engineering - Transgenic Animals – Mice and Sheep-Recombinant Cytokines and their use in the Treatment of Animal infections- -	4	Chalk and Talk, PPT, Quiz, Seminar
	Monoclonal Antibodies in Therapy- Vaccines and their Applications in Animal Infections - Human Gene Therapy- Germline and Somatic Cell Therapy	4	
	<i>Ex-vivo</i> Gene Therapy-SCID (Severe Combined Immuno Deficiency) – <i>In-vivo</i> Gene Therapy- CFTR (Cystic Fibrosis Transmembrane Regulator) –	3	
	Vectors in Gene Therapy-Viral and Non-Viral Vectors. Transgenic Plants– BtCotton, BtCorn, Round Readysoybean, FlavrSavr Tomato and GoldenRice.	4	

Course Learning Outcomes:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Illustrate the steps involved in introduction and expression of foreign DNA into bacteria, animal and plants cells and their screening.	K2
CLO-2	Discuss the various cloning vectors and their applications.	K3
CLO-3	Assess the usage and advantages of molecular tools.	K3
CLO-4	Explain plant and animal tissue culture protocols and gene transfer mechanism.	K3
CLO-5	Elucidate and understand the application of genetic engineering and gene therapy.	K4

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5
CLO1	2	2	3	3	2
CLO2	3	2	3	3	2
CLO3	3	2	3	3	3
CLO4	3	2	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	CLO 1	Up to K-2	2	K1 & K2	1	K2	2 (K2&K2)	1(K2)
2	CLO 2	Up to K-3	2	K1 & K2	1	K2	2 (K3&K3)	1(K3)
3	CLO 3	Up to K-3	2	K1 & K2	1	K3	2 (K3&K3)	1(K3)
4	CLO 4	Up to K-3	2	K1 & K2	1	K3	2 (K3&K3)	1(K3)
5	CLO 5	Up to K-4	2	K1 & K2	1	K4	2 (K2&K2)	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, 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	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 MICROBIOLOGY					CLASS: III B.Sc., Microbiology			
Sem	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
V	MAJOR PRACTICAL	23U5RCCP5	MAJOR PRACTICAL V	3	3	25	75	100
Nature of course								
Skill oriented		✓	Employability oriented		Entrepreneurship Oriented			

Objectives:

- To familiarize students with medical microbiology techniques and technical knowledge on collection and processing of clinical samples.
- To learn the techniques for isolation and identification of bacterial pathogens.
- To gain expertise in various techniques of clinically important viral pathogens and their identification.
- To get acquainted with medically important fungi and their metabolism.
- To categorize parasites and understand their role in infections.

Unit	Description	Hours	K-level	CLO
I	Collection and Transport of Clinical specimens Simple, Differential and Special staining of Clinical materials. Culture techniques used to isolate microorganisms.	9	K4	CLO 1
II	Identification of bacterial pathogens by their biochemical reactions. Antimicrobial susceptibility testing by disc-diffusion technique and determination of Minimum Inhibitory Concentration.	9	K4	CLO 2
III	Isolation of Bacteriophages from Sewage and other natural sources. Identification of Viruses in Slides/Smears/Spotters. Demonstration of Negri bodies (Staining). Cultivation of Viruses in Embryonated eggs – Amniotic, Allantoic, Yolk sac routes and Chorio-allantoic membrane.	9	K4	CLO 3
IV	Microscopic identification of medically important Fungi –	9	K4	CLO 4

	KOH and Lactophenol cotton Blue staining. Slide culture techniques for fungal Identification. Identification of Dermatophytes. Germ tube test, Carbohydrate fermentation and assimilation tests for Yeasts.			
V	Direct Examination of Faeces – wet mount and Iodine mount – Demonstration of Protozoan cysts and Helminthes eggs. Concentration techniques of stool specimen – Flootation and Sedimentation methods. Examination of blood for Malarial parasites thin and thick smear preparations. -Identification of Medically important parasites in slides / specimens as spotters.	9	K4	CLO 5

Books for Study:

1. Dubey, R.C. and Maheswari, D.K. (2020). S. Chand Publishers. ISBN-13: 978-8121921534, ISBN-10: 8121921538.
2. K.R. Aneja (2017). Experiments in Microbiology, Plant Pathology, Tissue Culture and Microbial Biotechnology. 5th Edition. New Age International Publishers. ISBN-10: 9386418304, ISBN-13: 978-9386418302.
3. Collee, J.G., Fraser, A.G., Marnion, B.P. and Simmons, A. (1996). Mackie & McCartney Practical Medical Microbiology. 14th Edition. Elsevier. ISBN-10: 813120393X, ISBN-13: 978-8131203934.

Books for References:

1. Patricia M. Tille (2021). Bailey & Scott's Diagnostic Microbiology, 15th Edition. Elsevier. ISBN-10: 0323681050, ISBN-13: 978-0323681056.
2. Monica Cheesbrough (2006). District Laboratory Practice in Tropical Countries. Part 1. 2nd Edition. Cambridge University Press. ISBN-10: 0521171571, ISBN-13: 978-0521171571.
3. Michael A. Pfaller (ed.) (2015). Manual of Clinical Microbiology. Vol. 1 and 2. 11th Edition. ASM Press. ISBN-10: 9781555817374, ISBN-13: 978-1555817374.

Web Resources

1. <https://www.microcarelab.in/media/microcarelab.in/files/Sample-Collection-Manual.pdf>
2. http://ssu.ac.ir/cms/fileadmin/user_upload/Daneshkadaha/pezeshki/microb/file_amuzeshi/Lab_QA_Microbiology_QA.pdf
3. https://www.academia.edu/11977315/Basic_Laboratory_Procedures_in_Clinical_Bacteriology
4. <https://cmr.asm.org/content/31/3/e00062-17.full.pdf>
5. <https://microbiologyinfo.com/techniques-of-virus-cultivation/>

Rationale for Nature of the course

Medical Microbiology Laboratory is a crucial course that provides students with hands-on experience in the diagnosis, prevention, and control of infectious diseases. The course is designed to equip students with the essential skills and knowledge required to work in a medical microbiology laboratory setting.

Activities having direct bearing on Skill development / Employability Entrepreneurship

The Students will learn to isolate and identify microorganisms from clinical specimens using various laboratory techniques.

Pedagogy

The Medical Microbiology Lab is designed to provide students with a comprehensive understanding of microbiological principles and techniques. The pedagogical approach emphasizes hands-on learning, critical thinking, and problem-solving.

Course Designer(s):

Dr. K. Rajeswari

Course Learning Outcomes:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Demonstrate methods to observe and measure microorganisms by standard microbiological techniques	K4
CLO-2	Identify pathogenic microorganisms in the laboratory set-up and interpret their sensitivity towards commonly administered antibiotics.	K4
CLO-3	Understand experimental tools used to cultivate and characterize clinically important viruses and bacteriophages	K4
CLO-4	Elucidate clinically important fungi.	K4
CLO-5	Investigate Parasites of medical importance and identify them from clinical specimens.	K4

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

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

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

Assessment Scheme Components of CIA

COMPONENT	WEIGHT /MARK
Continuous Internal Assessment Test Attendance and Class Participation	25
End Semester Examination	75
Total	100

DEPARTMENT OF MICROBIOLOGY					CLASS: III B.Sc., Microbiology			
Sem.	Course type	Course code	Course title	Credits	Contact hours/week	CIA	Ext	Total
V	CORE ELECTIVE I	23U5RDET1	BIOSAFETY & BIOETHICS	4	5	25	75	100
Nature of course								
Skill oriented		✓	Employability oriented		Entrepreneurship Oriented			

Objectives:

- To create research environment-encourage investigation, analysis and studying the bioethical principles, values, concepts, and social and juridical implications contained in the Universal
- Declaration on Bioethics and Human Rights in order to assist their application and promotion in the areas of science, biotechnology and medicine.
- To discuss about various aspects of biosafety regulations, IPR and bioethics concerns arising from the commercialization of biotech products.
- To introduce fundamental aspects of Intellectual property Rights to students who are going to Play a major role in development and management of innovative projects in industries.
- To understand the importance of IPR, Patents and Patent laws.

Unit	Description	Hours	K-level	CLO
I	Basics of Biosafety - Laboratory Hazards and Hazard symbols. Definitions on Biohazard, Biosafety and Biosecurity- Biohazard- LAI, BP. Biohazard Classification. Biological Risk Groups. Need and application of biosafety. Good Laboratory Practices (GLP), Good Manufacturing Practices (GMP).	15	K2	CLO 1
II	Hazardous materials in Biotechnology - Categories of Waste in the Biotechnology Laboratories, Biohazardous was teand their disposal and treatments-issues in use of GMO's risk for animal/human/agriculture and environment owing to GMO. Hazardous materials, Emergency response/ first aids in Laboratories.	15	K3	CLO 2

III	Biological Safety Containment in Laboratory - Primary and secondary containments - Physical and biological containment. Types of biosafety containments (level I,II,III),PPE, Biosafety guidelines in India-Roles of Institutional Biosafety Committee, RCGM, GEAC.	15	K3	CLO 3
IV	Introduction and need of Bioethics - its relationship with other branches, Ethical implications of biotechnological products and techniques. Ethical Issues involving human cloning, human genome project, prenatal diagnosis, agriculture and animal rights, Social and ethical implications of biological weapons.	15	K4	CLO 4
V	IPR, Patents and Patent laws - Intellectual property rights-TRIP-GATT International conventions patents, Methods of application of patents, Legal implications. Biodiversity and farmer rights, Objectives of the patent system, Basic principles and general requirements of patent law, Biotechnological inventions, and patent law. Legal development-Patentable subjects and protection in biotechnology. The patenting of living organisms.	15	K4	CLO 5

Books for Study:

1. Usharani .B, S Anbazhagi, C K Vidya, (2019). Biosafety in Microbiological Laboratories- 1st Edition, Notion Press, ISBN-101645878856
2. Satheesh.M.K.,(2009).BioethicsandBiosafety-1stEdition,J.KInternationalPublishing House Pvt. Ltd: Delhi,ISBN :9788190675703
3. DeepaGoel and ShominiParashar, (2013). IPR, Biosaftey and Bioethics- 1st Edition, Pearson education: Chennai, ISBN-13: 978-8131774700

Books for References:

1. Nithyananda,KV.(2019).IntellectualPropertyRights:ProtectionandManagement,India,IN: Cengage Learning India Private Limited, ISBN-10: 9386668572
2. Neeraj,P.,&Khusdeep,D.(2014).IntellectualPropertyRights,India,IN:PHIlearningPrivate Limited,ISBN:9788120349896
3. Ahuja,VK.(2017).LawrelatingtoIntellectualPropertyRights,India,IN:LexisNexis,ISBN- 10: 8131251659.

Web Resources

1. <http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf>.
2. http://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf.
3. <https://www..niehs.nih.gov/bioethics>
4. <https://www.sist.sathyabama.ac.in>
5. <https://www.longdom.org/bioethics-and-biosafety>

Rationale for Nature of the course:

This course helps the student to understand the risk involved in biological research and how to mitigate it.

Activities having direct bearing on Skill development/Employability/Entrepreneurship

Discussion on issues related patent and Ethical Issues involving human cloning

Pedagogy

Chalk and talk, PPT, Seminar, Quiz

Course Designer:

Dr. A.P. ASHA KANNAN

Lecture Schedule

Unit	Topics	Hrs	Mode
Unit I	Basics of Biosafety - Laboratory Hazards and Hazard symbols. Definitions on Biohazard, Biosafety and Biosecurity	6	Chalk and talk, PPT, Quiz
	Biohazard- LAI, BP. Biohazard Classification. Biological Risk Groups. Need and application of biosafety.	6	
	Good Laboratory Practices (GLP), Good Manufacturing Practices (GMP).	3	
Unit II	Hazardous materials in Biotechnology - Categories of Waste in the Biotechnology Laboratories	4	Chalk and talk, PPT, Quiz
	Biohazardous waste and their disposal and treatments	4	
	Issues in use of GMO's, risk for animal/human/ agriculture and environment owing to GMO	4	
	Hazardous materials, Emergency response/ first aids in Laboratories.	3	
Unit III	Biological Safety Containment in Laboratory - Primary and secondary containments - Physical and biological containment.	5	Chalk and talk, PPT, Quiz
	Types of biosafety containments (level I, II, III), PPE	5	
	Biosafety guidelines in India-Roles of Institutional Biosafety Committee, RCGM, GEAC.	5	
Unit IV	Introduction and need of Bioethics - its relationship with other branches,	4	Chalk and talk, PPT, Quiz
	Ethical implications of biotechnological products and techniques.	4	
	Ethical Issues involving human cloning, human genome project, prenatal diagnosis, agriculture and animal rights	4	
	Social and ethical implications of biological weapons.	3	
Unit V	IPR, Patents and Patent laws - Intellectual property rights-TRIP- GATT International conventions patents	5	Chalk and talk, PPT, Seminar, Quiz
	Methods of application of patents, Legal implications.	2	
	Biodiversity and farmer rights, Objectives of the patent system, Basic principles and general requirements of patent law, Biotechnological inventions, and patent law.	5	
	Legal development-Patentable subjects and protection in biotechnology. The patenting of living organisms.	3	

Course Learning Outcomes:

On completion of this course, students will;

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Understand the control measures of laboratory hazards (chemical, Biological and physical) and to practice safety strategies and personal protective equipment	K2
CLO-2	Develop strategies for the use of genetically modified organisms and Hazardous materials	K3
CLO-3	Develop skills of critical ethical analysis of contemporary moral Problems in medicine and healthcare.	K3
CLO-4	Analyze and respond to the comments of other students regarding Philosophical issues.	K4
CLO-5	Pave the way for the students to catchup Intellectual Property (IP) as a career option a. R&D IP Counsel b. Government Jobs – Patent Examiner Private Jobs. Patent agent and Trade mark agent Entrepreneur	K4

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

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

Advance application-3;

Intermediate level-2;

Basic level-1

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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 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 (K2&K3)	1(K3)
4	CLO 4	Up to K4	2	K1& K2	1	K2	2 (K4&K4)	1(K4)
5	CLO 5	Up to K4	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	15.8	16%
K2	5	6	15	10	36	30	30%
K3	-	-	20	30	50	41.7	42%
K4	-	-	5	10	15	12.5	12%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF MICROBIOLOGY					CLASS: III B.Sc., Microbiology			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
V	MAJOR INTER DISCIPLINARY	23U5RIDT1	BIO ECONOMICS	4	5	25	75	100
Nature of Course								
Skill Oriented		✓	Employability Oriented		✓	Entrepreneurship Oriented		

Objectives:

- To introduce the basic concepts of bioeconomics
- To give a broad perception of biobased resources and value chains
- To equip with the distinguishing features among bioenergy and marine bioeconomy
- To understand the recent advancements in Banking
- To know the budgetary procedure and the Union Government

Unit	Description	Hours	K-level	CLO
I	Introduction to Bioeconomics Bioeconomics: Definition and Concept - Evolution and Development of Economics and Biology- Role of ecological economics- Indian bioeconomy status and initiatives- CRISPR and synthetic biology impacts- Pros and cons: GM foods	15	K2	CLO 1
II	Biobased Resources Classification of agricultural products - Types: Crops, forestry products, agricultural residues, and waste. Marine resources - Types: Algae, seaweed, fishery by-products, and other marine biomass. Circular economy models- Biobased chain model, biological resource recovery model and circular bioenergy system. Methods of biomass conversion-mechanical and chemical – biotechnological approaches-Life cycle assessment of biobased products.	15	K2	CLO 2
III	Bioenergy and Marine Bioeconomy Economics of bioenergy – Agricultural, Algal bioenergy- Economic feasibility of agricultural biomass- Supply chain economics, Commercial viability of algal cultivation- Market potential and challenges. Marine bioeconomics – Conservation Economics of coral reefs, marine turtle, sea weed - Sustainable fishing policies- Impact of climate change on marine stocks	15	K2	CLO 3

IV	Unit IV: Money and Banking Fundamentals of Money and Sustainable Finance - Evolution and Functions of Money- Environmental cost of physical currency - Digital transformation and ecological impact - Green currency initiatives Sustainable Banking Principles-Functions of Commercial Banks, Reserve Bank of India/Central Bank – Recent Advancements in Banking Sector: E-Banking, RTGS and NEFT, BHIM, GPay, Phone Pay, Paytm, Debit and Credit Card - Role of Banks in promoting Science – Green banking initiatives- Environmental risk assessment.	15	K2	CLO 4
V	Unit: V Budgetary Procedure Budget Fundamentals -Meaning and Importance of Budgets- Budgetary Principles-Traditional budgetary principles- Incorporating environmental considerations-Budgetary Procedure-Budget Preparation-Estimating revenue and expenditure-Incorporating green budgeting practices for sustainable development. Assessing environmental impact- Inclusion of sustainability goals in budgets Carbon pricing & green finance initiatives	15	K2	CLO 5

Books for Study:

1. Sundar, Principles of bioeconomics, (2017). Vedams Books pvt limited, New Delhi
2. Iris Lewandowski, Bioeconomy shaping the transition to a sustainable , biobased economy, (2018). Springer
3. Koslowki Peter . Sociobiology and bioeconomics. (1999). Springer.
4. Mithani, D. M, Money, Banking, International Trade and Public Finance, ., (2020). HimalayaPublishing House, Mumbai.
5. Samkaran, S. Fiscal Economics, . (2020). Margham Publications, Chennai.

Books for References:

1. Arrow, K., Bolin, B., Costanza, R., Dasgupta, P., Folke, C., Holling, C.S., Jansson, B.O.,
2. Levin, S., Maler, K.G., Perrings, C., Pimentel, D. (1995). Economic growth, carrying capacity, and the environment. Ecological Economics 15: 91-95.
3. Perman, R. (2003). Natural Resource and Environmental Economics. Pearson Education.
4. Singh, K. & Shishodia, A. (2007). Environmental Economics: Theory and Applications.Sage Publications.

Web Resources

1. <https://www.youtube.com/watch?v=2xvXkOMRTs4>
2. <https://www.youtube.com/watch?v=gqjmdWHzlhk>
3. <https://www.youtube.com/watch?v=1yjsx9wHmiTY>
4. https://www.youtube.com/watch?v=bYD_VpCDdbE
5. https://my.uopeople.edu/pluginfile.php/57436/mod_book/chapter/37370/book.wrightmoneybanking.optimized.complete.pdf

Rationale for Nature of the course

Understanding of the basic knowledge of bioeconomics to students so that they can explore entrepreneurship opportunities in the bio-based industry. This course also serves interdisciplinary innovation in terms of sustainable bioeconomy

Activities having direct bearing on Skill development / Employability Entrepreneurship

Students will be able to understand basic concept of Bioeconomics, challenges, opportunities and regulations. Students will be able to understand advancements in banking and the budgetary procedure in India

Pedagogy

Chalk and talk, PPT, Group discussion, Seminar, Screening of educational videos and quiz

Course Designer(s):

1. **Department of Microbiology**
2. **Department of Economics**

Lecture Schedule

Unit	Topics	Hrs	Mode
Unit I	Bioeconomics: Definition and Concept- Evolution and Development of Economics and Biology-Role of ecological economics	8	Chalk and Talk & PPT
	Indian bioeconomy status and initiatives- CRISPR and synthetic biology impacts- Pros and cons: GM foods	7	
Unit II	Classification of agricultural - Types: Crops, forestry products, agricultural residues, and waste. Marine resources - Types: Algae, seaweed, fishery by-products, and other marine biomass.	8	Chalk and Talk & PPT
	Circular economy models- methods of biomass conversion- mechanical and chemical – Biotechnological Approaches- Life cycle assessment of biobased products	7	
Unit III	Economics of bioenergy - Agricultural bioenergy- Economic feasibility of agricultural biomass- Supply chain economics, Algal bioenergy- Commercial viability of algal cultivation- Market potential and challenges.	8	Chalk and Talk & PPT
	Marine bioeconomics –Conservation Economics of coral reefs, marine turtle, sea weed - Sustainable fishing policies- Impact of climate change on marine stocks	7	
Unit IV	Fundamentals of Money and Sustainable Finance - Evolution and Functions of Money- Traditional functions (Medium of exchange, Store of value, Unit of account)- Environmental cost of physical currency - Digital transformation and ecological impact - Green currency initiatives.	8	Chalk and Talk & PPT
	Sustainable Banking Principles-Functions of Commercial Banks – Functions of Reserve Bank of India/Central Bank – Recent Advancements in Banking Sector: E-Banking, RTGS and NEFT, BHIM, GPay, Phone Pay, Paytm, Debit and Credit Card - Role of Banks in promoting Science – Green banking initiatives- Environmental risk assessment	7	
Unit V	Budget Fundamentals -Meaning and Importance of Budgets- Budgetary Principles-Traditional budgetary principles- Incorporating environmental considerations-Budgetary Procedure-Budget Preparation-Estimating revenue and expenditure-Incorporating green budgeting practices	8	Chalk and Talk & PPT
	Assessing environmental impact-Green budgeting for sustainable development Inclusion of sustainability goals in budgets Carbon pricing & green finance initiatives	7	

Course Learning Outcomes:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Explain the basic concepts of bioeconomics, challenges, opportunities& regulations	K2
CLO-2	Discuss a broad perception of biobased resources, value chain, innovative use of biomass and biological knowledge to provide food, feed and industrial products	K2
CLO-3	Acquaint the distinguishing features among marine bioeconomy	K2
CLO-4	Able to understand the advancements in banking	K2
CLO-5	Capacity to know the budgetary procedure in India	K2

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5
CLO1	-	2	2	2	-
CLO2	2	2	2	3	2
CLO3	2	2	2	2	3
CLO4	3	2	-	2	2
CLO5	3	3	3	3	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 & K2	1	K1	2 (K1&K2)	1(K1)
2	CLO 2	Up to K-2	2	K1 & K2	1	K1	2 (K1&K2)	1(K1)
3	CLO 3	Up to K-2	2	K1 & K2	1	K2	2 (K1&K2)	1(K2)
4	CLO 4	Up to K-2	2	K1 & K2	1	K2	2 (K1&K2)	1(K2)
5	CLO 5	Up to K-2	2	K1 & K2	1	K2	2 (K1&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	Consolidated
K1	10	2	5	2	59	49.1	100%
K2	-	3	5	3	61	50.9	
Total Marks	10	5	50	50	120	100.00	100%

DEPARTMENT OF MICROBIOLOGY				Class: III B.Sc Microbiology				
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
V	Industrial Visit	23U5RINTR	Industrial Visit	2				
Nature of Course								
Skill oriented		✓	Entrepreneurship oriented		✓	Employability oriented		✓

Objectives:

- To develop problem-solving and critical thinking skills
- To foster relationships between academia and industry.
- To understand industrial applications of microbiology
- To learn about quality control and assurance
- To enhance career awareness and opportunities

During the duration of the programme, students shall be taken to Industrial visit. This programme includes preparation and submission of work diary and report of visit along with certificates (if any).

Course Learning Outcomes.

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

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	develop critical thinking and develop problem-solving skills by observing and analysing industrial processes and challenges.	Upto K3
CLO2	explore to various industrial processes, equipments, and technologies used in microbiology-based industries.	Upto K3
CLO3	familiarize with industries that utilize microbiological principles.	Upto K4
CLO4	understand how microbiological principles are applied to ensure product safety and quality.	Upto K4
CLO5	enhance with insights into career opportunities in microbiology-based industries.	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	2	1	3	3	3
CLO-3	3	3	2	2	3
CLO-4	3	2	3	3	3
CLO-5	2	3	3	1	3

Mapping of CLOs with POs

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

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

Valuation Schema for Industrial Visit

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 MICROBIOLOGY					Class: III B.Sc Microbiology			
Sem.	Course type	Course code	Course title	Credits	Contact hours/week	CIA	Ext	Total
VI	CORE THEORY–VIII	23U6RCCT8	ENVIRONMENTAL AND AGRICULTURE MICROBIOLOGY	4	6	25	75	100
Nature of Course								
Skill Oriented		✓	Employability Oriented	✓	Entrepreneurship Oriented		✓	

Objectives:

- To discuss the distribution and association of microorganism in various ecosystems and to know about the role of microorganism in water pollution and water quality.
- To acquire knowledge about the role of microorganism in water pollution and water quality
- Gain knowledge about microbes as biofertilizers and the aspects of application.
- To learn about the process of solid waste management and sewage water treatment.
- Gain knowledge on various plant diseases and pathogens

Unit	Description	Hours	K-level	CLO
I	Microorganisms and their Habitats: Structure and function of ecosystems. Terrestrial Environment: Soil profile and soil microflora, Microbial succession in decomposition of soil organic matter. Role of microorganisms in elemental cycles in nature: Carbon, Nitrogen. Aquatic Environment: Microflora of fresh water and marine habitats, factors influencing microbial growth in the aquatic environments. Atmosphere: Aeromicroflora and dispersal of microbes, Assessment of air quality, Enumeration of microorganism in air, Air sanitation. Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels. Predisposing factors for Environmental diseases – infectious (water and air borne) and pollution related, spread and control of these diseases. Environmental Protection Agency (EPA) - role in environmental protection.	18	K2	CLO 1

II	Water potability: Sources and types of water surface, ground, stored, distilled, mineral and de-mineralized water and their pollution, biological indicators of water Pollution, Eutrophication. Conventional Bacteriological standards of Water Quality, MPN index, coliform test, Membrane filtration. BOD, COD. Advanced molecular methods for water analysis. Water borne diseases. Central Pollution Control Board (CPCB) standards.	18	K3	CLO 2
III	Microbial Interactions: Rhizosphere microflora. Concepts of Nitrogen fixation – Symbiotic and asymbiotic nitrogen fixers. Brief account of microbial interactions: Symbiosis, neutralism, commensalism, competition, Ammensalism, Synergism, parasitism, and predation. General account and Significance of Biofertilizers and biocontrol agents– Bacterial, cyanobacterial, VAM. Mass production of Rhizobial biofertilizer. Biocontrol agents – Bacterial, viral, fungal.	18	K3	CLO 3
IV	Waste treatment and bioremediation: Solid waste management: Sources and types of solid waste, composting, vermin composting, production of biogas. Liquid waste management: Primary, secondary, and tertiary sewage treatment. Bioremediation and waste management: Need and scope of bioremediation. Degradation of hydrocarbons, oil spills, heavy metals – Chromium, lead, and xenobiotics – PCB.	18	K4	CLO 4
V	Plant pathology: Mode of entry of pathogens, Microbial enzymes, toxins, growth regulators and suppressor of plant defense in plant diseases. Plant defense mechanisms. Bacterial diseases – Citrus canker, Blight of paddy. Viral disease – TMV, CMV. Fungal disease- red rot of sugarcane, Tikka disease. Plant disease management.	18	K4	CLO 5

Books for Study:

1. Joseph C. Daniel. (2006). Environmental aspects of Microbiology 2nd Edition. BrightSun Publications.
2. Pradipta. K.M. (2008). Textbook of Environmental Microbiology. I.K. Publishing. House.
3. Ramanathan, and Muthukaruppan SM. (2005). Environmental Microbiology. OmSakthiPathipagam, Annamalai Nagar.
4. K. Vijaya Ramesh. (2004). Environmental Microbiology. 1st Edition. MJP Publishers.
5. SubbaRao. N.S. (2017). Soil Microbiology. 4th Edition. Oxford and IBH Publishing Pvt. Ltd.

Books for References:

1. Dirk, J. Elsas, V., Trevors, J.T., Wellington, E.M.H. (1997). Modern Soil Microbiology, Marcel Dekker INC, New York, Hong Kong.
2. EcEldowney S, Hardman D.J., Waite D.J., Waite S. (1993). Pollution: Ecology and Biotreatment – Longman Scientific Technical.
3. Mitchel, R. (1992). Environmental Microbiology. Wiley – John Wiley and Sons. Inc. Publications, New York.
4. Clescri, L.S., Greenberg, A.E. and Eaton, A.D. (1998). Standard Methods for Examination of Water and Wastewater, 20th Edition. American Public Health Association.
5. Atlas, R.M. and Bartha, R. (1992). Microbial Ecology: Fundamentals and Applications, 2nd Edition. The Benjamin / Cummings Publishing Co., Redwood City, CA.

Web Resources

1. <https://nptel.ac.in/courses/126105016>
2. <https://www.classcentral.com/course/swayam-plant-pathology-and-soil-health-14236>
3. <https://www.wasteonline.org.uk/resources/InformationSheets/WasteDisposal.htm>
4. https://plantpath.cornell.edu/labs/enelson/PDFs/Hill_et_al_2000.pdf
5. <https://onlinelibrary.wiley.com/doi/full/10.1111/j.1365-2389.2005.00781.x>

Rationale for Nature of the course

The course Environment and Agriculture Microbiology is designed to equip students with the knowledge and skills in the fields of aeromicrobiology, water microbiology and waste water treatment.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Case study and Mini-project

Pedagogy

Lecture, Chalk and Talk, PowerPoint presentation.

Course Designer(s):

Dr. P. Sasikumar

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Microorganisms and their Habitats: Structure and function of ecosystems. Terrestrial Environment: Soil profile and soil microflora, Microbial succession in decomposition of soil organic matter. Role of microorganisms in elemental cycles in nature: Carbon, Nitrogen.	3	Lecture, Chalk and Talk, PPT, Group Discussion, Quiz, Seminar
	Aquatic Environment: Microflora of fresh water and marine habitats, factors influencing microbial growth in the aquatic environments.	3	
	Atmosphere: Aeromicroflora and dispersal of microbes, Assessment of air quality, Enumeration of microorganism in air, Air sanitation.	4	
	Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels.	4	
	Predisposing factors for Environmental diseases – infectious (water and air borne) and pollution related, spread and control of these diseases. Environmental Protection Agency (EPA) - role in environmental protection.	4	
Unit II	Water potability: Sources and types of water surface, ground, stored, distilled, mineral and de-mineralized water and their pollution, biological indicators of water Pollution, Eutrophication.	3	Lecture, Chalk and Talk, PPT, Group Discussion
	Conventional Bacteriological standards of Water Quality, MPN index, coliform test, Membrane filtration	3	
	BOD, COD.	4	
	Advanced molecular methods for water analysis.	4	
	Water borne diseases. Central Pollution Control Board (CPCB) standards.	4	

Unit III	Microbial Interactions: Rhizosphere microflora.	3	Lecture, Chalk and Talk, PPT, Group Discussion, Quiz, Seminar
	Concepts of Nitrogen fixation – Symbiotic and asymbiotic nitrogen fixers.	3	
	Brief account of microbial interactions: Symbiosis, neutralism, commensalism, competition, Ammensalism, Synergism, parasitism, and predation.	4	
	General account and Significance of Biofertilizers and biocontrol agents –Bacterial, cyanobacterial, VAM. Mass production of Rhizobial biofertilizer.	4	
	Biocontrol agents – Bacterial, viral, fungal.	4	
Unit IV	Waste treatment and bioremediation: Solid waste management:	3	Lecture, Chalk and Talk, PPT, Group Discussion, Quiz, Seminar
	Sources and types of solid waste, composting, vermin composting, production of biogas.	3	
	Liquid waste management: Primary, secondary, and tertiary sewage treatment.	4	
	Bioremediation and waste management: Need and scope of bioremediation.	4	
	Degradation of hydrocarbons, oil spills, heavy metals – Chromium, lead, and xenobiotics – PCB.	4	
Unit V	Plant pathology: Mode of entry of pathogens, Microbial enzymes, toxins, growth regulators and suppressor of plant defense in plant diseases.	3	Lecture, Chalk and Talk, Interaction, PPT, Assignment, Group Discussion
	Plant defense mechanisms.	3	
	Bacterial diseases – Citrus canker, Blight of paddy.	4	
	Viral disease – TMV, CMV.	4	
	Fungal disease- red rot of sugarcane, Tikka disease. Plant disease management.	4	

Course Learning Outcomes:

On completion of this course the students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Describe about the structure and function of ecosystems and understand the role of microbes in various environments	K2
CLO-2	Identify the cause of water pollution, and perform methods to assess the quality of water.	K3
CLO-3	Explain the production of biofertilizers and biopesticides.	K3
CLO-4	Explain about waste treatment process and microbial decomposition and bio-remediation process.	K4
CLO-5	Describe about plant diseases caused by microbes and acquire a clear idea on plant pathogenic interaction	K4

Mapping of CLOs with PSOs

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

Mapping of CLOs with PO

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

Advance application– 3;

Intermediate level–2;

Basic level–1

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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 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 (K2&K3)	1(K3)
4	CLO 4	Up to K4	2	K1& K2	1	K2	2 (K4&K4)	1(K4)
5	CLO 5	Up to K4	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	15.8	16%
K2	5	6	15	10	36	30	30%
K3	-	-	20	30	50	41.7	42%
K4	-	-	5	10	15	12.5	12%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF MICROBIOLOGY					Class: III B.Sc Microbiology			
Sem.	Course type	Course code	Course title	Credits	Contact hours/week	CIA	Ext	Total
VI	CORE THEORY–IX	23U6RCCT9	FOOD, DAIRY AND PROBIOTIC MICROBIOLOGY	4	6	25	75	100
Nature of Course								
Skill Oriented		✓	Employability Oriented	✓	Entrepreneurship Oriented		✓	

Objectives:

- To impart current knowledge of basic and applied microbiological aspects of fluid milks and dairy products for improved quality and food safety.
- Gives an insight into various types of food borne diseases and their prevention
- To gain information about microflora of milk
- To study about the production of fermented dairy products
- To impart current knowledge of probiotics, prebiotics and functional dairy foods for the health benefits.
- To create a sustainable environmentally and technologically advanced dairy farm

Unit	Description	Hours	K-level	CLO
I	Food as a substrate for microorganisms-. Microorganisms important in food microbiology; Molds, yeasts and bacteria - General Characteristics -Classification and importance. Principles of food preservation - Asepsis - Removal of microorganisms, - High temperature - Low temperature - Drying - Food additives. Nanoscience in food preservation; microencapsulation.	18	K2	CLO1
II	Contamination and spoilage of food products -Food borne infections (Bacillus cereus, Salmonellosis, Shigellosis, <i>Listeria monocytogenes</i> and <i>Campylobacter jejuni</i>) and intoxications – (<i>Staphylococcus aureus</i> , <i>Clostridium botulinum</i> , <i>Clostridium perfringens</i> and mycotoxins) Food borne disease outbreaks - newly emerging pathogens. Conventional and Novel technology in control of food borne pathogens and preventive measures - Food sanitation - plant sanitation - Employees’ health standards. Regulatory Agencies & criteria for food safety.	18	K3	CLO2

III	Microflora of raw milk - sources of contamination. Spoilage and preservation of milk and milk products. -antimicrobial systems in raw milk. Importance of biofilms, their role in transmission of pathogens in dairy products and preventive strategies.	18	K3	CLO3
IV	Food fermentations: Indian Pickles Bread, vinegar, fermented vegetables (sauerkraut), fermented dairy products (yoghurt, cheese, Acidophilus Milk, Kefir, Koumiss). Oriental fermented foods-Miso –Tempeh Ontjom Natto, Idli Spoilage and defects of fermented dairy products -. Functional fermented foods and nutraceuticals, bioactive proteins and bioactive peptides, genetically modified foods.	18	K4	CLO4
V	Probiotic microorganisms, concept, definition safety of probiotic microorganisms, legal status of probiotics Characteristics of Probiotics for selection: stability maintenance of probiotic microorganisms. Role of probiotics in health and disease: Mechanism of probiotics. Application of bacteriocins in foods. Biopreservation. Prebiotics: concept, definition, criteria, types and sources of prebiotics, prebiotics and gut microflora - Prebiotics and health benefits: mineral absorption, immune response, cancer prevention, elderly health and infant health, prebiotics in foods.	18	K4	CLO5

Books for Study:

1. Frazier WC and West off DC. (2017). Food microbiology. 5th Edition TATA McGraw Hill Publishing Company Ltd. New Delhi.
2. Adams, M.R., Moss, M.O.(2018). Food Microbiology 1st edition. New Age Publishers by New Age International (P) Ltd., Publishers
3. R.C. Dubey. (2014). Advanced Biotechnology. S. Chand publishers
4. Banwart GJ. (1989). Basic food microbiology, Chapman & Hall, New York.
5. Sugumar D. (1997). Outlines of dairy technology, Oxford University press. 1997.

Books for References:

1. Jay JM, Loessner MJ and Golden DA. (2005). Modern Food Microbiology. 7th Edition CBS Publishers and Distributors, Delhi, India.

2. Prescott, Harley and Klein Wim. (2008). Microbiology, 7th Edition McGraw Hill Publications
3. Robinson, R. K. (2002). Dairy Microbiology Handbook - The Microbiology of Milk and Milk Products (Third Edition), A John Wiley & Sons, Inc., New York.
4. Yuankunlee, Sepposalmiinen. (2008). Handbook of probiotics and prebiotics Second Edition. A John Wiley & Sons publication Inc.
5. Dharumaurai Dhansekaran, Alwarappan Sankaranarayanan. (2021). Advances in Probiotics Microorganisms in Food and Health 1st Edition. eBook ISBN:9780128230916

Web Resources

1. https://www.researchgate.net/publication/15326559_A_Dynamic_Approach_to_Predicting_Bacterial_Growth_in_Food/link/5a1d2e02aca2726120b28eba/download
2. <https://www.fda.gov/food/laboratory-methods-food/bam-foodsamplingpreparation-sample-homogenate>
3. https://www.researchgate.net/publication/243462186_Foodborne_diseases_in_India_-_A_review
4. https://www.researchgate.net/publication/228662659_Fermented_Dairy_Products_Starter_Cultures_and_Potential_Nutritional_Benefits/link/000084160cf23f86393d5764/download
5. <https://www.fda.gov/food>

Rationale for Nature of the course

The course Food, Dairy, and Probiotic Microbiology aims to explore the role of microorganisms in food production, preservation, and safety, with a focus on dairy products and probiotics. It provides insights into their beneficial applications and importance in health and industry.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Group discussion, Model Making and Mini-project

Pedagogy

Chalk and Talk. Group discussion Seminar, PPT presentation

Course Designer(s):

Dr. M. Rajesh Kannan

Lecture Schedule

Unit	Topics	Hrs	Mode
Unit I	Food as a substrate for microorganisms-. Microorganisms important in food microbiology; Molds, yeasts and bacteria -General Characteristics - Classification and importance.	9	Chalk and Talk, Group discussion, Quiz, Seminar, PPT presentation
	Principles of food preservation - Asepsis - Removal of microorganisms, - High temperature - Low temperature - Drying - Food additives. Nanoscience in food preservation; microencapsulation.	9	
Unit II	Contamination and spoilage of food products -Food borne infections (Bacillus cereus, Salmonellosis, Shigellosis, Listeria monocytogenes and Campylobacter jejuni) and intoxications – (Staphylococcus aureus, Clostridium botulinum, Clostridium perfringens and mycotoxins) Food borne disease outbreaks - newly emerging pathogens	9	Chalk and Talk, Group discussion, Quiz, Seminar, PPT presentation
	Conventional and Novel technology in control of food borne pathogens and preventive measures - Food sanitation - plant sanitation - Employees' health standards. Regulatory Agencies & criteria for food safety.	9	
Unit III	Microflora of raw milk - sources of contamination. Spoilage and preservation of milk and milk products. - antimicrobial systems in raw milk.	9	Chalk and Talk, Group discussion, Quiz, Seminar, PPT presentation
	Importance of biofilms, their role in transmission of pathogens in dairy products and preventive strategies.	9	
Unit IV	Food fermentations: Indian Pickles Bread, vinegar, fermented vegetables (sauerkraut), fermented dairy products (yoghurt, cheese, Acidophilus Milk, Kefir, Koumiss). Oriental fermented foods-Miso –Tempeh Ontjom.	9	Chalk and Talk, Group discussion, Quiz, Seminar, PPT presentation
	Natto, Idli Spoilage and defects of fermented dairy products -. Functional fermented foods and nutraceuticals, bioactive proteins and bioactive peptides, genetically modified foods.	9	

Unit V	Probiotic microorganisms, concept, definition safety of probiotic microorganisms, legal status of probiotics Characteristics of Probiotics for selection: stability maintenance of probiotic microorganisms. Role of probiotics in health and disease: Mechanism of probiotics.	9	Chalk and Talk, Group discussion, Quiz, Seminar, PPT presentation
	Application of bacteriocins in foods. Biopreservation. Prebiotics: concept, definition, criteria, types and sources of prebiotics, prebiotics and gut microflora - Prebiotics and health benefits: mineral absorption, immune response, cancer prevention, elderly health and infant health, prebiotics in foods.	9	

Course Learning Outcomes:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Gain knowledge about food as a substrate for various microbes, Understand about the principles and application of different types of food spoilage and preservation technique,	K2
CLO-2	Acquire a thorough understanding of food borne diseases, testing methods, and preventive technique	K3
CLO-3	Gain information about spoilage of milk and its products and its antimicrobial properties	K3
CLO-4	Learn about the various fermented product and its various stage spoilage.	K4
CLO-5	Impart current knowledge of probiotics, prebiotics and functional dairy foods for the health benefits	K4

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

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

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)
			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 (K2&K3)	1(K3)
4	CLO 4	Up to K4	2	K1& K2	1	K2	2 (K4&K4)	1(K4)
5	CLO 5	Up to K4	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	15.8	16%
K2	5	6	15	10	36	30	30%
K3	-	-	20	30	50	41.7	42%
K4	-	-	5	10	15	12.5	12%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF MICROBIOLOGY					Class: III B.Sc Microbiology			
Sem.	Course type	Course code	Course title	Credits	Contact hours/week	CIA	Ext	Total
VI	CORE THEORY–X	23U6RCCT10	PHARMACEUTICAL MICROBIOLOGY	4	6	25	75	100
Nature of Course								
Skill Oriented		✓	Employability Oriented		✓	Entrepreneurship Oriented		

Objectives:

- To provide the knowledge on basics of chemotherapy
- To learn the assays and testing methods of antibiotics
- To gain information about spoilage of pharmaceutical products
- To provide the knowledge on drug discovery and clinical trials
- To learn about regulations in pharmaceutical industry

Unit	Description	Hours	K-level	CLO
I	Introduction to Pharmaceutical microbiology: Ecology of microorganisms in pharmaceutical industry: Atmosphere, water, skin and respiratory flora of workers, raw materials, packaging, building and equipments and their control measures; Design and layout of sterile manufacturing.	18	K2	CLO 1
II	Microbial contamination and spoilage of pharmaceutical products: Microbial aspects of pharmaceutical products; Sterilization of pharmaceutical products: Heat, gaseous, radiation and filtration; Contamination and Spoilage of Pharmaceutical products: sterile injectable and non-injectable, ophthalmologic preparation, implants.	18	K3	CLO 2
III	Production of antibiotics: Production of antibacterial – Penicillin, Tetracycline; antifungal – Griseofulvin, Amphotericin; antiparasitic agents – Artemesin, Metronidazole; Semi-synthetic antibiotics and anticancerous agents; Additional application of microorganisms in pharmaceutical sciences: Enzymes- Streptokinase, Streptodornase, L-asperginase and clinical dextrin; Immobilization procedures for pharmaceutical applications (liposomes); Biosensors in pharmaceuticals.	18	K4	CLO 3

IV	Production of immunological products and their quality control: Vaccines - DNA vaccines, synthetic peptide vaccines, multivalent vaccines; Vaccine clinical trials; Immunodiagnostics - immuno sera and immunoglobulin; Quality control in Pharmaceutical: In – Process and Final Product Control; Sterility tests.	18	K4	CLO 4
V	Quality Assurance and Validation: Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP) in pharmaceutical industry; Regulatory aspects of quality control; Quality assurance and quality management in pharmaceuticals – BIS (IS), ISI, ISO, WHO and US certification.	18	K4	CLO 5

Books for Study:

1. Chand Pasha Kedernath. (2021). Text book of Pharmaceutical Microbiology. Ramnath Publisher.
2. Hugo WB and Russell AD. (2004). Pharmaceutical Microbiology VII edition. Blackwell Scientific Publication, Oxford.
3. Franklin, DJ. and Snow, GA. (2013). Biochemistry of antimicrobial action. Chapman & Hall.

Books for References:

1. Handa, S.S. and Kapoor, V.K. (2022) .Pharmacognosy. 4th Edition. Vallabh Prakashan Publishers, New Delhi.
2. Kuntal Das (2019). Pharmaceutical Microbiology, second edition, Nirali Prakashan.
3. Kokate, C.K., Durohit, A.P. and Gokhale, S.R., (2002). Pharmacognosy. 24th edition Nirali Prakashan Publishers, Pune.

Web Resources

1. <https://www.pharmapproach.com/introduction-to-pharmaceutical-microbiology/>
2. https://www.iptsalipur.org/wp-content/uploads/2020/08/BP303T_PMB_UNIT_I.pdf
3. <https://www.pharmanotes.org/2021/11/pharmaceutical-microbiology-b-pharma.html>

Rationale for Nature of the course

The course is designed to understand the knowledge about microbial-related products in pharmaceuticals. It emphasizes regulatory standards, modern analytical techniques in current scenario and real-world applications to meet national and international quality assurance demands.

Activities having direct bearing on Skill development / Employability Entrepreneurship

The paper gives knowledge about production, processing and its standard validation in pharmaceutical research and development.

Pedagogy

Lecture, Chalk and Talk, PowerPoint presentation, Seminar and Quiz

Course Designer(s):

Mr. J. AMALA JEYAKUMAR

Lecture Schedule

Unit	Topics	Hrs	Mode
Unit I	Introduction to Pharmaceutical microbiology	3	Chalk and talk PPT
	Ecology of microorganisms in pharmaceutical industry: Atmosphere, water, skin and respiratory flora of workers	4	
	Raw materials, packaging, building and equipments and their control measures.	5	
	Ecology of microorganisms in pharmaceutical industry: Design and layout of sterile manufacturing.	6	
Unit II	Microbial contamination and spoilage of pharmaceutical products:	6	Chalk and talk PPT
	Microbial aspects of pharmaceutical products; Sterilization of pharmaceutical products: Heat, gaseous, radiation and filtration.	6	
	Contamination and Spoilage of Pharmaceutical products: sterile injectable and non-injectable, ophthalmologic preparation, implants.	6	
Unit III	Production of antibiotics: Production of antibacterial – Penicillin, Tetracycline; antifungal – Griseofulvin, Amphotericin;	5	Chalk and talk PPT
	Antiparasitic agents – Artemesin, Metronidazole; Semi-synthetic antibiotics and anticancerous agents.	4	
	Additional application of microorganisms in pharmaceutical sciences: Enzymes- Streptokinase, Streptodornase, L-asperginase and clinical dextrin;	5	
	Immobilization procedures for pharmaceutical applications (liposomes); Biosensors in pharmaceuticals.	4	
Unit IV	Production of immunological products and their quality control:	5	Chalk and talk PPT
	Vaccines - DNA vaccines, synthetic peptide vaccines, multivalent vaccines; Vaccine clinical trials.	4	
	Immunodiagnosics - immuno sera and immunoglobulin;	4	
	Quality control in Pharmaceutical: In – Process and Final Product Control; Sterility tests.	5	

Unit V	Quality Assurance and Validation:	5	Chalk and talk PPT
	Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP) in pharmaceutical industry.	4	
	Regulatory aspects of quality control; Quality assurance and quality management	4	
	Quality management in pharmaceuticals – BIS (IS), ISI, ISO, WHO and US certification.	5	

Course Learning Outcomes:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Learn the basics of chemotherapy and action of antibiotics	K2
CLO-2	Carry out the microbiological assay of antibiotics	K3
CLO-3	Analyse Microbiological standardization of Pharmaceuticals, sterility testing of pharmaceutical products Apply sterilization in pharmaceutical industry	K4
CLO-4	Evaluate the process and develop new strategies for rational drug design	K4
CLO-5	Learn the Regulatory guidelines in pharmaceuticals product.	K4

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5
CLO1	2	2	1	1	2
CLO2	2	3	3	2	3
CLO3	3	2	1	2	3
CLO4	2	1	2	3	2
CLO5	3	2	1	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 & K2	1	K1	2 (K1&K2)	1(K2)
2	CLO 2	Up to K-3	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
3	CLO 3	Up to K-4	2	K1 & K2	1	K2	2 (K3&K3)	1(K4)
4	CLO 4	Up to K-4	2	K1 & K2	1	K2	2 (K4&K4)	1(K4)
5	CLO 5	Up to K-4	2	K1 & K2	1	K2	2 (K2&K2)	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	5	-	14	11.7	12%
K2	5	6	15	10	36	30	30%
K3	-	-	20	10	30	25	25%
K4	-	-	10	30	40	33.3	33%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF MICROBIOLOGY					Class: III B.Sc Microbiology			
Sem	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
VI	PRACTICAL	23U6RCCP6	MAJOR PRACTICAL - VI	3	3	25	75	100
Nature of Course								
Skill Oriented		✓	Employability Oriented		✓	Entrepreneurship Oriented		

Objectives:

- To assess the water quality and potability.
- To acquire knowledge on enumeration of bacteria from milk and milk quality analysis
- To investigate various extracellular enzyme producers in soil and to gain knowledge on preparation of biofertilizers
- Improve knowledge on plant pathogens
- To acquire knowledge on preparation of probiotics and prebiotics

Unit	Description	Hours	K-level	CLO
I	Physical, chemical, and microbiological assessment of water and potability test for water. Physical a – Color, pH, Chemical - alkalinity, acidity, DO, BOD, COD Microbiological – MPN index (Presumptive, Completed and Confirmatory test) Study of air microflora by settle plate method.	9	K4	CLO 1
II	Isolation and identification of bacteria and fungi from fruits and vegetables Direct microscopic count of milk. Methylene blue reductase test and Resazurin test Microbiological examination of milk by SPC.	9	K4	CLO 2
III	Isolation of extracellular enzyme producers –Amylase, protease, lipase Microbiological assay of antibiotics by cup plate method and other methods Isolation of <i>Rhizobium/ Azotobacter/</i> phosphate solubilizing organisms Preparation of biofertilizers – Demonstration	9	K4	CLO 3

IV	Study of plant pathogens- Tikka Disease, Red rot of sugarcane, Citrus canker, Blight of paddy. Study of fungi - <i>Mucor</i> , <i>Curvularia</i> , <i>Alternaria</i> , <i>Rhizopus</i> , <i>Aspergillus</i>	9	K4	CLO 4
V	Isolation of constituent flora of fermented milk. Growth of probiotic LAB in broth, milk and whey. Preparation of probiotic fermented milks like dahi, yoghurt, lassi and whey drink. Effect of prebiotics on the growth of LAB in milk and broth. Survivability of probiotic organisms in fermented milks. Antimicrobial potential of the functional dairy products.	9	K4	CLO 5

Books for Study:

1. Chand Pasha Kedernath. (2021). Text book of Pharmaceutical Microbiology. Ramnath Publisher.
2. Hugo WB and Russell AD. (2004). Pharmaceutical Microbiology VII edition. Blackwell Scientific Publication, Oxford.
3. Franklin, DJ. and Snow, GA. (2013). Biochemistry of antimicrobial action. Chapman & Hall.

Books for References:

1. Handa, S.S. and Kapoor, V.K. (2022). Pharmacognosy. 4th Edition. Vallabh Prakashan Publishers, New Delhi.
2. Kokate, C.K., Durohit, A.P. and Gokhale, S.R., (2002). Pharmacognosy. 12th edition Nirali Prakasham Publishers, Pune.
3. S. P. Vyas & V. K. Dixit. (2003). Pharmaceutical Biotechnology. CBS Publishers & Distributors, New Delhi.

Web Resources

1. <https://www.pharmapproach.com/introduction-to-pharmaceutical-microbiology/>
2. https://www.iptsalipur.org/wp-content/uploads/2020/08/BP303T_PMB_UNIT_I.pdf
3. <https://www.pharmanotes.org/2021/11/pharmaceutical-microbiology-b-pharma.html>
4. https://snsourseware.org/snscphs/notes.php?cw=CW_604b15c6313c5
5. <https://www.thermofisher.com>

Rationale for Nature of the course

Technical skills pertaining to isolation, identification and characterization of microbes will be useful for handling, analyzing and interpreting various biological samples. The goal of this course is to provide students with knowledge and skills on overview of how microbes are to solve agricultural problems and to analyze the microbes in spoiled food such as milk and canned food.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Students get the knowledge, technical skills on microbes role in water, food and agriculture products and quality checking. Screening plant pathogens and identifying microbes of economic importance. Employing microorganisms for production of biofertilizers.

Pedagogy

Demonstration and practical session

Course Designer(s):

Dr. P. SASIKUMAR

Dr. M. RAJESHKANNAN

Course Learning Outcomes:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Assess the microbial quality of water and relate the experimental results to the prescribed standards by the statutory bodies	K4
CLO-2	Carry out the microbiological assay of antibiotics	K4
CLO-3	Analyse Microbiological standardization of Pharmaceuticals, sterility testing of pharmaceutical products Apply sterilization in pharmaceutical industry	K4
CLO-4	Evaluate the process and develop new strategies for rational drug design	K4
CLO-5	Learn the Regulatory guidelines in pharmaceuticals product	K4

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

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

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

Assessment Scheme Components of CIA

COMPONENT	WEIGHT / MARK
Continuous Internal Assessment Test Attendance and Class Participation	25
End Semester Examination	75
Total	100

DEPARTMENT OF MICROBIOLOGY					CLASS: III B.SC MICROBIOLOGY			
Sem.	Course type	Course code	Course title	Credits	Contact hours/ Week	CIA	Ext	Total
VI	DISCIPLINE ELECTIVE - IV	23U6RDET2	ENTREPRENEURSHIP AND BIO-BUSINESS	2	4	25	75	100
Nature of Course								
Skill Oriented			Employability Oriented	✓	Entrepreneurship Oriented		✓	

Objectives:

- To understand the basic concepts in the area of entrepreneurship, the role and importance of entrepreneurship for economic development
- To develop personal creativity and entrepreneurial initiative, adopting the key steps in the elaboration of business idea.
- To understand the stages of the entrepreneurial process and the resources needed for the successful development of entrepreneurial ventures.
- To explain the central components of successful business strategies in biotechnology, and create a business plan.
- To understand the various funding resources and develop as Entrepreneur.

Unit	Description	Hours	K-level	CLO
I	Bio Entrepreneurship: Introduction to bio-business, SWOT analysis of bio-business. Ownership, Development of Entrepreneurship; Stages in entrepreneurial process; Government schemes and funding. Small scale industries: Definition; Characteristics; Need and rationale.	12	K2	CLO 1
II	Entrepreneurship Opportunity in Agricultural Biotechnology: Business opportunity, Essential requirement, marketing, strategies, schemes, challenges and scope-with case study on Plant cell and tissue culture technique, polyhouse culture. Herbal bulk drug production, Nutraceuticals, value added herbal products. Bioethanol production using Agricultural	12	K4	CLO 2

	waste, Algal source. Integration of system biology for agricultural applications. Biosensor development in Agriculture management.			
III	Entrepreneurship Opportunity in Industrial Biotechnology: Business opportunity, Essential requirement, marketing strategies, schemes, challenges, and scope- Pollution monitoring and Bioremediation for Industrial pollutants. Integrated compost production- microbe enriched compost. Bio pesticide/ insecticide production. Biofertilizer. Single cell protein. production. Biofertilizer. Single cell protein.	12	K4	CLO 3
IV	Therapeutic and Fermented products: Stem cell production, stem cell bank, production of monoclonal/polyclonal antibodies, secondary metabolite production – antibiotics, probiotic and prebiotics.	12	K3	CLO 4
V	Project Management, Technology Management and Startup Schemes: Building Biotech business challenges in Indian context biotech partners (BIRAC, DBT, Incubation centers. etc.), operational biotech parks in India. Indian Company act for Bio business-schemes and subsidies. Project proposal preparation, Successful start-ups-case study.	12	K4	CLO 5

Books for Study:

1. Craig Shimasaki. (2020). Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies. Academic Press.
2. Ashton Acton, O. (2022). Biological Pigments– Advances in Research and Application Scholarly Editions: Atlanta, Georgia.
3. Jennifer Merritt, Jason Feifer (2021). Start Your Own Business, 7th edition, Entrepreneur Press publisher.
4. Peter F. Drucker (2006). Innovation and Entrepreneurship. Harper Business publisher.
5. Leah Cannon (2017). How to Start a Life Science Company: A Comprehensive Guide for First-Time Entrepreneurs. International Kindle paperwhite.

Books for References:

1. Crueger, W, and Crueger. A.(2000). Biotechnology: A Text Book of Industrialmicrobiology, 2nd Edition, Sinauer Associates: Sunderland.Mass.
2. Paul S Teng. (2008). Bioscience Entrepreneurship in AsiaWorld Scientific Publishing Company.
3. Charles E. Bamford, Garry D. Bruton (2015). ENTREPRENEURSHIP: The Art, Science, and Process for Success, 2nd Edition, McGraw Hill publisher.
4. Yali Friedman (2021). Building Biotechnology: Biotechnology Business, Regulations, Patents, Law, Policy and Science 4th Edition, Logos press publication.
5. Stephanie A. Wisner (2022). Building Backwards to Biotech: The Power of Entrepreneurship to Drive Cutting-Edge Science to Market, International Kindle paperwhite.

Web Resources

1. <https://www.biotech.co.in/sites/default/files/2020-01/Bioentrepreneurship-Development.pdf>
2. <https://krishi.icar.gov.in/jspui/bitstream/123456789/35777/1/Agri-Enterpreneurship-New%20Book.pdf>
3. https://birac.nic.in/webcontent/bio_ent1.pdf
4. <https://pmc.ncbi.nlm.nih.gov/articles/PMC6723656/>
5. <https://www.investindia.gov.in/sector/biotechnology>

Rationale for Nature of the course

The course Entrepreneurship and Bio-Business is designed to equip students with the knowledge and skills required to navigate the unique challenges and opportunities in the biotechnology and life sciences industries. By combining principles of entrepreneurship with the specific regulatory, ethical, and scientific dimensions of bio-business, the course fosters innovative thinking and business acumen tailored to sectors like pharmaceuticals, agriculture, and healthcare. Students gain insights into market analysis, product development, funding strategies, and intellectual property management, empowering them to transform scientific discoveries into viable business ventures that address real-world problems. This interdisciplinary approach bridges the gap between science and commerce, preparing graduates to lead and innovate in the rapidly evolving bio-economy.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Case study and Mini-project

Pedagogy

Lecture, Chalk and Talk, PowerPoint presentation.

Course Designer(s): Dr. K. Raghavan

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Bio Entrepreneurship: Introduction to bio-business, SWOT analysis of bio-business	3	Lecture, Chalk and Talk, PPT, Group Discussion, Quiz, Seminar
	Ownership, Development of Entrepreneurship;	2	
	Stages in entrepreneurial process	2	
	Government schemes and funding.	2	
	Small scale industries: Definition; Characteristics; Need and rationale.	3	
Unit II	Entrepreneurship Opportunity in Agricultural Biotechnology: Business opportunity, Essential requirement, marketing, strategies, schemes	3	Lecture, Chalk and Talk, PPT, Group Discussion
	challenges and scope-with case study on Plant cell and tissue culture technique, polyhouse culture.	2	
	Herbal bulk drug production, Nutraceuticals, value added herbal products.	2	
	Bioethanol production using Agricultural waste, Algal source.	2	
	Integration of system biology for agricultural applications. Biosensor development in Agriculture management.	3	
Unit III	Entrepreneurship Opportunity in Industrial Biotechnology: Business opportunity, Essential requirement, marketing strategies, schemes	3	Lecture, Chalk and Talk, PPT, Group Discussion, Quiz, Seminar
	challenges, and scope- Pollution monitoring and Bioremediation for Industrial pollutants	3	
	Integrated compost production- microbe enriched compost.	2	
	Bio pesticide/ insecticide production.	2	
	Biofertilizer. Single cell protein.	2	
Unit IV	Therapeutic and Fermented products	3	Lecture, Chalk and Talk, PPT, Group Discussion, Quiz, Seminar
	Stem cell production, stem cell bank	2	
	Production of monoclonal/polyclonal antibodies	2	
	Secondary metabolite production – antibiotics	2	
	Probiotic and prebiotics	3	
Unit V	Project Management, Technology Management and Startup Schemes	3	Lecture, Chalk and Talk, Interaction, PPT, Assignment, Group Discussion
	Building Biotech business challenges in Indian context biotech partners (BIRAC, DBT, Incubation centers. etc.),	3	
	Operational biotech parks in India.	2	
	Indian Company act for Bio business-schemes and subsidies.	2	
	Project proposal preparation, Successful start-ups-case study.	2	

Course Learning Outcomes:

On completion of this course the students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Describe and apply several entrepreneurial ideas and business theories in practical framework. methods and its good laboratory practices.	K2
CLO-2	Analyze the business environment in order to identify business opportunities, identify the elements of success of entrepreneurial ventures, evaluate the effectiveness of different entrepreneurial strategies and interpret their own business plan.	K4
CLO-3	Express the mass production of microbial inoculants used as Biofertilizers and Bioinsecticides in response with field application and crop response.	K4
CLO-4	Analyze the application and commercial production of Monoclonal antibodies, Cytokines. TPH and teaching kits.	K3
CLO-5	Integrate and apply knowledge of the regulation of biotechnology industries, utilize effective team work skills within an effective management team with a common objective, and gain effective team work skills, with an awareness of cultural diversity and social inclusiveness and procedures for the microbiological analysis of food.	K4

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

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

Advance application- 3;

Intermediate level-2;

Basic level-1

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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 K2	2	K1& K2	1	K1	2 (K1&K1)	1(K2)
2	CLO 2	Up to K4	2	K1& K2	1	K1	2 (K2&K2)	1(K4)
3	CLO 3	Up to K4	2	K1& K2	1	K2	2 (K2&K2)	1(K3)
4	CLO 4	Up to K3	2	K1& K2	1	K2	2 (K1&K2)	1(K3)
5	CLO 5	Up to K4	2	K1& K2	1	K2	2 (K2&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 without choice	Consolidated
K1	5	2	3	-	24	20.0	20%
K2	5	3	6	1	51	42.5	42%
K3	-	-	1	2	25	20.9	21%
K4	-	-	-	2	20	16.6	17%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF MICROBIOLOGY					CLASS: III B.SC MICROBIOLOGY			
Sem.	Course type	Course code	Course title	Credits	Contact Hours/Week	CIA	Ext	Total
VI	PROFESSIONAL COMPETENCY SKILL	23U6RSED8	MICROBIAL QUALITY CONTROL AND TESTING	2	2	25	75	100
Nature of Course								
Skill Oriented		✓	Employability Oriented		✓	Entrepreneurship Oriented		

Objectives:

- To understand the use of various advanced techniques for application in the field of quality control and quality assurance.
- To cultivate skills involved execution of microbiological techniques and to develop the good laboratory practices.
- To ensure the food safety regulations and its standards.
- To acquire knowledge on laboratory testing, Control & safety process.
- To analyze microbial standards to establish the quality of food products.

Unit	Description	Hours	K-level	CLO
I	Microbial quality control: definition, history and introduction. Standard Methods involved in assessment of microbial quality control. Q.A and Q.C definitions and importance. Traditional Microbiological Quality Controlling methods: Sampling methods, TVC, APC and serial dilution techniques. Good laboratory practices, Good microbiological practices.	6	K2	CLO 1
II	Instruments associated in QC & QA: Principle involved, working conditions, uses and precautions of Laminar Air Flow (LAF), Autoclave, Incubator, pH meter, Colony counter, Hot air oven, Centrifuges, colorimeter/ spectrophotometer, ELISA and storage devices. Methodology of Disinfection, Autoclaving & Incineration.	6	K3	CLO 2

III	Culture media used in QC and QA: Design of specialized media for identification of pathogens. Good laboratory practices in culture media preparation: raw material, water, pH. Uses of media. Enrichment culture technique, Detection of specific microorganisms - on XLD agar, Salmonella Shigella Agar, Mannitol salt agar, EMB agar, McConkey Agar, Saboraud Agar.	6	K3	CLO 3
IV	Determining Microbes in Pharmaceutical Samples: Sterility testing for pharmaceutical products, Bioburden, pyrogen test, in process and final process control, safety and sterility test.	6	K3	CLO 4
V	HACCP for Food Safety and Microbial Standards: Hazard analysis of critical control point (HACCP) - Principles, flow diagrams, limitations. Microbial Standards for Different Foods and Water – BIS standards for common foods and drinking water. Ascertaining microbial quality of milk by MBRT, Rapid detection methods of microbiological quality of milk at milk collection centers.	6	K4	CLO 5

Books for Study:

1. W.B.Hugo&A.D.Russell. (2011). Pharmaceutical Microbiology.6thEdition. Blackwell scientific Publications.
2. Kulkarni A. K. Bewoor V. A. (2009). Quality Control,Wiley India Pvt. Ltd,
3. Chandrakant Kokare (2016). Pharmaceutical Microbiology, 1st Edition, Nirali Publication.
4. Brown.M.R.W. (2017). Microbiological Quality Assurance A Guide Towards Relevance and Reproducibility of Inocula,1st Edition. CRC press.
5. Dev Raj Rakesh Sharma And V K Joshi (2011). Quality Control For Value Addition In Food Processing, New India Publishing Agency.

Books for References:

1. Rosamund M. Baird, Norman A. Hodges, Stephen P. Denyer. (2000). Handbook of Microbiological Quality Control in Pharmaceuticals and Medical Devices. 1st Edition, CRC Press.

2. Konieczka, (2019). Quality Assurance and Quality Control in the Analytical Chemical Laboratory A Practical Approach (Hb), Routledge, Taylor and Francis group.
3. Singh Gajjar, Budhrani, Usman. (2021). Quality Control And Quality Assurance (M.Pharm)SVikas And Company.
4. David Roesti, Marcel Goverde (2019). Pharmaceutical Microbiological Quality Assurance and Control: Practical Guide for Non-Sterile Manufacturing, Wiley publication.
5. Amihud Kramer Bernard A. Twigg (2017). Quality Control For The Food Industry Fundamentals & Applications (Vol.1) 3rd Edition, MEDTEC publication.

Web Resources

1. <https://www.study.com/microbiology-quality-control-testing-definition-procedures>.
2. <https://www.biologydiscussion.com/microbiology-2/instruments/top-9-instruments-used-in-microbiology/66905>
3. <https://microbenotes.com/types-of-culture-media/>
4. https://www.ipc.gov.in/images/Revised_Microbial_Contamination_in_Non_sterile_Products_2.2.9.pdf
5. <https://microbiologyclass.net/hazard-analysis-critical-control-point-haccp/>

Rationale for Nature of the course

The course Microbial quality control and testing is designed to equip students with essential knowledge and practical skills to ensure the safety, efficacy, and compliance of microbial-related products across industries such as pharmaceuticals, food and beverage, cosmetics, and environmental monitoring. It emphasizes regulatory standards, modern analytical techniques and real-world applications to meet global quality assurance demands. By addressing emerging challenges like antimicrobial resistance, contamination control, and product stability, the course fosters critical thinking and problem-solving skills while preparing students for career opportunities in quality control, regulatory affairs, and microbiology laboratories.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Case study and Mini-project

Pedagogy

Lecture, Chalk and Talk, PowerPoint presentation.

Course Designer(s): Mrs. A.R. Saranyadevi

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Microbial quality control: definition, history and introduction	1	Lecture, Chalk and Talk, PPT, Group Discussion, Quiz, Seminar
	Q.A and Q.C definitions and importance	1	
	Standard Methods involved in assessment of microbial quality control	1	
	Traditional Microbiological Quality Controlling methods: Sampling methods	1	
	Traditional Microbiological Quality Controlling methods: TVC, APC and serial dilution techniques.	1	
	Good laboratory practices, Good microbiological practices.	1	
Unit II	Instruments associated in QC & QA: Principle involved, working conditions, uses and precautions of Laminar Air Flow (LAF), Autoclave, Incubator	1	Lecture, Chalk and Talk, PPT, Group Discussion
	Instruments associated in QC & QA: Principle involved, working conditions, uses and precautions of pH meter, Colony counter	1	
	Instruments associated in QC & QA: Principle involved, working conditions, uses and precautions of Hot air oven, Centrifuges	1	
	Instruments associated in QC & QA: Principle involved, working conditions, uses and precautions of colorimeter/spectrophotometer	1	
	Instruments associated in QC & QA: Principle involved, working conditions, uses and precautions of ELISA and storage devices	1	
	Methodology of Disinfection, Autoclaving & Incineration.	1	
Unit III	Culture media used in QC and QA: Design of specialized media for identification of pathogens.	1	Lecture, Chalk and Talk, PPT, Group Discussion, Quiz, Seminar
	Good laboratory practices in culture media preparation: raw material, water, pH	1	
	Uses of media. Enrichment culture technique	1	
	Detection of specific microorganisms on XLD agar, Salmonella Shigella Agar	1	
	Detection of specific microorganisms on Mannitol salt agar, EMB agar	1	
	Detection of specific microorganisms on McConkey Agar, Sabouraud agar	1	

Unit IV	Determining Microbes in Pharmaceutical Samples	1	Lecture, Chalk and Talk, PPT, Group Discussion, Quiz, Seminar
	Determining Microbes in Pharmaceutical Samples: Sterility testing for pharmaceutical products	1	
	Determining Microbes in Pharmaceutical Samples: Bioburden.	1	
	Determining Microbes in Pharmaceutical Samples: pyrogen test	1	
	Determining Microbes in Pharmaceutical Samples: in process and final process control	1	
	Determining Microbes in Pharmaceutical Samples: safety and sterility test	1	
Unit V	HACCP for Food Safety and Microbial Standards	1	Lecture, Chalk and Talk, Interaction, PPT, Assignment, Group Discussion
	Hazard analysis of critical control point (HACCP) - Principles, flow diagrams, limitations.	1	
	Microbial Standards for Different Foods– BIS standards for common foods.	1	
	Microbial Standards for Water – BIS standards for drinking water	1	
	Ascertaining microbial quality of milk by MBRT	1	
	Rapid detection methods of microbiological quality of milk at milk collection centers	1	

Course Learning Outcomes:

On completion of this course the students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO–1	understand the theoretical assessment of microbial quality methods and its good laboratory practices.	K2
CLO–2	describe the microbiological aspects of quality control of food and pharmaceutical products.	K3
CLO–3	explain the identification of pathogenic microorganisms and good laboratory practices.	K3
CLO–4	acquire the knowledge of different sterility test for the pharmaceutical products.	K3
CLO–5	illustrate the safety concern management and regulations of food and pharmaceutical industry and learn the basic standard methods and procedures for the microbiological analysis of food.	K4

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

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

Advance application– 3;

Intermediate level–2;

Basic level–

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Articulation Mapping - K Levels with Course Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section A		Section B		Section c (Open Choice)
			MCQs		Short Answers (5)		
			No. of Questions	K-Level	No. of Questions	K-Level	
1	CLO 1	Up to K2	6	K1& K2	1	K1/K2	1(K1/K2)
2	CLO 2	Up to K3	6	K1& K2	1	K1/K2	1(K2/K3)
3	CLO 3	Up to K3	6	K1& K2	1	K1/K2	1(K2/K3)
4	CLO 4	Up to K3	6	K1& K2	1	K1/K2	1(K2/K3)
5	CLO 5	Up to K4	6	K1& K2	1	K1/K2	1(K3/K4)
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 Section			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 without choice	Consolidated
K1	15	10	-	25	23.80	24%
K2	15	15	10	40	38.10	38%
K3	-	-	30	30	28.58	29%
K4	-	-	10	10	9.52	9%
Total Marks	30	25	50	105	100.00	100%

DEPARTMENT OF MICROBIOLOGY				CLASS: III B.SC MICROBIOLOGY				
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
VI	Project	23U6RPROV	Project and Viva Voce	2	3	25	75	100
Nature of Course								
Skill oriented		✓	Entrepreneurship oriented			Employability oriented		✓

Objectives:

- To assess students' ability to design, conduct, and present research projects
- To enhance communication and presentation skills
- To develop time management and organizational skills.
- To evaluate students' understanding of microbiological concepts and principles
- To recommend scientific writing skill 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 students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	conduct a research project using appropriate methodologies and techniques in microbiology	Upto K2
CLO2	respond to questions and criticisms from peers and experts in the field	Upto K3
CLO3	prioritize tasks and manage their time effectively to meet project deadlines.	Upto K3
CLO4	analyze and interpret data in the context of microbiological concepts and principles.	Upto K4
CLO5	use proper scientific writing conventions, including formatting, citations, and references.	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	3
CLO-3	3	3	3	3	3
CLO-4	3	3	3	3	3
CLO-5	3	3	3	3	3

Mapping of CLOs with POs

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

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

Internal & External Valuation for Project

Internal	External
25 Marks	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. (Project will be evaluated by Guide with External Examiner in the presence of HOD)

Department of Microbiology
The Madura College Madurai
M.Sc., Microbiology

SEM	COURSE CODE	COURSE TYPE	COURSE TITLE	CREDIT	HOURS
I	25P1RCCT1	CORE - I	General Microbiology and Microbial Diversity	5	6
	25P1RCCT2	CORE - II	Microbial Physiology	5	6
	25P1RCCP1	CORE PRACTICAL I	General Microbiology Microbial Diversity and Microbial Physiology	4	6
	25P1RECT1	DISCIPLINE ELECTIVE -I	Forensic Science/ Nanobiotechnology / Microalgal Technology (Among the three choices anyone can be chosen by the student)	3	5
	25P1RECT2	DISCIPLINE ELECTIVE -II	Bioinstrumentation / Herbal Technology and Cosmetic Microbiology / Essentials of Laboratory Management and Biosafety (Among the three choices anyone can be chosen by the student)	3	5
	25P1RSEN1	NME - I	Microbial World	2	2
			Total	22	30

SEM	COURSE CODE	COURSE TYPE	COURSE TITLE	CREDIT	HOURS
II	25P2RCCT3	CORE - III	Medical Bacteriology and Mycology	5	6
	25P2RCCT4	CORE - IV	Medical Virology and Parasitology	5	6
	25P2RCCP2	CORE PRACTICAL II	Medical Microbiology	4	6
	25P2RECT3	DISCIPLINE ELECTIVE -III	Epidemiology/ Clinical Diagnostic Microbiology/ Bioremediation (Among the three choices anyone can be chosen by the student)	3	5
	25P2RECT4	DISCIPLINE ELECTIVE -IV	Bioinformatics/ Biosafety, Bioethics and IPR / Clinical Research and Clinical Trials (Among the three choices anyone can be chosen by the student)	3	5
	25P2RSEN2	NME - II	Microbes in human welfare	2	2
			Total	22	30

Department of Microbiology
The Madura College Madurai
M.Sc., Microbiology

SEM	COURSE CODE	COURSE TYPE	COURSE TITLE	CREDIT	HOURS
III	25P3RCCT5	CORE - V	Immunology and Microbial Genetics	5	6
	25P3RCCT6	CORE - VI	Molecular Biology and Recombinant DNA Technology	5	6
	25P3RCCP3	CORE PRACTICAL III	Immunology, Microbial Genetics and Molecular Biology	4	6
	25P3RSED1	SKILL ENHANCEMENT COURSE	Fermentation Technology and Pharmaceutical Microbiology	3	5
	25P3RMDC	DISCIPLINE ELECTIVE - MDC	Computer Aided Drug Design Discovery	3	5
	25P3RIKS	INDIAN KNOWLEDGE SYSTEM	Organic Farming and Biofertilizer Technology	2	2
	25P3RINTR	INTERNSHIP - INDUSTRIAL VISIT	Internship - Industrial Visit	2	-
			Total	24	30

SEM	COURSE CODE	COURSE TYPE	COURSE TITLE	CREDIT	HOURS
IV	25P4RCCT7	CORE - VII	Food and Environmental Microbiology	5	6
	25P4RCCP4	CORE PRACTICAL -IV	Applied Microbiology	4	6
	25P4RCCT8	CORE- VIII RESEARCH METHODOLOGY AND RESEARCH ETHICS	Research Methodology and Biostatistics	2	4
	25P4RPROV	PROJECT WITH VIVA VOCE	Project with Viva-Voce	6	6
	25P4RECT6	ELECTIVE – INDUSTRY / ENTREPRENEURSHIP	Entrepreneurial skill in Microbiology / Bioenergy/ Marine Microbiology (Among the three choices any one can be chosen by the student)	3	4
	25P4RSED2	SKILL ENHANCEMENT COURSE PROFESSIONAL COMPETENCY	Life Science for Competitive Examinations	2	4
	25P4REXTN	EXTENSION ACTIVITY	Extension Activity	1	-
			Total	23	30

Credit Distribution for PG Course

S.No	Course Details	Credit
1.	Core Course Theory [7 Courses X 5 Credits]	35
2.	Core Course Practical [4 Courses X 4 Credits]	16
3.	Core Course Research Methodology [1 Course X 2 Credits]	2
4.	Core Course Indian Knowledge System [1 Course X 2 Credits]	2
5.	Elective Course [5 Courses X 3 Credits]	15
6.	Core Industry Skill Enhancement [1 Course X 3 Credits]	3
7.	Professional Competency Skill [1 Course X 2 Credits]	2
8.	Project Work <i>viva voce</i> [1 Course X 6 Credits]	6
9.	NME [2 Courses X 2 Credits]	4
10.	Multidisciplinary Course [1 Course X 3 Credits]	3
11.	Internship [1 Course X 2 Credits]	2
12.	Extension Activity [1 Course X 1 Credit]	1
	Total	91

Programme:	M.Sc. MICROBIOLOGY
Programme code:	25PGMB
Duration:	2 Years [PG]
Programme Outcomes:	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	PSO-1: Placement Prepare the students in varied disciplines like agriculture, industry - medical, pharma, dairy, hotel, food and food processing, immunological, cosmetics, vermitechology and water treatment for effective and respectful placement. PSO-2: Entrepreneurship

	To create effective entrepreneur by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations. PSO-3: Research and Development Design and implement HR systems that comply with good laboratory practices, following ethical values, leading the organization towards growth and development. . PSO-4: Contribution to Society To contribute to the development of society and produce microbiological products, by collaborating with stake holders, related to the betterment of environment and mankind at the national and global level. PSO 5 Communication skills To acquire and demonstrate proficiency in good laboratory practices in a Microbiological laboratory and Develop strong oral and written communication skills through the effective presentation of experimental results as well as through seminars.

Assessment Scheme

Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, short summary or overview
Application (K3)	Suggest idea/concept with examples, suggest formulae, solve problems, Observe, Explain
Analyze (K4)	Problem-solving questions, finish a procedure in many steps, Differentiate between various ideas, Map knowledge
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations.

DEPARTMENT OF MICROBIOLOGY				CLASS: I M.Sc. MICROBIOLOGY				
Sem.	Course type	Course code	Course title	Credits	Contact hours/week	CIA	Ext	Total
I	CORE-I	25P1RCCT1	GENERAL MICROBIOLOGY AND MICROBIAL DIVERSITY	5	6	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented		Entrepreneurship Oriented	

Objectives:

- Acquire knowledge on the principles of different types of microscopes and their applications.
- Explain various pure culture techniques and discuss sterilization methods.
- Exemplify, isolate and cultivate microalgae from diverse environmental sources.
- Compare and contrast the structure of bacteria and fungi.
- Illustrate nutritional requirements and growth in bacteria.
- Discuss the importance and conservation of microbial diversity.

Unit	Description	Hours	K-level	CLO
I	History and Scope of Microbiology. Microscopy – Principles and applications. Types of Microscopes - Bright field, Dark-field, Phase-contrast, Fluorescence microscope, Transmission electron microscope (TEM) and Scanning electron microscope (SEM). Sample preparation for SEM & TEM. Atomic force, Confocal microscope. Micrometry – Stage, Ocular and its applications.	18	K2	CLO 1
II	Microbial techniques - Safety guidelines in Microbiology Laboratories. Sterilization, Disinfection and its validation. Staining methods – Simple, Differential and Special staining. Automated Microbial identification systems - Pure cultures techniques – Cultivation of Anaerobic organisms. Maintenance and preservation of pure cultures. Culture collection centres - National and International.	18	K3	CLO 2

III	Algae - Distribution, morphology, classification, reproduction and economic importance. Isolation of algae from soil and water. Media and methods used for culturing algae, Strain selection and large-scale cultivation. Life cycle - <i>Chlamydomonas</i> , <i>Volvox</i> , <i>Spirogyra</i> (Green algae), <i>Nostoc</i> (Cyanobacteria) <i>Ectocarpus</i> , <i>Sargassum</i> (Brown algae), <i>Polysiphonia</i> , <i>Batrachospermum</i> (Red algae).	18	K3	CLO 3
IV	Bacterial Structure, properties and biosynthesis of cellular components – Cell wall. Actinomycetes and Fungi - Distribution, morphology, classification, reproduction and economic importance. Sporulation. Growth and nutrition - Nutritional requirements, Growth curve, Kinetics of growth, Batch culture, Synchronous growth, Measurement of growth and factors affecting growth.	18	K4	CLO 4
V	Biodiversity - Introduction to microbial biodiversity – Thermophiles -Classification, Thermophilic Archaeobacteria and its applications. Methanogens - Classification, Habitats, applications. Alkaliphiles and Acidophiles - Classification, discovery basin, its cell wall and membrane. Barophiles - Classification and its applications. Halophiles - Classification, discovery basin, cell walls and membranes – purple membrane, compatible solutes. Microbial stress response -Osmoadaptation / halotolerance - Applications of halophiles.	18	K4	CLO 5

Books for Study:

1. Kanunga R. (2017). Ananthanarayanan and Panicker's Text book of Microbiology. (10th Edition). Universities Press (India) Pvt. Ltd.
2. Chan E.C.S., Pelczar M. J. Jr. and Krieg N. R. (2010). Microbiology. (5th Edition). McGraw Hill. Inc, New York.
3. Prescott L. M., Harley J. P. and Klein D. A. (2004). Microbiology. (6th Edition). McGraw - Hill company, New York.
4. White D. Drummond J. and Fuqua C. (2011). The Physiology and Biochemistry of Prokaryotes, Oxford University Press, Oxford, New York.
5. Dubey R.C. and Maheshwari D. K. (2009). Textbook of Microbiology. S. Chand, Limited.

Books for References:

1. Tortora G. J., Funke B. R. and Case C. L. (2015). Microbiology: An Introduction (12th Edition). Pearson, London, United Kingdom
2. Webster J. and Weber R.W.S. (2007). Introduction to Fungi. (3rd Edition). Cambridge University Press, Cambridge.
3. Schaechter M. and Leaderberg J. (2004). The Desk encyclopedia of Microbiology. Elseiver Academic Press, California.
4. Ingraham, J.L. and Ingraham, C.A. (2000) Introduction to Microbiology. (2nd Edition). Books / Cole Thomson Learning, UK.
5. Madigan M. T., Bender K.S., Buckley D. H. Sattley W. M. and Stahl (2018) Brock Biology of Microorganisms. (15th Edition). Pearson.

Web Resources

1. <http://sciencenetlinks.com/tools/microbeworld>
2. <https://www.microbes.info/>
3. <https://www.asmscience.org/VisualLibrary>
4. <https://open.umn.edu/opentextbooks/BookDetail.aspx?bookId=404>
5. https://www.grsmu.by/files/file/university/cafedry//files/essential_microbiology.pdf

Rationale for Nature of the course

This course introduces the core concepts and basic principles in microbiology, examining microorganisms and how they interact with humans and the environment. Information regarding classification of microorganisms, characteristics of different cell types and processes critical for cell survival is presented.

Activities having direct bearing on Skill development / Employability Entrepreneurship

The course content provides the foundation of general microbiology necessary for students who are interested in applying to health profession programs.

Pedagogy

The course content provides the foundation of general microbiology necessary for students who are interested in applying to health profession programs.

Course Designer(s):

Dr. Asha Kannan A.P

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	History and Scope of Microbiology. Microscopy – Principles and applications	3	Chalk and talk Demonstration
	Types of Microscopes - Bright field, Dark-field, Phase-contrast, Fluorescence microscope,	6	
	. Transmission electron microscope (TEM) and Scanning electron microscope (SEM). Sample preparation for SEM & TEM.	4	
	Atomic force, Confocal microscope. Micrometry – Stage, Ocular and its applications.	5	
Unit II	Microbial techniques - Safety guidelines in Microbiology Laboratories. Sterilization, Disinfection and its validation.	4	Chalk and talk Demonstration
	Staining methods – Simple, Differential and Special staining.	4	
	Automated Microbial identification systems - Pure cultures techniques Cultivation of Anaerobic organisms.	5	
	Maintenance and preservation of pure cultures. Culture collection centres - National and International.	5	
Unit III	Algae - Distribution, morphology, Strain selection and large-scale cultivation.,	4	Chalk and talk PPT/video presentation
	Classification, reproduction and economic importance.	2	
	Isolation of algae from soil and water. Media and methods used for culturing algae	2	
	Life cycle - <i>Chlamydomonas</i> , <i>Volvox Spirogyra</i> (Green algae), <i>Nostoc</i> (Cyanobacteria)	4	
	Life cycle - <i>Ectocarpus</i> , <i>Sargassum</i> (Brown algae)	2	
	Life cycle- <i>Polysiphonia</i> , <i>Batrachospermum</i> (Red algae).	4	
Unit IV	Bacterial Structure, properties and biosynthesis of cellular components – Cell wall.,	4	Chalk and talk PPT/video presentation
	Actinomycetes and Fungi - Distribution, morphology, classification, reproduction and economic importance.	5	
	Sporulation. Growth and nutrition - Nutritional requirements, Growth curve, Kinetics of growth	4	
	Batch culture, Synchronous growth, Measurement of growth and factors affecting growth.	5	

Unit V	Biodiversity - Introduction to microbial biodiversity – Thermophiles - Classification, Thermophilic	4	Chalk and talk PPT/video presentation
	Archaeobacteria and its applications. Methanogens - Classification, Habitats, applications. Alkaliphiles and Acidophiles - Classification, discovery basin, its cell wall and membrane.	5	
	Barophiles - Classification and its applications. Halophiles - Classification, discovery basin, cell walls and membranes – purple membrane, compatible solutes.	5	
	Microbial stress response -Osmoadaptation / halotolerance - Applications of halophiles.	4	

Course Learning Outcomes:

On completion of this course the students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Examine various microbes employing the microscopic techniques learnt. Measure and compare the size of microbes.	K2
CLO-2	Create aseptic conditions by following good laboratory practices.	K3
CLO-3	Identify and cultivate the algae understanding their habitat. Analyze the morphology, classify and propagate depending on its economic importance.	K3
CLO-4	Differentiate and appreciate the anatomy of various microbes. Plan the growth of microbes for different environmental conditions.	K4
CLO-5	Categorize and cultivate a variety of extremophiles following standard protocols for industrial applications.	K4

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

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

Advance application– 3;

Intermediate level–2;

Basic level–1

Blueprint for Semester Examination

Learning Outcome Based Education & Assessment (LOBE) 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 K-2	2	K1 & K2	1	K1	2 (K1&K2)	1(K2)
2	CLO 2	Up to K-3	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
3	CLO 3	Up to K-3	2	K1 & K2	1	K2	2 (K2&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-4	2	K1 & K2	1	K2	2 (K2&K2)	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	5	-	14	11.7	12%
K2	5	6	20	10	41	34.1	34%
K3	-	-	15	20	35	29.2	29%
K4	-	-	10	20	30	25	25%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF MICROBIOLOGY				CLASS: I M.Sc. MICROBIOLOGY				
Sem.	Course type	Course code	Course title	Credits	Contact hours/week	CIA	Ext	Total
I	CORE-II	25P1RCCT2	MICROBIAL PHYSIOLOGY	5	6	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented		Entrepreneurship Oriented	

Objectives:

- Illustrate Bacterial nutrition and their utilization.
- Discuss cultivation methods and factors related to microbial growth.
- Demonstrate concepts of microbial metabolism.
- Impart the fundamentals and importance of biosynthetic pathways. Discuss the methods involved in Photosynthesis.

Unit	Description	Hours	K-level	CLO
I	Nutrition – Nutritional requirements and types in bacteria – Phototrophs, Chemotrophs, Autotrophs and Heterotrophs. Nutrient transport mechanisms- Passive diffusion, Facilitated diffusion, Active transport, Group translocation and Specific transport system.	18	K2	CLO 1
II	Microbial growth – Growth curve and Measurement of Growth – Cell Number and Cell Mass and metabolic activity. Batch, Continuous, Synchronous and Asynchronous cultures, Factors affecting growth.	18	K3	CLO 2
III	Enzymes – properties, functions and regulation. Basic concepts of metabolism, Oxidation – reduction reactions, Energy generation by anaerobic metabolism – Glycolysis, Pentose Phosphate pathway, ED pathway, Fermentation. Energy generation by Aerobic metabolism - TCA cycle, Glycoxylate pathway and Electron Transport chain, Mechanism of ATP synthesis – Chemiosmosis, Pasteur effect. Metabolism of lipids-β oxidation.	18	K4	CLO 3

IV	Anaerobic Respiration. Nitrogen, Sulphur, Iron and Hydrogen Oxidation. Methanogenesis. Biosynthesis – Gluconeogenesis, Peptidoglycan synthesis, Amino acids, Purines, Pyrimidines, Fattyacids, Triglycerides, Phospholipids and Sterols.	18	K4	CLO 4
V	Photosynthesis – process, antenna of light-harvesting pigments, Photochemical reaction centers, Photosynthetic Electron Transport ChainCyclic and Non-cyclic. Oxygenic and Anoxygenic Photosynthesis. CalvinBenson cycle. Bioluminescence - Process and application.	18	K4	CLO 5

Books for Study:

1. Stanier R.Y., Ingraham, J.L., Wheelis, M.L and Painter, P.R. (2010). General Microbiology. 5th Edn. Macmilan education Ltd. London.
2. Prescott. L.M., Harley. J.P., Klein. D.A. (1993). Microbiology. 2nd edn. Wm. C. Brown publishers, Dubugue.
3. Moat, A.G. and Foster, J.W. (2003). Microbial Physiology.4th Edn. John Wiley and Sons, New York.
4. Doelle, H.W. (1975) Bacterial Metabolism, 2nd Edn. Academic Press, London.
5. Caldwell, D.R (2000) Microbial physiology and metabolism, 2nd Edn. Star publishing, Belmont, California.

Books for References:

1. Salle. A.J. (1992). Fundamental Principles of Bacteriology. 7th edn. McGraw Hill Inc.New York.
2. Madigan, M.T., Martinko, J.M., & ParkerJ. (2000). Brock Biology of Microorganisms. 9th Edn. Prentice Hall International, Inc, London.
3. Ingraham, J.L., & Ingraham, C.A. (2000). Introduction to Microbiology. 2nd Edn. Brook /Cole. Singapore.
4. Gottschalk, G. (1986). Bacterial Metabolism.2nd Edn. Springer-Verlag, New York.
5. Rose, A.H. (1976). An Introduction to Microbial Physiology. 3rd Edn. Plenum, New York.

Web Resources

1. <https://courses.lumenlearning.com/boundlessmicrobiology/chapter/microbial-nutrition/>
2. <https://www.lamission.edu/lifesciences/lecturenote/mic20/Chap06Growth.pdf>
3. <https://www.tandfonline.com/doi/abs/10.3109/07388558409082583?journalCode=ibty20>
4. <https://www.sciencedirect.com/topics/neuroscience/microbial-respiration>.
5. <https://www.britannica.com/science/photosynthesis>.

Rationale for Nature of the course

The course Microbial Physiology is designed to provide a comprehensive understanding of the cellular and molecular mechanisms that govern microbial life, including metabolism, growth, adaptation, and regulation. It integrates concepts from biochemistry, molecular biology, and microbiology to explore how microorganisms interact with their environment and contribute to processes like nutrient cycling, pathogenesis, and industrial applications. By highlighting microbial diversity and unique metabolic pathways, the course equips students with the knowledge and skills necessary for solving real-world challenges in medicine, biotechnology, agriculture, and environmental sustainability. Ultimately, it serves as a foundation for research and innovation, fostering a deeper appreciation for the critical role microbes play in global ecosystems and human health.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Mini-project

Pedagogy

Lecture, Chalk and Talk, PowerPoint presentation.

Course Designer(s):

Dr. P. Sasi Kumar

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Nutrition – Nutritional requirements and types in bacteria – Phototrophs, Chemotrophs, Autotrophs and Heterotrophs.	6	Chalk and talk PPT/video presentation
	Nutrient transport mechanisms- Passive diffusion, Facilitated diffusion, Active transport.	6	
	Group translocation and Specific transport system.	6	
Unit II	Microbial growth – Growth curve and Measurement of Growth.	6	Chalk and talk PPT/video presentation
	Cell Number and Cell Mass and metabolic activity.	6	
	Batch, Continuous, Synchronous and Asynchronous cultures, Factors affecting growth.	6	
Unit III	Enzymes – properties, functions and regulation. Basic concepts of metabolism, Oxidation – reduction reactions	6	Chalk and talk PPT/video presentation
	Energy generation by anaerobic metabolism – Glycolysis, Pentose Phosphate pathway, ED pathway, Fermentation.	6	
	Energy generation by Aerobic metabolism - TCA cycle, Glyoxylate pathway and Electron Transport chain, Mechanism of ATP synthesis – Chemiosmosis, Pasteur effect. Metabolism of lipids-β oxidation.	6	
Unit IV	Anaerobic Respiration. Nitrogen, Sulphur, Iron and Hydrogen oxidation.	6	Chalk and talk Group discussion
	Methanogenesis. Biosynthesis – Gluconeogenesis, Peptidoglycan synthesis.	6	
	Amino acids, Purines, Pyrimidines, Fattyacids, Triglycerides, Phospholipids and Sterols.	6	
Unit V	Photosynthesis – process, antenna of light-harvesting pigments, Photochemical reaction centers.	6	Chalk and talk PPT/video presentation
	Photosynthetic Electron Transport Chain- Cyclic and Non-cyclic. Oxygenic and Anoxygenic Photosynthesis.	6	
	Calvin Benson cycle. Bioluminescence - Process and application.	6	

Course Learning Outcomes:

On completion of this course the students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Apply knowledge about nutritional requirement, modes of nutrient transport in microorganisms to various disciplines of Microbiology.	K2
CLO-2	Analyze microbial growth, factors influencing growth and its measurement techniques for applications in various industries.	K3
CLO-3	Compare various metabolic pathways and discuss the properties and functions of enzymes.	K4
CLO-4	Apply anaerobic respiration and biosynthetic pathways to enhance/control microbial growth.	K4
CLO-5	Assimilate methods involved in microbial photosynthesis and bioluminescence.	K4

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

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

Advance application– 3;

Intermediate level–2;

Basic level–1

Blueprint for Semester Examination

Learning Outcome Based Education & Assessment (LOBE) 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 K-2	2	K1 & K2	1	K1	2 (K1&K2)	1(K2)
2	CLO 2	Up to K-3	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
3	CLO 3	Up to K-4	2	K1 & K2	1	K2	2 (K3&K3)	1(K4)
4	CLO 4	Up to K-4	2	K1 & K2	1	K2	2 (K4&K4)	1(K4)
5	CLO 5	Up to K-4	2	K1 & K2	1	K2	2 (K2&K2)	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	5	-	14	11.7	12%
K2	5	6	15	10	36	30	30%
K3	-	-	20	10	30	25	25%
K4	-	-	10	30	40	33.3	33%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF MICROBIOLOGY				CLASS: I M.Sc. MICROBIOLOGY				
Sem.	Course type	Course code	Course title	Credits	Contact hours/week	CIA	Ext	Total
I	CORE PRACTICAL I	25P1RCCP1	GENERAL MICROBIOLOGY MICROBIAL DIVERSITY AND MICROBIAL PHYSIOLOGY	4	6	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented		Entrepreneurship Oriented	

Objectives:

- Gain knowledge on the fundamentals, handling and applications of microscopy.
- Provide fundamental skills in sterilization methods. Identify microbes by different staining methods.
- Prepare media for bacterial growth. Analyze microbial enzymes.
- Perform plating techniques and methods involved in microbial preservation.
- Measure bacterial growth, identify optimal growth parameters, cultivate bacteria, and perform antibiotic sensitivity.

Unit	Description	Hours	K-level	CLO
I	Microscopic Techniques: Light microscopy: Hay infusion broth. Wet mount to show different types of microbes, hanging drop. Micrometry. Dark field microscopy – Motility of Spirochetes. Washing and cleaning of glass wares: Sterilization methods: moist heat, dry heat, and filtration. Quality control check for each method.	18	K4	CLO 1
II	Staining techniques - Simple staining, Gram's staining, Acid fast staining, Meta chromatic granule staining, Spore, Capsule, Flagella.	18	K4	CLO 2
III	Media Preparation: Preparation of liquid, solid and semisolid media. Agar deeps, slants, plates. Preparation of basal, enriched, selective and enrichment media. Preparation of Biochemical test media, media to demonstrate enzymatic activities.	18	K4	CLO 3

IV	Purification and maintenance of microbes. Streak plate, pour plate, and slide culture technique. Aseptic transfer. Direct counts – Total cell count, Turbidometry. Viable count - pour plate, spread plate	18	K4	CLO 4
V	Bacterial growth curve. Effect of physical and chemical factors on growth. Anaerobic culture methods.	18	K4	CLO 5

Books for Study:

1. Dubey R.C. and Maheshwari D. K. (2010). Practical Microbiology. S. Chand.
2. Cappuccino, J. and Sherman, N. (2002). Microbiology: A Laboratory Manual, (6th Edition). Pearson Education, Publication, New Delhi.
3. Cullimore D. R. (2010). Practical Atlas for Bacterial Identification. (2nd Edition). -Taylor & Francis.
4. Moat, A.G. Foster, J.W. and Spector, M. P (2002) Microbial Physiology, 4th Edn. Wiley - Liss, New York.
5. Dawes, I. W. and Sutherland, I. W (1992) Microbial physiology, 2nd Edn. Black-well Scientific Publications, London.

Books for References:

1. Collee J. G., Fraser A.G. Marmion B. P. and Simmons A. (1996). Mackie & McCartney Practical Medical Microbiology. (14th Edition). Elsevier, New Delhi.
2. Stanier R.Y., Ingraham, J.L., Wheelis, M.L and Painter, P.R. (2010). General Microbiology. 5th Edn. Macmilan education Ltd. London.
3. Prescott. L.M., Harley. J.P., Klein. D.A. (1993). Microbiology. 2nd edn. Wm. C. Brown publishers, Dubuque.
4. Gottschalk, G. (1986). Bacterial Metabolism. 2nd Edn. SpringerVerlag, New York.
5. Rose, A.H. (1976). An Introduction to Microbial Physiology. 3rd Edn. Plenum, New York.

Web Resources

1. <http://textbookofbacteriology.net/>
2. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC149666/>
3. <http://sciencenetlinks.com/tools/microbeworld>
4. <https://www.microbes.info/>
5. <https://www.asmscience.org/VisualLibrary>

Rationale for Nature of the course

Learn to pursue experimental procedures. Extend skills to create answerable questions/hypotheses, forecast expected results. Find out how to make careful observations, collect and analyze data, and depict appropriate conclusions. Utilize hands on training in basic microbiology and immunology

Activities having direct bearing on Skill development / Employability Entrepreneurship

Lab demonstration, Group wise and individual experiments, Clinical Lab visit.

Pedagogy: Demonstration and Hands on training

Course Designer(s):

Dr. A.P. Asha Kannan and

Dr. P. Sasi Kumar

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Microscopic Techniques: Light microscopy: Hay infusion broth. Wet mount to show different types of microbes, hanging drop.	6	Lab Demo & Individual Experiment
	Micrometry. Dark field microscopy – Motility of Spirochetes.	6	
	Washing and cleaning of glass wares: Sterilization methods: moist heat, dry heat, and filtration. Quality control check for each method	6	
Unit II	Staining techniques - Simple staining, Gram's staining,	6	Lab Demo & Individual Experiment
	Acid fast staining, Meta chromatic granule staining	6	
	Spore, Capsule, Flagella.	6	
Unit III	Media Preparation: Preparation of liquid, solid and semisolid media. Agar deeps, slants, plates.	6	Lab Demo & Group wise Experiment
	Preparation of basal, enriched, selective and enrichment media.	6	
	Preparation of Biochemical test media, media to demonstrate enzymatic activities.	6	
Unit IV	Purification and maintenance of microbes. Streak plate, pour plate, and slide culture technique. Aseptic transfer.	6	Lab Demo & Group wise Experiment
	Direct counts – Total cell count, Turbidometry.	6	
	Viable count - pour plate, spread plate	6	
Unit V	Bacterial growth curve.	6	Lab Demo & Group wise Experiment
	Effect of physical and chemical factors on growth.	6	
	Anaerobic culture methods.	6	

Course Learning Outcomes:

On completion of this course the students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Apply microscopic techniques and staining methods in the identification and differentiation of microbes.	K4
CLO-2	Apply the knowledge on the sterilization of glass wares and media by different methods and measurement of cell growth.	K4
CLO-3	Perform and evaluate immunological reactions to aid diagnosis.	K4
CLO-4	Assess the level of lymphocytes in a blood sample and purify immunoglobulin employing appropriate techniques.	K4
CLO-5	Perform DNA extraction and gene transfer mechanisms, analyze and identify by gel electrophoresis	K4

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

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

Advance application– 3;

Intermediate level–2;

Basic level–1

EVALUATION (PRACTICAL)

Internal (Formative) : 25 marks

External (Summative) : 75 marks

Total : 100 marks

Question Paper Pattern for Internal Practical Examination (Major): 25 Marks

	Components	Marks	Total Marks
Internal [Formative]	Continuous assessment	10	25
	Test (Major 10, Minor 5, Spotters 5 and Record 5marks) scaled down to 15	15	
External [Summative]		75	75
Total Marks			100

Question Paper Pattern for External Practical Examination (Major): 75 Marks

Components	Marks
I – Major question	25
II – Minor question	15
III – Spotters (5 x 4)	20
IV –Record book	05
Viva-voce	10
Total	75

DEPARTMENT OF MICROBIOLOGY				CLASS: I M.Sc. MICROBIOLOGY				
Sem.	Course type	Course code	Course title	Credits	Contact hours/week	CIA	Ext	Total
I	DISCIPLINE ELECTIVE - I	25P1RECT1	FORENSIC SCIENCE	3	5	25	75	100

Nature of Course				
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented

Objectives:

- Understand the Scope, need and learn the tools and techniques in forensic science.
- Comprehend organizational setup of a forensic science laboratory.
- Identify and Examine body fluids for identification.
- Extract DNA from blood samples for investigation.
- Recognize medico legal post mortem procedures and their importance.

Unit	Description	Hours	K-level	CLO
I	Forensic Science - Definition, history and development of forensic science. Scope and need of forensic science in present scenario. Branches of forensic science. Tools and techniques of forensic science. Duties of a forensic scientist.	15	K3	CLO 1
II	Forensic science laboratories - Organizational setup of a forensic science laboratory. Central and State level laboratories in India. Mobile forensic science laboratory and its functions. Forensic microbiology - Types and identification of microbial organisms of forensic significance.	15	K3	CLO 2
III	Forensic serology - Definition, identification and examination of body fluids - Blood, semen, saliva, sweat and urine. Forensic examination and identification of hair and fibre.	15	K4	CLO 3
IV	DNA profiling - Introduction, history of DNA typing. Extraction of DNA from blood samples - Organic and Inorganic extraction methods. DNA fingerprinting - RFLP, PCR, STR. DNA testing in disputed paternity.	15	K4	CLO 4

V	Forensic toxicology - Introduction and concept of forensic toxicology. Medico legal post mortem and their examination. Poisons - Types of poisons and their mode of action.	15	K4	CLO 5

Books for Study:

1. Nanda B. B. and Tewari R. K. (2001) Forensic Science in India: A Vision for the Twenty First Century. Select Publishers, New Delhi. ISBN- 10:8190113526 / ISBN-13:9788190113526.
2. James S. H. and Nordby, J. J. (2015) Forensic Science: An Introduction to Scientific and Investigative Techniques. (5th Edition). CRC Press. ISBN-10:9781439853832 / ISBN-13:978-1439853832.
3. Li R. (2015) Forensic Biology. (2nd Edition). CRC Press, New York. ISBN-13:978-1-4398-8972-5.
4. Sharma B.R (2020) Forensic science in criminal investigation and trials. (6th Edition)Universal Press.
5. Richard Saferstein (2017). Criminalistics- An introduction to Forensic Science. (12th Edition).Pearson Press.

Books for References:

1. Nordby J. J. (2000). Dead Reckoning. The Art of Forensic Detection- CRC Press, New York. ISBN:0-8493-8122-3.
2. Saferstein R. and Hall A. B. (2020). Forensic Science Hand book, Vol. I, (3rd Edition). CRC Press, New York. ISBN-10:1498720196.
3. Lincoln, P.J. and Thomson, J. (1998). (2nd Edition). Forensic DNA Profiling Protocols. Vol. 98. Humana Press. ISBN: 978-0-89603443-3.
4. Val McDermid (2014). Forensics. (2nd Edition). ISBN 9780802125156.
5. Vincent J. DiMaio., Dominick DiMaio. (2001). Forensic Pathology (2nd Edition). CRC Press.

Web Resources

1. <http://clsjournal.ascls.org/content/25/2/114>
2. <https://www.ncbi.nlm.nih.gov/books/NBK234877/>
3. <https://www.elsevier.com/books/microbial-forensics/budowle/978-012-382006-8>

4. https://www.researchgate.net/publication/289542469_Methods_in_microbial_forensics
5. https://cisac.fsi.stanford.edu/events/microbial_forensics

Rationale for Nature of the course

The course in forensic science is designed to bridge the gap between science and law by applying scientific principles and techniques to the investigation and resolution of legal matters. It integrates knowledge from disciplines such as biology, chemistry, physics, and digital technology, providing students with a multidisciplinary foundation to analyze evidence, solve crimes, and uphold justice. The course emphasizes the development of critical thinking, analytical skills, and ethical awareness, ensuring that students are prepared to contribute responsibly to the criminal justice system. By exposing learners to cutting-edge advancements and practical applications, it prepares them for diverse career opportunities in fields such as crime scene investigation, forensic pathology, and digital forensics, while fostering a commitment to accuracy, objectivity, and societal well-being.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Case study and Mini-project

Pedagogy

Lecture, Chalk and Talk, PowerPoint presentation.

Course Designer:

Mrs. A.R. Saranyadevi

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Definition, history and development of forensic science. Branches of forensic science.	5	Chalk and talk PPT/video presentation
	Scope and need of forensic science in present scenario.	5	
	Tools and techniques of forensic science. Duties of a forensic scientist.	5	
Unit II	Forensic science laboratories - Organizational setup of a forensic science laboratory.	5	Chalk and talk PPT/video presentation
	Central and State level laboratories in India. Mobile forensic science laboratory and its functions.	5	
	Forensic microbiology - Types and identification of microbial organisms of forensic significance.	5	
Unit III	Forensic serology - Definition, identification and examination of body fluids - Blood, semen,	5	Chalk and talk PPT/video presentation
	identification and examination of body fluids - saliva, sweat and urine.	5	
	Forensic examination and identification of hair and fibre.	5	
Unit IV	DNA profiling - Introduction, history of DNA typing.	5	Chalk and talk Group discussion
	Extraction of DNA from blood samples - Organic and Inorganic extraction methods.	5	
	DNA fingerprinting - RFLP, PCR, STR. DNA testing in disputed paternity.	5	
Unit V	Forensic toxicology - Introduction and concept of forensic toxicology	5	Chalk and talk PPT/video presentation
	Medico legal post mortem and their examination.	5	
	Poisons - Types of poisons and their mode of action.	5	

Course Learning Outcomes:

On completion of this course the students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Identify the scope and need of forensic science in the present scenario.	K3
CLO-2	Plan for the organizational setup and functioning of forensic science laboratories.	K3
CLO-3	Analyze the biological samples found at the crime scene.	K4
CLO-4	Perform extraction and identification of DNA obtained from body fluids.	K4
CLO-5	Discuss the concept of forensic toxicology.	K4

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

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

Advance application– 3;

Intermediate level–2;

Basic level–1

Blueprint for Semester Examination

Learning Outcome Based Education & Assessment (LOBE) 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 K-3	2	K1 & K2	1	K1	2 (K1&K2)	1(K3)
2	CLO 2	Up to K-3	2	K1 & K2	1	K3	2 (K1&K2)	1(K3)
3	CLO 3	Up to K-4	2	K1 & K2	1	K2	2 (K3&K3)	1(K4)
4	CLO 4	Up to K-4	2	K1 & K2	1	K2	2 (K3&K4)	1(K4)
5	CLO 5	Up to K-4	2	K1 & K2	1	K3	2 (K2&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 without choice	Consolidated
K1	5	2	10	-	17	14.17	14%
K2	5	4	15	-	24	20	20%
K3	-	4	20	20	44	36.66	38%
K4	-	-	5	30	35	29.17	29%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF MICROBIOLOGY				CLASS: I M.Sc. MICROBIOLOGY				
Sem.	Course type	Course code	Course title	Credits	Contact hours/week	CIA	Ext	Total
I	DISCIPLINE ELECTIVE - I	25P1RECT1	NANO BIOTECHNOLOGY	3	5	25	75	100

Nature of Course				
Skill Oriented	✓	Employability Oriented		Entrepreneurship Oriented

Objectives:

- Analyze nanomaterials based on the understanding of nanobiotechnology.
- Discuss the methods of fabrication of nanomaterials.
- Gain Knowledge on characterization of nanomaterials.
- Discover nanomaterials for targeted drug delivery.
- Explain nanomaterials in nanomedicine and environmental pollution

Unit	Description	Hours	K-level	CLO
I	Introduction to nanobiotechnology, Nano size-changing phenomena at nano scale, Classification of nanomaterials based on their dimensions (0D, 1D, 2D and 3D materials) and based on realization of their applications (The First, second, third and fourth generation materials), Class of nanomaterials and their applications. Need for nanomaterials and the risks associated with the materials.	15	K3	CLO 1
II	Fabrication of Nanomaterials-Top-down and Bottom-up approaches, Solid phase synthesis-milling, Liquid phase synthesis Sol-gel synthesis, colloidal synthesis, micro emulsion method, hydrothermal synthesis and solvo thermal synthesis, Vapour/Gas phase synthesis-Inert gas condensation, flame pyrolysis, Laser ablation and plasma synthesis techniques. Microbial synthesis of nanoparticles.	15	K3	CLO 2

III	Characterization of nanoparticles – Based on particle size/morphology- Dynamic light scattering (DLS), Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Atomic force microscopy (AFM), Based on surface charge-zeta potential, Based on structure –X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), Energy dispersive X-ray analysis (EDX), Based on optical properties- UV – Spectrophotometer, Based on magnetic properties-Vibrating sample magnetometer (VSM).	15	K4	CLO 3
IV	Nanomaterial based Drug delivery and therapeutics-surface modified nano particles, MEMS/NEMS based devices, peptide/DNA coupled nanoparticles, lipid and inorganic nano particles for drug delivery, Metal/metall oxide nanoparticles as antibacterial, antifungal and antiviral agents. Toxicity of nanoparticles and Toxicity Evaluation.	15	K4	CLO 4
V	Nanomaterials in diagnosis-Imaging, nanosensors in detection of pathogens. Treatment of surface water, ground water and waste water contaminated by toxic metal ions, organic and inorganic solutes and microorganisms.	15	K4	CLO 5

Books for Study:

1. Brydson R. M., Hammond, C. (2005). Generic Methodologies for Nanotechnology: Characterization. In Nanoscale Science and Technology. John Wiley & Sons, Ltd.
2. Leggett G. J., Jones R. A. L. (2005). Bionanotechnology. In Nanoscale Science and Technology. John Wiley & Sons, Ltd.
3. Mohan Kumar G. (2016). Nanotechnology: Nanomaterials and nanodevices. Narosa Publishing House.
4. Goodsell D. S. (2004). Bionanotechnology. John Wiley & Sons, Inc.
5. Pradeep T. (2007). Nano: The Essentials-Understanding nanoscience and nanotechnology. Tata McGraw-Hill.

Books for References:

1. Nouailhat A. (2008). An Introduction to Nanoscience and Nanotechnology, Wiley.
2. Sharon M. and Maheshwar (2012). Bio-Nanotechnology: Concepts and Applications. New Delhi. Ane books Pvt Ltd.
3. Niemeyer C.M. and Mirkin C. A. (2005). Nanobiotechnology. Wiley Interscience.
4. Rehm, B. (2006). Microbial Bionanotechnology: Biological Self-Assembly Systems and Biopolymer-Based Nanostructures. Horizon Scientific Press
Reisner, D.E. (2009).

Web Resources

1. <https://www.gale.com/nanotechnology>
2. <https://www.understandingnano.com/resources.html>
3. <http://dbtnanobiotech.com/index2.php>
4. <http://www.istl.org/11-winter/internet1.html>
5. <https://www.cdc.gov/niosh/topics/nanotech/default.html>

Rationale for Nature of the course

Nanobiotechnology is an interdisciplinary field that combines nanotechnology and biology to address challenges in medicine, agriculture, and environmental science. This course is designed to provide students with a comprehensive understanding of nanoscale materials and their applications in biological systems, such as drug delivery, biosensors, and tissue engineering. By integrating principles from physics, chemistry, and biology, the course fosters critical thinking and innovation in designing advanced tools and techniques for healthcare and biotechnology. It equips students with the skills to explore cutting-edge technologies, such as nanomedicine and diagnostics, while emphasizing ethical considerations and societal impacts. This multidisciplinary approach prepares learners for careers in research, industry, and academia, contributing to advancements in science and technology for societal benefit.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Mini-project

Pedagogy

Lecture, Chalk and Talk, PowerPoint presentation.

Course Designer(s): Dr. K. Raghavan.

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Introduction to nanobiotechnology, Nano size-changing phenomena at nano scale	5	Chalk and talk PPT/video presentation
	Classification of nanomaterials based on their dimensions (0D, 1D, 2D and 3D materials) and based on realization of their applications (The First, second, third and fourth generation materials),	5	
	Class of nanomaterials and their applications. Need for nanomaterials and the risks associated with the materials.	5	
Unit II	Fabrication of Nanomaterials-Top-down and Bottom-up approaches,	5	Chalk and talk PPT/video presentation
	Solid phase synthesis-milling, Liquid phase synthesisSol-gel synthesis, colloidal synthesis, micro emulsion method, hydrothermal synthesis and solvo thermal synthesis,	5	
	Vapour/Gas phase synthesis-Inert gas condensation, flame pyrolysis, Laser ablation and plasma synthesis techniques. Microbial synthesis of nanoparticles.	5	
Unit III	Characterization of nanoparticles – Based on particle size/morphology- Dynamic light scattering (DLS), Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Atomic force microscopy (AFM), Based on optical properties- UV – Spectrophotometer,	5	Chalk and talk PPT/video presentation
	Based on surface charge-zeta potential, based on structure –X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), Energy dispersive X-ray analysis (EDX),	5	
	Based on magnetic properties-Vibrating sample magnetometer (VSM).	5	
Unit IV	Nanomaterial based Drug delivery and therapeutics-surface modified nano particles,	5	Chalk and talk Group discussion
	MEMS/NEMS based devices, peptide/DNA coupled nanoparticles, lipid and inorganic nano particles for drug delivery,	5	
	Metal/metal oxide nanoparticles as antibacterial, antifungal and antiviral agents. Toxicity of nanoparticles and Toxicity Evaluation.	5	
Unit V	Nanomaterials in diagnosis-Imaging,	5	Chalk and talk PPT/video presentation
	Nano sensors in detection of pathogens.	5	
	Treatment of surface water, ground water and waste water contaminated by toxic metal ions, organic and inorganic solutes and microorganisms.	5	

On completion of this course the students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Employ knowledge in the field of nanobiotechnology for development	K3
CLO-2	Identify various applications of nanomaterials in the field of medicine and environment.	K3
CLO-3	Examine the prospects and significance of nanobiotechnology.	K4
CLO-4	Identify recent advances in this area and create a career or pursue research in the field.	K4
CLO-5	Design non-toxic nanoparticles for targeted drug delivery.	K4

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

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

Advance application– 3;

Intermediate level–2;

Basic level–1

Blueprint for Semester Examination

Learning Outcome Based Education & Assessment (LOBE) 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 K-3	2	K1 & K2	1	K1	2 (K1&K2)	1(K3)
2	CLO 2	Up to K-3	2	K1 & K2	1	K3	2 (K1&K2)	1(K3)
3	CLO 3	Up to K-4	2	K1 & K2	1	K2	2 (K3&K3)	1(K4)
4	CLO 4	Up to K-4	2	K1 & K2	1	K2	2 (K3&K4)	1(K4)
5	CLO 5	Up to K-4	2	K1 & K2	1	K3	2 (K2&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 without choice	Consolidated
K1	5	2	10	-	17	14.17	14%
K2	5	4	15	-	24	20	20%
K3	-	4	20	20	44	36.66	38%
K4	-	-	5	30	35	29.17	29%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF MICROBIOLOGY				CLASS: I M.Sc. MICROBIOLOGY				
Sem.	Course type	Course code	Course title	Credits	Contact hours/week	CIA	Ext	Total
I	DISCIPLINE ELECTIVE - I	25P1RECT1	MICRO ALGAL TECHNOLOGY	3	5	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	

Objectives:

- Characterize the different groups of algae.
- Describe the cultivation and harvesting of algae.
- Identify the commercial applications of various algal products.
- Apply microalgae for environmental applications. Employ microalgae as alternate fuels.

Unit	Description	Hours	K-level	CLO
I	Introduction to Algae - General characteristics. Classification of algae according to Fritsch. Salient features of different groups of algae. Distribution - Freshwater, brackish water and marine algae. Identification methods. An overview of applied Phycology. Economically important microalgae.	15	K3	CLO 1
II	Cultivation of freshwater and marine microalgae - Growth media. Isolation and enumeration of microalgae. Laboratory cultivation and maintenance. Outdoor cultivation - Photobioreactors - construction, types and operation; raceway ponds - Heterotrophic and mixotrophic cultivation - Harvesting of microalgae biomass.	15	K3	CLO 2
III	Microalgae in food and nutraceutical applications - Algal single cell proteins. Cultivation of <i>Spirulina</i> and <i>Dunaliella</i> . Microalgae as aquatic, poultry and cattle feed. Microalgal biofertilizers. Valueadded products from microalgae. Pigments - Production of microalgal carotenoids and their uses. Phycobiliproteins - production and commercial applications. Polyunsaturated fatty acids as active nutraceuticals. Microalgal secondary metabolites - Pharmaceutical and cosmetic applications.	15	K4	CLO 3

IV	Microalgae in environmental applications. Phycoremediation - Domestic and industrial waste water treatment. High-rate algal ponds and surface-immobilized systems - Treatment of gaseous wastes by microalgae. Sequestration of carbon dioxide. Scavenging of heavy metals by microalgae. Negative effects of algae. Algal blooms, algicides for algal control.	15	K4	CLO 4
V	Microalgae as feed stock for production of biofuels - Carbonneutral fuels. Lipid-rich algal strains - <i>Botryococcus braunii</i> . Drop-in fuels from algae - hydrocarbons and biodiesel, bioethanol, biomethane, biohydrogen and syngas from microalgae biomass. Biocrude synthesis from microalgae. Integrated biorefinery concept. Life cycle analysis of algae biofuels.	15	K4	CLO 5

Books for Study:

1. Lee R.E. (2008). Phycology. Cambridge University Press.
2. Sharma O.P. (2011). Algae. Tata McGraw-Hill Education.
3. Shekh A., Schenk P., Sarada R. (2021). Microalgal Biotechnology. Recent Advances, Market Potential and Sustainability. Royal Society of Chemistry.
4. Lele. S.S., Jyothi Kishen Kumar (2008). Algal bio process technology. New Age International P(Ltd)

Books for References:

1. Andersen R.A. (2005). Algal culturing techniques. Academic Press, Elsevier.
2. Bux F. (2013). Biotechnological Applications of Microalgae: Biodiesel and Value- added Products. CRC Press.
3. Singh B., Baudh K., Bux, F. (2015). Algae and Environmental Sustainability. Springer.

Web Resources

1. <https://www.classcentral.com/course/algae-10442>
2. https://onlinecourses.nptel.ac.in/noc19_bt16/preview
3. <https://freevidelectures.com/course/4678/nptel-industrialbiotechnology/46>
4. <https://nptel.ac.in/courses/103103207>
5. <https://www.sciencedirect.com/topics/earth-and-planetarysciences/microalgae>

Rationale for Nature of the course

Students learn about conversion of algal and its products as human nutrition, biofuel, and manufacture of pharmaceuticals and cosmetics products. Students learn harvesting, processing technique.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Those who learned about processing, harvesting get employment in production unit and entrepreneurship opportunities in small, medium to large scale level.

Pedagogy

Chalk and Talk, PPT, Group discussion, Seminar

Course Designer(s):

Mr. J. Amala Jeyakumar

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Introduction to Algae - General characteristics. Classification of algae according to Fritsch. Salient features of different groups of algae.	5	Chalk and Talk, PPT, Group discussion, Seminar
	Distribution - Freshwater, brackish water and marine algae. Identification methods.	5	
	An overview of applied Phycology. Economically important microalgae	5	
Unit II	- Cultivation of freshwater and marine microalgae - Growth media. Isolation and enumeration of microalgae.	5	Chalk and Talk, PPT, Group discussion, Seminar
	Laboratory cultivation and maintenance. Outdoor cultivation - Photobioreactors - construction, types and operation; raceway ponds	5	
	Heterotrophic and mixotrophic cultivation - Harvesting of microalgae biomass	5	
Unit III	Microalgae in food and nutraceutical applications - Algal single cell proteins. Cultivation of <i>Spirulina</i> and <i>Dunaliella</i> . Microalgae as aquatic, poultry and cattle feed.	5	Chalk and Talk, PPT, Group discussion, Seminar
	Microalgal biofertilizers. Valueadded products from microalgae. Pigments - Production of microalgal carotenoids and their uses.	5	
	Phycobiliproteins - production and commercial applications. Polyunsaturated fatty acids as active nutraceuticals. Microalgal secondary metabolites - Pharmaceutical and cosmetic applications.	5	
Unit IV	Microalgae in environmental applications. Phycoremediation - Domestic and industrial waste water treatment.	5	Chalk and Talk, PPT, Group discussion, Seminar
	High-rate algal ponds and surface-immobilized systems - Treatment of gaseous wastes by microalgae.	5	
	Sequestration of carbon dioxide. Scavenging of heavy metals by microalgae. Negative effects of algae. Algal blooms, algicides for algal control.	5	
Unit V	Microalgae as feed stock for production of biofuels - Carbonneutral fuels. Lipid-rich algal strains - <i>Botryococcus braunii</i> .	5	Chalk and Talk, PPT, Group discussion, Seminar
	Drop-in fuels from algae - hydrocarbons and biodiesel, bioethanol, biomethane, biohydrogen and syngas from microalgae biomass.	5	
	Biocrude synthesis from microalgae. Integrated biorefinery concept. Life cycle analysis of algae biofuels.	5	

Course Learning Outcomes:

On completion of this course the students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Acquire knowledge in the field of microalgal technology and their characteristics.	K3
CLO-2	Identify the methods of algal cultivation and harvesting.	K3
CLO-3	Recognize and recommend the use of microalgae as food, feed and fodder.	K4
CLO-4	Promote microalgae in phycoremediation.	K4
CLO-5	Compare and critically evaluate recent applied research in these microalgal applications.	K4

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

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

Advance application– 3;

Intermediate level–2;

Basic level–1

Blueprint for Semester Examination

Learning Outcome Based Education & Assessment (LOBE) 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 K-3	2	K1 & K2	1	K1	2 (K1&K2)	1(K3)
2	CLO 2	Up to K-3	2	K1 & K2	1	K3	2 (K1&K2)	1(K3)
3	CLO 3	Up to K-4	2	K1 & K2	1	K2	2 (K3&K3)	1(K4)
4	CLO 4	Up to K-4	2	K1 & K2	1	K2	2 (K3&K4)	1(K4)
5	CLO 5	Up to K-4	2	K1 & K2	1	K3	2 (K2&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 without choice	Consolidated
K1	5	2	10	-	17	14.17	14%
K2	5	4	15	-	24	20	20%
K3	-	4	20	20	44	36.66	38%
K4	-	-	5	30	35	29.17	29%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF MICROBIOLOGY				CLASS: I M.Sc. MICROBIOLOGY				
Sem.	Course type	Course code	Course title	Credits	Contact hours/ week	CIA	Ext	Total
I	DISCIPLINE ELECTIVE - II	25P1RECT2	BIOINSTRUMENTATION	3	5	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	

Objectives:

- Explain the principles and working mechanisms of laboratory instruments.
- Discuss chromatography techniques and molecular biology techniques.
- Illustrate molecular techniques in biological applications.
- Acquire knowledge on spectroscopic techniques
- Demonstrate the use of radio isotopes in various techniques.

Unit	Description	Hours	K-level	CLO
I	Basic laboratory Instruments. Aerobic and anaerobic incubator – Biosafety Cabinets - Fume Hood, pH meter, Lyophilizer, Flow cytometry. Centrifugation techniques: Basic principles of centrifugation - Standard sedimentation coefficient - measurement of sedimentation co-efficient; Principles, methodology and applications of differential, rate zonal and density gradient centrifugation – Applications in determination of molecular weight.	15	K3	CLO 1
II	General principles of chromatography - Chromatographic Performance parameters; Types- Thin layer chromatography, Paper Chromatography, Liquid chromatography (LPLC & HPLC), Adsorption, ion exchange, Gel filtration, affinity, Gas liquid (GLC). Flash Chromatography and Ultra Performance convergence chromatography. Two dimensional chromatography. Stimulated moving bed chromatography (SEC).	15	K3	CLO 2
III	Electrophoresis: General principles - moving boundary	15	K4	CLO 3

	electrophoresis - electrophoretic mobility – supportive materials – electro endosmosis – types (horizontal, vertical and two dimensional electrophoresis) - Principle and applications - paper electrophoresis, Serum electrophoresis, starch gel electrophoresis, Disc gel, Agarose gel, SDS – PAGE, Immuno electrophoresis. Blotting techniques - Southern, northern and western blotting.			
IV	Spectroscopic techniques: Principle, simple theory of absorption of light by molecules, electromagnetic spectrum, instrumentation and application of UV-visible, Raman, FTIR spectrophotometer, spectrofluorimetry, Atomic Absorption Spectrophotometer, Flame spectrophotometer, NMR, ESR, Emission Flame Photometry and GC-MS. Detection of molecules in living cells - FISH and GISH. Biophysical methods: Analysis of biomolecules by Spectroscopy UV/visible.	15	K4	CLO 4
V	Radio isotopic techniques: Principle and applications of tracer techniques in biology. Radioactive isotopes - radioactive decay; Detection and measurement of radioactivity using ionization chamber, proportional chamber, Geiger- Muller and Scintillation counters, auto radiography and its applications. Commonly used isotopes in biology, labeling procedures and safety aspects.	15	K4	CLO 5

Books for Study:

1. Sharma B. K. (2014). Instrumental Method of Chemical Analysis. Krishna Prakashan Media (P) Ltd.
2. Chatwal G. R and Anand S. K. (2014.) Instrumental Methods of Chemical Analysis. Himalaya Publishing House.
3. Mitchell G. H. (2017). Gel Electrophoresis: Types, Applications and Research. Nova Science Publishers Inc.
4. Holme D. Peck H. (1998). Analytical Biochemistry. (3rd Edition). Prentice Hall.
5. Jayaraman J. (2011). Laboratory Manual in Biochemistry. (2nd Edition). Wiley Eastn Ltd., New Delhi.

Books for References:

1. Pavia D. L. (2012) Spectroscopy (4th Edition). Cengage.
2. Skoog A. and West M. (2014). Principles of Instrumental Analysis. (14th Edition). W.B.Saunders Co., Philadelphia.
3. Miller J. M. (2007). Chromatography: Concepts and Contrasts (2nd Edition) Wiley-Blackwell.
4. Gurumani N. (2006). Research Methodology for Biological Sciences. (1st Edition) MJP Publishers.
5. Ponmurugan P. and Gangathara P. B. (2012). Biotechniques. (1st Edition). MJP Publishers.

Web Resources

1. <https://norcaloa.com/BMIA>
2. <http://www.biologydiscussion.com/biochemistry/centrifugation/centrifuge-introduction-types-uses-and-other-details-with-diagram/12489>
3. <https://www.watelectrical.com/biosensors-types-its-working-andapplications>.
4. <http://www.wikiscales.com/articles/electronic-analytical-balance/>
5. <https://study.com/academy/lesson/what-is-chromatography-definition-types-uses>.

Rationale for Nature of the course

Bioinstrumentation is a multidisciplinary course that focuses on the design, development, and application of instruments used to monitor, diagnose, and treat biological systems. It combines principles from engineering, biology, and medical science to provide students with a solid foundation in the functioning and analysis of biomedical devices such as ECG machines, biosensors, imaging systems, and laboratory instruments. The course emphasizes both theoretical and practical knowledge, fostering skills in troubleshooting, data acquisition, and device innovation. By exploring the integration of technology and healthcare, students are prepared to address challenges in medical diagnostics, research, and therapeutic solutions, paving the way for careers in biomedical engineering, healthcare technology, and research industries

Activities having direct bearing on Skill development / Employability Entrepreneurship

Mini-project.

Pedagogy

Lecture, Chalk and Talk, PowerPoint presentation.

Course Designer(s): Mrs. A. R. Saranyadevi

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Basic laboratory Instruments. Aerobic and anaerobic incubator – Biosafety Cabinets - Fume Hood, pH meter, Lyophilizer, Flow cytometry.	5	Chalk and talk
	Centrifugation techniques: Basic principles of centrifugation - Standard sedimentation coefficient - measurement of sedimentation co-efficient	5	
	Principles, methodology and applications of differential, rate zonal and density gradient centrifugation – Applications in determination of molecular weight.	5	
Unit II	General principles of chromatography - Chromatographic Performance parameters;	5	Chalk and talk PPT/video presentation
	Types- Thin layer chromatography, Paper Chromatography, Liquid chromatography (LPLC &HPLC), Adsorption, ion exchange, Gel filtration, affinity, Gas liquid (GLC).	5	
	Flash Chromatography and Ultra Performance convergence chromatography. Two-dimensional chromatography. Stimulated moving bed chromatography (SEC).	5	
Unit III	Electrophoresis: General principles - moving boundary electrophoresis - electrophoretic mobility – supportive materials – electro endosmosis .	5	Chalk and talk PPT/video presentation
	Types (horizontal, vertical and two-dimensional electrophoresis) - Principle and applications - paper electrophoresis, Serum electrophoresis, starch gel electrophoresis, Disc gel, Agarose gel, SDS – PAGE,	5	
	Immuno electrophoresis. Blotting techniques - Southern, northern and western blotting.	5	
Unit IV	Spectroscopic techniques: Principle, simple theory of absorption of light by molecules, electromagnetic spectrum.	5	Chalk and talk Group discussion
	instrumentation and application of UV- visible, Raman, FTIR spectrophotometer, spectrofluorimetry, Atomic Absorption Spectrophotometer, Flame spectrophotometer, NMR, ESR, Emission Flame Photometry and GC-MS.	5	
	Detection of molecules in living cells - FISH and GISH. Biophysical methods: Analysis of biomolecules by Spectroscopy UV/visible.	5	
Unit V	Radioisotopic techniques: Principle and applications of tracer techniques in biology.	5	Chalk and talk PPT/video presentation
	Radioactive isotopes - radioactive decay; Detection and measurement of radioactivity using ionization chamber, proportional chamber, Geiger- Muller and Scintillation counters, auto radiography and its applications.	5	
	Commonly used isotopes in biology, labeling procedures and safety aspects.	5	

On completion of this course the students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Make use of the laboratory instruments- laminar air flow, pH meter, centrifugation methods, biosafety cabinets following SOP.	K3
CLO-2	Apply chromatography techniques in the separation of biomolecules.	K3
CLO-3	Perform molecular techniques like mutagenesis and their detection.	K4
CLO-4	Estimate molecules in biological samples by adopting UV spectroscopic techniques.	K4
CLO-5	Cultivate organisms anaerobically.	K4

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

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

Advance application– 3;

Intermediate level–2;

Basic level–1

Blueprint for Semester Examination

Learning Outcome Based Education & Assessment (LOBE) 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 K-3	2	K1 & K2	1	K1	2 (K1&K2)	1(K3)
2	CLO 2	Up to K-3	2	K1 & K2	1	K3	2 (K1&K2)	1(K3)
3	CLO 3	Up to K-4	2	K1 & K2	1	K2	2 (K3&K3)	1(K4)
4	CLO 4	Up to K-4	2	K1 & K2	1	K2	2 (K3&K4)	1(K4)
5	CLO 5	Up to K-4	2	K1 & K2	1	K3	2 (K2&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 without choice	Consolidated
K1	5	2	10	-	17	14.17	14%
K2	5	4	15	-	24	20	20%
K3	-	4	20	20	44	36.66	38%
K4	-	-	5	30	35	29.17	29%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF MICROBIOLOGY				CLASS: I M.Sc. MICROBIOLOGY				
Sem.	Course type	Course code	Course title	Credits	Contact hours/week	CIA	Ext	Total
I	DISCIPLINE ELECTIVE - II	25P1RECT2	HERBAL TECHNOLOGY AND COSMETIC MICROBIOLOGY	3	5	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	✓

Objectives:

- Impart knowledge of Indian Medicinal Plants and their applications in microbiology.
 - Promote the technical skills involved in preparation of different types of plant extracts.
 - Explain methods to analyze the antimicrobial activity of medicinal plants.
 - Acquire knowledge on cosmetic microbiology and role of microorganisms in cosmetics.
- Gain insight into pharmacopeial microbial assays and biosafety.

Unit	Description	Hours	K-level	CLO
I	Herbs, Herbal medicine - Indian medicinal plants: Scope and Applications of Indian medicinal plants in treating bacterial, fungal and viral diseases. Basic principles involved in Ayurvedha, Sidha, Unani and Homeopathy.	15	K3	CLO 1
II	Collection and authentication of selected Indian medicinal plants: <i>Emblica officinalis</i> , <i>Withania somnifera</i> , <i>Phyllanthus amarus</i> , <i>Tinospora cordifolia</i> , <i>Andrographis paniculata</i> , <i>Piper longum</i> , <i>Ocimum sanctum</i> , <i>Azardirchata indica</i> , <i>Terminalia chebula</i> , <i>Allium sativum</i> . Preparation of extracts- Hot and cold methods. Preparation of stock solutions.	15	K3	CLO 2
III	Antimicrobial activity of selected Indian medicinal Plants: - In vitro determination of antibacterial and fungal activity of selected whole medicinal plants/ parts – well-diffusion methods. MIC - Macro and micro dilution techniques. Antiviral activity- cell lines- cytotoxicity, cytopathic and non-cytopathic effect.	15	K4	CLO 3

IV	History of Cosmetic Microbiology – Need for cosmetic microbiology, Scope of cosmetic microbiology, - Role of microbes in cosmetic preparation. Preservation of cosmetics. Antimicrobial properties of natural cosmetic products – Garlic, neem, turmeric, aloe vera and tulsi. Sanitary practices in cosmetic manufacturing - HACCP protocols in cosmetic microbiology.	15	K4	CLO 4
V	Cosmetic microbiology test methods - Antimicrobial preservative efficacy, microbial content testing and biological toxicological testing. Validation methods - bioburden and Pharmacopeial microbial assays. Preservatives of cosmetics - Global regulatory and toxicological aspect of cosmetic preservatives.	15	K4	CLO 5

Books for Study:

1. Ayurvedic Formulary of India. (2011). Part 1, 2 & 3. Pharmacopoeia
2. Commission for Indian Medicine and Homeopathy. ISBN10:8190648977.
3. Panda H. (2004). Handbook on herbal medicines. Asia Pacific Business Press Inc. ISBN:8178330911.
4. Mehra P. S. (2019). A Textbook of Pharmaceutical Microbiology. Dreamtech Press. ISBN 13:9789389307344.
5. Geis P. A. (2020). Cosmetic microbiology: A Practical Approach. (3rd Edition). CRC Press. ISBN:9780429113697.
6. Brannan D. K. (1997). Cosmetic microbiology: A Practical Handbook. CRC Press. ISBN-10:0849337135.

Books for References:

1. Indian Herbal Pharmacopoeia (2002). Vol. I & II Indian Drug Manufacturers Association, Mumbai.
2. British Herbal Pharmacopoeia.(1990).Vol.I. British Herbal Medicine Association.ISBN: 0903032090.
3. Verpoorte R. and Mukherjee, P. K. (2010). GMP for Botanicals: Regulatory and Quality issues on Phytomedicines. In GMP for botanicals: regulatory and quality issues on

phytomedicines. (2nd edition). Saujanya Books, Delhi. ISBN-10:81-900788-5-2/8190078852. ISBN-13:978-81-900788-5-6/9788190078856.

4. Turner R. (2013). Screening methods in Pharmacology. Elsevier. ISBN:9781483264233.
5. Cupp M. J. (2010). Toxicology and Clinical Pharmacology of Herbal Products (pp. 85-93). M. J. Cupp. Humana Press. Totowa, NJ, USA. ISBN-10:1617371904.

Web Resources

1. https://www.academia.edu/50236711/Modern_Extraction_Methods_for_Preparation_of_Bioactive_Plant_Extracts
2. https://www.nhp.gov.in/introduction-and-importance-of-medicinal-plants-and-herbs_mtl
3. <https://pubmed.ncbi.nlm.nih.gov/17004305/>
4. <https://www.fda.gov/cosmetics/potential-contaminants-cosmetics/microbiological-safety-and-cosmetics>
5. <https://pubmed.ncbi.nlm.nih.gov/15156038/>

Rationale for Nature of the course

The beneficiary earns knowledge on herbal, herbal derived products on processing, quality checking and standardization.

Activities having direct bearing on Skill development / Employability Entrepreneurship

The learners get employment in herbal based industries as trainer, quality analyst, research and development in processing unit.

Pedagogy

Chalk and Talk, PPT, Group discussion, Seminar

Course Designer:

Mr. J. Amala Jeyakumar

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Herbs, Herbal medicine - Indian medicinal plants:	5	Chalk and Talk, PPT, Group discussion, Seminar
	Scope and Applications of Indian medicinal plants in treating bacterial, fungal and viral diseases.	5	
	Basic principles involved in Ayurvedha, Sidha, Unani and Homeopathy.	5	
Unit II	Collection and authentication of selected Indian medicinal plants: Emblica officinalis, Withania somnifera, Phyllanthus amarus, Tinospora cordifolia, Andrographis paniculata,	5	Chalk and Talk, PPT, Group discussion, Seminar
	Collection and authentication of selected Indian medicinal plants : Piper longum, Ocimum sanctum, Azardirchata indica, Terminalia chebula, Allium sativum.	5	
	Preparation of extracts- Hot and cold methods. Preparation of stock solutions.	5	
Unit III	Antimicrobial activity of selected Indian medicinal Plants: - In vitro determination of antibacterial and fungal activity of selected whole medicinal plants/ parts	5	Chalk and Talk, PPT, Group discussion, Seminar
	Well-diffusion methods. MIC - Macro and micro dilution techniques.	5	
	Antiviral activity- cell lines- cytotoxicity, cytopathic and non-cytopathic effect.	5	
Unit IV	History of Cosmetic Microbiology – Need for cosmetic microbiology, Scope of cosmetic microbiology, - Role of microbes in cosmetic preparation.	5	Chalk and Talk, PPT, Group discussion, Seminar
	Preservation of cosmetics. Antimicrobial properties of natural cosmetic products – Garlic, neem, turmeric, aloe vera and tulsi.	5	
	Sanitary practices in cosmetic manufacturing - HACCP protocols in cosmetic microbiology.	5	
Unit V	Cosmetic microbiology test methods - Antimicrobial preservative efficacy, microbial content testing and biological toxicological testing.	5	Chalk and Talk, PPT, Group discussion, Seminar
	Validation methods - bioburden and Pharmacopeial microbial assays.	5	
	Preservatives of cosmetics - Global regulatory and toxicological aspect of cosmetic preservatives.	5	

Course Learning Outcomes:

On completion of this course the students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Identify the applications of Indian medicinal plants in treating diseases.	K-3
CLO-2	Identify and authenticate herbal plants.	K-3
CLO-3	Evaluate the antimicrobial activity of medicinal plants.	K-4
CLO-4	Describe the role of microorganisms and their metabolites in the preparation of cosmetics.	K-4
CLO-5	Validate procedures and biosafety measures in the mass production of cosmetics.	K-4

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

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

Blueprint for Semester Examination

Learning Outcome Based Education & Assessment (LOBE) 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 K-3	2	K1 & K2	1	K1	2 (K1&K2)	1(K3)
2	CLO 2	Up to K-3	2	K1 & K2	1	K3	2 (K1&K2)	1(K3)
3	CLO 3	Up to K-4	2	K1 & K2	1	K2	2 (K3&K3)	1(K4)
4	CLO 4	Up to K-4	2	K1 & K2	1	K2	2 (K3&K4)	1(K4)
5	CLO 5	Up to K-4	2	K1 & K2	1	K3	2 (K2&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 without choice	Consolidated
K1	5	2	10	-	17	14.17	14%
K2	5	4	15	-	24	20	20%
K3	-	4	20	20	44	36.66	38%
K4	-	-	5	30	35	29.17	29%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF MICROBIOLOGY				CLASS: I M.Sc. MICROBIOLOGY				
Sem.	Course type	Course code	Course title	Credits	Contact hours/week	CIA	Ext	Total
I	DISCIPLINE ELECTIVE - II	25P1RECT2	ESSENTIALS OF LABORATORY MANAGEMENT AND BIOSAFETY	3	5	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	

Objectives:

- Impart knowledge of Indian Medicinal Plants and their applications in microbiology.
- Promote the technical skills involved in preparation of different types of plant extracts.
- Explain methods to analyze the antimicrobial activity of medicinal plants.
- Acquire knowledge on cosmetic microbiology and role of microorganisms in cosmetics.
- Gain insight into pharmacopeial microbial assays and biosafety.

Unit	Description	Hours	K-level	CLO
I	Introduction to the laboratory and laboratory hazards - General laboratory facilities – Occupational safety- Lab accidents - Fires, chemical burns, slips and falls, Animal bites. Cuts from broken glass. Toxic fume inhalation. General laboratory rules, Good laboratory practice (GLP). Laboratory plan.	15	K2	CLO 1
II	Common hazards in laboratory: Chemical hazards- Safe handling of chemicals and gases, hazard labels and symbols. Material safety datasheet (MSDS), Chemical handling - Fume hood, Storage of chemicals. Chemical Waste Disposal Guideline. Physical hazards - Physical agent data sheets (PADS), Electric hazards- Electrical shock, Electrical explosions, Electrical burns. Safe work practices. Potential ignition sources in the lab. Stages of Fire. Fire Extinguishers. Fire Response.	15	K3	CLO 2

III	Prevention and First aid for laboratory accidents. Personal protective equipment (PPE), Proper attire (Eye/Face Protection, laboratory coats, gloves, respirators. Disposal/Removal of PPE. Emergency equipment safety - Showers/ Eye Washes. Laboratory security and emergency response. First aid for - Injuries caused by broken glass, Acid/Alkali splashes on the skin, swallowing acid/alkali, burns caused by heat, electric shock.	15	K4	CLO 3
IV	Biosafety - Historical background. Blood borne pathogens (BBP) and laboratory - acquired infections. Introduction to biological safety cabinets. Primary containment for biohazards. Biosafety levels of specific microorganisms. Recommended biosafety. Levels for infectious agents and infected animals. Risk groups with examples - Risk assessment. Safety levels. Case studies - Safe working, hand hygiene. Laboratory instruments, packing, sending, transport, import and export of biological agents. Hygiene, disinfection, decontamination, sterilization.	15	K4	CLO 4
V	Biosafety regulations and guidelines. Centers for disease control and prevention and the National institutes of health. Occupational safety and health administration. Recombinant DNA advisory committee (RDAC), Institutional biosafety committee (IBSC), Review committee on genetic manipulation (RCGM), Genetic engineering approval committee (GEAC). Implementation of biosafety guidelines.	15	K4	CLO 5

Books for Study:

1. Sateesh M. K. (2013). Bioethics and Biosafety, IK International Pvt Ltd. ISBN: 8190675702.
2. Muthuraj M. and Usharani B. (2019). Biosafety in Microbiological Laboratories. (1st Edition). Notion Press. ISBN 10: 1645878856

3. Biosafety in Microbiological and Biomedical Laboratories - U.S. Health Department and Human Services. (2016). (5th Edition). Lulu.com.
4. Kanai. L. Mukherjee. (Medical Laboratory Technology (4th Edition). CBS Publishers.
5. Ramakrishnan (2012). Manual of Medical Laboratory Techniques. JP brothers

Books for References:

1. World Health Organization, Biosafety programme management. (2010). (4th Edition). WHO Publications.
2. Rashid N. (2013). Manual of Laboratory Safety (Chemical,
3. Radioactive, and Biosafety with Biocides) (1st Edition).
4. Dayuan X. (2015). Biosafety and Regulation for Genetically Modified Organisms, Alpha Science International Ltd, ISBN-10 : 1842657917
5. Ochei J. Kolhatkar(2000). A. (Medical Laboratory Science – Theory and Practice. ISBN; 13:978-0074632239.
6. Lynne S. Garcia. Clinical Laboratory Management (2nd Edition). ASM Press

Web Resources

1. <https://www.cdc.gov/labs/pdf/CDCBiosafetymicrobiologicalBiomedicalLaboratories-2009-P.pdf>
2. https://ucanaplym.s3.ap-south.amazonaws.com/RGU/notifications/E_learning/Online_study/PG-SEM-IV-Biosafety%20regulation.pdf
3. <https://consteril.com/biosafety-levels-difference/>
4. <https://www.cdc.gov/labs/pdf/CDCBiosafetymicrobiologicalBiomedicalLaboratories-2009-P.pdf>
5. <https://www.who.int/publications/i/item/9789240011311>

Rationale for Nature of the course

This course is fundamentally critical as it equips laboratory personnel with essential knowledge and skills to protect themselves, their colleagues, and the environment from various laboratory hazards including chemical, physical, and biological risks. Understanding and implementing proper safety protocols, regulatory compliance, and emergency response procedures is crucial not only for preventing accidents but also for ensuring the integrity of scientific work while maintaining a secure laboratory environment.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Group discussion, Model Making and Mini-project.

Pedagogy

Chalk and talk, PPT, group discussion, seminar, screening of educational videos, quiz, peer teaching and learning, ICT enabled teaching.

Course Designer(s):

Dr. M. Rajesh Kannan

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Introduction to the laboratory and laboratory hazards - General laboratory facilities – Occupational safety- Lab accidents - Fires, chemical burns, slips and falls, Animal bites. Cuts from broken glass	8	Chalk and talk PPT/video presentation
	Toxic fume inhalation. General laboratory rules, Good laboratory practice (GLP). Laboratory plan.	7	
Unit II	Common hazards in laboratory: Chemical hazards- Safe handling of chemicals and gases, hazard labels and symbols. Material safety datasheet (MSDS), Chemical handling - Fume hood, Storage of chemicals. Chemical Waste Disposal Guideline.	8	Chalk and talk PPT/video presentation
	Physical hazards - Physical agent data sheets (PADS), Electric hazards- Electrical shock, Electrical explosions, Electrical burns. Safe work practices. Potential ignition sources in the lab. Stages of Fire. Fire Extinguishers. Fire Response.	7	
Unit III	Prevention and First aid for laboratory accidents. Personal protective equipment (PPE), Proper attire (Eye/Face Protection, laboratory coats, gloves, respirators. Disposal/Removal of PPE.	8	Chalk and talk PPT/video presentation
	Emergency equipment safety - Showers/ Eye Washes. Laboratory security and emergency response. First aid for - Injuries caused by broken glass, Acid/Alkali splashes on the skin, swallowing acid/alkali, burns caused by heat, electric shock.	7	
Unit IV	Biosafety - Historical background. Blood borne pathogens (BBP) and laboratory - acquired infections. Introduction to biological safety cabinets. Primary containment for biohazards. Biosafety levels of specific microorganisms. Recommended biosafety. Levels for infectious agents and infected animals. Risk groups with examples	8	Chalk and talk PPT/video presentation
	Risk assessment. Safety levels. Case studies - Safe working, hand hygiene. Laboratory instruments, packing, sending, transport, import and export of biological agents. Hygiene, disinfection, decontamination, sterilization.	7	
Unit V	Biosafety regulations and guidelines. Centers for disease control and prevention and the National institutes of health. Occupational safety and health administration. Recombinant DNA advisory committee(RDAC),	8	Chalk and talk PPT/video presentation
	Institutional biosafety committee(IBSC), Review committee on genetic manipulation(RCGM), Genetic engineering approval committee (GEAC). Implementation of biosafety guidelines.	7	

Course Learning Outcomes:

On completion of this course the students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Employ skills on laboratory safety and avoid laboratory accidents	K2
CLO-2	Prevent laboratory hazards by practicing safety strategies.	K3
CLO-3	Practice various first aid procedures during common laboratory accidents.	K4
CLO-4	Ensure biosafety strategies in laboratory.	K4
CLO-5	Recognize the importance of biosafety guidelines.	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	3
CLO-3	3	3	3	3	3
CLO-4	3	3	3	3	3
CLO-5	3	3	3	3	3

Mapping of CLOs with POs

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

Advance application– 3;

Intermediate level–2;

Basic level–1

Blueprint for Semester Examination

Learning Outcome Based Education & Assessment (LOBE) 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 K-2	2	K1 & K2	1	K1	2 (K1&K2)	1(K2)
2	CLO 2	Up to K-3	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
3	CLO 3	Up to K-4	2	K1 & K2	1	K2	2 (K3&K3)	1(K4)
4	CLO 4	Up to K-4	2	K1 & K2	1	K2	2 (K4&K4)	1(K4)
5	CLO 5	Up to K-4	2	K1 & K2	1	K2	2 (K2&K2)	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	5	-	14	11.7	12%
K2	5	6	15	10	36	30	30%
K3	-	-	20	10	30	25	25%
K4	-	-	10	30	40	33.3	33%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF MICROBIOLOGY				CLASS: I M.Sc. MICROBIOLOGY				
Sem.	Course type	Course code	Course title	Credits	Contact hours/week	CIA	Ext	Total
I	NME - I	25P1RSEN1	MICROBIAL WORLD	2	2	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented		Entrepreneurship Oriented	

Objectives:

- To know the structure and nomenclature of microorganisms
- To impart basic knowledge on history of microbiology.
- To identify the uses of environmentally friendly microorganisms
- To know the beneficial aspects of microbes
- To study harmful aspects of microbes

Unit	Description	Hours	K-level	CLO
I	Basic structure and properties of microorganisms Introduction – types, structure and properties of microorganisms- bacteria, fungi, microscopic algae, protozoan and viruses	6	K2	CLO 1
II	Contribution of scientists in the field of microbiology History of Microbiology – Anton van Leeuwenhock – spontaneous generation of organisms, contributions by Redi, Spallanzani, Louis Pasteur, Robert Koch, Edward Jenner and Alexander Fleming in the field of Microbiology.	6	K2	CLO 2
III	Interaction of microbes with environment Role and significance of microbes in the environment – superbugs, Biogeochemical cycle, Biogas, Bio-fertilizer, biological control, Bio-remediation.	6	K2	CLO 3
IV	Significant aspects of microbes Beneficial aspects of microbes- any four important uses and its economic importance with specific examples from Algae, Fungi and Bacteria.	6	K2	CLO 4
V	Adverse effects of microbes Harmful aspects of microbes – any four harmful effects of Fungi, Bacteria and viruses with specific examples	6	K2	CLO 5

Books for Study:

1. Pelczar, Jr. M.J., Chan, E.C.S. and Kreig, N.R. (2006). Microbiology. 5th Edition. McGraw Hill Inc., New York.
2. Dubey, R.C. (2004). Basic Microbiology, S.Chand Publications, New Delhi.

Books for References:

1. Hurst, C.J., Crawford, R.L., Garland, J.L., Lipson, D.A. and Mills, A.L. (2002). Manual of Environmental Microbiology, 2nd Edition. . ASM Press, New Delhi.
2. Atlas, R.A. (1995). Principles of Microbiology. Mosby Publications, USA.
3. Madigan, M.T. and Martinko, J.M. (2014). Brock Biology of Microorganisms. 14th Edition. Prentice Hall International Inc., USA.

Web Resources

1. <https://microbiologyinfo.com/category/basic-microbiology/>
2. <https://microbiologyinfo.com/category/basic-microbiology/>
3. <https://www.britannica.com/science/microbiology>

Rationale for Nature of the course

Microorganisms play a vital role in nutrient cycling, biodegradation, climate changes and in making life-saving drugs and manufacture of biofuels. Bio-treatment of waste has become environmentally friendly alternative to other options. Microbes are also known to cause deadly disease and cause an adverse impact on other living organisms

Activities having direct bearing on Skill development / Employability Entrepreneurship

Determination of the morphological characteristic of microorganisms, Categories environmentally friendly microbes, Microbial adverse effects on other life.

Pedagogy

Chalk and talk, PPT, Group discussion, Seminar, Screening of educational videos and quiz

Course Designer(s):

Mrs. N. Sumathy

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Basic structure and properties of microorganisms Introduction – types, structure	3	Chalk and talk PPT/video presentation
	Properties of microorganisms- bacteria, fungi, microscopic algae, protozoan and viruses	3	
Unit II	Contribution of scientists in the field of microbiology History of Microbiology – Anton van Leeuwenhock – spontaneous generation of organisms.	3	Chalk and talk PPT/video presentation
	Contributions by Redi, Spallanzani, Louis Pasteur, Robert Koch, Edward Jenner and Alexander Fleming in the field of Microbiology.	3	
Unit III	Interaction of microbes with environment Role and significance of microbes in the environment – superbugs	3	Chalk and talk PPT/video presentation
	Biogeochemical cycle, Biogas, Bio-fertilizer, Biological control, Bio-remediation.	3	
Unit IV	Significant aspects of microbes Beneficial aspects of microbes- any four important uses	3	Chalk and talk Group discussion
	Economical importance with specific examples from Algae, Fungi and Bacteria.	3	
Unit V	Adverse effects of microbes Harmful aspects of microbes – any four harmful effects of Fungi	3	Chalk and talk PPT/video presentation
	Bacteria and viruses with specific examples	3	

Course Learning Outcomes:

On completion of this course the students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Explain the morphological and cultural characteristics of microorganisms	K2
CLO-2	Understand the contributions of scientists in the field of microbiology	K2
CLO-3	Summarize application of microorganisms in bioremediation	K2
CLO-4	Understand the beneficial aspects of microbes	K2
CLO-5	Classify the harmful microbial characteristics of microbes	K2

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

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

Advance application– 3;

Intermediate level–2;

Basic level–1

Blueprint for Semester Examination

Learning Outcome Based Education & Assessment (LOBE) 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 K-2	2	K1 & K2	1	K1	2 (K1&K2)	1(K1)
2	CLO 2	Up to K-2	2	K1 & K2	1	K1	2 (K1&K2)	1(K1)
3	CLO 3	Up to K-2	2	K1 & K2	1	K2	2 (K1&K2)	1(K2)
4	CLO 4	Up to K-2	2	K1 & K2	1	K2	2 (K1&K2)	1(K2)
5	CLO 5	Up to K-2	2	K1 & K2	1	K2	2 (K1&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

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	10	2	5	2	59	49.1	100%
K2	-	3	5	3	61	50.9	
Total Marks	10	5	50	50	120	100.00	100%

DEPARTMENT OF MICROBIOLOGY				CLASS: I M.Sc. MICROBIOLOGY				
Sem.	Course type	Course code	Course title	Credits	Contact hours /week	CIA	Ext	Total
II	CORE - III	25P2RCCT3	MEDICAL BACTERIOLOGY AND MYCOLOGY	5	6	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented		Entrepreneurship Oriented	

Objectives:

- Acquire Knowledge on collection, transportation and processing of various kinds of clinical specimens.
- Explain morphology, characteristics and pathogenesis of bacteria.
- Discuss various factors leading to pathogenesis of bacteria.
- Acquire knowledge on antifungal agents and their importance.
- Describe various diagnostic methods available for fungal disease diagnosis.

Unit	Description	Hours	K-level	CLO
I	Classification of medically important bacteria, Normal flora of human body, Collection, transport, storage and processing of clinical specimens, Microbiological examination of clinical specimens, antimicrobial susceptibility testing. Handling and maintenance of laboratory animals – Rabbits, guinea pigs and mice.	18	K3	CLO 1
II	Morphology, classification, characteristics, pathogenesis, laboratory diagnosis and treatment of diseases caused by species of <i>Staphylococci</i> , <i>Streptococci</i> , <i>Pneumococci</i> , <i>Neisseriae</i> , <i>Bacillus</i> , <i>Corynebacteria</i> , <i>Mycobacteria</i> and <i>Clostridium</i> .	18	K3	CLO 2
III	Morphology, classification, characteristics, pathogenesis, laboratory diagnosis and treatment of diseases caused by Enterobacteriaceae members, <i>Yersinia</i> , <i>Pseudomonas</i> , <i>Vibrio</i> , <i>Mycoplasma</i> , <i>Helicobacter</i> , <i>Rickettsiae</i> , <i>Chlamydiae</i> , <i>Bordetella</i> , <i>Francisella</i> ., <i>Spirochaetes- Leptospira</i> , <i>Treponema</i> and <i>Borrelia</i> . Nosocomial, zoonotic and opportunistic infections - prevention and control.	18	K4	CLO 3

IV	Morphology, taxonomy and classification of fungi. Detection and recovery of fungi from clinical specimens. Dermatophytes and agents of superficial mycoses. <i>Trichophyton</i> , <i>Epidermophyton</i> & <i>Microsporum</i> . Yeasts of medical importance – <i>Candida</i> , <i>Cryptococcus</i> . Mycotoxins. Antifungal agents, testing methods and quality control.	18	K4	CLO 4
V	Dimorphic fungi causing Systemic mycoses, <i>Histoplasma</i> , <i>Coccidioides</i> , <i>Sporothrix</i> , <i>Blastomyces</i> . Fungi causing Eumycotic Mycetoma, Opportunistic fungi- Fungi causing secondary infections in immunocompromised patients. Immunodiagnostic methods in mycology- Recent advancements in diagnosis. Antifungal agents.	18	K4	CLO 5

Books for Study:

1. Kanunga R. (2017). Ananthanarayanan and Panicker's Text book of Microbiology.(2017).Orient Longman, Hyderabad.
2. Greenwood, D., Slack, R. B. and Peutherer, J. F. (2012) Medical Microbiology, (18th Edition). Churchill Livingstone, London.
3. Finegold, S. M. (2000) Diagnostic Microbiology, (10th Edition). C.V. Mosby Company, St. Louis.

Books for References:

1. Salle A. J. (2007). Fundamental Principles of Bacteriology. (4th Edition). Tata McGraw-Hill Publications.
2. Collee J.C. Duguid J.P. Foraser, A.C, Marimon B.P, (1996). Mackie & McCartney Practical Medical Microbiology. 14thedn, Churchill Livingston.
3. Cheesbrough M. (2006). District Laboratory Practice in Tropical countries.- Part 22ndedn.Cambridge University Press.
4. Topley and Wilson's. (1998). Principles of Bacteriology.9th edn. Edward Arnold, London..
5. Murray P.R., Rosenthal K.S. and Michael A. (2013). Medical Microbiology. Pfaller. 7th edn. Elsevier, Mosby Saunders.

Web Resources

1. <http://textbookofbacteriology.net/nd>
2. <https://microbiologysociety.org/members-outreach-resources/links.html>
3. <https://www.pathselective.com/micro-resources>
4. <http://mycology.cornell.edu/fteach.html>
5. <https://www.adelaide.edu.au/mycology/>

Rationale for Nature of the course

Students will be able to determine various ways to treat diseases caused but also finds measures that can be used to prevent or at least minimize infection rates.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Employ various methods to detect microbes in clinical samples and apply knowledge on diagnosis.

Pedagogy

Chalk and talk, PPT, Group discussion, Seminar, Screening of educational videos and quiz

Course Designer:

Dr. P. N. Rajarajan

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Classification of medically important bacteria, Normal flora of human body, Collection, transport, storage.	6	Chalk and talk, PPT, Group discussion
	Sample processing of clinical specimens, Microbiological examination of clinical specimens, antimicrobial susceptibility testing.	6	
	Handling and maintenance of laboratory animals – Rabbits, guinea pigs and mice.	6	
Unit II	Morphology, classification, characteristics, pathogenesis, laboratory diagnosis and treatment of diseases caused by species of <i>Staphylococci</i> , <i>Streptococci</i> ,	6	Chalk and talk, PPT, Group discussion, Seminar
	Morphology, classification, characteristics, pathogenesis, laboratory diagnosis and treatment of diseases caused by species of <i>Pneumococci</i> , <i>Neisseriae</i> , <i>Bacillus</i> , <i>Corynebacteria</i> ,	6	
	Morphology, classification, characteristics, pathogenesis, laboratory diagnosis and treatment of diseases caused by species of <i>Mycobacteria</i> and <i>Clostridium</i> .	6	
Unit III	Morphology, classification, characteristics, pathogenesis, laboratory diagnosis and treatment of diseases caused by Enterobacteriaceae members, <i>Yersinia</i> , <i>Pseudomonas</i>	5	Chalk and talk, PPT, Group discussion
	Morphology, classification, characteristics, pathogenesis, laboratory diagnosis and treatment of diseases caused by Enterobacteriaceae members of <i>Vibrio</i> , <i>Mycoplasma</i> , <i>Helicobacter</i> , <i>Rickettsiae</i> , <i>Chlamydiae</i> , <i>Bordetella</i> ,	4	
	Morphology, classification, characteristics, pathogenesis, laboratory diagnosis and treatment of diseases caused by <i>Francisella</i> ., <i>Spirochaetes- Leptospira</i> , <i>Treponema</i> and <i>Borrelia</i> .	5	
	Nosocomial, zoonotic and opportunistic infections - prevention and control.	4	
Unit IV	Morphology, taxonomy and classification of fungi. Detection and recovery of fungi from clinical specimens.	6	Chalk and talk, PPT, Group discussion, Seminar
	Dermatophytes and agents of superficial mycoses. <i>Trichophyton</i> , <i>Epidermophyton</i> & <i>Microsporum</i> .	6	
	Yeasts of medical importance – <i>Candida</i> , <i>Cryptococcus</i> . Mycotoxins. Antifungal agents, testing methods and quality control.	6	

Unit V	Dimorphic fungi causing Systemic mycoses, <i>Histoplasma</i> , <i>Coccidioides</i> , <i>Sporothrix</i> , <i>Blastomyces</i> .	6	Chalk and talk, PPT, Group discussion, Seminar
	Fungi causing Eumycotic Mycetoma, Opportunistic fungi- Fungi causing secondary infections in immunocompromised patients.	6	
	Immunodiagnostic methods in mycology- Recent advancements in diagnosis. Antifungal agents.	6	

Course Learning Outcomes:

On completion of this course the students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Collect, transport and process of various kinds of clinical specimens.	K2
CLO-2	Analyze various bacteria based on morphology and pathogenesis.	K3
CLO-3	Discuss various treatment methods for bacterial disease.	K4
CLO-4	Employ various methods detect fungi in clinical samples and apply knowledge on antifungal agents.	K4
CLO-5	Apply various immunodiagnostic method to detect fungal infections.	K4

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

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

Advance application– 3;

Intermediate level–2;

Basic level–1

Blueprint for Semester Examination

Learning Outcome Based Education & Assessment (LOBE) 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 K-3	2	K1 & K2	1	K1	2 (K1&K2)	1(K3)
2	CLO 2	Up to K-3	2	K1 & K2	1	K3	2 (K1&K2)	1(K3)
3	CLO 3	Up to K-4	2	K1 & K2	1	K2	2 (K3&K3)	1(K4)
4	CLO 4	Up to K-4	2	K1 & K2	1	K2	2 (K3&K4)	1(K4)
5	CLO 5	Up to K-4	2	K1 & K2	1	K3	2 (K2&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 without choice	Consolidated
K1	5	2	10	-	17	14.17	14%
K2	5	4	15	-	24	20	20%
K3	-	4	20	20	44	36.66	38%
K4	-	-	5	30	35	29.17	29%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF MICROBIOLOGY				CLASS: I M.Sc. MICROBIOLOGY				
Sem.	Course type	Course code	Course title	Credits	Contact hours/week	CIA	Ext	Total
II	CORE - IV	25P2RCCT4	MEDICAL VIROLOGY AND PARASITOLOGY	5	6	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented		Entrepreneurship Oriented	

Objectives:

- Describe the replication strategy and cultivation methods of viruses.
- Acquire knowledge about oncogenic virus and human viral infections.
- Develop diagnostic skills, in the identification of virus infections.
- Impart knowledge about parasitic infections.
- Develop diagnostic skills, in the identification of parasitic infections.

Unit	Description	Hours	K-level	CLO
I	General properties of viruses - Structure and Classification - viroids, prions, satellite RNAs and virusoids. Cultivation of viruses - embryonated eggs, experimental animals and cell cultures. Purification and Assay of viruses – Physical and Chemical methods (Electron Microscopy, Protein and Nucleic acids studies) Infectivity Assays (Plaque and end-point).	18	K2	CLO 1
II	Virus Entry, Host Defenses Against Viral Infections, Epidemiology, pathogenic mechanisms, Pathogenesis, laboratory diagnosis, treatment for the following viruses: DNA Viruses- Pox, Herpes, Adeno, Papova and Hepadna, RNA Viruses- Picorna, Orthomyxo, Paramyxo, Rhabdo, Rota, HIV and other Hepatitis viruses, Arbo – Dengue virus, Ebola virus, Emerging and reemerging viral infections.	18	K3	CLO 2
III	Bacterial viruses - ΦX 174, M13, MU, T4, lambda, Pi; Structural organization, life cycle and phage production. Lysogenic cycle-typing and application in bacterial genetics. Diagnosis of viral infections –conventional serological and molecular methods. Antiviral agents and viral vaccines.	18	K4	CLO 3

IV	Introduction to Medical Parasitology – Classification, host-parasite relationships. Epidemiology, life cycle, pathogenic mechanisms, laboratory diagnosis, treatment for the following: Protozoa causing human infections – <i>Entamoeba</i> , Aerobic and Anaerobic amoebae, <i>Giardia</i> , <i>Trichomonas</i> , <i>Balantidium</i> . <i>Toxoplasma</i> , <i>Cryptosporidium</i> , <i>Leishmania</i> , and <i>Trypanasoma</i> .	18	K4	CLO 4
V	Classification, life cycle, pathogenicity, laboratory diagnosis and treatment for parasites – Helminthes - Cestodes – <i>Taenia solium</i> , <i>T. Saginata</i> , <i>T. Echinococcus</i> . Trematodes – <i>Fasciola hepatica</i> , <i>Fasciolopsis buski</i> , <i>Paragonimus</i> , <i>Schistosomes</i> . Nematodes - <i>Ascaris</i> , <i>Ankylostoma</i> , <i>Trichuris</i> , <i>Trichinella</i> , <i>Enterobius</i> , <i>Strongyloides</i> and <i>Wuchereria</i> . Other parasites causing infections in immune compromised hosts and AIDS. Cultivation of parasites. Diagnosis of parasitic infections – Serological and molecular diagnosis. Antiprotozoan drugs.	18	K4	CLO 5

Books for Study:

1. Kanunga R. (2017). Ananthanarayanan and Panicker's Text book of Microbiology. (10th Edition). Universities Press (India) Pvt. Ltd.
2. Dubey, R.C. and Maheshwari D.K. (2010). A Text Book of Microbiology. S. Chand & Co.
3. Rajan S. (2007). Medical Microbiology. MJP publisher.
4. Paniker J. (2006). Text Book of Parasitology. Jay Pee Brothers, New Delhi.
5. 5.Arora, D. R. and Arora B. B. (2020). Medical Parasitology. (5th Edition). CBS Publishers & Distributors Pvt. Ltd. New Delhi.

Books for References:

1. Carter J. (2001). Virology: Principles and Applications (1st Edition). Wiley Publications.
2. Willey J., Sandman K. and Wood D. Prescott's Microbiology. (11th Edition). McGraw Hill Book.
3. Jawetz E., Melnick J. L. and Adelberg E. A. (2000). Review of Medical Microbiology. (19th Edition). Lange Medical Publications, U.S.A.
4. Finegold S.M. (2000). Diagnostic Microbiology. (10th Edition). C.V. Mosby Company, St. Louis.

5. Levanthal R. and Cheadle R. S. (2012). Medical Parasitology. (6th Edition). S.A. Davies Co. Philadelphia.

Web Resources

1. <https://en.wikipedia.org/wiki/Virology>
2. <https://academic.oup.com/femsre/article/30/3/321/546048>
3. <https://www.sciencedirect.com/science/article/pii/S0042682215000859>
4. <https://nptel.ac.in/courses/102/103/102103039/>
5. <https://www.healthline.com/health/viral-diseases#contagiousness>

Rationale for Nature of the course

Identify viral and parasitic infections and able to do serological and molecular diagnosis.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Case study, project model

Pedagogy

Chalk and talk, PPT, Group Discussion, Seminar

Course Designer(s):

Mrs.N.Sumathy

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	General properties of viruses - Structure and Classification - viroids, prions, satellite RNAs and virusoids.	5	Chalk and Talk
	Cultivation of viruses - embryonated eggs, experimental animals and cell cultures.	5	
	Purification and Assay of viruses – Physical and Chemical methods (Electron Microscopy, Protein and Nucleic acids studies)	4	
	Infectivity Assays (Plaque and end-point).	4	
Unit II	Virus Entry, Host Defenses Against Viral Infections, Epidemiology, pathogenic mechanisms, Pathogenesis, laboratory diagnosis, treatment for the following viruses: DNA Viruses- Pox, Herpes, Adeno, Papova and Hepadna ,	5	Chalk and Talk,PPT
	Virus Entry, Host Defenses Against Viral Infections, Epidemiology, pathogenic mechanisms, Pathogenesis, laboratory diagnosis, treatment for RNA Viruses- Picorna, Orthomyxo, Paramyxo, Rhabdo, Rota	5	
	Virus Entry, Host Defenses Against Viral Infections, Epidemiology, pathogenic mechanisms, Pathogenesis, laboratory diagnosis, treatment for HIV and other Hepatitis viruses, Arbo – Dengue virus,	4	
	Virus Entry, Host Defenses Against Viral Infections, Epidemiology, pathogenic mechanisms, Pathogenesis, laboratory diagnosis, treatment for Ebola virus, Emerging and reemerging viral infections.	4	
Unit III	Bacterial viruses - ΦX 174, M13, Structural organization, life cycle and phage production.	5	Chalk and Talk,PPT,Quiz
	Bacterial viruses - MU, T4, lambda, Pi; Structural organization, life cycle and phage production.	5	
	Lysogenic cycle-typing and application in bacterial genetics.	4	
	Diagnosis of viral infections –conventional serological and molecular methods. Antiviral agents and viral vaccines.	4	

Unit IV	Introduction to Medical Parasitology – Classification, host-parasite relationships. the following: Protozoa causing human infections – <i>Entamoeba</i> ,	5	Chalk and Talk, PPT, Quiz, Seminar
	Epidemiology, life cycle, pathogenic mechanisms, laboratory diagnosis, treatment for Aerobic and Anaerobic amoebae,	5	
	Epidemiology, life cycle, pathogenic mechanisms, laboratory diagnosis, treatment for <i>Giardia</i> , <i>Trichomonas</i> , <i>Balantidium</i> . <i>Toxoplasma</i> ,	4	
	Epidemiology, life cycle, pathogenic mechanisms, laboratory diagnosis, treatment for <i>Cryptosporidium</i> , <i>Leishmania</i> , and <i>Trypanasoma</i> .	4	
Unit V	Classification, life cycle, pathogenicity, laboratory diagnosis and treatment for parasites – Helminthes - Cestodes – <i>Taenia solium</i> ,	5	Chalk and Talk, PPT, Quiz, Seminar
	Classification, life cycle, pathogenicity, laboratory diagnosis and treatment for <i>T. Saginata</i> , <i>T. Echinococcus</i> . Trematodes – <i>Fasciola hepatica</i> , <i>Fasciolopsis buski</i> , <i>Paragonimus</i> , <i>Schistosomes</i> .	5	
	Nematodes - <i>Ascaris</i> , <i>Ankylostoma</i> , <i>Trichuris</i> , <i>Trichinella</i> , <i>Enterobius</i> , <i>Strongyloides</i> and <i>Wuchereria</i> . Other parasites causing infections in immune compromised hosts and AIDS.	4	
	Cultivation of parasites. Diagnosis of parasitic infections – Serological and molecular diagnosis. Antiprotozoan drugs.	4	

Course Learning Outcomes:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Cultivate viruses by different methods and aid in diagnosis. Perform purification and viral assay.	K2
CLO-2	Investigate the symptoms of viral infections and presumptively identify the viral disease.	K3
CLO-3	Diagnose various viral diseases by different methods. (serological, conventional and molecular)	K4
CLO-4	Educate public about the spread, control and prevention of parasitic diseases.	K4
CLO-5	Identify the protozoans and helminthes present in stool and blood specimens. Perform serological and molecular diagnosis of parasitic infections.	K4

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CLO-1	2	2	1	1	1	3
CLO-2	3	2	3	1	1	3
CLO-3	3	2	3	2	2	3
CLO-4	3	2	3	2	2	3
CLO-5	3	3	3	2	2	3

Mapping of CLOs with POs

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

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

Blueprint for Semester Examination

Learning Outcome Based Education & Assessment (LOBE) 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 K-2	2	K1 & K2	1	K1	2 (K1&K2)	1(K2)
2	CLO 2	Up to K-3	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
3	CLO 3	Up to K-4	2	K1 & K2	1	K2	2 (K3&K3)	1(K4)
4	CLO 4	Up to K-4	2	K1 & K2	1	K2	2 (K4&K4)	1(K4)
5	CLO 5	Up to K-4	2	K1 & K2	1	K2	2 (K2&K2)	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	5	-	14	11.7	12%
K2	5	6	15	10	36	30	30%
K3	-	-	20	10	30	25	25%
K4	-	-	10	30	40	33.3	33%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF MICROBIOLOGY				CLASS: I M.Sc. MICROBIOLOGY				
Sem.	Course type	Course code	Course title	Credits	Contact hours/week	CIA	Ext	Total
II	CORE PRACTICAL II	25P2RCCP2	MEDICAL MICROBIOLOGY	4	6	25	75	100

Nature of Course				
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented

Objectives:

- Develop skills in the diagnosis of bacterial infections and antimicrobial sensitivity.
- Impart knowledge on fungal infections and its diagnosis.
- Cultivation, identification and assay of viruses for diagnostics and vaccine production
- Diagnose parasitic infections.
- Identification of medically important vectors.

Unit	Description	Hours	K-level	CLO
I	Staining of clinical specimens - Wet mount, Differential and Special staining methods. Isolation and identification of bacterial pathogens from clinical specimens - cultivation in basal, differential, enriched, selective and special media – Biochemical identification tests. Enumeration of bacteria in urine to detect significant bacteriuria. Antimicrobial sensitivity testing - Kirby Bauer method and Stokes method. Minimum inhibitory concentration (MIC) test. Minimum bactericidal concentration (MBC) test.	18	K4	CLO 1
II	Identification and Classification of common fungi. Examination of different fungi by Lactophenol cotton blue staining. Examination of different fungi by KOH staining. Cultivation of fungi and their identification - <i>Mucor</i> , <i>Rhizopus</i> , <i>Aspergillus</i> , <i>Penicillium</i> . Microscopic observation of different asexual fungal spores. Microscopic observation of fungal fruiting bodies. Identification of Dermatophytes.	18	K4	CLO 2

III	Isolation and characterization of bacteriophage from natural sources by phage titration. Cultivation of viruses –Egg Inoculation methods. Diagnosis of Viral Infections –ELISA –HIA. Spotters of viral inclusions and CPE-stained smears.	18	K4	CLO 3
IV	Examination of parasites in clinical specimens - Ova/cysts in faeces. Concentration: methods – Flootation methods-simple Saturated salt solution method – Zinc sulphate methods - Sedimentation methods- Formal ether method. Blood smear examination for malarial parasites. Thin smear by Leishman's stain – Thick smear by J.B. stain.	18	K4	CLO 4
V	Identification of common arthropods of medical importance - spotters of <i>Anopheles</i> , <i>Glossina</i> , <i>Phlebotomus</i> , <i>Aedes</i> , Ticks and mites.	18	K4	CLO 5

Books for Study:

1. Cullimore D. R. (2010). Practical Atlas for Bacterial Identification, 2nd Edition. Publisher- Taylor and Francis.
2. Abbott A.C. (2010). The Principles of Bacteriology. Nabu Press.
3. Parija S. C. (2012). Textbook of Practical Microbiology. Ahuja Publishing House.
4. Cappuccino, J. and Sherman, N. (2002) Microbiology: A Laboratory Manual, (6th Edition). Pearson Education, Publication, New Delhi.
5. Morag C. and Timbury M.C. (1994). Medical Virology. 4th edn. Blackwell Scientific Publishers.

Books for References:

1. Collee J. G., Fraser A.G. Marmion B. P. and Simmons A. (1996). Mackie & McCartney Practical Medical Microbiology. (14th Edition). Elsevier, New Delhi.
2. Chart H. (2018). Practical Laboratory Bacteriology. CRC Press.
3. Moore V. A. (2017). Laboratory Directions for Beginners in
4. Bacteriology. Triste Publishing Ltd.
5. Cheesbrough M. (2006). District Laboratory Practice in Tropical countries.- Part 22nd Edition. Cambridge University Press.

6. Murray P.R., Rosenthal K.S. and Michael A. (2013). Medical Microbiology. Pfaller. 7th Edition. Elsevier, Mosby Saunders

Web Resources

1. <http://textbookofbacteriology.net/>
2. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7173454/>
3. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3768729>
4. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC149666/>
5. <https://www.intechopen.com/books/current-issues-in-molecular-virologyviral-genetics- and-biotechnological-applications/vaccines-andantiviral-agents>

Rationale for Nature of the course

Microbiology is one of the most significant fields in biology. The progress of microbiology has been seen in the fields of Agriculture, Environmental management, Medicine, Clinical research, Pharmacy and industries

Activities having direct bearing on Skill development / Employability Entrepreneurship

Learn to pursue experimental procedures. Extend skills to create answerable questions/hypotheses, forecast expected results. Find out how to make careful observations, collect and analyze data, and depict appropriate conclusions. Utilize hands on training in Medical microbiology

Pedagogy

Demonstration and practical session

Course Designer(s):

1. Dr.P.N.Rajarajan
2. Mrs.N.Sumathy

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Fundamentals of epidemiology - Definitions of epidemiology – Epidemiology of infectious diseases in Public Health. Natural history of disease - Historical aspects of epidemiology.	3	Chalk and Talk, PPT, Group discussion, Seminar
	Common risk factors - Epidemiologic Triad - Agent factors, host factors and environmental factors. Transmission basics - Chain of infection, portal of entry.	4	
	Modes of transmission - Direct and indirect. Stages of infectious diseases. Agents and vectors of communicable diseases of public health importance and dynamics of disease transmission.	4	
	Epidemiology of Zoonosis - Factors, routes of transmission of bacterial, viral, parasitic and fungal zoonotic agents. Control of zoonosis.	4	
Unit II	Tools of Epidemiology - Measures of Disease - Prevalence, incidence. Index case. Risk rates.	5	Chalk and Talk, PPT, Group discussion, Seminar
	Descriptive Epidemiology - Cohort studies, measuring infectivity, survey methodology including census procedures.	5	
	Surveillance strategies - Disease surveillance, geographical indication system, outbreak investigation in public health and contact investigation	5	
Unit III	Epidemiological aspects of diseases of national importance - Background to communicable and non-communicable diseases. Vector borne diseases in India. Diarrhoeal diseases. Zoonoses. Viral haemorrhagic fevers.	4	Chalk and Talk, PPT, Group discussion, Seminar
	Mycobacterial infections. Sexually transmitted diseases. Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome (HIV/AIDS).	3	
	Emerging disease threats - Severe Acute Respiratory Syndrome (SARS), Covid-19, Ebola, MDR-TB, Malaria, Mucor mycosis, Avian flu. Dengue, Swine Flu, Chikungunya.	4	
	Epidemiology, prevention, and control of non-communicable diseases - Asthma, Coronary heart disease, Malignancy, diabetes mellitus, respiratory diseases, eye diseases, Dental disorders. Emerging and Re-emerging Diseases.	4	

Unit IV	Mechanisms of Antimicrobial resistance - Multidrug Efflux pumps, Extended Spectrum β -lactamases (ESBL).	5	Chalk and Talk, PPT, Group discussion, Seminar
	Hospital acquired infections - Factors, infection sites, mechanisms, Role of Multidrug resistant pathogens. Role of Pseudomonas, Acinetobacter, Clostridium difficile	5	
	HBV, HCV, Rotavirus, Cryptosporidium and Aspergillus in Nosocomial infections. Prevention and management of nosocomial infections.	5	
Unit V	National Programmes related to Communicable and Non-Communicable diseases - National Malaria Eradication Programme, Revised National Tuberculosis Control Programme,	5	Chalk and Talk, PPT, Group discussion, Seminar, Assignment
	Vector Borne Disease Control Programme, National AIDS Control Programme, National Cancer Control Programme and National Diabetes Control Programme	5	
	Biochemical and immunological tools in epidemiology - Biotyping, Serotyping, Phage typing, FAME (Fatty acid methyl ester analysis), Curie Point PyMS (Pyrolysis Mass spectrometry), Protein profiling, Molecular typing methods.	5	

Course Learning Outcomes:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Collection of different clinical samples, transport, culture and examination.	K4
CLO-2	Identify medically important fungus from the clinical samples.	K4
CLO-3	Perform and Interpret serological tests for viral diseases.	K4
CLO-4	Exam and identify ova and cyst in samples.	K4
CLO-5	Collection and identification of arthropod vectors.	K4

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CLO-1	2	2	1	1	1	3
CLO-2	3	2	3	1	1	3
CLO-3	3	2	3	2	2	3
CLO-4	3	2	3	2	2	3
CLO-5	3	3	3	2	2	3

Mapping of CLOs with POs

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

Advance application- 3;

Intermediate level-2;

Basic level-1

EVALUATION (PRACTICAL)

Internal (Formative) : 25 marks

External (Summative) : 75 marks

Total : 100 marks

Question Paper Pattern for Internal Practical Examination (Major): 25 Marks

	Components	Marks	Total Marks
Internal [Formative]	Continuous assessment	10	25
	Test (Major 10, Minor 5, Spotters 5 and Record 5marks) scaled down to 15	15	
External [Summative]		75	75
Total Marks			100

Question Paper Pattern for External Practical Examination (Major): 75 Marks

Components	Marks
I – Major question	25
II – Minor question	15
III – Spotters (5 x 4)	20
IV –Record book	05
Viva-voce	10
Total	75

DEPARTMENT OF MICROBIOLOGY				CLASS: I M.Sc. MICROBIOLOGY				
Sem.	Course type	Course code	Course title	Credits	Contact hours/week	CIA	Ext	Total
II	DISCIPLINE ELECTIVE - III	25P2RECT3	EPIDEMIOLOGY	3	5	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented		Entrepreneurship Oriented	

Objectives:

- Describe the role of epidemiology in public health.
- Explain about epidemiology tools and disease surveillance methods.
- Analyze various communicable and non-communicable diseases in India.
- Discuss on mechanism of antimicrobial resistance.
- Outline on National health programmes that have been designed to address the issues.

Unit	Description	Hours	K-level	CLO
I	Fundamentals of epidemiology - Definitions of epidemiology – Epidemiology of infectious diseases in Public Health. Natural history of disease - Historical aspects of epidemiology. Common risk factors - Epidemiologic Triad - Agent factors, host factors and environmental factors. Transmission basics - Chain of infection, portal of entry. Modes of transmission - Direct and indirect. Stages of infectious diseases. Agents and vectors of communicable diseases of public health importance and dynamics of disease transmission. Epidemiology of Zoonosis - Factors, routes of transmission of bacterial, viral, parasitic and fungal zoonotic agents. Control of zoonosis.	15	K2	CLO 1
II	Tools of Epidemiology - Measures of Disease - Prevalence, incidence. Index case. Risk rates. Descriptive Epidemiology - Cohort studies, measuring infectivity, survey methodology including census procedures. Surveillance strategies - Disease surveillance, geographical indication system, outbreak investigation in public health and contact investigation	15	K3	CLO 2

III	Epidemiological aspects of diseases of national importance - Background to communicable and non-communicable diseases. Vector borne diseases in India. Diarrhoeal diseases. Zoonoses. Viral haemorrhagic fevers. Mycobacterial infections. Sexually transmitted diseases. Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome (HIV/AIDS). Emerging disease threats - Severe Acute Respiratory Syndrome (SARS), Covid-19, Ebola, MDR-TB, Malaria, Mucor mycosis, Avian flu. Dengue, Swine Flu, Chikungunya. Epidemiology, prevention, and control of non-communicable diseases - Asthma, Coronary heart disease, Malignancy, diabetes mellitus, respiratory diseases, eye diseases, Dental disorders. Emerging and Re-emerging Diseases.	15	K4	CLO 3
IV	Mechanisms of Antimicrobial resistance - Multidrug Efflux pumps, Extended Spectrum β -lactamases (ESBL). Hospital acquired infections - Factors, infection sites, mechanisms, Role of Multidrug resistant pathogens. Role of Pseudomonas, Acinetobacter, Clostridium difficile, HBV, HCV, Rotavirus, Cryptosporidium and Aspergillus in Nosocomial infections. Prevention and management of nosocomial infections.	15	K4	CLO 4
V	National Programmes related to Communicable and Non-Communicable diseases - National Malaria Eradication Programme, Revised National Tuberculosis Control Programme, Vector Borne Disease Control Programme, National AIDS Control Programme, National Cancer Control Programme and National Diabetes Control Programme. Biochemical and immunological tools in epidemiology - Biotyping, Serotyping, Phage typing, FAME (Fatty acid methyl ester analysis), Curie Point PyMS (Pyrolysis Mass spectrometry), Protein profiling, Molecular typing methods.	15	K4	CLO 5

Books for Study:

1. Dicker R., Coronado F., Koo. D. and Parrish. R. G. (2012). Principles of Epidemiology in Public Health Practice., (3rd Edition). CDC.

2. Gerstman B. (2013). *Epidemiology Kept Simple: An Introduction to Classic and Modern Epidemiology*. (3rd Edition). Wiley Blackwell.
3. Greenwood, D., Slack, R. B. and Peutherer, J. F. (2012) *Medical Microbiology*, (18th Edition). Churchill Livingstone, London.
4. Jawetz E., Melnick J. L. and Adelberg E. A. (2000). *Review of Medical Microbiology*. (19th Edition). Lange Medical Publications, U.S.A.
5. Dimmok N. J. and Primrose S. B. (1994). *Introduction to Modern Virology*. 5th edn. Blackwell Scientific Publishers.

Books for References:

1. Bhopal R. S. (2016). *Concepts of Epidemiology - An Integrated Introduction to the Ideas, Theories, Principles and Methods of Epidemiology*. (3rd Edition). Oxford University Press, New York.
2. Celentano D. D. and Szklo M. (2018). *Gordis Epidemiology*. (6th Edition). Elsevier, USA.
3. Cheesbrough, M. (2004). *District Laboratory Practice in Tropical Countries - Part 2*, (2nd Edition). Cambridge University Press.
4. Ryan K. J. and Ray C. G. (2004). *Sherris Medical Microbiology*. (4th Edition), McGraw Hill, New York.
5. Topley W.W. C., Wilson, G. S., Parker M. T. and Collier L. H. (1998). *Principles of Bacteriology*. (9th Edition). Edward Arnold, London

Web Resources

1. <https://www.scielo.br/j/rbca/a/mjDFGTtfWtBm786ZmR9TG9d/?lang=en>
2. <https://hal.archives-ouvertes.fr/hal-00902711/document>
3. <https://www.who.int/csr/resources/publications/whodscsreph200212.pdf>
4. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7187955/>
5. https://www.who.int/diseasecontrol_emergencies/publications/idhe2009_london_outbreaks.pdf

Rationale for Nature of the course

The course helps to plan and evaluate strategies to prevent illness and management, execution of patients who have already developed a disease. Prevention, surveillance, monitoring and designing health policy at various level.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Students enhanced with knowledge on epidemic diseases get the employment relate with planning, data collection, collaboration with various organization and administrative level.

Pedagogy

Chalk and Talk, PPT, Group discussion, Seminar and Assignment.

Course Designer(s): Dr.K.Rajeswari

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Fundamentals of epidemiology - Definitions of epidemiology – Epidemiology of infectious diseases in Public Health. Natural history of disease - Historical aspects of epidemiology.	3	Chalk and Talk, PPT, Group discussion, Seminar
	Common risk factors - Epidemiologic Triad - Agent factors, host factors and environmental factors. Transmission basics - Chain of infection, portal of entry.	4	
	Modes of transmission - Direct and indirect. Stages of infectious diseases. Agents and vectors of communicable diseases of public health importance and dynamics of disease transmission.	4	
	Epidemiology of Zoonosis - Factors, routes of transmission of bacterial, viral, parasitic and fungal zoonotic agents. Control of zoonosis.	4	
Unit II	Tools of Epidemiology - Measures of Disease - Prevalence, incidence. Index case. Risk rates.	5	Chalk and Talk, PPT, Group discussion, Seminar
	Descriptive Epidemiology - Cohort studies, measuring infectivity, survey methodology including census procedures.	5	
	Surveillance strategies - Disease surveillance, geographical indication system, outbreak investigation in public health and contact investigation	5	
Unit III	Epidemiological aspects of diseases of national importance - Background to communicable and non-communicable diseases. Vector borne diseases in India. Diarrhoeal diseases. Zoonoses. Viral haemorrhagic fevers.	4	Chalk and Talk, PPT, Group discussion, Seminar
	Mycobacterial infections. Sexually transmitted diseases. Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome (HIV/AIDS).	3	
	Emerging disease threats - Severe Acute Respiratory Syndrome (SARS), Covid-19, Ebola, MDR-TB, Malaria, Mucor mycosis, Avian flu. Dengue, Swine Flu, Chikungunya.	4	
	Epidemiology, prevention, and control of non-communicable diseases - Asthma, Coronary heart disease, Malignancy, diabetes mellitus, respiratory diseases, eye diseases, Dental disorders. Emerging and Re-emerging Diseases.	4	

Unit IV	Mechanisms of Antimicrobial resistance - Multidrug Efflux pumps, Extended Spectrum β -lactamases (ESBL).	5	Chalk and Talk, PPT, Group discussion, Seminar
	Hospital acquired infections - Factors, infection sites, mechanisms, Role of Multidrug resistant pathogens. Role of Pseudomonas, Acinetobacter, Clostridium difficile	5	
	HBV, HCV, Rotavirus, Cryptosporidium and Aspergillus in Nosocomial infections. Prevention and management of nosocomial infections.	5	
Unit V	National Programmes related to Communicable and Non-Communicable diseases - National Malaria Eradication Programme, Revised National Tuberculosis Control Programme,	5	Chalk and Talk, PPT, Group discussion, Seminar, Assignment
	Vector Borne Disease Control Programme, National AIDS Control Programme, National Cancer Control Programme and National Diabetes Control Programme	5	
	Biochemical and immunological tools in epidemiology - Biotyping, Serotyping, Phage typing, FAME (Fatty acid methyl ester analysis), Curie Point PyMS (Pyrolysis Mass spectrometry), Protein profiling, Molecular typing methods.	5	

Course Learning Outcomes:

On completion of this course the students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Apply the knowledge acquired on concepts of epidemiology to clinical and public health environment.	K2
CLO-2	Plan various strategies to trace the epidemiology.	K3
CLO-3	Plan the control of communicable and non-communicable diseases.	K4
CLO-4	Analyze the implications of drug resistance in the society and design the control of antimicrobial resistance and its management.	K4
CLO-5	Employ National control programs related to Communicable and Non-Communicable diseases with the public.	K4

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

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

Advance application– 3;

Intermediate level–2;

Basic level–1

Blueprint for Semester Examination

Learning Outcome Based Education & Assessment (LOBE) 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 K-2	2	K1 & K2	1	K1	2 (K1&K2)	1(K2)
2	CLO 2	Up to K-3	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
3	CLO 3	Up to K-4	2	K1 & K2	1	K2	2 (K3&K3)	1(K4)
4	CLO 4	Up to K-4	2	K1 & K2	1	K2	2 (K4&K4)	1(K4)
5	CLO 5	Up to K-4	2	K1 & K2	1	K2	2 (K2&K2)	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	5	-	14	11.7	12%
K2	5	6	15	10	36	30	30%
K3	-	-	20	10	30	25	25%
K4	-	-	10	30	40	33.3	33%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF MICROBIOLOGY				CLASS: I M.Sc. MICROBIOLOGY				
Sem.	Course type	Course code	Course title	Credits	Contact hours/week	CIA	Ext	Total
II	DISCIPLINE ELECTIVE - III	25P2RECT3	CLINICAL DIAGNOSTIC MICROBIOLOGY	3	5	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	✓

Objectives:

- Describe appropriate safety protocol and laboratory techniques for handling specimens and biomedical waste management.
- Develop working knowledge of techniques used to identify infectious agents in the clinical microbiology lab.
- Elucidate various diagnostic procedures in microbiology.
- Acquire knowledge on different methods employed to check antibiotic sensitivity.
- Gain knowledge on hospital acquired infections and their control measures.

Unit	Description	Hours	K-level	CLO
I	Microbiology Laboratory Safety Practices -General Safety Guidelines, Handling of Biological Hazards, Infectious health care waste disposal - Biomedical waste management, Emerging and Re-emerging infections	15	K2	CLO 1
II	Diagnostic procedures - General concept of Clinical specimen collection, transport, storage and general processing in Microbiology laboratory - Specimen acceptance and rejection criteria.	15	K3	CLO 2
III	Diagnosis of microbial diseases - Clinical, differential, Microbiological, immunological and molecular diagnosis of microbial diseases. Modern and novel microbial diagnostic methods. Automation in Microbial diagnosis	15	K4	CLO 3
IV	Antibiotic sensitivity tests - Disc diffusion - Stokes and Kirby Bauer methods, E test - Dilution - Agar dilution & broth dilution - MBC/MIC - Quality control for antibiotics and standard strains.	15	K4	CLO 4

V	Nosocomial infections – common types, sources, reservoir and mode of transmission, pathogenesis and control measures. Hospital Infection Control Committee (HICC) – Functions.	15	K4	CLO 5

Books for Study:

1. Collee J. G., Fraser A.G. Marmion B. P. and Simmons A. (1996). Mackie & McCartney Practical Medical Microbiology. (14th Edition). Elsevier, New Delhi. ISBN-10:0443047219 / ISBN-13-978-0443047213.
2. Tille P. M. (2021). Bailey and Scott's Diagnostic Microbiology. (15 th Edition). Elsevier. ISBN:9780323681056.
3. Mukherjee K.L. (2000). Medical Laboratory Technology. Vol. 1-3. (2nd Edition). Tata McGraw-Hill Education. ISBN-10:0074632604.
4. Sood R. (2009). Medical Laboratory Technology – Methods and Interpretations. (6th Edition). Jaypee Brothers Medical Publishers (P) Ltd. New Delhi. ISBN:9788184484496.

Books for References:

1. Murray P. R., Baron E. J., Jorgenson J. H., Pfaller M. A. and Tenover F.C. (2003). Manual of Clinical Microbiology. (8th Edition). American Society for Microbiology, Washington, DC. ISBN:1-555810255-4.
2. Bennett J. E., Dolin R. and Blaser M. J. (2019). Principles and Practice of Infectious Diseases. (9 th Edition). Elsevier. EBook ISBN:9780323550277. Hardcover ISBN:9780323482554.
3. Ridgway G. L., Stokes E. J. and Wren M. W. D. (1987). Clinical Microbiology 7th Edition. Hodder Arnold Publication. ISBN10:0340554231 / ISBN13:9780340554234.
4. Koneman E.W., Allen S. D., Schreckenber P. C. and Winn W. C. (2020). Koneman's Color Atlas and Textbook of Diagnostic Microbiology. (7 th Edition). Jones & Bartlett Learning. ISBN:1284322378 9781284322378.
5. Cheesbrough, M. (2004). District Laboratory Practice in Tropical Countries - Part 2, (2nd Edition). Cambridge University Press. ISBN-13:978-0-521-67631-1 / ISBN-10:0- 521-67631-2.

Web Resources

1. <https://www.ncbi.nlm.nih.gov/books/NBK20370/>
2. <https://www.msdmanuals.com/en-in/home/infections/diagnosis-of-infectious3disease/diagnosis-of-infectious-disease>.
3. <https://journals.asm.org/doi/10.1128/JCM.02592-20>
4. <https://www.sciencedirect.com/science/article/pii/S2221169116309509>
5. http://www.textbookofbacteriology.net/normalflora_3.html

Rationale for Nature of the course

The course "Clinical and Diagnostic Microbiology" equips students with skills in laboratory safety, specimen handling, and advanced diagnostic techniques. It emphasizes antimicrobial susceptibility testing, nosocomial infection control, and biomedical waste management. This prepares students for employability, entrepreneurship, and skill development in clinical microbiology.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Group discussion, Model Making and Mini-project

Pedagogy

Chalk and talk, PPT, group discussion, seminar, screening of educational videos, quiz, peer teaching and learning, ICT enabled teaching

Course Designer(s):

Dr. M. Rajesh Kannan

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Microbiology Laboratory Safety Practices -General Safety Guidelines, Handling of Biological Hazards.	8	Chalk and Talk, Group discussion,
	Infectious health care waste disposal - Biomedical waste management, Emerging and Re-emerging infections	7	Quiz, Seminar, PPT presentation
Unit II	Diagnostic procedures - General concept of Clinical specimen collection, transport	8	Chalk and Talk, Group discussion,
	storage and general processing in Microbiology laboratory - Specimen acceptance and rejection criteria	7	Quiz, Seminar, PPT presentation
Unit III	Diagnosis of microbial diseases - Clinical, differential, Microbiological, immunological and molecular diagnosis of microbial diseases	8	Chalk and Talk, Group discussion,
	Modern and novel microbial diagnostic methods. Automation in Microbial diagnosis	7	Quiz, Seminar, PPT presentation
Unit IV	Antibiotic sensitivity tests - Disc diffusion - Stokes and Kirby Bauer methods, E test	8	Chalk and Talk, Group discussion,
	Dilution - Agar dilution & broth dilution - MBC/MIC - Quality control for antibiotics and standard strains	7	Quiz, Seminar, PPT presentation
Unit V	Nosocomial infections – common types, sources, reservoir and mode of transmission, pathogenesis	8	Chalk and Talk, Group discussion,
	Control measures. Hospital Infection Control Committee (HICC) – Functions.	7	Quiz, Seminar, PPT presentation

Course Learning Outcomes:

On completion of this course the students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Apply Laboratory safety procedures and hospital waste disposal strategies.	K2
CLO-2	Collect various clinical specimens, handle, preserve and process safely.	K3
CLO-3	Identify the causative agents of diseases by conventional and molecular methods following standard protocols.	K4
CLO-4	Assess the antimicrobial susceptibility pattern of pathogens.	K4
CLO-5	Trace the sources of nosocomial infection and recommend control measures	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	3
CLO-3	3	3	3	3	3
CLO-4	3	3	3	3	3
CLO-5	3	3	3	3	3

Mapping of CLOs with POs

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

Advance application– 3;

Intermediate level–2;

Basic level–1

Blueprint for Semester Examination

Learning Outcome Based Education & Assessment (LOBE) 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 K-2	2	K1 & K2	1	K1	2 (K1&K2)	1(K2)
2	CLO 2	Up to K-3	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
3	CLO 3	Up to K-4	2	K1 & K2	1	K2	2 (K3&K3)	1(K4)
4	CLO 4	Up to K-4	2	K1 & K2	1	K2	2 (K4&K4)	1(K4)
5	CLO 5	Up to K-4	2	K1 & K2	1	K2	2 (K2&K2)	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	5	-	14	11.7	12%
K2	5	6	15	10	36	30	30%
K3	-	-	20	10	30	25	25%
K4	-	-	10	30	40	33.3	33%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF MICROBIOLOGY				CLASS: I M.Sc. MICROBIOLOGY				
Sem.	Course type	Course code	Course title	Credits	Contact hours/week	CIA	Ext	Total
II	DISCIPLINE ELECTIVE - III	25P2RECT3	BIOREMEDIATION	3	5	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented		Entrepreneurship Oriented	

Objectives:

- Describe the nature and importance of bioremediation and use in real world applications.
- Describe the typical composition of waste water and application of efficient technologies for water treatment.
- Explain the fundamentals of treatment technologies and the considerations for its design and implementation in treatment plants.
- Explain the potential of microbes in ore extraction and acquaint students with methods of reducing health risks caused by xenobiotics.
- Familiarize the role of plants and their associated microbes in remediation and management of environmental pollution

Unit	Description	Hours	K-level	CLO
I	Bioremediation - process and organisms involved. Bioaugmentation - Ex-situ and in-situ processes; Intrinsic and engineered bioremediation. Major pollutants and associated risks; organic pollutant degradation. Microbial aspects and metabolic aspects. Factors affecting the process. Recent developments and significance.	15	K2	CLO 1
II	Microbes involved in aerobic and anaerobic processes in nature. Water treatment - BOD, COD, dissolved gases, removal of heavy metals, total organic carbon removal. Secondary waste water treatments - use of membrane bioreactor. Aquaculture effluent treatment. Aerobic sludge and landfill leachate process. Aerobic digestion.	15	K3	CLO 2

III	Composting of solid wastes, anaerobic digestion - methane production and important factors involved, Pros and cons of anaerobic process, sulphur, iron and nitrate reduction, hydrocarbon degradation, degradation of nitroaromatic compounds. Bioremediation of dyes, bioremediation in paper and pulp industries. Aerobic and anaerobic digesters – design. Various types of digester for bioremediation of industrial effluents.	15	K4	CLO 3
IV	Microbial leaching of ores - process, microorganisms involved and metal recovery with special reference to copper and iron. Biotransformation of heavy metals and xenobiotics. Petroleum biodegradation - reductive and oxidative. Dechlorination. Biodegradable of plastics and super bug.	15	K4	CLO 4
V	Phytoremediation of heavy metals in soil - Basic principles of phytoremediation - Uptake and transport, Accumulation and sequestration. Phytoextraction. Phytodegradation. Phytovolatilization. Rhizodegradation. Phytostabilization – Organic and synthetic amendments in multi metal contaminated mine sites. Role of Arbuscular mycorrhizal fungi and plant growth promoting rhizobacteria in phytoremediation.	15	K4	CLO 5

Books for Study:

1. Bhatia H.S. (2018). A Text book on Environmental Pollution and Control. (2nd Edition). Galgotia Publications.
2. Chatterjee A. K. (2011). Introduction to Environmental Biotechnology. (3rd Edition). Printice-Hall, India.
3. Pichtel, J. (2014). Waste Management Practices: Municipal, Hazardous, and Industrial, 2nd edition, CRC Press.
4. Liu, D.H.F and Liptak, B.G (2005). Hazardous Wastes and Solid Wastes, Lewis Publishers.
5. Rajendran, P. & Gunasekaran, P. (2006). Microbial Bioremediation. 1st edition. MJP Publishers

Books for References:

1. Sangeetha J., Thangadurai D., David M. and Abdullah M.A. (2016). Environmental Biotechnology: Biodegradation,
2. Bioremediation, and Bioconversion of Xenobiotics for Sustainable Development. (1st Edition). Apple Academic Press.
3. Singh A. and Ward O. P. (2004). Biodegradation and Bioremediation. Soil Biology. Springer.
4. Singh A., Kuhad R. C., and Ward O. P. (2009). Advances in Applied Bioremediation (1st Edition). Springer-Verlag Berlin Heidelberg, Germany.
5. Atlas, R.M & Bartha, R. (2000). Microbial Ecology. Addison Wesley Longman Inc.
6. Rathoure, A.K. (Ed.). (2017). Bioremediation: Current Research and Applications. 1st edition. I.K. International Publishing House Pvt. Ltd.

Web Resources

1. Bioremediation- Objective, Principle, Categories, Types, Methods, Applications (microbenotes.com)
2. <https://agris.fao.org/agris-search>
3. <https://www.sciencedirect.com/topics/earth-and-planetarysciences/bioremediation>
4. <https://www.intechopen.com/chapters/70661>
5. <https://microbiologysociety.org/blog/bioremediation-the-pollution-solution.html>

Rationale for Nature of the course

Bioremediation is an interdisciplinary subject that blends biology, environmental science, and engineering to address environmental contamination challenges using natural or engineered biological processes. The course is designed to provide theoretical knowledge and practical skills essential for addressing real-world environmental issues. It aims to enhance employability and entrepreneurial potential through its focus on sustainable and innovative approaches to pollution mitigation.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Bioremediation develops skills in microbial techniques, pollutant analysis, and bioreactor design, enhancing employability in environmental consulting, wastewater management, and R&D. Activities like internships, fieldwork, and certifications build expertise, while entrepreneurship opportunities include creating bioremediation startups, consulting, and product development. This fosters innovation, sustainability, and industry-ready professionals in environmental biotechnology.

Pedagogy

Chalk and talk, PPT, group discussion, seminar, screening of educational videos, quiz, peer teaching and learning, ICT enabled teaching.

Course Designer(s): Dr. P. Sasikumar

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Bioremediation - process and organisms involved. Bioaugmentation - Ex-situ and in-situ processes; Intrinsic and engineered bioremediation.	5	Chalk and talk
	Major pollutants and associated risks; organic pollutant degradation. Microbial aspects and metabolic aspects.	5	
	Factors affecting the process. Recent developments and significance.	5	
Unit II	Microbes involved in aerobic and anaerobic processes in nature.	5	Chalk and talk
	Water treatment - BOD, COD, dissolved gases, removal of heavy metals, total organic carbon removal. Secondary waste water treatments - use of membrane bioreactor.	5	
	Aquaculture effluent treatment. Aerobic sludge and landfill leachate process. Aerobic digestion.	5	
Unit III	Composting of solid wastes, anaerobic digestion - methane production and important factors involved, Pros and cons of anaerobic process, sulphur, iron and nitrate reduction	5	Chalk and talk PPT/video presentation
	Hydrocarbon degradation, degradation of nitroaromatic compounds. Bioremediation of dyes, bioremediation in paper and pulp industries.	5	
	Aerobic and anaerobic digesters – design. Various types of digester for bioremediation of industrial effluents.	5	
Unit IV	Microbial leaching of ores - process, microorganisms involved and metal recovery with special reference to copper and iron.	5	Chalk and talk Group discussion
	Biotransformation of heavy metals and xenobiotics.	5	
	Petroleum biodegradation - reductive and oxidative. Dechlorination. Biodegradable of plastics and super bug.	5	
Unit V	Phytoremediation of heavy metals in soil - Basic principles of phytoremediation - Uptake and transport, Accumulation and sequestration.	5	Chalk and talk PPT/video presentation
	Phytoextraction. Phytodegradation. Phytovolatilization. Rhizodegradation. Phytostabilization – Organic and synthetic amendments in multi metal contaminated mine sites.	5	
	Role of Arbuscular mycorrhizal fungi and plant growth promoting rhizobacteria in phytoremediation.	5	

Course Learning Outcomes:

On completion of this course the students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Differentiate Ex-situ bioremediation and In-situ bioremediation. Assess the roles of organisms in bioremediation.	K2
CLO-2	Distinguish microbial processes necessary for the design and optimization of biological processing unit operations.	K3
CLO-3	Identify, formulate and design engineered solutions to environmental problems.	K4
CLO-4	Explore microbes in degradation of toxic wastes and playing role on biological mechanisms.	K4
CLO-5	Establish the mechanisms of Arbuscular mycorrhizal fungi and Plant growth promoting <i>Rhizobacteria</i> in phytoremediation.	K4

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

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

Advance application– 3;

Intermediate level–2;

Basic level–1

Blueprint for Semester Examination

Learning Outcome Based Education & Assessment (LOBE) 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 K-2	2	K1 & K2	1	K1	2 (K1&K2)	1(K2)
2	CLO 2	Up to K-3	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
3	CLO 3	Up to K-4	2	K1 & K2	1	K2	2 (K3&K3)	1(K4)
4	CLO 4	Up to K-4	2	K1 & K2	1	K2	2 (K4&K4)	1(K4)
5	CLO 5	Up to K-4	2	K1 & K2	1	K2	2 (K2&K2)	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	5	-	14	11.7	12%
K2	5	6	15	10	36	30	30%
K3	-	-	20	10	30	25	25%
K4	-	-	10	30	40	33.3	33%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF MICROBIOLOGY				CLASS: I M.Sc. MICROBIOLOGY				
Sem	Course type	Course code	Course title	Credits	Contact hours /week	CIA	Ext	Total
II	Discipline Elective -IV	25P2RECT4	BIOINFORMATICS	3	5	25	75	100

Nature of Course				
Skill Oriented	✓	Employability Oriented		Entrepreneurship Oriented

Objectives:

- Discuss about various biological data mining concepts, tools.
- Elucidate the principles and applications of sequence alignment methods and tools.
- Demonstrate different phylogenetic tree construction methods and its uses in phylogenetic analysis.
- Acquaint with various approaches in predicting 3D and 2D structure of proteins.
- Describe various tools and techniques used in molecular docking, immunoinformatics and subtractive genomics.

Unit	Description	Hours	K-level	CLO
I	Biological Data Mining – Exploration of Data Mining Tools. Cluster Analysis Methods. Data Visualization. Biological Data Management. Biological Algorithms – Biological Primary and Derived Databases. Concept of Alignment, Pairwise Sequence Alignment (PSA), Multiple Sequence Alignment (MSA), BLAST, CLUSTALW, Scoring Matrices, Percent Accepted Mutation (PAM), Blocks of Amino Acid Substitution Matrix (BLOSUM).	15	K3	CLO 1
II	Phylogenetic Tree Construction - Concept of Dendrograms. Evolutionary Trees - Distance Based Tree Reconstruction - Ultrametric trees and Ultrametric distances – Reconstructing Trees from Additive Matrices - Evolutionary Trees and Hierarchical Clustering - Character Based Tree Reconstruction - Maximum Parsimony Method, Maximum likelihood method - Reliability of Trees – Substitution matrices – Evolutionary models.	15	K3	CLO 2

III	Computational Protein Structure prediction – Secondary structure – Homology modelling- Fold recognition and ab initio 3D structure prediction – Structure comparison and alignment – Prediction of function from structure. Geometrical parameters – Potential energy surfaces – Hardware and Software requirements-Molecular graphics – Molecular file formats-Molecular visualization tools.	15	K4	CLO 3
IV	Prediction of Properties of Ligand Compounds – 3D Autocorrelation 3D Morse Code-Conformation Dependent and Independent Chirality Codes – Comparative Molecular Field Analysis – 4 D QSAR – HYBOT Descriptors – Structure Descriptors – Applications – Linear Free Energy Relationships – Quantity Structure - Property Relationships – Prediction of the Toxicity of Compounds.	15	K4	CLO 4
V	Molecular Docking- Flexible - Rigid docking- Target-Ligand preparation- Solvent accessibility- Surface volume calculation, Active site prediction- Docking algorithms- Genetic, Lamarckian - Docking analyses- Molecular interactions, bonded and nonbonded - Molecular Docking Software and Working Methods. Genome to drug discovery – Subtractive Genomics – Principles of Immunoinformatics and Vaccine Development.	15	K4	CLO 5

Books for Study:

1. Lesk A. M. (2002). Introduction to Bioinformatics. (4th Edition). Oxford University Press.
2. Lengauer T. (2008). Bioinformatics- from Genomes to Therapies (Vol-1).Wiley- VCH.
3. Rastogi S.C., Mendiratta N. and Rastogi P. (2014). Bioinformatics - Methods and Applications (Genomics, Proteomics and Drug Discovery) (4th Edition). Prentice-Hall of India Pvt.Ltd.
4. Attwood, T.K. and Parry-Smith, D.J. (1999). Introduction to Bioinformatics. Addison Wesley Longman Limited, England.
5. Mount D.W., (2013).Bioinformatics sequence and genome analysis, 2ndedn.CBS Publishers, New Delhi.

Books for References:

1. Baxevanis A. D. and Ouellette F. (2004). Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. (2nd Edition). John Wiley and Sons.
2. Bosu O. and Kaur S. (2007). Bioinformatics - Database, Tools, and Algorithms. Oxford University Press.
3. David W. M. (2001). Bioinformatics Sequence and Genome Analysis (2nd Edition). CBS Publishers and Distributors(Pvt.)Ltd.
4. Xiong J, (2011). Essential bioinformatics, First south Indian Edition, Cambridge University Press.
5. Harshawardhan P.Bal, (2006). Bioinformatics Principles and Applications, Tata McGraw-Hill Publishing Company Limited.

Web Resources

1. <https://www.hsls.pitt.edu/obrc/>
2. <https://www.hsls.pitt.edu/obrc/index.php?page=dna>
3. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1669712/>
4. <https://www.ebi.ac.uk/>
5. <https://www.kegg.jp/kegg/kegg2.html>

Rationale for Nature of the course

Bioinformatics is an interdisciplinary field that combines biology, computer science, and data analysis to understand and interpret biological data. This course equips students with the skills to analyze complex datasets, such as genomic sequences, protein structures, and biological networks, using computational tools and algorithms. By integrating principles of molecular biology and programming, the course fosters innovation in fields like personalized medicine, drug discovery, and evolutionary biology. Emphasizing practical applications and problem-solving, students learn to manage and interpret vast biological datasets, enabling them to address challenges in research and healthcare. This prepares graduates for careers in biotechnology, academia, and biomedical research, contributing to advancements in life sciences and technology.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Mini-project

Pedagogy

Lecture, Chalk and Talk, PowerPoint presentation.

Course Designer(s):

Dr. K.Raghavan

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Biological Data Mining – Exploration of Data Mining Tools. Cluster Analysis Methods. Data Visualization. Biological Data Management.	5	Chalk and talk PPT/video presentation
	Biological Algorithms – Biological Primary and Derived Databases. Concept of Alignment, Pairwise Sequence Alignment (PSA), Multiple Sequence Alignment (MSA), BLAST, CLUSTALW	5	
	Scoring Matrices, Percent Accepted Mutation (PAM), Blocks of Amino Acid Substitution Matrix (BLOSUM).	5	
Unit II	Phylogenetic Tree Construction - Concept of Dendrograms. Evolutionary Trees - Distance Based Tree Reconstruction	5	Chalk and talk PPT/video presentation
	Ultrametric trees and Ultrametric distances – Reconstructing Trees from Additive Matrices - Evolutionary Trees and Hierarchical Clustering.	5	
	Character Based Tree Reconstruction - Maximum Parsimony Method, Maximum likelihood method - Reliability of Trees – Substitution matrices – Evolutionary models.	5	
Unit III	Computational Protein Structure prediction – Secondary structure – Homology modelling-	5	Chalk and talk PPT/video presentation
	Fold recognition and ab initio 3D structure prediction – Structure comparison and alignment – Prediction of function from structure.	5	
	Geometrical parameters – Potential energy surfaces – Hardware and Software requirements-Molecular graphics – Molecular file formats-Molecular visualization tools.	5	
Unit IV	Prediction of Properties of Ligand Compounds – 3D	5	Chalk and

	Autocorrelation 3D Morse Code-Descriptors – Structure		talk Group discussion
	Conformation Dependent and Independent Chirality Codes –Comparative Molecular Field Analysis – 4 D QSAR – HYBOT	5	
	Descriptors – Applications – Linear Free Energy Relationships – Quantity Structure - Property Relationships – Prediction of the Toxicity of Compounds.	5	
Unit V	Molecular Docking- Flexible - Rigid docking- Target-Ligand preparation- Solvent accessibility- Surface volume calculation, Active site prediction-	5	Chalk and talk PPT/video presentation
	Docking algorithms- Genetic, Lamarckian - Docking analyses- Molecular interactions, bonded and nonbonded - Molecular Docking Software and Working Methods.	5	
	Genome to drug discovery – Subtractive Genomics – Principles of Immunoinformatics and Vaccine Development.	5	

On completion of this course the students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Access to databases that provides information on nucleic acids and proteins.	K3
CLO-2	Invent algorithms for sequence alignment.	K3
CLO-3	Construct phylogenetic tree.	K4
CLO-4	Predict the structure of proteins.	K4
CLO-5	Design drugs by predicting drug ligand interactions and molecular docking.	K4

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

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

Advance application– 3;

Intermediate level–2;

Basic level–1

Blueprint for Semester Examination

Learning Outcome Based Education & Assessment (LOBE) 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 K-3	2	K1 & K2	1	K1	2 (K1&K2)	1(K3)
2	CLO 2	Up to K-3	2	K1 & K2	1	K3	2 (K1&K2)	1(K3)
3	CLO 3	Up to K-4	2	K1 & K2	1	K2	2 (K3&K3)	1(K4)
4	CLO 4	Up to K-4	2	K1 & K2	1	K2	2 (K3&K4)	1(K4)
5	CLO 5	Up to K-4	2	K1 & K2	1	K3	2 (K2&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 without choice	Consolidated
K1	5	2	10	-	17	14.17	14%
K2	5	4	15	-	24	20	20%
K3	-	4	20	20	44	36.66	38%
K4	-	-	5	30	35	29.17	29%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF MICROBIOLOGY				CLASS: I M.Sc. MICROBIOLOGY				
Sem.	Course type	Course code	Course title	Credits	Contact hours/week	CIA	Ext	Total
II	DISCIPLINE ELECTIVE - IV	25P2RECT4	BIOSAFETY, BIOETHICS AND IPR	3	5	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented		Entrepreneurship Oriented	

Objectives:

- Create a research environment. Encourage investigation, analysis and study the bioethical principles, values, concepts, and social and juridical implications in the areas of science, biotechnology and medicine.
- Discuss about various aspects of biosafety regulations, IPR and bioethics concerns arising from the commercialization of biotechnological products.
- Familiarize fundamental aspects of Intellectual property Rights in the development and management of innovative projects in industries.
- Acquire knowledge about bioethics, biodiversity and Genetically modified foods and food crops
- Provide students with an understanding of bioethics in research associated with medicine

Unit	Description	Hours	K-level	CLO
I	Intellectual Property Rights: Different forms of Intellectual Property Rights – their relevance, importance to industry, Academia. Role of IPR's in Biotechnology, Patent Terminology - Patents, trademarks, copyrights, industrial designs, geographical indications, trade secrets, non-disclosure agreements. Patent life and geographical boundaries. International organizations and IPR - Overview of WTO, TRIPS, WIPO, GATT, International conventions, Trade agreements, Implication of TRIPS for developing countries.	15	K3	CLO 1

II	Process involved in patenting. Patent Search - Procedural steps in patenting, process of filing, PCT application, pre-grant & post-grant opposition, PCT and patent harmonization including Sui-generis system, patent search methods, patent databases and libraries, online tools, Country-wise patent searches (USPTO, EPO, India etc.), patent mapping.	15	K3	CLO 2
III	Patentability of biotechnology inventions - Patentability of biotechnology inventions in India, statutory provisions regarding biotechnological inventions under the current Patent Act 1970 (as Amended 2005). Biotechnological inventions as patentable subject matter, territorial nature of patents - from territorial to global patent regime, interpreting trips in the light of biotechnology inventions, feasibility of a uniform global patent system, merits and demerits of uniform patent law, relevance of the existing international patent, tentative harmonisation efforts, implications of setting up a uniform world patent system.	15	K4	CLO 3
IV	Introduction to bioethics - need of bioethics, applications and issues related to bioethics, social and cultural issues. Bioethics and biodiversity - conserving natural biodiversity, convention on protecting biodiversity, protocols in exchanging biological material across borders. Bioethics & GMO's - issues and concerns pertaining to genetically modified foods and food crops, organisms and their possible health implications and mixing up with the gene-pool.	15	K4	CLO 4
V	Bioethics in medicine - Protocols of ethical concerns related to prenatal diagnosis, gene therapy, organ transplantation, xeno transplantation, ethics in patient care, informed consent. bioethics and cloning - permissions and procedures in animal cloning, human cloning, risks and hopes. Bioethics in research: stem cell research, human genome project, use of animals in research, human volunteers for clinical research, studies on ethnic races. he Nuremberg code.	15	K4	CLO 5

Books for Study:

1. Usharani B., Anbazhagi S. and Vidya C. K. (2019). Biosafety in Microbiological Laboratories. (1st Edition). Notion Press. ISBN101645878856
2. Satheesh M. K. (2009). Bioethics and Biosafety. (1st Edition). J. K
3. International Publishing House Pvt. Ltd: Delhi. ISBN:9788190675703
4. Goel D. and Parashar S. (2013). IPR, Biosafety and Bioethics. (1st Edition). Pearson education: Chennai. ISBN-13: 978-8131774700
5. Raj Mohan joshi. Biosafety and Bioethics. Wiley Publications.
6. Sibi. GIntellectual, Property Rights, Bioethics, Biosafety and Entrepreneurship in biotechnology. (2021). Wiley Publications.

Books for References:

1. Nithyananda K. V. (2019). Intellectual Property Rights: Protection and Management, India, IN: Cengage Learning India Private Limited.
2. Neeraj, P. and Khusdeep, D. (2014). Intellectual Property Rights, India, IN: PHI learning Private Limited,
3. Ahuja, V K. (2017). Law relating to Intellectual Property Rights, India, IN: Lexis Nexis.
4. Tony Hope (2004). Medical Ethics: A very Short introduction,. Oxford Publication.
5. Goel Parashar. IPR, Biosafety and Bioethics (2013). Pearson Publications..

Web Resources

1. <http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf>.
2. https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf.
3. <https://www.cdc.gov/training/quicklearns/biosafety/>
4. <https://bioethics.msu.edu/what-is-bioethics>
5. https://www.wto.org/english/tratop_e/trips_e/intel1_e.htm

Rationale for Nature of the course

The study of biosafety and bioethics is important because it helps to prevent harmful incidents and exploitation of biological resources for the benefit of mankind

Activities having direct bearing on Skill development / Employability Entrepreneurship

Equipped with the principles involved in ethical, legal, and regulatory issues. Discussion on patented products and its relevance

Pedagogy

Blended learning ,

Course Designer:

Dr. Asha Kannan A.P

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Intellectual Property Rights: Different forms of Intellectual Property Rights their relevance, importance to industry, Academia.,	4	Discussion, chalk and talk
	Role of IPR's in Biotechnology, Patent Terminology - Patents, trademarks, copyrights, industrial designs, geographical indications, trade secrets, non-disclosure agreements.	4	
	Patent life and geographical boundaries. International organizations and IPR - Overview of WTO, TRIPS, WIPO, GATT	4	
	International conventions, Trade agreements, Implication of TRIPS for developing countries.	3	
Unit II	Process involved in patenting. Patent Search - Procedural steps in patenting, process of filing, PCT application, Country-wise patent searches (USPTO, EPO, India etc.), patent mapping.	5	Discussion, chalk and talk
	Pre-grant & post-grant opposition, PCT and patent harmonization including Sui-generis system, ,	5	
	patent search methods, patent databases and libraries, online tools	5	
Unit III	Unit III: Patentability of biotechnology inventions - Patentability of biotechnology inventions in India, statutory provisions regarding biotechnological inventions under the current Patent Act 1970 (as Amended 2005).	5	Discussion, chalk and talk
	Biotechnological inventions as patentable subject matter, territorial nature of patents - from territorial to global patent regime, interpreting trips in the light of biotechnology inventions,	5	
	feasibility of a uniform global patent system, merits and demerits of uniform patent law, relevance of the existing international patent, tentative harmonisation efforts, implications of setting up a uniform world patent system.	5	

Unit IV	Introduction to bioethics - need of bioethics, applications and issues related to bioethics, social and cultural issues.	5	Discussion, chalk and talk
	Bioethics and biodiversity - conserving natural biodiversity, convention on protecting biodiversity, protocols in exchanging biological material across borders.	5	
	Bioethics & GMO's - issues and concerns pertaining to genetically modified foods and food crops, organisms and their possible health implications and mixing up with the gene-pool.	5	
Unit V	Bioethics in medicine - Protocols of ethical concerns related to prenatal diagnosis, gene therapy, organ transplantation, xeno transplantation, ethics in patient care, informed consent.	5	Discussion, chalk and talk
	Bioethics and cloning - permissions and procedures in animal cloning, human cloning, risks and hopes.	5	
	Bioethics in research: stem cell research, human genome project, use of animals in research, human volunteers for clinical research, studies on ethnic races. The Nuremberg code.	5	

Course Learning Outcomes:

On completion of this course the students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Execute the role of IPR, Patent, Trademarks and its importance.	K3
CLO-2	Develop patent procedure, patent filling and its mapping.	K3
CLO-3	Become Patent attorneys and Patent officers.	K4
CLO-4	Apply bioethics in GMO, food crops and its biodiversity.	K4
CLO-5	Analyze the importance of bioethics in research associated with HGP, clinical research, stem cell therapy.	K4

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

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

Advance application– 3;

Intermediate level–2;

Basic level–1

Blueprint for Semester Examination
Learning Outcome Based Education & Assessment (LOBE) 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 K-3	2	K1 & K2	1	K1	2 (K1&K2)	1(K3)
2	CLO 2	Up to K-3	2	K1 & K2	1	K3	2 (K1&K2)	1(K3)
3	CLO 3	Up to K-4	2	K1 & K2	1	K2	2 (K3&K3)	1(K4)
4	CLO 4	Up to K-4	2	K1 & K2	1	K2	2 (K3&K4)	1(K4)
5	CLO 5	Up to K-4	2	K1 & K2	1	K3	2 (K2&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

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Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF MICROBIOLOGY				CLASS: I M.Sc. MICROBIOLOGY				
Sem.	Course type	Course code	Course title	Credits	Contact hours/week	CIA	Ext	Total
II	DISCIPLINE ELECTIVE - IV	25P2RECT4	CLINICAL RESEARCH AND CLINICAL TRIALS	3	5	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	

Objectives:

- Provide an overview of history and methods involved in conducting clinical research.
- Design the principles involved in ethical, legal, and regulatory issues in clinical research on human subjects.
- Describe principles and issues involved in monitoring patientoriented research.
- Formulate a well- defined quality assurance and quality control plans.
- Acquire business development skills in the area of clinical research.

Unit	Description	Hours	K-level	CLO
I	Introduction to Clinical Research: Clinical Research: An Overview, Different types of Clinical Research. Clinical Pharmacology: Pharmacokinetics, Pharmacodynamics, Pharmacoepidemiology, Bioavailability, Bioequivalence, Terminologies and definition in Clinical Research. Drug Development Process: Drug Discovery Pipeline, Drug Discovery Process. Preclinical trail, Human Pharmacology (Phase-I), Therapeutic Exploratory trail (Phase-II), Therapeutic Confirmatory Trail (Phase-III) and Post marketing surveillance (Phase-IV).	15	K3	CLO 1

II	Ethical Considerations and Guideline in Clinical Research: Historical guidelines in Clinical Research-Nuremberg code, Declaration of Helsinki, Belmont report. International Conference on Harmonization (ICH)-Brief history of ICH, Structure of ICH & ICH Harmonization Process, Guidelines for Good Clinical Practice. Regulation in Clinical Research Drug and cosmetic act, FDA, Schedule-Y- Ethics Committee and their responsibilities. Clinical Research Regulatory Submission & approval Process- IND, NDA and ANDA submission Procedure. DCGI submission procedure. Other Regulatory authorities- EMEA, MHRA, PhRMA.	15	K3	CLO 2
III	Clinical Trial Management: Key Stakeholders in Clinical Research, Ethics Committees and Institutional Review Board, Responsibilities of Sponsor. Responsibilities of Investigator, Protocol in Clinical Research Clinical Trial Design, Project Planning Project Managements - Informed Consent, Investigator's Brochure (IB), Selection of an Investigator and Site, Patient screening, Inclusion and exclusion criteria, Randomization, Blinding. Essential Documents in clinical research -IB, ICF, PIS, TMF, ISF, CDA & CTA.	15	K4	CLO 3
IV	Quality Assurance, Quality Control & Clinical Monitoring: Defining the terminology-Quality, Quality system, Quality Assurance & Quality Control-QA audit plan. 21 CFR Part 11, Site Auditing, Sponsor Compliance and Auditing, SOP For Clinical Research-CRF Review & Source Data Verification, Drug Safety Reporting Corrective and preventative action process.	15	K4	CLO 4
V	Business Development in the Clinical Research Industry: Introduction & Stages of Business Development-Start-up Phase, Growth Phase, Maturity Phase, Decline Phase. Outsourcing in Clinical Research, Reasons for outsourcing to contract research organizations, The India Advantage, Scope and Future of CRO, List of Clinical Research Organizations in India, List of IT companies offering services in Clinical Research. Role of business development manager.	15	K4	CLO 5

Books for Study:

1. Gallin J. I., Ognibene F. P. and Johnson L. L. (2007). Principles and Practice of Clinical Research. (4th Edition). Elsevier, 2007. ISBN-10: 0128499052
2. Friedman L. M., Furberg C. D. and Demets D. (1998). Fundamentals of Clinical Trials, Vol: XVIII. (3rd Edition). Springer Science & Business Media.
3. Hulley S. B., Cummings S. R., Browner W. S., Grady D. G.
4. and Newman T. B. (2013). Designing Clinical Research. (4th Edition). Jaypee Medical. ISBN-13: 978-1608318049.
5. Reed, G. (2004). Prescott and Dunn's Industrial Microbiology, 4th edn, CBS publication and distributors.
6. Himanshu B. Text book of Clinical Research, Pee Vee books

Books for References:

1. Friedman L.M., Fuberge C.D., DeMets D. and Reboussen,
2. D.M. (2015). Fundamentals of Clinical Trials, Springer.
3. Browner W. S., (2012). Publishing and Presenting Clinical Research. (3rd Edition). Lippincott Williams and Wilkins.
4. Rondel R. K., Varley S. A. and Webb C. F. (2008). Clinical Data Management. (2nd Edition). Wiley.
5. Peppler, H.J. and Pearl Man, D. (1979). Fermentation Technology, Vol 1 & 2, 2nd Edition Academic Press, London
6. E1-Mansi, E.M.T., 5. E1-Mansi, E.M.T., Bryce, C.F.A., Demain, A.L. and Allman, A.R. (2007). Fermentation Microbiology and Biotechnology. 2nd Edition, CRC press, Taylor and Francis Group.

Web Resources

1. [https://www.hzu.edu.in/uploads/2020/10/Textbook-of-ClinicalTrials-Wiley-\(2004\).pdf](https://www.hzu.edu.in/uploads/2020/10/Textbook-of-ClinicalTrials-Wiley-(2004).pdf)
2. <https://www.routledge.com/A-Practical-Guide-to-ManagingClinical-Trials/Pfeiffer-Wells/p/book/9780367497828>
3. <https://www.auctoresonline.org/journals/clinical-research-and-clinical-trials>
4. https://www.who.int/health-topics/clinical-trials#tab=tab_1
5. <https://www.cancerresearchuk.org/about-cancer/find-a-clinicaltrial/what-clinical-trials-are/types-of-clinical-trials>

Rationale for Nature of the Course

The course Clinical Research and Clinical Trials is designed to provide an in-depth understanding of the principles, methodologies, and ethical considerations involved in conducting clinical research. It covers key aspects such as study design, patient recruitment, data collection, statistical analysis, and regulatory compliance, equipping students with the skills necessary to ensure the safety, efficacy, and integrity of clinical trials. By emphasizing Good Clinical Practices (GCP), ethical guidelines, and global regulatory frameworks, the course prepares students for careers in clinical research organizations, pharmaceutical industries, and healthcare institutions. It also fosters critical thinking and problem-solving skills, enabling learners to contribute to the development of new medical treatments and innovations in healthcare.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Mini-project and hands-on training in in healthcare innovation and contract research.

Pedagogy

Lecture, Chalk and Talk, PowerPoint presentation.

Course Designer(s):

Dr. P.N. Rajarajan

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	History and Scope of Microbiology. Microscopy – Principles and applications. Sample preparation for SEM & TEM.	5	Chalk and talk
	Types of Microscopes - Bright field, Dark-field, Phase-contrast, Fluorescence microscope, Transmission electron microscope (TEM) and Scanning electron microscope (SEM).	5	
	Atomic force, Confocal microscope. Micrometry – Stage, Ocular and its applications.	5	
Unit II	Microbial techniques - Safety guidelines in Microbiology Laboratories. Sterilization, Disinfection and its validation.	5	Chalk and talk PPT/video presentation
	Staining methods – Simple, Differential and Special staining. Automated Microbial identification systems - Pure cultures techniques – Cultivation of Anaerobic organisms.	5	
	Maintenance and preservation of pure cultures. Culture collection centers - National and International.	5	
Unit III	Algae - Distribution, morphology, classification, reproduction and economic importance.	5	Chalk and talk PPT/video presentation
	Isolation of algae from soil and water. Media and methods used for culturing algae, Strain selection and large-scale cultivation.	5	
	Life cycle - <i>Chlamydomonas</i> , <i>Volvox</i> <i>Spirogyra</i> (Green algae), <i>Nostoc</i> (Cyanobacteria) <i>Ectocarpus</i> , <i>Sargassum</i> (Brown algae), <i>Polysiphonia</i> , <i>Batrachospermum</i> (Red algae).	5	
Unit IV	Bacterial Structure, properties and biosynthesis of cellular components – Cell wall. Actinomycetes and Fungi - Distribution, morphology, classification, reproduction and economic importance.	5	Chalk and talk Group discussion
	Sporulation. Growth and nutrition - Nutritional requirements, Growth curve, Kinetics of growth, Batch culture.	5	
	Synchronous growth, Measurement of growth and factors affecting growth.	5	

Unit V	Biodiversity - Introduction to microbial biodiversity – Thermophiles - Classification, Thermophilic Archaeobacteria and its applications.	5	Chalk and talk PPT/video presentation
	Methanogens - Classification, Habitats, applications. Alkaliphiles and Acidophiles - Classification, discovery basin, its cell wall and membrane. Barophiles - Classification and its applications.	5	
	Halophiles - Classification, discovery basin, cell walls and membranes – purple membrane, compatible solutes. Microbial stress response -Osmoadaptation / halotolerance - Applications of halophiles.	5	

On completion of this course the students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Examine various microbes employing the microscopic techniques learnt. Measure and compare the size of microbes.	K3
CLO-2	Create aseptic conditions by following good laboratory practices.	K3
CLO-3	Identify and cultivate the algae understanding their habitat. Analyze the morphology, classify and propagate depending on its economic importance.	K4
CLO-4	Differentiate and appreciate the anatomy of various microbes. Plan the growth of microbes for different environmental conditions.	K4
CLO-5	Categorize and cultivate a variety of extremophiles following standard protocols for industrial applications.	K4

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

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

Advance application– 3;

Intermediate level–2;

Basic level–1

Blueprint for Semester Examination

Learning Outcome Based Education & Assessment (LOBE) 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 K-3	2	K1 & K2	1	K1	2 (K1&K2)	1(K3)
2	CLO 2	Up to K-3	2	K1 & K2	1	K3	2 (K1&K2)	1(K3)
3	CLO 3	Up to K-4	2	K1 & K2	1	K2	2 (K3&K3)	1(K4)
4	CLO 4	Up to K-4	2	K1 & K2	1	K2	2 (K3&K4)	1(K4)
5	CLO 5	Up to K-4	2	K1 & K2	1	K3	2 (K2&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

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K2	5	4	15	-	24	20	20%
K3	-	4	20	20	44	36.66	38%
K4	-	-	5	30	35	29.17	29%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF MICROBIOLOGY				CLASS: I M.Sc. MICROBIOLOGY				
Sem.	Course type	Course code	Course title	Credits	Contact hours/week	CIA	Ext	Total
II	NME-II	25P2RSEN2	MICROBES IN HUMAN WELFARE	2	2	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented		Entrepreneurship Oriented	

Objectives:

- Learn their importance in food preservation and production. Explore the significance of microbes
- in producing alcohols, beverages, biofuels, and other industrially relevant products. Gain
- knowledge of soil microflora and rhizosphere interactions. Understand the impact of probiotics
- on intestinal microbiota and human health. Learn microbial roles in Understand microbial
- contributions to biogas (methane) production.

Unit	Description	Hours	K-level	CLO
I	Microbes in Food, Dairy and fermented beverages - <i>Saccharomyces</i> , <i>Lactobacillus</i> , <i>Agaricus</i> , <i>Spirulina</i> . General account of food preservation. Microbiological production of fermented foods – bread, cheese, yogurt SCP and edible mushrooms	6	K2	CLO 1
II	Microbes in Industrial products Microorganisms of industrial importance Industrial production of alcohols (ethyl alcohol), beverages (beer and wine), biofuels (biogas - methane)	6	K2	CLO 2
III	Microbes in Agriculture Soil microflora, Rhizosphere, organic manure. Bio control agents- Biofertilizers (Bacteria- <i>Rhizobium</i> , Fungi- <i>Trichoderma</i> , Blue green algae- <i>Anabaena</i> . Bioinsecticides- <i>Bacillus thuringiensis</i> .	6	K2	CLO 3
IV	Microbes as Probiotics Intestinal microbiota, intake of probiotic bacteria and impact on health and disease as well as the interaction between probiotic bacteria and food.	6	K2	CLO 4

V	Microbes in sewage treatment Introduction of sewage, Trickling filter, activated sludge, oxidation pond, oxidation ditch. Microbes in production of biogas.	6	K2	CLO 5

Books for Study:

1. Dubey, R.C. and Maheswari, D.K. (2005). A text book of Microbiology. Revised Multicolour Edition. Published by S. Chand & Company Limited. New Delhi.
2. Pelczar, T.R., Chan, E.C.S. and Kreig, N.R. (2006) Microbiology. 5th Edition. Tata McGraw – Hill, New Delhi.
3. General Microbiolog. Seventh edition. Cambridge University Press. UK.

Books for References:

1. Prescott, M. (2005). Microbiology. 6th Edition. Tata McGraw – Hill. New Delhi.
2. Albert Moat, G. and John Foster, W. (2004). Microbial Physiology. 4th Edition. John Wiley & Sons. New York.
3. Robert Boyd , F. (1984). General Microbiology. Times Mirror / Mosby College Publishers. UK.
4. Purohit, S.S. (2005). Microbiology – Fundamentals and Applications. Reprinted & Published by Student Edition. Behind Nasrani Cinema, Chopasani Road, Jodhpur. Schlegel, H.G. (1993).

Web Resources

1. <https://www.periobasics.com/basic-microbiology>
2. <https://www.microbiologynutsandbolts.co.basic-concepts>
3. <https://www.microbiologyinfo.com/category/basic-microbiology>
4. <https://www.Microbiology-Overview-youtube.com>
5. <https://www.Introductiontomicrobiology.youtube.com>

Rationale for Nature of the course

This course introduces the core concepts and basic principles in microbiology, examining microorganisms and how they interact with humans and the environment. Information regarding classification of microorganisms, characteristics of different cell types and processes critical for cell survival is presented.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Employing microorganisms for production of biogas in rural areas. Identifying essential microbes for producing food and health products. Exploring research related to biocontrol agents

Pedagogy

Chalk and talk PPT/video presentation

Course Designer(s):

Dr. K. Raghavan

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Introduction, History of Microbiology, Discovery of microorganisms	1	Chalk and talk
	Contributions of Leeuwenhoek, Louis Pasteur, Edward Jenner , Robert Koch, Elie Metchnikoff and Fleming	3	
	Classification based on Carl Woese (The three domains) and Robert H. Whittaker (Five Kingdom system)	2	
Unit II	Study of <i>Saccharomyces</i> nutritional requirement and commercial application in fermented beverages.	2	Chalk and talk
	Probiotic properties, diversity and beneficial activity of <i>Lactobacillus</i> in food and feed.	2	
	Isolation, cell structure, metabolism, nutritional status, chemical composition, utilization of <i>Spirulina</i> and <i>Agaricus</i> as food source. Microbes used in ethanol fermentation	2	
Unit III	History, raw material, manufacturing processes and quality control of Insulin.	2	Chalk and talk PPT/video presentation
	Penicillin: Discovery and its commercial production.	2	
	Introduction to vaccines and WHO recommendations for routine immunization schedule for children. Role of vaccines for small pox, rabies and polio	2	
Unit IV	Mode of action of microbial biological control agents against plant diseases: Relevance beyond efficacy.	2	Chalk and talk Group discussion
	Recent advances and future prospects of biofertilizers.	2	
	Role of microorganisms in soil health and uses of organic manure.	2	
Unit V	Study of physical and biological environment processes for sewage treatment.	2	Chalk and talk PPT/video presentation
	Biogas Production from Organic Waste: Recent Progress and Perspectives.	2	
		2	

Course Learning Outcomes:

On completion of this course the students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Demonstrate knowledge of microbial roles in producing fermented foods, beverages, SCP, and edible mushrooms, and evaluate food preservation techniques.	K2
CLO-2	Explain the microbial processes in industrial production of alcohols, biofuels, and beverages, emphasizing their relevance to biotechnology.	K2
CLO-3	Apply microbial solutions such as biofertilizers, biocontrol agents, and bioinsecticides to enhance sustainable agriculture.	K2
CLO-4	Analyze the impact of probiotics on gut health and disease prevention, focusing on their interaction with food and intestinal microbiota.	K2
CLO-5	Explain microbial contributions to sewage treatment and biogas production, highlighting their role in environmental sustainability.	K2

Mapping of CLOs with PSOs

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

Mapping of CLOs with POs

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

Advance application– 3;

Intermediate level–2;

Basic level–1

Blueprint for Semester Examination

Learning Outcome Based Education & Assessment (LOBE) 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 K-2	2	K1 & K2	1	K1	2 (K1&K2)	1(K1)
2	CLO 2	Up to K-2	2	K1 & K2	1	K1	2 (K1&K2)	1(K1)
3	CLO 3	Up to K-2	2	K1 & K2	1	K2	2 (K1&K2)	1(K2)
4	CLO 4	Up to K-2	2	K1 & K2	1	K2	2 (K1&K2)	1(K2)
5	CLO 5	Up to K-2	2	K1 & K2	1	K2	2 (K1&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

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	10	2	5	2	59	49.1	100%
K2	-	3	5	3	61	50.9	
Total Marks	10	5	50	50	120	100.00	100%



DEPARTMENT OF BIOTECHNOLOGY

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. Biotechnology) – Regulation 2023

Department of Biotechnology

Vision

To produce disciplined and competent students of high calibre, to become socially committed and ethically strong to meet the challenges.

Mission

- To foster excellence in the field of biotechnology.
- To adopt proper pedagogical methods to ensure quality education and academic excellence.
- To provide conducive environment for learning following ethical, 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 Specific Outcomes (PSOs)

On the successful completion of B.Sc., Biotechnology the students will be able to

	PSOs	Graduate Attributes
PSO-1	Infer knowledge in core concepts, recent developments and laboratory skills in various domains of biotechnology.	• Knowledge on core competency • Modern Tool Usage
PSO-2	Identify the various biological processes in prokaryotic and eukaryotic organisms and make use of skills in biological and computational tools and techniques.	• Life-long learning • Design • Problem analysis
PSO-3	Correlate and apply physio-chemical, biological, computational, biological and chemical principles and techniques in various areas of Biotechnology.	• Problem analysis • Conduct investigations of • complex problems • Design & Development of • solutions for complex problems • Modern Tool Usage
PSO-4	Exhibit in depth knowledge in various thrust areas of Biotechnology so as to meet the demands in industry and academia.	• Individual and team work • Communication • Life-long learning
PSO-5	Explain the importance of ethics and socioeconomic development through Biotechnology.	• Ethics • Environment and sustainability

The Madura College, Madurai

Department of Biotechnology

Programme structure for B.Sc., Biotechnology (2023 -2024 onwards)

Sem	Course Category	Subject Code	Title of the Course	H	C
I	Language – I	23U1TLAN1/ 23U1HLAN1	Tamil / Hindi	6	3
	Language – II	23U1NENG1	English	6	3
	Core	23U1LCCT1	Cell and Molecular Developmental Biology	5	5
	Core Practical	23U1LCCP1	Major Practical-I	3	3
	Allied/GEC	23U1CGET1	Biological Chemistry	4	4
	Allied/GEC - Practical	23U1CGEP1	Allied Practical-I	2	1
	Foundation course	23U1LFCT1	Basics of Biotechnology	2	2
	SEC	23U1LSED1	Food Chemistry	2	2
				30	23
II	Language – I	23U2TLAN2/ 23U2HLAN2	Tamil / Hindi	6	3
	Language – II	23U2NENG2	English	6	3
	Core	23U2LCCT2	Genetics	5	5
	Core Practical	23U2LCCP2	Major Practical-II	3	3
	Allied/GEC	23U2CGET2	Bioinstrumentation	4	4
	Allied/GEC - Practical	23U2CGEP2	Allied Practical-II	2	1
	SEC	23U2LSED2	Mushroom Cultivation	2	2
	SEC	23U2LSED3	Clinical Nutrition & Dietary Management	2	2
	Part-V	23U2YRC1/ 23U2NSS1/ 23U2PED1			
				30	23
III	Language – I	23U3TLAN3/ 23U3HLAN3	Tamil / Hindi	6	3
	Language – II	23U3NENG3	English	6	3
	Core	23U3LCCT3	Immunology and Immunotechnology	4	4
	Core Practical	23U3LCCP3	Major Practical-III	3	3
	Allied/GEC	23U3RGET1	Fundamentals of Microbiology	4	4
	Allied/GEC - Practical	23U3RGEP1	Allied Practical-I	2	1
	SEC	23U3LSED4	Food and Bioprocess Technology	2	2
	SEC	23U3LSED5	Vermitechnology	2	2
		23U4EVST1		1	
				30	22

Sem	Course Category	Subject Code	Title of the Course	H	C
IV	Language – I	23U4TLAN4/ 23U4HLAN4/ 23U4SLAN4	Tamil / Hindi / Sanskrit	6	3
	Language – II	23U4NENG4	English	6	3
	Core	23U4LCCT4	Genetic Engineering and rDNA Technology	4	4
	Core Practical	23U4LCCP4	Major Practical-IV	3	3
	Allied/GEC	23U4RGET2	Bioinformatics and Biostatistics	4	4
	Allied/GEC - Practical	23U4RGEP2	Allied Practical-II	2	1
	SEC	23U4LSED6	Poultry Science and Management	2	2
	SEC	23U4LSED7	Aquaculture	2	2
	EVS	23U4EVST1		1	2
				30	24
V	Core	23U5LCCT5	Plant Biotechnology	5	4
	Core	23U5LCCT6	Animal Biotechnology	5	4
	Core	23U5LCCT7	Pharmaceutical Biotechnology	5	4
	Core-Practical	23U5LCCP5	Major Practical-V	3	3
	Discipline Elective	23U5LDET1(A)	Enzymology	5	4
		23U5LDET1(B)	Marine Biotechnology		
	IDC	23U5LIDT	Computer Aided Drug Design	5	4
	Value Education	23U5VENT1		2	2
	Industrial Visit/ Internship/ Field Visit	23U5LINTR		--	2
				30	27
VI	Core	23U6LCCT8	Environmental and Industrial Biotechnology	6	4
	Core	23U6LCCT9	Medical Biotechnology	6	4
	Core	23U6LCCT10	Bioentrepreneurship	6	4
	Core-Practical	23U6LCCP6	Major Practical-VI	3	3
	Discipline Elective Course	23U6LDET2(A)	Bioethics and Biosafety	4	2
		23U6LDET2(B)	Nanobiotechnology		
	SEC-PC	23U6LSED8	Biotechnology for Competitive exam	2	2
	Project and viva-voce	23U6LPROV	Project and viva-voce	3	2
				30	21

Ancillary Biotechnology Papers for B.Sc., Microbiology

Semester	Course	Subject Code	Title of the Course	H	C
I	Allied/GEC	23U1LGET1	Basic and Clinical Biochemistry	4	4
	Allied/GEC-Practical	23U1LGEP1	Allied Practical-I	2	1
II	Allied/GEC	23U2LGET2	Clinical Laboratory Technology	4	4
	Allied/GEC-Practical	23U2LGEP2	Allied Practical-II	2	1

Certificate Course

Subject Code	Course	Title of the Course	Hours	Credits
23LC01	Certificate Course	Organic Farming and Health Management	30	2

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

Evaluation Pattern

Theory

	Components	Marks	Total Marks
Internal [Formative]	Test	10	25
	Assignment	5	
	Attendance/Quiz	5	
	Quiz/ Documentation/ Case lets/ ICT based assignments/ Mini Projects	5	
External [Summative]		75	75
Total Marks			100

Question Paper Pattern for External Examination - Theory (75 marks)

Section	Question type	Marks
A	Multiple Choice Questions (10 X 1 mark)	10
B	Short Answer questions (5 X 2 marks)	10
C	Either or Choice questions (5 X 5 marks)	25
D	Open Choice questions – 3 out of 5 (3 X 10 Marks)	30
	Total	75

Practicals

	Components	Marks	Total Marks
Internal [Formative]	Continuous assessment	10	25
	Observation	5	
	Test	10	
External [Summative]		75	75
Total Marks			100

Question Paper pattern for External examination - Practicals (75 marks)

Section		Marks
I	Major Question (1 X 25 Marks)	25
II	Minor Question (1 X 20 Marks)	20
III	Spotters (4 X 5 marks)	20
IV	Record Notebook	10
	Total	75

Add-on courses for B.Sc. Biotechnology

Semester	Subject Code	Title of the paper	H	C
III		Forensic Biotechnology	2	2
IV		Herbal Medicine	2	2

Evaluation pattern for Add-on courses

Internal evaluation : 50 % marks

External evaluation : 50 % marks

Continuous Internal Assessment components	Marks
Assignment (3nos)/mini project	20
Paper presentation/seminar	15
Quiz	15
Total	50

External examination duration: 2 hours

Question paper pattern

Part-A Multiple choice type 10 x 1 = 10 marks

Part- B Descriptive type [4 out of 7] 4 x 10 = 40 marks

Self-study courses for B.Sc. Biotechnology

Semester	Subject Code	Title of the paper	H	C
IV		Good Laboratory Practices		2

Evaluation pattern for Self-study courses

Assessment components	Marks
Assignments (minimum 2)	25
Project/innovative experimental design	25
Paper presentation/ viva voce	25
Internal test	25
Total	100

DEPARTMENT OF BIOTECHNOLOGY				CLASS: III B.SC BIOTECHNOLOGY				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
V	Major Core	23U5LCCT5	Plant Biotechnology	4	5	25	75	100

Nature of Course					
Skill oriented	✓	Employability oriented	✓	Entrepreneurship oriented	

Course Objectives

- To explore the history of Plant Biotechnology and state the importance of the organization of plant genomes.
- To be acquainted with the molecular basis of plant hormone action and gene expression.
- To illustrate various culture medium preparations and techniques for producing haploid and triploid plants, as well as their applications.
- To develop molecular technique skills for crop improvement.

Unit	Description	Hours	K-level	CLO
I	History of plant biotechnology- Conservation of Plant using Biotechnology- <i>In- situ</i> and <i>Ex-situ</i> conservation- Cryopreservation. Plant genome organization: structural features of a representative plant gene, gene families in plants. Organization of chloroplast genome and mitochondrial genome.	15	2	1
II	Plant Growth Regulators: Auxins, cytokinin and gibberellins – mode of action, phytochrome – role in photomorphogenesis, abscisic acid –stress – induced promoter switches in the control of gene expression, Ethylene and fruit ripening.	15	3	2
III	Plant Tissue Culture- Media composition (MS media), callus culture, micropropagation technique -- direct and indirect organogenesis, somoclonal variation, somatic embryogenesis, haploid and triploid plant production, protoplast isolation - fusion and culture, hybrid and cybrid production, Synthetic seed production. Cell Suspension Cultures.	15	4	3

IV	Gene transfer in plants – vector mediated- Ti plasmids, Mechanism of T-DNA transfer to plants, -Ti plasmid derived vectors, Viruses mediated- -caulimoviruses and gemini viruses. Non – vector mediated, particle bombardment, silicon carbide fibre mediated, PEG, liposome, Marker genes - selectable antibiotics resistance - <i>npt-II</i> , <i>hpt</i> , <i>aadA</i> , Antimetabolite marker <i>-dhfr</i> ,	15	4	4
V	Transgenics: Crop improvement - herbicide resistance- Glyphosate-resistant, insect resistance- bt cotton, virus resistance- the ‘N’ gene for resistance to tobacco mosaic virus (TMV), plants as bioreactor - Ig G production. Plant vaccines- Hepatitis B, genetically modified food- Golden Rice, future perspectives & ecological impact of transgenic plants. Symbiotic nitrogen fixation in Rhizobia-nif gene	15	3	5

Books for Study

- Trivedi PC. 2000. Applied Biotechnology: Recent Advances. PANIMA Publishing Corporation.
- Narayanaswamy S. 1994. Plant cell and tissue culture. Tata McGraw Hill Publishing Company limited, New Delhi.
- Chawla HS. 2009. Introduction to Plant Biotechnology, 3rd Edition, Science Publishers.

Books for Reference

- Stewart CN. 2008. Plant Biotechnology and Genetics: Principles, Techniques and Applications, Wiley-Interscience.
- Heldt HW. 1997. Plant Biochemistry & Molecular Biology, Oxford University Press.
- Trigiano RN and Gray DJ. 1996. Plant tissue culture: Concepts and laboratory exercise. CRC Press.

Web resources

- <https://nptel.ac.in/courses/102103016>
- <https://science.umd.edu/classroom/bsci124/lec41.html>
- <https://www.nifa.usda.gov/grants/programs/biotechnology-programs/plant-biotechnology>
- <http://mydunotes.blogspot.com/p/plant-biotechnology.html>

Rationale for nature of the course

This course provides students with the knowledge and skills to understand the molecular, genetic, and biotechnological principles that shape modern plant breeding, conservation, and plant biotechnology. By addressing various aspects of plant growth regulation, genetic manipulation, crop improvement, and environmental considerations, the course prepares students to address global challenges in agriculture, conservation, and industry. They would be competent to get a placement in the Plant Breeding and Tissue Culture Institute.

Activities having direct bearing on Skill development / Employability /Entrepreneurship

The activities in plant biotechnology are presented during the lecture session, which involve group discussions and preparing mind map of cloning strategies of transgenic plants.

PedagogyThe teaching methods may include Chalk and talk, power point, demonstrations, assignments, group discussions and problem solving

Course content designers:

Dr. N. Kamala Dhasan

LECTURE SCHEDULE

Unit	Description	Hours	Mode
I	Conservation of Plant using Biotechnology- <i>In-situ</i> and <i>Ex-situ</i> conservation-	6	Chalk and talk, Quiz, PPT
	Cryopreservation. Plant genome organization: structural features of a representative plant gene, gene families in plants.	6	
	Organization of chloroplast genome and mitochondrial genome.	3	
II	Auxins, cytokinin and gibberellins – mode of action,	6	Chalk and talk, PPT
	phytochrome – role in photomorphogenesis,	6	
	abscisic acid –stress – induced promoter switches in the control of gene expression, Ethylene and fruit ripening.	3	
III	Media composition (MS media), callus culture, micropropagation technique -- direct and indirect organogenesis,	3	Chalk and talk, group discussion PPT
	somoclonal variation, somatic embryogenesis, haploid and triploid plant production, protoplast isolation - fusion and culture,	6	
	hybrid and cybrid production, Synthetic seed production. Cell Suspension Cultures	6	
IV	vector mediated- Ti plasmids, Mechanism of T-DNA transfer to plants, -Ti plasmid derived vectors	6	Chalk and talk, group discussion PPT
	, Viruses mediated- -caulimoviruses and gemini viruses. Non – vector mediated, particle bombardment, silicon carbide fibre mediated, PEG, liposome,	5	
	Marker genes - selectable antibiotics resistance - <i>npt-II</i> , <i>hpt</i> , <i>aadA</i> , Antimetabolite marker - <i>dhfr</i> ,	4	
V	Crop improvement - herbicide resistance-Glyphosate-resistant , insect resistance- bt cotton, virus resistance- the ‘N’ gene for resistance to tobacco mosaic virus (TMV),	6	Chalk and talk, group discussion, PPT
	plants as bioreactor - Ig G production, . Plant vaccines- Hepatitis B, genetically modified food- Golden Rice,	6	
	future perspectives & ecological impact of transgenic plants. Symbiotic nitrogen fixation in Rhizobia-nif gene	3	

Course Learning Outcomes

On completion of this course the students will be able to

#	CLOs	K – Level
CLO-1	Describe about Plant genome organization	Up to K-2
CLO-2	Illustrate the molecular basis mode of action of plant growth regulators	Up to K-3
CLO-3	Discuss about the Media composition, micropropagation techniques and Secondary metabolite production.	Up to K-4
CLO-4	Explain about the Agrobacterium mediated gene transfer and Symbiotic nitrogen fixation involving nif gene	Up to K-3
CLO-5	Briefly discuss about the crop improvement through various genetic engineering techniques to produces transgenic plants.	Up to K-4

Mapping of Course outcomes with Program specific Outcomes

CLO/PSO	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

Mapping of Course outcomes with Program Outcomes

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	3	3	2	3	3	2
CLO-2	3	3	3	3	3	2
CLO-3	3	2	3	2	3	2
CLO-4	3	3	3	3	3	2
CLO-5	3	3	2	3	3	2

Advance application-3; Intermediate level-2 & Basic level-1

Learning Outcome Based Education & Assessment (LOBE)

Blue Print – Plant Biotechnology

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 K-2	2	K1 & K2	1	K1	2 (K1&K1)	1(K2)
2	CLO 2	Up to K-3	2	K1 & K2	1	K2	2 (K2&K2)	1(K3)
3	CLO 3	Up to K-4	2	K1 & K2	1	K2	2 (K3&K3)	1(K4)
4	CLO 4	Up to K-3	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
5	CLO 5	Up to K-4	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 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	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%

Distribution of Unit-wise questions with K Levels

Section A	Section B	Section C	Section D
2 Questions for each Unit (K1 & K2 Level)	1 Question from each Unit (K1 & K2 Level)	2 Questions from Unit-I (K2 Level)	1 Question from Unit-I (K3 Level)
		2 Questions from Unit-II (K3 Level)	1 Question from Unit-II (K4 Level)
		2 Questions from Unit-III (K3 Level)	1 Question from Unit-III (K3 Level)
		2 Questions from Unit-IV (K4 Level)	1 Question from Unit-IV (K3 Level)
		2 Questions from Unit-V (K1 Level)	1 Question from Unit-V (K2 Level)

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 interferences with evidences

DEPARTMENT OF BIOTECHNOLOGY				CLASS: III B.SC BIOTECHNOLOGY				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
V	Core Course	23U5LCCT6	Animal Biotechnology	4	5	25	75	100
Nature of Course								
Skill oriented		✓	Employability oriented	✓	Entrepreneurship oriented			

Course Objectives

- To understand the basic concepts, techniques, and applications of animal cell culture and cell laboratory practices.
- To understand the principles of various cell culture methodology.
- To elaborate the transformation process and selection of transformed cells.
- To solve the problems related to reproductive problems in human and cattle

Unit	Description	Hours	K-level	CLO
I	Animal cell culture – History and development, Pluripotency, Media, balanced salt solutions, Constitution of a media - Physical, chemical and metabolic functions of constituents of culture media, Role of carbon dioxide, Serum, growth factors and amino acids in media. Serum-containing and serum-free media. Essential equipment required for animal cell culture.	15	2	1
II	Types of cell culture- Primary, Secondary, Organ culture and cell lines. Role of feeder layers in cell culture, Cell separation techniques, cell synchronization, Cell counting methods, cryopreservation, Cell banking procedures. Biology of cultured cells- Apoptosis and cell death.	15	3	2
III	Transfection of cells in culture- Animal viral vectors- Retrovirus, SV 40, Adenovirus, Physical methods of transfection- microinjection, selectable markers-CAT, TK, DHFR and HGPRTase. Micro manipulation of cells, Gene targeting, gene silencing RNAi, Gene knockout and their applications.	15	4	3
IV	Transgenics Protein production by genetically engineered mammalian cell lines- α 1-Antitrypsin, glucocerebrosidase, Transgenic Animals- Harvard Oncomouse, low cholesterol milk-cows, GloFish, male sterile transgenic mosquitoes. Stem cells –types and their applications	15	3	4

V	Assisted Reproductive Technology: Collection and preservation of embryos, Semen banking, MOET, AI, IVF, GIFT, ZIFT and ICSI.	15	4	5

Books for Study

1. Ramasamy. P. 2002. Trends in Biotechnology, University of Madras of Publications
2. Srivastava.K. 2009, Animal Biotechnology, Oxford & IBH Publishing Co. Pvt. Ltd
3. Jenkins. N. 1999. Animal cell Biotechnology: Methods and protocols. Humana press, New Jersey.

Books for Reference

1. Freshney RI. 2010. Culture of Animal cells – A Manual of Basic Technique Fourth Edition, Wiley Liss & Publications.
2. Glick BR and Pasternark. 2002. Molecular Biotechnology: Principle and Applications of recombinant DNA.
3. Walker JM and Gingold EB. 1999. Molecular biology and Biotechnology, 3rd edition, Panima Publishing Corporation.

Web resources

1. <http://ecoursesonline.iasri.res.in/course/view.php?id=350>
2. https://biocyclopedia.com/index/biotechnology/animal_biotechnology/manipulation_of_reproduction_and_transgenic_animals/biotech_in_vitro_fertilization_technology.php
3. <https://people.ucalgary.ca/~browder/transgenic.html>

Rationale for the nature of the course

The Animal Biotechnology course provides a thorough understanding of animal cell culture, genetic engineering, and reproductive biotechnology. Through case studies, students will explore practical applications. Upon completion, students will be equipped with the knowledge and skills for careers in research, biotechnology, veterinary medicine, pharmaceuticals, and academia, contributing to advancements in human health, animal welfare, and agriculture

Activities having direct bearing on Skill development / Employability /Entrepreneurship

Students will learn techniques for cell culture, gene manipulation, protein production, stem cell biology, and reproductive technologies, including transfection, gene targeting, embryo collection, semen banking, and assisted reproduction.

Pedagogy

The teaching methods may include Chalk and talk, PowerPoint, demonstrations, assignments, group discussions and Problem solving.

Course content designers: Dr. N. Vidhyalakshmi

LECTURE SCHEDULE

Unit	Description	Hours	Mode
I	History and development, Pluripotency, Media, balanced salt solutions, Constitution of a media -.	6	Chalk, Quiz and talk, Problem-solving
	Physical, chemical and metabolic functions of constituents of culture media, Role of carbon dioxide, Serum, growth factors and amino acids in media.	6	
	Serum-containing and serum-free media. Essential equipment required for animal cell culture	3	
II	Primary, Secondary, Organ culture and cell lines. Role of feeder layers in cell culture,	5	Chalk, and talk, Problem-solving
	Cell separation techniques, cell synchronization, Cell counting methods, cryopreservation,	5	
	Cell banking procedures. Biology of cultured cells- Apoptosis and cell death.	5	
III	Animal viral vectors- Retrovirus, SV 40, Adenovirus, Physical methods of transfection- microinjection	5	Chalk and talk, PPT
	selectable markers-CAT, TK, DHFR and HGPRTase. Micro manipulation of cells,	5	
	Gene targeting, gene silencing RNAi, Gene knockout and their applications.	5	
IV	Protein production by genetically engineered mammalian cell lines- α 1-Antitrypsin, glucocerebrosidase,	5	Chalk, and talk, PPT
	Transgenic Animals- Harvard Oncomouse, low cholesterol milk-cows, GloFish, ,	4	
	male sterile transgenic mosquitoes. Stem cells –types and their applications	6	
V	Collection and preservation of embryos	5	Chalk and talk, group discussion,
	Semen banking, MOET, AI,	6	
	IVF, GIFT, ZIFT and ICSI.	4	

Course Learning Outcomes

On completion of this course the students will be able to

#	CLOs	K – Level
CLO-1	Describe the physio-chemical properties of animal cell culture medium	Up to K-2
CLO-2	Illustrate the various techniques used for cell culture	Up to K-3
CLO-3	Sketch the methods and techniques used for transgenic animal production	Up to K-4
CLO-4	Highlights significance of stem cells and their applications	Up to K-3
CLO-5	Elaborate the various reproductive assisted techniques	Up to K-4

Mapping of Course outcomes with Program specific Outcomes

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

Advance application-3; Intermediate level-2 & Basic level-1

Mapping of Course outcomes with Program Outcomes

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	2	2	3	2	2	3
CLO-2	3	3	3	2	2	2
CLO-3	3	3	2	3	3	2
CLO-4	2	3	2	2	3	3
CLO-5	2	2	2	2	2	2

Advance application-3; Intermediate level-2 & Basic level-1

Learning Outcome Based Education & Assessment (LOBE)

Blue Print – Animal Biotechnology

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 K-2	2	K1 & K2	1	K1	2 (K1&K1)	1(K2)
2	CLO 2	Up to K-3	2	K1 & K2	1	K2	2 (K2&K2)	1(K3)
3	CLO 3	Up to K-4	2	K1 & K2	1	K2	2 (K3&K3)	1(K4)
4	CLO 4	Up to K-3	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
5	CLO 5	Up to K-4	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 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	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%

Distribution of Unit-wise questions with K Levels

Section A	Section B	Section C	Section D
2 Questions for each Unit (K1 & K2 Level)	1 Question from each Unit (K1 & K2 Level)	2 Questions from Unit-I (K2 Level)	1 Question from Unit-I (K3 Level)
		2 Questions from Unit-II (K3 Level)	1 Question from Unit-II (K4 Level)
		2 Questions from Unit-III (K3 Level)	1 Question from Unit-III (K3 Level)
		2 Questions from Unit-IV (K4 Level)	1 Question from Unit-IV (K3 Level)
		2 Questions from Unit-V (K1 Level)	1 Question from Unit-V (K2 Level)

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 interferences with evidences

DEPARTMENT OF BIOTECHNOLOGY				CLASS: III B.SC BIOTECHNOLOGY				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
V	Major Core	23U5LCCT7	Pharmaceutical Biotechnology	4	5	25	75	100
Nature of Course								
Skill oriented		✓	Employability oriented	✓	Entrepreneurship oriented			

Course Objectives

- To understand the series of processes involved in drug development, patenting and drug approval.
- To acquire knowledge on recombinant products that pharmaceutically important
- To gain knowledge on drug toxicity
- To gain knowledge on National and International Drug approval agencies

Unit	Description	Hours	K-level	CLO
I	Objectives of Pharmaceutical Biotechnology - Generic and Biogeneric drugs. Stages in the drug development process - Drug discovery - Drug designing - Drug production - Preclinical trials - Clinical trials - Pharmacokinetics and Pharmacodynamics - Patenting & Drug Approval - Drug Marketing - Post clinical trials.	15	2	1
II	Production of recombinant proteins - Human Insulin (Humulin), Growth hormones (Humatrope) - Blood coagulating factor (factor VIII - Kogenate) - Erythropoietin - (Epogen) Granulocyte colony stimulating factors (Neulasta) - Interferons (Avonex) - Antimicrobial peptides (β - defensin 2) - Vaccines (Pentavac), Biologics (Humira - Adalimumab), - Cancer based biologics (rituximab)	15	3	2
III	Drug metabolism: Biotransformation, Phase I and II, excretion and elimination of drugs- renal and biliary, entero hepatic, Clinical situations resulting in changes in drug half-life, optimization of dose and loading dose. Factors affecting drug metabolism including stereo chemical aspects.	15	4	3

IV	Drug toxicity analysis - Common side effects of drugs and managements - Drugs of abuse - Life changing complications - Prevention and management with reference to paracetamol, atropine poisoning, heavy metals and antagonists.	15	4	4
V	Pharmaceutical regulations and Drug approval: Biopharmaceutical considerations - Pharmaceutical regulations - Formulation of Biotechnology products - Drug delivery - Pharmacognosy National and International Drug approval agencies - Top National and International pharmaceutical industries - Scope and career opportunities in pharmaceutical sectors.	15	3	5

Books for Study

- Kokate C and Pramod HJ. 2011. Text Book of Pharmaceutical Biotechnology, Elsevier.
- Crommelin, Dean JA, Sindelar, Robert, Meobohm, Bernd. 2019. Pharmaceutical Biotechnology: Fundamentals and Applications, Springer.
- Dixit A, Tiwari P and Chatap VK. 2015. Textbook of Pharmaceutical Biotechnology, Studium Press (India) Pvt. Ltd.

Books for Reference

- Walsh G. 2003. Biopharmaceuticals: Biochemistry and Biotechnology, John Wiley & Sons
- Kayser O and Warzecha H. 2012. Pharmaceutical Biotechnology: Drug Discovery and Clinical Applications, Wiley - Blackwell.
- Yui-Wing FL and Stuart S. 2019. Pharmacogenomics: Challenges and Opportunities in Therapeutic Implementation, Academic Press.

Web resources

- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5178364/>
- https://www.patentdocs.org/biotech_news/
- <https://www.pharmamanufacturing.com/>
- <https://nptel.ac.in/courses/102/103/102103013/>

Rationale for nature of the course

This course emphasizes on the various stages of drug design and development. Students gain knowledge on the mode of action, metabolism and toxicity of drugs. Students will gain knowledge in pharmaceutical science. They would be competent to get a placement in pharma- based companies

Activities having direct bearing on Skill development / Employability /Entrepreneurship

Activities include small group activities that are given during the lecture session to reinforce ideas discussed in lecture. The activities may include to prepare mind map for drug design and development. Prepare mind map about drug toxicity group discussion about pharmaceutically important proteins.

Pedagogy

The teaching methods may include Chalk and talk, PowerPoint, demonstrations, assignments, group discussions and Problem solving

Course content designers:

R Suguna

LECTURE SCHEDULE

Unit	Description	Hours	Mode
I	Objectives of Pharmaceutical Biotechnology - Generic and Biogeneric drugs. Stages in the drug development process -	6	Chalk, Quiz and talk Problem solving
	Drug discovery - Drug designing - Drug production - Preclinical trials - Clinical trials - Pharmacokinetics and Pharmacodynamics -	6	
	Patenting & Drug Approval - Drug Marketing - Post clinical trials.	3	
II	Production of recombinant proteins - Human Insulin (Humulin), Growth hormones (Humatrope) - Blood coagulating factor (factor VIII - Kogenate)	5	Chalk, and talk Problem solving
	- Erythropoietin - (Epogen) Granulocyte colony stimulating factors (Neulasta) - Interferons (Avonex) - Antimicrobial peptides (β - defensin 2) - Vaccines (Pentavac), Biologics (Humira - Adalimumab), -	5	
	Cancer based biologics (rituximab).- Biopharmaceutical considerations - Pharmaceutical regulations - Formulation of Biotechnology products - Drug delivery - Pharmacognosy	5	
III	Biotransformation, Phase I and II, excretion and elimination of drugs- renal and biliary, entero hepatic,	5	Chalk and talk PPT
	Clinical situations resulting in changes in drug half-life, optimization of dose and loading dose.	5	
	Factors affecting drug metabolism including stereo chemical aspects.	5	
IV	Drug toxicity analysis	5	Chalk, and talk PPT
	Common side effects of drugs and managements	5	
	Drugs of abuse - Life changing complications - Prevention and management paracetamol, atropine poisoning, heavy metals and antagonists.	5	
V	Biopharmaceutical considerations - Pharmaceutical regulations - Formulation of Biotechnology products - Drug delivery -	5	Chalk and talk, group discussion,
	Pharmacognosy National and International Drug approval agencies - Top National and International pharmaceutical industries -	5	
	Scope and career opportunities in pharmaceutical sectors.	5	

Course Learning Outcomes

On completion of this course the students will be able to

#	CLOs	K – Level
CLO-1	Describe the stages in drug discovery	Up to K-2
CLO-2	Illustrate the production of recombinant proteins	Up to K-3
CLO-3	Compare the strategies in various gene therapy methods	Up to K-4
CLO-4	Explain about drug toxicity, side effects and abuse	Up to K-3
CLO-5	Categorize various Drug approval agencies	Up to K-4

Mapping of Course outcomes with Program specific Outcomes

CLO/PSO	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

Mapping of Course outcomes with Program Outcomes

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-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

Learning Outcome Based Education & Assessment (LOBE)

Blue Print – Pharmaceutical Biotechnology

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 K-2	2	K1 & K2	1	K1	2 (K1&K1)	1(K2)
2	CLO 2	Up to K-3	2	K1 & K2	1	K2	2 (K2&K2)	1(K3)
3	CLO 3	Up to K-4	2	K1 & K2	1	K2	2 (K3&K3)	1(K4)
4	CLO 4	Up to K-3	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
5	CLO 5	Up to K-4	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 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	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%

Distribution of Unit-wise questions with K Levels

Section A	Section B	Section C	Section D
2 Questions for each Unit (K1 & K2 Level)	1 Question from each Unit (K1 & K2 Level)	2 Questions from Unit-I (K2 Level)	1 Question from Unit-I (K3 Level)
		2 Questions from Unit-II (K3 Level)	1 Question from Unit-II (K4 Level)
		2 Questions from Unit-III (K3 Level)	1 Question from Unit-III (K3 Level)
		2 Questions from Unit-IV (K4 Level)	1 Question from Unit-IV (K3 Level)
		2 Questions from Unit-V (K1 Level)	1 Question from Unit-V (K2 Level)

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 interferences with evidences

DEPARTMENT OF BIOTECHNOLOGY				CLASS:III B.SC BIOTECHNOLOGY				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
V	Discipline Elective Course-I	23U5LDET1(A)	Enzymology	4	5	25	75	100

Nature of Course						
Skill oriented	✓	Employability oriented	✓	Entrepreneurship oriented		

Course Objectives

- To acquire knowledge on enzymes and its importance in biological reactions
- To understand the enzyme specificity
- .To gain knowledge on enzyme kinetics
- To gain knowledge on applications of enzymes in industries and clinical diagnosis

Unit	Description	Hours	K-level	CLO
I	Introduction: History, Definitions, Nomenclature and classification of enzymes Union of Biochemistry and Molecular Biologists Convention. Properties of enzymes and factors influencing rate of enzyme action - pH, temperature, substrate concentration, enzyme concentration, activators and inhibitors. Apoenzyme, holoenzyme, zymogens. Transition state theory, activation energy. Coenzymes – Vitamin and Non vitamin origin. NAD/NADP, FAD, FMN, Coenzyme A TPP, PLP, lipoic acid and biotin.	15	2	1
II	Enzyme specificity: Active site - definition, characteristic features, active centre, Bi-substrate and multi-substrate reactions. ES complex formation, lock and key model and induced fit model. Enzyme units - IU & Katal. Turnover number. Isoenzymes-LDH & CPK.	15	3	2
III	Mechanism of enzyme catalysis: Acid Base catalysis, covalent catalysis, electrostatic catalysis, metal ion catalysis, proximity and orientation effect. Multienzyme complexes - Pyruvate dehydrogenase complex. Isoenzyme with reference to LDH Ribozymes & Abzymes.	15	4	3

IV	Enzyme Kinetics: Michaelis-Menten equation and its derivation, significance of K_m and V_{max} , Lineweaver-Enzyme inhibition - Competitive, Non-competitive, Uncompetitive (Derivations not included). Allosteric inhibition - sequential model, concerted model, feedback inhibition.	15	3	4
V	Applications of enzymes: Chemical and Physical methods of immobilization. Clinical and industrial applications of immobilized enzymes. Enzyme engineering and Designer enzymes. Pharmaceutical, Clinical and Industrial uses of enzymes.	15	4	5

Books for Study

- Jain JL, 2014, Fundamentals of Biochemistry, 7th edition, S. Chand publishing
- Nicholas CPrice and Lewis Stevens Fundamentals of Enzymology, Oxford University Press, New Delhi
- Voet D. and Voet JG. 2016. Biochemistry, 5th edition. John Wiley and Sons, Inc.,

Books for Reference

- Palmer. 2004. Enzyme, 18th edition, Portland Press, London
- Jeremy MB, Tymoczko JL, and Stryer L. 2006. Biochemistry, 6th Edition, Freeman Publications.
- Ralph AM. 2012. Immobilised Enzymes Academic Press, NY.

Web resources

[NDLI: Protein biochemistry and enzymology \(iitkgp.ac.in\)](http://ndli.iiitkgp.ac.in/)

[https://chem.libretexts.org/Bookshelves/Biological_Chemistry/Supplemental_Modules_\(Biological_Chemistry\)/Enzymes/Enzymes](https://chem.libretexts.org/Bookshelves/Biological_Chemistry/Supplemental_Modules_(Biological_Chemistry)/Enzymes/Enzymes)

Rationale for nature of the course

The course focuses on enzymes- structure, kinetics, functions, purification, industrial production and its applications. Upon completion of the course the students would gain knowledge on to solve the problems related to enzyme kinetics. It also emphasize on the applications of enzyme.

Activities having direct bearing on Skill development / Employability /Entrepreneurship

Activities include small group activities that are given during the lecture session to reinforce ideas discussed in lecture. The activities may include solving the problems related to the enzyme kinetics, discussion about enzyme production and applications, preparing mind map for enzyme purification.

Pedagogy

The teaching methods may include Chalk and talk, PowerPoint, demonstrations, assignments, group discussions and Problem solving

Course content designer: R Suguna

LECTURE SCHEDULE

Unit	Description	Hours	Mode
I	History, Definitions, Nomenclature and classification of enzymes Union of Biochemistry and Molecular Biologists Convention. Properties of enzymes and	6	Chalk, and talk Quiz , Problem solving
	Factors influencing rate of enzyme action - pH, temperature, substrate concentration, enzyme concentration, activators and inhibitors). Apoenzyme, holoenzyme, zymogens.. Transition state theory, , activation energy.	6	
	Coenzymes – Coenzymes – (Vitamin and Non vitamin origin) NAD/NADP, FAD, FMN, Coenzyme A TPP, PLP, lipoic acid and biotin.	3	
II	Active site (definition, characteristic features), active centre, Bi-substrate and multi-substrate reactions	5	Chalk and talk Problem solving
	. ES complex formation, lock and key model and induced fit model.	5	
	Enzyme units - IU & Katal. Turnover number. Isoenzymes (LDH & CPK),	5	
III	Acid Base catalysis, covalent catalysis, electrostatic catalysis, metal ion catalysis, proximity and orientation effect..	5	Chalk and talk PPT
	Multienzyme complexes - Pyruvate dehydrogenase complex.	5	
	Isoenzyme with reference to LDH Ribozymes & Abzymes	5	
IV	Enzyme Kinetics – Michaelis-Menten equation and its derivation, significance of Km and Vmax, Lineweaver- Burk plot	5	Chalk and talk PPT
	Enzyme inhibition - Competitive, Non- competitive, Uncompetitive – (Derivations not included).	5	
	Allosteric inhibition - sequential model, concerted model, feedback inhibition.	5	
V	Chemical and Physical methods of immobilization . Clinical and industrial applications of immobilized enzymes. Enzyme engineering and Designer enzymes. Pharmaceutical, Clinical and Industrial uses of enzymes.	5	Chalk and talk, group discussion
	Clinical and industrial applications of immobilized enzymes..	5	
	Enzyme engineering and Designer enzymes. Pharmaceutical, Clinical and Industrial uses of enzymes	5	

Course Learning Outcomes

On completion of this course the students will be able to

#	CLOs	K – Level
CLO-1	Describe the classification and properties of enzymes	Up to K-2
CLO-2	Illustrate the enzyme specificity	Up to K-3
CLO-3	Compare the kinetics of enzyme catalysis	Up to K-4
CLO-4	Explain about enzyme kinetics	Up to K-3
CLO-5	Categorize various applications of enzymes	Up to K-4

Mapping of Course outcomes with Program specific Outcomes

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

Advance application-3; Intermediate level-2 & Basic level-1

Mapping of Course outcomes with Program Outcomes

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	3	2	2	3	3	3
CLO-2	3	3	3	2	3	2
CLO-3	2	3	3	3	3	3
CLO-4	3	2	3	2	2	3
CLO-5	3	3	3	3	2	3

Advance application-3; Intermediate level-2 & Basic level-1

Learning Outcome Based Education & Assessment (LOBE)

Blue Print – Enzymology

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 K-2	2	K1 & K2	1	K1	2 (K1&K1)	1(K2)
2	CLO 2	Up to K-3	2	K1 & K2	1	K2	2 (K2&K2)	1(K3)
3	CLO 3	Up to K-4	2	K1 & K2	1	K2	2 (K3&K3)	1(K4)
4	CLO 4	Up to K-3	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
5	CLO 5	Up to K-4	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 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	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%

Distribution of Unit-wise questions with K Levels

Section A	Section B	Section C	Section D
2 Questions for each Unit (K1 & K2 Level)	1 Question from each Unit (K1 & K2 Level)	2 Questions from Unit-I (K2 Level)	1 Question from Unit-I (K3 Level)
		2 Questions from Unit-II (K3 Level)	1 Question from Unit-II (K4 Level)
		2 Questions from Unit-III (K3 Level)	1 Question from Unit-III (K3 Level)
		2 Questions from Unit-IV (K4 Level)	1 Question from Unit-IV (K3 Level)
		2 Questions from Unit-V (K1 Level)	1 Question from Unit-V (K2 Level)

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 interferences with evidences

DEPARTMENT OF BIOTECHNOLOGY				CLASS:III B.SC BIOTECHNOLOGY				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
V	Discipline Elective Course-I	23U5LDET1(B)	Marine Biotechnology	4	5	25	75	100
Nature of Course								
Skill oriented		✓	Employability oriented	✓	Entrepreneurship oriented			

Course Objectives

- To focus on the marine ecosystem and its diversity
- To understand about the transgenic marine organisms

Unit	Description	Hours	K-level	CLO
I	Marine Ecosystems & Its functioning, Ocean currents, Physical & chemical properties of seawater, Ecological divisions of the Sea- Euphotic-Mesopelagic- Bathopelagic- Benthos-Intertidal, Estuarine- Salt Marsh- Mangrove- Coral Reef.	15	Up to K-2	1
II	Marine microbial habitats- Screening for Secondary metabolites from marine microbes (Bacteria, Fungi, Actinomycetes and marine microalgae). Biofouling, Biofilm, Antifouling, Anticorrosion. Probiotic bacteria and their importance in aquaculture.	15	Up to K-3	2
III	Definitions- Medicinal compounds from flora (Seaweeds, Seagrass and Mangrove) and fauna (Sponges, Sea anemone and Corals)- marine toxins- antiviral and antimicrobial agents.	15	Up to K-4	3
IV	Culture aspect-Seaweed (<i>Kappaphycus alvarezii</i>), Fish chromosome manipulation in aquaculture- Hybridization- Gynogenesis- Androgenesis- Polyploidy, Artificial Insemination, Eyestalk ablation- Trangenesis and Cryopreservation.	15	Up to K-3	4
V	Agar- Agarose - Alginate- Carrageenan- Chitin- Chitosan- Heparin.	15	Up to K-4	5

- To gain knowledge on the various bioactive compounds from marine resources

Books for Study

1. Italy, E (Eds). 1998, New Developments in Marine Biotechnology, Plenum Pub. Corp.
2. Milton Fingerman and Rachakonda Nagabhushanam, 1996, Molecular Genetics of Marine Organisms, Science Pub Inc

Books for Reference

1. David H. Attaway, 2001. Marine Biotechnology, Volume 1, Pharmaceutical and Bioactive Natural Products..
2. Scheupr, P.J. (Ed.), 1984. Chemistry of Marine Natural Products, ,Chemical and Biological Perspectives. Vol. I III, Academic Press, New York

Web Resources

<http://coe.genomics.org.cn/>

<http://www.bcb.iastate.edu/>

Rationale for nature of the course

The elective course on Marine biotechnology focuses on the marine resources that could produce new products and processes, and help address the global challenges of food, energy, and health. It is a key to understand the potential of marine bio-resources – a potential that until now remains largely untapped.

Activities having direct bearing on Skill development / Employability /Entrepreneurship

- Poster preparation on core concepts of marine ecology.
- Scientific discussion on drugs derived from marine sources.

Pedagogy

The teaching methods may include Chalk and talk, PowerPoint, demonstrations, assignments, group discussions and Problem solving

Course content designer

Dr N Kamala Dhasan

Course Learning Outcomes

On completion of this course the students will be able to

#	CLOs	K – Level
CLO-1	Describe the various components of marine ecosystem	Up to K-2
CLO-2	Illustrate the methods of screening of secondary metabolites	Up to K-3
CLO-3	Outline the medicinal compounds in marine organism	Up to K-4
CLO-4	Demonstrate the culture of seaweeds	Up to K-3
CLO-5	Illustrate the significance of marine natural products	Up to K-4

Mapping of Course outcomes with Program Outcomes

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5
CLO-1	2	2	3	2	2
CLO-2	3	2	3	2	2
CLO-3	2	3	2	3	2
CLO-4	2	2	2	3	2
CLO-5	2	2	2	3	3

Advance application-3; Intermediate level-2 & Basic level-1

Mapping of Course outcomes with Program specific Outcomes

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

Advance application-3; Intermediate level-2 & Basic level-1

LESSON PLAN

Unit	Description	Hours	Mode
I	Marine Ecosystems & Its functioning, Ocean currents, Physical & chemical properties of seawater,	8	Chalk and talk Quiz and assignments
	Ecological divisions of the Sea- Euphotic- Mesopelagic- Bathopelagic- Benthos-Intertidal, Estuarine- Salt Marsh- Mangrove- Coral Reef.	7	
II	Marine microbial habitats- Screening for Secondary metabolites from marine microbes (Bacteria, Fungi, Actinomycetes and marine microalgae).	5	Chalk and talk Quiz and assignments
	Biofouling, Biofilm, Antifouling, Anticorrosion.	5	
	Probiotic bacteria and their importance in aquaculture	5	
III	Definitions- Medicinal compounds from flora (Seaweeds, Seagrass and Mangrove) and	5	Chalk and talk Quiz and assignments
	fauna (Sponges, Sea anemone and Corals)-	5	
	marine toxins- antiviral and antimicrobial agents.	5	
IV	Culture aspect-Seaweed (<i>Kappaphycus alvarezii</i>), Fish chromosome manipulation in aquaculture-	5	Chalk and talk Quiz and assignments
	Hybridization- Gynogenesis- Androgenesis- Polyploidy,	5	
	Artificial Insemination, Eyestalk ablation- Trangenesis and Cryopreservation.	5	
V	Agar- Agarose - Alginate-	8	Chalk and talk Quiz and assignments
	Carrageenan- Chitin- Chitosan- Heparin.	7	

Learning Outcome Based Education & Assessment (LOBE)

Blue Print – Marine Biotechnology Course

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 K-2	2	K1 & K2	1	K1	2 (K1&K1)	1(K2)
2	CLO 2	Up to K-3	2	K1 & K2	1	K2	2 (K2&K2)	1(K3)
3	CLO 3	Up to K-4	2	K1 & K2	1	K2	2 (K3&K3)	1(K4)
4	CLO 4	Up to K-3	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
5	CLO 5	Up to K-4	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 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	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%

Distribution of Unit-wise questions with K Levels

Section A	Section B	Section C	Section D
2 Questions for each Unit (K1 & K2 Level)	1 Question from each Unit (K1 & K2 Level)	2 Questions from Unit-I (K1 Level)	1 Question from Unit-I (K2 Level)
		2 Questions from Unit-II (K2 Level)	1 Question from Unit-II (K3 Level)
		2 Questions from Unit-III (K3 Level)	1 Question from Unit-III (K4 Level)
		2 Questions from Unit-IV (K3 Level)	1 Question from Unit-IV (K3 Level)
		2 Questions from Unit-V (K4 Level)	1 Question from Unit-V (K3 Level)

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 interferences with evidences

DEPARTMENT OF BIOTECHNOLOGY				CLASS:III B.SC BIOTECHNOLOGY				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
V	Interdisciplinary Course	23U5LIDT1	Computer Aided Drug Design	4	5	25	75	100
Nature of Course								
Skill oriented		✓	Employability oriented	✓	Entrepreneurship oriented			

Course Objectives

- To provide students with an understanding of the process of drug discovery and development
- To understand how to relate chemical structure to biological activity.
- To learn about novel chemical entities with the potential to be developed into novel therapeutic agents.
- To impart knowledge in basic Linux commands.
- To understand and implement Linux commands in Cygwin and remote login using Putty.

Unit	Description	Hours	K-level	CLO
I	Introduction to Drug Discovery and Development Stages of drug discovery and development Lead discovery and Analog Based Drug Design. Rational approaches to lead discovery -based on traditional medicine, Random screening, Non-random screening, serendipitous drug discovery, lead discovery based on drug metabolism, lead discovery based on clinical observation.	15	Up to K-2	1
II	Virtual screening techniques Virtual Screening techniques: Drug likeness screening, Concept of pharmacophore mapping and pharmacophore-based Screening, Molecular docking: Rigid docking, flexible docking, manual docking, Docking based screening. De novo drug design. ADME databases, chemical, biochemical and pharmaceutical databases. Conformational Analysis.	15	Up to K-2	2

III	Protein structure prediction Secondary structure prediction – Chou Fasman, GOR, Tertiary protein structure prediction – <i>ab initio</i> modelling, comparative modelling - homology modelling, SWISS modeller, protein threading, evaluation of predicted structure -Ramachandran plot, molecular visualization tools -Rasmol and Swiss PDB viewer	15	Up to K-2	3
IV	Shell and Basic Linux Commands Shell – Changing the Running Shell – Shell Prompt – Creating User Account – Basic syntax for Command – Creating alias for long command – Input/Output Redirection – Listing Files and Directories – cat command – wc command.	15	Up to K-2	4
V	Manipulating Files and Directories – Compressing Files – Archiving Files – Managing Disk Space – Changing your Password – File Access Permissions – Granting Access to Files – Creating Group Account – Sudo Command – Change File Owner and Group – Communication Command.	15	Up to K-2	5

Books for Study

1. Andrew R. Leach. 2001. Molecular modelling, Principles and applications, Prentice-Hall.
2. Vinter JG and Mark Gardener.1994. Molecular modelling and drug design, MacMillan.
3. Gary Walsh. 2003. Biopharmaceuticals: Biochemistry and Biotechnology. Wiley – Blackwell.

Books for Reference

1. Leach AR. 2001.Molecular Modelling - Principles and Applications, 2nd Edition, Prentice-Hall.
2. Ramachandran KI, Deepa G, Namboori K. 2008. Computational Chemistry and Molecular Modeling: Principles and Applications, Springer.

Web resources

- <https://www.cygwin.com/cygwin-ug-net/cygwin-ug-net.pdf><https://www.cygwin.com/cygwin-ug-net/cygwin-ug-net.pdf>
- https://www.lrz.de/services/compute/courses/x_lecturenotes/191007_PuTTY_Tutorial_2019.pdf
- <https://www.cs.dartmouth.edu/~campbell/cs50/putty-cygwin-tutorial.pdf>
- http://ftp.it.murdoch.edu.au/pub/units/ICT106/Practicals/ict106_pract_week1.pdf

Rationale for nature of the course

The course focuses on the basics of drug discovery, development and design of drugs using computer programmes. The course has been designed to enrich the students' knowledge to meet the demands in competitive biotechnology and pharmacology. Linux is an open-source platform to develop user friendly, High Security, High Stability applications and supports various forums.

Activities having a direct bearing on Skill development / Employability /Entrepreneurship

Seminar on recent trends in drug design and development, Poster preparation on core concepts of computer-aided drug design, Scientific discussion on various computer programmes and packages used in drug design, usage of Linux commands .

Pedagogy

The teaching methods may include Chalk and talk, PowerPoint, demonstrations, assignments, group discussions and Problem-solving

Course content designers:

Dr. N. Krithiga & Mr. N. Radhakrishnan

LESSON PLAN

Unit	Description	Hours	Mode
I	Stages of drug discovery and development Lead discovery and Analog Based Drug Design. Rational approaches to lead discovery -based on traditional medicine, Random screening, Non-random screening,	8	Chalk and talk, Quiz & assignments
	Serendipitous drug discovery, lead discovery based on drug metabolism, lead discovery based on clinical observation.	7	
II	Virtual Screening techniques: Drug likeness screening, Concept of pharmacophore mapping and pharmacophore-based Screening	5	Chalk and talk, PPT, Quiz & assignments
	Molecular docking: Rigid docking, flexible docking, manual docking, Docking based screening.	5	
	De novo drug design. ADME databases, chemical, biochemical and pharmaceutical databases. Conformational Analysis,	5	
III	Protein structure prediction Secondary structure prediction – Chou Fasman, GOR, Tertiary protein structure prediction – <i>ab initio</i> modelling, comparative modelling - homology modelling, SWISS modeller,	7	Chalk and talk, Quiz & assignments
	protein threading, evaluation of predicted structure - Ramachandran plot, molecular visualization tools -Rasmol and Swiss PDB viewer	8	
IV	Shell and Basic Linux Commands Shell – Changing the Running Shell –.	5	Chalk and talk, PPT, Quiz & assignments
	Shell Prompt – Creating User Account – Basic syntax for Command	5	
	Creating alias for long command – Input/Output Redirection – Listing Files and Directories – cat command – wc command	5	
V	Manipulating Files and Directories – Compressing Files – Archiving Files – Managing Disk Space – Changing your Password – File Access Permissions	7	Chalk and talk, Quiz & assignments
	– Granting Access to Files – Creating Group Account – Sudo Command – Change File Owner and Group – Communication Command.	8	

Course Learning Outcomes

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

#	CLOs	K – Level
CLO-1	Explain about various stages of drug discovery	Up to K-2
CLO-2	Elaborate on the virtual screening and molecular docking of drugs	Up to K-2
CLO-3	Outline the steps in protein structure prediction	Up to K-2
CLO-4	Describe various Linux Commands	Up to K-2
CLO-5	Illustrate Linux commands in Cygwin tool.	Up to K-2

Mapping of Course outcomes with Program Outcomes

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5
CLO-1	3	2	3	2	2
CLO-2	3	2	3	2	2
CLO-3	3	2	3	2	2
CLO-4	3	3	3	2	2
CLO-5	3	3	3	2	2

Advance application-3; Intermediate level-2 & Basic level-1

Mapping of Course outcomes with Program specific Outcomes

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

Advance application-3; Intermediate level-2 & Basic level-1

Learning Outcome Based Education & Assessment (LOBE)

Blue Print – Computer-Aided Drug Design Course

Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

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	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		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 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	-		10	7.69	100
K2	-	70	50	120	92.30	
K3	-	-	-	-	-	-
K4	-	-	-	-	-	-
Total Marks	10	35	30	130	100.00	100

K1 – Remembering and recalling facts with specific answers

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

DEPARTMENT OF BIOTECHNOLOGY				CLASS: III B.SC BIOTECHNOLOGY				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
V	Major Practical	23U5LCCP5	Major Practical-V	3	3	25	75	100
Nature of Course								
Skill oriented		✓	Employability oriented	✓	Entrepreneurship oriented			

Course Objectives

- To make the students to solve the problems
- To identify the various stages of mitosis and meiosis.

	Experiments
1	Plant tissue culture media preparation & sterilization techniques.
2	Isolation of plant protoplast & viability test. Callus culture, anther culture
3	Preparation of Animal Tissue culture medium and membrane filtration
4	Cell viability- Tryphan blue
5	Isolation of plant DNA
6	Enzyme extraction , purification- Phosphatase / lipase/ amylase (any one)
7	Enzyme kinetics –MM and LB plot
8	Estimation of total phenol / flavonoids
9	Minimal Inhibitory Concentration
10	Inhibition of biofilm formation
Spotters: Ti plasmid, ADMET, SV40, CaMV, Lipinski rule, Dolly, QSAR, Hepatitis B, Baculovirus, Microinjection	

Books for study

1. Abhijit Dutta. 2011. Experimental Biology: A laboratory Manual. Narosa publications.
2. Practical Manual on "Fundamentals of Genetics" (PBG-121). 2019, Edition: First Publisher: Odisha University of Agriculture & Technology. Editor: Kaushik Kumar Panigrahi

Course content designers:

Dr N Vidhya Lakshmi

Course Learning Outcomes

On completion of this course the students will be able to

#	CLOs	K –Level
CLO-1	Demonstrate the plant tissue culture media preparation	Upto K2
CLO-2	Analyse the various animal tissue culture medium	Upto K3
CLO-3	Demonstrate the methods of DNA isolations	Upto K4
CLO-4	Experiment with enzymes	Upto K3
CLO-5	Demonstrate cell viability	Upto K4

Rationale for nature of the course

The course focuses on the student's ability to solve the problems related to inheritance and identify the various stages in cell division.

Activities having direct bearing on Skill development /Employability /Entrepreneurship

- Individual experimental activity to the students.
- Analysis and interpretation of results.

Mapping of Course outcomes with Program Outcomes

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	3	3	3	3	2	3
CLO-2	3	3	3	3	2	3
CLO-3	3	3	3	3	2	3
CLO-4	3	3	3	3	2	3
CLO-5	3	3	3	3	2	3

Mapping of Course outcomes with Program specific Outcomes

CO/PSO	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

DEPARTMENT OF BIOTECHNOLOGY				CLASS: III B.SC BIOTECHNOLOGY				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
V	Industrial Visit	23U5LINTR	Industrial Visit	2		25	75	100
Nature of Course								
Skill oriented		✓	Employability oriented	✓	Entrepreneurship oriented			

Course Objectives

- To make students to take up community driven activities, visits and projects.
- To develop the societal awareness of students.
- To recommend environmental sustainability and G20 High-Level Principles on Lifestyles for Sustainable Development (LiFE) among students.

During the duration of the programme, students shall be taken to Industrial visit. This programme includes preparation and submission of work diary and report of visit along with certificates (if any).

Course Learning Outcomes

On completion of this course the students will be able to

#	CLOs	K – Level
CLO1	gain practical understanding of industry operations and insights into the potential career paths	Upto K3
CLO2	apply theoretical knowledge to real-world scenarios	Upto K3
CLO3	analyse with current technologies and observe workplace practices	Upto K4
CLO4	develop an awareness of recent trends	Upto K4
CLO5	enhance critical thinking skills through interaction with industry professionals	Upto K3

Mapping of Course outcomes with Program specific Outcomes

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

Advance application-3; Intermediate level-2 & Basic level-1

Mapping of Course outcomes with Program Outcomes

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	3	3	3	3	3	3
CLO-2	2	2	2	2	2	2
CLO-3	3	3	3	3	3	3
CLO-4	3	3	3	3	3	3
CLO-5	2	2	3	3	3	3

Advance application-3; Intermediate level-2 & Basic level-1

Valuation Schema for Industrial Visit

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 BIOTECHNOLOGY				CLASS: III B.SC BIOTECHNOLOGY				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
VI	Core Theory	23U6LCCT8	Environmental and Industrial Biotechnology	4	6	25	75	100
Nature of Course								
Skill oriented		✓	Employability oriented	✓	Entrepreneurship oriented			

Course Objectives

- Explain environmental issues and management process
- Illustrate the significance of bioreactors in bioprocess engineering and culture methods.
- Explain downstream processing, microbial production of various goods using biotechnology methods
- Speculate the role and importance of microorganisms behind the ore leaching, production of food products and Bio fertilizers.

Unit	Description	Hours	K-level	CLO
I	Environmental Pollution: Sources and types - Water, Air, Thermal, Industrial and Radiation. Environmental issues - Global warming, Greenhouse effect, acid rain, ozone depletion, and photochemical smog, Management strategies and safety, Biotechnological approaches for management.	18	2	1
II	Waste water treatment: Aerobic and anaerobic methods - Primary, Secondary and Tertiary. Primary, Secondary-Aerobic suspended, Aerobic attached, Anaerobic suspended, Anaerobic attached, Pond treatment, Tertiary- removal of Solids, nitrogen and phosphorous.–Solid waste management. Bioenergy and SCP from waste. Biotechnological approach to industrial effluent - Paper, Tannery and Dye.	18	3	2

III	Bioremediation and biodegradation Process: Bioremediation – Definition, Types: In-situ &Ex-situ, Factors affecting microbial bioremediation, advantage and disadvantages. Biostimulation, Bioaugmentation, Biofiltration, biomagnification, Genetically engineered bacteria for bioremediation - <i>Pseudomonas</i> as a universal agent, Phytoremediation – Rhizofiltration, Rhizodegradation. Biodegradation of hydrocarbons, pesticides and herbicide, Aerobic and Anaerobic degradation of Aliphatic and Aromatic Compounds, Microbial enhanced oil recovery (MEOR),	18	4	3
IV	Microbial Production - Microbial Polysaccharide production- Xanthan, Dextran. Secondary metabolites: antibiotics - penicillin and streptomycin, vitamins- riboflavin and B12. , Organic acids - gluconic acid and lactic acid . amino acids - L- glutamic acid and L-Lysine. Growth factors- gibberellic acid, Hormones steroid biotransformation, vaccine production -BCG and Rabies	18	3	4
V	Production of Bio-products - Biofertilizers - <i>Rhizobium</i> and <i>Azotobacter</i> , biocontrol agents- <i>Pseudomonas fluorescens</i> and <i>trichoderma</i> , Bio-pesticides – <i>Bacillus thuringiensis</i> and nuclear polyhedrosis virus, bio-herbicides-mycoherbicide, biofuels –Microbial Fuel Cell (MFC); Biomass utilization – ethanol, methanogenesis and biogas production, Biodegradable plastics - PHA, PHB using <i>Clostridium</i>	18	4	5

Books for Study

1. Chatterji AK. 2002. Introduction to Environmental Biotechnology. Prentice-Hall of India, New Delhi.
2. Anil Kumar. 2000. Environmental Chemistry. 4th Edition. New Age International, New Delhi.
3. S.M.Reddy 2012. Basic industrial Biotechnology. New Age International, New Delhi.

Books for Reference

1. Alan Scragg, 1999. Environmental Biotechnology, Pearson Education Limited, England,
2. Stanbury PF, Whitaker A, Hall SJ. 2013. Principles of Fermentation Technology Second Edition, Elsevier Science Ltd.
3. Waites MJ, Morgan NL, Rockey JS and Higton G. 2001. Industrial Microbiology: An Introduction. Blackwell Science Ltd.

Web resources

- <https://nptel.ac.in/courses/120/108/120108004/>
- <https://www2.hcmuaf.edu.vn/data/quoctuan/Environmental%20Biotechnology%20-%20Theory%20and%20Application,%20G%20M%20Evans%20&%20J%20C%20Furlong.pdf>
- www.e-bug.eu/

Rationale for nature of the course

The course on Environmental and Industrial Biotechnology focuses on the fundamental concepts and applications of biotechnology in all aspects of environment and industrial production. Environmental Biotechnology emphasizes on the recent development of biotechnology for protection, restoration and sustainability and accessing the microbial potential in mitigation of environmental issues.

Activities having direct bearing on Skill development / Employability /Entrepreneurship

Preparation of mind map and poster on various biotechnological processes used for industrial biotechnological, environmental issues, scientific discussion and analysis on theoretical concepts.

Pedagogy

The teaching methods may include Chalk and talk, PowerPoint, demonstrations, assignments, group discussions and Problem solving.

Course content designers:

Dr. P. Vimal

LECTURE SCHEDULE

Unit	Description	Hours	Mode
I	Environmental Pollution – Sources and types - Water, Air, Thermal, Industrial and Radiation.	6	Chalk and talk, Quiz, Problem-solving
	Environmental issues - Global warming, Greenhouse effect, acid rain, ozone depletion, and photochemical smog	6	
	Management strategies and safety, Biotechnological approaches for management.	6	
II	Waste water treatment: Aerobic and anaerobic methods - Primary, Secondary and Tertiary.	4	Chalk and talk, Problem-solving
	Primary, Secondary-Aerobic suspended, Aerobic attached, Anaerobic suspended, Anaerobic attached, Pond treatment, Tertiary- removal of Solids, nitrogen and phosphorous.–Solid waste management.	8	
	Bioenergy and SCP from waste. Biotechnological approach to industrial effluent - Paper, Tannery and Dye.	6	
III	Bioremediation – Definition, Types: In-situ &Ex-situ, Factors affecting microbial bioremediation, advantage and disadvantages.	6	Chalk and talk PPT
	Biostimulation, Bioaugmentation, Biofiltration, biomagnification, Genetically engineered bacteria for bioremediation - Pseudomonas as a universal agent, Phytoremediation – Rhizofiltration, Rhizodegradation.	6	
	Biodegradation of hydrocarbons, pesticides and herbicide, Aerobic and Anaerobic degradation of Aliphatic and Aromatic Compounds, Ore leaching- copper and uranium - methods and examples, Microbial enhanced oil recovery (MEOR),	6	
IV	Microbial Production - Microbial Polysaccharide production- Xanthan, Dextran. Secondary metabolites:	6	Chalk, and talk PPT
	antibiotics - penicillin and streptomycin, vitamins- riboflavin and B12. , Organic acids - gluconic acid and lactic acid. amino acids - L- glutamic acid and L-Lysine.	6	
	Growth factors- gibberellic acid, Hormones steroid biotransformation, vaccine production -BCG and Rabies	6	

V	Biofertilizers - Rhizobium and Azotobacter, biocontrol agents Pseudomonas fluorescens and trichoderma,	6	Chalk and talk, group discussion,
	Bio-pesticides – <i>Bacillus thuringiensis</i> and nuclear polyhedrosis virus, bio-herbicides-mycoherbicide, biofuels – Microbial Fuel Cell (MFC);	6	
	Biomass utilization – ethanol, methanogenesis and biogas production, Biodegradable plastics - PHA, PHB using <i>Clostridium</i>	6	

Course Learning Outcomes

On completion of this course the students will be able to

#	CLOs	K – Level
CLO-1	Explain various kinds of pollutants and their effects	Up to K-2
CLO-2	Illustrate various methods of analysis and treatments of pollutant	Up to K-3
CLO-3	Explain the bioremediation	Up to K-4
CLO-4	Prepare the flow charts for various microbial production	Up to K-3
CLO-5	Explain various bioproduct production	Up to K-4

Mapping of Course outcomes with Program specific Outcomes

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

Advance application-3; Intermediate level-2 & Basic level-1

Mapping of Course outcomes with Program Outcomes

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	2	2	3	2	2	3
CLO-2	3	3	3	2	2	2
CLO-3	3	3	2	3	3	2
CLO-4	2	3	2	2	3	3
CLO-5	2	2	2	2	2	2

Advance application-3; Intermediate level-2 & Basic level-1

Learning Outcome Based Education & Assessment (LOBE)

Blue Print - Environmental and Industrial Biotechnology

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 K-2	2	K1 & K2	1	K1	2 (K1&K1)	1(K2)
2	CLO 2	Up to K-3	2	K1 & K2	1	K2	2 (K2&K2)	1(K3)
3	CLO 3	Up to K-4	2	K1 & K2	1	K2	2 (K3&K3)	1(K4)
4	CLO 4	Up to K-3	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
5	CLO 5	Up to K-4	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 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	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%

Distribution of Unit-wise questions with K Levels

Section A	Section B	Section C	Section D
2 Questions for each Unit (K1 & K2 Level)	1 Question from each Unit (K1 & K2 Level)	2 Questions from Unit-I (K2 Level)	1 Question from Unit-I (K3 Level)
		2 Questions from Unit-II (K3 Level)	1 Question from Unit-II (K4 Level)
		2 Questions from Unit-III (K3 Level)	1 Question from Unit-III (K3 Level)
		2 Questions from Unit-IV (K4 Level)	1 Question from Unit-IV (K3 Level)
		2 Questions from Unit-V (K1 Level)	1 Question from Unit-V (K2 Level)

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 interferences with evidences

DEPARTMENT OF BIOTECHNOLOGY				CLASS: III B.SC BIOTECHNOLOGY				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
VI	Core Theory	23U6LCCT9	Medical Biotechnology	4	6	25	75	100
Nature of Course								
Skill oriented		✓	Employability oriented	✓	Entrepreneurship oriented			

Course Objectives

- To understand the applications of biotechnology in diagnosis of diseases and therapy
- To gain knowledge on recombinant therapeutic proteins and vaccines
- To create awareness on use of stem cell technology in medical field.

Unit	Description	Hours	K-level	CLO
I	Nucleic acid Therapeutics - Gene therapy: types-germ cell and somatic cell, approaches – <i>ex-vivo</i> and <i>in-vivo</i> , methods of gene therapy: viral-mediated – retrovirus, adenovirus and adeno-associated, treatment of ADA deficiency, haemophilia and cystic fibrosis, non-viral mediated -DNA constructs, lipoplexes, receptor-mediated, RNA interference-mechanism, antisense technology for AIDS and cancer treatment	18	2	1
II	Molecular Diagnostics -DNA based Diagnosis: PCR-principles, nucleic acid hybridization-DNA probes, mechanism of probes, radioactive and non-radioactive detection system, microarray-technique and applications. genetic diseases-cystic fibrosis, sick-cell anaemia. DNA fingerprinting, RFLP, protozoan- malaria, VNTR and SNP. Protein based Diagnosis: Sandwich ELISA – Cancer, indirect ELISA.	18	3	2
III	Diagnosis of infectious diseases- Viral diseases – HIV, influenza; bacterial diseases - enteric diseases, mycobacterium diseases; immune arrays. ELISA, FACS, FISH techniques.	18	4	3
IV	Molecular therapeutics- Immunoblot analysis of antigens and allergens, Productions and application of therapeutic agents - Production of cytokines and interferons. Hybridoma technology - principle, production and purification. Applications of monoclonal antibodies - Diagnostics and Therapeutics.	18	3	4

V	Principles of project management in Clinical trials and its application. Principles of research ethics; Ethical issues in clinical trials; Animal rights and use of animals in the advancement of medical technology. Use of humans in Scientific Experiments; Introduction to ethical codes and conduct.	18	4	5

Books for Study

- Roli, M. 2017. National Ethical Guidelines for Biomedical and Health Research Involving Human Participants.
- Lela B. and Maribeth LF. 2011. Molecular Diagnostics: Fundamentals, Methods and Clinical Applications, 1st Edition), Philadelphia, USA.

Books for Reference

- Bernard RG, Terry LD and Cherryl LP. 2014. Medical Biotechnology, 2nd edition.
- Patrick RM. Kenneth SR and Michael AP. 2016. Medical Microbiology, 8th edition, Elsevier
- Pamela G. Michelle M. 2009. Molecular Therapeutics: 21st century medicine, 1st Edition, Wiley Publishers.

Web resources

- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2881260/>
- <https://www.nature.com/articles/s41577-021-00542-x>
- <https://www.sciencedirect.com/topics/medicine-and-dentistry/dna-sequencing>
- <http://aquafind.com/articles/Elisa.php>

Rationale for nature of the course

The core paper on Medical Biotechnology focuses on students' ability to understand the applications of bio-products obtained by biotechnological processes. This paper would help the students to design and develop novel medical diagnostic methods and treatment approach for various genetic and metabolic diseases in human.

Activities having direct bearing on Skill development / Employability /Entrepreneurship

- Creating mind map for diagnostics process used
- Learning the production of therapeutics using flowchart method
- Seminar presentation and assignment writing for self-study topics

Course content designers: Dr N Krithiga

LECTURE SCHEDULE

Unit	Description	Hours	Mode
I	Antibodies and vaccines - Therapeutic production of antibodies, antibody mediated drug delivery of vaccines,	6	Chalk, and talk, Problem-solving, Quiz
	Different kind of vaccines and applications of recombinant vaccines.	6	
	Diagnosis - Biochemical diagnostics, inborn errors of metabolism, haemoglobinopathies.	6	
II	Molecular basis of disease, Recombinant DNA Technology in medicine,	4	Chalk and talk, Problem-solving
	gene probes as molecular diagnostic reagents. Polymerase Chain Reaction in clinical diagnostics	8	
	DNA sequencing of representative clones to detect mutations	6	
III	Diagnosis of infectious diseases, Viral diseases – HIV, influenza;	6	Chalk and talk, PPT
	bacterial diseases - enteric diseases, mycobacterium diseases; immune arrays.	6	
	FACs immunocytochemical staining, ELISA, FISH techniques.	6	
IV	Immunoblot analysis of antigens and allergens.	6	Chalk, and talk PPT
	Production of therapeutic agents – Productions and application of therapeutic agents,	6	
	Production of cytokines and interferons.	6	
V	Principles of project management in Clinical trials and its application	6	Chalk and talk, group discussion,
	Principles of research ethics; Ethical issues in clinical trials; Animal rights and use of animals in the advancement of medical technology.	6	
	Use of humans in Scientific Experiments; Introduction to ethical codes and conduct.	6	

Course Learning Outcomes

On completion of this course the students will be able to

#	CLOs	K – Level
CLO-1	Use biotechnological principles and processes in the development of antibody mediated drug delivery	Up to K-2
CLO-2	Illustrate the significance of gene probes in molecular diagnostics	Up to K-3
CLO-3	Point out the methods of molecular diagnostics of infectious disease	Up to K-4
CLO-4	Infer the principle behind the therapeutic agents	Up to K-3
CLO-5	Describe the ethics in clinical trials	Up to K-4

Mapping of Course outcomes with Program specific Outcomes

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

Advance application-3; Intermediate level-2 & Basic level-1

Mapping of Course outcomes with Program Outcomes

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	2	2	3	2	2	3
CLO-2	3	3	3	2	2	2
CLO-3	3	3	2	3	3	2
CLO-4	2	3	2	2	3	3
CLO-5	2	2	2	2	2	2

Advance application-3; Intermediate level-2 & Basic level-1

Learning Outcome Based Education & Assessment (LOBE)

Blue Print - Medical Biotechnology

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 K-2	2	K1 & K2	1	K1	2 (K1&K1)	1(K2)
2	CLO 2	Up to K-3	2	K1 & K2	1	K2	2 (K2&K2)	1(K3)
3	CLO 3	Up to K-4	2	K1 & K2	1	K2	2 (K3&K3)	1(K4)
4	CLO 4	Up to K-3	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
5	CLO 5	Up to K-4	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 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	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%

Distribution of Unit-wise questions with K Levels

Section A	Section B	Section C	Section D
2 Questions for each Unit (K1 & K2 Level)	1 Question from each Unit (K1 & K2 Level)	2 Questions from Unit-I (K2 Level)	1 Question from Unit-I (K3 Level)
		2 Questions from Unit-II (K3 Level)	1 Question from Unit-II (K4 Level)
		2 Questions from Unit-III (K3 Level)	1 Question from Unit-III (K3 Level)
		2 Questions from Unit-IV (K4 Level)	1 Question from Unit-IV (K3 Level)
		2 Questions from Unit-V (K1 Level)	1 Question from Unit-V (K2 Level)

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 interferences with evidences

DEPARTMENT OF BIOTECHNOLOGY				CLASS: III B.SC BIOTECHNOLOGY				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
VI	Major Core	23U6LCCT10	Bioentrepreneurship	4	6	25	75	100
Nature of Course								
Skill oriented		✓	Employability oriented	✓	Entrepreneurship oriented		✓	

Course Objectives

- To identify the challenges of being a Bioentrepreneur
- To understand the Business proposal for starting a company
- To learn about Vermicomposting and Sericulture.
- To aspire to set up Mushroom Cultivation.
- To learn the technique of Single cell protein Cultivation.

Unit	Description	Hours	K-level	CLO
I	Basics of Bio entrepreneurship: Biotechnology in a Global scale; types of Bio-industries – Biopharma, Bioagri and Bioservice innovations. Successful Entrepreneur – Creativity, Leadership, Managerial skills, Team building, Decision making. Public and private funding agencies -MSME, DBT, BIRAC, Startup & Make in India	15	2	1
II	Business plan preparation: Business feasibility analysis by SWOT, business plan proposal for virtual startup company, statutory and legal requirements for starting a company/venture, basics in accounting practices. Market Conditions, Identifying the need of the customers.	15	3	2
III	Vermicomposting: Earthworms-Ecological types, Vermiculture –Compost pit, Vermibed-applications. Sericulture-Mulberry cultivation, Silkworm Rearing - Economics of silkworm Production, Chawki Rearing, Sericulture in India.	15	4	3
IV	Phases of Mushroom Cultivation: Selection of an acceptable mushroom species/strains, Management of mushroom development, Mushroom harvesting, Mushroom diseases, Medicinal and Nutritional properties of mushroom. Aquaponics- Systems, Fish and Vegetables, Nutrients and Biofilters, Advantages and Disadvantages.	15	4	4

V	Single Cell Protein Production: Source - Algae, Bacteria, Yeast, Cultivation of Single Cell protein: SPIRULINA Cultivation– Production site, Microorganism, Experimental design, harvesting and Drying- value-added product from the cultivation of Spirulina	15	3	5

Books for Study

- Shimasaki CD. 2014. Biotechnology entrepreneurship: Starting, managing, and leading biotech companies. Elsevier. Academic Press.
- Onetti A and Zucchella A. 2018. Business modelling for life science and biotech companies: Creating value and competitive advantage with the milestone bridge. Routledge.
- Ismail SA. 2005. The Earthworm book, Other India Press, Goa
- Ganga G and Sulochana Chetty J.2023. An Introduction to sericulture, 2nd Edition, Oxford & IBH Publishing.
- Murugesh Babu. 2018. Silk: Processing, Properties and Applications, Woodhead Publishing.

Books for Reference

- Adams DJ and Sparrow JC. Enterprise for life scientists: Developing innovation and entrepreneurship in the biosciences. Bloxham: Scion.
- Jordan JF. 2014. Innovation, Commercialization, and Start-Ups in Life Sciences. CRC Press.
- Desai, V.The Dynamics of Entrepreneurial Development and Management. New Delhi: Himalaya Pub. House.
- The Essential Guide to Cultivating Mushrooms: Simple and Advanced Techniques for Growing Shiitake, Oyster, Lion's Mane, and Maitake Mushrooms at Home by Stephen Russell
- Neutraceutical spirulina: Commercial cultivation using rural technology in india by Pushpa Srivastava

Web resources

- <https://archive.india.gov.in › citizen › agriculture>
- <http://www.recirculatingfarms.org/resources/>
- <https://academy.vertical-farming.net/intro-to-mushroom-growing/>

Rationale for nature of the course

The rationale for offering a course in bio-entrepreneurship is grounded in the increasing need for entrepreneurs who can bridge the gap between science and business, as well as address the evolving challenges in the biotechnology and life sciences sectors. The course provides students with the skills, knowledge, and networks required to launch successful ventures that can have a meaningful impact on global health, sustainability, and innovation.

Activities having direct bearing on Skill development / Employability /Entrepreneurship

By engaging in these hands-on activities, students in a Bio-entrepreneurship course will not only develop a deep understanding of the biotechnology industry but also enhance practical skills such as business planning, pitching, market analysis, and ethical decision-making. These activities are designed to provide real-world relevance, cultivate entrepreneurial mindsets, and prepare students to launch their own biotech ventures or contribute to existing bio-entrepreneurial ecosystems.

Pedagogy

The teaching methods may include Chalk and talk, PowerPoint, demonstrations, assignments and group discussions

Course content designers:

Dr. N. Kamala Dhasan

LECTURE SCHEDULE

Unit	Description	Hours	Mode
I	Basics of Bio entrepreneurship -Biotechnology in a Global scale; types of Bio-industries – Biopharma, Bioagri and Bioservice innovations	6	Chalk and talk, PPT
	Successful Entrepreneur – Creativity, Leadership, Managerial skills, Team building, Decision making	6	
	Public and private funding agencies (MSME, DBT, BIRAC, Startup & Make in India)	3	
II	Business plan preparation; business feasibility analysis by SWOT, business plan proposal for virtual start-up company;	6	Chalk and talk, PPT
	Statutory and legal requirements for starting a company/venture; basics in accounting practices.	6	
	Market Conditions, Identifying the need of the customers.	3	
III	Vermicomposting–Earthworms- Ecological types- Vermiculture - Compost pit- Vermibed-applications.	6	Chalk and talk, group discussion PPT
	Sericulture-Mulberry cultivation-Silkworm Rearing- Economics of silkworm Production-	6	
	Chawki Rearing-Sericulture in India.	3	
IV	Phases of Mushroom Cultivation; Selection of an acceptable mushroom species/strains, Management of mushroom development,	5	Chalk and talk, group discussion PPT
	Mushroom harvesting; Mushroom diseases, Medicinal and Nutritional properties of mushroom.	5	
	Aquaponics- Systems-Fish and Vegetables-Nutrients and Biofilters-Advantages and Disadvantages.	5	
V	Single Cell Protein Production: Source: Algae, Bacteria, Yeast	3	Chalk and talk, group discussion, PPT
	Cultivation of Single Cell protein: SPIRULINA Cultivation – Production site, Microorganism	6	
	Experimental design; harvesting and Drying- value-added product from the cultivation of Spirulina.	6	

Course Learning Outcomes

On completion of this course the students will be able to

#	CLOs	K – Level
CLO-1	Describe how to become the successful entrepreneur in biotechnology	Up to K-2
CLO-2	Give a description of a business plan proposal for a virtual startup company.	Up to K-3
CLO-3	Discuss about the cultivation and Economics of Vermiculture and sericulture	Up to K-4
CLO-4	Explain how to become a successful entrepreneur by cultivating mushrooms and aquaponics systems.	Up to K-3
CLO-5	Briefly discuss the value-added product from the cultivation of Spirulina.	Up to K-4

Mapping of Course outcomes with Program specific Outcomes

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

Advance application-3; Intermediate level-2 & Basic level-1

Mapping of Course outcomes with Program Outcomes

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	2	3	3	2	2	2
CLO-2	2	2	2	2	3	2
CLO-3	3	3	2	2	3	3
CLO-4	2	2	3	3	2	2
CLO-5	3	3	3	2	3	2

Advance application-3; Intermediate level-2 & Basic level-1

Learning Outcome Based Education & Assessment (LOBE)

Blue Print – Bioentrepreneurship

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 K-2	2	K1 & K2	1	K1	2 (K1&K1)	1(K2)
2	CLO 2	Up to K-3	2	K1 & K2	1	K2	2 (K2&K2)	1(K3)
3	CLO 3	Up to K-4	2	K1 & K2	1	K2	2 (K3&K3)	1(K4)
4	CLO 4	Up to K-3	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
5	CLO 5	Up to K-4	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 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	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%

Distribution of Unit-wise questions with K Levels

Section A	Section B	Section C	Section D
2 Questions for each Unit (K1 & K2 Level)	1 Question from each Unit (K1 & K2 Level)	2 Questions from Unit-I (K2 Level)	1 Question from Unit-I (K3 Level)
		2 Questions from Unit-II (K3 Level)	1 Question from Unit-II (K4 Level)
		2 Questions from Unit-III (K3 Level)	1 Question from Unit-III (K3 Level)
		2 Questions from Unit-IV (K4 Level)	1 Question from Unit-IV (K3 Level)
		2 Questions from Unit-V (K1 Level)	1 Question from Unit-V (K2 Level)

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 interferences with evidences

DEPARTMENT OF BIOTECHNOLOGY				CLASS: III B.SC BIOTECHNOLOGY				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
VI	Discipline Elective	23U6LDET2 (A)	Bioethics & Biosafety	2	4	25	75	100
Nature of Course								
Skill oriented		✓	Employability oriented	✓	Entrepreneurship oriented			

Course Objectives

- Able to understand the concepts of Bioethics and Biosafety.
- Will know about the importance of Ethical Clearance understand & the need of the Bioethics.
- Will get knowledge about Patents Rights in the field of Research
- Will know about Biosafety and GLP.

Unit	Description	Hours	K-level	CLO
I	Human Rights: Definition, Classification and Scope of Human Rights. United Nations Commission for Human Rights, National and State Human Rights Commission. Article 21 of Indian Constitution – UDHR. Social issues of Human rights.	12	2	1
II	Impact of gene cloning & Bioethics-Issues concerning reproduction, Birth, life and Death - Artificial insemination, egg donation, IVF, embryo transplants, Prenatal diagnosis and sex selection & Abortion.	12	3	2
III	Bioethics – ELSI, animal ethics - licensing of animal house - Human cloning - Ethical issues. Ethical clearance norms for conducting studies on animals and human. Guidelines for research in transgenic plants and Animals.	12	4	3
IV	Patents - Introduction -Treaties and Conventions of Patents, TRIPS -Basis of Patentability, Non Patentable Inventions. Patent Application Procedure in India. Other Forms of IPR- Copyright, Trade Mark, Industrial designs. Plant breeders Rights – UPOV, PPV&FR. Patenting of Biotechnology products and processes.	12	3	4

V	Biosafety – Biosafety levels, guidelines on biosafety in conducting research. Risk assessment studies- Hazardous materials used in Biotechnology, Handling and Disposal. Good manufacturing practices & Good Laboratory practices, Containment facilities. Regulation on field experiments and release of GMO's - Labelling of GM foods	12	4	5

Books for Study

1. Ignacimuthu S. 2009. Bioethics, Narosa Publication House.
2. Sree Krishna V. 2007. Bioethics and Biosafety in Biotechnology, New Age International Private Limited.
3. Smith R. 2003. International Human rights, Blackstone Press.
4. Manual of patent practice and procedure. 2005. IPR India.

Books for Reference

1. Trayer PC, Fredrick R and Koch M. 2002. Biosafety. Michigan State University
2. Beauchamp & Leroy. 1999. Contemporary issues in Bioethics. Wardsworth Pub. Co. Belmont, California.
3. Thomas JA. 2004. Biotechnology and safety assessment

Web resources

- www.ipr-helpdesk.org/
- www.patentoffice.nic.in/ipr/patent/patents.htm
- www.bangalorebio.com/GovtInfo/ipr.htm

Rationale for nature of the course

The Elective paper on Bioethics and IPR aimed to provide understanding about intellectual property rights and significance of ethics in the field of Biotechnology. This course highlights adequate knowledge to the students on intellectual property rights and makes use of those in future as a researcher and entrepreneur.

Activities having direct bearing on Skill development / Employability /Entrepreneurship

Student seminar on important aspects of patenting process, scientific discussion among students about various case studies of ethics and patenting

Pedagogy

The teaching methods may include Chalk and talk, PowerPoint, demonstrations, assignments, group discussions and Problem solving.

Course content designers: Dr. P. Vimal

LECTURE SCHEDULE

Unit	Description	Hours	Mode
I	Human Rights: Definition, Classification and Scope of Human Rights.	3	Chalk and talk, Problem-solving
	United Nations Commission for Human Rights, National and State Human Rights Commission.	3	
	Article 21 of Indian Constitution – UDHR. Social issues of Human rights.	3	
II	Impact of gene cloning & Bioethics-Issues concerning reproduction	6	Chalk and talk, Problem-solving
	Birth, life and Death - Artificial insemination, egg donation, IVF, embryo transplants, Prenatal diagnosis and sex selection & Abortion.	6	
III	Bioethics – ELSI, animal ethics - licensing of animal house - Human cloning - Ethical issues.	6	Chalk and talk, PPT
	Ethical clearance norms for conducting studies on animals and human. Guidelines for research in transgenic plants and Animals.	6	
IV	Patents - Introduction -Treaties and Conventions of Patents, TRIPS -Basis of Patentability, Non Patentable Inventions.	6	Chalk and talk, PPT
	Patent Application Procedure in India. Other Forms of IPR- Copyright, Trade Mark, Industrial designs. Plant breeders Rights – UPOV, PPV&FR. Patenting of Biotechnology products and processes.	6	
V	Biosafety – Biosafety levels, guidelines on biosafety in conducting research. Risk assessment studies- Hazardous materials used in Biotechnology, Handling and Disposal.	6	Chalk and talk, group discussion,
	Good manufacturing practices & Good Laboratory practices, Containment facilities. Regulation on field experiments and release of GMO's - Labelling of GM foods	6	

Course Learning Outcomes

On completion of this course the students will be able to

#	CLOs	K – Level
CLO-1	Discuss about fundamentals of human rights and its scope	Up to K-2
CLO-2	Relate various impact of cloning with various issues	Up to K-3
CLO-3	Highlight the ethical issues related to experimentation on animals and human	Up to K-4
CLO-4	Points out the significance of various intellectual property forms	Up to K-3
CLO-5	Compare various biosafety levels and GLP used in biological research.	Up to K-4

Mapping of Course outcomes with Program specific Outcomes

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

Advance application-3; Intermediate level-2 & Basic level-1

Mapping of Course outcomes with Program Outcomes

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	2	2	3	2	2	3
CLO-2	3	3	3	2	2	2
CLO-3	3	3	2	3	3	2
CLO-4	2	3	2	2	3	3
CLO-5	2	2	2	2	2	2

Advance application-3; Intermediate level-2 & Basic level-1

Learning Outcome Based Education & Assessment (LOBE)

Blue Print – Bioethics & Biosafety

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 K-2	2	K1 & K2	1	K1	2 (K1&K1)	1(K2)
2	CLO 2	Up to K-3	2	K1 & K2	1	K2	2 (K2&K2)	1(K3)
3	CLO 3	Up to K-4	2	K1 & K2	1	K2	2 (K3&K3)	1(K4)
4	CLO 4	Up to K-3	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
5	CLO 5	Up to K-4	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 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	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%

Distribution of Unit-wise questions with K Levels

Section A	Section B	Section C	Section D
2 Questions for each Unit (K1 & K2 Level)	1 Question from each Unit (K1 & K2 Level)	2 Questions from Unit-I (K2 Level)	1 Question from Unit-I (K3 Level)
		2 Questions from Unit-II (K3 Level)	1 Question from Unit-II (K4 Level)
		2 Questions from Unit-III (K3 Level)	1 Question from Unit-III (K3 Level)
		2 Questions from Unit-IV (K4 Level)	1 Question from Unit-IV (K3 Level)
		2 Questions from Unit-V (K1 Level)	1 Question from Unit-V (K2 Level)

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 interferences with evidences

DEPARTMENT OF BIOTECHNOLOGY				CLASS: III B.SC BIOTECHNOLOGY				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
VI	Discipline Elective	23U6LDET2 (B)	Nanobiotechnology	2	4	25	75	100
Nature of Course								
Skill oriented		✓	Employability oriented	✓	Entrepreneurship oriented			

Course Objectives

- To understand the basic concepts in frontier of nanobiotechnology.
- To provide students with a basic understanding and knowledge on nanobiotechnology
- To learn the applications of the nanoparticle in biotechnology

Unit	Description	Hours	K-level	CLO
I	Glimpse of Nanotechnology based material in ancient India: Wootz steel (iron carbide) and the Delhi iron pillar (anticorrosive nanomaterial), Bhasma (nanomaterial as medicine). Contributions of Indian Research Institutes in the field of nanobiotechnology.	12	2	1
II	Metals: Silver nanoparticle synthesis and its analyses by UV-spectroscopy and FTIR. Self-Assembly nanomaterial: Cell membrane and its analyses by SEM	12	3	2
III	Nano-thin films: Chitosan thin film, Nanodevices (nanorobots), Nanotubes: Microtubules assembly and its importance, Nano shells- Dendrimers: Liposomes, Nanofibers: Collagen, Fibronectin & elastin, nano fluidics: Extracellular matrix assembly and its importance.	12	4	3
IV	Agriculture: Crop production- Nano fertilizers technology, Biomaterial to improve shelf life of vegetables. Medicine: Collagen thin films in wound healing mechanism, Nanoscale devices – DNA microarray for disease diagnosis, Antibodies and Targeted drug delivery system.	12	3	4
V	Nano biosensors (Firefly-luciferase) and its applications, Introduction to Biomimetics (Gecko foot effect, Lotus leaf effect: Paint and fabrics, Box fish based Car	12	4	5

Books for Study

1. Vasantha Patabhi and Gautham N. 2009. Biophysics, Narosa Publishing House, New Delhi.
2. Mahendra R and Clemens Posten. 2013. Green biosynthesis of nanoparticles: Mechanisms and applications, CABI.
3. Pradeep T. 2012. Textbook of Nanoscience and Nanotechnology, McGraw Hill publications.

Books for Reference

1. David SG. 2004. Bionanotechnology”, John Wiley & Sons Inc.
2. Guozhong Cao. 2004. Nanostructures and Nanomaterials, synthesis, properties and applications, Imperial College Press.
3. Niemeyer CM and Mirkin CA. 2007. Nanobiotechnology, WILEY-VCH

Web resources

1. http://vvm.org.in/study_material/ENG%20-20Indian%20Contributions%20to%20Science.
2. <https://nptel.ac.in/courses/118/107/118107015/>

Rationale for nature of the course

The skill based course on Nanobiotechnology to provide the basic understanding about nanoscience and its application in Biotechnology. Understanding about nanotechnology would make the students to become an interdisciplinary researcher in the future.

Activities having direct bearing on Skill development / Employability /Entrepreneurship

- Preparation of mind map and poster for nanomaterial preparation
- Scientific discussion and analysis on theoretical concepts

Pedagogy

The teaching methods may include Chalk and talk, PowerPoint, demonstrations, assignments, group discussions and Problem solving

Course content designer: Dr N Krithiga

LECTURE SCHEDULE

Unit	Description	Hours	Mode
I	Glimpse of Nanotechnology based material in ancient India: Wootz steel (iron carbide) and the Delhi iron pillar (anticorrosive nanomaterial),	4	Chalk and talk, Problem-solving, Quiz
	Bhasma (nanomaterial as medicine). Contributions of Indian	4	
	Research Institutes in the field of nanobiotechnology.	4	
II	Metals: Silver nanoparticle synthesis and its analyses by UV-spectroscopy and	6	Chalk and talk, Problem-solving
	FTIR. Self-Assembly nanomaterial: Cell membrane and its analyses by SEM	6	
III	Nano-thin films: Chitosan thin film, Nanodevices (nanorobots), Nanotubes: Microtubules assembly and its importance,	6	Chalk and talk, PPT
	Nano shells- Dendrimers: Liposomes, Nanofibers: Collagen, Fibronectin & elastin, nano fluidics: Extracellular matrix assembly and its importance.	6	
IV	Agriculture: Crop production- Nano fertilizers technology, Biomaterial to improve shelf life of vegetables.	6	Chalk and talk, PPT
	Medicine: Collagen thin films in wound healing mechanism, Nanoscale devices – DNA microarray for disease diagnosis, Antibodies and Targeted drug delivery system.	6	
V	Nano biosensors (Firefly-luciferase) and its applications,	6	Chalk and talk, group discussion
	Introduction to Biomimetics (Gecko foot effect, Lotus leaf effect: Paint and fabrics, Box fish based Car	6	

Course Learning Outcomes

On completion of this course the students will be able to

#	CLOs	K – Level
CLO-1	Discuss about the glimpses of nanomaterials	Up to K-2
CLO-2	Relate various methods to analyse nanomaterials	Up to K-3
CLO-3	Highlight the applications of nano films	Up to K-4
CLO-4	Points out the significance of various nano fertilizers	Up to K-3
CLO-5	Compare various biosensors	Up to K-4

Mapping of Course outcomes with Program specific Outcomes

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

Advance application-3; Intermediate level-2 & Basic level-1

Mapping of Course outcomes with Program Outcomes

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	2	2	3	2	2	3
CLO-2	3	3	3	2	2	2
CLO-3	3	3	2	3	3	2
CLO-4	2	3	2	2	3	3
CLO-5	2	2	2	2	2	2

Advance application-3; Intermediate level-2 & Basic level-1

Learning Outcome Based Education & Assessment (LOBE)

Blue Print – Nanobiotechnology

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 K-2	2	K1 & K2	1	K1	2 (K1&K1)	1(K2)
2	CLO 2	Up to K-3	2	K1 & K2	1	K2	2 (K2&K2)	1(K3)
3	CLO 3	Up to K-4	2	K1 & K2	1	K2	2 (K3&K3)	1(K4)
4	CLO 4	Up to K-3	2	K1 & K2	1	K1	2 (K3&K3)	1(K3)
5	CLO 5	Up to K-4	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 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	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%

Distribution of Unit-wise questions with K Levels

Section A	Section B	Section C	Section D
2 Questions for each Unit (K1 & K2 Level)	1 Question from each Unit (K1 & K2 Level)	2 Questions from Unit-I (K2 Level)	1 Question from Unit-I (K3 Level)
		2 Questions from Unit-II (K3 Level)	1 Question from Unit-II (K4 Level)
		2 Questions from Unit-III (K3 Level)	1 Question from Unit-III (K3 Level)
		2 Questions from Unit-IV (K4 Level)	1 Question from Unit-IV (K3 Level)
		2 Questions from Unit-V (K1 Level)	1 Question from Unit-V (K2 Level)

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 interferences with evidences

DEPARTMENT OF BIOTECHNOLOGY				CLASS: I B.SC BIOTECHNOLOGY				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
VI	Major Practical	23U6LCCP6	Major Practical-VI	3	3	25	75	100
Nature of Course								
Skill oriented		✓	Employability oriented	✓	Entrepreneurship oriented			

Course Objectives

- To make the students to understand the growth kinetics of bacteria
- To demonstrate the biogas production
- To grade the milk samples

	Experiments
1	Water analysis – Chloride, Nitrate
2	Estimation of BOD / COD
3	Study of Growth Curve and Generation time of Bacteria/ Yeast using turbidometry.
4	Immobilization of whole yeast cells/ enzyme by Alginate beads.
5	Production and estimation of alcohol
6	Isolation and identification of starter organisms from Idli batter/ curd
7	Isolation of Lipase/ amylase producing bacteria.
8	Isolation of phosphate solubilizing bacteria
9	RFLP
10	Biofertilizer production/Spirulina production - field visit. (Report should be included in the record)
Spotters: Azolla, Nostoc, Bioreactor, downstream process, RFLP, Hybridoma technology, ADA, WIPO, Trademarks, SCP	

Books for study

1. Abhijit Dutta. 2011. Experimental Biology: A laboratory Manual. Narosa publications.
2. Practical Manual on "Fundamentals of Genetics" (PBG-121). 2019, Edition: First Publisher: Odisha University of Agriculture & Technology. Editor: Kaushik Kumar Panigrahi

Course content designers: Dr N Kamaal Dhasan

Course Learning Outcomes

On completion of this course the students will be able to

#	CLOs	K –Level
CLO-1	Demonstrate the isolation of air borne bacteria	Upto K2
CLO-2	Analyse the BOD	Upto K3
CLO-3	Demonstrate the methods of fermentation	Upto K4
CLO-4	Experiment with the Preparations and maintenance of culture medium	Upto K3
CLO-5	Demonstrate biofertilizer production	Upto K4

Rationale for nature of the course

The course focuses on the students' ability to solve the problems related to inheritance and identify the various stages in cell division.

Activities having direct bearing on Skill development /Employability /Entrepreneurship

- Individual experimental activity to the students.
- Analysis and interpretation of results.

Mapping of Course outcomes with Program Outcomes

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	3	2	3	3	2	2
CLO-2	3	3	3	2	2	3
CLO-3	3	2	2	3	2	2
CLO-4	3	3	3	2	2	3
CLO-5	3	3	3	3	2	3

Mapping of Course outcomes with Program specific Outcomes

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

Advance application-3; Intermediate level-2 & Basic level-1

DEPARTMENT OF BIOTECHNOLOGY				CLASS: III B.SC BIOTECHNOLOGY				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
VI	Skill Enhancement Course	23U6LSED8	Biotechnology for Competitive Exam	2	2	25	75	100
Nature of Course								
Skill oriented		✓	Employability oriented	✓	Entrepreneurship oriented			

Course Objectives

- To prepare the students to face the competitive exams
- To gain knowledge on various concepts in life sciences
- To solve problems related to biological questions

Unit	Description	Hours	K-level	CLO
I	Cell Biology -Cell organelles, Cell membrane, transport across membrane, genome organization in eukaryotes, Chromosome structure, Specialized chromosomes – polytene and lamp brush, pedigree analysis.	6	2	1
II	Biochemical and Biophysical Techniques – pH meter calculation centrifugation- sedimentation coefficient, RCF to rpm conversion, chromatography techniques- affinity, ion-exchange, GLC, electrophoretic techniques- SDS-PAGE, agarose gel electrophoresis, spectroscopic techniques- electromagnetic spectrum, UV spectroscopy, radio isotopic techniques- half-life of radioactivity, applications of radioisotopes.	6	3	2
III	Plant Physiology: Photosynthesis – components and mechanism, C3 & C4 pathways, Photoperiodism and vernalization. Mineral nutrients, Plant hormones and its function.	6	4	3
IV	Animal Physiology: Digestive system, muscle structure and mechanism of contraction, Exchange of O ₂ & CO ₂ , Origin and conduction of heart beat, ECG, Formation of urine	6	3	4

V	Biochemistry: Classification & nutritive values of carbohydrates, Amino acids and Proteins, Lipids, BMI-significance, Vitamins – classification and deficiency, Hormones – functions, diseases related to hormonal imbalance.	6	4	5

Books for Study

1. Jain JL. 2005. Fundamentals of Biochemistry. S. Chand & Company Ltd.
2. Avinash Upadhya, Kakoli Upadhyay, 2009, Biophysical Chemistry (Principles and Techniques), Himalaya Publishing
3. V K Jain. 2022, Fundamentals of Plant Physiology, S. Chand & Company Ltd.

Books for Reference

1. Stryer L. 2000 Biochemistry, Fourth edition. W.H. Freeman and Company. New York
2. Wilson, K and Walker, J, Principles and Techniques of Practical Biochemistry, 1995, Cambridge University Press, New York.

Web resources

- <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=MNhNzp1RQIU+6LM40KjY1Q=>
- <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=1p0OY7YTBClr5D2KEqnvVg==>

Rationale for nature of the course

The course on Biotechnology for Competitive exam focusses on topics that prepares the students for various entrance and competitive examinations.

Activities having direct bearing on Skill development / Employability /Entrepreneurship

Quiz, Seminars, group discussion

Pedagogy

The teaching methods may include Chalk and talk, PowerPoint, demonstrations, assignments, group discussions and Problem solving.

Course content designers: Dr. P. Vimal

LECTURE SCHEDULE

Unit	Description	Hours	Mode
I	Cell Biology & Genetics: Cell organelles, Cell membrane, transport across membrane	2	Chalk and talk, Problem-solving
	genome Organization in eukaryotes, Chromosome structure	2	
	Special chromosomes – polytene and lamp brush	2	
II	Biochemical and Biophysical Techniques - centrifugation-sedimentation coefficient, RCF to rpm conversion, chromatography techniques- affinity, ion-exchange, GLC, electrophoretic techniques- techniques- applications of radioisotopes.	3	Chalk and talk, Problem-solving
	SDS-PAGE, agarose gel electrophoresis, Blotting- Southern, Northern, Western, spectroscopic techniques- electromagnetic spectrum, UV spectroscopy, FT-IR, radio isotopic	3	
III	Plant Physiology: Photosynthesis – components and mechanism, C3 & C4 pathways,	3	Chalk and talk, PPT
	Photoperiodism and vernalization. Mineral nutrients, Plant hormones and its function.	3	
IV	Animal Physiology: Digestive system, muscle structure and mechanism of contraction,	3	Chalk and talk, PPT
	Exchange of O ₂ & CO ₂ , Origin and conduction of heart beat, ECG, Formation of urine	3	
V	Biochemistry: Classification & nutritive values of carbohydrates, Proteins and Lipids,	3	Chalk and talk, group discussion,
	BMI-significance, Vitamins – classification and deficiency, Hormones - functions	3	

Course Learning Outcomes

On completion of this course the students will be able to

#	CLOs	K – Level
CLO-1	Discuss about the cell organelles	Up to K-2
CLO-2	Relate various biochemical and bio analytical techniques	Up to K-3
CLO-3	Highlight the various physiological process	Up to K-4
CLO-4	Points out the animal physiological process	Up to K-3
CLO-5	Compare various biochemical compounds and its function	Up to K-4

Mapping of Course outcomes with Program specific Outcomes

CLO/PSO	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

Mapping of Course outcomes with Program Outcomes

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	3	3	3	3	2	3
CLO-2	3	3	3	3	2	3
CLO-3	3	3	3	3	2	3
CLO-4	3	3	3	3	2	3
CLO-5	3	3	3	3	2	3

Advance application-3; Intermediate level-2 & Basic level-1

Learning Outcome Based Education & Assessment (LOBE)
Blue Print – Bioethics & Biosafety
Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

S. No.	CLOs	K-Level	Section A		Section B (Open Choice)	Section C (Open Choice)
			MCQs			
			No. of Questions	K-Level		
1	CLO 1	Up to K-2	6	K1 & K2	1 (K1)	1(K2)
2	CLO 2	Up to K-3	6	K1 & K2	1 (K2)	1(K3)
3	CLO 3	Up to K-4	6	K1 & K2	1 (K3)	1(K4)
4	CLO 4	Up to K-3	6	K1 & K2	1 (K3)	1(K3)
5	CLO 5	Up to K-4	6	K1 & K2	1 (K4)	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 Section			30		15	30

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section C (Open Choice)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	15	5	-	20	19.05	47.62
K2	15	5	10	30	28.57	
K3	-	10	30	40	38.05	38.05
K4	-	5	10	15	14.29	14.29
Total Marks	30	25	50	105	100	100%

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 interferences with evidences

DEPARTMENT OF BIOTECHNOLOGY				CLASS: III B.SC BIOTECHNOLOGY				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
VI	Project	23U6LPROV	Project and Viva Voce	2	3	25	75	100
Nature of Course								
Skill oriented		✓	Employability oriented	✓	Entrepreneurship oriented			

Course Objectives

- To make students to take up the research projects in their field of interest.
- To develop scientific temper and 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

On completion of this course the students will be able to

#	CLOs	K – Level
CLO-1	Survey scientific literature available and identify gaps in existing studies	Upto K2
CLO-2	Design a scientific study taking practical constraints into account	Upto K3
CLO-3	Perform the scientific study taking practical constraints into account	Upto K3
CLO-4	Analyze the results	Upto K4
CLO-5	Communicate the findings based on ethical standards of reporting.	Upto K3

Mapping of Course outcomes with Program specific Outcomes

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

Advance application-3; Intermediate level-2 & Basic level-1

Mapping of Course outcomes with Program Outcomes

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	3	3	3	3	3	3
CLO-2	2	2	2	2	2	2
CLO-3	3	3	3	3	3	3
CLO-4	3	3	3	3	3	3
CLO-5	2	2	3	3	3	3

Advance application-3; Intermediate level-2 & Basic level-1

Internal & External Valuation for Project

Internal	External
25 Marks	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. (Project will be evaluated by Guide with External Examiner in the presence of HOD)

DEPARTMENT OF BIOTECHNOLOGY				Certificate Course				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours	CIA	Ext	Total
	Certificate Course	23LC01	Organic Farming and Health Management		30	50	50	100

Course Objectives:

- To gain the knowledge about Principles and Policies in Organic farming and Certification agencies
- To realize the Concept of Health and importance of well being
- To make the students become an entrepreneur

UNIT	Contents	No. of Hours
I	Fundamental of organic farm management - Land management in organic farming - Water management in organic farming, Organic insect disease management - Organic pest disease management	6
II	Composting – Microbial Compost – Vermicompost – Setup for vermicompost unit - Nutrition garden – Ring garden – Double digging – Cultivating vegetables – Common medicinal herbs – Identification and Cultivation.	6
III	Organic farming – Principles and Policies – Certification agencies – AGMARK, fssai, Halal certification – Participatory grading system (PGS) – Storage – Packing – Transportation – Marketing. Micro-enterprises – Self Help Groups – Economics of cultivations – Sustainability.	6
IV	Health: Concept of Health, changing concepts definitions of health, dimensions of health, concept of well being, spectrum of health, determinants of health, ecology of health, right to health, responsibility for health, indicators of health.	6
V	Exercise and Health related fitness: Health related fitness, health promotion, physical activity for health benefits. Sports related fitness: Role of nutrition in sports, nutrition to athletic performance.	6

Books for Study

- Veeresh GK. 2006. Organic farming, 1st edition, India Foundation Books.
- Mangala Rai. 2012. Hand Book of Agriculture, 6th Edition, ICAR New Delhi.
- Sharma BB. 2007. A Guide to Home Gardening, 2nd Edition, MIB India, New Delhi.

Books for Reference

- Gehlot D. Organic Farming: Components and Management AGROBIOS (INDIA).
- Adrianne EH. 2009. Physical Activity and Health – The evidence explained, 2nd Edition, Taylor and Francis .

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BIOTECHNOLOGY

Sem	Course Code	Title of the Course	Hours	Credits	Nature of Course(Employability/ Entrepreneurship/ Skill Development)			Scope of Focus (Local / National / Global developmental needs)			% of Syllabus Revision/New
					Empl	Ent	Skill	Local	National	Global	
I	23U1LCCT1	Cell and Molecular Developmental Biology	5	5			✓			✓	New
	23U1LCCP1	Major Practical-I	3	3			✓				New
	23U1LSED1	Food Chemistry	2	2	✓	✓	✓	✓	✓	✓	New
	23U1LFCT1	Basics of Biotechnology	2	2			✓	✓	✓	✓	--
	23U1LGET1	Basic and Clinical Biochemistry	4	4	✓			✓	✓		New
	23U1LGEP1	Allied Practical-I	2	1			✓	✓	✓		New
II	23U2LCCT2	Genetics	5	5	✓		✓		✓	✓	45
	23U2LCCP2	Major Practical-II	3	3	✓		✓		✓	✓	
	23U2LSED2	Mushroom Cultivation	2	2	✓	✓	✓	✓	✓	✓	New
	23U2LSED3	Clinical Nutrition & Dietary Management	2	2	✓	✓	✓	✓	✓	✓	New
	23U2LGET2	Clinical Laboratory Technology	4	4	✓		✓	✓	✓	✓	New
	23U2LGEP2	Allied Practical-II	2	1	✓		✓				

Emp- Employability; Ent- Entrepreneurship; Skill- Skill Development

Sem	Course Code	Title of the Course	Hours	Credits	Nature of Course(Employability/ Entrepreneurship/ Skill Development)			Scope of Focus (Local / National / Global developmental needs)			% of Syllabus Revision/New
					Empl	Ent	Skill	Local	National	Global	
III	23U3LCCT3	Immunology and Immunotechnology	4	4	✓		✓	✓	✓	✓	13%
	23U3LCCP3	Major Practical-III	3	3	✓		✓				New
	23U3LSED4	Food and Bioprocess Technology	2	2	✓	✓	✓	✓	✓	✓	New
	23U3LSED5	Vermitechnology	2	2	✓	✓	✓	✓	✓	✓	New
IV	23U4LCCT2	Genetic Engineering and rDNA Technology	4	4			✓		✓	✓	43%
	23U4LCCP4	Major Practical-IV	3	3			✓				New
	23U4LSED6	Poultry Science and Management	2	2	✓	✓	✓	✓	✓		New
	23U4LSED7	Aquaculture	2	2	✓	✓	✓	✓	✓		New
	23U4LGET2	Clinical Laboratory Technology	4	4	✓		✓	✓	✓	✓	New
	23U4LGEP2	Allied Practical-I	2	1	✓			✓	✓	✓	New

Emp- Employability; Ent- Entrepreneurship; Skill- Skill Development

Sem	Course Code	Title of the Course	Hours	Credits	Nature of Course(Employability/ Entrepreneurship/ Skill Development)			Scope of Focus (Local / National / Global developmental needs)			% of Syllabus Revision/New
					Empl	Ent	Skill	Local	National	Global	
V	23U5LCCT6	Plant Biotechnology	5	4			✓		✓	✓	46%
	23U5LCCT6	Animal Biotechnology	5	4			✓		✓	✓	60%
	23U5LCCT7	Pharmaceutical Biotechnology	5	4	✓		✓	✓	✓	✓	90%
	23U5LCCP5	Major Practical-V	3	3	✓		✓				New
	23U5LDET1(A)	Enzymology	5	4			✓				New
	23U5LDET1(B)	Marine Biotechnology	5	4			✓				New
	23U5LIDT1	Computer Aided Drug Design	5	4	✓		✓	✓	✓	✓	25%
	23U5VENT1	VE	2	2			✓				New
	23U5LINTR	Industrial Visit	--	2			✓				New
VI	23U6LCCT8	Environmental and Industrial Biotechnology	6	4	✓						38%
	23U6LCCT9	Medical Biotechnology	6	4	✓		✓	✓	✓	✓	New
	23U6LCCT10	Bioentrepreneurship	6	4	✓	✓	✓				New
	23U6LCCP6	Major Practical-VI	3	3	✓		✓		✓	✓	New
	23U6LDET2(A)	Bioethics and Biosafety	4	2			✓				66%
	23U6LDET2(B)	Nanobiotechnology	4	2			✓				New
	23U6LSED8	Biotechnology for Competitive Exam	2	2	✓		✓				New
	23U6LPROV	Project	3	2	✓		✓		✓	✓	New

Emp- Employability; Ent- Entrepreneurship; Skill- Skill Development

CLASS: II B.A. / B.Sc. / B.Com								
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
III	Add-on course	23U3ADD1	HEALTH & WELLNESS	2	2	100	-	100

Skill Areas:

Physical Fitness, Nutrition, Mental Health, Awareness on Drug addiction and its effects

Purpose:

The Health & Wellness course focuses on teaching the elements of physical, mental, emotional, social, intellectual, environmental well-being which are essential for overall development of an individual. The course also addresses the dangers of substance abuse and online risks to promote emotional and mental health.

Learning Outcomes:

Upon completion of the Health & Wellness course, students will be able to:

1. Demonstrate proficiency in sports training and physical fitness practices.
2. Improve their mental and emotional well-being, fostering a positive outlook on health and life.
3. Develop competence and commitment as professionals in the field of health and wellness.
4. Awareness on drug addiction and its ill effects

Focus:

During the conduct of the Health & Wellness course, the students will benefit from the following focus areas:

1. Stress Management.
2. Breaking Bad Habits.
3. Improving Interpersonal Relationships.
4. Building Physical Strength & Inner Strength.

Role of the Facilitator:

The faculty plays a crucial role in effectively engaging with students and guiding them towards achieving learning outcomes. Faculty participation involves the following areas.

1. **Mentorship & Motivation:** The facilitator mentors students in wellness and self-discipline while inspiring a positive outlook on health. Faculty teach stress management, fitness and daily well-being.
2. **Promoting a Safe and Inclusive Environment:** The facilitator ensures a safe, inclusive and respectful learning environment for active student participation and benefit.
3. **Individualized Support and Monitoring Progress:** The facilitator plays a crucial role in providing personalized support, monitoring and guidance to students.

Guided Activities:

In this course, several general guided activities have been suggested to facilitate the achievement of desired learning outcomes. They are as follows:

1. Introduction to Holistic Well-being.
2. Holistic Wellness Program - Nurturing Body and Mind
3. Breaking Bad Habits Workshop
4. Improving the elements of physical, emotional, social, intellectual, environmental and mental well-being.
5. Creating situational awareness, digital awareness.
6. Understanding substance abuse, consequences and the way out.

Period Distribution:

The following are the guided activities suggested for this Audit course.

The Physical Director should plan the activities by the students.

Arrange the suitable Mentor / Guide for the wellness activities.

Additional activities and programs can be planned for Health and Wellness.

Assessments:

- Use Self-reflective worksheets to assess their understanding.
- Submit the worksheets to internal audit/external audit.

- Every student's activities report should be documented and the same have to be assessed by the Physical Director with the mentor. The evaluation should be for 100 marks. No examination is required.

Scheme of Evaluation

Part	Description	Marks
A	Report	40
B	Attendance	20
C	Activities (Observation during practice)	40
Total		100

Online Resources:

1. United Nations Sustainable Development Goals – Goal 3 – Good Health & Well-being: <https://www.un.org/sustainabledevelopment/health/>
2. Mindfulness and Meditation: Stanford Health Library offers mindfulness and meditation resources:
<https://healthlibrary.stanford.edu/books-resources/mindfulness-meditation.html>
3. Breaking Bad Habits: James Clear provides a guide on how to build good habits and break bad ones: <https://jamesclear.com/habits>
4. 6 Ways to Keep Your Brain Sharp
<https://www.lorman.com/blog/post/how-to-keep-your-brain-sharp>
5. What is Social Wellbeing? 12+ Activities for Social Wellness
<https://positivepsychology.com/social-wellbeing/>
6. How Does Your Environment Affect Your Mental Health?
<https://www.verywellmind.com/how-your-environment-affects-your-mental-health-5093687>
7. How to say no to others (add why you shouldn't feel guilty)
<https://www.betterup.com/blog/how-to-say-no>