DEPARTMENT OF BOTANY				*CLASS: II B.Sc. Botany*				
Sem	**Course Type**	**Course Code**	**Course Title**	**Credits**	**Contact Hours/week**	**CIA**	**Ext**	**Total**
IV	SBE- II	20U4BSM2	Biological Techniques	2	2	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	

Course Objectives: This course will enable the students

1. To acquire knowledge on the working principle and methodology of various techniques in biological sciences.
2. To understand the scope and applications of major bio-techniques.
3. To demonstrate the operation of bio-instruments mentioned in the syllabi and provides hands-on-experiences.

UNITS	CONTENT	CLO	K LEVEL	HOURS
I	**Microscopy:** Microscope: Compound, bright field, dark field, Phase contrast, and fluorescence microscope, Electron microscope- SEM, TEM. Micro-preparations- Fixation and Staining. Microtome- Components and functions.	**1**	**Up to K4**	**6**
II	**Colorimetry and Photometry:** pH meter principle and applications. Beer- Lamberts Law, colorimeter and spectrophotometer. EM spectrum, UV spectroscopy, NMR.	**2**	**Up to K4**	**6**
III	**Chromatography:** Principle and applications- mobile and stationary phases, Rf value, Paper chromatography, TLC Gel filtration chromatography and HPLC.	**3**	**Up to K4**	**6**
IV	**Electrophoresis:** Principle and applications- Separation of macromolecules by Agarose Gel (AG), Poly Acrylamide Gel (SDS- PAGE) and Two dimensional Gel Electrophoresis.	**4**	**Up to K4**	**6**
V	**Centrifugation:** Centrifuge: principle, parts and applications, types (bench-top & ultra). Velocity gradient, isopycnic & differential centrifugation.	**5**	**Up to K4**	**6**

Books for Study

1. Jayaraman, J. (2019). Laboratory Manual in Biochemistry (Revised). Wiley Eastern Ltd., New Delhi.
2. Krishnamurthy, K. V. (1988). Methods in Plant Histo-chemistry. S. Viswanathan & Co., Madras.
3. Dwivedi, J. N. and Singh, R. B. (1985). Essential of Plant Technique. Scientific Publications, Jodhpur.

Books for References

1. Jensen, W. A. (1962). Botanical Histochemistry: Principles and Practice. W.H. Freeman and Co., San Francisco, USA.
2. Johansen, D. A. (1940). Plant Microtechnique. McGraw Hill, New York.
3. Sass, J. E. (1967). Botanical Microtechnique. 3rd ed. Oxford & IBH Publishing Co., New Delhi.
4. Skoog, A. and West, M. (1980). Principles of Instrumental Analysis –W. B. Saunders Co., Philadephia, USA.
5. Wilard, H. H., Meritt, L. L. Jr. and Dean, J. A. (1965). Instrumental Methods of Analysis. 4th ed. Van Nostrand Inc. Princeton, New Jersey.
6. Williams, B. L. and Wilson, K. (1983). A Biologist's Guide to Principles Techniques of Practical Biochemistry. Edward Arnold, London. Spectroscopy. Volume 1. Edited by B.B. Straughan and S. Walker. Chapman and Hall Ltd.

Web Resources

1. https://ww.biologydiscussion.com/biology/someimportant-techniques-used-in-biology/2627
2. https://ww.biologydiscussion.com/biology/someimportant-techniques-used-in-biology/15683
3. https://www.www.biotechniques.com
4. https://www.microscopemaster.com; https://www.azom.com
5. https://www.onlinelibrary.wiley.com; https://www.khanacademy.org

Rationale for Nature of the Course

The course focuses on understanding the working principles, methodologies and application of various instrumentation techniques applied in the field of biology.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

The techniques learned from the course help the students to get a position in various scientific laboratories and its allied fields.

Pedagogy

Chalk and Talk, PPT, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Labs & Learning Management System (CANVAS).

Course Designer: Dr. P. Kannan, Assistant Professor

Course Learning Outcomes: On the successful completion of the course the students will be able to

CLOs	CLO Statement	Knowledge level
CLO-1	Understand the working principles and components of various microscopy and microtome.	**Up to K4**
CLO-2	Familiarize the knowledge on standard methodologies followed in colorimetry and photometry.	**Up to K4**
CLO-3	Demonstrate the operation protocols in most frequently used chromatography used in research studies.	**Up to K4**
CLO-4	Evaluate the advanced scientific significances of electrophoresis.	**Up to K4**
CLO-5	Synthesize by develop unique skills by hands-on-training on various centrifugation techniques.	**Up to K4**

Mapping Programme Specific Outcomes with Course Learning Outcome

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7	PSO-8	PSO-9
CLO-1	2	3	3	3	3	3	2	2	2
CLO-2	3	3	2	3	3	2	1	1	2
CLO-3	3	3	3	3	2	2	2	1	1
CLO-4	2	2	3	3	2	3	3	2	1
CLO-5	3	3	2	2	3	2	2	1	1

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

Mapping Programme Outcomes with Course Learning Outcome

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

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

Lesson Plan

Unit	Description	Staff Name	Hours	Mode
I	Compound microscopy-components	-	1	Discussion
	Bright, dark, phase-contrast & fluorescent microscopy	-	2	Power point
	SEM and TEM compare studies	-	2	Power point
	Microtome components and functions	-	1	Demontration
II	Colorimeter components,EMS, Spectrophotometer	-	2	Discussion
	UV spectroscopy & NMR	-	3	Power point
	pH meter components	-	1	Power point
III	Paper chromatography	-	1	Black board
	Gel type- components and its application	-	1	Black board
	Thin Layer Chromatography	-	2	Power point
	HPLC	-	2	LMS
IV	Macromolecules separation-overview	-	1	Discussion
	Agarose gel electrophoresis	-	2	Black board
	Polyacrlamide gel electrophoresis	-	2	Power point
	Two Dimensional electrophoresis	-	1	LMS
V	Centrifuge- Principle and Application	-	1	Discussion
	Parts and types of Centrifuge	-	1	Black board
	Velocity Centrifugation	-	2	Power point
	Isopycnic & Differential Centrifugation	-	2	Video-clips
Total			**30**	

Blue Print – Model for External Examination

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

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

K1 - Remembering and recalling facts with specific answers

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

K3- Application oriented – Solving Problems

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

Distribution of Section- wise marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	**Total Marks**	% of Marks without choice	**Consolidated**
K1	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%**

Blue Print – Model for Internal Examination

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

Sl. No	**CLOs**	**K- Level**	**Section – A**		**Section – B**		**Section C (Either/ Choice)**	**Section D (Open Choice)**	**Total**
			MCQs		**Short Answer**				
			No. of Questions	**K – Level**	**No. of Questions**	**K - Level**			
1	CLO x	Up to K 4	2	K1&K2	2	K1& K2	2(K2&K2)	1 (K2/K3)	
2	CLO y	Up to K 4	2	K1&K2	1	K2	2(K3&K3)	2 (K3& K4)	
No. of Question to be asked			4		3		4	3	14
No. of Question to be answered			4		2		2	2	10
Mark for each question			1		2		5	10	
Total Marks for each section			4		6		10	20	40

K1 - Remembering and recalling facts with specific answers

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

K3- Application oriented – Solving Problems

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

Distribution of Section- wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	**Total Marks**	% of Marks without choice	**Consolidated**
K1	2	2		-	**4**	6.67	**50**
K2	2	4	10	10	**26**	43.33	
K3	-	-	10	10	**20**	33.33	**33**
K4	-	-		10	**10**	16.67	**17**
Total Marks	4	6	20	30	**60**	100.00	**100%**

DEPARTMENT OF BOTANY				*CLASS: II B.Sc. Botany*				
Sem	**Course Type**	**Course Code**	**Course Title**	**Credits**	**Contact Hours/week**	**CIA**	**Ext**	**Total**
IV	SBE- II	20U4BSM2	Organic Farming	2	2	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	✓

Course Objectives: This course will enable the students

1. To impart knowledge on the eco-friendly aspects of organic farming and importance of sustainable agriculture.
2. To educate students on the marketing of organic farm products.

UNITS	CONTENT	CLO	K LEVEL	HOURS
I	**Soil:** Physical and chemical properties - Soil pollution: fertilizers, pesticides, herbicides, non-degradable solids - Biomagnification - Consequences of land pollution, damage to soil and crops, heavy metal contamination -Impact of monoculture.	**1**	**Up to K4**	**6**
II	**Organic Farming:** Basic concept - Integrated plant nutrient supply management - Integrated pest and disease management, biopesticides against microbial parasites, predators and pests - Integrated soil and water management - Sustainable agriculture practices: crop rotation, crop diversification, mixed cropping.	**2**	**Up to K4**	**6**
III	**Management of Organic Wastes:** Organic manures: organic residue, chemical nature, green manure, importance - Animal based organic manure: cow dung, poultry waste - Vermicompost: Methods, production and utilization - Preparation of Panchakavya, Dasagavya, Amirthakaraisal.	**3**	**Up to K4**	**6**
IV	**Biofertilizers:** Classification, Nitrogen fixers: *Rhizobium*, Cyanobacteria, *Azolla* and VAM - Production, field application and benefits.	**4**	**Up to K4**	**6**
V	**Organic Protection:** Operational structure of NPOP - IPR and Patenting issues - Principles of Biosafety - GMO and regulations - Organic products: Inspection and Certification - Accredited certifying agents (National and International) - Quality assurance: Logo and labeling and marketing.	**5**	**Up to K4**	**6**

Books for Study

1. Ranjan Kumar Biswas, 2014. Organic farming in India. New Delhi Publishers, India.
2. Reddy, S.R., 2017. Principles of organic farming. Kalyani Publishers, India.

Books for Reference

1. Sharma, A.K., 2003. Biofertilizers for sustainable agriculture, Agrobios.
2. NIIR Board, 2004. The Complete Technology Book on Biofertilizer and Organic Farming, National Institute of Industrial Research.
3. Palaniappan, S.P., and K. Annadurai, 2008. Organic Farming: Theory and Practice. Scientific Publishers.
4. Sarath Chandran, Unni M.R and Sabu Thomas, 2018. Organic farming. Woodhead Publishing, UK.

Web Resources

1. http://ec.europa.eu/agriculture/organic/organic-farming/whatorganic_en
2. http://attra.ncat.org/organic.html#list
3. http://www.epa.gov/agriculture/tbio.html

Rationale for Nature of the Course:

The course focuses on soil profile and management of organic wastes generated in various domestic and industrial supplies.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

The skills obtained from the course will help the students to prepare organic manure by utilizing the various wastes generated in different sectors.

Pedagogy:

Chalk and Talk, PPT, Group Discussion, Seminar, Interaction, Problem Solving, Quiz, Virtual Labs & Learning Management System (CANVAS).

Course Designer: Dr. P. Janci Rani, Assistant Professor

Course Learning Outcomes: On the successful completion of the course the students will be able to

CLOs	Course Learning Outcome Statement	Knowledge Level
CLO 1	Acquire familiarity on the various properties of soil	**Up to K4**
CLO 2	Develop entrepreneur skills to practice organic farming	**Up to K4**
CLO 3	Comprehend management practices suitable for organic farming	**Up to K4**
CLO 4	Explore knowledge on the use of biofertilizers for crop improvement	**Up to K4**
CLO 5	Understand the marketing and quality control aspects of organic products	**Up to K4**

Mapping Programme Specific Outcomes with Course Learning Outcomes:

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9
CLO 1	-	2	2	3	2	1	3	2	3
CLO 2	2	2	3	3	3	3	3	3	3
CLO 3	-	3	3	2	3	3	2	2	3
CLO 4	1	3	3	3	2	3	3	3	3
CLO 5	2	2	3	3	3	3	3	3	3

3-Advance Application; 2 - Intermediate Level; 1 - Basic Level

Mapping Programme Outcomes with Course Learning Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5
CLO 1	3	2	1	3	1
CLO 2	3	3	2	3	2
CLO 3	2	2	1	3	3
CLO 4	3	2	3	3	2
CLO 5	3	3	3	3	3

3-Advance Application; 2 - Intermediate Level; 1 - Basic Level

Lesson Plan

Unit	Description	Name of Staff	Hrs	Mode
1	a) Physical and chemical properties of soil	-	1	Black Board
	b) Soil pollution:fertilizers, pesticides, herbicides, non-degradable solids	-	2	Power Point
	c) Biomagnification, Consequences of land pollution, damage to soil and crops, heavy metal contamination	-	2	Seminar
	d) Impact of monoculture	-	1	Black Board
2	a) Basic concept of organic farming	-	1	Black Board
	b) Integrated plant nutrient supply management	-	1	Power Point
	c) Integrated pest and disease management, biopesticides against microbial parasites, predators and pests	-	2	Discussion
	d) Integrated soil and water management	-	1	Discussion
	e) Sustainable agriculture practices: crop rotation, crop diversification, mixed cropping	-	1	Power Point
3	a) Organic manures: organic residue, chemical nature, green manure, importance	-	1	LMS (CANVAS)
	b) Animal based organic manure: cow dung, poultry waste	-	1	Power Point
	c) Vermicompost: Methods, production and utilization	-	2	Discussion
	d) Preparation of Panchakavya, Dasagavya, Amirthakaraisal	-	2	LMS (CANVAS)
4	a) Biofertilizers: Classification	-	2	Black Board
	b) Nitrogen fixers: *Rhizobium*, Cyanobacteria, *Azolla* and VAM	-	2	Power Point
	c) Production of biofertilizers, field application and benefits	-	2	Black Board
5	a) Operational structure of NPOP, IPR and Patenting issues	-	2	Power Point
	b) Principles of biosafety, GMO and regulations	-	2	LMS (CANVAS)
	c) Organic products: Inspection and certification, Accredited certifying agents (National and International)	-	1	Black Board
	d) Quality assurance: logo and labeling and marketing.	-	1	Discussion

Blue Print – Model for External Examination

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

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

K1 - Remembering and recalling facts with specific answers

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

K3- Application oriented – Solving Problems

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

Distribution of Section- wise marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	**Total Marks**	% of Marks without choice	**Consolidated**
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K3	-	-	20	30	**50**	41.67	**42%**
K4	-	-	10	10	**20**	16.67	**16%**
Total Marks	10	10	50	50	**120**	100.00	**100%**

Blue Print – Model for Internal Examination

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

Sl. No	CLOs	K- Level	Section – A		Section – B		Section C (Either/ Choice)	Section D (Open Choice)	Total
			MCQs		Short Answer				
			No. of Questions	K – Level	No. of Questions	K - Level			
1	CLO x	Up to K 4	2	K1&K2	2	K1& K2	2(K2&K2)	1 (K2/K3)	
2	CLO y	Up to K 4	2	K1&K2	1	K2	2(K3&K3)	2 (K3& K4)	
No. of Question to be asked			4		3		4	3	14
No. of Question to be answered			4		2		2	2	10
Mark for each question			1		2		5	10	
Total Marks for each section			4		6		10	20	40

K1 - Remembering and recalling facts with specific answers
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K3	-	-	10	10	**20**	33.33	**33**
K4	-	-		10	**10**	16.67	**17**
Total Marks	4	6	20	30	**60**	100.00	**100%**