A.V.V.M. Sri Pushpam College (Autonomous), Poondi – 613 503

PG & Research Department of Botany

M.Sc. Programme in Botany

OUTCOME BASED EDUCATION - CHOICE BASED CREDIT SYSTEM

SCHEME OF PROGRAMME AND SYLLABUS

(For the candidates admitted from 2023-2024 onwards)

Vision and Mission of the college

Vision

To provide quality academic programmes and value oriented higher education to the rural community, equip them to encounter current regional, national and global demands upholding moral standards and intellectual competency.

Mission

- To provide conducive environment for quality teaching-learning process and innovative research.
- To bestow substantial educational experience that is intellectually, socially, and personally transformative.
- To strive to bring out the latent potentiality and core competency of the learners
- To foster the culture of research-based learning, independent academic inquiry by encouraging the students to involve in research activities ranging from hands on training, student projects, publications etc.,
- To nurture essential skills, competent minds and compassionate hearts.
- To impart a practical, demanding and overall development of the personality generated by love, consideration and care for the society.
- To serve the society by extending needful outreach programmes to the rural populace.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

- Make the learners realise the transformative power of education.
- Acquire profound disciplinary, applied, integrative knowledge and intellectual competency and domain specific and generic skills.
- Pursue lifelong learning and generate innovative solutions for the problems at individual and social level.
- Create a collaborative and inclusive environment, and serve the betterment of the society with moral integrity.
- Motivate to become a committed professional with necessary ethics as a leader as well as a team player.

Introduction: PO & PSO

Programme Outcome, Programme Specific Outcome and Course Outcome

Students completing this programme will be able to present their core post-graduate discipline clearly and precisely, make abstract ideas precise by formulating them in the language of the specific discipline, describe related ideas from multiple perspectives and explain fundamental concepts. Completion of this programme will also enable the learners to join teaching profession, enhance their employability for government jobs, jobs in various other public and private enterprises.

PROGRAMME OUTCOMES for M.Sc., Botany Programme

PO1: Disciplinary Knowledge: Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form part of Post graduate programmes 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 earning to real-life situations.

PO4: Analytical & Scientific 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: Research related skills: Ability to analyze, interpret and draw conclusions from quantitative / qualitative data; and critically evaluate ideas, evidence, and experiences from an open-minded and reasoned research perspective; develop sense of inquiry and capability for asking relevant questions / problem arising / synthesizing / articulating / ability to recognize cause and effect relationships / define problems. Formulate hypothesis, Test / analyze / Interpret the results and derive conclusions.

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 for M.Sc., Botany Programme

PSO1: Acquire good knowledge and understanding, to solve specific theoretical and applied problems in different areas of the specific discipline of study.

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

PSO3: To prepare the students who will demonstrate respectful engagement with other's ideas, behaviors, beliefs and apply diverse frames of references to decisions and actions. To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations. To encourage practices grounded in research that comply with employment laws, leading the organization towards growth and development.

Curriculum Structure for PG Programmes (OBE- CBCS) - 2023

	Nature of Course	Total No. of Courses	Total marks	Total credits	Total credits for the Programme
Part – A	Core Course	13	1300	51	80 (CGPA)
	Elective Course	05	500	15	
	Extra Disciplinary Course	01	100	3	
	Core Industry Module (CIM)	01	100	3	
Part – B (i)	Skill Enhancement Course (SEC)	04	400	8	
Part – B (ii)	Ability Enhancement Compulsory Course (AECC) – Soft Skill	04	400	8	10 (Non CGPA)
	Internship / Industrial Activity	--	--	2	
	Total	**28**	**2800**	**90**	**90**
Value Added Course (VAC)		01	100	--	
Extra Credit Course - **MOOC / Field visit / Hands on Training**		--	--	Max: 4	

Part A component and Part B (i) will be taken into account for CGPA calculation for the postgraduate programme and the other components Part B and Part C have to be completed during the duration of the programme as per the norms, to be eligible for obtaining the PG degree

Course Structure: M.Sc. BOTANY (2023)

S. No.	Semester	Category	Course Code	Title of the Course	Maximum Marks			Minimum Marks for Pass			Hours/ Week	Credits
					CIA	EE	Total	CIA	EE	Total		
1	I	Core	23P1BOC1	Plant Diversity-I Algae, Fungi, Lichens and Bryophytes	25	75	100	10	30	50	5	4
2		Core	23P1BOC2	Plant Diversity-II: Pteridophytes, Gymnosperms and Paleobotany	25	75	100	10	30	50	5	4
3		Core	23P1BOCP1	Practical I: Plant Diversity-I and Plant Diversity - II	25	75	100	10	30	50	6	4
4		Elective 1	23P1BOEL1A/ 23P1BOEL1B	Microbiology, immunology and Plant Pathology/ Mushroom cultivation	25	75	100	10	30	50	5	3
5		Elective 2	23P1BOEL2A/ 23P1BOEL2B	Horticulture/ Herbal Technology	25	75	100	10	30	50	5	3
6		SEC 1	23P1BOSEC1	Nursery and Gardening	25	75	100	10	30	50	2	2
7		AECC 1	23P1BOAECC1	Communicative Skill and Personality Development	25	75	100	10	30	50	2	2
		Extra Credit	Field visit / Hands on Training		-	-	-	-	-	-	-	-
8	II	Core	23P2BOC3	Taxonomy of Angiosperms, Ecology and Phytogeography	25	75	100	10	30	50	5	4
9		Core	23P2BOC4	Plant Anatomy and Embryology of Angiosperms	25	75	100	10	30	50	5	4
10		Core	23P2BOCP2	Practical II: Taxonomy of Ecology and Phytogeography; Plant Anatomyand Embryology of Angiosperms	25	75	100	10	30	50	6	4
11		Elective 3	23P2BOEL3A/ 23P2BOEL3B	Medicinal Botany/ Biopesticide Technology	25	75	100	10	30	50	5	3
12		Elective 4	23P2BOEL4A/ 23P2BOEL4B	Nanobiotechnology/ Applied bioinformatics	25	75	100	10	30	50	5	3
13		SEC 2	23P2BOSEC2	Agriculture and Food Microbiology	25	75	100	10	30	50	2	2
14		AECC 2	23P2BOAECC2	Language Lab	25	75	100	10	30	50	2	2

S. No.	Semester	Category	Course Code	Title of the Course	Maximum Marks			Minimum Marks for Pass			Hours/ Week	Credits
					CIA	EE	Total	CIA	EE	Total		
15	III	Core	23P3BOC5	Cell Biology, Genetics and Plant Breeding	25	75	100	10	30	50	6	4
16		Core	23P3BOC6	Molecular Biology and Recombinant DNA technology	25	75	100	10	30	50	6	4
17		Core	23P3BOCP3	Practical III: Cell Biology, Genetics and Plant Breeding; Molecular Biology and Recombinant DNA technology	25	75	100	10	30	50	6	4
18		Core-CIM	23P3BOCIM	Industrial Module - Industrial Botany	25	75	100	10	30	50	4	3
19		EDC	23P3BOEDC	Entrepreneurial Opportunities in Botany	25	75	100	10	30	50	4	3
20		SEC 3	23P3BOSEC3	Plant Tissue Culture	25	75	100	10	30	50	2	2
21		AECC 3	23P3BOAECC3	Research Methodology	25	75	100	10	30	50	2	2
		Internship / Industrial Activity (Carried out in summer vacation at the end of I Year – 30 hours)									-	2
		Extra Credit	MOOC (Massive open online course)		-	-	-	-	-	-	-	-
22	IV	Core	23P4BOC7	Plant Physiology and Plant metabolism	25	75	100	10	30	50	6	4
23		Core	23P4BOC8	Biochemistry and Applied Biotechnology	25	75	100	10	30	50	6	4
24		Core	23P4BOCP4	Practical IV: Plant Physiology and Plant metabolism; Biochemistry and Applied Biotechnology	25	75	100	10	30	50	6	4
25		Elective 5	23P4BOEL5A/ 23P4BOEL5B	Forestry and Wood Technology/ Organic farming	25	75	100	10	30	50	5	3
26		Core	23P4BOC9PR	Project with Viva Voce	25	75	100	10	30	50	3	3
27		SEC 4	23P4BOSEC4	Botany for Advanced Research	25	75	100	10	30	50	2	2
28		AECC 4	23P4BOAECC4	Comprehensive Knowledge	-	100	100	-	-	50	2	2
				Total			**2800**					**90**
		Value Added Course		Herbal Products	-	100	100	-	50	50	SS	-
		Extra Credit	MOOC (Massive open online course)		-	-	-	-	-	-	-	-

Internship/ Industrial Activity:

Students must complete in-plant training in any industry or organization where a programme-related procedure is being used, and this training must be done during the summer vacation at the end of I Year. A minimum of 30 hours should be spent on training. Students must submit a report on their training together with a certificate from the relevant industry or organization authority.

Ability Enhancement Compulsory Course (AECC): (Communicative Skill and Personality Development, Language Lab, Research Methodology and Comprehensive Knowledge)

Mode of Assessment for these courses is Viva-Voce examination.

Components of Evaluation:

Internal Marks : 25
External Marks : 75
Total 100

Field visit / Hands on Training:

In order to achieve experiential learning, these programmes with a minimum of 15 hours of contact time are offered as Extra Credit Courses in the I Semester.

Evaluation of visit report will be held at the end of II Semester.

Components of Evaluation:

Internal Marks 25
External Marks 75
Total 100

MOOC: Massive Open Online Course is offered in the III and IV Semester as an Extra Credit Course. Students can avail any one or more of the courses available in MOOC to equip their skill and knowledge themselves. To receive the extra credit, students must provide their MOOC course completion certificate at the end of the second year.

Skill Enhancement courses (SEC) offered by the Botany Department

1. Nursery and Gardening
2. Agriculture and Food Microbiology
3. Professional Communication Skill
4. Botany for Advanced Research

Extra Disciplinary Course (EDC) offered by the Botany Department: "Entrepreneurial Opportunities in Botany"

Value Added Course offered by the Botany Department:

"Herbal Products" will be conducted for II PG students as a certificate Course.
Entrepreneurial Opportunities in Botany

A. VEERIYA VANDAYAR MEMORIAL SRI PUSHPAM COLLEGE (AUTONOMOUS), POONDI, THANJAVUR DIST.
(NAAC Re-Accredited with A grade in 4th cycle)
Question Pattern for UG and PG Programmes (For the students admitted from 2023 – 2024 onwards)

Bloom's Taxonomy based Assessment pattern

Bloom's category	Section	Choice	Marks	Total
K1 to K6	A	Compulsory	10 x 2 = 20	75
	B	Either / Or	5 x 5 = 25	
	C	3 out of 5	3 x 10 = 30	

SECTION – A (10 x 2 = 20)
Answer All the questions (Two Questions from each units)

CO	K Level	Q. No.	Questions
		1.	
		2.	
		3.	
		4.	
		5.	
		6.	
		7.	
		8.	
		9.	
		10.	

SECTION – B (5 x 5 = 25)
Answer All the questions (One Question from each unit)

		11(a).	
(OR)			
		11(b).	
		12(a).	
(OR)			
		12(b).	
		13(a).	
(OR)			
		13(b).	
		14(a).	
(OR)			
		14(b).	
		15(a).	
(OR)			
		15(b).	

SECTION – C (3 x 10 = 30)
Answer ANY THREE questions (One Question from each unit)

		16.	
		17.	
		18.	
		19.	
		20.	

M.Sc. Botany

OBE QUESTION PATTERN

Bloom's Taxonomy Action Verbs

K1 Remember	K2 Understand	K3 Apply	K4 Analyze	K5 Evaluate	K6 Create
• Choose • Copy • Define • Describe • Discover • Duplicate • Enumerate • Examine • Find • How • Identify • Label • List • Locate • Match • Memorize • Name • Omit • Recall • Recognize • Relate • Select • Show • Spell • State • Tabulate • Tell • What • When • Where • Which • Who • Why	• Associate • Classify • Compare • Contrast • Convert • Demonstrate • Describe • Differentiate • Discuss • Distinguish • Estimate • Explain • Express • Extend • Identify • Illustrate • Indicate • Infer • Interpret • Outline • Paraphrase • Predict • Relate • Rephrase • Show • Summarize • Translate	• Apply • Build • Calculate • Change • Choose • Complete • Construct • Demonstrate • Develop • Discover • Dramatize • Experiment • Identify • Interview • Interpret • Illustrate • Make use of • Manipulate • Model • Modify • Organize • Paint • Plan • Prepare • Produce • Relate • Select • Show • Sketch • Solve • Use • Utilize	• Advertise • Appraise • Analyze • Assume • Break down • Categorize • Classify • Compare • Conclusion • Connect • Contrast • Differentiate • Discover • Dissect • Distinguish • Discriminate • Divide • Examine • Explain • Function • Inference • Inspect • List • Motive • Order • Point out • Prioritize • Relationships • Select • Separate • Simplify • Subdivide • Survey • Take part in • Test for • Theme	• Agree • Appraise • Assess • Award • Choose • Compare • Conclude • Convince • Criteria • Criticize • Decide • Deduct • Defend • Determine • Discriminate • Estimate • Evaluate • Explain • Find errors • Grade • Importance • Influence • Interpret • Judge • Justify • Mark • Measure • Order • Predict • Prioritize • Prove • Rank • Rate • Recommend • Reframe • Select • Summarize • Support • Value	• Adapt • Build • Change • Choose • Combine • Compile • Compose • Construct • Create • Design • Develop • Discuss • Elaborate • Estimate • Formulate • Generalize • Hypothesize • Imagine • Improve • Integrate • Invent • Make up • Maximize • Minimize • Modify • Originate • Organize • Plan • Predict • Prepare • Produce • Propose • Rearrange • Rewrite • Role-play • Solution • Solve • Substitute • Write

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
I	**23P1BOC1**	**PLANT DIVERSITY I (Algae, Fungi, Lichens and Bryophytes)**	**5**	**4**

Nature of the course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented	√	Relevant to Regional need	√	Addresses Environment and Sustainability	
Skill development Oriented		Relevant to National need	√	Addresses Human Values	√
		Relevant to Global development need		Addresses Professional Ethics	

Course Objectives

The main objectives of this course are:

1. To understand the classification, range of thallus structure, reproduction methods and life cycle patterns of lower plants.
2. To gain knowledge about the ecological importance of algae, fungi, lichensand bryophytes.
3. To learn various culture techniques for growing freshwater and marine algae in laboratory condition.
4. To know the classification range of structural variations in gametophytes, sporophytes,
5. To understand economic importance of Algae, Fungi Lichens and Bryophytes.

SYLLABUS

Unit	Content	No. of Hours
I	**ALGAE:** General account of algology, Contributions of Indian Phycologist (T.V.Desikachary, V.Krishnamurthy and V.S. Sundaralingam), Classification of algae by F.E. Fritsch (1935-45). Salient features of major classes: Cyanophyceae, Chlorophyceae, Xanthophyceae, Chrysophyceae, Cryptophyceae, Dinophyceae, Chloromonadineae, Euglenophyceae, Charophyceae, Bacillariophyceae, Phaeophyceae and Rhodophyceae. Range of thallus organization, algae of diverse habitats, reproduction (vegetative, asexual and sexual) and life cycles. Phylogeny and inter-relationships of algae, origin and evolution of sex in algae. Structure, reproduction and life histories of the following genera: *Oscillatoria*, *Scytonema, Ulva, Codium, Diatoms, Dictyota* and *Gelidium.*	15

II	**FUNGI:** General Characteristics, occurrence and distribution. Mode of nutrition in fungi. Contributions of Indian Mycologists (C.V.Subramanian), Classification of Fungi by Alexopoulos and Mims (1979) & Recent trends in the classification of fungi - Phylogeny and inter-relationships of major groups of fungi. General characters of major classes: Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina. Heterothallism in fungi, sexuality in fungi, Para sexuality, sex hormones in fungi. Structure, reproduction and life histories of the following genera: *Plasmodiophora, Phytophthora, Rhizopus, Taphrina, Polyporus* & *Colletotrichum.*	15
III	**LICHENS:** Introduction and Classification (Hale, 1969). Occurrence and inter-relationship of phycobionts and mycobionts, structure and reproduction in Ascolichens, Basiodiolichens and Deuterolichens.	15
IV	**BRYOPHYTES:** General characters and Classification of Bryophytes by Watson (1971). Distribution, Structural variations and evolution of gametophytes and sporophytes in Hepoticopsida Anthocerotopsida and Bryopsida. General characters of major groups - Marchantiales, Anthocerotales, Sphagnales, Funariales and Polytrichales. Reproduction - Vegetative and sexual, spore dispersal mechanisms in bryophytes, spore germination patterns in bryophytes. Structure, reproduction and life histories of the following genera: *Targionia, Marchantia, Porella* and *Polytrichum.*	15
V	**ECONOMIC IMPORTANCE:** Algae - Economic importance in Food and feed - Single cell protein, Industrial products (Agar-Agar, Carrageenan, Alginic acid, Iodine, biofertilizers, Vitamins and biofuel), Medicinal value and Diatomaceous earth. Fungi – Economic importance in food, industries and medicine. Culturing and cultivation of mushrooms - *Pleurotus.* Lichen – economic importance and as indicator pollution. Bryophytes – Ecological and economic importance – industry, horticulture and medicine.	15

Textbook:

1. Kumar, H.D. and Singh, H.N., (1971). A text book of Algae. East West Press Pvt. Ltd., New Delhi.
2. Vasisthta, B.R., (1977). Botany for Degree students- Part –I. Algae. S. Chand and company Ltd. Ram Nagar, New Delhi
3. Gangulee and Kar, College Botany, Vol. II, New Central Book Agency, Calcutta.
4. Parihar, N.S., (1957). An Introduction to Bryophyta. Central Book Depot, Allahabad.
5. Vijayakumar, S., (2020). Introduction to Applied Phycology. Mayas Publication. Tamil Nadu.
6. Sharma, O.P. 2014. Bryophyta, Mcgraw Hill, ISBN: 9781259062872, 1259062872

7. Singh, Pandey and Jain. 2020. A text book of Botany, 5th Edition, Rastogi Publication, Meerut.

References:

1. Bold, H.C. and Wynne, M.J., (1978). Introduction of Algae-structure and reproduction, Prentice Hall, New Jersey.
2. Alexopoulos, C.J., (1973). Introductory Mycology. Wiley Eastern Private Ltd., New York.

Web resources:

1. https://youtu.be/1P1yggEZm9w
2. https://youtu.be/MbXH-qJ3hT8
3. https://youtu.be/hBHAVnupcak
4. https://youtu.be/GkFFuj4V9ws
5. https://youtu.be/czBdDUL_xSg

Pedagogy: Teaching / Learning methods

Lecture, Tutorial, Assignment, PPT presentation, Quiz, Group Discussion, e-content Seminar)

Course Outcomes

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

Course outcomes: CO	On completion of this course the student will be able to CO statement	Programme outcomes
CO1	Relate to the structural organizations of algae, fungi, lichens and Bryophytes.	K1
CO2	Demonstrate both the theoretical and practical knowledge in understanding the diversity of basic life forms and their importance.	K2
CO3	Explain life cycle patterns in algae, fungi, lichens and Bryophytes.	K3
CO4	Compare and contrast the mode of reproduction in diverse groups of basic plant forms.	K4
CO5	Discuss and develop skills for effective conservation and utilization of lower plant forms.	K5 & K6

Cognitive Level: K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	3	2	3	2	1	2	2	2	2
CO2	3	3	2	2	3	3	2	3	2	3
CO3	2	2	3	3	1	2	1	3	1	3
CO4	3	3	3	3	3	2	3	3	3	3
CO5	3	3	2	3	2	3	3	3	3	3

S-Strong (3) M-Medium (2) L-Low (1)

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
I	**23P1BOC2**	**PLANT DIVERSITY II (Pteridophytes, Gymnosperms and Paleobotany)**	**5**	**4**

Nature of the course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented		Relevant to Regional need		Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to National need	√	Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	√

Course Objectives

The main objectives of this course are :

1. To know the classification, salient features of Pteridophytes and Gymnosperms
2. To study the stelar evolution of pteridophytes.
3. To study of the morphology, sporophyte and gametophyte of Pteridophytes and Gymnosperms
4. To understand economic importance of Pteridophytes and Gymnosperms
5. To study the concept of fossils and fossilization.

SYLLABUS

Unit	Content	No. of Hours
I	**PTERIDOPHYTES:** General characteristics and classification (K.R. Sporne, 1975). Range of structure, reproduction and evolution of the gametophytes, Gametophyte types – sex organs. Apogamy and Apospory. Life cycles. Stelar evolution. Heterospory and seed habit, Telome theory, morphogenesis, Economic importance of Pteridophytes.	15
II	**PTERIDOPHYTES:** Structure, reproduction and life cycle of the following genera: A*ngiopteris, Osmunda, Pteris, Azolla, Salvinia, Adiantum, Gleichenia* and *Hymenophyllum.*	15
III	**GYMNOSPERMS:** General characters - distribution - phylogeny and classification (K.R.Sporne, 1965). Morphology, anatomy, reproduction of Lyginopteridaceae, Medullosaceae, Williamosoniaceae and Pentoxylaceae. Economic importance of Gymnosperms.	15

IV	**GYMNOSPERMS:** Structure (Exomorphic and endomorphic), anatomy, reproduction and life cycle of the following genera: *Taxus, Cupressus, Araucaria, Podocarpus, Gnetum* and *Ephedra*. *Pinus* and *Ginkgo*.	15
V	**PALEOBOTANY:** Geological Scale; Radiocarbon dating; Contribution of Birbal Sahni to Paleobotany. Gondwana flora of India. Study of fossils in understanding evolution. Fossilization and fossil types. Economic importance of fossils – fossil fuels and industrial raw materials. Study of fossils genera: *Rhynia, Lepidocarpon, Calamites, Cordaites* and *Lyginopteris.*	15

Recommended Text:

1. Vashishta, P.C. Sinha, A.K and Anil Kumar. 2016. Botany for Degree students. Gymnosperms. S. Chand and Company Ltd., New Delhi.
2. Singh, V., Pande, P.C and Jain, D.K. 2021. A Text Book of Botany. Rastogi Publications, Meerut.
3. Bhatnagar, S.P and Alok Moitra. 2020. Gymnosperms, New Age International (P) Ltd., Publishers, Bengaluru.
4. Sharma, O.P. 2017. Pteridophyta, McGraw Hill Education, New York.
5. Vashishta. P.C., A.K. Sinha and Anil Kumar. 2018. Botany for Degree students - Gymnosperms. S. Chand and Company Ltd., New Delhi.
6. Johri, R.M, Lata, S, Tyagi, K. 2005. A text book of Gymnosperms, Dominate pub and Distributer, New Delhi.

Reference books:

1. Parihar, N.S. 2019. An Introduction to Embryophyta Pteridophytes. 5th Edition, Surjeet Publication, Delhi.
2. Pandey, S.N and Trivedi, P.S. 2015. A Text Book of Botany Vol. II- 12 th edition (Paper back), Vikas Publishing.
3. Rashid, A. 2013. An introduction to Pteridophyta – Diversity, Development and differentiation (2nd edition), Vikas Publications.
4. Arnold A.C. 2005. An Introduction to Paleobotany. Agrobios (India). Jodhpur.
5. Sporne, K.R. 2017. The morphology of Pteridophytes (The structure of Ferns and Allied Plants) (Paper back), Andesite Press.
6. Sporne, K.R. 1967. The Morphology of Gymnosperms. Hutchinson & Co., London.
7. Taylor, E, Taylor, T, Krings, M. 2008. Paleobotany: The Biology and Evolution of FossilPlants, 2nd Edition, Academic Press.

Web resources:

1. https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/
2. http://www.bsienvis.nic.in/Database/Pteridophytes-in-India_23432.aspx
3. https://books.google.co.in/books/about/Gymnosperms.html?id=4dvyNckni8wC

4. https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine-cones-an-introduction-to-gymnosperms.pdf
5. https://www.palaeontologyonline.com/

Pedagogy: Teaching / Learning methods

(Please mention teaching / Learning methods like Lecture, Tutorial, Assignment, PPT presentation, Quiz, Group Discussion, e-content Seminar etc.)

Course Outcomes

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

Course outcomes	On completion of this course the student will be able to	Programme outcomes
CO1	Recall on classification, recent trends in phylogenetic relationship,general characters of Pteridophytes and Gymnosperms.	K1 & K3
CO2	Learn the morphological/anatomical organization, life history of major types of Pteridophytes and Gymnosperms.	K3 & K4
CO3	Comprehend the economic importance of Pteridophytes, Gymnosperms, and fossils.	K3 & K5
CO4	Understanding the evolutionary relationship of Pteridophytes and Gymnosperms.	K2
CO5	wareness on fossil types, fossilization and fossil records of Pteridophytes and Gymnosperms.	K1 & K3

Cognitive Level: K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	3	3	3
CO 2	3	3	3	3	3	3	3	3	3	3
CO 3	2	3	3	3	3	1	3	3	3	3
CO 4	3	3	2	3	3	3	3	2	3	2
CO 5	3	2	2	2	2	2	2	1	2	1

S-Strong (3) **M-Medium (2)** **L-Low(1)**

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
I	**23P1BOCP1**	**PRACTICAL – I** **Plant Diversity-I and Plant Diversity - II**	**6**	**4**

Nature of the course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented		Relevant to Regional need		Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to National need	√	Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	√

Course Objectives

The main objectives of this course are:

1. To learn how to employ the use of instruments, technologies and methodologies related to thallophytes and non-flowering plant groups
2. To enhance information on the identification of each taxonomical group by developing the skill-based detection of the morphology and microstructure of algae, and fungi.
3. To comprehend the fundamental concepts and methods used to identify bryophytes, pteridophytes and gymnosperms through morphological changes and evolution, anatomy and reproduction.
4. To develop the technical abilities in staining, sectioning, sterilizing, and characterizing. thallophytes, and other varieties of non-flowering plants.
5. To compare the structural diversity of fossil and extant plant species.

SYLLABUS

Units	Content	No. of Hours
I	**ALGAE** Study of algae in the field and laboratory of the genera included in theory. External morphology and internal anatomy of the vegetative and reproductive structures of the following living forms: *Oscillatoria*, *Scytonema, Ulva, Codium, Diatoms, Dictyota* and *Gelidium* (depending on availability of the specimen). To record the local algal flora–Study of their morphology and structure.	18

	Identification of algae to species level (at least One). Preparation of culture media and culture of green algae and blue green algae in the laboratory (Demonstration).	
II	**FUNGI** Study of morphological and reproductive structures of the following living forms: *Plasmodiophora, Phytophthora, Rhizopus, Taphrina, Polyporus* and *Colletotrichum*. Isolation and identification of fungi from soil, air, and Baiting method. Preparation of culture media. Cultivation of mushroom in the laboratory (Demonstration). **LICHENS** Study of morphological and reproductive structures of the genera *Parmelia.*	18
III	**BRYOPHYTES** External morphology and internal anatomy of the vegetative and reproductive organs of the following living forms: *Targionia, Marchantia, Porella* and *Polytrichum* (depending on availability of the specimen).	18
IV	**PTERIDOPHYTES** External morphology and internal anatomy of the vegetative and reproductive organs of the following living forms: *Angiopteris, Osmunda, Pteris, Azolla, Salvinia, Adiantum, Gleichenia and Hymenophyllum*. Fossil slides observation: *Rhynia, Lepidocarpon, Calamites.*	18
V	**GYMNOSPERMS** External morphology and internal anatomy of the vegetative and reproductive organs of the following living forms: *Taxus Cupressus, Araucaria, Podocarpus, Gnetum, Ephedra. Pinus and Ginkgo*. Fossil slides observation*: Cordaites, Lyginopteris, Medullosa, Williamsonia, Pentoxylon*	18

Recommended Text:

1. Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi.
2. Das, S and Saha, R. 2020. Microbiology Practical Manual. CBS Publishers andDistributors (P) Ltd., New Delhi, India.
3. Sharma, O.P. 2012. Pteridophyta, Tata McGraw-Hills Ltd, New Delhi.
4. Sharma O.P and S, Dixit. 2002. Gymnosperms. Pragati Prakashan.
5. Johri, R.M, Lata, S, Tyagi, K. 2005. A text book of Gymnosperms, Dominate pub and Distributer, New Delhi.

Reference Books:

1. Chmielewski, J.G and Krayesky, D. 2013. General Botany laboratory Manual. Author House, Bloomington, USA.

2. Webster, J and Weber, R. 2007. Introduction to Fungi, 3rd Ed. Cambridge University Press, Cambridge.
3. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd, New Delhi.
4. Ashok, M. Bendre and Kumar. 2010. A text book of Practical Botany, Algae, Fungi, Lichen, Bryophyta, Pteridophyta, Gymnosperms and Palaeobotany. Revised edition. Published by Rakesh Kumar Rastogi publication.
5. Gangulee, H.C and A.K. Kar. 2013. College Botany. Vth Edition. S. Chand.

Web resources:

1.https://www.frontiersin.org/articles/10.3389/fmicb.2017.00923/full
2.https://microbiologyonline.org/file/7926d7789d8a2f7b2075109f68c3175e.pdf
3.http://www.cuteri.eu/microbiologia/manuale_microbiologia_pratica.pdf

Pedagogy: Teaching / Learning methods

(Please mention teaching / Learning methods like Lecture, Tutorial, Assignment, PPT presentation, Quiz, Group Discussion, e-content Seminar etc.)

Course Outcomes

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

Course outcomes:	**\On completion of this course the student will be able to**	**Programme outcomes**
CO1	Recall and applying the basic keys to distinguish at species level identification of important algae and fungi through its structural organizations.	K1 & K4
CO2	Demonstrate practical skills in thallophytes, Pteridophytes and Gymnosperms.	K2
CO3	Structure of algae, fungi, lichens, Bryophytes, Pteridophytes and Gymnosperms.	K3
CO4	Determine the importance of structural diversity in the evolution of plant forms.	K5
CO5	Formulate techniques to isolate and culture of alga and fungi as well as to understand the diversity of plant forms.	K5 & K6

Mapping with Programme Outcomes:

Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	2	3	3	3	3	3	3	3	3	3
CO2	3	3	2	3	3	3	1	3	1	3
CO3	3	3	3	3	3	3	2	3	2	3
CO4	3	3	2	1	2	2	1	2	1	3
CO5	3	3	3	3	3	3	3	2	3	2

S - Strong (3) **M - Medium (2)** **L – Low (1)**

Semester	Course Code	Course Title	Hours of Teaching/Cycle	No. of Credits
I	23P1BOEL1A	ELECTIVE - I MICROBIOLOGY, IMMUNOLOGY AND PLANT PATHOLOGY	5	3

Nature of the course

Employability Oriented	√	Relevant to Local need	√	Addresses Gender Sensitization	
Entrepreneurship Oriented		Relevant to Regional need		Addresses Environment and Sustainability	√
Skill development Oriented	√	Relevant to National need	√	Addresses Human Values	√
		Relevant to Global development need	√	Addresses Professional Ethics	

Course Objectives

The main objectives of this course are:

1. To Provide students with basic understanding of microbiology, immunology, plant pathologyand the etiology of specific plant diseases.
2. To Provide comprehensive knowledge about microbes and its effect on man and environment.
3. To Provide comparative analysis of major groups of microbes.
4. To Study the principles of immune system, immunizing agents like antibodies and vaccines andgene therapy methods.
5. To Enhance the knowledge and skills needed for self-employment using the microbial derivedproducts.

SYLLABUS

Unit	Content	No. of Hours
I	**BACTERIA:** Types of microorganisms. General characteristic of bacteria – Outline classification of Bergey's manual (9^{th} edition). Classification of bacteria based on morphological, cultural, physiological and molecular characteristics. Bacterial growth – batch culture and continuous culture. Factors affecting growth. Determination of bacterial growth – Direct method: Haemocytometer, Viable plate count; Indirect method: Turbidity. Nutritional types. Reproduction - Fission and sporulation, - Transformation, Transduction and Conjugation. Isolation and cultivation of bacteria. Maintenance of bacterial culture.	15

II	**VIRUSES:** General characters, Classification, Structure, Multiplication. Overview of Phycoviruses and Mycoviruses. Viruses of Eukaryotes – Animal & Plant viruses. Cultivation of viruses – in embryonated egg and in plants. Control of viral infections. Bacteriophages- classification, replication of DNA and RNA phages -Lytic and Lysogenic cycle. Viroids and prions. Mycoplasma: Structure and classification.	15
III	**IMMUNOLOGY:** Introduction; Immune System; Types of Immunity - Innate and Acquired.Immune Cells - Hematopoiesis, B and T lymphocytes - Antigen: Definition, Properties and types. Antibody – Structure, types and function. Generation of antibody diversity. Antigen - Antibody interactions: Agglutination, Complement fixation. Immune Response – Humoral and Cell Mediated. Vaccines – history, types and recombinant vaccines. Immunodiagnosis – Blood Grouping, Enzyme-Linked Immunosorbent Assay (ELISA) and Immunoelectrophoresis.	15
IV	**PLANT PATHOLOGY I:** History and significance of plant pathology. Classification of plant diseases, Symptomology (important symptoms of plant pathogens). Principles of plant infection –Inoculum, inoculum potential, Pathogenicity. Disease triangle. Causal agents of plant diseases - biotic causes (fungi, bacteria virus, mycoplasma, nematodes, parasitic algae, angiospermic parasites - Abiotic causes (Physiological, deficiency of nutrients & minerals and pollution). Mechanism of penetration - Disease development of pathogen (colonization) and dissemination of pathogens. Role of enzymes and toxins in disease development. Defence mechanism of host – structural and biochemical defences.	15
V	**PLANT PATHOLOGY II:** Important diseases of crop plants in India; Diseases caused by bacteria (blight of paddy, black arm of cotton) - fungi (blast of paddy, red rot of sugarcane, tikka disease of groundnut) - Diseases caused by virus (bunchy top of banana and TMV) - Diseases caused by mycoplasma (*Citrus* stubborn, corn stunt); Principles of disease management – Cultural practices, physical, chemical and biological methods, diseases controlled by immunization. Integrated Pest Management system.	15

Recommended Text:

1. Singh, R.S. 2018. Introduction to Principles of Plant Pathology, 4th Edition.
2. Bilgrami, K.S and H.C. Dube. 2010 A text book of Modern Plant Pathology – Vikas Publishing House (P) Ltd., New Delhi
3. Mehrotra, R.S. and Aggarwal, A. 2017. Plant Pathology. McGraw Hill Publisher.
4. Dube, H.C. 2010. A text Book of Fungi, Bacteria and Viruses, 3rd Edition, Agrobios India, ISBN: 8188826383.
5. Vaman Rao, C. 2006. Immunology. 2nd Edition. Narosa Publisher.
6. Kenneth, M. 2017. Janeway's Immunobiology. 9th Edition. Garland Publisher.

Reference Books:

1. Agrios, A.G. 2007. Plant Pathology, Elsevier. ISBN: 9780120445653.
2. Jeffery, C., Pommerville. 2014. Alcamos Fundalmedals of Microbiology. 10th Edition. Johnsand Bartlett Learning.
3. Pelczar, M. J. 2007. Microbiology. 35th Edition, Tata-McGraw Hill Publications, New York, ISBN: 0074623260.
4. Ravi Chandra, N.G. 2013. Fundamentals of Plant Pathology, Phi Learning, ISBN:812034703X.
5. Willie, J. and Sherwood, L. 2016. Prescott's Microbiology McGraw-Hill Education; 10th Edition, ISBN: 978-1259281594
6. Chaube, H.S. and Singh, R. 2015. Introductory Plant Pathology CBS Publishers, ISBN: 978-8123926704.
7. Rangasamy, G. 2006. Disease of crop plants in India (4th edition). Tata Mc Graw Hill New Delhi.
8. Mishra, A., A. Bohra and A, Mishra. 2011. Plant Pathology-Disease and Management. Agro Bios, Jodhpur.

Web resources:

1. https://www.wileyindia.com/a-textbook-of-plant-pathology.html
2. https://www.britannica.com/science/plant-disease.
3. https://www.planetatural.com/pest-problem-solver/plant-disease/
4. https://www.elsevier.com/books/plant-pathology/agrios/978-0-08-047378-9
5. https://www.elsevier.com/life-sciences/immunology-and-microbiology/books
6. https://www.amazon.in/INTRODUCTION-IMMUNOLOGY-RAFIA-IMRAN-ebook/dp/B09B66SD3J

Pedagogy: Teaching / Learning methods

Lecture, Tutorial, Assignment, PPT presentation, Quiz, Group Discussion, e-content Seminar)

Course Outcomes

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

Course outcomes	On completion of this course the student will be able to	Programme outcomes
CO1	Recognize the general characteristics of microbes, plant defense and immune cells.	K1
CO2	Explain about the stages in disease development and various defense mechanisms in plants and humans.	K2
CO3	Elucidate concepts of microbial interactions with plant and humans.	K3
CO4	Analyze the importance of harmful and beneficial microbes and immune system	K4
CO5	Determine and interpret the detection of pathogens and appreciate their adaptive strategies.	K5 & K6

Cognitive Level: K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	2	3	2
CO2	3	3	2	2	3	3	2	1	2	1
CO3	3	3	3	3	3	3	1	3	1	3
CO4	3	3	2	2	3	3	2	1	2	1
CO5	3	3	3	3	3	3	3	2	3	2

S-Strong (3) M-Medium (2) L-Low (1)

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
1	**23P1BOEL1B**	**Elective - I MUSHROOM CULTIVATION**	**5**	**3**

Nature of the course

Employability Oriented	√	Relevant to Local need	√	Addresses Gender Sensitization	
Entrepreneurship Oriented	√	Relevant to Regional need		Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to National need		Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	√

Course Objectives

The main objectives of this course are to:

1. To teach the identification of mushrooms.
2. To differentiate the edible mushrooms with toxic and hallucinating fungi.
3. To study the cultivation technique of mushrooms
4. To learn the economic importance of mushroom in various fields.
5. To study how to establish mushroom cultivation as business enterprise.

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**INTRODUCTION:** Introduction to mushrooms - history, scope and importance mushroom cultivation; Edible Mushroom cultivation, commercial production, medicinal value of mushrooms, nutraceuticals and dietary supplements using mushrooms; Nutritive Value – proteins – amino acids, mineral elements, carbohydrates, Crude fiber content and vitamins of edible mushrooms.	15
II	**MORPHOLOGICAL AND MICROSCOPICAL IDENTIFICATION OF MUSHROOMS**: Keys for identification of edible mushrooms: *Agaricus bisporus*, *Pleurotus sajorcaju*, *Volvariella volvcea* and *Calocybe indica.* Key for identifying hallucinogenic mushroom (*Psilocybe* sp.) Medicinal Mushroom – *Cordyceps,* Identification of Poisonous Mushrooms, *Amanita phalloides, Conocybe silaris Ganoderma lucidum* and *Lentinus edodes.*	15

III	**CULTIVATION:** Substrate sterilization, bed preparation, cropping room and maintenance, raising of pure culture and spawn preparation, factors effecting button mushroom production (Temp, pH, air and water management, competitor moulds and other disease). Mushroom bed preparation – Paddy straw, sugarcane thrash, maize straw, banana leaves. Factors affecting the mushroom bed preparation - low cost technology, composting technology in Mushroom production.	15
IV	**POST-HARVEST MANAGEMENT:** Harvest, storage: Short-term storages (Refrigeration - upto 24 hrs); Long term storage (canning, pickles, papads), drying, storage in salt solutions, quality assurance of mushrooms. Pest management	15
V	**MARKETING OF MUSHROOMS:** World production edible mushroom, Legal and regulatory issues of introducing the medicinal mushrooms in different countries. Developing small scale industry and Government schemes. Mushroom Research Centres – National and International.	15

Textbook:

1. Marimuthu, T., Krishnamoorthy, A.S., Sivaprakasam, K. and Jayarajan, R., (1991). Oyster Mushrooms, Department of plant pathology, Tamil Nadu Agricultural University, Coimbatore.
2. Swaminathan, M., (1990). Food and Nutrition, Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore 560 018.
3. Tewari, PankajKapoor, S.C., (1988). Mushroom Cultivation, Mittal Publications Delhi.
4. Suman, B.C., Sharma V.P., (2007). Mushroom Cultivation in India. Daya Publication House.
5. Chang S.T. and Mies.P.G (2004). Mushroom Cultivation, Nutritional value, Medicinal effect and Environmental Impact (2nd Edition) CRC Press.

References:

1. Adegbeye, M.J. Ravi Kanth Reddy P, Obaisi A.I, Elghandour M.M.M.Y, Oyebamiji, K.J. Salem, A.Z.M. Morakinyo-Fasipe, O.T. Cipriano-Salazar, M. and Camacho-Díaz, L.M. 2020. Sustainable agriculture options for production, greenhouse gasses and pollution alleviation, and nutrient recycling in emerging and transitional nations - An overview, *Journal of Cleaner Production*, https://doi.org/10.1016/j.jclepro.2019.118319.
2. Gayathri, G., Gomathi, S., Ambikapathy, V., Panneerselvam, A., and Babu, S. (2023). Production, Cost Benefit Analysis and Marketing of Oyster Mushroom. In: Amaresan, N., Dharumadurai, D., Babalola, O.O. (eds) *Food Microbiology Based Entrepreneurship. Springer, Singapore.*https://doi.org/10.1007/978-981-19-5041-4_3.
3. Murray C. Tseng, John H. Luong, (1984). Chapter 3 - Mushroom Cultivation - Technology for Commercial Production, Editor(s): GEORGE T. TSAO, Annual Reports on Fermentation Processes, Elsevier, https://doi.org/10.1016/B978-0-12-040307-3.50008-1

4. Abirami, G., Gomathi, S., Ambikapathy, V., Gayathri, G., Shijila Rani, A.S., Panneerselvam, A. (2023). Small/Large Scale Production, Cost Benefits Analysis, and Marketing of Milky Mushroom. In: Amaresan, N., Dharumadurai, D., Babalola, O.O. (eds) *Food Microbiology Based Entrepreneurship. Springer, Singapore*. https://doi.org/10.1007/978-981-19-5041-4_5.

Web resources:

1. https://agricoop.nic.in/sites/default/files/ICAR_8.pdf
2. https://www.mycoiq.com/mushroom-technology
3. https://www.academia.edu/11324578/Mushroom_Production_and_Processing_Teaching_Note_
4. https://books.google.co.in/books/about/Mushroom_Cultivation_Technology.html?id=OfKJDwAAQBAJ&redir_esc=y
5. https://www.biologydiscussion.com/fungi/mushrooms-meaning-values-and-cultivation-procedure/46635

Pedagogy:

Lecture, Tutorial, Assignment, PPT presentation, Quiz, Group Discussion, e-content Seminar.

Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	Knowledge on identification of edible and toxic mushrooms Belonging to Ascomycota and Basidiomycota.	**K1**
CO2	Outline the nutraceutical properties of edible mushrooms.	**K2**
CO3	Knowledge on cultivation techniques of edible and medicinal mushrooms.	**K3**
CO4	Understand the harvest and post-harvest techniques of mushroom crops.	**K4**
CO5	Knowledge on the production and marketing strategies for mushrooms.	**K5**

Cognitive Level: K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	2	2
CO2	3	3	2	2	3	3	2	3	2	3
CO3	3	3	2	2	1	3	1	3	1	2
CO4	3	3	3	3	3	2	3	3	3	3
CO5	3	3	2	3	2	3	3	3	3	3

S-Strong (3) **M-Medium (2)** **L-Low(1)**

Semester	Course Code	Course Title	Hours of Teaching /Cycle	No. of Credits
I	**23P1BOEL2A**	**ELECTIVE II - HORTICULTURE**	**5**	**3**

Nature of the course

Employability Oriented	√	Relevant to Local need	√	Addresses Gender Sensitization	√
Entrepreneurship Oriented	√	Relevant to Regional need		Addresses Environment and Sustainability	√
Skill development Oriented	√	Relevant to National need		Addresses Human Values	
		Relevant to Global development need		Addresses Professional Ethics	

Course Objectives

The main objectives of this course are to:

1. Know about the brief history, divisions, classification and structure of horticultural plants.
2. Acquire knowledge on plant growth processes and stages of plant growth. Understand the arts of floriculture and landscape gardening
3. Understand the plant growth environment in relation to soil, nutrients, fertilizers, and bio inoculants.
4. Study the sexual and vegetative propagation methods including propagation through specialized vegetative structures.
5. Develop practical skills in micro propagation techniques and soil-less production of horticultural crops.

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**INTRODUCTION TO HORTICULTURE:** Definition; Brief History, Divisions of Horticulture, Classification of horticultural plants – Water irrigation -Roof gardening; Green house and shade house – Role of horticulture in allied industries – Employment opportunities in horticulture – Horticultural therapy – Role of computers and internet in horticulture - GIS and GPS applications. Horticulture institutes in India	15
II	**FACTORS AFFECTING PLANT GROWTH:** Abiotic factors, Soil –Profile structure, Primaryand Secondary nutrients and their functions, Organic matter, Fertilizers – organic, Inorganic and	15

	Potting Media, Bio inoculants, Methods of fertilizerapplication, Directing Plant growth - Training -Pruning and thinning.	
III	**PLANT PROPAGATION:** Seed germination, Viability, Mechanism of Dormancy and Dormancy Breaking: Methods of Direct and Indirect Seedling Production in Nurseries and Transplantation; Propagation through specialized underground structures – Corm, Tuber, Sucker, Bulb, Bulbil, Rhizome; Plant propagation methods – cutting, layering, grafting, budding, stock - scion relationship	15
IV	**MICROPROPAGATION TECHNIQUES:** Stages, multiplication by shoot tip, Nodal culture and Callus culture-Application and Limitations, Somatic embryogenesis, Synthetic seeds – Preparation and Potential uses of artificial seeds, Embryo Rescue, Soil-less Production of Horticultural crops – Hydroponics, sand culture, gravel culture.	15
V	**AESTHETICS OF HORTICULTURE:** Design: Elements and Principles of Design, Flower Arrangement, Terrarium Culture, Bonsai, Growing Plants in Indoors, Turf Production, Lawn making and its maintenance - Rock Garden – Rosary – Water Garden _ Terrace Garden - Kitchen Garden. Landscaping - Principles, Types of Parks, Xeriscaping. Post harvest handling of Horticultural Products – Harvesting, Storage, Processing, Elements of Marketing. Robotics in Horticulture.	15

Textbook:

1. Acquaah, G. 2011.Horticulture: Principles and Practices. (4th ed), Pearson Education, London, UK.
2. Janik, J. 1972. Horticultural Science. W.H. Freeman & Company, San Francisco.
3. Kumar, N. 1994. Introduction to Horticulture, Rajalakshmi Publication, India.
4. Manibhushan Rao, K. 2005. Text Book of Horticulture. (2nd ed), Macmillan India Ltd., New Delhi.
5. Schilletter, J. C. and Richey, H. W. 2005. Text Book of general Horticulture. 2nd ed. Biotech Books, Delhi.
6. Sharma, R.R. 2016. Propagation of horticultural crops. Kalyani Publishers, New Delhi.

References:

1. Acquaah, G. 2002. Horticulture Principles and Practices. 2nd ed. Pearson Education (Singapore) Pvt. Ltd.
2. Ashman, M.A. and Puri, G. 2002. Essential soil science-A clear and concise introduction to soil science. Blackwell scientific publishers, London.
3. Denisen, E.L. 1979. Principles of Horticulture. MacMillan Publishing co, Inc. New York.
4. Dirr, M. and Heuser, C.W. 2009. The Reference Manual of Woody Plant Propagation: From Seed to Tissue Culture. Timber Press, Oregon, USA.
5. Thomson, L.M. and Troen, F.R. 1975. Soils and soil fertility Tata, McGraw Hill Publication Co. Ltd. New Delhi.

6. Tolanus, S. 2006. Soil fertility, Fertilizer and Integrated Nutrient management. CBS Publication, Delhi, India.

Web resources:

1. https://www.kobo.com/in/en/ebooks/horticulture
2. https://www.gale.com/gardening-and-horticulture
3. https://www.iaritoppers.com/p/horticulture-icar-ecourse-pdf-books.html
4. https://www.amazon.in/Introduction-Horticulture-N-Kumar-ebook/dp/B08M4289M6

Pedagogy:Teaching / Learning methods

Lecture, Tutorial, Assignment, PPT presentation, Quiz, Group Discussion, e-content Seminar.

Course Outcomes

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

CO Number	CO Statement	Programme outcomes
CO1	Identify and categorize various horticultural plants and the conditions that affect their growth and productivity.	K1
CO2	Explain the various structures and growth processes of horticultural plants.	K2
CO3	Demonstrate the propagation, growth, and maintenance of plants in horticulture systems.	K3
CO4	Correlate the soil characteristics and fertility to good plant growth.	K4
CO5	Utilize the role plant tissue culture techniques in the production of quality planting stock in horticulture.	K5
CO6	Apply horticultural skills and knowledge to explore career opportunities in horticulture industry.	K6

Cognitive Level: K1 - Remember; K2 - Understanding; K3 - Apply; K4 - Analyze; K5 – Evaluate; K6 – Create

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	3	3	3
CO2	2	1	3	3	3	3	3	3	3	2
CO3	3	1	3	3	3	3	3	2	3	3
CO4	3	3	3	1	1	2	2	3	1	3
CO5	3	3	3	3	3	3	2	3	3	2

S-Strong (3) M-Medium (2) L-Low(1)

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
I	23P1BOEL2B	Elective II - HERBAL TECHNOLOGY	5	3

Nature of the course

Employability Oriented	√	Relevant to Local need	√	Addresses Gender Sensitization	√
Entrepreneurship Oriented	√	Relevant to Regional need		Addresses Environment and Sustainability	√
Skill development Oriented	√	Relevant to National need		Addresses Human Values	
		Relevant to Global development need		Addresses Professional Ethics	

Course Objectives

The main objectives of this course are to:

1. To understand the importance of herbal technology.
2. To understand various plants-based drugs used in ayurvedha, unani, homeopathy, siddha etc.
3. To apply the knowledge to cultivate medical plants.
4. To know the pharmacological importance of medicinal plants.
5. To enlist phytochemicals and secondary metabolites of market and commercial value.

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**PHARMACOGNOSY:** Pharmacognosy scope and importance - source - Crude Drugs – Scope and Importance, Classification (Taxonomical, Morphological Chemical, Pharmacological); Cultivation, Collection and processing of crude drugs. Cultivation and utilization of medicinal and aromatic plants in India.	15
II	**PLANT TISSUE CULTURE AS SOURCE OF MEDICINES:** Plant tissue culture as source of medicines, Role of plant tissue culture in enhancing secondary metabolite production (*Withania somnifera, Rauwolfia serpentina, Catheranthus roseus, Andrographis paniculata* and *Dioscorea* sp.) - Elicitation - Biotransformation, Hairy root culture. Factors affecting secondary metabolites production. Biogenesis of phytopharmaceuticals.	15

III	**ANALYSIS OF PHYTOCHEMICALS:** Methods of Drug evaluation (Morphological, microscopic, physical and chemical). Phytochemical investigations – standardization and quality control of herbal drugs. Preliminary screening, Assay of Drugs - Biological evaluation/assays, Microbiological methods - Chemical Methods of Analysis, Detection of Adulterants: Chemical estimations, Spectrophotometry and fluorescence analysis. Drug adulteration - Types of adulterants.	15
IV	**TYPES OF PHYTOCHEMICALS I:** Carbohydrates and derived products: Glycosides - extraction methods (*Digitalis, Dioscorea*); Tannins (Hydrolysable and Condensed types); Volatile oils - extraction methods (Clove, Mentha). Study of some herbal formulation techniques as drug cosmetics.	15
V	**TYPES OF PHYTOCHEMICALS II:** Alkaloids - extraction methods (*Taxus, Cinchona*); Flavonoids- extraction methods, Resins- extraction method: Application of phytochemicals in phytopharmacueticals; Biocides, Biofungicides, Biopesticides. Women entrepreneurship development – marketing cultivated medicinal plants – National Medicinal Plants Board of India.	15

Recommended Text:

1. Kokate, C.K., Purohit, A.P and S.B. Gokhale. 1996. Pharmacognosy. NiraliPrakashan, 4th Ed.
2. Roseline, A. 2011. Pharmacognosy. MJP publishers, Chennai.
3. Tilgner, Sharol Marie. 2018. Herbal ABC's: The Foundation of Herbal Medicine.
4. Natural Products in medicine: A Biosynthetic approach. 1997. Wiley.
   Hornok, L. (ed.).
5. Chichister, U.K.J. 1999. Cultivation and Processing of Medicinal Plants, Wiley & Sons.
   Treaseand Evans.
6. Mukherjee, P.K. 2008. Quality control of herbal drugs. 3rd edition. Business Horizons Pharmaceutical Publishers, New Delhi, India.
7. Kirthikar and Basu. 2012. Indian Medicinal Plants. University Bookstore, Delhi. India
8. Biswas, P.K. 2006. Encyclopedia of Medicinal plants (Vol. I-VII). Dominant Publishers, New Delhi.
9. Chaudhuri, A.B. 2007. Endangered Medicinal Plants. Daya Publishing House, New Delhi.
10. Tilgner, Sharol Marie. 2018. Herbal ABC's: The Foundation of Herbal Medicine.

Reference Books:

1. Wallis, T.E. 1999. Text book of Pharmacognosy. CBS Publishers and Distributors, New Delhi.
2. Kumaresan, V and Annie Regland. 2004. Taxonomy of Angiosperms systematic Botany, Economic Botany, Botany &Ethnobotany.
3. Vallabh. 2000. Practical Pharmacognosy, Kolkata. New Delhi.
4. Acharya Vipul Rao. 2000. Herbal cure for common diseases. Diamond books, Pvt. Ltd.

5. Dey, A.C. 1998. Indian medicinal plants used in Ayurvedic preparations, Bishen Singh Mahendra Pal Singh.
6. Sathya, S., Jaiganesh, K.P and Sudha, T. 2019. Current Trends in Herbal Drug Technology. Pharmacy Council of India New Delhi.
7. Lewis, W.H and M.P.F. Elwin Lewis. 1976. Medical Botany. Plants affecting Man's Health. A Wiley Inter Science Publication. John Wiley and Sons, New York.

Web resources:

1. https://www.kopykitab.com/Herbal-Science
2. http://cms.herbalgram.org/heg/volume8/07July/HerbalEBooks.html?t=1310004932&ts=1579066352&signature=1dd0d5aef818b19bcdcd6c063a78e404
3. https://www.dattanibookagency.com/books-herbs-science.html
4. https://www.springer.com/gp/book/9783540791157

Pedagogy: Teaching / Learning methods

Lecture, Tutorial, Assignment,PPT presentation, Quiz, Group Discussion, e-content Seminar etc.

Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	Recollect the importance of herbal technology.	K1
CO2	Understand the classification of crude drugs from various botanical sources.	K2
CO3	Analyze on the application of secondary metabolites in modern medicine.	K3
CO4	Create new drug formulations using therapeutically valuable phytochemical compounds for the healthy life of society.	K4
CO5	Comprehend the current trade status and role of medicinal plants in socio economic growth.	K5 &K6

Cognitive Level:K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	2	1	3
CO2	3	3	3	3	3	3	3	1	3	3
CO3	3	3	3	3	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	1	3	3
CO5	3	3	3	3	3	3	3	1	2	3

S-Strong (3) M-Medium (2) L-Low (1)

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
I	**23P1BOSEC1**	**SKILL ENHANCEMENT COURSE - NURSERY AND GARDENING**	**2**	**2**

Nature of the course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented	√	Relevant to Regional need		Addresses Environment and Sustainability	√
Skill development Oriented	√	Relevant to National need	√	Addresses Human Values	
		Relevant to Global development need		Addresses Professional Ethics	√

Course Objectives

The main objectives of this course are:

1. To recognize the importance of nursery and gardening
2. To gain an understanding of nursery management.
3. To develop skills necessary to manage a wholesale nursery
4. To acquire knowledge regarding theory and practice of rising plants.
5. To develop an interest to become an entrepreneur.

SYLLABUS

Unit	Content	No. of Hours
I	**NURSERY:** Definition, objectives and scope and building up of infrastructure for nursery, planning and seasonal activities - Planting - direct seeding and transplants Seed dormancy; - causes and methods of breaking dormancy - Seed storage: Seed banks. Air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings - Hardening of plants	15
II	**GARDENING:** Definition, objectives and scope - different types of gardening - landscape and home gardening - parks and its components - plant materials and design - Computer applications in landscaping. Soil laying, manuring, watering, management of pests and diseases and harvesting. Sowing/raising of seeds and seedlings: Transplanting of seedlings - Study of cultivation of different vegetables: cabbage, brinjal, lady's finger - Storage and marketing procedures.	15

Recommended Text:

1. Bose T.K and Mukherjee, D. 1972. Gardening in India, Oxford & IBH Publishing Co., New Delhi.
2. Sandhu, M.K. 1989. Plant Propagation, Wile Eastern Ltd., Bengaluru.
3. Kumar, N. 1997. Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.
4. Edmond Musser and Andres. 1957. Fundamentals of Horticulture, McGraw Hill Book Co., New Delhi.
5. Agrawal, P.K. 1993. Hand Book of Seed Technology, Dept. of Agriculture and Cooperation,National Seed Corporation Ltd., New Delhi.

Reference Books:

1. N.L. Patel, S.L. Chawla, T.R. Ahlawat: Commercial Horticulture□, 2016, ASPEE College ofHorticulture, Navsari Agricultural University, Navsari 396 450, Gujarat,
2. Prasad S & Kumar U. 2005. Greenhouse Management for Horticultural Crops. 2nd Ed. Agrobios.
3. George Acquaah, 2002, Horticulture-principles and practices. Prentice-Half of India pvt. Ltd., New Delhi.
4. Abraham, A and Vatsala, P. 1981. Introduction to Orchids. Trop. Bot. Garden, Trivandrum.

Hartman, H.T and Kester, D.E. 1989. Plant propagation. Printice Hall Ltd., New Delhi.

Web resources

1. https://www.kopykitab.com/Nursery-And-Gardening-SEC-by-Prof-C-D-Patil-Dr-G-M-Rane-Dr-S-A-Patil
2. https://www.wonderslate.com/nursery-and-gardening-management/ebook details?siteName=books&bookId=38078&preview=true
3. https://books.google.co.in/books/about/Nursery_Hindi_Book_Bonsai_Plants_Nursery.html?id=nfDDwAAQBAJ&redir_esc=y
4. https://www.amazon.in/Gardening-Books/b?ie=UTF8&node=1318122031
5. https://www.worldcat.org/title/handbook-of-horticulture/oclc/688653648

Pedagogy: Teaching / Learning methods

Lecture, Tutorial, Assignment, PPT presentation, Quiz, Group Discussion, e-content Seminar)

Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	Recognize the basic process required for growing and maintaining plants in nurseries.	**K1**
CO2	Explain the different methods of plant propagation and various gardening styles	**K2**
CO3	Apply techniques for effective hardening of plants and computer applications for creative gardening	**K3 & K6**
CO4	Compare and contrast cultivation of different vegetables and growth of plants in nursery and gardening.	**K4**
CO5	Develop new strategies to enhance growth and quality of nursery plants.	**K5 &K6**

Cognitive Level: K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	3	2
CO2	3	3	2	2	3	3	2	3	2	3
CO3	2	2	3	3	1	2	1	3	3	1
CO4	3	3	3	3	3	2	3	3	3	1
CO5	3	3	2	3	2	3	1	2	3	2

S-Strong (3) M-Medium (2) L-Low(1)

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
I	**23P1BOAECC1**	**Ability Enhancement Compulsory Course - Communicative Skill And Personality Development**	**2**	**2**

Nature of the course

Employability Oriented	√	Relevant to Local need	√	Addresses Gender Sensitization	
Entrepreneurship Oriented	√	Relevant to national need	√	Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to regional need	√	Addresses Human Values	√
		Relevant to Global development need	√	Addresses Professional Ethics	√

Course Objectives

The main objectives of this course are to:

1. Cultivate positive personality traits for successful life.
2. Groom Winning Attitude among the learners.
3. Assist the learners to identify their own potential and realize their aspirations.
4. Enable a holistic development.
5. Facilitate optimum means of improving personal performance.

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	1. Personality- Definition. 2. Determinants of Personality. 3. Perceptual Process. 4. Personality Traits. 5. Developing Effective Habits. 6. Self Esteem (Freud and Erikson). 7. Self Appraisal and Self Development. 8. Dos and Don'ts to develop positive self esteem. 9. Interpersonal Relationship. 10. Difference between Aggressive, Submissive and Assertive behaviour. 11. Mind Mapping, Competency Mapping, 360 degree assessment. **12.** Presentation Skills – Opening, ending, Handling nerves, Handling audience, Power Storytelling, Visual aids, Question and answer session	15
II	1. Projecting Positive Body Language. 2. Conflict Management. 3. Change Management. 4. Stress Management. 5. Time Management.	15

	6. Goal Setting. 7. Assertiveness and Negotiating Skill. 8. Problem Solving Skill. 9. Decision Making Skills. 10. Leadership Qualities of a Successful Leader. 11. Attitudes – Positive Attitudes. 12. Public Speaking – Engaging, Connecting, and Influencing the audiences. 13. Employability Skill – Group Discussion, Interview Questions, Psychometric analysis.	

Textbook:

1. Andrews, Sudhir. *How to Succeed at Interviews*. 21st (rep) New Delhi:Tata McGrew Hill 1988.
2. Hurlock.E.B (2006) :*Personality Development*, 28th Reprint. New Delhi: Tata McCraw Hill.
3. Kumar, Pravesh.*All about Self Motivation*. New Delhi:Goodwill Publication House. 2005**.**
4. Preston,David Lawrence.*365 Steps to Self-Confidence*. Mumbai: Jaico Publishers, 2007
5. Stephen.P.Robbins and Timothy. A.Judge: *Organisation Behaviour.*16thEdition.Prentice Hall. 2014

References:

1. Grellet ,Françoise. *Developing Reading Skills*. Cambridge: Cambridge University Press, 2007.
2. Kristine, Brown and Susan Hood.*Academic Encounters Life in Society Reading, Study Skills, Writing*. , New Delhi:Cambridge University Press,2010.
3. Little ,Graham R .*Operations Team Leadership*. Mumbai :Jaico Publishers, 2006.
4. Nurnberg ,Maxwell and Morris Rosenblum *How to Build a Better Vocabulary*. New York :Warner Books, 1989.
5. O' Connell ,Sue with LousieHashemi.*Cambridge First Certificate: Listening and Speaking* –, Cambridge University Press, Cambridge, 2000.
6. Pfeifer , William Sanborn and T.V.S.Padmaja*Technical Communication : A Practical Approach,* (Sixth edition) New Delhi: Pearson, 2006.
7. Withrow, Jean, Gay Brookers and Martha Cumings .*Inspired to Write*. New York: Cambridge University Press, 2004.

Web resources:

https://www.managementstudyguide.com/personality-development.htm
https://www.artofliving.org/in-en/personality-development
https://study.com/academy/lesson/what-is-conflict-management-definition-styles-strategies.html
https://www.hays.com.au/career-advice/upskilling/soft-skills
https://www.skillsyouneed.com/presentation-skills.html

Pedagogy: Teaching / Learning methods

Lecture, Tutorial, Assignment, PPT presentation, Group Discussion, e-content, Seminar, Tasks, Role play, Debate, Group Activities etc.

Course Out comes

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

CO Number	CO Statement	Cognitive Level
CO1	understand the significance of developing progressive and positive personality	**K1,K2**
CO2	Gain self-confidence and broaden perception of life.	**K3**
CO3	Maximize their potential and steer that into their career choice.	**K4**
CO4	Enhance one's self image and self-esteem.	**K3, K5**
CO5	Find a means to achieve excellence and derive fulfillment.	**K6**

Cognitive Level:K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze;
K5 – Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Specific Outcomes

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3

3 - Strongly Correlated; 2 - Moderately Correlated;
1 - Weakly Correlated;0 – No correlation

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
II	**23P2BOC3**	**TAXONOMY OF ANGIOSPERMS, ECOLOGY AND PHYTOGEOGRAPHY**	**5**	**4**

Nature of the course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented		Relevant to Regional need		Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to National need	√	Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	√

Course Objectives

The main objectives of this course are:

1. To enable the students to get a fair knowledge on taxonomy of angiosperms
2. To enrich the students to know the modern trends in taxonomy of angiosperms
3. To inculcate students to develop their skill in identifying plants up to species level
4. To acquire knowledge on economic importance of locally available plants
5. To understand the remote sensing and its applications.

SYLLABUS

Unit	Content	No. of Hours
I	**TAXONOMY AND SYSTEMATICS:** A brief study on the morphology of Angiosperms - root, stem, leaf (types and modifications), inflorescence, flower and fruit – Floral formula and Floral diagram. Botanical contribution with special reference to India by William Roxburgh, J.D. Hooker, and Gamble, J.S. Principles of classification: Artificial – Linnaeus, Natural – Bentham and Hooker, Phylogenetic system - Hutchinson, Modern – Takhtajan. Botanical gardens and herbaria of world, preparation and maintenance of Herbarium. Botanical survey of India – its organization and role. Angiosperm Phylogeny Group – Major revisions in APG I to IV.	15
II	**NOMENCLATURE AND MODERN TRENDS IN TAXONOMY:** Botanical Nomenclature - ICBN uninominal systems - binomial nomenclature, importance and principle - ICN (Shenzhen Code, 2018). Important articles,	15

	typification, principles of priority, effective and valid publication, author citation. Taxonomic literature (Index Kewensis). Types of Keys - Preparation of dichotomous key. Phylogeny – Origin and evolution of Angiosperms. Flora - Monographs and revisions. Modern trends in taxonomy, chemotaxonomy, numerical taxonomy, molecular Taxonomy.	
III	**SYSTEMATIC ANALYSIS OF PLANTS:** Vegetative, Floral characteristics, and Economic importance of selected families. Dicotyledons: Polypetalae – Nymphaeaceae, Sterculiaceae, Portulaceae, Meliaceae, Rhamnaceae, Combretaceae, Myrtaceae, Passifloraceae; Gamopetalae - Sapotaceae, Boraginaceae, Convolvulaceae, Scrophulariaceae, Bignoniaceae, Pedaliaceae; Monochlamydeae **-** Nyctaginaceae, Loranthaceae, Aristolochiaceae, Casuarinaceae; Monocotyledons - Liliaceae, Amaryllidaceae, Commelinaceae, Zingiberaceae, Typhaceae, Cyperaceae	15
IV	**ECOLOGY**: Ecological classification – Autecology- Synecology- Gene ecology - Population ecology; Ecosystem concept - components, structure and functions; Ecological pyramids - Ecosystem energetics – Energy flow; Ecosystems - Freshwater, Marine, Mangrove, Terrestrial, Forest, Grassland and Desert ecosystem; Environmental factors - Climatic, edaphic and biotic factors. Ecological adaptations - Hydrophytes, Mesophytes, Xerophytes and Halophytes.	15
V	**PHYTOGEOGRAPHY**: Phytogeographical Zones - Vegetation types of India and Tamil Nadu, Distribution: Continuous, Discontinuous and Endemism. Theories of discontinuous distribution: Continental drift, Age and area hypothesis; Geographical Information System (GIS) - Principles of remote sensing and its applications.	15

Text books:

1. Sharma OP, 2014. Plant Taxonomy - Second Edition. McGraw Hill Education Pvt Ltd., New Delhi.
2. Pandey BP, 2021. Taxonomy of Angiosperms. S. Chand and Company Ltd., New Delhi.
3. Verma BK, 2011.Introduction to Taxonomy of Angiosperms. PHI Learning Pvt. Ltd., New Delhi.
4. Sinha, R.K., 2013. Practical Taxonomy of Angiosperms. I.K. International Publishing House Pvt. Ltd., New Delhi.
5. Sharma P.D. 2019. Plant ecology and phytogeography, Rastogi Publications, Meerut.
6. Chandra, A.M and Ghosh, S.K. 2010. Remote sensing and Geographical Information System, Narosa Publishing House Pvt. Ltd. New Delhi.
7. Eugene Odum, 2017. Fundamentals of Ecology 5th Ed. Cengage, Bengaluru.

References:

1. Lawrence GHM, 1951. Taxonomy of vascular plants. MacMillan Co., New York, USA
2. Simpson MG, 2011. Plant Systematics. Elsevier - Academic Press, California, USA.
3. Jeffrey C, 1968. An introduction to Plant Taxonomy. Cambridge University Press, New York, USA.
4. Takhtajan A, 2009. Flowering plants – Second Edition. Springer.
5. Johnson AT, Smith HA, Stocjdale AP, 2019. Plant Names Simplified – Third Edition. 5M Publishing Ltd., Sheffield, UK.
6. Beentje H, 2010. The Kew Plant Glossary – an illustrated dictionary of plant terms. Royal Botancial Gardens, Kew.
7. Keddy, P.A. 2017. Plant Ecology: Origins, processes, consequences. 2nd ed. Cambridge University Press. ISBN. 978-1107114234.
8. Kormondy, E.J. 2017. Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.
9. Gillson, L. 2015. Biodiversity Conservation and Environmental Change, Oxford University Press, Oxford.

Web resources:

1. APG I, 1998. Angiosperm phylogeny group. An ordinal classification for the families of flowering plants. Annals of Missouri Botanical Garden 85; pp. 531–553. https://doi.org/10.2307/2992015
2. APG II, 2003. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants. Botanical Journal of the Linnean Society 141: pp. 399-436. https://doi.org/10.1046/j.1095-8339.2003.t01-1-00158.x
3. APG III, 2009. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants. Botanical Journal of the Linnean Society 161; pp. 105-121. https://doi.org/10.1111/j.1095-8339.2009.00996.x
4. APG IV, 2016. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants. Botanical Journal of the Linnean Society 181: pp. 1-20. https://doi.org/10.1111/boj.12385
5. International Code of Nomenclature for Algae, Fungi, and Plants (Shenzhen Code, 2018).https://www.iapt-taxon.org/nomen/main.php
6. POWO, 2023. Plants of the World Online. Royal Botanic Gardens, Kew. http://www.plantsoftheworldonline.org/
7. Stevens PF 2017. Angiosperm Phylogeny Website. Version 14. http://www.mobot.org/MOBOT/research/APweb/
8. eFlora of India is an open access online database of India' s plant diversity. Botanical Survey of India, Kolkata.https://efloraindia.bsi.gov.in/eFlora/eFloraHomePage.action
9. https://plato.stanford.edu/entries/biodiversity/
10. https://sciencing.com/four-types-biodiversity-8714.html.
11. http://www.bsienvis.nic.in/Database/Status_of_Plant_Diversity_in_India_17566.aspx

Pedagogy: Teaching / Learning methods

(Please mention teaching / Learning methods like Lecture, Tutorial, Assignment, PPT presentation, Quiz, Group Discussion, e-content Seminar etc.)

Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	Recollect the basic concepts of morphology of leaves, flowers. Identify the types of leaves, inflorescence and fruits. Explain the various types of classification.	K1, K2
CO2	Explain the principles of taxonomy. Summarize the taxonomic hierarchy. Define Binomial nomenclature. Group Activity –Construction of key	K3
CO3	Construction of floral formula and floral diagram	K1, K2
CO4	Characteristic features of ecological concepts.	K5, K6
CO5	Explain the regulation analysis and physiologeography	K1, K2

Cognitive Level: K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping of Course Outcomes (CO)with Programme Specific Outcomes (PSO)

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	3	3	3
CO2	3	3	2	3	3	2	2	1	2	2
CO3	3	3	2	3	1	3	2	3	3	1
CO4	3	2	3	3	2	3	3	1	3	3
CO5	3	3	2	2	1	2	1	3	2	1

S-Strong (3) M-Medium (2) L-Low(1)

Semester	Course Code	Course Title	Hours of Teaching/Cycle	No. of Credits
II	**23P2BOC4**	**PLANT ANATOMY AND EMBRYOLOGY OF ANGIOSPERMS**	**5**	**4**

Nature of the course

Employability Oriented		Relevant to Local need	√	Addresses Gender Sensitization	
Entrepreneurship Oriented		Relevant to regional need		Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to national need		Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	√

Course Objectives

The main objectives of this course are:

1. To learn the importance of plant anatomy in plant production systems.
2. To classify meristems and identify their structures, functions and roles in monocot and dicot plants growth and secondary growth of woody plants.
3. To understand the mechanism underling the shift from vegetative to reproductive phase.
4. To trace the development of male and female gametophyte.
5. To understand the recent advances in palynology.

SYLLABUS

Unit	Content	No. of Hours
I	**CELL WALL AND TISSUES:** Plasmodesmata- types of pits – growth of cell wall – formation of intercellular spaces; Meristems: Classifications: Theories of shoot and root apices. Vascular Cambium: Composition and organization – multiplicative and additive divisions. Xylem: Primary and secondary xylem – tracheary elements and vessels - vessel-less dicots – xylem rays and axial parenchyma of angiosperm wood; Phloem: Ultra structure and ontogeny of sieve tube elements and companion cell. Evolution of tracheary elements. Dendrochronology – grain, texture and figure in wood; reaction wood; ring porous and diffuse porous wood.	15

II	**PERIDERM:** Structure, organization and activity of phellogen. Polyderm and Rhytiderm – wound periderm. Normal secondary thickening in Dicot; Stem and root. Anomalous secondary growth in Dicot Stem (Amaranthaceae, Aristolochiaceae, Bignoniaceae, Piperaceae, Nyctaginaceae) and arborescent Monocots. Primary thickening in palms; Ontogeny of leaf, Structure and types of Stomata; Leaf abscission;Major nodal types. Kranz anatomy and its significance.	15
III	**MICROSPORANGIUM AND MEGASPRORANGIUM:** Male gametophyte; Structure and development of Micro sporangium Ultrastructure and physiology of tapetum; Morphology and ultrastructure of pollen wall, pollen kit, pollen analysis, pollen storage, pollen sterility and pollen physiology. Female gametophyte: Structure and development of megasporangium; Types of ovules, Endothelium, obturator and nucellus. megasporogenesis: Female gametophyte: Structure, types, haustorial behavior and nutrition of embryo sacs.	15
IV	**FERTILIZATION AND POLYEMBRYONY:** Fertilization: Double fertilization and triple fusion. Endosperm: Development of endosperm, types, physiological efficiency of endosperm haustoria and functions; Ruminate endosperm. Embryogeny: Development of monocot (Grass) and dicot (Crucifer) embryos Polyembryony: Causes of Polyembryony, classification, induction and practical application. Apomixis and its significance. Seed and Fruit development and role of growth substances. Parthenocarpy and its importance.	15
V	**MICROTECHNIQUE:** Principle of killing and fixation, dehydration and rehydration of botanical specimens. Stains: Principle of double staining (fast-green and light green) of free hand sections; Protocol for serial sectioning of paraffin wax impregnated specimens; Mounting and mounting media.	15

Textbook:

1. Bhojwani, S.S. Bhatnagar, S.P and Dantu, P.K. 2015. The Embryology of Angiosperms (6th revised and enlarged edition). Vikas Publishing House, New Delhi.
2. Maheshwari, P. 1963. Recent Advances in Embryology of Angiosperms. Intl. Soc. Plant Morphologists, New Delhi.
3. Sharma, P.C. 2017. Text Book of Plant Anatomy. Arjun Publishing House, New Delhi.
4. Pandey.S.N and Ajanta Chandha. 2006. Plant Anatomy and Embryology. Vikas Publishinf House Pvt. Ltd, New Delhi.
5. Narayanaswamy, S. 1994. Plant Cell and Tissue Culture. Tata McGraw Hill Ltd. New Delhi.

References:

1. Krishnamurthy, K.V. 1988. Methods in Plant Histochemistry. S. Viswanathan & Co., Madras.
2. Swamy, B.G.L and Krishnamurthy. K.V 1990. From flower to fruits, Tata – McGraw Hill

publishing Co Ltd, New Delhi.

3. Pullaiah, T., Lakshiminarayana, K and Hanumantha Rao, B. 2006. Text book of Embryology of Angiosperms. Regency Publications, New Delhi.
4. Bierhorst, D.W. 1971. Morphology of Vascular Plants. Macmillan publishers, New York.
5. Cutler, D. F., Botha, T and Stevenson, D.W. 2008. Plant Anatomy: An Applied Approach. Blackwell Publishing, Malden, USA.
7. Eames, A.J and Mac Daniels, L.H. 2013. Introduction to Plant Anatomy, 3rd Edition. McGraw-Hill Inc., US.

Web resources:

1. https://www.ipni.org/
2. http://www.theplantlist.org/
3. https://faculty.etsu.edu/liuc/plant_anatomy_sites.htm
4. http://aryacollegeludhiana.in/E_BOOK/Botany/plant_anatomy.pdf
5. https://www.uou.ac.in/sites/default/files/slm/BSCBO-202.pdf
6. https://www.askiitians.com/

Pedagogy: Teaching / Learning methods

(Please mention teaching / Learning methods like Lecture, Tutorial, Assignment,PPT presentation, Quiz, Group Discussion, e-content Seminar etc.)

Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	Learn the structures, functions and roles of apical *vs* lateral meristems in monocot and dicot plant growth.	K1 &K2
CO2	Study the function and organization of woody stems derived from secondary growth in dicot and monocot plants.	K1 & K4
CO3	Understand the various concepts of plant development and reproduction	K3 & K6
CO4	Profitably manipulate the process of reproduction in plants with a professional and entrepreneurial mindset.	K5
CO5	Apply their idea on sectioning and dissection of plants to demonstrate various stages of plant development.	K3 & K6

Cognitive Level:K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	3	3	3	3	3	3	3	3	3
CO2	3	1	3	3	3	3	3	3	3	3
CO3	3	1	3	3	3	3	3	2	3	1
CO4	3	3	3	1	1	2	3	2	2	1
CO5	3	3	3	3	3	3	2	3	3	2

S-Strong (3) M-Medium (2) L-Low (1)

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
II	**23P2BOCP2**	**Practical – II Taxonomy of Angiosperms, Ecology and Phytogeography; Plant Anatomy and Embryology of Angiosperms**	**6**	**4**

Nature of the course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented		Relevant to Regional need		Addresses Environment and Sustainability	√
Skill development Oriented	√	Relevant to National need	√	Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	√

Course Objectives

The main objectives of this course are:

1. To understand and develop skill sets in plant morphological, floral characteristics and artificialkey preparation.
2. To expedite skilled workers to carry out research in frontier areas of plant science.
3. To classify meristems and identify their structures, functions and roles in monocot and dicotplants growth and secondary growth of woody plants
4. To learn the importance of plant anatomy in plant production systems.
5. To know about different vegetation sampling methods.

Unit	Content	Hours
I	**PLANT TAXONOMY:** 1. Study of local flora/campus flora and preparation of artificial key for any three families in the syllabus. 2. Description of a species, based on virtual herbarium and live specimens of the families mentioned in the theory. 3. Solving nomenclature problems. 4. **Field trip:** A field trip at least 3-4 days to a floristically rich area to study plants in nature and field report submission of not less than 20 herbarium sheets representing the families studied.	18

II	**ECOLOGY:** 1. Determination of the quantitative characters of a plant community by random quadrat method (abundance, density, dominance, species diversity, frequency) in grazing land, forests. 2. Estimation of above ground and below ground biomass in a grazing land employing minimum size of quadrat.	18
III	**PHYTOGEOGRAPHY:** 1. Mapping of world vegetation 2. Mapping of Indian vegetation.	18
IV	**ANATOMY:** *1.* Study of shoot apex of *Hydrilla* 2. Observation of cambial types. 3. Sectioning and observation of nodal types. 4. Study of anomalous secondary growth of the following: STEM- *Nyctanthus, Boerhavia, Aristolochia, Bignonia, Piper betle* and *Mirabilis*. ROOT: *Achyranthus* 5. Observation of stomatal types by epidermal peeling. 6. Maceration of wood and observation of the components of xylem. 7. Double staining technique to study the stem anomali.	18
V	**EMBRYOLOGY:** 1. Observation of T.S. of anther. 2. Observation of ovule types. 3. Observation of mature embryo sacs. 4. Dissection and observation of embryos (globular & cordate embryos). 5. Study of pollen morphology 6. Study of in vitro pollen germination. 7. Observation of endosperm types.	18

Textbooks:

1. Sharma OP, 2014. Plant Taxonomy - II Edition. McGraw Hill Education Pvt Ltd., New Delhi.
2. Sinha, R. K., 2010. Practical Taxonomy of Angiosperms, Third Edition, I.K. International Publishing House Pvt. Ltd., New Delhi.
3. Pandey, B.P., 2010. Modern Practical Botany Vol. II, S. Chand & Company Pvt. Ltd, New Delhi.
4. Gokhale, S.B., Kokate, C.K. and Gokhale, A. 2016. Pharmacognosy of Traditional Drugs. NiraliPrakashan, 1st Edition. ISBN: 9351642062.
5. Cutler, D.F., Botha, C.E.J., Stevenson, D.W., and William, D. 2008. Plant anatomy: an applied approach (No. QK641 C87). Oxford: Blackwell, UK.
6. Sundara, R. S. 2000. Practical manual of plant anatomy and embryology. Anmol Publ. PVT LTD, New Delhi.
7. Panshin, A.J and C. de Zeeuw.1980.Textbook of wood technology. Structure, identification and uses of the commercial woods of the United States and Canada. Fourth Edition. New York: McGraw-Hill Book Company.
8. Sharma, H.P. 2009. Plant Embryology: Classical and Experimental, Bombay Popular Prakashan, ISBN-8173199698, 9788173199691.

Reference books:

1. Gamble, J.S. (1935) The Flora of the Presidency of Madras, Volume I-III, Adlard& Son, Ltd, London.
2. Matthew, K.M., 1983. The Flora of the Tamil Nadu Carnatic, Volume I-III, The Rapinat Herbarium, St Joseph's College, Tiruchirapalli, India.
3. AlerGingauz.2001. Medicinal Chemistry. Oxford University Press & Wiley Publications.
4. Gopalan, C., B.V. Ramasastri and S.C. Balasubramanian. 1985. Nutritive Value of Indian Foods. National Institute of Nutrition, Hyderabad.
5. Harborne. J.B. 1998. Phytochemical methods. A guide to modern techniques of Plant Analysis, Chapman and Hall publication, London.
6. Traditional plant medicines as sources of new drugs. P.J. Houghton in Pharmacognosy. Trease and Evan's.16th Ed, 2009.
7. Sundara Rajan, S, 2003. Practical Manual of Plant Anatomy and Embryology 1st ed, Anmol Publications, ISBN-812610668.
8. Katherine Esau. 2006. Anatomy of Seed Plants. 2nd edition, John Wiley and Sons.

Web resources:

1. APG IV, 2016. https://doi.org/10.1111/boj.12385
2. ICN - Shenzhen Code, 2018. https://www.iapt-taxon.org/nomen/main.php
3. Plants of the World Online. http://www.plantsoftheworldonline.org/
4. Angiosperm Phylogeny http://www.mobot.org/MOBOT/research/APweb/
5. eFlora of India. https://efloraindia.bsi.gov.in/eFlora/eFloraHomePage.action
6. International Plants Name Index - http://www.ipni.org

CO Number	CO Statement	Cognitive Level
CO1	Recollect the basic concepts to plant morphology and nomenclature	K1 &K2
CO2	Studying population ecology by quantitative methods	K1 & K4
CO3	Remembering vegetation analysis	K3 & K6
CO4	Understand the anatomy of plant root and stem	K5
CO5	Demonstration on reproductive structures	K3 & K6

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	S	3	3
CO2	3	3	2	3	3	2	1	2	3	2
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	1	2	3
CO5	3	2	2	3	3	3	3	2	3	3

S-Strong (3) M-Medium (2) L-Low(1)

Semester	Course Code	Course Title	Hours of Teaching / Cycle	Credit
II	**23P2BOEL3A**	**Elective III - MEDICINAL BOTANY**	**5**	**3**

Nature of the course

Employability Oriented	√	Relevant to Local need	√	Addresses Gender Sensitization	
Entrepreneurship Oriented	√	Relevant to Regional need		Addresses Environment and Sustainability	√
Skill development Oriented	√	Relevant to National need		Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	√

Course Objectives

The main objectives of this course are :

1. To understand the uses and effects of medicinal plants and herbal supplements.
2. To gain knowledge about the historical and modern uses of plants in medicine.
3. To gain insights into the perspectives of ethnobotanical research.
4. To know the various methods of harvesting, drying and storage of medicinal herbs.
5. To create new strategies to enhance the growth and quality of medicinal herbs.

SYLLABUS

Unit	Content	No. of Hours
I	**TRADITIONAL SYSTEM OF MEDICINE** Systems of medicine: origin and development of biomedicine; Indian Systems of Medicine (Ayurveda, Siddha, Unani, Yoga and Naturopathy) Ayurveda: Historical perspective, *Athuravritta* (disease management and treatment which involves eight specialties including Internal medicine and surgery); Fundamental principles of Ayurveda: Panchabhootha theory, Thridosha theory, Saptadhatu theory and *Mala* theory; Ayurvedic, Pharmacopeia; *Vrikshayurveda.*	15
II	**PHYTOCHEMISTRY AND PHARMACOGNOSY:** Phytochemistry, important phytoconstituents, their plant sources, medicinal properties. Histochemistry – definition, principles, staining methods. Biological stains – bright field dyes and flurochromes, detection and localization of phytochemicals. Raw drugs, authenticity, study through physical, microscopic	15

	and analytical methods. Different types of formulations. Adulteration and Admixtures. Bioprospecting, drug discovery from plants, product development and quality control.	
III	**ACTIVE PRINCIPLES & DRUG DISCOVERY:** Brief description of selected plants, Active principles, biochemical properties and medicinal uses of Guggul (*Commiphora*) for hypercholesterolemia, *Boswellia* for inflammatory disorders, Arjuna (*Terminalia arjuna*) for cardio protection, turmeric (*Curcuma longa*) for wound healing, antioxidant and anticancer properties, Kutaki (*Picrorhiza kurroa*) for hepatoprotection, Opium Poppy for analgesic and antitussive, *Salix* for analgesic, *Cinchona* and *Artemisia* for Malaria, *Rauwolfia* as tranquilizer, *Belladona* as anticholinergic, *Digitalis* as cardiotonic, *Podophyllum* as antitumor, *Stevia rebaudiana* for antidiabetic, *Catharanthus roseus* for anticancer.	15
IV	**ECONOMIC BOTANY:** General account on utilization of selected crop plants: (i) Cereals (rice and wheat) – (ii) Pulses (red gram and black gram), (iii) Drug yielding plants (*Withania somnifera* and *Coleus aromaticus*) (iv) Oil yielding plants (Groundnut, sunflower). (v) Sugar yielding plants (sugarcane and sugar beet), (vi) Spices and condiments (cardamom, cinnamon). (vii) Commercial crops - fibre (jute), (viii) Timber (Teak and red sanders wood), (ix) Resins and gums (Asafoetida and gum arabic) – (x) Essential oils (lemon grass and menthol), (xi) Beverages (tea, coffee).	15
V	**INTELLECTUAL PROPERTY RIGHTS:** Intellectual Property Rights – Introduction, Kinds of Intellectual Property Rights- Patents, Trademarks, Copyrights, Trade Secrets. Need for intellectual property right, Advantages and Disadvantages of IPR. International Regime Relating to IPR – TRIPS, WIPO, WTO, GATTS. IPR in India genesis and development. Geographical Indication – introduction, types. Patent filing procedure for ordinary application.	15

Recommended Text:

1. AYUSH, 2014. *An overview of Ayurveda*, *Yoga and Naturopathy*, *Unani*, *Siddha and Homeopathy.* New Delhi: Department of Ayurveda, Yoga & Naturopathy, Unani, Siddha and Homoeopathy, Ministry & Family Welfare, Govt. of India. (www.indianmedicine.nic.in)
2. Bhat, S.V., Nagasampagi, B.A., & Meenakshi, S. 2009. Natural Products – Chemistry and Applications. Narosa Publishing House, India Ltd.
3. CSIR- Central Institute of Medicinal and Aromatic Plants, Lucknow. 2016. *AushGyanya*: Handbook of Medicinal and Aromatic Plant Cultivation.
4. Kapoor, L. D. 2001. Handbook of Ayurvedic medicinal plants. Boca Raton, FL: CRC Press.
5. Sharma, R. 2003. Medicinal Plants of India-An Encyclopedia. Delhi: Daya Publishing House.
6. Sharma, R. 2013. Agro Techniques of Medicinal Plants. Daya Publishing House, Delhi.
7. Thakur, R. S., H. S. Puri, and Husain, A. 1989. *Major medicinal plants of India*. Central Institute of Medicinal and Aromatic Plants, Lucknow, India.

Reference Books:

1. Akerele, O., Heywood, V and Synge, H. 1991. The Conservation of Medicinal Plants. Cambridge University Press.
2. Evans, W.C. 2009. Trease and Evans Pharmacognosy, 16th edn. Philadelphia, PA: Elsevier Saunders Ltd.
3. Jain, S.K. and Jain, Vartika. (eds.). 2017. Methods and Approaches in Ethnobotany: Concepts, Practices and Prospects. Deep Publications, Delhi
4. Bhattacharjee, S.K. 2004. Hand Book of Medicinal plants. Pointer Publishers, Jaipur.
5. Handa, S.S and V.K. Kapoor. 1993. Pharmacognosy. VallabhPrakashan, New Delhi.

Web resources:

1. https://www.amazon.in/Medical-Botany-Plants-Affecting-Health/dp/0471628824
2. https://www.amazon.in/Current-Trends-Medicinal-Botany-Muhammad/dp/9382332502
3. https://link.springer.com/book/10.1007/978-3-030-74779-4
4. https://www.elsevier.com/books/medicinal-plants/da/978-0-08-100085-4
5. https://www.pdfdrive.com/medicinal-plants-books.html

Pedagogy: Teaching / Learning methods

Lecture, Tutorial, Assignment, PPT presentation, Quiz, Group Discussion, e-content Seminar)

Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	Understand the role of plants in the survival of human beings and other organisms.	K1
CO2	Recognition of the contribution made by primitive people in exploration of plant knowledge to alleviate common diseases and development of systems of medicine.	K2
CO3	Gaining knowledge on different classes of phytochemicals present in higher and lower plants species.	K3
CO4	Demonstrate the various aspects of extraction, isolation and characterization of secondary metabolites.	K4
CO5	Know the methods of screening of secondary metabolites for various biological properties.	K5 &K6

Cognitive Level: K1 - Remembering; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	2	1	3	3
CO2	3	2	3	3	3	2	2	1	3	2
CO3	3	2	3	3	3	3	3	2	3	3
CO4	3	2	2	3	3	3	3	2	3	3
CO5	3	2	2	3	3	3	3	2	3	3

S-Strong (3) M-Medium (2) L-Low (1)

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
II	**23P2BOEL3B**	**Elective III - BIOPESTICIDE TECHNOLOGY**	**5**	**3**

Nature of the course

Employability Oriented		Relevant to Local need	√	Addresses Gender Sensitization	
Entrepreneurship Oriented		Relevant to regional need		Addresses Environment and Sustainability	√
Skill development Oriented	√	Relevant to national need		Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	

Course Objectives

The main objectives of this course are to:

1. Understand the value and applications of biopesticides.
2. Comprehend the various issues related to the use of chemical pesticides in horticulture, forestry, and agriculture.
3. Gain knowledge about several biopesticides (bio-insecticides, bio-fungicides, bio-bactericides, bio-nematicides and bio-herbicides).
4. Gain knowledge of the techniques for mass production of selected biopesticides.
5. Be aware of the application strategies and weeds, nematodes, and disease targets.

SYLLABUS

Unit	Content	No. of Hours
I	**INTRODUCTION:** Introduction of biopesticides. Biological control, History and concept of biopesticides. Importance, scope and potential of biopesticide. Advantages for the use of biopesticides.	15
II	**TYPES OF BIOPESTICIDES:** Classification of biopesticides, botanical pesticides and biorationals. Mass production technology of bio-pesticides. Major classes-Properties and uses of Bioinsecticides, biofungicides, biobactericides, bionematicides and bioherbicides. Importance of neem in organic agriculture.	15

III	**IMPORTANT BIOINSECTICIDES:** **Bioinsecticides:** *Bacillus thuringiensis*, NPV, entomopathogenic fungi (*Beauveria, Metarhizium, Verticillium, Paecilomyces*). Biofungicides: *Trichoderma, Gliocladium,* non- pathogenic *Fusarium, Pseudomonas* spp., *Bacillus* spp. Biobactericides: *Agro bacterium radiobacter*. Bionematicides: *Paecilomyces*, *Trichoderma*, Bioherbicides: *Phytophthora, Colletotrichum*.	15
IV	**STANDARDIZATION OF BIOPESTICIDES:** Target pests and crops of important biopesticides and their mechanisms of action. Testing of quality parameters and standardization of biopesticides.	15
V	**FORMULATION:** Mass multiplication and formulation technology of biopesticides. Prospects and problems in commercialization and efficacy of biopesticides. Commercial products of biopesticides.	15

Textbook:

1. Johri,J.2020.RecentAdvancesinBiopesticides:BiotechnologicalApplications.NewIndiaPublishingAgency (NIPA), NewDelhi.
2. Kaushik,N.2004.Biopesticidesforsustainableagriculture:prospectsandconstraints.TERIPress, New Delhi.
3. Sahayaraj,K.2014.BasicandAppliedAspectsofBiopesticides.SpringerIndia,NewDelhi.
4. Tebeest,D.O.2020.MicrobialControlofWeeds.CBSPublishersandDistributors,New Delhi.
5. Joshi, S.R. 2020. Biopesticides: A Biotechnological Approach. New Age International (P) ltd. New Delhi.

References:

1. Ainsworth, G.C. 1971. A Dictionary of the Fungi. Commonwealth Mycological Institute, Kew, Surrey, England.
2. Carlile, M.J., Watkinson, S.C and Gooday, G.W. 2001. The Fungi. 2nd Edition. Academic Press, San Diego
3. Manoj Parihar, Anand Kumar. 2021. Biopesticides. Volume 2: Advances in Bio-inoculants. Elsevier.
4. Bailey, A., Chandler, D., Grant, W. P., Greaves, J., Prince, G., Tatchell, M. 2010. Biopesticides: pest management and regulation.Plumx.
5. Manoharachary, C., Singh, H.B., Varma, A. 2020. Trichoderma: Agricultural Applications and Beyond. Springer International Publishing, New York, USA.
6. Nollet, L.M.L and Rathore, H.S. 2019. Biopesticides Handbook. CRC Press, Florida, USA.
7. Anwer, M.A. 2021. Biopesticides and Bioagents: Novel Tools for Pest Management. Apple Academic Press, Florida, USA.
8. Awasthi, L.P. 2021. Biopesticides in Organic Farming: Recent Advances. CRC Press, Florida, USA.
9. Bailey, A., Chandler, D., Grant, W., Greaves, J., Prince, G., Tatchell, M., 2012. Biopesticides: Pest Management and Regulation. CABI, Surrey, UK.
10. Glare, T.R and Moran-Diez, M.E. 2016. Microbial-Based Biopesticides: Methods and

Protocols. Humana Press, New Jersey, USA.

11. Gnanamanickam,S.S.2019.BiologicalControlofCropDiseases.CRCPress,Florida,USA.

Web resources:

1. https://www.kobo.com/gr/en/ebook/phytochemistry-2
2. https://www.amazon.in/Textbook-Pharmacognosy-Phytochemistry-Kumar-Jayaveera-ebook/dp/B06XKSY76H
3. https://www.amazon.in/Computational-Phytochemistry-Satyajit-Dey-Sarker-ebook/dp/B07CV96NZJ
4. https://studyfrnd.com/pharmacognosy-and-phytochemistry-book/
5. https://www.worldcat.org/title/textbook-of-pharmacognosy-and-phytochemistry/oclc/802053616
6. https://www.worldcat.org/title/phytochemistry/oclc/621430002

Pedagogy: Teaching / Learning methods

(Please mention teaching / Learning methods like Lecture, Tutorial, Assignment, PPT presentation,Quiz, Group Discussion, e-content Seminar etc.)

Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	Understand the issue in use of chemical pesticide and their harmful effects on life	**K1 &K2**
CO2	Aware the significance of biopesticides and their beneficial role in controlling insect pests, diseases, nematodes and weeds.	**K1 & K4**
CO3	Knowledge on identification of promising biopesticides and their mechanisms of action against insect pests, diseases, nematodes and weeds.	**K3**
CO4	Learn the mass production and formulation technology of selected biopesticides.	**K4**
CO5	Knowledge on product development for commercialization of biopesticides	**K5 & K6**

Cognitive Level:K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping of Course Outcomeswith Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	3	3	3
CO2	3	2	2	2	3	2	3	1	3	3
CO3	3	3	3	3	1	2	S	2	3	2
CO4	3	2	2	2	3	3	2	1	2	1
CO5	3	3	3	3	2	2	2	3	2	3

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
II	**23P2BOEL4A**	**Elective IV - NANOBIOTECHNOLOGY**	**5**	**3**

Nature of the course

Employability Oriented		Relevant to Local need	√	Addresses Professional Ethics	
Entrepreneurship Oriented	√	Relevant to national need	√	Addresses Gender Sensitization	
Skill development Oriented	√	Relevant to regional need		Addresses Environment and Sustainability	√
Relevant to Global need				Addresses Human Values	√

Course Objectives

The main objectives of this course are:

1. To introduce the learners to the basic concepts in the emerging frontiers of nanotechnology.
2. To give perspective to researchers and students who are interested in nanoscale physical and biological systems and their applications in medicine.
3. To introduce the concepts in nanomaterials and their use with biocomponents to synthesize and interact with larger systems.
4. To impart knowledge on the most recent molecular diagnostic and therapeutic tools used to treat various diseases.
5. Incorporate sustainability in to account when you develop nanotechnology responsibly.

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**INTRODUCTORY NANOTECHNOLOGY:** Definition - History of Nanoscience, History of Nanotechnology, – Need, challenges and present status of nanotechnology -Nanoscience in India and abroad–Social and ethical issues in nanotechnology. Nanomaterials – Types, classification and properties – Quantum dots – Significance of surface volume ratio–Preparation of nanomaterials –Top-down and Bottom-up approaches.	15
II	**NANOSTRUCTURE:** Nanostructures – Nanopores – nanowires – Nanotubes – Nanochannels - Nanorobots – Nanoshells – Nano-transistors; Carbon nanotubes and fullerenes -	15

	types, properties and applications. Synthesis of nanoparticles - Microbial and green synthesis – Nanobiosensors - Antibodies as biosensors – Engineered nanopores to detect DNA sequences; Detection of glucose level by biosensors; Nanocomposites- Nanopolymers – Nanoglasses – Nano ceramics.	
III	**APPLIED NANOTECHNOLOGY:** Nanotechnology applications in medicine – cancer therapy – implants; Nano computing technology; Nanomaterial based sunscreens and cosmetics; Nanotechnology in fuel cells, displays, batteries – Nanomaterials as catalysts. Nanotechnology in water purification, reducing environmental pollution, agriculture, food industries and military battle suits.	15
IV	**MEDICAL NANOTECHNOLOGY:** Nanotechnology and its applications in gene therapy stem cell technology. Protein based nanotechnology – Microarray – types and applications - Computer aided drug design - Targeted drug delivery and its advantages – Nanotechnology in tissue engineering.	15
V	**INSTRUMENTS IN NANOTECHNOLOGY:** Atomic Force Microscope (AFM) – Scanning Tunneling Microscope (STM) - Scanning Electron Microscope (SEM) – Confocal microscope –Dynamic light scattering (DLS) - X-Ray Diffractometer (XRD) – UV-Vis-Spectrophotometer - FT-IR - Zeta potential analyzer.	15

Textbook:

1. Atkinson, W.I. 2011. Nanotechnology. Jaico Book House, New Delhi.
2. Sharon, M and Sharon, M. 2012. Bio-Nanotechnology- Concepts and Applications, CRC Press
3. Ravichandran K, Swaminathan, K, Sakthivel B, Ravidhas C (2018). Introduction to the characterization of nanomaterials and thin films. Research India Publication,New Delhi.ISBN:978-93-81521-84-7.
4. Shanmugam S (2019). Nanotechnology. MJP Publishers, Chennai, India.ISBN10:8180940640
5. Pradeep, T. 2012. Textbook of Nanoscience and Nanotechnology, McGraw Hill Education (India) Private Limited.

References:

1. Goodsell DS (2004). Bio-nanotechnology lessons from nature. John Wiley & Sons, Inc., Hoboken, New Jersey. ISBN0-471-41719-X.
2. Papazoglou, ES, Parthasarathy A (2007). Bio-Nanotechnology. Morgan & Claypool Publishers, London, UK. ISBN:1598291386
3. Pradeep T (2017). NANO: The Essentials – Understanding Nanoscience and Nanotechnology. McGrowHill Education (India) Pvt.Ltd, NewDelhi. ISBN:0-07-061788-0
4. Ramsden JR (2009). Applied Nanotechnology. Elsevier Inc., Burlington, MA01803,USA.ISBN: 978-0-8155-2023-8
5. Murty, B.S., Shankar, P., Raj, B., Rath, B.B., Murday, J. 2013. Textbook of Nanoscience and Nanotechnology. Spirnger Publication.

6. Prashant Kesharwani. 2019. Nanotechnology-Based Targeted Drug Delivery Systems for Lung Cancer. Academic Press. An imprint of Elsevier.

Web resources:

1. https://youtu.be/t12i76lnOnY
2. https://youtu.be/CyJWeVMFPSU
3. https://onlinelibrary.wiley.com/doi/book/10.1002/3527602453
4. https://www.elsevier.com/books/nanobiotechnology/ghosh/978-0-12-822878-4
5. https://www.routledge.com/Nanobiotechnology-Concepts-and-Applications-in-Health-Agriculture-and/Tomar-Jyoti-Kaushik/p/book/9781774635179

Pedagogy: Teaching / Learning methods Lecture, Tutorial, Assignment, PPT presentation, Quiz, Group Discussion, e-content Seminar)

Course Outcomes

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

Course outcomes CO	On completion of this course the student will be able to	Programme outcomes
CO1	Recall the essential features of biology and nanotechnology that are converging to create the new area of bionanotechnology.	K1
CO2	Formulate procedures for the synthesis of nanoparticles which are ofmedicalimportance which could be used to treat specific diseases.	K2
CO3	Characterize the various types of nano particle synthesis and advocate promotes the use of nano materials and anno composites.	K3
CO4	Analyze and apply the important of nanoparticles in plant diversity.	K4
CO5	Construct various types of nanomaterial for application and evaluate the impact on environment.	K5 & K6

Cognitive Level: K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	2	1	2	3
CO3	3	3	3	2	3	3	3	2	2	3
CO4	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
II	**23P2BOEL4B**	**Elective IV - APPLIED BIOINFORMATICS**	**5**	**3**

Nature of the course

Employability Oriented	√	Relevant to Local need	√	Addresses Gender Sensitization	√
Entrepreneurship Oriented	√	Relevant to regional need		Addresses Environment and Sustainability	√
Skill development Oriented	√	Relevant to national need		Addresses Human Values	
		Relevant to Global development need		Addresses Professional Ethics	

Course Objectives

The main objectives of this course are to:

1.To learn about the bioinformatics databases, databanks, data format and data retrieval from the online sources.

2.To explain the essential features of the interdisciplinary field of science for better understanding biological data.

3.To outline the types of biological databases.

4.To demonstrate different online bioinformatics tools.

5.To summarize the strong foundation for performing further research in bioinformatics.

SYLLABUS		
Unit	Content	No. of Hours
I	**BIOINFORMATICS AND INTERNET:** Internet Basics - File Transfer Protocol - The World Wide Web - Internet Resources –databases – types- Applications - NCBI Data Model - SEQ-Ids – Biosequences - Biosequence sets – Sequence annotation – Sequence description.	15
II	**GENBANK SEQUENCE DATABASE:** Primary And Secondary Databases - Format Vs. Content - Genbank Flatfile- Submitting DNA Sequences to the Databases - DNA/RNA - Population, Phylogenetic tree, and Mutation Studies - Protein-Only Submissions - Consequences of DNA Model- EST/STS/GSS/HTG/SNP and Genome	15

	Centers - Contact points for submission of sequence data to DBJ/EMBL/Genbank.	
III	**STRUCTURE DATABASES:** Introduction to Structures - Protein Data Bank (PDB) - Molecular Modeling Database at NCBI Structure File Formats - Visualizing Structural Information - Database Structure Viewers - Advanced Structure Modeling - Structure Similarity Searching.	15
IV	**SEQUENCE ALIGNMENT AND DATABASE SEARCHING:** Introduction - Evolutionary Basis of SequenceAlignment - Modular Nature of Proteins - Optimal Alignment Methods - Substitution Scores and Gap Penalties- Database Similarity Searching - FASTA – BLAST (BlastP, BlastN, etc.,) - Position Specific Scoring Matrices, Spliced Alignments.	15
V	**PREDICTIVE METHODS:** Using Protein Sequences Protein Identity Based on Composition - Physical Properties Based on Sequence - Motifs and Patterns - Secondary Structure and Folding Classes - Specialized Structures or Features - Tertiary Structure.	15

Textbook:

1. Baxevanis, A. D. & Ouellette, B. F. 2001. Bioinformatics: A practical guide to the analysis ofgenes and proteins. New York: Wiley-Interscience.
2. Bourne, P. E., & Gu, J. 2009. Structural bioinformatics. Hoboken, NJ: Wiley-Liss.
3. Lesk, A. M. 2002. Introduction to bioinformatics. Oxford: Oxford University Press.
4. Mount, D. W. 2001. Bioinformatics: Sequence and genome analysis. Cold Spring Harbor, NY:Cold Spring Harbor Laboratory Press.
5. Pevsner, J. 2015. Bioinformatics and functional genomics. Hoboken, NJ: Wiley-Blackwell.

References:

1. Campbell, A.M and Heyer, L.J. 2003. Discovering genomics, proteomics, and bioinformatics.San Francisco: Benjamin Cummings.
2. Green, M.R and Sambrook, J. 2012. Molecular cloning: A laboratory manual. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.
3. Liebler, D.C. 2002. Introduction to proteomics: Tools for the new biology. Totowa, NJ: HumanaPress.
4. Old, R.W., Primrose, S.B., and Twyman, R.M. 2001. Principles of gene manipulation: Anintroduction to genetic engineering. Oxford: Blackwell Scientific Publications.
5. Primrose, S.B., Twyman, R.M., Primrose, S.B., and Primrose, S.B. 2006. Principles of gene manipulation and genomics. Malden, MA: Blackwell Pub.

Web resources:

1. Bioinformatics: Algorithms & Applications by Prof. M. Michael Gromiha IIT-Madras. https://nptel.ac.in/courses/102/106/102106065/#.
2. Christopher Burge, David Gifford, and Ernest Fraenkel. *7.91*.J Foundations of Computational andSystems *Biology.* Spring 2014. Massachusetts Institute of Technology: MIT Open Course Ware, https://ocw.mit.edu.
3. https://link.springer.com/book/10.1007/978-3-540-72800-9.
4. https://www.amazon.in/Applied-Bioinformatics-Paul-Maria-Selzer-ebook/dp/B001AUOYY2.

Pedagogy:

Teaching / Learning methods like Lecture, Tutorial, Assignment, PPT presentation, Quiz, Group Discussion, e-content Seminar.

Course Outcomes

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

CO	CO Statement	Programme outcomes
CO1	Familiarize with the tools of DNA sequence analysis.	K1 & K2
CO2	Use and explain the application of bioinformatics.	K2 & K3
CO3	Master the aspects of protein-protein interaction, BLAST and PSI - BLAST.	K3 & K4
CO4	Describe the features of local and multiple alignments.	K3 & K4
CO5	Interpret the characteristics of phylogenetic methods in bioinformatics applications.	K4 & K5

Cognitive Level: K1 - Remember; K2 - Understanding; K3 - Apply; K4 - Analyze; K5 – Evaluate; K6 – Create

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	3	3	3
CO2	2	3	3	3	3	2	2	3	2	2
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	1	3	3
CO5	3	2	2	2	3	3	3	3	3	3

S-Strong (3) M-Medium (2) L-Low(1)

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
II	**23P2BOSEC2**	**SKILL ENHANCEMENT COURSE - AGRICULTURE AND FOOD MICROBIOLOGY**	**2**	**2**

Nature of the course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented		Relevant to regional need	√	Addresses Environment and Sustainability	√
Skill development Oriented		Relevant to national need		Addresses Human Values	
		Relevant to Global development need		Addresses Professional Ethics	

Course Objectives

The main objectives of this course are:

1. To provide comprehensive knowledge about plant – microbe interactions
2. To provide basic understanding about factors affecting growth of microbes
3. To appreciate the role of microbes in food preservation
4. To understand about the benefits of microbes in agriculture and food industry.
5. To gain knowledge about practices involved in food industry.

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**MICROORGANISMS IN AGRICULTURE:** Biofertilizers: Types, Production, Field application and Role of symbiotic, non-symbiotic Cyanobacteria, Mycorrhiza and Phosphate Solubilizing Microorganisms (PSM) and Vermi-compost in agriculurre. Plant Growth Promoting Microorganisms (PGPM). Biocontrol of plant pathogens, pests and weeds. Restoration of waste and degraded lands.	6
II	**MICROBES AS SOURCE OF FOOD** Mushrooms, Single Cell Protein. Microbes and fermented foods-Butter, Cheese and Bakery products. Food preservation – Temperature, drying, radiation and chemicals. Intrinsic and extrinsic factors influencing growth of microorganisms in food. Microbial spoilage of foods – Cereals, vegetables, pickles, fish and dairy products. Food poisoning and food intoxiation.	6

Textbook:

1. Pelczar M.J., Chan E.C.S. and Krieg N.R. 2003. Microbiology. 5th Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.
2. Subba Rao, N. S. 2000. Soil microbiology. 4th Edition, Oxford and IBH publishing Co. Pvt. Ltd., Calcutta, New Delhi, India.
3. Rangaswami, G. and Bagyaraj, D.J. 2006. Agricultural Microbiology. 2nd Unit 2nd Edition, PHI Learning, New Delhi, India.
4. Prescott, L.M., Harley J.P., Klein D. A. 2005. Microbiology, McGraw Hill, India. 6thedition.
5. Goldman, E. and Green, L.H. 2015. Practical Handbook of Microbiology (3rd Ed.). CRC Press.

References:

1. Adams, M.R. and Moss M. O. 2008. Food Microbiology, 3rd Edition, Royal Society of Chemistry, Cambridge, U.K.
2. Sylvia D.M. 2004. Principles and Applications of Soil Microbiology, 2nd Edition, Prentice Hall, USA.
3. Frazier, W.C. 1995. Food Microbiology, 4th Edition, Tata McGraw Hill Education, Noida, India.
4. Waites M.J., Morgan N.L., Rockey J.S. and Higton G. 2001. Industrial Microbiology: An Introduction. 1st Edition, Blackwell Science, London, UK.
5. Das, S. and Saha, R. 2020. Microbiology Practical Manual. CBS Publishers and Distributors (P) Ltd., New Delhi, India.

Web resources:

1. https://www.kopykitab.com/Agriculture-And-Food-Microbiology-In-Hindi-by-Dr-Q-J-Shammi
2. https://agrimoon.com/agricultural-microbiology-icar-ecourse-pdf-book/
3. https://play.google.com/store/books/details/Applied_Microbiology_Agriculture_Environmental_Foo?id=DgVLDwAAQBAJ&hl=en_US&gl=US
4. https://www.scientificpubonline.com/websitebooks/ebooks/agriculture/microbiology
5. https://www.amazon.in/Food-Microbiology-Martin-R-Adams-ebook/dp/B01D6B7V6A

Pedagogy: Lecture, Assignment, PPT Presentation, Quiz, Group Discussion, Seminar.

Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	Recognize the general characteristics of microbes and factors affecting its growth	K1
CO2	Explain the significance of microbes in increasing soil fertility	K2
CO3	Elucidate concepts of microbial interactions with plant and food.	K3
CO4	Analyze the impact of harmful microbes in agriculture and food Industry	K4
CO5	Determine and appreciate the role of microbes in food preservation and as biocontrol.	K5 & K6

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	2	1
CO2	3	3	2	2	3	3	2	3	3	3
CO3	2	2	3	3	1	2	1	3	1	2
CO4	3	3	3	3	3	2	3	3	3	2
CO5	3	3	2	3	2	3	3	3	2	3

S-Strong (3) **M-Medium (2)** **L-Low (1)**

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
II	**23P2BOAECC2**	**Ability Enhancement Compulsory Course - Language Lab**	**2**	**2**

Nature of the course

Employability Oriented	√	Relevant to Local need	√	Addresses Gender Sensitization	
Entrepreneurship Oriented	√	Relevant to national need	√	Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to regional need	√	Addresses Human Values	√
		Relevant to Global development need	√	Addresses Professional Ethics	√

Course Objectives

The main objectives of this course are to:

1. To facilitate computer-assisted multi-media instruction enabling individualized and independent language learning
2. o sensitize students to the nuances of English speech sounds, word accent, intonation and rhythm
3. To bring about a consistent accent and intelligibility in students' pronunciation of English by providing an opportunity for practice in speaking
4. To improve the fluency of students in spoken English and neutralize their mother tongue influence
5. To train students to use language appropriately for public speaking and Interviews

Unit – I LSRW

Listening Skills: Introduction to Phonetics – Speech Sounds – Vowels and Consonants, Listen to News, poem, songs, Motivational speech, stories, movies, interesting facts, sign of zodiac, dialogues, idioms, dictation – Common errors

Speaking Skills: Stress, Intonation, Homophone, Silent Letters, Greetings, Small Talk, Telephone English, Role Play, Tongue Twisters, Welcome Speech & Vote of Thanks, Compering, Declamation, Sing Along, Brain Storming, JAM (Just A Minute)

Reading Skills: Reading test, Skit, Proof Reading, Oral Reading Fluency, Reading Stories,

Writing Skills: learn English Grammar through Tamil Translation, Reading Comprehension-short stories, informational passages, Advanced Critical reading –Intelligence Augmentation, Dialogues, Sentence Completion, Word Definition, Classic Analogy Bridges, Sentence Analogies, Same Sound, Divided Syllables, Finish the Story, Answering the questions, Practical Writing, Making a formal Argument, Free Writing, Using Precise Language

Unit – II Career and Soft Skills

Career Skills: Body Language (BL) : BL Interview, BL Model, BL Tips, Business English,

Communication skills, GD, Interview Skills

Soft Skills: Assertiveness, Creativity, Critical Thinking and Problem Solving, Empathy, Enthusiasm and attitude, Goal Setting, Great interviews, Negotiation Skills, Personality Development, Professionalism, Self Esteem, Stress Management, Team Building, Time Management, Motivation and Attitude, Interpersonal relationship and skills, Networking,

Reference:

1. Materials prepared by the Department of English for Writing skills
2. Soft Skills – Know Yourself and know the world, Dr.K.Alex, Chand Publications, 3rd revised edition 2014
3. Software : Express Pro Lite

The Language Lab focuses on the production and practice of sounds of language and familiarizes the students with the use of English in everyday situations both in formal and informal contexts.

Learning Outcomes: Students will be able to attain

- Better understanding of nuances of English language through audio- visual experience and group activities
- Neutralization of accent for intelligibility
- Speaking skills with clarity and confidence which in turn enhances their employability skills

Minimum Requirement of infrastructural facilities for Language Lab:

1. Computer Assisted Language Learning (CALL) Lab:

The Computer Assisted Language Learning Lab has to accommodate 40 students with 40 systems, with one Master Console, LAN facility and English language learning software for self- study by students.

System Requirement (Hardware component):

Computer network with LAN facility (minimum 40 systems with multimedia) with the following specifications:

i) Computers with Suitable Configuration
ii)High Fidelity Headphones

2. Interactive Communication Skills (ICS) Lab:

The Interactive Communication Skills Lab: A Spacious room with movable chairs and audio-visual aids with a Public-Address System, a LCD and a projector etc.

Semester	Course Code	Course Title	Hours of Teaching/Cycle	No. of Credits
III	**23P3BOC5**	**CELL BIOLOGY, GENETICS AND PLANT BREEDING**	**6**	**4**

Nature of the course

Employability Oriented	√	Relevant to Local need	√	Addresses Gender Sensitization	
Entrepreneurship Oriented	√	Relevant to regional need		Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to national need	√	Addresses Human Values	√
		Relevant to Global development need	√	Addresses Professional Ethics	

Course Objectives

The main objectives of this course are to:

1. To enable to learn various cell structures and functions of prokaryotes and eukaryotes and understandthe salient features and functions of cellular organelles.
2. To understand the cell division and its molecular mechanism so as to appreciate andmanipulate normal and abnormal cell and tissue growth.
3. The students will be able to have conceptual understanding of laws of inheritance, genetic basis of loci and alleles and their linkage
4. To understand the chemical basis of genes and their interactions
5. To familiarize with genetic basis of heterosis and Role of various non-conventional methods used in crop improvement.

SYLLABUS

Unit	Content	No. of Hours
I	**CELL BIOLOGY I:** Concept of prokaryotes and Eukaryotes. Structural organization of plant cell, Cell wall - Structure and functions, Plasma membrane; structure, models and functions, site for ATPase, ion carrier's channels and pumps, receptors. Plasmodesmata and its role in movement of molecule. Nucleus: Structure and function, nuclear pore, Nucleosome organization, euchromatin and heterochromatin. Ribosome - Structure and functionalsignificance.	18

II	**CELL BIOLOGY II:** Chloroplast - structure and function, genome organization, gene expression, Mitochondria; structure, genome organization, biogenesis. Plant Vacuole - Tonoplast membrane, ATPases transporters as a storage organelle. Structure and function of other cell organelles- Golgi apparatus, lysosomes, endoplasmic reticulum and microbodies. Cell cycle and Apoptosis; Control mechanisms, role of cyclin dependent kinases.	18
III	**GENETICS I:** Mendal's Law of inheritance. Gene interactions and modified dihybrid ratios. Quantitative inheritance. Sex determination in plants and theories of sex determination. Sex linked characters. Structure of Gene, Operon, inducible operon, Operator site, Promoter, Polycistronic mRNA, Regulator, repressor, super repressor, inducer. Gene function and regulation in prokaryotes with reference to Lac operon and trp operon. Producer gene, structural gene and integrator gene. Gene Regulation in eukaryotes – Britten and Davidson model, Arabidopsis - gene regulation in flowering plants.	18
IV	**GENETICS II:** Recombination: Homologous and non-homologous recombination, site-specific recombination. Transposable genetic elements: transposon, UV induced mutation and its repair mechanism. Mismatch DNA repair mechanism. ABO blood group in humans - QTL mapping. Gene mapping methods**:** Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids. Extra chromosomal inheritance, maternal inheritance. Organelle genomes: Organization and functions of chloroplast and mitochondrial DNA.	18
V	**PLANT BREEDING:** Objectives of plant breeding - Genetic basis of breeding of self and cross - pollinated crops. Introduction and domestication - Methods of plant breeding – Selection -Pure line, mass and clonal selection. Hybridization –Pedigree breeding, bulk breeding and back cross breeding -Heterosis breeding - Mutation in plant breeding - Polyploidy in plant breeding.	18

Textbook:-

1. Roy, S.C and Kumar, K.D.C. 1977. Cell Biology, New Central Book Agency, Calcutta.
2. Karp, G. 2010.Cell and Molecular Biology: Concepts and Experiments.6th edition. John Wiley& Sons.
3. Aminul, I. 2011. Text Book of Cell Biology. Books and Allied (P) Ltd, Kolkata, India.
4. GeoffreyM.Cooper.2019.TheCell:AMolecularApproach, Oxford University Press.

5. Turner, P.C., Mclenann,A.G., Bates, A.D. and White, M.R.H. 2001. Instant notes on molecular biology.
6. Watson, J.D, Baker T.A., Bell S.P., Gann A., Levine M., Losick R. 2014. Molecular Biology of the Gene (7th edition), Pearson Press.
7. Benjamin, A. Pierce. 2012. Genetics- A conceptual Approach. W.H. Freeman and Company, New York, England.
8. Sinnott, E.W.Dunn, L.E and Dobzhansky, T. 1973. Principles of Genetics. McGraw-Hill.New York.
9. Chaudhari, H.K.1984. Elementary Principles of Plant Breeding. Oxford & IBH Publishing Company.
10. Singh, B.D. 2013. Plant Breeding: Principles and Methods, Kalyani Publishers, New Delhi
11. Chaudhary, R.C. 2017. Introductory principles of plant breeding, Oxford IBH Publishers, New Delhi.

References:

1. Alberts B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J. D. 1989. Molecular biology of the Cell (2nd edition). Garland Pub. Inc., New York.
2. Karp, G. 1999. Cells and Molecular Biology: Concepts & Experiments. John Wiley and Sons, Inc., USA.
3. Lodish S, Baltimore B , Berk, C and Lawrence K, 1995 , Molecular Cell Biology , 3rd edn, Scientific American Books, N.Y
4. De Robertis and De Robertis, 1988, Cell and Molecular Biology, 8th edn, Info-Med, Hongkong.
5. Acquash, G.2007. Principles of Plant Genetics and Breeding. Blackwell Publishing.
6. William.S., Klug and Michael, R. Cummings, 2003. Concepts of Genetics. Seventh edition. Pearson Education (Singapore)Pvt.Ltd.
7. Simmonds, N.W. 1979. Principles of Crop improvement. Longman, London.
8. Lewin, B. 2000. Genes VII, Oxford University Press, USA.
9. Strickberger, M.W. 2005. Genetics (III Ed). Prentice Hall, New Delhi, India.
10. Allard, R.W. 2010. Principles of Plant Breeding. 2 nd ed. John Wiley and Sons, Inc. New Jersey, US.

Web resources:

1. https://www.pdfdrive.com/cell-biology-books.html
2. http://www.bio-nica.info/Biblioteca/Bolsover2004CellBiology.pdf
3. https://www.e-booksdirectory.com/listing.php?category=549
4. https://www.elsevier.com/books/molecular-biology/clark/978-0-12-813288-3
5. https://www.kobo.com/in/en/ebooks/molecular-biology

Pedagogy: Teaching / Learning methods

Lecture, Tutorial, Assignment,PPT presentation, Quiz, Group Discussion, e-content Seminar etc.)

Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	recall a plant cell structure and explain its function.	**K1**
CO2	illustrate and explain the structure of various cell organelles.	**K2**
CO3	explain the structure and functional significance of nucleic acid.	**K3**
CO4	compare and contrast the DNA replication (prokaryotes andeukaryotes), enzymes involved in replication, DNA repair	**K4**
CO5	discuss and develop skills for DNA/gene manipulating and theenzymes involved.	**K5& K6**

Cognitive Level:K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping of Course Outcomes with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	2	1
CO2	3	3	2	2	3	3	2	3	3	3
CO3	2	2	3	3	1	3	2	3	1	2
CO4	3	3	3	3	3	2	3	3	3	2
CO5	3	3	2	3	2	3	3	3	2	3

Semester	Course Code	Course Title	Hours of Teaching/Cycle	No. of Credits
III	**23P3BOC6**	**MOLECULAR BIOLOGYAND RECOMBINANT DNA TECHNOLOGY**	**6**	**4**

Nature of the course

Employability Oriented	√	Relevant to Local need	√	Addresses Gender Sensitization	
Entrepreneurship Oriented	√	Relevant to regional need		Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to national need	√	Addresses Human Values	√
		Relevant to Global development need	√	Addresses Professional Ethics	

Course Objectives

The main objectives of this course are:

1. To familiar with the basics of molecular biology and enlighten with recent developments
2. To thorough examination of DNA structure, replication process, transcription process and translation processes.
3. To learn the applied aspects of molecular biology and recombination technology, gene insertion and production of recombined new plants.
4. To impart knowledge that leads to comprehensive understanding of the principles, tools and practices of rDNA technology.
5. To enable students to gain basic understanding of rDNA techniques and its applications.

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**INTRODUCTION TO MOLECULAR BIOLOGY I:** Molecular biology – Basic concepts and scope - Structure and functions of nucleic acids – DNA – double helix – Types of DNA - Super coiling – Types of RNA – mRNA, rRNA and tRNA. Eukaryotic genome organization - Structure of chromatin, coding and non-coding sequences - DNA - Semi conservative replication - Enzymes involved in DNA replication - helicases, topoisomerases, DNA polymerases, DNA ligase, nucleases and methylases.	18
II	**MOLECULAR BIOLOGY II:** DNA replication (prokaryotes and eukaryotes), enzymes involved in replication,	18

	DNA repair. DNA sequencing. Transcription - Mechanism of transcription in prokaryotes and eukaryotes, enzymes involved in transcription, post transcription changes, reverse transcription - RNA splicing, RNA editing. Translation – genetic code - overlapping genes. Gene cloning: cloning vectors, molecular cloning and DNA libraries. Molecular genetic elements, insertion elements, transposons. Recombinant DNA. Direct and indirect gene transfer. Detection of recombinant molecule, production of gene products from cloned genes. Genome library, cDNA library.	
III	**INTRODUCTION TO RECOMBINANT DNA TECHNOLOGY I:** Recombinant DNA (DNA insertion in to Plasmid) - DNA/gene manipulating enzymes: endonucleases, ligases, polymerases, phosphatases, transcriptase, transferase, topoisomerase. Transformation - Direct and indirect gene transfer. Construction and screening of Genomic libraries and cDNA libraries.	18
IV	**APPLICATIONS OF RECOMBINANT DNA TECHNOLOGY II:** Production of antibiotic medicines: Human Deoxyribonuclease I, Human Tissue Plasminogen Activator, β-Glucocerebrosidase, L-Asparaginase, Deoxycytidine kinase, Acid sphingomyelinase. Penicillins, aminoglycosides, tetracyclines like antibiotics produced from fungi and bacteria. Recombinant hormones**:** insulin (somatotrophin), erythropoietin used in the treatment of anemia.	18
V	**APPLICATIONS OF RECOMBINANT DNA TECHNOLOGY III:** rDNA technology uses in animal husbandry and sericulture **-** Milk production in cattle, cheese ripening, and reduction of lactose levels. Fungal α-amylase silk production in sericulture. Uses in agriculture **-** disease resistant crops like Bt-cotton, Bt-brinjal and golden rice.	18

Textbook:

1. Neal Stewart, Jr. 2008. Plant Biotechnology and Genetics: Principles, Techniques and Applications. JohnWiley&sons Inc.
2. Smith. J.K. 1996. Biotechnology – 3 rd Ed. Cambridge Univ. Press, Cambridge.
3. Khan. I.A. and A. Khanum .2004. Fundamentals of Biotechnology – Forensic Science Genetic Engineering. Ukaaz publication, Hyderabad.
4. Mba, C., Afza, R., Bado, S., and Jain, S.M. 2010. Plant Cell Culture: Essential Methods, John Wiley & Sons, UK.
6. Abdin, M.Z., Kiran, U., Kamaluddin, M., Ali, A. (Eds.). 2017. Plant Biotechnology: Principles and Applications, Springer publishers.

References:

1. Watson, J.D. *et al.* 2003. Molecular Biology of the Gene. Fourth Edition. The Benjamin Cummings Pub. Co.
2. Lewin, B. 2003. Genes VIII. Oxford University Press.
3. Grierson, D.S. and Covey, S.N., (1988). Molecular Biology 2nd Ed., Blackie, Chapman and Hall, New York, USA.

4. Malchensky and Frifelder, (2003). Molecular Biology. Narosa Publishing House, New Delhi.
5. Friefelder, D. 2005. Molecular Biology. Second Edition. Narosa Publishing House.
6. Sobtir.C. and Gobe. 1991. Eukaryotic chromosomes. Narosa Publishing House.
7. Smith-Keary, P. 1991. Molecular Genetics. Macmillan Pub. Co. Ltd. London.

Web resources:

1.https://www.nature.com/scitable/topic/cell-biology

2.https://plato.stanford.edu/entries/molecular-biology/

3.https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/bioinformatics

4.https://onlinelibrary.wiley.com/doi/book/10.1002/9780470686522

5.https://books.google.co.in/books?id=oe_liIY_tVsC&printsec=frontcover#v=onepage&q&f=false

Pedagogy: Teaching / Learning methods

Lecture, Tutorial, Assignment, PPT presentation, Quiz, Group Discussion, e-content Seminar.

Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	Understand the basics of recombinant DNA technology.	K1
CO2	Demonstrate and to recollect the production of vitamins.	K2
CO3	Analyze theproduction of antibiotics.	K3
CO4	Compare and contrast the recombined organism and natural organisms.	K4
CO5	Create and develop skills for rDNA techniques and in producing hybrids varieties.	K5 & K6

Cognitive Level:K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	3	2	1	2
CO2	3	2	2	2	3	3	2	3	3	2
CO3	2	2	3	3	1	2	1	3	2	1
CO4	3	3	3	3	3	2	3	3	2	3
CO5	3	3	2	3	2	2	3	3	2	2

S - Strong (3) **M - Medium (2)** **L - Low (1)**

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
III	**23P3BOCP3**	**PRACTICAL – III: Cell Biology, Genetics and Plant Breeding; Molecular Biology and Recombinant DNA technology**	**6**	**4**

Nature of the course

Relevant to Local need	√	Employability Oriented	√	Addresses Professional Ethics	√
Relevant to national need	√	Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to regional need		Skill development Oriented	√	Addresses Environment and Sustainability	
Relevant to Global need	√			Addresses Human Values	√

Course Objectives

The main objectives of this course are :

1. To Observe the different stages of mitosis and chromosome behaviour and organization duringvarious stages and to learn staining techniques of various plant tissues.
2. To Explain the principles of linkage, crossing over and the hereditary mechanisms.
3. To Expose the students to gain recent advances in molecular biology.
4. To Understand the principles of plant breeding to apply crop improvement programmes
5. To Understand the principles of rDNA techniques.

SYLLABUS	
Unit	**Content**
I	**CELL BIOLOGY: 18 Hrs** 1. Identification of different stages of mitosis from suitable plant material. (Onion root tips, garlic root tips). 2. Identification of meiosis from plant materials (Onion/Tradeschantia floral buds). 3. Demonstration cell organelles: Mitochondria, Chloroplast, Nucleus, Lysosomes and there assay by succinate dehydrogenase activity (Mitochondria), acid phosphatase activity (Lysosome), acetocarmine staining (Nucleus) and microscopic observation (Chloroplast) 4. Study of mitotic index from suitable plant material. 5. Study of cyclosis in cells of suitable plant material. 6. To study plant vacuole in cells of onion leaf peel.

	7. To study the structure and organization of plant cell in various tissues of various plants (incl. leaf, stem and roots).
II	**GENETICS: 18 Hrs** Demostration of the following experiments using chart/ pictures/ models / LCD 1. Problem solving on dihybrid phenotypic, genotypic and test cross ratios. 2. Incomplete dominance in plants. 3. Interactions of factors and modified dihybrid ratios. 4. Multiple alleles in plants, blood group inheritance in human. 5. Sex linked inheritance in Drosophila and plants. 6. Quantitative inheritance in plants. 7. Tetrad analysis in Neurospora. 8. Complementation analysis to find out complementation groups in viruses. 9. Chromosome mapping from three-point test cross data. Calculation of chiasmatic interference.
III	**PLANT BREEDING: 18 Hrs** 1. Plant breeding techniques.
IV	**MOLECULAR BIOLOGY: 18 Hrs** Demonstration using advanced techniques 1. Restriction digestion of DNA samples using restriction endonucleases (RE). 2. Estimation of genomic DNA. 3. Electrophoresis of nucleic acid. 4. Preparation of competent *E.coli* cells. 5. Estimation of plasmid DNA.
V	**rDNA TECHNOLOGY: 18 Hrs** Demonstration using advanced techniques. 1. Transformation and recovery of plasmid clones. 2. Southern blotting technique. 3. Plasmid insertion techniques 4. Recombinant plasmids

Textbook:

1. George M Malacinski. 2015. Freifelders Essentials of Molecular Biology (4th ed.). Jones & Bartlett.
2. Gupta P.K. 2017. Cell and Molecular Biology (5th ed.), Rastogi Publications, Meerut.
3. Gupta, P.K. 2018. Cytogenetics, Rastogi Publications, Meerut.
4. Bharadwaj, D.N. 2012. Breeding of field crops (pp. 1-23). Agrobios (India).
5. Singh, R.J. 2016. Plant Cytogenetics. CRC press, US.
6. Shivakumar, S. 2002. Molecular analysis: Laboratory Manual. Madurai, India.

Reference books:

1. Gardener, J, Simmons, H.J and Snustad, D.P. 2006. Principle of Genetics, John Wiley & Sons, New York.
2. De Robertis E.D.P. and De Robertis E.M.P. 2017. Cell and Molecular Biology (8thed.) (South Asian Edition), Lea and Febiger, Philadelphia, USA.
3. Jackson, S.A., Kianian, S.F., Hossain, K.G., and Walling, J. G. 2012. Practical laboratory exercises for plant molecular cytogenetics. In Plant Cytogenetics (pp. 323-333). Springer, New York, NY.

4. Glick, B.R and J.E. Thompson. 1993. Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boca Raton, Florida.
5. Gunning, B.E.S and M. W. Steer. 1996. Plant Cell Biology: Structure and function. Jones and Bartlett Publishers, Boston, Massachusetts.
6. Henry, RJ. 1997. Practical applications of plant molecular biology, Chapman & Hall, London.
7. Krebs, J.E., Goldstein E.S. and Kilpatrick S.T. 2017. Lewin's GENES XII (12thed.). Jones & Bartlett Learning.

Web Resources:

1. https://www.madrasshoppe.com/cell-biology-practical-manual-dr-renu-gupta-9788193651223-200674.html
2. https://www.bjcancer.org/Sites_OldFiles/_Library/UserFiles/pdf/Cell_Biology_Laboratory_Manual.pdf
3. https://www.kopykitab.com/Practical-Plant-Breeding-by-Gupta-S-k
4. https://www.amazon.in/Plant-Tissue-Culture-Theory-Practicals/dp/9386347350

Pedagogy: Teaching / Learning methods

Lecture, Tutorial, Assignment, PPT presentation, Quiz, Group Discussion, e-content Seminar etc.

Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	Recall or remember the various aspects of cell biology, genetics, molecular biology, plant breeding and tissue culture.	K1
CO2	Understand various concepts of cell biology, genetics, plant breeding and tissue culture.	K2
CO3	Apply the theory knowledge gained into practical mode in order to acquire applied knowledge by day-to-day hands-on experiences.	K3
CO4	Analyze or interpret the results achieved in practical session in the context of existing theory and knowledge.	K4
CO5	Evaluate the theory and practical skills gained during the course.	K5 & K6

Cognitive Level: K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	2	1
CO2	3	3	2	2	3	3	2	3	3	3
CO3	2	2	3	3	1	2	1	3	1	2
CO4	3	3	3	3	3	2	3	3	3	2
CO5	3	3	2	3	2	3	3	3	2	3

S-Strong (3) M-Medium (2) L-Low (1)

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
III	**23P3BOCIM**	**INDUSTRY MODULE – INDUSTRIAL BOTANY**	**4**	**3**

Nature of the course

Employability Oriented	√	Relevant to Local need	√	Addresses Gender Sensitization	
Entrepreneurship Oriented	√	Relevant to Regional need		Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to National need	√	Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	√

Course Objectives

The main objectives of this course are to:

1. To learn the applied aspects of industrial application of algae, fungi, bacteria, plants, molecular biology and recombination technology.
2. The student would be competent to work in industries.
3. To educate people about the widespread commercial uses of fungi.
4. To know about the economic importance of plants.
5. To acquire knowledge on in vitro cultivation techniques to develop protocols targeted towards commercialization.

SYLLABUS

Unit	Content	No. of Hours
I	**ALGAE IN INDUSTRIES:** Fertilizer industry - Seaweeds, pharmaceutical industry – antibiotics, agar, carrageenan, alginin, diatomite earth, mineral industry, fodder industry – Cultivation, production and marketing of *Spirulina*.	12
II	**FUNGI IN INDUSTRIES:** Beneficial use of yeast, Fermentation of alcohol, preparations of enzyme, organic acid preparation, cheese production, protein manufacture, vitamins, fats - Cultivation, production and marketing of edible mushrooms.	12
III	**PLANT PRODUCTS:** Fibres and Fibre-yielding Plants, wood and cork, tannins and dyes, rubber, fatty oils and vegetable fats, sugars and starches, pulp and paper, gums and resins.	15

IV	**BACTERIA IN INDUSTRY:** Food industry, dairy products, bioleaching, biogas production, bioremediation	12
V	**RECOMBINANT PLANTS:** Tissue culture: Micropropagation, somatic seeds, cell culture – Synthetic seed production.	12

Text books:

1. Trivedi, P.C. 2001. Algal Biotechnology. Point publisher, Jaipur.India.
2. Dinabandhu, S and Kaushik. B.D. 2012. Algal Biotechnology and Environment. I.K. Internationa Delhi.
3. Poonam Singh and Ashok Pandey. 2009. Biotechnology for agro-Industrial residues utili Springer.
4. Dilip K. Arora. 2003. Handbook of Fungal Biotechnology. CRC Press book.
5. Vardhana, R. 2009. Economic Botany. 1st ed. Sarup Book Publishers Pvt Ltd. New Delhi.
6. Dubey R.C. 2004. A text book of Biotechnology aspects of microbiology, British Sun Publication
7. Pelzer, M.J., Chan, E.C.S and Krieg, N.R. 1983. Microbiology , Tata MaGraw Hill Publishing New Delhi.
8. Narayanaswamy, S. 1994. Plant Cell and Tissue Culture. Tata McGraw Hill Ltd. New Delhi

Reference books:

1. Becker. E.W. 1994. Micro algae Biotechnology and Microbiology. Cambridge University press.
2. Borowitzka, M.A. and borowizka, L.J. 1996. Microalgal Biotechnology. Cambridge University Press, Cambridge,
3. Sahoo, D. 2000. Farming the ocean: seaweed cultivation and utilization. AravaliInternational, New Delhi.
4. Mahendra Rai. 2009. Advances in Fungal Biotechnology. I.K. International Publishing House, New Delhi.
5. Street, H.E.1978. Essay in Plant Taxonomy, Academic Press, London,UK.
6. Alexander N. Glazer and Hiroshi Nikaido. 1994. Microbial Biotechnology.
7. Pandey, B.P. 2005. College Botany I: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. S Chand & Company.
8. Chichister, U.K.J. 1999. Cultivation and Processing of Medicinal Plants, Wiley & Sons
9. William Charles Evans.1989. Pharmacognosy, 14th ed. Harcourt Brace & Company.
10. Kumar, H.D.1999. Introductory Phycology. Affiliated East-West Press, Delhi.
11. Das, S and Saha, R. 2020. Microbiology Practical Manual. CBS Publishers and Distributors Ltd., New Delhi, India.
12. Reinert, J. Bajaj. T.P.S. 1977. Applied and Fundamental Aspects of Plant cell, tissue and organ C Springer – Verlaug.

Web resources:

1. https://www.elsevier.com/books/algal-biotechnology/ahmad/978-0-323-90476-6
2. https://www.amazon.in/Fungi-Biotechnology-Prakash-ebook/dp/B07PBF2R3D
3. https://www.amazon.in/Plant-Based-Natural-Products-Derivatives-Applications-ebook/dp/B0743
4. https://link.springer.com/book/10.1007/978-981-16-5214-1
5. https://link.springer.com/book/10.1385/0896031616

Course outcomes:	On completion of this course the student will be able to CO statement	Programme outcomes
CO1	Understand the basics of algae in industrial applications.	K1
CO2	Demonstrate and to recollect the uses in fungi in industries.	K2
CO3	Explain bacterial role in industries.	K3
CO4	Compare and contrast the use of plants in industries.	K4
CO5	Discuss and develop skills for working in industries specializing in biomolecules.	K5 & K6

Cognitive Level: K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	1	2	2
CO2	3	3	2	2	3	3	2	3	2	3
CO3	2	2	3	3	1	2	1	2	1	3
CO4	3	3	3	3	3	2	3	2	3	3
CO5	3	3	2	3	2	3	3	3	3	3

S - Strong (3) **M - Medium (2)** **L - Low(1)**

Semester	Course Code	Course Title	Hours of Teaching/Cycle	No. of Credits
III	**23P3BOEDC**	**EXTRA DISCIPLINARY COURSE - ENTREPRENEURIAL OPPORTUNITIES IN BOTANY**	**4**	**3**

Nature of the course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented		Relevant to Regional need		Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to National need	√	Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	√

Course Objectives

The main objectives of this course are to:

1. Understand the different classifications of horticultural crops, nursery management, and use of technology in horticulture.
2. Develop their competency on pre and post-harvest technology in horticultural crops.
3. Analyze the different methods of weed control and harvest treatments of horticultural crops.
4. Examine the economic implications of cultivation of tropical and sub-tropical vegetable crops.
5. Evaluate the importance of floriculture and contribution spices and condiments on economy.

SYLLABUS

Unit	Content	No. of Hours
I	**ORGANIC FARMING:** Organic manures and fertilizers. Composition of fertilizer, NPK content of various fertilizers. Common organic manures bone meal, cow dung, poultry waste, oil cakes, organic mixtures and compost. Preparation of compost, Vermicompost preparation, Vermiwash, Panchakaviya. Advantages of Vermicompost and Panchakaviya.	12
II	**GARDENING I:** Common garden tools. Methods of plant propagation by seeds. Vegetative propagation, cutting, grafting, budding and layering. Use of growth regulators for rooting. Advantages of Horticulture.	12

III	**GARDENING II:** Gardening – types of gardens, ornamental, indoor garden, kitchen garden, terrace garden, vegetable garden for marketing. Rockery and artificial ponds. Ornamental garden designing, garden components flower beds, borders, hedges, edges.	12
IV	**HORTICULTURE:** Packaging of fruits, vegetables. Preservation techniques drying, heat treatment, low temperature storage and by chemicals. Preparation of wine, vinegar and dairy products.	12
V	**EDIBLE MUSHROOM CULTIVATION:** Significance of edible mushrooms. Types of mushrooms. Cultivation of mushrooms - Spawn and mushrooms bed preparation (Button mushroom, Oyster mushroom), Storage of mushrooms. Recipes from mushroom – Pickles, Omelette, Briyani, Pakoda.	12

Text Book:

1. Chmielewski, J.G and Krayesky, D. 2013.General Botany laboratory Manual. Bloomington, USA.

2. Russell, T. 2012. Nature Guide: Trees: The world in your hands(Nature Guides). Mukherjee D. Gardening in India, Oxford IBH publishing co, New Delhi.

3. Kumar, N. 1997. Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.

4. Webster, J and Weber, R. 2007. Introduction to Fungi, 3rd Ed. Cambridge University Press, Cambridge.

5. Bendre, M. Ashok and Ashok Kumar, A. 2020. Text Book of Practical Botany 1 (10thed). Rastogi Publications, Meerut.

6. Singh, R and U.C. Singh 2020. Modern mushroom cultivation, 3d Edition Agrobios (India), Jodhpur.

Reference Books:

1. Adams, C.R. Banford, K.M. and Early, M.P. 1993. Principles of Horticulture.
2. Sathe, T.V. 2004. Vermiculture and Organic farming, Daya Publishers.
3. Peter, K.V. 2017. Basic Horticulture.
4. Hartman, H.T. and D.F. Kestler. 1976. Plant propagation principles and practice. Prentice Hall of India, New Delhi.
5. Jules Janick, 1982. Horticulture Science. Surjeet publications, New Delhi.
6. Ignacimuthu, S.1998. Plant Biotechnology. Tata Mc Graw Hill Ltd., New Delhi.
7. Gupta. P.K.,1998. Elements of Biotechnology. Rastogi publications, Meerut.
8. Edmond Musser and Andres, Fundamentals of Horticulture, McGraw Hill Book Co., New Delhi.

9. Janick Jules. 1979. Horticultural Science. (3rd Ed.), W.H. Freeman and Co, San Francisco, USA.

Web resources:

1. https://www.kobo.com/in/en/ebook/composting-process-organic-manures-through-eco-friendly-waste-management-practices
2. https://books.google.co.in/books/about/Plant_Propagation.html?id=K-gQh6OI7GcC&redir_esc=y
3. https://www.ebooks.com/en-us/subjects/gardening/
4. https://www.amazon.in/Preservation-Techniques-Publishing-Technology-Nutrition-ebook/dp/B00RXCXB3Q
5. https://www.elsevier.com/books/food-preservation-techniques/zeuthen/978-1-85573-530-9

Course outcomes: CO	**On completion of this course, the students will be able to: CO statement**	**Programme outcomes**
CO1	Students can acquire knowledge about organic farming and their Advantages	K1
CO2	Analyze both the theoretical and practical knowledge in understanding various horticultural techniques.	K2
CO3	To develop kitchen garden or terrace garden in their living area.	K3
CO4	Evaluate the horticultural techniques to students can develop self employment and economical improvement.	K4
CO5	Create and develop skills for mushroom cultivation.	K5 & K6

Mapping with Programme Outcomes:

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	1	3	2	1	2	2	3	2
CO2	3	3	2	2	3	3	2	3	2	3
CO3	2	2	3	3	1	2	1	3	3	1
CO4	3	3	3	3	3	2	3	3	3	3
CO5	3	3	2	3	2	3	3	3	3	2

S-Strong (3) M-Medium (2) L-Low(1)

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
III	**23P3BOSEC3**	**Skill Enhancement Course - Plant Tissue Culture**	**3**	**2**

Nature of the course

Employability Oriented	√	Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented		Relevant to Regional need		Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to National need	√	Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	√

Course Objectives

The main objectives of this course are to:

1. To know various aspects of Plant tissue culture
2. To know the concept and techniques of plant tissue culture.
3. To study the culture of tissues and organs
4. To know about the haploid production.
5. To understand the applications of tissue culture.

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	Introduction –History, scope and concepts of basic techniques in plant tissue culture – Laboratory requirements – Sterilizaiton – Medium preparation – Composition of MS medium. Culture of Cell, tissue and organ – explants preparation – Organogenesis – Direct and indirect – Somatic embryogenesis – Factors affecting embryogenesis.	12
II	Haploid production – Anther culture – Haploids in plant breeding – In vitro pollination – Ovule and embryo culture and its importance. Protoplast culture – Isolation and production of protoplasts – Viabilty- Protoplast fusion – Spontaneous, mechanical, induced and electro – fusion – importance of protoplast culture – Application of tissue culture – Biotechnological Industries in India.	12

Books for References

1. Bhojwant, S.,S. and Razdan, M.K. (1983), Plant Tissue Culture : Theory and practice. Elsevier Science Publishers, Netherlands.
2. Dodds, J.H. and Roberts, I.W. (1985), Experiments in Plant Tissue culture. Camb ridge University Press, UK
3. Hammoond, J. McGarvey, P and Yusibov, V.(2000). Plant Biotechnology. Springer Verlag, New York.
4. Johri, B.M. (1982) Experimental Embryology of Vascular Plants. Narosha Publishing House, New Delhi.
5. Ramawat, K.G. (2000). Plant Biotechnology. S.Chand & Co., New Delhi.
6. Reinert, J. and Bajaj, Y.P.S. (1977). Plant Cell Tissue and organ culture: A Laboratory Manual, Narosa Publishiing House, New Delhi.
7. K.Karthikeyan,. C.Chandran and S.Kulothugan (2007). Plant Biotechology.
8. Dr.Rite Singh (2004) PLand Biotechnology, global vision publisher, New Delhi – 110002.

Text Books:

1. Bhajwani, S and Razdan, 1984. Plant Tissue Culture. Theory and practice.
2. Ignacimuthu, S.J. 2003. Plant Biotechnology. Oxford & IBH Publishing, New Delhi.
3. Bhojwant, S.S. and Razdan, M.K. 2004. Plant Tissue Culture, Read Elsevier India. PVt. Ltd.
4. Purohit, S.S. 2010. Plant Tissue Culture, Student Edition, Jodhpur.
5. Bajaj, Y.P.S. 1987. Biotechnology in agricult ure nad forestry – springer- verlag.

Web Sources :

1. http://www.freeboocentre.net/biology/BioTechnology-Book.html
2. http://www.kobo.com/us/en/ebook/plant-biotechnolgy- i
3. http://www.kobo.com/us/en/ebook/plant-biotechnolgy- i
4. http://www.worldcat.org/title/molecular-biology/oclc/1062496183

Pedagogy: Teaching / Learning methods

Lecture, Tutorial, Assignment, PPT presentation, Quiz, Group Discussion, e-content Seminar etc.

Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	Knowledge of various aspects of Plant tissue culture	K1
CO2	Outline the concept and techniques of plant tissue culture.	K2
CO3	Understand the culture of tissues and organs	K3
CO4	Knowledge about the haploid production	K4
CO5	Understand the applications of tissue culture.	K5 & K6

Cognitive Level: K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	2	1
CO2	3	3	2	2	3	3	2	3	3	3
CO3	2	2	3	3	1	2	1	3	1	2
CO4	3	3	3	3	3	2	3	3	3	2
CO5	3	3	2	3	2	3	3	3	2	3

S-Strong (3) M-Medium (2) L-Low (1)

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
III	**23P3BOAECC3**	**Ability Enhancement Compulsory Course - RESEARCH METHODOLOGY**	**2**	**2**

Nature of the course

Employability Oriented		Relevant to Local need		Addresses Gender Sensitization	
Entrepreneurship Oriented		Relevant to regional need		Addresses Environment and Sustainability	√
Skill development Oriented	√	Relevant to national need		Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	√

Course Objectives

The main objectives of this course are to:

1. To make the students to learn the principles and applications of biological techniques.
2. To learn the students to understand the problem selection for research and project design
3. To lay a strong foundation for the students to understand the basics of research publication,journal metrices and ethics in research.

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**BASIC LABORATORY REQUIREMENTS:** Handling and maintenance of chemicals, solvents and glassware. Sterilization methods – Heat sterilization (Autoclave) and Chemical sterilization. Distillation, Pipetting, Filtering, Decanting and Lyophilization processes. Centrifugation – principle, calibration of instruments – types of centrifuges. Basic principle and applications of pH meter. Principle, procedure, types and applications of chromatographic techniques. Spectrophotometer – principle and applications.	15
II	**RESEARCH DESIGN AND PUBLICATION ETHICS** Choosing a problem for research – Review of literature – Primary, Secondary and Tertiary sources – Analysis of data – Bibliography. Reporting the results of research in conferences – Oral presentation and Poster Presentation. Journal:	15

	peer reviewed and non-peer reviewed journals - Impact factor - Citation. Indexing databases - Web of Science and Scopus. Unique object identifiers - Publication ethics - COPE, Scientific misconducts and Predatory publications.	

Textbook:

1. Gurumani N, 2006. Research Methodology for Biological Sciences, MJP Publishers, Chennai.
2. Kothari CR, 2009. Research Methodology: Methods and Techniques (2nd Revised Edition), New Age International Publishers, New Delhi, India.
3. Ravichandran K, Ravichandran AT, Ayyanar M, Kavitha P, 2022. Research Methodology and Publication Ethics, A Researcher's Handbook, Jazym Publications, Trichy, India.
4. Mani K, Vijayaraj S, Padmanaban. Bioinformatics for Beginners.

References:

1. Jayaraman, J. 2000. Laboratory manual of Biochemistry, Wiley Eastern Limited, New Delhi 110 002.
2. Mishra Shanthi Bhusan. 2015. Handbook of Research Methodology - A Compendium for Scholars & Researchers, Ebooks2go Inc.
3. Narayana, P.S.D. Varalakshmi, T. Pullaiah. 2016. Research Methodology in Plant Science, Scientific Publishers, Jaipur, Rajasthan.
4. Zar, J.H., 1984. Biostatistics Analysis, Prentice Hall International, England Cliffs, New Jerseym.
5. SreeRamulu, V.S., 1988. Thesis Writing, Oxford & IBH Pub., New Delhi.

Web resources:

1. https://www.kobo.com/in/en/ebook/bioinstrumentation-1
2. https://www.worldcat.org/title/bioinstrumentation/oclc/74848857
3. https://www.amazon.in/Bioinstrumentation-M-H-Fulekar-Bhawana-Pandey-ebook/dp/B01JP3M9TW
4. https://en.wikipdia.org/wiki/bioinstrumentation
5. https://www.britannica.com/science/chromatography

Pedagogy: Lecture, Assignment, PPT Presentation, Quiz, Group Discussion, Seminar.

Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	learn and remember the basic laboratory requirements.	**K1**
CO2	gain some knowledge on principles of bioinstruments.	**K2**
CO3	analyze the basic information on application of bioinstruments.	**K2, K4**
CO4	evaluate the various aspects research and research design in thesis writing.	**K5**
CO5	create awareness on the standards of research journals and check plagiarism.	**K6**

K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	3	3	3	1	3	3
CO2	3	2	2	3	3	3	3	2	3	3
CO3	3	1	2	3	3	3	3	1	3	3
CO4	3	2	1	3	3	3	2	1	3	2
CO5	3	1	2	2	3	3	3	2	3	3

S-Strong (3) **M-Medium (2)** **L-Low (1)**

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
IV	**23P4BOC7**	**PLANT PHYSIOLOGY AND PLANT METABOLISM**	**6**	**4**

Nature of the course

Employability Oriented		Relevant to Local need	√	Addresses Gender Sensitization	
Entrepreneurship Oriented		Relevant to Regional need		Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to National need	√	Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	√

Course Objectives

The main objectives of this course are:

1. To acquire knowledge on the functional aspects of plants.
2. To understand the biophysical and biochemical processes of plants.
3. To study the metabolism of plants.
4. To learn the plant growth regulations.
5. To know the adaptive mechanisms of plants in adverse environmental conditions.

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**WATER RELATIONS AND SOLUTE TRANSPORT:** Physical and chemical properties of water –Components of water potential - Plasmolysis - water absorption by roots – Apoplast and Symplast concept - water transport through the xylem — Transpiration and evapotranspiration- stomatal structure and function – mechanism of stomatal opening and closing – Mineral nutrition – essential nutrients – macro and micro nutrients – deficiencies and plant disorders – absorption of solutes – translocation of solutes – pathways and mechanisms. phloem loading and unloading - translocation of photosynthates – source- sink relationship – partitioning of assimilates and harvest index	18
II	**PHOTOSYNTHESIS:** The physical nature of light – the absorption and fate of light energy – absorption and action spectra- photoreceptors - Ultrastructure and biochemical compartmentation of Chloroplast; Photosynthetic Electron Transport and	18

	Photophosphorylation (cyclic and noncyclic): Photosystems and reaction centres - Light Harvesting complexes - Photosystem I & II and Oxidation of Water; Carbon metabolism: C3, C4 and CAM pathways and their distinguishing features - photorespiration and its significance. Biochemistry and Molecular Biology of RUBISCO.	
III	**RESPIRATION:** An overview of plant respiration – Aerobic and Anaerobic respiration - Glycolysis – TCA cycle – Electron Transport System – oxidative phosphorylation and ATP synthesis – Chemiosmotic Theory - Respiration and its significance in crop improvement. Nitrogen fixation (Biological - symbiotic and non-symbiotic), Physiology and Biochemistry of nitrogen fixation.	18
IV	**PHOTOMORPHOGENESIS:** Growth and development – Phases of plant growth – growth types- Growth substances - Auxins, gibberellins, cytokinins, abscisic acid, ethylene, brassinosteroids - physiological effect and mechanism of action in agricultural and horticultural crops – Photoperiodism – Classification of plants and mechanism of flowering – Phytochrome and their action on flowering – Vernalization- Mechanism and its practical application, biological rhythms and movements. Seed dormancy and causes and Seed germination and their biochemical changes.	18
V	**SENESCENCE AND STRESS PHYSIOLOGY:** Plant senescence – Types and Mechanism of senescence - Abscission: Morphological and biochemical changes – Significance. Fruit ripening - Biochemical, Physiological changes and control of fruit ripening. Plant response to environmental stress: Biotic and Abiotic stress – Water, temperature, light and salinity- Adaptive mechanism to various stresses (avoidance, escape, tolerance) – stress responsive proteins – anti-oxidative mechanism.	18

Recommended Text:

1. Gauch, H.G.1972. Inorganic Plant Nutrition. Hutchinson & Dowd. New York.
2. Govindji. 1982. Photosynthesis. AP. New York.
3. Jacob, W.P. 1979. Plant Hormones and Plant Development. Cambridge University Press. Cambrigde
4. Khan, A.A. 1982. The Physiology and Biochemistry of Seed development, Dormancy and Germination. Elesiver. Amsterdam.
5. Salisbury, F. B. and C.W. Ross.1991. Plant Physiology. Wassworth Pub. Co. Belmont.
6. Ting, I.P. 1982. Plant Physiology. Addison Wesley Pb. Philippines.
7. Sage, R and R.K. Monson (eds). 1999. The Biology of C4 Plants AP New York.
8. Postgate, J. 1987. Nitrogen Fixation. 2nd Edition Cassel, London.

9. Lincoln Taiz, Eduardo Zeiger, Ian Max Moller and Angus Murphy. 2015. Plant Physiology. 6th Ed., Sinauer Associates.
10. Stacey, G.R.H. Burris and Evans, H.J. 1992. Biological Nitrogen Fixation. Chapman and Hall, New York
11. Mann, J. 1987. Secondary Metabolism Clarendron Press, Oxford.
12. Jain, V.K. 2017. Plant Physiology, S. Chand & Company Ltd. New Delhi.
13. Lincoln, T, Eduardo, Z, Ian Max, M, and Angus, M. 2018. Fundamentals of Plant Physiology. Sinauer Associates Inc., US.
14. Pandey, N.S and Pandey, P. 2016. Textbook of Plant Physiology. Daya Publishing House, New Delhi.

References Book

1. Bidwell, R.G.S. 1974. Plant Physiology, Macmillan Publisher, Boston.
2. Devlin, R.M. 1996. Plant Physiology, PWS publisher, Boston.
3. Jain, V.K. 2017. Fundamentals of Plant Physiology. Chand & Company Ltd., New Delhi.
4. Gontia. 2016. A textbook of Plant Physiology. Satish Serial publishing House, New Delhi.
5. Leopold, A.C, 1994. Plant Growth and Development, McGraw Hill, New York.
6. Lincoln Taiz *et al.,* 2014. Plant Physiology and Development. Sinauver Associates Inc.Publishers, Sunderland, Massachusetts.
7. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (2nd Edition). SpringerVerlag, New York, USA.
8. Noggle, R.G and Fritz, G.J. 2010. Introductory Plant Physiology, PHI Learning Pvt Ltd, New Delhi.
9. Park S. Nobel. 2005. Physicochemical and Environmental Plant Physiology. Elsevier Academic Press, New York.
10. Panda, S.K, 2005. Advances in Stress Physiology of Plants. Scientific Publishers India, Jodhpur.
11. Shinha. R.K. 2007. Modern Plant Physiology. Ane Books India, New Delhi.

Web resources:

1. https://www.sciencedirect.com/topics/agriculture-and0biological-sciences/plant-physiology.
2. https://learn.careers360.com/biology/plant-physiology-chapter/
3. https://www.biologydiscussion.com/plants/plant-physiology/top-6-processes-of- plant-physiology/24154.
4. https://apan.net/meetings/apan45/files/17/17-01-01-01.pdf
5. https://basicbiology.net/plants/physiology
6. https://learn.careers360.com/biology/plant-physiology-chapter/4
7. https://swayam.gov.in/nd2_cec20_bt01/preview
8. https://www.nature.com/subjects/plant-physiology

Pedagogy: Teaching / Learning methods

Lecture, Tutorial, Assignment, PPT presentation, Quiz, Group Discussion, e-content Seminar)

Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	Relate understand properties and importance of water in biological system, nutrients and its translocation.	K1
CO2	Demonstrate the importance of light in plant growth and the harvest of energy.	K2
CO3	Explain the energy requirement and nitrogen metabolism.	K3
CO4	Compare the various growth regulators that influence plant growth.	K4
CO5	Discuss the senescence and plant response to environmental stress.	K5 & K6

Cognitive Level: K1 - Remembering; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	3	2
CO2	3	3	2	2	3	3	2	3	2	3
CO3	2	2	3	3	1	2	1	3	3	1
CO4	3	3	3	3	3	2	3	3	3	3
CO5	3	3	2	3	2	3	3	3	3	2

S-Strong (3) M-Medium (2) L-Low (1)

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
IV	**23P4BOC8**	**BIOCHEMISTRY ANDAPPLIED BIOTECHNOLOGY**	**6**	**4**

Nature of the course

Employability Oriented		Relevant to Local need	√	Addresses Gender Sensitization	
Entrepreneurship Oriented		Relevant to Regional need		Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to National need	√	Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	√

Course Objectives

The main objectives of this course are :

1. To study the fundamentals and significance of Plant Biochemistry.
2. To know the structure and properties of plant biomolecules.
3. To study the mechanism of enzyme action and inhibition.
4. To expose the students on the fundamental concepts of genetic transformation.
5. To study the application of Biotechnology

SYLLABUS

Unit	Content	No. of Hours
I	**BIOENERGETICS:** Atomic structure: chemical bonds - ionic bond, covalent bond, coordinate covalent bond, hydrogen bond, hydrogen ion concentration (pH), buffers. Thermodynamics principle: First Law of Thermodynamics - Energy – Enthalpy; Second law of thermodynamics - Spontaneity and disorder - Entropy - Free energy - Redox potential - Dissociation and association constant - Activation energy - Binding energy.	18
II	**BIOMOLECULES:** Carbohydrates – Classification, structure and properties of monosaccharides, Oligosaccharides, Polysaccharides – Glycoproteins. Protein and Amino acids: Structure, Classification and properties of proteins; Peptides - Structure: Primary and secondary, Ramachandran plot, tertiary and quaternary structures. Classification of Lipids: Structure and properties of fatty acids, phospholipids, glycolipids, lipoproteins, cholesterol - structure and functions.	18

III	**ENZYMES:** Classification and nomenclature of enzymes - chemical nature of enzymes – factors affecting enzyme action – Michaelis-Menton constant, MM equation, Lineweaver Burk plot, Enzyme inhibition, co enzymes- mechanism of enzyme action, isoenzymes. Secondary Metabolites: Structure, classification and properties of alkaloids, steroids, terpenoids, flavonoids and glycosides - their chemical nature and role.	18
IV	**TRANSGENICS:** Transgenic plants - pest resistance, herbicidal resistance, Disease resistant, abiotic and biotic stress tolerant, in improving crop yield, food quality - Golden rice, Edible vaccines, Virus and Bacteria based transient gene expression systems. Virus-induced gene complementation, Virus-induced gene silencing. Cytoplasmic male sterility and fertility restoration, Terminator - Seed technology, antisense technology for delayed fruit ripening, Plants as factories for useful products and pharmaceuticals.	18
V	**APPLIED BIOTECHNOLOGY:** Screening of Biotransformants - Fermentation techniques. Industrial production of enzymes: amylase, protease and lipase and their applications. Immobilization for enzymes production. Antibiotic penicillin production. Amino acid - Glutamic acid production. Production of Alcohol and Xanthan Gum. Bioreactors for culturing plant cells - production of secondary metabolites, Super bug and its role in biodegradation. Bioremediation - *In situ* and *Ex situ*.	18

Textbook:

1. Satyanarayana, U and chakrapani, U. 2005. Biochemistry, Books and Allied (P) Ltd. Calcutta.
2. A.L.Lehninger, D.L.Nelson&M.M.Cox. 1993. Principles of Biochemistry. Worth Publishers, New York.
3. Stryer, L. 1994. Biochemistry. Freeman & Co, New York.
4. Zubay, G. 1988. Biochemistry. 1988 Macmillan Publishing Co, New York.
5. Jain, J.L. 2005. Fundamentals of Biochemistry. S. Chand & Co. New Delhi.
6. Lehninger, A.L. 1982. Principles of biochemistry, CBS Publication. Halford, N. 2015. Plant Biotechnology: Current and Future Applications of Genetically Modified crops, John Wiley and Sons.
7. Kumar, Pradeep. 2018. Advances in Microbial Biotechnology: Current Trends and Future Prospects. 10.1201/9781351248914.

References:

1. Bonner, J. and Warner, W.H. 1961. Plant Biochemistry. Academic Press. Inv. New York.
2. Gupta, S.N. 2016. Biochemistry Rastogi Publications, Meerut.
3. Satyanarayana, U. and Chakkrapani, U. 2013. Biochemistry. Elsevier India Pvt Ltd & Books Allied Pvt.Ltd, New Delhi.
4. Nelson, D.L. and Cox, M.M. 2017. Lehninger's Principles of Biochemistry, Prentice Hall, International N.J, 7th Edition.
5. Heldt, H-W. 2005. Plant Biochemistry, 3rd Edition. Elsevier Academic Press.

6. Buchanan, B.B., Grissem, W. and Jones, R.L. 2000. Biochemistry and molecular biology of plants. 5th Edition. Wiley-Blackwell.
7. Jain, J.L., Jain, S. and Jain, N. 2016. Fundamentals of Biochemistry. Chand Publishing, New Delhi.
8. Chawla, H.S. 2009. Introduction to Biotechnology, 2nd edn. Oxford IBH, ISBN:978-81-204-1732-8.
9. Halford, N. 2015. Plant Biotechnology: Current and Future Applications of Genetically Modified Crops, John Wiley and Sons.

Web resources:

1. https://swayam.gov.in/nd2_cec20_bt12/preview
2. https://www.biorxiv.org/content/10.1101/660639v2
3. https://www.scribd.com/document/378882955/
4. https://nptel.ac.in/courses/102/107/102107075/
5. https://.britannica.com/technology/biotechnolog/
9. https://manavrachna.edu.in/blog/scope-of-biotechnology/

Pedagogy: Teaching / Learning methods

Lecture, Tutorial, Assignment,PPT presentation, Quiz, Group Discussion, e-content Seminar.

Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	Knowledge on the fundamentals and significance of Plant Biochemistry	K1
CO2	Understanding on the structure and properties of plant biomolecules.	K2
CO3	Explain the role of enzymes in plants.	K3
CO4	Compare and contrast the methods of transgenic plants production and natural plants.	K4
CO5	Discuss and develop skills for effective utilization of microbial/plant enzymes and their role in biological cells.	K5 & K6

Cognitive Level:K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	3	1
CO2	3	3	2	2	3	3	2	3	2	3
CO3	3	2	3	3	1	2	1	3	3	1
CO4	3	3	3	3	3	2	3	1	3	3
CO5	3	3	2	3	2	3	3	1	3	2

S - Strong (3) **M - Medium (2)** **L - Low (1)**

Semester	Course Code	Course Title	Hours of Teaching/Cycle	No. of Credits
IV	**23P4BOCP4**	**PRACTICAL - IV** **Plant Physiology and Plant metabolism; Biochemistry and Applied Biotechnology**	**6**	**4**

Nature of the course

Employability Oriented		Relevant to Local need	√	Addresses Gender Sensitization	
Entrepreneurship Oriented		Relevant to Regional need		Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to National need	√	Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	√

Course Objectives

The main objectives of this course are to:

1. Extract biomolecule of diverse nature from different sources so that they will be able to assess the metabolic profile of their source material.
2. Recognize the role that water plays in several physiological processes in plants.
3. To learn the fundamental and applications of Plant Biotechnology.
4. Learn about chromatographic techniques.
5. Expose the students to gain recent advances in molecular biology.

SYLLABUS

Unit	Content	No. of Hours
I	**PLANT PHYSIOLOGY:** 1. Determination of osmotic potential by plasmolytic method. 2. Determination of water potential using gravimetric method. 3. Determination of water potential using dye method (Chardakov's method). 4. Effect of Monochromatic light on apparent photosynthesis. 5. Effect of CO_2 concentration on apparent photosynthesis.	18
II	**PLANT PHYSIOLOGY:** 1. Effect of temperature on protoplasmic membrane. 2. Separation of chloroplast pigments using paper chromatographic technique. 3. Estimation of chlorophyll content using Arnon's method. 4. Determination of rate of photosynthesis using O_2 electrode. 5. Experiment to study the rate of Hill activity of isolated chloroplast by dye-reduction.	18

III	**BIOCHEMISTRY:** 1. Rice coleoptile growth test for Indole Acetic Acid. 2. Effect of auxin on root initiation. 3. Experiments to show the herbicidal action of Auxin (2-4,D). 4. Effect of synthetic Cytokinin on the destruction of chlorophyll.	18
IV	**BIOCHEMISTRY:** 1. Estimation of Proline content. 2. Estimation of Glycine betaine content. 3. Determination of Relative Water Content.	18
V	**APPLIED BIOTECHNOLOGY:** 1. Isolation of genomic DNA. 2. Electrophoresis of nucleic acid. 3. Preparation of competent *E.coli* cells. 4. Transformation and recovery of plasmid clones.	18

Textbook:

1. Plummer, D. 1988. An introduction to Practical Biochemistry, Tata McGraw–Hill Publishing Company Ltd., New Delhi.
2. Palanivelu, P. 2004. Laboratory Manual for analytical biochemistry and separation techniques, School of Biotechnology, Madurai Kamaraj University, Madurai.
3. Jayaraman.J.1981. Laboratory Manual in Biochemistry. Whiley Eastern Limited, New Delhi.
4. Bendre, A.M. and Ashok Kumar, 2009. A text book of practical Botany. Vol. I & II. Rastogi Publication. Meerut. 9th Edition.
5. Manju Bala, Sunita Gupta, Gupta NK. 2012. Practicals in Plant Physiology and Biochemistry. Scientific Publisher.
6. Joy, P.P., Surya, S and Aswathy, C. 2015. Laboratory Manual of Biochemistry, Agricultural University, Pineapple Research Station, Ernakulam, Kerala.
7. Gupta P.K. 2017. Cell and Molecular Biology (5th ed.), Rastogi Publications, Meerut.
8. Kumar, H.D. 2007. Molecular Biology and Biotechnology, Vikas Publishing House, New Delhi.
9. Shivakumar, S. 2002. Molecular analysis: Laboratory Manual. University press, Palkalai nagar, Madurai, India.

Reference books:

1. Bala, M., Gupta, S., Gupta, N.K and Sangha, M.K. 2013. Practicals in plant physiology and biochemistry. Scientific Publishers (India).
2. Wilson, K and J. Walker (Eds). 1994. Principles and Techniques of Practical Biochemistry (4th Edition) Cambridge University Press, Cambridge.
3. Bendre, A.M and Ashok Kumar. 2009. A text book of practical Botany. Vol. I & II. Rastogi Publication. Meerut. 9th Edition.
4. Wilson, K and J. Walker. 2005. Principles and Techniques of Practical Biochemistry, 5th Edition. Cambridge University press, New York.

5. Rodney Boyer. 2000. Modern Experimental Biochemistry, 3rd Edition. Published by Addison Wesley Longman. Singapore.
6. Bala, M., Gupta, S., Gupta, N.K and Sangha, M.K. 2013. Practical in plant physiology and biochemistry. Scientific Publishers (India).
7. Manju Bala, Sunita Gupta, Gupta, N.K. 2012. Practical in Plant Physiology and Biochemistry. Scientific Publisher.
8. Wilson, K and J. Walker. 2005. Principles and Techniques of Practical Biochemistry, 5th Edition. Cambridge University press, New York.
9. Glover, D.M and B.D. Hames (Eds). 1995. DNA cloning 1: A Practical Approach; Core Techniques, 2nd edition PAS, IRL press at Oxford University Press, Oxford.

Web Resources:

1. https://kau.in/document/laboratory-manual-biochemistry
2. https://www.amazon.in/Practical-Manual-on-Plant-Biochemistry/dp/6200539790
3. https://www.amazon.in/Laboratory-Manual-Physiology-Mukesh-Amaregouda/dp/6133993502
4. https://www.kopykitab.com/Cell-And-Molecular-Biology-A-Lab-Manual-by-K-V-Chaitanya

Pedagogy: Teaching / Learning methods

Lecture, Tutorial, Assignment, PPT presentation, Quiz, Group Discussion and practical demonstration.

Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	Perform quantitative tests for all major macro molecules and file a report of chemical profile of a plant cell.	K1
CO2	Analyze the structure and properties of various enzymes.	K2
CO3	Understand the fundamentals of water and its relation to plants.	K1 & K3
CO4	Understand the role of pigment in photosynthetic mechanism and related events of plants.	K4
CO5	Evaluate the theory and practical skills gained during the course and create idea to seek for suitable job in relevant industries.	K5 & K6

Cognitive Level: K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	3	3
CO2	3	3	2	2	3	3	2	3	2	3
CO3	3	2	3	3	1	2	1	3	1	3
CO4	3	3	3	3	3	2	3	3	3	3
CO5	3	3	2	3	2	3	3	3	3	3

S-Strong (3) M-Medium (2) L-Low (1)

Semester	Course Code	Course Title	Hours of Teaching/	No. of Credits
IV	23P4BOEL5A	Elective V - FORESTRY AND WOOD TECHNOLOGY	5	3

Nature of the course

Employability Oriented	√	Relevant to Local need	√	Addresses Gender Sensitization	√
Entrepreneurship Oriented	√	Relevant to regional need		Addresses Environment and Sustainability	√
Skill development Oriented	√	Relevant to national need		Addresses Human Values	
		Relevant to Global development need		Addresses Professional Ethics	

Course Objectives

The main objectives of this course are :

1. To Study various aspects of Forest Botany.
2. To Understand the importance and different forests and plants species.
3. To Know the ecological significance of forests.
4. To Enable the students to information on forests laws.
5. To Raise student awareness of the need to create a sustainable way of living and the current Globalissues with forestry caused by human interference.

SYLLABUS

Unit	Content	No. of Hours
I	**INTRODUCTION TO FORESTS AND ITS TYPES:** Introduction and scope of Forest Botany - Merits of combining traditional Botany and Forestry practices. General introduction to forests, natural and manmade. Types of forests - tropical, temperate, evergreen, semi evergreen, deciduous. Forest and climate - Forest and Biodiversity - Forest and gene conservation - Forest and ecosystem - Forest and civilization. Geographical history of the forest vegetation - natural vs. artificial.	15
II	**ECOSYSTEM SERVICES:** Forest genetics, Forest physiology, forest ecology – strong interrelationships. Macro-dynamic ecosystem reserves, hydrological cycles, balance. Identification of timber plants based on vegetative features. Seedlings, leaves, bark branching pattern architectural models of trees. Major and minor forest products, use and misuse of forests by man, direct and indirect forest wealth, forest policies, forest protection through peoples committee.	15

III	**SILVICULTURE AND FOREST CLASSIFICATION:** Silviculture: concept and scope, composition. Classification of world forests and Indian forests - Forest cover in India and the World - Classification based on its quality, density, tolerance, crown; water cycles of forest. Photosynthetic processes in forest: nitrogen and mineral nutrition in forests – Afforestation - Social/Urban forestry - Scope and necessity - People's participation	15
IV	**CONSERVATION BIOLOGY:** Conservation of resources: IUCN - Red list categories – Endemism – Biodiversity Hotspots - Endangered flora and fauna – Red Data Book – Conservation strategies: *Ex-situ* approach - tissue culture and cryopreservation, gene bank, pollen bank and seed bank; *In-situ* approach - Biosphere reserves, National parks and Sanctuaries. Forest Laws - Indian Forest Act, 1927; Wild Life Protection Act, 1972; The Environmental Protection Act 1986. Man and Biosphere Programme - Convention on Biological Diversity (CBD)	15
V	**WOOD TECHNOLOGY:** Physical properties of wood: colour, odour, weight and density, specific gravity, moisture content variations and their practical significance. Chemical composition and analysis of wood - Chemistry of wood - cell wall components - cellulose, hemi-cellulose, pectin and lignin; extractives, organic and inorganic materials - Their impact on the various strength properties. Kinds of wood – Hardwood and Softwood; Heartwood and sapwood – Growth rings. Forest products - timber, fuel, pulp, paper, rayon and match.	15

Textbook:

1. Manikandan, K and S. Prabhu. 2013. Indian forestry, a breakthrough approach to forest service. Jain Bros.
2. Roger Sands. 2013. Forestry in a global context, CAB international.
3. Balakathiresan.S.1986.EssentialsofForestManagement.NatrajPublishers,Dehradun.
4. Chundawat, B.S. and Gautham, S.K. 1996. Text book of Agro forestry. Oxford and IBH publisher, New Delhi.
5. Singhi, G.B. 1987. Forest Ecology of India, Publisher: Rawat.
6. WWF. 2007. Timber identification manual. TRAFFIC, New Delhi.
7. Mehta, T. 1981. A handbook of forest utilization. Periodical Expert Book Agency, New Delhi.

References:

1. Donald L. Grebner. Jacek P. Siry and Pete Bettinger. 2012. Introduction to forestry and Natural resources Academic press

2. West, P.W. 2015. Tree and forest measurement, Springer international publishing Switzerland.
3. Kollmann, F.F.P and Cote, W.A. 1988. Wood science and Technology. Vol. I & II Springer Verlag, New York.
4. Rao, K.R. and Juneja, K.B.S. 1992. Field identification of 50 important timbers of India. ICFRE Publi. Dehradun 123 p.
5. Avery, T.E. 1967. Forest Measurements. Mc Grand Hill Book Company, New York.
6. Manikandan K, Prabhu S. 2018. Indian Forestry A Breakthrough Approach To Forest Services, Jain Brothers.
7. Powell, Baden B.H. 2004. Manual of Forest Law. New Delhi: Biotech.
8. Chaturvedi, A.N. and Khanna, L.S. 2015. Hand Book of Forestry (5th Edition).
9. Parthiban, K.T. 2018. Introduction to Forestry & Agroforestry.

Web resources:

1. http://wwwwds.worldbank.org/external/default/WDServer/WDSP/IB/2006/10/19/000112742_2006 1019150049/Rendered/PDF/367890Loggerheads0Report.pdf.
2. https://www.britannica.com/science/forestry
3. https://en.wikipedia.org/wiki/Forestry.
4. https://www.sciencedirect.com/topics/agriculture-and-biological-science-forest-product.

Pedagogy:Teaching / Learning methods

Lecture, Tutorial, Assignment, PPT presentation,Quiz, Group Discussion, e-content Seminar.

Course Outcomes

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

CO	CO Statement	Programme outcomes
CO1	Knowledge on various aspects of Forest Botany	K1
CO2	Understand the importance and of different forests.	K2
CO3	Analyze the ecological significance of forests	K3
CO4	To understand the dynamics of the forest.	K4
CO5	Understanding on various Indian forests laws and acts.	K5&K6

Cognitive Level: K1 - Remember; K2 - Understanding; K3 - Apply; K4 - Analyze; K5 – Evaluate; K6 – Create

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	2	1
CO2	3	3	2	2	3	3	2	3	3	3
CO3	2	2	3	3	1	2	1	3	1	2
CO4	3	3	3	3	3	2	3	3	3	2
CO5	3	3	2	3	2	3	3	3	2	3

S-Strong (3) M-Medium (2) L-Low (1)

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
IV	23P4BOEL5B	Elective V - ORGANIC FARMING	5	3

Nature of the course

Employability Oriented	√	Relevant to Local need	√	Addresses Gender Sensitization	
Entrepreneurship Oriented	√	Relevant to Regional need		Addresses Environment and Sustainability	√
Skill development Oriented	√	Relevant to National need	√	Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	

Course Objectives

The main objectives of this course are:

1. To Understand the students about the organic farming.
2. To Study various aspects of organic farming.
3. To Know the importance of organic farming in the present scenario and its impact on environmentand soil health.
4. To Awareness on the importance of organic farming in the present scenario and its impact onenvironment and soil health.
5. To Expose the students to about quality aspect and grading.

SYLLABUS		
Unit	**Content**	**No. of Hours**
I	**AGRONOMY:** Organic farming- concept, characteristics, significance, organic ecosystem, scope of organic farming in India - Principles and types of organic farming. Choice of crops & varieties in organic farming - Initiative by Govt/NGOs/Other organizations for promotion of organic farming Operational structure of NPOP (National Programme for Organic Production) - Concept of dryland agronomy Organic nutrient resources & their fortification, restriction to nutrient use in organic farming - Organic production methods for cereals, vegetables and fruit crops.	15
II	**SOIL SCIENCE:** Organic farming for sustainable agriculture; Manures- compost, methods of composting - Green manuring, vermicompost and biofertilizer. Harmful effect of	15

	non-judicious chemical fertilization - Organic farming practices for improving soil health. Quality parameters of organic manures and specifications - Soil fertility in organic farming systems - Manure preparation methodology - Soil improvement.	
III	**FUNDAMENTAL OF ORGANIC FARM MANAGEMENT:** Land management in organic farming - Water management in organic farming. Organic insect disease management - Organic pest disease management. Preventive and cultural methods for insects and pest control - Identification of different fungal and bacterial biocontrol agents. Indigenous technical knowledge for insects-pest, disease - Weed and nutrient management in organic farming.	15
IV	**POST HARVEST MANAGEMENT:** Processing, labeling of organic produce – Storage and transport of organic produce.	15
V	**ORGANIC QUALITY CONTROL STANDARDS:** Certification- types, process & procedure and agencies. Quality aspect and grading - Packaging and handling. Economic considerations and viability of organic products - Export of organic product and marketing.	15

Recommended Text:

1. NIIR Board. 2012. The complete Technology Book on Biofertilizer and organic farming. 2nd Edition. NIIR Project Consultancy Services.
2. Sathe, T.V. 2004. Vermiculture and Organic Farming. Daya publishers.
3. Subba Rao N.S. 2017. Biofertilizers in Agriculture and Forestry. Fourth Edition. Medtech.
4. Vayas,S.C, Vayas, S. and Modi, H.A. 1998. Bio-fertilizers and organic Farming Akta Prakashan, Nadiad.
5. Singh, S M. 2018. Organic Manure: Sources Preparation and Usage in Farming Lands,Siya Publishing House

References Book

1. Reddy, S.R. 2019. Fundamentals of Agronomy Kalyani Publications, Uttar Pradesh
2. Tolanur, S. 2018. Fundamentals of Soil Science IIndEdition , CBS Publishers , New Delhi
3. Reddy, S.R. 2017. Principles of Organic Farming Kalyani Publishers , New Delhi
4. S. Gomathi, V. Ambikapathy, A. Panneerselvam, 2023, Biodegradation and bioaugmentation of pesticides using potential fungal species, Plant-Microbe Interaction - Recent Advances in Molecular and Biochemical Approaches, ISBN 9780323918763, https://doi.org/10.1016/B978-0-323-91876-3.00013-0.
5. Dongarjal, R.P and Zade, S.B. 2019. Insect Ecology and Integrated Pest Management Akinik Publications, New Delhi.
6. G. Gayathri, S. Gomathi, V. Ambikapathy, A. Panneerselvam, 2023, Improvement of soil fertility through plant microbial interaction, Plant-Microbe Interaction - Recent Advances in

Molecular and Biochemical Approaches, ISBN 9780323918756, https://doi.org/10.1016/B978-0-323-91875-6.00005-0.

7. Ahmad Mehraban. 2013. The Basis of Organic Fertilizers, LAP LAMBERT Academic Publishing.

Web resources:

1. https://www.amazon.in/Healthy-earth-organic-Hari-prasad-ebook/dp/B08L5KFKDV
2. https://doi.org/10.1016/B978-0-323-91875-6.00005-0.
3. https://www.kobo.com/in/en/ebook/organic-farming-for-sustainable-agriculture
4. https://doi.org/10.1016/B978-0-323-91876-3.00013-0
5. https://www.elsevier.com/books/organic-farming/chandran/978-0-12-813272-2
6. https://link.springer.com/book/10.1007/978-3-030-04657-6
7. https://www.afrimash.com/product-category/livestock-section/book/organic-farmingebooks/

Pedagogy: Teaching / Learning methods

Lecture, Tutorial, Assignment, PPT presentation, Quiz, Group Discussion, e-content Seminar)

Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	Knowledge on various aspects of organic farming.	K1
CO2	Understand the relevance of organic farming, its advantages.	K2
CO3	Explain the short comings against conventional high input agriculture.	K3
CO4	Compare the packaging methods of harvest.	K4
CO5	Discussanddevelopskillsforpostharvestmanagement.	K5 & K6

Cognitive Level: K1 - Remembering; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	1	2
CO2	3	3	2	2	3	3	2	3	3	2
CO3	2	2	3	1	1	2	1	3	2	1
CO4	3	3	3	3	3	2	3	3	2	3
CO5	3	3	2	3	2	3	3	2	3	1

S-Strong (3) M-Medium (2) L-Low (1)

Semester	Course Code	Course Title	Hours of Teaching / Cycle	No. of Credits
IV	23P4BOSEC4	SKILL ENHANCEMENT COURSE - BOTANY FOR ADVANCED RESEARCH	2	2

Nature of the course

Employability Oriented	√	Relevant to Local need	√	Addresses Gender Sensitization	
Entrepreneurship Oriented		Relevant to Regional need		Addresses Environment and Sustainability	
Skill development Oriented	√	Relevant to National need	√	Addresses Human Values	
		Relevant to Global development need	√	Addresses Professional Ethics	√

Course Objectives

The main objectives of this course are to:

1. To be familiar with the basic concepts and principles of plant systematics.
2. Learn the importance of plant anatomy in plant production systems.
3. To expose the students a fundamental of the various techniques used in molecular studies.
4. To learn about the physiological processes that underlie plant metabolism.
5. To know the energy production and its utilization in plants.

SYLLABUS		
Unit	**Content**	**Hours**
I	**MOLECULAR BIOLOGY:** Genomics: Structural genomics, Genetic and physical mapping (RFLP), microsatellite maps, cyotogenetic maps, chromosome walks and jumps, Genome sequencing, genome databases, human genome sequencing project. Functional genomics. transcriptome, proteome and metabolome, Metabolomics: Identification and quantification of cellular metabolites in biological samples. Pharmacogenomics and drug designing. Molecules and genomes in plant systematics, techniques used in molecular taxonomy, molecular systematics in crop evolution. Biochemistry and genetics of incompatibility, methods to overcome incompatibility, pollen viability tests, molecular basis of incompatibility.	15

II	**PLANT PHYSIOLOGY:** Modern concepts Photosynthesis – Biochemical control of respiration. Photo-morphogenesis - Dose-response relations in photomorphogenesis, light induced chloroplast differentiation, effect of photoreceptors. Biological clock: Circadian rhythms, rhythm responses to environment, clock mechanism. Mechanism of enzyme action role of enzyme in chemical action, various factors affecting the enzyme activity. Stress physiology	15

Textbook:

1. Sharma, O.P. 2017. Plant Taxonomy. (II Edition). The McGraw Hill Companies.

2. Maheshwari, P. 1963. Recent Advances in Embryology of Angiosperms. Intl. Soc. Plant Morphologists, New Delhi.

3. Sharma, P.C. 2017. Text Book of Plant Anatomy. Arjun Publishing House, New Delhi.

4. Jain, V.K. 2017. Plant Physiology, S.Chand & Company Ltd. New Delhi.

5. Lincoln, T, Eduardo, Z, Ian Max, M, and Angus, M. 2018. Fundamentals of Plant Physiology. Sinauer Associates Inc., US.

6. Becker, W.M., Kleinsmith L.J. & Hardin J. 2005. The World of the Cell (6th edition). Benjamin/Cummings Pub. Co. New York.

7. Brooker, R. J. 1999. Genetics Analysis and Principles. Addison Wesley Longman Inc., New York.

8. Bruce, A. *et.al.,* 2002. Molecular Biology of the Cell. Garland Publishing. New York.

Reference books:

1. Pandey.B.P. 1999. Economic Botany. S. Chand Limited, New Delhi.
2. Bhojwani, S.S. and Soh, W.Y. 2013. Current trends in the embryology of angiosperms. Springer Science & Business Media, Germany.
3. Cutler, D. F., Botha, T and Stevenson, D.W. 2008. Plant Anatomy: An Applied Approach. Blackwell Publishing, Malden, USA.
4. Steward, F.C. 2012. Plant Physiology Academic Press, US.
5. Hopkins, W.G and Huner, N.P. 2009. Introduction to Plant Physiology (4th ed.). John Wiley & Sons. U.S.A.
6. Noggle G.R and G.J. Fritz. 2002. Introductory Plant Physiology. Prentice Hall of India, New Delhi.
7. Anthony J . F. G .2000. An Introduction to Genetic Analysis. W. H. Freeman &Co. New York.
8. Lodish Harvey. 1999. Molecular Cell Biology. W.H. Freeman &Co. New York.
9. Russell, P.J. 2005. Genetics: A Molecular Approach (2nd edition). Pearson/Benjamin Cumming, San Francisco.

Web Resources:

1. http://www.ornl.gov.
2. http://ash.gene.ncl.ac.nk.
3. http:www.gdb.org.
4. http://www.negr.org.
5. http://www.genetics.wustl.edu.
6. http://genome.imb-jena.dc.

Pedagogy: Teaching / Learning methods

Lecture, Tutorial, Assignment, PPT presentation, Quiz, Group Discussion, e-content Seminar etc.

Course Outcomes

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

CO Number	CO Statement	Cognitive Level
CO1	Understand of the basic principles of systematics, including identification, nomen classification, and the inference of evolutionary patterns from data	K1, K2 & K5
CO2	Learn the structures, functions and roles of apical *vs* lateral meristems in monocot and dicot plant growth.	K1, K3 & K5
CO3	Understand the organization of nuclear genome	K3 & K5
CO4	Understand the various steps involved in the basic functioning of plant growth and the nutritive value of food.	K2, K3 & K5
CO5	Gain awareness about the various process involved in the energy production in plants and metabolic pathways.	K1, K5 & K6

Cognitive Level: K1 - Remember; **K2 -** Understanding; **K3 -** Apply; **K4 -** Analyze; **K5 –** Evaluate; **K6 –** Create

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	2	2
CO 2	3	3	2	2	3	3	2	3	2	3
CO 3	2	2	3	3	1	2	1	3	1	3
CO 4	3	3	3	3	2	2	3	2	3	1
CO 5	3	3	2	3	2	1	3	3	2	3

S-Strong (3) M-Medium (2) L-Low (1)