G. VENKATASWAMY NAIDU COLLEGE (AUTONOMOUS),

(Re-Accredited with 'A' grade by NAAC| DBT Star College Scheme)

(Affiliated to M. S. University, Tirunelveli)

KOVILPATTI – 628 502

DEPARTMENT OF BOTANY

MASTER OF SCIENCE

BOARD OF STUDIES

For the candidates admitted from the Academic Year 2023-2024 and onwards

Under CBCS Pattern

DEPARTMENT OF BOTANY

VISION

- Provision of knowledge to contribute towards the sustainable utilization of Plant Biosphere.

MISSION

- To foster an environment of excellence by providing a comprehensive set of courses in plant sciences that enhances the understanding, depth of knowledge and technical competency of the students.
- To provide the students competence for entry-level research and teaching positions in biological sciences.
- To inculcate the students with an environment that fosters the development of appropriate scientific vocabulary, reasoning skills and effective oral and written communication abilities for students.
- To create a holistic understanding of the allied subjects through interdisciplinary.

PROGRAMME OUTCOMES

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

PO2 Disciplinary Knowledge: Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate programme of study.

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

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

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

PO7 Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way.

PROGRAMME EDUCATIONAL OBJECTIVES

PEO1 Students will pursue the study of the biological concepts, appreciate the diversity in biology and kindle interest towards the creative and innovative in Life Sciences.

PEO2 Students will understand and gain the knowledge of basic plant biology and study its relevant applications.

PEO3 Students will be able to demonstrate proficiency in the experimental techniques and methods of analysis appropriate for their area of specialization within biology.

PROGRAMME SPECIFIC OUTCOMES

PSO1 Implement the concept of science and technology to foster the traditional and modern techniques for solving the complex problems in Plant Biology and understanding the scope and significance of Botany.

PSO2 Develop the scientific problem solving skills during experimentation, research projects, analysis, and interpretation of data and generate useful information to address various issues in Botany.

PSO3 Enhanced capacity to think critically; ability to design and execute experiments independently and/or team under multidisciplinary settings.

GRADUATE ATTRIBUTES

1) Clear, comprehensive, Skill in practical work, experiments, use of biological tool and techniques and advanced mastery in the field of Botany.
2) Understand Proficiency in the use of recent advanced biological technologies, advanced areas of biological sciences with special reference to Botany and its applied branches.
3) Confidence to apply the acquired knowledge in practical life, ensure the implementation of a holistic pedagogical model in botany so as to make our country self-reliant.
4) To mould a responsible citizen who is aware of most basic domain-independent Knowledge, including critical thinking and communication.
5) To enable the graduate prepare for national level competitive Examinations, especially UGC-CSIR NET and UPSC Civil Services Examination
6) The students would learn the use of the new technologies used in learning biology, digital platforms for fast transfer of information. Students will acquire digital skills and integrate the fundamental concepts with modern tools.

7) The vast and deep knowledge of the subject, analytical and scientific reasoning, effective communication and problem solving task develop special qualities in a person to attract and influence the audience, which would be gained after the completion of this course. Students are expected to be familiar with decision making process and basic managerial skills to become a better leader.

PROGRAMME STRUCTURE FOR M.SC., BOTANY
(for those admitted from the academic year 2023-2024 and onwards)

Course Type	Course code	Course Title	Contact Hrs.	Exam Hrs.	Marks			Credits
					CIA	ESE	Total	
Semester: I								
Core :1	P23BO101	Plant Diversity - I: Algae, Fungi, Lichens and Bryophytes	7	3	25	75	100	5
Core : 2	P23BO102	Plant Diversity - II: Pteridophytes, Gymnosperms and Paleobotany	7	3	25	75	100	5
Core : 3 (Core Lab – I)	P23BO1P1	Core Lab – I: Plant Diversity I & II	6	3	40	60	100	4
Core Elective - I	P23BO1E1A	Microbiology, Immunology and Plant Pathology	5	3	25	75	100	3
	P23BO1E1B	Conservation of Natural Resources and Policies						
	P23BO1E1C	Mushroom Cultivation						
Core Elective -II	P23BO1E2A	Algal Technology	5	3	25	75	100	3
	P23BO1E2B	Ethnobotany, Naturopathy and Traditional Healthcare						
	P23BO1E2C	Horticulture						
Comprehension – I (Self Study Course - Online Exam)	P23BO1C1	Comprehension in Botany – I	-	1	-	50	50	1
Ability Enhancement	P23AE101	Cyber Security	-	2	-	50	50	2
NPTEL (Self Study Course – online – To be completed within 4 semester)								1
TOTAL			**30**				**600**	**24**
Semester-II								
Core : 4	P23BO204	Taxonomy of Angiosperms and Economic Botany	5	3	25	75	100	4
Core : 5	P23BO205	Plant Anatomy and Embryology of Angiosperms	5	3	25	75	100	4
Core : 6	P23BO206	Ecology, Phytogeography, Conservation Biology and Intellectual Property Rights	5	3	25	75	100	3
Core : 7 (Core Lab – II)	P23BO2P2	Core Lab – II : Taxonomy of Angiosperms and Economic Botany; Plant Anatomy and Embryology of Angiosperms; Ecology, Phytogeography, Conservation	6	3	40	60	100	3

		Biology and Intellectual Property Rights						
Core Elective- III	P23BO2E3A	Medicinal Botany	3	3	25	75	100	3
	P23BO2E3B	Photochemistry						
	P23BO2E3C	Research Methodology, Computer Applications & Bioinformatics						
Core Elective- IV	P23BO2E4A	Applied Bioinformatics	3	3	25	75	100	3
	P23BO2E4B	Biostatistics						
	P23BO2E4C	Intellectual Property Rights						
Skill enhancement course (SEC1)	P23BO2SE1	Agriculture and Food Microbiology	3	3	25	75	100	2
Comprehension – II (Self Study Course - Online Exam)	P23BO2C2	Comprehension in Botany - II	-	1	-	50	50	1
Ability Enhancement	P23AE202	Teaching and Learning Process and Core Teaching Skills	-	-	50	-	50	1
Internship / Institutional Training / Minor Project	P23BO3IT	Internship / Institutional Training / Minor Project (Carried out in Summer Vacation at the end of II Semester)	-	-	-	-	-	-
TOTAL			**30**				**800**	**24**
Semester-III								
Core : 8	P23BO308	Cell and Molecular Biology	5	3	25	75	100	4
Core : 9	P23BO309	Genetics, Plant Breeding & Biostatistics	5	3	25	75	100	4
Core : 10	P23BO310	Recombinant DNA technology and Industrial application	5	3	25	75	100	4
Core : 11 (Industry Module)	P23BO311	Industrial Botany	5	3	25	75	100	4
Core : 12 (Core Lab – III)	P23BO3P3	Core Lab – III : Cell and Molecular Biology; Genetics, Plant Breeding & Biostatistics; Recombinant DNA technology and Industrial application.	4	3	40	60	100	3
Core Elective- V	P23BO3E5A	Entrepreneurial Opportunities in Botany	3	3	25	75	**100**	**3**
	P23BO3E5B	Applied plant cell & tissue culture						
	P23BO3E5C	Silviculture and Commercial Landscaping						

Skill enhancement course (SEC 2)	P23BO3SEP	Professional Communication Skill (Seminar paper)	3	-	40	60	100	**2**
Comprehension –III (Self Study Course - Online Exam)	P23BO3C3	Comprehension in Botany-III	-	1	-	50	50	1
Internship / Institutional Training / Minor Project	P23BO3IT	Internship / Institutional Training / Minor Project	-	3	40	60	**100**	**2**
TOTAL			**30**				**850**	**27**
Semester-IV								
Core : 13	P23BO413	Plant Physiology and Plant metabolism	5	3	25	75	100	4
Core : 14	P23BO414	Biochemistry and Applied Biotechnology	5	3	25	75	100	4
Core : 15 (Core Lab – IV)	P23BO4P4	Core Lab – IV : Plant Physiology and Plant metabolism; Biochemistry and Applied Biotechnology.	4	3	40	60	**100**	3
Core Elective- VI	P23BO4E6A	Organic Farming	4	3	25	75	100	3
	P23BO4E6B	Forestry and Wood Technology						
	P23BO4E6C	Farm Sciences – Green wealth						
Major Project	P23BO4MP	Project with Viva-voce	8	3	50	150	200	7
Comprehension –IV (Self Study Course- Online Exam)	P23BO4C4	Comprehension in Botany-IV	-	1	-	50	50	1
Professional Competency Skill Enhancement	P23BO4SE3	Training for Competitive Examinations • Botany for NET/UGC-CSIR/SET/TRB Competitive Examinations (2 hours) • General Studies for UPSC/TNPSC/other Competitive Examinations (2 hours)	4	3	100	-	100	2
Extensions activity	P23EA401	Extension Activity						1
Research paper Publication (Minimum One)- Submission only								1
			30				**750**	**26**
Total Marks/Credits			**3000/101**					

CORE – 8 CELL AND MOLECULAR BIOLOGY – P23BO308

Lecture Hours	**: 70**	**Tutorial Hours**	**: 5**
Practical Hours	**: -**	**No. of Credits**	**: 4**
Contact Hours per Semester: 75hrs			
Contact hours per Week	**: 5**		
Internal Marks	**: 25**		
External Marks	**: 75**		
Total Marks	**: 100**		

Objectives of the Course

- To learn various cell structures and functions of the cellular organelles.
- To understand the cell division and its mechanism and anomalosity.
- To understand the DNA structure, genome organization and cell cycle.
- To comprehend the molecular processes.
- To know about replication, transcription and translation processes.

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the Course, the students should be able to

CO1 understand the cell structure and their function.

CO2 recognize the structures of various cell organelles.

CO3 comprehend the structure and functions of nucleic acids and the mechanism of cell cycle.

CO4 understand the DNA replication (prokaryotes and eukaryotes) and DNA Sequencing.

CO5 gain knowledge develop the skills for DNA / gene manipulation and the enzymes involved.

CO-PO AND PSO MAPPING (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3	3	1	3	2	1	2	2
CO2	3	3	2	2	3	3	2	3
CO3	2	2	3	3	1	3	2	3
CO4	3	3	3	3	3	2	3	3
CO5	3	3	2	3	2	3	3	3
Total Contribution of COs to POs	14	14	11	14	11	12	12	14
Weighted Percentage of COs contribution to POs	93	93	73	93	73	80	80	93

0 – No Correlation 1 – Weak 2 – Moderate 3 – Strong

Course Content

Unit I Cell Structures (L-15hrs; T-1 hr)

Prokaryotic and Eukaryotic cell. Structural organization of plant cell - Cell wall- Structure and functions, Plasma membrane; structure, models (Fluid mosaic model) and functions, site for ATPase, ion carriers channels and pumps, receptors. Plasmodesmata and its role.

Unit II Plant Cell Organelles (L-15hrs; T-1 hr)

Chloroplast- Structure, function and genome organization. Mitochondria- Structure, function and genome organization. Plant Vacuole- Tonoplast membrane, Transport of solutes across membrane. Structure and function of Golgi apparatus, lysosomes, endoplasmic reticulum and microbodies.

Unit III Nucleus and Genetic Material (L-15hrs; T-1 hr)

Nucleus: Structure and function, nuclear pore, Nucleosome organization, euchromatin and heterochromatin. Ribosome- Structure and functional significance. DNA Structure, A, B and Z Forms. Protein synthesis - transcription, post transcriptional modification, RNA editing and translation. DNA damage and repair (Thymine dimer, photoreactivation, excision repair).

Unit IV DNA Replication, Transcription and Translation (L-13hrs; T-1 hr)

Cell cycle - role of cyclin dependent kinases, cytokinesis and cell plate formation.Mechanisms of programmed cell death and Apoptosis.DNA replication (prokaryotes and eukaryotes), enzymes involved in replication. DNA sequencing - methods. cDNA and genomic library, reverse transcription, overlapping genes.

Unit V Gene manipulation and Cloning Techniques (L-12hrs; T-1 hr)

DNA/gene manipulating enzymes: endonuclease, ligase, polymerase, phosphatase, transcriptase, transferase, topoisomerase. Gene cloning: cloning vectors, molecular cloning and DNA libraries. Insertion elements, transposons. Recombinant DNA. Direct and indirect gene transfer. Detection of recombinant molecule.

Recommended Text

1. Amnol, I. *Text Book of Cell Biology*. Books and Allied Pvt. Ltd., Kolkata, India. 2011.
2. Clark, D. *Molecular Biology*. Academic Press Publication. 2010.
3. David Freifelder. *Essentials of Molecular Biology*. Narosa Publishing house. New Delhi. 2008.
4. Gardner. M.J, Simmons, D.P. Snustad. *Principles of Genetics*. 8th ed., Wiley India. 2006.
5. Geoffrey M. Cooper. The Cell: *A Molecular Approach, Oxford University Press*. 2019.
6. Karp, G. *Cells and Molecular Biology: Concepts & Experiments*. 6th ed. John Wiley and Sons, Inc., USA. 2010.
7. Turner, P.C., Mclenann, A.G., Bates, A.D. and White, M.R.H. *Instant notes on molecular biology*. 2001.

Reference Books

1. Alberts, B, Bray, D, Raff, M, Roberts, K and Watson JD. *Principles of Biochemistry* –Lehninger, Garland Publishers, W.H. Freeman and Company. 1999.
2. Cooper G M and Hausman R E. *The Cell: Molecular Approach.* 4th ed. Sinauer Associates, USA. 2007.
3. De Robertis and De Robertis. *Cell and Molecular Biology*. 8th ed. Info-Med, Hongkong. 1988.
4. Genes X – Benjamin Lewin, Jones and Bartlett. *Molecular Biology of the Cell*. 2011.
5. Lewin, B. *GENE VII*. Oxford University Press, New York, USA. 2000.
6. Lodish S, Baltimore B, Berk, C and Lawrence K. *Molecular Cell Biology*. 3rd ed. Scientific American Books, N.Y.1995.
7. Monroe W. Strickberger. *Genetics*. 3rd ed. Prentice- Hall of India Pvt. Ltd., 2015.
8. Watson, J.D, Baker T.A., Bell S.P., Gann A., Levine M., Losick R. *Molecular Biology of the Gene*. 7th ed. Pearson Press. 2014.

Website and E-learning Sources

1. https://www.pdfdrive.com/cell-biology-books.html
2. http://www.bio-nica.info/Biblioteca/Bolsover2004 CellBiology.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

CORE – 9 GENETICS, PLANT BREEDING & BIOSTATISTICS –P23BO309

Lecture Hours	**: 70**	**Tutorial Hours**	**: 5**
Practical Hours	**: -**	**No. of Credits**	**: 4**
Contact Hours per Semester:	**75**		
Contact hours per Week	**: 5**		
Internal Marks	**: 25**		
External Marks	**: 75**		
Total Marks	**: 100**		

Objectives of the Course

- To gain basic knowledge on Mendelian genetics and extensions.
- To develop critical understanding of Linkage and crossing over.
- To familiarize with Gene regulation and Genomics.
- To reflect upon the role of various non-conventional methods used in crop improvement.
- To solve problems quantitatively using appropriate arithmetical, algebraic, or statistical methods.

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the Course, the students should be able to

CO1 understand the Mendal's Laws of inheritance and gene interactions.

CO2 gain knowledge on concept of linkage, crossing over and gene mapping.

CO3 recognize the mechanism of gene regulation and genomics.

CO4 comprehend the genetic basis of breeding self and cross – pollinated crops.

CO5 apply the skills of statistics in biology.

CO-PO AND PSO MAPPING (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	1	1	3	2	1	2	2	3	1
CO 2	3	3	2	2	3	3	2	3	3	3
CO 3	2	2	3	3	1	3	1	3	2	2
CO 4	3	3	3	3	3	2	3	3	3	3
CO 5	3	3	2	3	2	3	3	3	3	3
Total Contribution of COs to POs	14	12	11	14	11	12	11	14	14	13
Weighted Percentage of COs contribution to POs	93	80	73	93	73	80	73	93	93	87

0 – No Correlation 1 – Weak 2 – Moderate 3 – Strong

Course Content

Unit I Mendelian Genetics and Extensions (L -16hrs; T-1 hr)

Mendel's law of inheritance-Incomplete dominance & Co dominance, Complementary genes, Epistasis, Hypostasis. Polygenic inheritance: Kernel colour in Wheat, Multiple alleles and Pseudo alleles-Plastid inheritance in *Mirabilis jalaba* and Cytoplasmic male sterility in maize

Unit II Linkage and Crossing over (L 15hrs; T-1 hr)

Linkage and crossing over: Linkage:theories of linkage, coupling and repulsion hypothesis, linkage map in maize.Crossing over: mechanism of crossing over, cytological proof for crossing over in maize, Chromosomal mapping- interference and coincidence. Mutation – types, molecular mechanism of mutations.

Unit III Gene Regulation and Genomics (L -15hrs; T-1 hr)

Gene arrangement in Prokaryotes and Eukaryotes. Regulation of Gene expression in Prokaryots(*lac, trp* and *ara* operon), Regulation of gene expression in eukaryotes- Hormonal regulation. Terminator gene technology and its importance. Structural and functional, genetic polymorphism, DNA markers – SSR, SCAR, DNA finger printing, genomics of *Arabidopsis thaliana*a model plant.

Unit IV Plant Breeding (L -14hrs; T-1 hr)

Objectives of plant breeding, characteristics improved by plant breeding, Genetic basis of breeding, self and cross – pollinated. Pure line selection and mass selection, clonal selection methods. Hybridization, Genetics and physiological basis of heterosis.

Unit V Biostatistics (L- 10hrs; T-1 hr)

Measures of central tendency (Mean,Median, Mode) and dispersion (Mean deviation,standard deviation), standard errors.Probability distributions (Binomial, and normal); sampling distribution;

difference between parametric and non-parametric statistics; confidence interval; errors; levels of significance; regression and correlation; t-test; ANOVA (One way).

Recommended Text

1. Ahluwalia, B. K. *Genetics.* 2nd Edn. New Age International Publishers, New Delhi. 2009.
2. Gupta, P.K. *Molecular biology*, 2nd ed. (Paperback), Rastogi Publication, UP, India. 2018.
3. Gurumani, N. *Biostatistics*, 2nd edn. MJP publications, India. 2005.
4. Singh, B.D. *Plant Breeding*: *Principles and Methods*, Kalyani Publishers, New Delhi. 2013.
5. Singh, P. *Fundamentals of Plant Breeding*, Kalyani Publishers. 2017.

Reference Books

1. Acquaah, G. *Principles of Plant Genetics and Breeding*. Blackwell Publishing. 2007.
2. Friefelder, D. *Molecular Biology*. Second Edition. Narosa Pub. House. 2005.
3. Strickberger, M.W. *Genetics* (III Ed). Prentice Hall, New Delhi, India. 2005.
4. Zar, J.K. *Biostatistical Analysis*, Fourth Edition, Prantice-Hall International, New Jersey, USA. 2011.

Website and E-learning Sources

1. https://www.cdc.gov/genomics/about/basics.htm
2. https://ocw.mit.edu/courses/biology/7-03-genetics-fall-2004/lecture-notes/
3. http://galaxy.ustc.edu.cn:30803/zhangwen/Biostatistics/Fundamentals+of +Biostatistics+8th+edition.pdf
4. https://www.britannica.com/science/cell-biology
5. https://medlineplus.gov/genetocs/understanding/basics/cell/

CORE – 10 RECOMBINANT DNA TECHNOLOGY AND INDUSTRIAL APPLICATIONS – P23BO310

Lecture Hours	**: 70**	**Tutorial Hours**	**: 5**
Practical Hours	**: -**	**No. of Credits**	**: 4**
Contact Hours per Semester:	**75**		
Contact hours per Week	**: 5**		
Internal Marks	**: 25**		
External Marks	**: 75**		
Total Marks	**: 100**		

Objectives of the Course

- To understand the fundamental concepts of rDNA technology.
- To acquire knowledge on the industrial applications of microbes.
- To gain knowledge on the production of antibiotics from microbes.
- To analyze the importance of rDNA in the production of hormones.
- To gain basic understanding of rDNA techniques and its applications.

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the Course, the students should be able to

CO1 understand the basics of recombinant DNA technology.

CO2 gain knowledge on the basic concepts of industrial biotechnology.

CO3 know the different methods and techniques involved in production of antibiotics.

CO4 understand the importance of hormones and vaccines for human welfare

CO5 comprehend the applications of rDNA technology.

CO-PO AND PSO MAPPING (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	1	3	2	1	3	2	3	3
CO 2	3	2	2	2	3	3	2	3	3	2
CO 3	2	2	3	3	1	2	1	3	2	2
CO 4	3	3	3	3	3	2	3	3	3	3
CO 5	3	3	2	3	2	2	3	3	3	3
Total Contribution of COs to POs	14	13	11	14	11	11	12	14	14	3
Weighted Percentage of COs contribution to POs	93	87	73	93	73	73	80	93	93	87

0 – No Correlation 1 – Weak 2 – Moderate 3 – Strong

Course Content

Unit I Genetic Engineering (L 14hrs; T-1hr)

Concept of rDNA technology. Types of vectors -Plasmids, Phages, Cosmids and Caulimovirus. DNA manipulative enzymes-ligases, nucleases, restriction endonucleases, alkaline phosphatases, terminal transferases and reverse transcriptases. Construction of Genomic and cDNA library. Gene transfer methods-Indirect (Ti and Ri plasmid) Direct methods- electroporation, Biolistics (Gene gun) and liposome mediated delivery.

Unit II Industrial production of Vitamins by rDNA technology (L 14hrs; T-1 hr)

Industrial production of vitamin B12 by recombinant bacteria like *Paracoccusdenitrificans, Propionibacteriumshermanii*, *E.Coli* and Vitamin-C by *Saccharomyces cerevisiae* , *Zygosaccharomycesbailii* and by large scale fermentation (Only conditions required and production steps involved).

Unit III Industrial production of Antibiotics (L 14hrs; T-1 hr)

Production of antibiotic medicines: Human Deoxyribonuclease I, Human Tissue Plasminogen Activator, β-Glucocerebrosidase, L-Asparaginase, Deoxycytidine kinase, Acid sphingomyelinase. Penicillin, aminoglycoside and tetracycline

Unit IV Recombinant hormones (L 14rs; T-1 hr)

Insulin (somatotrophin), erythropoietin used in the treatment of anemia. Vaccines -Hepatitis B, Interferons, and Interferon-alpha, hairy cell leukemia. Interferon- alpha, beta-1b - used in treatment of relapsing multiple sclerosis, malignant glioma, and melanoma.

Unit V Applications of rDNA technology (L 14hrs; T-1hr)

Production of monoclonal antibodies and their importance. Edible vaccines- History and its importance (e.g. banana). Biotransformation- Introduction, Screening of Biotransformants. Fermentation techniques- Types. Industrial Production of enzymes-amylase, protease & lipase and their applications. Bioremediation: Super bug and its role in biodegradation.

Recommended Text

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

Reference Books

1. Friefelder, D. *Molecular Biology*. Second Edition. Narosa Pub. House. 2005.
2. Glick, B.R and Pasternak J. J. *Molecular Biotechnology*, 4th edition ASM press Washington D.C, USA. 2010.
3. Lewin, B. *Genes* VIII. Oxford University Press. 2003.
4. Primrose, S.B. and Twyman R. M. *Principles of gene manipulation and genomics*, Black well publishers, USA. 2006.
5. Watson, J.D. *et al. Molecular Biology of the Gene*. Fourth Edition. The Benjamin Cummings Pub. Co. 2003.

Website and E-learning Sources

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.

CORE – 11 INDUSTRY MODULE - INDUSTRIAL BOTANY –P23BO311

Lecture Hours	**: 70**	**Tutorial Hours**	**: 5**
Practical Hours	**: -**	**No. of Credits**	**: 4**
Contact Hours per Semester:	**75**		
Contact hours per Week	**: 5**		
Internal Marks	**: 25**		
External Marks	**: 75**		
Total Marks	**: 100**		

Objectives of the Course

- To learn the applied aspects of industrial application of algae, fungi, bacteria, plants, molecular biology and recombination technology.
- To educate people about the widespread commercial uses of fungi.
- To know about the economic importance of plants.
- To acquire knowledge on *in vitro* cultivation techniques to develop protocols targeted towards commercialization.

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the Course, the students should be able to

CO1 understand the basics of algae and its industrial applications.

CO2 demonstrate and recollect the uses of fungi in industries.

CO3 explain bacterial role in industries.

CO4 compare and contrast the use of plants in industries.

CO5 discuss and develop skills for working in industries specializing in biology.

CO-PO AND PSO MAPPING (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	1	3	2	1	2	1	2	2
CO 2	3	3	2	2	3	3	2	3	2	3
CO 3	2	2	3	3	1	2	1	2	1	3
CO 4	3	3	3	3	3	2	3	2	3	3
CO 5	3	3	2	3	2	3	3	3	3	3
Total Contribution of COs to POs	14	14	11	14	11	12	11	11	11	14
Weighted Percentage of COs contribution to POs	93	93	73	93	73	80	73	73	73	93

0-No Correlation **1-Weak** **2-Moderate** **3-Strong**

Course Content

Unit I Algae in Industries **(L 14 hrs; T-1 hr)**

Fertilizer industry- sources, extracts and cultivation procedure of Seaweeds, pharmaceutical industry – antibiotics, agar, carageenin, alginin, diatomate earth, mineral industry, fodder industry.

Unit II Fungi in industries **(L 14 hrs; T-1 hr)**

Beneficial use of yeast, Fermentation of alcohol, preparations of enzymes, organic acid preparation, cheese production, protein manufacture, vitamins, fats.

Unit III Bacteria in Industry **(L 14 hrs; T-1 hr)**

Food industry, dairy products, bioleaching, biogas production**,** bioremediation.

Unit IV Plant Products **(L 14 hrs; T-1 hr)**

Fibres and Fibre- Yielding plants, wood and cork, tannins and dyes, rubber, fatty oils and vegetable fats, sugars and starches, pulp and paper, gum and resins.

Unit V Recombinant Plants **(L 14 hrs; T-1 hr)**

Tissue culture: Basics of tissue culture, Micropropagation, somatic seeds, cell culture, GM plants.

Recommended Text

1. Trivedi, P.C. *Algal Biotechnology*. Point publisher, Jaipur. India. 2001.

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

Reference Books

1. Becker. E.W. *Micro algae Biotechnology and Microbiology*. Cambridge University press. 1994.
2. Borowitzka, M.A. and borowizka, L.J. *Micro algal Biotechnology*. Cambridge University Press, Cambridge, 1996.
3. Sahoo, D. *Farming the ocean: seaweed cultivation and utilization*. Aravali International, New Delhi. 2000.
4. Mahendra Rai. *Advances in Fungal Biotechnology*. I.K. International Publishing House, New Delhi. 2009.
5. Street, H. E. *Essay in Plant Taxonomy*, Academic Press, London, UK. 1978.
6. Alexander N. Glazer and Hiroshi Nikaido. *Microbial Biotechnology*. 1994.
7. Pandey, B.P. College Botany I: *Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta*. S Chand & Company. 2005.
8. Chichister, U.K.J. *Cultivation and Processing of Medicinal Plants*, Wiley & Sons. 1999.
9. William Charles Evans. *Pharmacognosy*, 14th ed. Harcourt Brace & Company. 1989.
10. Kumar, H. D. *Introductory Phycology*. Affiliated East-West Press, Delhi. 1999.
11. Das, SandSaha, R. *Microbiology Practical Manual*.CBS Publishers and Distributors (P) Ltd., New Delhi, India. 2020.
12. Willie, J and Sherwood, L. Prescott's. *Microbiology*. McGraw-Hill Education; 10th Edition, ISBN: 978-1259281594. 2016.

Website and E-learning Sources

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/B07438N1CJ
4. https://link.springer.com/book/10.1007/978-981-16-5214-1
5. https://link.springer.com/book/10.1385/0896031616.

CORE: 12 (CORE LAB – III)

CELL & MOLECULAR BIOLOGY; GENETICS, PLANT BREEDING & BIOSTATISTICS; RECOMBINANT DNA TECHNOLOGY & INDUSTRIAL APPLICATION (P23BO3P3)

Lecture Hours	**: -**	**Tutorial Hours**	**: -**
Practical Hours	**: 90**	**No. of Credits**	**: 3**
Contact Hours per Semester:	**60**		
Contact hours per Week	**: 6**		
Internal Marks	**: 40**		
External Marks	**: 60**		
Total Marks	**: 100**		

Objectives of the Course

- To understand the principles of linkage, crossing over and the hereditary mechanisms.
- To know the methods involved in quantitative, chromosome mapping and genotypic frequency.
- To recognize the techniques in plant breeding programmes.
- To know the principles of isolation and separation of nucleic acids by electrophoresis.
- To understand the principles and techniques of r DNA technology.

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the Course, the students should be able to

CO1 understand the principles of linkage, crossing over and the hereditary mechanisms.

CO2 analyze the principles of isolation and separation of nucleic acids by gel electrophoresis.

CO3 gain knowledge on the methods involved in quantitative, inheritance chromosome mapping and genotypic frequency.

CO4 apply the principles of plant breeding techniques.

CO5 evaluate the principles and techniques of r DNA technology.

CO-PO AND PSO MAPPING (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2	2	1	2	1	2	2	3	3	3
CO 2	2	2	1	2	1	2	2	3	3	3
CO 3	2	2	1	2	1	2	2	3	3	3
CO 4	2	2	1	2	1	2	2	3	3	3
CO 5	2	1	1	1	1	2	2	2	2	2
Total Contribution of COs to POs	10	9	5	9	5	10	10	14	14	14
Weighted Percentage of COs contribution to POs	67	60	33	60	33	67	100	93	93	93

0 – No Correlation 1 – Weak 2 – Moderate 3 – Strong

Course Content

Unit I Mitosis and Meiosis (P12 hrs)

1. Identification of different stages of mitosis and mitotic index from suitable plant material. (Onion root tips).
2. Identification of Stages of meiosis from suitable plant material. (Tradeschantia /Rheo floral buds).

Unit II Genetics & Nucleus and Nucleic Acids (P 12 hrs)

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.
5. Localization of nucleus and plant vacuole in Onion peel.
6. Restriction digestion of DNA samples using restriction endonucleases (RE).

Unit III Genetics (P 12 hrs)

1. Quantitative inheritance in plants.
2. Chromosome mapping from three point test cross data. Calculation of chiasmatic interference.
3. Calculate gene and genotypic frequency by Hardy- Weinberg equation

Unit IV Plant Breeding (P 12 hrs)

Techniques in plant hybridization- Emasculation, Seed Purity test, Vegetative propagation: Cutting- Stem, Layering- Air; Grafting- Cleft; Budding- Patch.

Unit V rDNA Technology **(P12 hrs)**

1. Isolation of genomic DNA- Della Porta method
2. Electrophoresis of nucleic acid.- AGE.
3. Southern blot.
4. Calculation of G+C content of DNA – Spectrophotometric method
5. Vectors diagram, Schematic diagram for r DNA technology and Cloning techniques

Recommended Text

1. Bharadwaj, D.N. *Breeding of field crops*, Agrobios (India), 1-23. 2012.
2. Gupta P.K. *Cell and Molecular Biology*, 5thed, Rastogi Publications, Meerut. 2017.
3. Gupta, P.K. *Cytogenetics*, Rastogi Publications, Meerut. 2018.
4. Jackson, S.A., Kianian, S.F., Hossain, K.G and Walling, J.G. *Practical laboratory exercises for plant molecular cytogenetics*. *In Plant Cytogenetics*, Springer, New York, 323-333. 2012.
5. Kumar, H.D. *Molecular Biology and Biotechnology*, Vikas Publishing House, New Delhi. 2007.

Reference Books

1. De Robertis E.D.P. and De Robertis E.M.P. *Cell and Molecular Biology*, 8thed, (South Asian Edition), Lea and Febiger, Philadelphia, USA. 2017.
2. Gelvin, S.B., Schilperoort, R.A. *Plant Molecular Biology* Manual, 2 ed, Springer, German. 2000.
3. Glick, B.R and J.E. Thompson. *Methods in Plant Molecular Biology* and Biotechnology. CRC Press, Boca Raton, Florida. 1993.
4. Henry, R.J. *Practical applications of plant molecular biology*, Chapman & Hall, London. 1997.
5. Shivakumar, S. *Molecular analysis*: *Laboratory Manual*. University press, Palkalainagar, Madurai, India. 2002.
6. Singh, B.D. *Plant Breeding principles and methods*, 12 th ed.MedTech Science Press, New Delhi. 2022.

Website andE-learning Sources

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/Genetics-With-Practicals-by-Prof-S-S-Patole-Dr-V-R-Borane-Dr-R-K-Petare
4. https://www.kopykitab.com/Practical-Plant-Breeding-by-Gupta-S-k
5. https://www.kopykitab.com/Cell-And-Molecular-Biology-A-Lab-Manual-by-K-V-Chaitanya.

CORE ELECTIVE-V ENTREPRENEURIAL OPPORTUNITIES IN BOTANY – P23BO3E5A

Lecture Hours	**: 40**	**Tutorial Hours**	**: 5**
Practical Hours	**: -**	**No. of Credits**	**: 3**
Contact Hours per Semester:	**45**		
Contact hours per Week	**: 3**		
Internal Marks	**: 25**		
External Marks	**: 75**		
Total Marks	**: 100**		

Objectives of the Course

- To understand the importance of bio fertilizers in agriculture.
- To develop bio business strategies in processing and marketing of plant based products.
- To apply skills in horticulture and floriculture techniques for commercial purpose.
- To know the importance of food preservation techniques.
- To create self-employability opportunities through mushroom cultivation.

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the Course, the students should be able to

CO1 recognize the different forms of bio-fertilizers and their uses.

CO2 explore the use of plant based products in cottage industries.

CO3 develop and apply skills and techniques in horticulture and floriculture for commercial purpose.

CO4 learn the methods and apply the methods and techniques in food preservation.

CO5 develop strategies in cultivation and production of mushrooms.

CO-PO AND PSO MAPPING (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	1	3	2	1	2	2	3	3
CO 2	3	3	2	2	3	3	2	3	3	3
CO 3	2	2	3	3	1	2	1	3	2	2
CO 4	3	3	3	3	3	2	3	3	3	3
CO 5	3	3	2	3	2	3	3	3	3	3
Total Contribution of	14	14	11	14	11	12	11	14	14	14

COs to POs										
Weighted Percentage of COs contribution to POs	93	93	73	93	73	80	73	93	93	93

0 – No Correlation 1 – Weak 2 – Moderate 3 – Strong

Course Content

Unit I Biofertilizers (L 8 hrs; T-1 hr)

Organic manures and fertilizers. Bio-fertilizer-Azolla cultivation and marketing. Composition of fertilizer, NPK content of various fertilizers. Common organic manures -bone meal, cow dung, poultry waste, oil cakes, organic mixtures and compost. Preparation and advantages of compost, aerobic and anaerobic. vermicompost preparation, vermiwash. panchakaviya.

Unit II Entrepreneur Opportunities (L 10 hrs; T-1 hr)

Bio-business- Processing and marketing ofcoconut (Copra, coir, tender coconut).Cultivation of medicinal and aromatic plants (*Gloriosasuperba*and *Curcumalonga*).Herbal cosmetics production – *Aloe vera*. Extraction and processing of Plant fiber products (Musa spp.).

Unit III Horticulture and floriculture (L 8 hrs; T-1 hr)

Gardening – types of garden, Green house. Nursery; ornamental, indoor garden, kitchen garden, roof top garden.Vegetable garden plants marketing and vegetable carving. Bonsai, Terrarium. Flower arrangement, Cut flower, bouquet making. Flower craft. Naturopathy; Flower therapy.

Unit IV Food Preservation (L 8 hrs; T-1 hr)

Preservation techniques - drying, heat treatment, low temperature, chemicals. Preservation by preservatives - vinegar and citric acid.Preservation by high concentration of sugar – Jam and Jelly. Preservation by fermentation- Preparation of wine. Ready to Serve (RTS)-Fruit squashes, Ketchup and sauce.

Unit V Mushroom cultivation (L 6 hrs; T-1 hr)

Mushrooms and their importance. Types of mushrooms (button mushroom, oyster mushroom). Spawn preparation. Cultivation and usage of spent mushrooms. Value added products from mushroom – pickles and mushrooms recipes.

Recommended Text

1. Chmielewski, J.G and Krayesky, D. *General Botany laboratory Manual*. Author House, Bloomington, USA. 2013.
2. Kumar, N. *Introduction to Horticulture,* Rajalakshmi Publications, Nagercoil. 1997.
3. Russell, T. *Nature Guide*: *Trees: The world in your hands (Nature Guides)*. Mukherjee D.

Gardening in India, Oxford IBH publishing co, New Delhi. 2012.

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

Reference Books

1. Adams, C.R. Banford, K.M. and Early, M.P. *Principles of Horticulture*. 1993.
2. Edmond Musser and Andres, *Fundamentals of Horticulture*, McGraw Hill Book Co., New Delhi.
3. Hartman, H.T. and D.F. Kestler. *Plant propagation principles and practice*. Prentice Hall of India, New Delhi. 1976.
4. Peter, K.V. *Basic Horticulture*. New India Publishing Agency. 3rd Edition. 2017.
5. Sathe, T.V. *Vermiculture and Organic farming*, Daya Publishing House. 2004.

Website and E-learning Sources

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
   https://www.masterclass.com/articles/a-guide-to-home-food-preservation-how-to-pickle-can-ferment-dry-and-preserve-at-home.

CORE ELECTIVE V - APPLIED PLANT CELL & TISSUE CULTURE – P23BO3E5B

Lecture Hours	**: 40**	**Tutorial Hours**	**: 5**
Practical Hours	**: -**	**No. of Credits**	**: 3**
Contact Hours per Semester: 45			
Contact hours per Week	**: 3**		
Internal Marks	**: 25**		
External Marks	**: 75**		
Total Marks	**: 100**		

Objectives of the Course

- To comprehend the basic principles and methodologies of plant tissue culture.
- To acquire knowledge on *in vitro* cultivation techniques to develop protocols targeted towards commercialization.
- To gain understanding of the various techniques of tissue culture for secondary metabolites production.
- To recognize the worth of traditional germplasm and receive training in preserving and enhancing crop varieties to meet consumer demand and global legal policies.
- To impart practical information on plant tissue culture in order to produce labour suitable for the demands of the industry and research facilities.

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the Course, the students should be able to

CO1 Recall the principles and culture techniques of cells, callus, organs, pollen, anthers, embryos and protoplasts.

CO2 Understand the techniques used in plant growth and regeneration under in vitro conditions.

CO3 Apply the role plant tissue culture techniques in the production some secondary metabolites and planting stock in horticulture.

CO4 Analyze the conditions that are suitable for direct and indirect plant regeneration.

CO5 Evaluate the self-skills obtained during the course thorough internal and external assessment systems.

CO-PO AND PSO MAPPING (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	1	3	2	1	2	2	3	3
CO 2	3	3	2	2	3	3	2	3	3	3
CO 3	2	2	3	3	1	2	1	3	2	2
CO 4	3	3	3	3	3	2	3	3	3	3
CO 5	3	3	2	3	2	3	3	3	3	3
Total Contribution of COs to POs	14	14	11	14	11	11	11	14	14	14
Weighted Percentage of COs contribution to POs	93	93	73	93	73	73	73	93	93	93

0 – No Correlation 1 – Weak 2 – Moderate 3 – Strong

Course Content

Unit I Basic Plant Tissue Culture (L 10 hrs; T-1 hr)

Totipotency and concepts of plant tissue culture – Laboratory organization – Design of different laboratories and management - Aseptic techniques - Plant culture media – Inorganic nutrients – Macronutrients – Micronutrients - Carbon and energy sources – Organic supplements – Growth regulators – Solidifying agent – MS medium and B5 medium – Explant preparation - Methods of sterilization – Transfer and incubation of culture – Transplantation area.

Unit II Micropropagation (L 8 hrs; T-1 hr)

Micropropagation – Stages of micropropagation - Multiplication by axillary and apical shoots – Multiplication by adventitious shoots – Multiplication through callus culture – Organogenesis and somatic embryogenesis – Multiplication and Rooting - Hardening - Factors effecting micropropagation – Technical problems in micropropagation - Practical applications of micropropagation – Somaclonal&gametoclonal variation – synthetic seed technology - Shoot tip/Meristem culture for virus free plants.

Unit III Cell and Protoplast Cultures and Haploid Production (L 6 hrs; T-1 hr)

Single cell and cell suspension culture – Applications - Production of haploids - Anther culture and pollen culture – Induction of haploids from un-pollinated ovaries and ovules – Role of haploids in Plant breeding - Protoplast culture: Protoplast isolation, purification – regeneration – culturing. Protoplast fusion techniques – somatic hybridization and cybridization - Applications of protoplast culture and hybridization.

Unit IV Metabolic Engineering (L 8 hrs; T-1 hr)

Application of cell culture systems in metabolic engineering - advantages of cell, tissue and organ culture as a source of secondary metabolites - Hairy root culture - Screening of high yielding cell lines - Procedures for extraction of high value industrial products – Alkaloids, food additives and insecticides in *in vitro* system.

Unit V Cryopreservation and Bioreactors (L 8 hrs; T-1 hr)

Germplasm storage and conservation – Methods of in vitro conservation – Cryopreservation and steps involved in cryopreservation of plant materials - Types of bioreactors (Stirred tank and airlift) and their uses - Industrial scaling – Upstream and downstream processing - Manipulation in production profile by biotic and abiotic elicitation – Biotransformation – Food vaccines, bioplastics, plantibodies, plantigens - Applications of tissue culture in agriculture, Horticulture and forestry.

Recommended Text

1. Bhojwani, S. S and Dantu, P.K. *Plant tissue culture: an introductory text* (Vol. 318). New Delhi, India: Springer. 2013.
2. Vasil, I.K. and Thorpe, T.A. *Plant Cell and Tissue Culture*, Kluwer Academic Press, The Netherlands. 1994.
3. Loyola-Vargas, V.M. Ochoa-Alejo, N. *Somatic embryogenesis: Fundamental aspects and applications*, Springer international publishing, Switzerland. 2016.
4. Elhiti, M., Stasolla, C and Wang, A. Molecular *regulation of plant somatic embryogenesis. In Vitro Cellular & Developmental Biology-Plant*, 49(6), 631-642. 2013.
5. Collins, H.A. and Edwards, S. *Plant Cell Culture*, Bios Scientific Publishers, Oxford, UK. 1998.
6. Hall, R.D. (Ed.). *Plant Tissue Culture: Techniques and Experiments*, Academic Press, New York. 1999.
7. Kartha, K.K. *Cyropreservation of plant cells and organs*. CRC Press, Boca Raton, Florida. 1985.
8. Rihan, H.Z., Kareem, F., El-Mahrouk, M.E., and Fuller, M.P. *Artificial seeds* (principle, aspects and applications). Agronomy, 7(4), 7. 2017.
9. Pullaiah, T. *Plant Tissue Culture: Theory and Practicals*, Scientific Publishers Journals 2009.
10. Timir Baran Jha and Biswajit Ghosh. *Plant Tissue Culture: Basic and Applied*, Platinum Publishers; 2nd Edn. 2016.
11. Anis Mohammad and Ahmad Naseem. *Plant Tissue Culture*: *Propagation, Conservation and Crop Improvement*, Springer. Singapore**.** 2016.
12. Loyola-Vargas, V.M and Vázquez-Flota, F. *Plant cell culture protocols* (Vol. 318). USA: Humana Press, New Jersey. 2006.

13. Mba, C., Afza, R., Bado, S., and Jain, S.M. *Plant Cell Culture*: Essential Methods, John Wiley & Sons, UK. 2010.

14. Abdin, M.Z., Kiran, U., Kamaluddin, M., Ali, A. (Eds.). *Plant Biotechnology*: *Principles and Applications*, Springer publishers. 2017.
15. Fett-Neto, Arthur Germano (Ed.). *Biotechnology of Plant Secondary Metabolism*: *Methods and Protocols*, Springer publishers. 2016.
16. Smith, R.H. *Plant tissue culture: techniques and experiments*. Academic Press, UK. 2012.
17. Trigiano, R. N., and Gray, D. J. *Plant tissue culture, development, and biotechnology*. CRC Press, US. 2011.
18. Kartha, K.K. *Cryopreservation of Plant Cells and Organs*. CRC Press, Boca Raton, Florida, USA. 1985.

Website andE-learning Sources

1. https://nptel.ac.in/courses/102/103/102103016/
2. http://ugcmoocs.inflibnet.ac.in/ugcmoocs/spoc.php?coordinator=574
3. https://www.youtube.com/watch?v=bi755vQVNx8
4. https://www.elsevier.com/books/plant-tissue-culture/park/978-0-12-821120-5
5. https://onlinelibrary.wiley.com/doi/book/10.1002/9780470686522

CORE ELECTIVE V - SILVICULTURE AND COMMERCIAL LANDSCAPING - P23BO3E5C

Lecture Hours	**: 40**	**Tutorial Hours**	**: 5**
Practical Hours	**: -**	**No. of Credits**	**: 3**
Contact Hours per Semester:	**45**		
Contact hours per Week	**: 3**		
Internal Marks	**: 25**		
External Marks	**: 75**		
Total Marks	**: 100**		

Objectives of the Course

- To understand the basic concepts of horticulture.
- To learn the various methods of plant propagation.
- To know the art of fruit crop and vegetable crop cultivation.
- To know about the fundamental concepts of gardening and landscaping.
- To provide an overview of various gardening styles and its scope in recreation and bio-aesthetic planning.

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the Course, the students should be able to

CO1 understand the importance and divisions of horticulture.

CO2 demonstrate the art of floriculture and landscape gardening.

CO3 explain plant propagation and fruit crop cultivation.

CO4 compare and contrast the vegetable cultivation and kitchen gardening.

CO5 discuss and develop skills for effective understanding on landscaping and components of gardens.

CO-PO AND PSO MAPPING (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	2	1	2	1	2	2	3	3
CO 2	3	3	2	2	3	3	2	3	3	3
CO 3	2	2	3	3	1	2	1	3	2	2
CO 4	3	3	3	3	3	2	3	3	3	3
CO 5	3	3	2	3	2	3	3	3	3	3
Total Contribution of COs to POs	14	14	12	12	11	11	11	14	14	14
Weighted Percentage of COs contribution to POs	93	93	80	80	73	73	73	93	93	93

0 – No Correlation 1 – Weak 2 – Moderate 3 – Strong

Course Content

Unit I Basics of Horticulture (L 6 hrs; T-1 hr)

Importance and scope of Horticulture - Divisions of Horticulture – Climate, soil and nutritional needs – Manures and fertilizers – Organic manures – Inorganic fertilizers – Biofertilizers – Methods of applications of manures and fertilizers - Water irrigation – Surface irrigation – Sub irrigation – Special irrigation methods – Plant protection and pest control for horticulture crops.

Unit II Plant propagation (L 10 hrs; T-1 hr)

Natural method: Propagation through seeds and specialized vegetative structures - Artificial methods: Cutting: types (root, stem, leaf cuttings), advantages and disadvantages - Layering: types (simple, compound, tip, trench, mound, air-layering) advantages and disadvantages - Grafting: types (inarching, side, splice, whip/tongue, veneer, cleft, bark, epicotyl, top-working) advantages and disadvantages - Budding: Types (T-budding, shield, patch, and ring budding) advantages and disadvantages - Stock – scion relationships – Micropropagation.

Unit III Fruit crops (L 8 hrs; T-1 hr)

Training and pruning methods for fruit plants – Induction of flowering, flower thinning - fruit setting and fruit development – Seedlessness in horticultural fruits – Importance of plant growth regulators in fruit crops – Cultivation and harvesting methods of important fruit crops; Mango, Sapota, Pomegranate, Grapes and Guava.

Unit IV Flower and Vegetable Crops (L 8 hrs; T-1 hr)

Floriculture – Cultivation of commercial flower crops – Rose, Jasmine, Chrysanthemum, Crossandra, Anthurium and Gerberas – Cut flowers – Vase life period – Packages for export of cut flowers - Flower decoration – Dry and wet decoration - State Integrated Board of Studies – Botany PG 32 Classification of vegetables – Cultivation of important vegetables - Tomato, Potato, Onion, Cabbage and Snake guard – Layout for a model kitchen garden.

Unit V Landscape Designing (L 8 hrs; T-1 hr)

Principles and methods of landscape designing – Types of garden – Garden components – Shrubs and shrubberies, ornamental hedges, edges, flower beds, borders and carpet beds – Climbers and creepers – Foliage plants - Succulents and cacti – Ornamental palms – Orchids - Topiary and trophy - Rockeries and arches – Lawn making and maintenance – Water garden - Layout for college garden - Indoor gardening – Hanging baskets - Bonsai plants – Training and pruning - Terrace garden - Cultivation of tree species – Eucalyptus and teak.

Recommended Text

1. Edmond, J.B. *Fundamentals of Horticulture*. Tata McGraw Hill Publishers Co. Ltd., New Delhi. 1977.
2. Kumar, N. *Introduction to Horticulture*, Midtech Publisher. 2017.
3. Manibushan Rao, K. Textbook of Horticulture. Macmillan Publishing Co., New York. 1991.
4. Rao, K.M. *Text book of Horticulture*. Macmillan India Ltd, New Delhi. 2000.
5. George, A. *Horticulture Principles and Practices*. 2nd Edition. Pearson Education, Delhi. 2002.
6. Bohra, M.P.S. and Arora, *Introduction to Horticulture*, 2 nd Edition. 2017.
7. Singh, J. *Fundamentals of Horticulture*. Kalyani Publishers. 2018.
8. Acquaah, J. *Horticulture – principles and practices*, 4th edition, PHI learning Pvt. Ltd. 2009.
9. Rao Manibhushan K. 1991. *Textbook of horticulture*. MaCMillan India Ltd.
10. Gangulee H. C. and Kar A. K. 2004. *College Botany* Vol II, New Central Book Agency
11. Sharma V. K. *Encyclopedia of Practical Horticulture*, Vol I –IV, Deep and Deep Publ. Pvt. Ltd. 1999.

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1. Edment Senn Andrews. 1994. *Fundamentals of Horticulture*. Tata. McGraw Hill Publishing Co., Ltd., Delhi.
2. Adams, 2005. *Principles of Horticulture*. IVth Ed. Elsevier India Pv. Ltd
3. Antje Rugullis. 2008. 1001 *Garden Plants and Flowers*. Parragon Publishers.
4. Berry, F. and Kress, J. 1991. Heliconia: *An Identification Guide*. Smithsonian Books.
5. Butts, E. and Stensson, K. 2012.*Sheridan Nurseries*: *One hundred years of People, Plans, and Plants*. Dundurn Group Ltd.

6. Russell, T. 2012. *Nature Guide*: *Trees: The world in your hands* (Nature Guides).

Website and E-learning Sources

1. https://courses.opened.uoguelph.ca/contentManagement.do?method=load&code=CM000019
2. www.teachervision.com/gardening
3. https://pace.oregonstate.edu/catalog/master-gardener-series-oregon-master-gardener-program
4. https://www.amazon.in/Gardening-Landscape-Design-and-Botanical-Garden/s?rh=n%3A1318122031%2Cp_27%3Aand+Botanical+Garden
5. https://www.overdrive.com/subjects/gardening
6. https://www.scribd.com/book/530538456/Opportunities-in-Landscape-Architecture-Botanical-Gardens-and-Arboreta-Careers

SKILL ENHANCEMENT COURSE (SEC1)

Seminar paper (or)

Professional Communication Skill

Course Code: P23BO3SEP

Lecture	Tutorial	LabPractice	Total
3	-	--	5

Evaluation Pattern

Split Up	Components	K Level	Marks	Total Marks
CIA*	Content	K3, K4,K5,k6 Any level can be used	10	40
	Presentation		15	
	Subject Knowledge		15	
ESE	Visual Aids and Materials: Assessment Methods: PowerPoint slides, handouts, and other supporting materials.		15	60
	Presentation		20	
	Mastery of the seminar topic.		20	
	Participation and Engagement in Seminars		5	

* Students are required to select seminar topics from their core courses. As part of the Continuous Internal Assessment (CIA), each student must deliver a minimum of two seminars over the duration of their course. These seminars should be based on topics from their core courses to ensure alignment with the curriculum and to deepen their understanding of the core subjects.

CORE-13 PLANT PHYSIOLOGY AND PLANT METABOLISM – P23BO413

Lecture Hours	**: 70**	**Tutorial Hours**	**: 5**
Practical Hours	**: -**	**No. of Credits**	**: 4**
Contact Hours per Semester:	**75**		
Contact hours per Week	**: 5**		
Internal Marks	**: 25**		
External Marks	**: 75**		
Total Marks	**: 100**		

Objectives of the Course

- To identify the function of plants in response to internal and external factors
- To gain knowledge on mineral nutrition in plants and process of photosynthesis
- To understand the process and importance of respiration and nitrogen metabolism
- To comprehend various phytohormones and their role in plant growth and development
- To make students aware of physiology of flowering, various kinds of environmental stress on plants and the mechanisms to overcome them.

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the Course, the students should be able to

CO1 understand the concept of water potential and importance of mineral nutrition in plants.

CO2 know the importance on photosynthesis and different mechanisms of CO_2 fixation.

CO3 gain knowledge on the process of respiration, ATP synthesis and nitrogen metabolism.

CO4 analyse the role and mode of action of various phytohormones and importance of photoperiodism, and vernalization.

CO5 comprehend the importance of seed physiology, mechanism of stress and adaptations to overcome it.

CO-PO AND PSO MAPPING (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	1	3	2	1	2	2	3	3
CO 2	3	3	2	2	3	3	2	3	3	3
CO 3	2	2	3	3	1	2	1	3	2	2
CO 4	3	3	3	3	3	2	3	3	3	3
CO 5	3	3	2	3	2	3	3	3	3	3
Total Contribution of COs to POs	14	14	11	14	11	11	11	14	14	14
Weighted Percentage of COs contribution to POs	93	93	73	93	73	73	73	93	93	93

0 – No Correlation 1 – Weak 2 – Moderate 3 – Strong

Course Content

Unit I Water Relations (L 14 hrs; T-1 hr)

Physical and chemical properties of water –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.

Unit II Photosynthesis (L 14 hrs; T-1 hr)

The physical nature of light – absorption and action spectra- photoreceptors. Light harvesting complexes - Photosystem I & II, photolysis of water. Photosynthetic Electron Transport and Photophosphorylation (cyclic and noncyclic). Carbon metabolism: C3, C4 and CAM pathways and their distinguishing features - photorespiration and its consequences. A brief account on RUBISCO.

Unit III Respiration (L 14 hrs; T-1 hr)

Glycolysis – TCA cycle– Electron Transport – oxidative phosphorylation and ATP synthesis – Chemiosmotic Theory - Pentose Phosphate Pathway. Cyanide resistant respiration, AO respiration. Nitrogen fixation (Biological - symbiotic and non-symbiotic), Physiology and Biochemistry of nitrogen fixation.

Unit IV Growth and Development (L 14 hrs; T-1 hr)

Phases of plant growth – growth types.Physiological effect, mode of action and applications of Growth hormones - Auxins, gibberellins, cytokinins, abscisic acid, ethylene, brassinosteroids.Cryptochrome,Photoperiodism – Types, mechanism of flowering – Phytochrome and

their action on flowering.Vernalization- Mechanism and its practical application. Biological rhythms and movements. Seed dormancy and viability.

Unit V Plant Senescence **(L 14 hrs; T-1 hr)**

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.

Recommended Text

1. Jain V.K. 2007. *Fundamentals of plant physiology*. 7thEdn. S. Chand and Company Ltd., New Delhi.
2. Kumar, H.D. and H.N. Singh. 1993. *Plant Metabolism*. Edn. 2nd. Affiliated East west Press Pvt. Ltd.,New Delhi.
3. Pandey, S.N. and B.K. Sinha. 2006. *Plant Physiology*. Edn. 4th. Vikas Publishing House PVT Ltd. New Delhi.
4. Salisbury, F.B. and L.W. Ross. 2006. *Plant Physiology* (Paperback). CBS Publisher.

REFERENCE BOOKS

1. Bidwell, R.G.S. 1979. *Plant physiology*. Edn 2nd. Collier Macmillan Publishers, London.
2. Noggle G.R. and G.J. Fritz. 2002. *Introductory Plant Physiology*. Prentice Hall of India Pvt. Ltd, New Delhi.
3. Prasad, M.N.B. 1997. *Plant Ecophysiology*. John Wiley and sons, USA
4. Tais, L. and E. Zeiger. 2015. *Plant Physiology and Development*. VI Edn. Synaeve associations.
5. Wilkins, B.M. 1984. *Advanced Plant Physiology*. Longman scientific and technical publications, UK.
6. Hall. D.O. and K.K.Rao, 1999. *Photosynthesis* 6th Edition, 214 pp. Cambridge: Cambridge University Press.

Website and E-learning Sources

1. http://www.esalq.usp.br/lepse/imgs/conteudo/Plant-Physiology-by-Vince-Ordog.pdf
2. http://www.frutvasf.univasf.edu.br/images/physiology.pdf
3. https://exa.unne.edu.ar/biologia/fisiologia.vegetal/PlantPhysiologyTaiz2002.pdf
4. https://www.mpgmahavidyalaya.org/userfiles/Plant%20physiology%20development%20and%20metabolism.pdf
5. https://www.academia.edu/27225799/Plant_Physiology_Taiz_and_Zeiger_.

CORE-14 BIOCHEMISTRY AND APPLIED BIOTECHNOLOGY – P23BO414

Lecture Hours	**: 70**	**Tutorial Hours**	**: 5**
Practical Hours	**: -**	**No. of Credits**	**: 4**
Contact Hours per Semester:	**75**		
Contact hours per Week	**: 5**		
Internal Marks	**: 25**		
External Marks	**: 75**		
Total Marks	**: 100**		

Objectives of the Course

- To understand the basics of atomic structure , chemical bond and thermodynamics
- To gain knowledge on the structure and properties of carbohydrates, proteins and lipids.
- To know the properties and mechanism of action of enzymes and secondary metabolites
- To learn the fundamental & applications of Plant tissue culture
- To understand the principles and applications of biotransformats.

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the Course, the students should be able to

CO1 gain Knowledge on the fundamentals and significance of Plant Biochemistry

CO2 understand the structure and properties of plant biomolecules.

CO3 analyse the role of enzymes in plants.

CO4 comprehend the methods and applications of plant tissue culture.

CO5 discuss the production of transgenic plants and the importance of biotransformation.

CO-PO AND PSO MAPPING (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	1	3	2	1	2	1	2	2
CO 2	3	3	2	2	3	3	2	3	2	3
CO 3	3	2	3	3	1	2	1	2	1	3
CO 4	3	3	3	3	3	2	3	2	3	1
CO 5	3	3	2	3	2	3	3	3	3	1
Total Contribution of COs to POs	15	14	11	14	11	11	11	11	11	10
Weighted Percentage of COs contribution to POs	100	93	73	93	73	73	73	73	73	67

0-No Correlation **1-Weak** **2-Moderate** **3-Strong**

Course Content

Unit I Atomic structure **(L 14 hrs; T-1 hr)**

Chemical bonds - ionic bond, covalent bond, coordinate covalent bond, hydrogen bond. pH and buffers. Thermodynamics principle, First Law of Thermodynamics a) energy (b) Enthalpy (ii) second law of thermodynamics - entropy ,free energy, redox potential, dissociation and association constant, activation energy and binding energy.

Unit II Biomolecules **(L 14 hrs; T-1 hr)**

Classification of carbohydrates; Structure and properties of monosaccharides (one e.g.) Oligosaccharides, Polysaccharides. Protein and Amino acids: Structure, Classification and properties; Protein - Structure: Primary, secondary, tertiary and quaternary structures. Lipids: Classification of lipid, Structure and properties of fatty acids, phospholipids, glycolipids and lipoproteins.

Unit III Enzymes **(L 14 hrs; T-1 hr)**

Classification and nomenclature, chemical nature of enzymes,mechanism of enzyme action– factors affecting enzyme action – Michaelis – Menton constant, MM equation, Lineweaver Burk plot. Ramachandran plot. Enzyme inhibition, co enzymes- isoenzymes. Secondary Metabolites: classification and properties of alkaloids (One eg. Each) steroids, terpenoids, flavonoids and Glycosides.

Unit IV Plant Tissue Culture and Applications **(L 14 hrs; T-1 hr)**

Introduction–Totipotency,Tissue culture media components and plant growth regulators (auxins and cytokinin).Type of explants-callus culture, differentiation, organogenesis, somatic embryogenesis, encapsulation of somatic embryos and Somoclonal variations. Micropropagation-stages of

micropropagation - 0toVI. Antherculture – production of haploids, protoplast culture and somatic hybridization (hybrids and cybrids).

Unit V Applied biotechnology **(L 14 hrs; T-1 hr)**

Transgenic plants: Virus resistance- crop protein mediated, Insect resistance- Bt toxins, Herbicide resistance –Glyphosate. Production of secondary metabolites using hairy root culture. Antisense RNA technology - improvement of shelf life of fruits.

Recommended Text

1. Chawla, H.S. 2009. *Introduction to Biotechnology*, 2nd edn. Oxford IBH, ISBN: 978-81-204-1732-8.
2. Harold, F.M. 1986. *The vital force: A study of Bioenergetics*. Freeman & Co, New York.
3. Lehninger, A.L., D. L. Nelson & M. M. Cox. 1993. *Principles of Biochemistry*. Worth Publishers, New York.
4. Satyanarayana, U. and Chakkrapani, U. 2013. *Biochemistry*. Elsevier India Pvt Ltd & Books Allied Pvt.Ltd, New Delhi.
5. Stryer, L. 1994. *Biochemistry*. Freeman & Co, New York.
6. Zubay, G. 1988. *Biochemistry*. 1988 Macmillan Publishing Co, New York.
7. Razdan M.K. 2019. *Introduction to Plant Tissue culture* (Third Edison).

Reference Books

1. Bonner, J. and Warner, W.H. 1961. *Plant Biochemistry*. Academic Press. Inv. New York.
2. Buchanan, B.B., Grissem, W. and Jones, R.L. 2000. *Biochemistry and molecular biology of plants*. 5th Edition. Wiley-Blackwell.
3. Gupta, S.N. 2016. *Biochemistry*. Rastogi Publications, Meerut.
4. Halford, N. 2015. *Plant Biotechnology*: *Current and Future Applications of Genetically Modified Crops*. John Wiley and Sons.
5. Heldt, H-W. 2005. *Plant Biochemistry*, 3rd Edition. Elsevier Academic Press.
6. Nelson, D.L. and Cox, M.M. 2017. *Lehninger's Principles of Biochemistry*, Prentice Hall, International N.J, 7th Edition.

Website andE-learning Sources

1. http://www.brainkart.com/subject/Plant-Biochemistry_257/
2. https://swayam.gov.in/nd2_cec20_bt12/preview
3. https://www.scribd.com/document/378882955/
4. https://nptel.ac.in/courses/102/107/102107075/
5. https://.britannica.com/technology/biotechnolog/
6. https://manavrachna.edu.in/blog/scope-of-biotechnology/

CORE: 15 (CORE LAB-IV)

PLANT PHYSIOLOGY & PLANT METABOLISM; BIOCHEMISTRY & APPLIED BIOTECHNOLOGY (P23BO4P4)

Lecture Hours	**: -**	**Tutorial Hours**	**: -**
Practical Hours	**: -**	**No. of Credits**	**: 3**
Contact Hours per Semester: 60			
Contact hours per Week	**: 4**		
Internal Marks	**: 40**		
External Marks	**: 60**		
Total Marks	**: 100**		

Objectives of the Course

- To gain knowledge on quantitative estimation of various biomolecules such as proteins, amino acids, sugars and lipids.
- To identify the methods of qualitative analysis of primary and secondary metabolites.
- To understand the nature, distribution and role of stomata and mineral absorption in plants.
- To estimate important Biomolecules and enzymes - IAA, nitrate reductase, amylase, protein, proline and photosynthetic pigments
- To comprehend the mechanism of stress by enzyme activity and accumulation of protein

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the Course, the students should be able to

CO1 understand the number and distribution of stomata in plants growing under different habitats; quantify the amount of chloride ions accumulation through volumetry.

CO2 analyze the amount of photosynthetic pigments by spectrophotometry and mechanism of CO_2 fixation

CO3 examine the activity of enzyme Nitrate reductase

CO4 comprehend the effect of PGRs on seedling growth and quantification of auxins

CO5 relate the mechanism for delaying of senescence due to cytokinin treatment; enzyme activity and accumulation of protein in plants growing under stress.

CO-PO AND PSO MAPPING (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	1	3	2	1	2	2	3	3
CO 2	3	3	2	2	3	3	2	3	3	3
CO 3	3	2	3	3	1	2	1	3	3	2
CO 4	3	3	3	3	3	2	3	3	3	3
CO 5	3	3	2	3	2	3	3	3	3	3
Total Contribution of COs to POs	15	14	11	14	11	11	11	14	15	14
Weighted Percentage of COs contribution to POs	100	93	73	93	73	73	73	93	100	93

0-No Correlation **1-Weak** **2-Moderate** **3-Strong**

Course Content

Unit I Plant Physiology **(P 12 hrs)**

- Measurement of stomatal frequency and stomatal index
- Stomatal movement - opening and closing in GA and ABA
- Determination of Ion accumulation – Chloride ions by volumetry
- pKa - detemination of glycine
- Reducing Sugar - Nelson - Somagyi method
- Estimation of Amino acid – Ninhydrin Method
- Estimation ofProtein – Lowry's method
- Lipid –Gravimetric method by using oil seeds.

Unit II Biochemistry **(P 12 hrs)**

- Absorption spectrum of chlorophyll at room temperature – spectroscopy
- Quantification of Photosynthetic pigments – Spectroscopy with reference to light and shade plants.
- I_2KI test for identification of C_3 and C_4 plants- Histochemical staining
- Qualitative analysis Primary metabolites – Sugar, starch, amino acid and protein.
- Qualitative analysis Secondary metabolites- Alkaloids, glycosides, tannins, steroids and saponins.

Unit III Plant physiology **(P 12 hrs)**

- Estimation of Nitrate reductase activity

- Separation of Leaf/ flower pigments by -paper chromatography and TLC
- Isolation of Alkaloids – Soxhlet method (Demonstration)
- Determination of km value of Catalase enzyme

Unit IV Plant Propagation (P 12 hrs)

- Effect of Plant Growth Hormones (Auxin and Gibberellin) on seed germination and seedling growth in *Oryza sativa* and *Vignaradiata*
- Quantification of IAA- Salkowski method
- Preparation medium for tissue culture Callus initiation using seedling organs of hypocotyl of *Lycopersiconesculentum*
- Anther culture – *Datura,* Embryo culture – *Arachis hypogea*.

Unit V Applied Biotechnology (P 12 hrs)

- Determination of Seed viability – TTC test
- Estimation of βAmylase activity in germinating seeds
- Estimation of Proline content in stress conditions
- Delaying of senescence by cytokinin treatment (Demonstration)
- Meristem culture (Axilliary bud)- any Acanthceae member
- Immobilization of callus.

Recommended Text

1. Jain V.K. 2007. *Fundamentals of plant physiology*. 7thEdn. S. Chand and Company Ltd., New Delhi.
2. Pandey, S.N. and B.K. Sinha. 2006. *Plant Physiology*. Edn. 4th. Vikas Publishing House PVT Ltd. New Delhi.
3. Jayaraman.J.1981. *Laboratory Manual in Biochemistry*. Whiley Eastern Limited, NewDelhi.
4. Kumar, H.D. 2007. *Molecular Biology and Biotechnology*, Vikas Publishing House, New Delhi.
5. Palanivelu,P.2004. *Laboratory Manual for analytical biochemistry and separation techniques*. School of Biotechnology, Madurai Kamaraj University, Madurai.
6 Plummer,D.1988. *An introduction to Practical Biochemistry*,TataMcGraw–HillPublishing Company Ltd.,New Delhi.
7. Shivakumar, S. 2002. *Molecular analysis*: *Laboratory Manual*. University press, Palkalai.

Reference Books

1. Joy P.P, Surya, S. and Aswathy, C. 2015. *Laboratory Manual of Biochemistry*, Agricultural University, Pineapple Research Station, Ernakulam, Kerala.

2. Poonam Sharma – Natu, Vijay Paul and P.S. Deshmukh. 2021. *Laboratory manual Experimental Plant Physiology*. Division of Plant Physiology, Indian Agricultural Research Institute, New Delhi.
3. Bala, M., Gupta, S., Gupta, N.K and Sangha, M.K. 2013. *Practicals in plant physiology and biochemistry*. Scientific Publishers (India).
4. Kayan Kumar dev, Rajesh, Praneethkumar and Mahesh (2012). *Plant Tissue culture techniques* AkiNik publications
5. Roseline, A. 2011. *Pharmacognosy*, MJP Publishers, Chennai.
6. Saharan, Moond, Chouhan and Gupta, 2008. *A textbook of Pharmacognosy*. Saraswati Purohit Publishers, Jodhpur.
7. Wilson, Kand J.Walker.2005. *Principles and Techniques of Practical Biochemistry*, 5th Edition. Cambridge University press, New York.

Website and E-learning Sources

1. https://www.researchgate.net/publication/321269055_Laboratory_Manual_Experimental_Plant_Physiology_-_I/link/60d30f82a6fdcce58bab39cd/download
2. http://www.kau.in/document/laboratory-manual-biochemistry
3. https://www.rlbcau.ac.in/pdf/Forestry/FBT-111%20%20Plant%20Physiology.pdf
4. https://metabolism.net/bidlack/pphys/manual.s18.pdf
5. https://metabolism.net/bidlack/pphys/manual.s18.pdf
6. https://kau.in/document/laboratory-manual-biochemistry
7. https://www.kopykitab.com/A-Laboratory-Manual-of-Plant-Physiology-Biochemistry-and-Ecology-by-Akhtar-Inam.
8. https://www.kopykitab.com/Cell-And-Molecular-Biology-A-Lab-Manual-by-K-V-Chaitanya.
9. https://thunderbooks.files.wordpress.com/2009/05/plant-propagation-by-tissue-culture-vol1-the-background-springer-2007.pdf
10. https://www.pdfdrive.com/basic-biotechnology-d175979595.html

CORE ELECTIVE VI –ORGANIC FARMING – P23BO4E6A

Lecture Hours	**: 55**	**Tutorial Hours**	**: 5**
Practical Hours	**:**	**No. of Credits**	**: 3**
Contact Hours per Semester: 60			
Contact hours per Week	**: 4**		
Internal Marks	**: 25**		
External Marks	**: 75**		
Total Marks	**: 100**		

Objectives of the Course

- To study various aspects of organic farming.
- To understand the relevance of organic farming, its advantages and short comings against conventional high input agriculture.
- To know the importance of organic farming in the present scenario and its impact on environment and soil health.
- To create an awareness on the importance of organic farming in the present scenario and its impact on environment and soil health.
- Expose the students to about quality aspect and grading.

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the Course, the students should be able to

CO1 develop knowledge on various aspects of organic farming.

CO2 understand the relevance of organic farming and its advantages.

CO3 explain the short comings of conventional high input agriculture.

CO4 compare the packaging methods of harvest.

CO5 discuss and develop skills for post-harvest management

CO-PO AND PSO MAPPING (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	1	3	2	1	2	2	2	2
CO 2	3	3	2	2	3	3	2	2	2	3
CO 3	2	2	3	1	1	2	1	1	1	3
CO 4	3	3	3	3	3	2	3	3	3	3
CO 5	3	3	2	3	2	3	3	3	3	2
Total Contribution of COs to POs	14	14	11	12	11	11	11	11	11	12
Weighted Percentage of COs contribution to POs	93	93	73	80	93	73	73	73	73	80

0-No Correlation **1-Weak** **2-Moderate** **3-Strong**

Course Content

Unit I Agronomy **(L 14 hrs; T-1 hr)**

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

Unit II Soil Science **(L 10 hrs; T-1 hr)**

Organic farming for sustainable agriculture; Manures- compost, methods of composting - Green manuring, vermicompost and biofertilizerHarmful effect of 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.

Unit III Fundamental of Organic Farm Management **(L 12 hrs; T-1 hr)**

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 agent'sIndigenous technical knowledge for insects-pest, disease - Weed and nutrient management in organic farming.

Unit IV Post Harvest Management **(L 12 hrs; T-1 hr)**

Processing, labeling of organic produce - Storage and transport of organic produce.

Unit V Organic Quality Control Standards **(L 12 hrs; T-1 hr)**

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.

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.SubbaRao 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* AktaPrakashan,

5.Nadiad.Singh, S M. 2018. *Organic Manure: Sources Preparation and Usage in Farming Lands*, Siya Publishing House.

Reference Books

1.Tolanur, S. 2018. *Fundamentals of Soil Science.* IIndEdition , CBS Publishers , New Delhi

2.Reddy, S.R. 2017. *Principles of Organic Farming.* Kalyani Publishers , New Delhi

3.Dongarjal, R.P and Zade, S.B. 2019. *Insect Ecology and Integrated Pest Management.* Akinik Publications, New Delhi.

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

Website and E-learning Sources

https://www.kobo.com/in/en/ebook/organic-farming-for-sustainable-agriculture

https://www.elsevier.com/books/organic-farming/chandran/978-0-12-813272-2

https://link.springer.com/book/10.1007/978-3-030-04657-6

https://www.afrimash.com/product-category/livestock-section/book/organic-farming-ebooks/

CORE ELECTIVE VI- FORESTRY AND WOOD TECHNOLOGY - P23BO4E6B

Lecture Hours	**: 55**	**Tutorial Hours**	**: 5**
Practical Hours	**:**	**No. of Credits**	**: 3**
Contact Hours per Semester: 60			
Contact hours per Week	**: 4**		
Internal Marks	**: 25**		
External Marks	**: 75**		
Total Marks	**: 100**		

Objectives of the course

- To study various aspects of Forest Botany.
- To understand the importance of different forests and plants species.
- To know the ecological significance of forests.
- To enable the students to information on forests laws.
- To raise student awareness of the need to create a sustainable way of living and the current Global issues with forestry caused by human interference.

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the course the students should be able to

CO1 knowledge on various aspects of Forest Botany

CO2 understand the importance and of different forests.

CO3 analyze the ecological significance of forests

CO4 understand the dynamics of the forest.

CO5 understand various Indian forests laws and acts.

CO-PO AND PSO MAPPING (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	1	3	2	3	2	2	1	2
CO 2	3	3	2	2	3	2	2	3	3	2
CO 3	2	2	3	1	1	3	2	3	2	1
CO 4	3	3	3	3	3	2	2	3	2	3
CO 5	3	3	2	3	2	1	2	2	3	2
Total Contribution of COs to POs	14	14	11	12	11	11	10	13	11	10
Weighted Percentage of COs contribution to POs	93	93	73	80	73	73	67	87	93	67

0-No Correlation **1-Weak** **2-Moderate** **3-Strong**

Course Content

Unit I Introduction and scope of Forest Botany **(L 10 hrs; T-1 hr)**

Types of forests; monoculture, multipurpose, social and industrial. Forest and climate - Forest and Biodiversity - Forest and gene conservation - Forest and ecosystem - Forest and civilization. Special emphasizes on social forestry, Industrial forestry and Multi-purpose forestry. Preservation of natural forest - Pollution control.

Unit II Forest genetics **(L 14 hrs; T-1 hr)**

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 protection through peoples committee.

Unit III Silviculture **(L 10 hrs T-1 hr)**

concept and scope of study, forest in general form, composition, classification of world forests and Indian forests. Classification based on its quality density, tolerance, crown.

Unit IV Seed dynamics in forest **(L 10 hrs; T-1 hr)**

Seed production, dissemination, germination, establishment and mortality, growth of trees in general terms – height, diameter, volume, growth of stands – gross increment, net increment, stand reaction to varies types of cuttings.

Unit V Measurement **(L 11 hrs; T-1hr)**

Definition, direct measurements, direct and indirect estimate, and prediction. Measurement of diameter – rules and methods, measurement of height – different rules, methods, instruments, total height and merchantable length. Measurement of volume – common units, different methods and procedures of volume measurements. Measurement of age: direct estimate, averages, standard error, and sampling, General concept of indirect estimate based on one or more independent variables. Forestry for social and national development. Forest Laws- Indian Forest Act, 1927; Forest conservation Act. Wild Life Protection Act, 1972.

Recommended Text

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. *Essentials of Forest Management*.NatrajPublishers, Dehradun.
4. Agarwala,V.P.1990. *Forests in India, Environmental and Protection Frontiers*. Oxford & IBH Publishing Co. New Delhi.
5. Chundawat, B.S. and Gautham, S.K. 1996. *Text book of Agro forestry*. Oxford and IBH publisher, New Delhi.
6. Singhi, G.B. 1987. *Forest Ecology of India*, Publisher: Rawat.
7. Ramprakash. 1986. *Forest management*. IBD Publishers, Debra Dun.
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10. Dhiman, A.K. 2003. *Sacred plants and their medicinal uses*. Daya publishing house, New Delhi.
11. Mehta, T. 1981. *A handbook of forest utilization*. Periodical Expert Book Agency, New Delhi.
12. Nair, N.C and Henry, A.N. 1983. *Flora of Tamilnadu*, India. Series: 1, Analysis, Vol.1. BSI, Coimbatore, India.

Reference Books

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. Agarwal,V.P.1990. *Forests in India, Environmental and Protection Frontiers*. Oxford IBH PublishingCo., New Delhi.
5. Rao, K.R. and Juneja, K.B.S. 1992. Field identification of 50 important timbers of India. ICFRE Publi. Dehradun 123 p.
6. Avery, T.E. 1967. *Forest Measurements*. Mc Grand Hill Book Company, New York.
7. Manikandan K, Prabhu S. 2018. *Indian Forestry A Breakthrough Approach To Forest Services*. Jain Brothers.
8. Pathak, P.S, Ram Newaj. 2012. *Agro forestry: Potentials and Opportunities*. India Agrobios.
9. Powell, Baden B.H. 2004. *Manual of Forest Law*. New Delhi: Biotech.
10. Uthappa, A.R. 2015. Sangram Bhanudas Chavan, *Competitive Forestry*, New Vishal Publications, 1st ed.
11. Chaturvedi, A.N. and Khanna, L.S. 2015. *Hand Book of Forestry* (5th Edition).
12. Frederick Franklin Moon, 2018. *The Book of Forestry*. Repro Books.
13. Parthiban, K.T. 2018. *Introduction to Forestry & Agroforestry*.

Website and E-learning Sources

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.biologydiscussion.com/forest/essay-forest-importance.major-products-and-its-conservation/25119
5. https://academic.oop.com https://www.sciencedirect.com/topics/agriculture-and-biological-science-forest-product.

CORE ELECTIVE VI- FARM SCIENCES: GREEN WEALTH -P23BO4E6C

Lecture Hours	**: 55**	**Tutorial Hours**	**: 5**
Practical Hours	**:**	**No. of Credits**	**: 3**
Contact Hours per Semester: 60			
Contact hours per Week	**: 4**		
Internal Marks	**: 25**		
External Marks	**: 75**		
Total Marks	**: 100**		

Objectives of the Course

- To understand the concept of agronomy and sustainable agriculture.
- To evaluate the importance of crop management technology.
- To develop their understanding on the concept of fertilizers.
- To develop the integrated management for better crop production by using fertilizers.
- To develop the skills for cultivation of plants and their value added processing/storage/quality control.

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the Course, the students should be able to

CO1 identify the importance of agronomy and its scope.

CO2 demonstrate both the theoretical and practical knowledge in weed management principles.

CO3 explain the methods of herbicide and fertilizer application.

CO4 compare and contrast the yield estimation and water management.

CO5 discuss and develop skills for effective conservation, harvesting and storage methods.

CO-PO AND PSO MAPPING (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	1	3	2	3	2	1	2	2
CO 2	3	3	2	2	3	2	2	3	2	3
CO 3	2	2	3	3	1	3	2	2	1	3
CO 4	3	3	3	3	3	2	2	2	3	3
CO 5	3	3	2	2	3	1	2	2	2	3
Total Contribution of COs to POs	14	14	11	13	12	11	10	12	10	14
Weighted Percentage of COs contribution to POs	93	93	73	87	80	73	67	80	67	93

0-No Correlation **1-Weak** **2-Moderate** **3-Strong**

Course Content

Unit I Principles of Crop Management **(L 11hrs; T-1 hr)**

Agronomy and its scope, seeds and sowing, tillage and tilth, crop density and geometry, Crop nutrition, manures and fertilizers, nutrient use efficiency, water resources, soil plant water relationship, crop water requirement, water use efficiency, irrigation- scheduling criteria and methods, quality of irrigation water, water logging. Efficient utilization of water through soil and crop management practices. Management of crops in rain fed areas, Contingent crop planning for aberrant weather conditions, Concept, objective, principles and components of watershed management, factors affecting watershed management.

Unit II Weed Management and Growth Strategies **(L 11 hrs; T-1 hr)**

Weeds- importance, classification, crop weed competition, concepts of weed management principles and methods, herbicides- classification, selectivity and resistance, allelopathy. Growth and development of crops, factors affecting growth and development, plant ideotypes, crop rotation and its principles, adaptation and distribution of crops, crop management technologies in problematic areas, harvesting and threshing of crops.

Unit III Crop and Input identification **(L 11hrs; T-1 hr)**

Identification of crops, seeds, fertilizers, pesticides and tillage implements, Effect of sowing depth on germination and seedling vigor, Identification of weeds in crops, Methods of herbicide and fertilizer application.

Unit IV Yield Estimation and Germination Testing **(L 11 hrs; T-1 hr)**

Study of yield contributing characters and yield estimation, Seed germination and viability test, Numerical exercises on fertilizer requirement, plant population, herbicides and water requirement, Use of tillage implements-reversible plough, one way plough, harrow, leveler, seed drill, Study of soil moisture measuring devices, Measurement of field capacity, particle density, bulk density and infiltration rate, Measurement of irrigation water.

Unit V Harvesting and Storage **(L 11 hrs; T-1 hr)**

Harvesting, storage, physiological disorders of important vegetable crops like solanaceous fruit vegetables (brinjal, tomato &chilli), tuber crops (Potato), cucurbits (pumpkin, cucumber, watermelon & gourds), pod vegetables (pea & bean), cole crops (cabbage & cauliflower), bulb crops (onion, garlic), root crops (radish & carrot), common leafy vegetables, spices: turmeric and ginger, black pepper and cardamom.

Recommended Text

1. Reddy, T.Y and G.H. Sankar Reddi. *Principles of Agronomy*. Kalyani Publishers. 2015.
2. Reddy, S.R. *Principles of Agronomy*. Kalyani Publishers. 2016.
3. Brady, N.C and Weil, R.R. *The Nature and Properties of Soils* - Weil, Prentice Hall Inc. 1996.
4. Craig, C. Sheaffer and Kristine, M. Moncada. *Introduction to Agronomy-Food crops and Environment* (Second Edition). 2012.
5. George Acquaah. *Principles of Crop production: Theory, Techniques, and Technology*. Pearson education. 2004.

Reference Books

1. Yawalkar, K.S. Agarwal, J. P and S. Bokde. *Manures and fertilizers* – Agri Horticultural Publication House. 1967.
2. Russell, J.E. *Soil Conditions and Plants Growth* - Daya Books. 2002.
3. Hansen, V. E. Israelsen, O.W and G. E. Stringham. *Irrigation Principles and Practices* -, New York Wiley. 1980.
4. Reddy, S.R. *Principles of Agronomy*. Kalyani Publishers. 2017.
5. Sathe, T.V. *Vermiculture and Organic Farming*. Daya publishers. 2004.

Website andE-learning sources

1. https://www.amazon.in/Green-Wealth-Unusable-Moneymaking-Assets-ebook/dp/B004D2AYPW
2. https://www.kobo.com/us/en/ebook/green-wealth
3. https://nishat2013.files.wordpress.com/2013/11/agronomy-book.pdf
4. https://www.kobo.com/in/en/ebook/weed-2
5. https://www.amazon.in/Handbook-Fertilizers-Sources-Make-Up-Effects-ebook/dp/B00D45LHAK

Major Project –P23BO4MP

Lecture Hours	**: -**	**Tutorial Hours**	**: -**
Practical Hours	**: -**	**No. of Credits**	**: 7**

Contact Hours per Semester: 120

Contact hours per Week : 8

Internal Marks : 50

External Marks : 150

Total Marks : 200

Objectives of the Course

- To gain knowledge on the tools and techniques used in research
- To understand the process of research and application of thrust areas in the field of Botany viz., medicinal plants, mushroom cultivation, anatomy and histochemistry, algal technology, natural dyes, tissue culture, organic farming, physiology, pharmacognosy, phytochemistry, bioremediation, seed biology, solid waste management, taxonomy.
- To analyse the components and parts of a thesis and become trained in thesis writing
- Participate for assessment of the viva –voce examination.

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the Course, the students should be able to

CO1 demonstrate the tools and techniques used in Research

CO2 develop skills for experimentation in different thrust areas of Botany

CO3 document the observations of research in a systematic manner

CO4 comprehend the method of thesis writing

CO5 expand their knowledge and face the viva-voce examination

CO-PO AND PSO MAPPING (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	3	1	3	3	2	3	3	3
CO 2	3	3	3	3	3	2	2	3	2	1
CO 3	3	3	3	3	3	3	2	3	2	1
CO 4	3	2	3	3	3	2	2	3	3	2
CO 5	3	3	3	3	3	1	2	3	3	3
Total Contribution of COs to POs	15	14	15	13	15	11	10	15	13	10
Weighted Percentage of COs contribution to POs	100	93	100	87	100	73	67	100	87	67

0-No Correlation **1-Weak** **2-Moderate** **3-Strong**

Course Content

Unit I Project Allocation, Dissertation Submission, and Evaluation Process (P 27 hrs)

Each student will be allotted a Project Guide from the faculty of the department concerned by lot method. The topic of the dissertation shall be assigned to the candidate before the beginning of third semester. After the completion of the project work, the student that to submit four copies of dissertation with report carrying his/her project report for evaluation by examiners. After evaluation, one copy is to be retained in the College Library.

Project work will be evaluated by both the external and the internal (Project Guide) examiners for the maximum of 100marks in total on the scale of the maximum of 50marksforthe internal andthe externaleach.

Viva-voce will be conducted by the panel comprising, external examiner and Internal Examiner for the maximum of 100 marks in total on the scale of the maximum of 50marksforthe internal andthe externaleach.

Unit II Project Requirements: Dissertation and Soft Copy Submission (P27 hrs)

All the candidates of M.Sc (Botany) are required to undergo a major project and submit the following:

1. Dissertation/Thesis based on the work done by the student.
2. Soft copy of the project on CD/DVD.

Unit III Suggested Areas of work: (P 27 hrs)

Algae, fungi, microbiology, biocontrol agents, plant tissue culture, plant physiology, phytochemistry, biochemistry, anatomy, plant taxonomy, Ethnobotany, ecology, sustainable agriculture, herbal formulations, cytogenetics, molecular biology, biotechnology, bioinformatics, nanotechnology and applied botany.

Unit IV Methodology **(P 29 hrs)**

Each project should contain the following details:

1. Brief introduction on the topic
2. Review of Literature
3. Materials and Methods
4. Results and Discussion – evidences in the form of figures, tables and photographs.
5. Summary 6. Bibliography

PROFESSIONAL COMPETENCY SKILL ENHANCEMENT

Lecture Hours	**: 55**	**Tutorial Hours**	**: 5**
Practical Hours	**: -**	**No. of Credits**	**: 2**
Contact Hours per Semester:	**60**		
Contact hours per Week	**: 4**		
Internal Marks	**: 100**		
External Marks	**: -**		
Total Marks	**: 100**		

Objectives of the Course

- Understand the concept of agronomy and sustainable agriculture.
- To gain knowledge about the cell, organelles and physiology.
- To understand the biodiversity and DNA recombination technology.
- Describe the basic signal transduction pathway and to recognize the overarching principles of prokaryotic and eukaryotic cellular communication.
- Understand the mechanism underling the shift from vegetative to reproductive phase.

Course Learning Outcomes (for Mapping with POs and PSOs)

On completion of the Course, the students should be able to

CO1 learn about the structure of atoms, molecules, and chemical bonds.

CO2 demonstrate both the theoretical and practical knowledge in cell biology and molecular biology.

CO3 explain the methods of recombinant technology.

CO4 compare and contrast the physiological functions and metabolism

CO5 discuss and develop skills for effective comprehension and communication.

CO-PO AND PSO MAPPING (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	1	3	2	3	2	1	2	2
CO 2	3	2	2	2	1	2	2	3	2	3
CO 3	2	1	2	3	2	3	2	1	2	3
CO 4	3	3	3	3	3	2	2	2	1	3
CO 5	3	3	2	2	2	1	2	1	3	3
Total Contribution of COs to POs	14	11	10	13	10	11	10	8	10	14
Weighted Percentage of COs contribution to POs	93	73	67	87	67	73	67	53	67	93

0-No Correlation **1-Weak** **2-Moderate** **3-Strong**

Course Content

Unit I Molecules and Their Interaction Relevant to Biology (L 11hrs; T-1 hr)

Structure of atoms, molecules, and chemical bonds. Composition, structure, and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids, and vitamins). Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.). Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties). Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers. Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymesConformation of proteins (Ramachandran plot, secondary structure, domains, motif, and folds).Conformation of nucleic acids (helix (A, B, Z), t-RNA, micro-RNA).Stability of proteins and nucleic acids. Metabolism of carbohydrates, lipids, amino acids nucleotides, and vitamins.

Unit II Cellular Organization (L 11hrs; T-1 hr)

Membrane structure and function: structure of model membrane, lipid bilayer, and membrane protein diffusion, osmosis; ion channels; active transport; membrane pumps; mechanism of sorting and regulation of intracellular transport; electrical properties of membranes.

Structural organization and function of intracellular organelles (cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of the cytoskeleton and its role in motility).

Organization of genes and chromosomes: Operon, unique and repetitive DNA, interrupted genes, gene families, the structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons).Cell division and the cell cycle: mitosis and meiosis, their regulation, steps in the cell

cycle, regulation, and control of the cell cycle. Microbial Physiology: Growth yield and characteristics, strategies of cell division, stress response.

Unit III Fundamental Processes (L 11hrs; T-1 hr)

DNA replication, repair, and recombination: Unit of replication, enzymes involved, replication origin and replication fork, the fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms, homologous and site-specific recombination.

RNA synthesis and processing: Transcription factors and machinery, a formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing, and polyadenylation, structure, and function of different types of RNA, RNA transport).

Protein synthesis and processing: Ribosome, the formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyltRNAsynthetase, and translational proofreading, translational inhibitors, Post-translational modification of proteins).

Control of gene expression at transcription and translation level: Regulating the expression of phages, viruses, prokaryotic and eukaryotic genes, the role of chromatin in gene expression and gene silencing).

Unit IV Cell Communication and Cell Signaling (L 11hrs; T-1 hr)

Host-parasite interaction: Recognition and entry processes of different pathogens like bacteria, viruses into animal and plant host cells, alteration of host cell behavior by pathogens, virus-induced cell transformation, pathogen-induced diseases in animals and plants, cell-cell fusion in both normal and abnormal cells.

Cell signaling: Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two-component systems, light signaling in plants, bacterial chemotaxis, and quorum sensing.

Cellular communication: Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation.

Cancer: Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer, and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth.

Innate and adaptive immune system:

Cells and molecules involved in innate and adaptive immunity, antigens, antigenicity, and immunogenicity. B and T cell epitopes, structure, and function of antibody molecules. generation of antibody diversity, monoclonal antibodies, antibody engineering, antigen-antibody interactions, MHC molecules, antigen processing and presentation, activation and differentiation of B and T cells, B and T cell receptors, humoral and cell-mediated immune responses, primary and secondary immune

modulation, the complement system, Toll-like receptors, cell-mediated effector functions, inflammation, hypersensitivity and autoimmunity, immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections, congenital and acquired immune deficiencies, vaccines.

Unit V Developmental Biology (L 11hrs; T-1 hr)

Basic concepts of development: Potency, commitment, specification, induction, competence, determination, and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in the analysis of the development.

Gametogenesis, fertilization, and early development: Production of gametes, cell surface molecules in sperm-egg recognition in animals; embryo sac development and double fertilization in plants; zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis, establishment of symmetry in plants; seed formation and germination.

Morphogenesis and organogenesis in animals: Cell aggregation and differentiation in Dictyostelium; axes and pattern formation in Drosophila, amphibia, and chick; organogenesis – vulva formation in CaenorhabditisElegans, eye lens induction, limb development and regeneration in vertebrates; differentiation of neurons, post-embryonic development- larval formation, metamorphosis; environmental regulation of normal development; sex determination.

Morphogenesis and organogenesis in plants: Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in Arabidopsis and Antirrhinum Programmed cell death, aging, and senescence.

Recommended Text

1.Bhojwani, S.S. Bhatnagar, S.P and Dantu, P.K. *The Embryology of Angiosperms* (6th revised and enlarged edition). Vikas Publishing House, New Delhi. 2015.

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

3.Roy, S.C and Kumar, K.D.C. *Cell Biology*, New Central Book Agency, Calcutta. 1977.

4.Karp, G. *Cell and Molecular Biology*: Concepts and Experiments.6th edition. John Wiley& Sons. 2010.

5.Ramavat, K.G. *Plant Biotechnology*. S. Chand and Co. Ltd., New Delhi. 2006.

6.Trivedi, P.C. *Plant Biotechnology-Recent Advances*. Panima Publication Corporation, New Delhi. 2000.

7.Chawla, H.S. *Introduction to Biotechnology*. 2nd edn. Oxford IBH, ISBN: 978-81-204- 1732-8. 2009.

Reference Books

1. Karp, G. *Cell and Molecular Biology*: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc. 2010.
2. Gupta. P.K. *Cell and Molecular Biology*, Rastogi Pub. Meerut. 2000.
3. Ignacimuthu, S. *Basic Bioinformatics*, Narosa publishing house. 2005.
4. Lesk, A.M. *Introduction to Bioinformatics*. Oxford University press. 2002.
5. Rastogi. *Cell and molecular biology*. New age international publishers. 1996.
6. Elliott, W.H. and Ellioff. *Biochemistry and molecular biology*. Oxford. 1997.
7. Freifelder D. *Molecular Biology*. Narosa publishing house. 1987.
8. Rastoji, S.C., Mendiratta, N., Rastogi, P. *Bioinformatics: Methods and Applications*, PHI, Third Edition. 2009.

Website and E-learning Sources

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://.britannica.com/technology/biotechnolog/
5. https://nptel.ac.in/courses/102/107/102107075/
6. https://plantae.org/plant-physiology-top-articles-of-2020-based-on- altmetric-scores/