MANONMANIAM SUNDARANAR UNIVERSITY
TIRUNELVELI – 12

M.SC BOTANY

TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION, CHENNAI – 600 005

FROM THE ACADEMIC YEAR 2023 – 2025

Contents

1. Introduction: PO & PSO

Programme Outcome, Programme Specific Outcome and Course Outcome

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

TANSCHE REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR POSTGRADUATE EDUCATION	
Programme	**M.Sc. Botany**
Programme Code	
Duration	**PG - 2 years**
Programme Outcomes (Pos)	**PO1: Problem Solving Skill** Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context. **PO2: Decision Making Skill** Foster analytical and critical thinking abilities for data-based decision-making. **PO3: Ethical Value** Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities. **PO4: Communication Skill** Ability to develop communication, managerial and interpersonal skills. **PO5: Individual and Team Leadership Skill** Capability to lead themselves and the team to achieve organizational goals. **PO6: Employability Skill** Inculcate contemporary business practices to enhance employability skills in the competitive environment. **PO7: Entrepreneurial Skill** Equip with skills and competencies to become an entrepreneur. **PO8: Contribution to Society** Succeed in career endeavours and contribute significantly to society. **PO 9 Multicultural competence** Possess knowledge of the values and beliefs of multiple cultures and a global perspective. **PO 10: Moral and ethical awareness/reasoning** Ability to embrace moral/ethical values in conducting one's life.
Programme Specific Outcomes (PSOs)	**PSO1 – Placement** To prepare the students who will demonstrate respectful engagement with others' ideas, behaviours, beliefs and apply diverse frames of reference to decisions and actions. **PSO 2 - Entrepreneur**

	To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate start-ups and high potential organizations. **PSO3 – Research and Development** Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development. **PSO4 – Contribution to Business World** To produce employable, ethical and innovative professionals to sustain in the dynamic business world. **PSO 5 – Contribution to the Society** To contribute to the development of the society by collaborating with stakeholders for mutual benefit.

Component wise Credit Distribution

Credits	Sem I	Sem II	Sem III	Sem IV	Total
Part A	14	14	19	17	**64**
Part B Discipline Centric / Generic Skill	6	6	3	3	**18**
Soft Skill	-	2	2	2	**06**
Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity	-	-	2	-	**02**
Part C - Extension Activity	-	-	-	1	**01**
Total	**20**	**22**	**26**	**23**	**91**

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

Written Examination: Theory Paper (Bloom's Taxonomy based)
Question paper Model

1. **Testing Pattern (25 +75)**
   Internal - 25 marks
   External - 75 marks

2. **Internal Assessment**
   Internal – 25 marks

Theory Course:

For theory courses there shall be three tests conducted by the faculty concerned and the average of the best two can be taken as the Continuous Internal Assessment (CIA) for a maximum of 15 marks. The duration of each test shall be one/one and a half hour.

Continuous Internal Assessment	15 marks
Seminar	5 marks
Assignment	5 marks

For theory Papers:
Part A 15 X 1 = 15 Marks - Answer all questions (No choice)
Part B 5 X 4 = 20 Marks - Choosing either (a) or (b)
Part C 5 X 8 = 40 Marks - Choosing either (a) or (b)
Total = 75 marks

Laboratory Courses:
Internal - 50 marks
External - 50 marks

For Laboratory Courses, there shall be Continuous Internal Assessment Test and Record. One test in Laboratory part, attendance and class participation.

The CIA for a maximum of 50 marks. The duration of each test shall be 3 hours

Methods of Evaluation Practical's (The existing pattern will be followed)		
Internal	Continuous Internal Assessment Test	50 Marks
	Attendance and Class Participation	
External	End Semester Examination	50 Marks

There is no improvement for CIA of both theory and laboratory, and, also for University End Semester Examination.

***As per the final template received from the TANSCHE for PG Programmes Professional Competency Course is not included for PG first semester – #MSU**

Programme: M.Sc. Botany:	**Duration: 2 years**
Programme outcomes (PO)	
The M.Sc. Botany program is designed to achieve the following objectives	
PO 1	To impart knowledge on the fundamental, advanced and emerging concepts in Botany.
PO 2	To provide up-to-date theoretical knowledge on various forms of plants, their interactions with biotic and abiotic entities in the ecosystem and relevant practical skills.
PO 3	To comprehend and interpret various facets of Botany including the importance and judicious utilization of plant sources.
PO 4	To address various critical issues in conserving the biodiversity with special reference to economically important plants and the plants listed in RED data.

PO 5	To understand the principles and applications of various traditional and modern techniques used in Botany.
PO 6	To disseminate knowledge on the design and execution of experiments in Botany with emphasis on the operation of relevant sophisticated instruments.
PO 7	To impart knowledge on the economic importance of plant/microbial resources and their products and to promote entrepreneurship skill.
PO 8	To promote proficiency in designing the research problems, review of literature, laboratory experiments, data analyses and preparation of reports with professional ethics.
PO 9	To motivate the students to take up innovative and cutting-edge research in frontier areas of Botany and related biology subjects.
PO 10	To enable the students to take up various qualifying examinations concerning Botany and to face the challenges in career opportunities.

Program Specific Outcomes (PSO)

On successful completion of the M.Sc. Botany program, the students are expected to	
PSO1	Familiarize with the fundamental, advanced and emerging concepts in Botany.
PSO2	Understand the role of plants and their interactions with other organisms in various ecosystems.
PSO3	Identify the potency of plant resources in contemporary research and visualize future thrust areas in Botany.
PSO4	Design scientific experiments independently and to generate useful information to address various issues in Botany.
PSO5	Acquire basic knowledge on principles and applications of laboratory instruments and adequate skills to handle them.
PSO6	Choose and apply appropriate tools, techniques, resources, etc. To perform various experiments in Botany.
PSO7	Carryout scientific experiments independently or in collaboration with inter-disciplinary or multidisciplinary approaches.
PSO8	Disseminate knowledge on conservation of biodiversity and protection of environment.
PSO9	Awareness on the sustainable utilization of plant/microbial resources following the bioethical norms.
PSO10	Demonstrate proficiency in communicating with various stakeholders like students, teachers, scientists and society.

Template for P.G., Programmes – Botany 2023 – 2024

Semester–I	Credit	Hours	Semester-II	Credit	Hours	Semester-III	Credit	Hours	Semester–IV	Credit	Hours
1.1 Core-I	5	7	2.1 Core - V	4	5	3.1. Core-X	4	5	4.1 Core-XVI	5	5
1.2 Core-II	5	7	2.2 Core - VI	4	5	3.2 Core-XI	4	5	4.2 Core-XVII	5	5
1.3 Core III - Laboratory Course - 1	2	3	2.3 Core – VII	4	5	3.3 Core –XII	4	5	4.3 Core XVIII– Laboratory course- 7	2	2
1.4 Core IV – Laboratory Course - 2	2	3	2.4 Core VIII - Laboratory Course - 3	2	3	3.4 Core XIII Laboratory course- 5	2	2	4.4 Core XIX– Laboratory course- 8	2	2
1.5 Discipline Centric Elective - I	3	5	2.5 Core IX - Laboratory Course - 4	2	3	3.5 Core XIV Laboratory course- 6	2	2	4.5. Core - XX Project with Viva Voce	4	8
1.6 Generic Centric Elective - II	3	5	2.6 Discipline Centric Elective – III	2	3	3.6 Core –XV	4	5	4.6 Generic Centric Elective – VI	2	4
			2.7 Generic Centric Elective - IV	2	3	3.7 Discipline Centric Elective – V	2	3	4.7 Skill Enhancement course III / Professional Competency Skill	2	4
			2.8 SEC -I	2	3	3.8 SEC-II	2	3	4.8. Extension Activity	1	-
						3.9 Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity	2	-			
	20	**30**		**22**	**30**		**26**	**30**		**23**	**30**
									Total Credit Points	**91**	

Choice Based Credit System (CBCS), Learning Outcomes Based Curriculum Framework (LOCF) Guideline Based Credits and Hours Distribution System for all Post – Graduate Courses including Lab Hours

First Year - Semester – I

Part	Courses	Credit	No. of Hours
	1.1 Core-I	5	7
	1.2 Core-II	5	7
	1.3 Core III - Laboratory Course - 1	2	3
	1.4 Core IV – Laboratory Course - 2	2	3
	1.5 Elective - I	3	5
	1.6 Elective - II	3	5
		20	**30**
Semester - II			
Part	**Courses**	**Credit**	**No. of Hours**
	2.1. Core - V	4	5
	2.2 Core - VI	4	5
	2.3 Core – VII	4	5
	2.4 Core VIII - Laboratory Course - 3	2	3
	2.5 Core IX - Laboratory Course - 4	2	3
	2.6 Elective – III	2	3
	2.7 Elective IV	2	3
	2.8 Skill Enhancement course I	2	3
		22	**30**
Second Year – Semester - III			
Part	**Courses**	**Credit**	**No. of Hours**
	3.1. Core-X	4	5
	3.2 Core-XI	4	5
	3.3 Core –XII	4	5
	3.4 Core XIII Laboratory course- 5	2	2
	3.5 Core XIV Laboratory course- 6	2	2
	3.6 Core –XV	4	5
	3.7 Elective – V	2	3
	3.8 Skill Enhancement course - II	2	3
	3.9 Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity	2	-
		26	**30**
	Semester - IV		
Part	**Courses**	**Credit**	**No. of Hours**
	4.1 Core-XVI	5	5
	4.2 Core-XVII	5	5
	4.3 Core XVIII– Laboratory course - 7	2	2
	4.4 Core XIX–Laboratory course - 8	2	2
	4.5. Core – XX Project with Viva Voce	4	8
	4.6 Elective – VI	2	4
	4.7 Skill Enhancement course III / Professional Competency Skill	2	4
	4.8. Extension Activity	1	-
		23	**30**
	Total Credits for PG Courses	**91**	

Credit Distribution for PG Programmes - Semester wise papers – Botany - 2023 – 2024

Course Name		Lecture & Tutorial Hours Per week 1 contact hour = 1 credit	Credits
SEMESTER 1			
CORE	Core I Plant Diversity - I: Algae, Fungi, Lichens and Bryophytes	7	5
	Core II Plant Diversity - II: Pteridophytes, Gymnosperms and Paleobotany	7	5
	Core III - Laboratory Course - 1: Covering Core Paper - I	**3**	**2**
	Core IV – Laboratory Course – 2 Covering Core Paper - II	**3**	**2**
Elective I (Generic Discipline-Centric)	EG1: (One from each Group A) 1. Microbiology, immunology and plant pathology	5	3
	2. Conservation of natural resources and policies		
	3. Mushroom cultivation		
	4. Phytopharmacognosy		
Elective II (Generic Discipline-Centric)	ED1: (One from each Group B) 1. Algal Technology	5	3
	2. Ethnobotany, naturopathy and Traditional Healthcare		
	3. Horticulture		
	4. Herbal Technology		
	Total	**30**	**20**
SEMESTER 2			
CORE	Core V Taxonomy of Angiosperms and Economic Botany	5	4
	Core VI Plant Anatomy and Embryology of Angiosperms	5	4
	Core VII Ecology, phytogeography, Conservation Biology and Intellectual	5	4

	property rights		
	Core VIII - Laboratory course - 3 Covering Core Paper V	**3**	**2**
	Core IX - Laboratory course – 4 Covering Core Papers VI and VII	**3**	**2**
Elective III (Generic Discipline-Centric)	EG2: (One from each Group C) 1.. Medicinal Botany (or)	3	2
	2. Phytochemistry		
	3. Research methodology, computer applications & bioinformatics		
	4. Biopesticide Technology (4)		
Elective IV (Generic Discipline-Centric)	ED2: (One from each Group D) 1. Applied bioinformatics 2. Biostatistics 3. Intellectual Property Rights 4. Nanobiotechnology (4)	3	2
Skill Enhancement Course I	SEC1 Agriculture and Food Microbiology	3	2
	Total	**30**	**22**
SEMESTER 3			
CORE	Core X - Cell and Molecular Biology	5	4
	Core XI - Genetics, Plant Breeding & Biostatistics	5	4
	Core XII - Recombinant DNA technology and industrial applications	5	4
	Core XIII - Laboratory course - 5 Covering Core Papers X and XII	**2**	**2**
	Core XIV- Laboratory course - 6 Covering Core Paper XI	**2**	**2**
Industry Module	Core –XV Industrial Botany:	5	4
Elective V (Generic Discipline-Centric)	EG3: (One from Group E) 1.. Secondary Plant Products and Fermentation Biotechnology 2. Entrepreneurial Opportunities in Botany 3. Applied plant cell & tissue culture	3	2

	4. Silviculture and Commercial Landscaping		
Skill Enhancement Course II	SEC2 Seminar paper (Open Choice) Professional Communication Skill (2)	3	2
	Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity	-	2
	Total	**30**	**26**
SEMESTER 4			
CORE	Core XVI Plant Physiology and Plant metabolism	5	5
	Core XVII Biochemistry & Applied Biotechnology	5	5
	Core XVIII– Laboratory course – 7 Covering Core Paper XVI	**2**	**2**
	Core XIX–Laboratory course- 8 Covering Core Paper XVII	**2**	**2**
Project	Core – XX Project with Viva Voce	8	4
Elective VI (Generic Discipline - Centric)	EG3 (One from Group F) 1. Organic farming 2. Forestry and Wood Technology 3. Gene Cloning and Gene Therapy 4. Farm Sciences- Green Wealth	4	2
Professional Competency / Skill Enhancement Course III	SEC3 1. Botany for competitive examinations (NET/UGCSIR/SET/TRB/UPSC/TNPSC/ other competitive examinations) 2. Botany for Advanced Research 3. Naan Mudhalvan Scheme	4	2
	Extension Activity	-	1
	Total	**30**	**23**
	Total Credits	**-**	**91**

II YEAR – III SEMESTER

CORE X - CELL AND MOLECULAR BIOLOGY

Title of the Course		**CELL AND MOLECULAR BIOLOGY**					
Paper Number		**CORE X**					
Category	**Core**	**Year**	**II**	**Credits**	**4**	**Course Code**	
		Semester	**III**				
Instructional Hours Per week		**Lecture**	**Tutorial**	**Lab Practice**		**Total**	
		3	**2**	**-**		**5**	
Pre-requisite		To acquire knowledge on cell and expose the students a fundamental of the various techniques used in molecular studies.					
Learning Objectives		1. Enable to learn various cell structures and functions of prokaryotes and eukaryotes and understand the salient features and functions of cellular organelles.					
		2. To understand the cell division and it molecular mechanism so as to appreciate and manipulate normal and abnormal cell and tissue growth.					
		3. To enlighten people of past molecular biology developments.					
		4. To comprehend the molecular processes.					
		5. A thorough examination of DNA structure, replication process, transcription process and translation processes.					

UNIT	CONTENTS
I	Concept of prokaryote and eukaryote cell. Cell Theory, Structural organization of plant cell, specialized plant cell types. Cell wall- Structure and functions, Plasma membrane; structure, models and functions, site for ATPase, ion carriers channels and pumps, receptors. Plasmodesmata and its role in movement of molecule.
II	Chloroplast-structure and function, genome organization, gene expression, RNA editing, Mitochondria; structure, genome organization, biogenesis. Plant Vacuole - tonoplast membrane, ATPases transporters as a storage organelle. Structure and function of other cell organelles- Golgi apparatus, lysosomes, endoplasmic reticulum and microbodies.
III	Nucleus: Structure and function, nuclear pore, Nucleosome organization, euchromatin and heterochromatin. Ribosome- Structure and functional significance. RNA and DNA structure. A, B and Z forms. Cell cycle and Apoptosis; Control mechanisms, role of cyclin dependent kinases. Retinoblastoma and E2F proteins, cytokinesis and cell plate formation, mechanisms of programmed cell death.
IV	DNA replication (prokaryotes and eukaryotes), enzymes involved in replication, DNA damage and repair (Thymine dimer, photoreactivation, excision repair), DNA sequencing: definition, Sanger sequencing - Transcription, enzymes involved in transcription, post transcription changes, reverse transcription, Translation, overlapping genes**.**
	Genetic code and its characteristics, Wobble hypothesis; Central dogma –

V	Mutation types- frame shift mutation, addition, deletion, substitution, transition and transversion, germinal verses somatic mutants. Molecular basis of mutations; Chromosomal aberrations: aneuploidy - autopolyploidy and allopolyploidy; with example. Structural aberrations of chromosomes. Giant chromosomes - Polytene and Lampbrush chromosomes. Differential staining of the chromosomes- Q-banding, G banding, C banding, R banding: In situ hybridization-FISH and GISH:	
Course outcomes	**On completion of this course, the students will be able to:**	**Programme outcomes**
CO1	Recall a plant cell structure and explain its function.	**K1**
CO2	Illustrate and explain the structure of various cell organelles.	**K2**
CO3	Explain the structure and functional significance of nucleic acid.	**K3**
CO4	Compare and contrast the DNA replication (prokaryotes and eukaryotes), enzymes involved in replication, DNA repair	**K4**
CO5	Discuss and develop skills for DNA/gene manipulating and the enzymes involved.	**K5 & K6**
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/others to be solved (To be discussed during the Tutorial hour)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill	

Recommended Text:

1. Roy, S.C and Kumar, K.D.C. 1977. Cell Biology, New Central Book Agency, Calcutta.
2. Karp, G. 2010.Cell and Molecular Biology: Concepts and Experiments.6th edition. John Wiley& Sons.
3. Aminul, I. 2011. Text Book of Cell Biology. Books and Allied (P) Ltd, Kolkata, India.
4. Geoffrey M. Cooper. 2019. The Cell: A Molecular Approach, Oxford University Press.
5. Turner, P.C., Mclenann, A.G., Bates, A.D. and White, M.R.H. 2001. Instant notes on molecular biology.
6. Watson, J.D, Baker T.A., Bell S.P., Gann A., Levine M., Losick R. 2014. Molecular Biology of the Gene (7th edition), Pearson Press.
7. Snustad Peter, D. Michael J. Simmons. 2015. Principles of Genetics, John Wiley Sons.
8. Clark, D. 2010. Molecular Biology. Academic Press Publication.
9. David Freifelder. 2008. Essentials of Molecular Biology. Narosa Publishing house. New Delhi.
10. Geoffrey M. Cooper and Robert E. Hausman. 2015. The Cell: A Molecular Approach. 7th edn. Sinauer Associates is an imprint of Oxford University Press.

Reference Books:

1. Alberts B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J. D. 1989. Molecular biology of the Cell (2nd edition). Garland Pub. Inc., New York.
2. Karp, G. 1999. Cells and Molecular Biology: Concepts & Experiments. John Wiley and Sons, Inc., USA.
3. Lodish S, Baltimore B, Berk, C and Lawrence K, 1995, Molecular Cell Biology, 3rd edn, Scientific American Books, N.Y

4. De Robertis and De Robertis, 1988, Cell and Molecular Biology, 8th edn, Info-Med, Hongkong.
5. Lewin, B. 2000. GENE VII. Oxford University Press, New York, USA 7. Cooper G M and Hausman R E, 2007, The Cell: Molecular Approach 4th Edn, Sinauer Associates, USA.
6. Genes X– Benjamin Lewin, Jones and Bartlett, 2011 4. Molecular Biology of the Cell – Alberts, B, Bray, D, Raff, M, Roberts, K and Watson JD, Garland Publishers, 1999
7. Principles of Biochemistry – Lehninger, W.H. Freeman and Company, 2002

Web Resources

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

Mapping with Programme Outcomes:

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

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

CORE XI - GENETICS, PLANT BREEDING & BIOSTATISTICS

Title of the Course		**GENETICS, PLANT BREEDING &BIOSTATISTICS**					
Paper Number		**CORE XI**					
Category	**Core**	**Year**	**II**	**Credits**	**4**	**Course Code**	
		Semester	**III**				
Instructional Hours Per week		**Lecture**	**Tutorial**	**Lab Practice**		**Total**	
		3	**2**	**-**		**5**	
Pre-requisite		To acquire knowledge on genetic traits and plant breeding techniques for crop improvement.					
Learning Objectives		1. The students will be able to have conceptual understanding of laws of inheritance, genetic basis of loci and alleles and their linkage.					
		2. Develop critical understanding of chemical basis of genes and their interactions at population and evolutionary levels.					
		3. Familiarize with genetic basis of heterosis.					
		4. Reflect upon the role of various non-conventional methods used in crop improvement.					
		5. Solve problems quantitatively using appropriate arithmetical, algebraic, or statistical methods					

UNIT	**CONTENTS**
I	Mendal's Law of inheritance. Gene interactions and modified dihybrid ratios (Epistasis, duplicate genes, complementary genes, supplementary genes. lethal genes, incomplete dominance). Polygenic Inheritance. Sex determination in plants and theories of sex determination. Sex linked characters. Structure and function of Gene, Operon, inducible operon, Operator site, Promoter, Polycistronic mRNA, Regulator, repressor, inducer. Regulation in prokaryotes with reference to Lac operon and trp operon. Producer gene, structural gene and integrator gene. Gene Regulation eukaryotes – Britten and Davidson model, Arabidopsis - gene regulation in flowering.
II	Recombination: Homologous and non-homologous recombination, site-specific recombination. Holiday model of recombination. Transposable genetic elements: Ac element, transposase, transposon, Is element. Transposons in *Zea mays*. Transposable elements in prokaryotes. UV induced mutation and its repair mechanism. Mutagenesis - site directed mutagenesis, transposon mutagenesis, insertional mutagenesis. Mismatch DNA repair mechanism.
III	ABO blood group in humans. Gene mapping methods**:** Linkage maps, tetrad analysis, mapping with molecular markers. Extra-chromosomal inheritance - Chloroplast Inheritance. Organelle genomes: Organization and functions of chloroplast and mitochondrial DNA.
IV	**PLANT BREEDING:** Objectives of plant breeding, characteristics improved by plant breeding, Plant introduction, Genetic basis of breeding self and cross – pollinated crops. Pure line theory, pure line, mass and clonal selection methods. Hybridization – steps

	and types, Genetics and physiological basis of heterosis. Mutation breeding - important varieties produced.	
V	**BIOSTATISTICS:** Measures of central tendency (Mean, Median, Mode) and dispersal (Mean deviation, standard deviation), standard errors ANOVA (One way). probability distributions (Binomial, Poisson and normal); difference between parametric and non-parametric statistics; confidence interval; errors; levels of significance; regression and correlation; t-test; analysis of variance; Chi-square test.	
Course outcomes	**On completion of this course, the students will be able to:**	**Programme outcomes**
CO1	Understand the Mendal's Law of inheritance and gene interactions	K1
CO2	Analyze the various factors determining the heredity from one generation to another.	K2
CO3	Explain Gene mapping methods**:** Linkage maps.	K3
CO4	Compare and contrast the genetic basis of breeding self- and cross-pollinated crops.	K4
CO5	Discuss and develop skills for statistical analysis of biological problems.	K5 & K6
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/others to be solved (To be discussed during the Tutorial hour)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill	

Recommended Text:

1. Benjamin, A. Pierce. 2012. Genetics- A conceptual Approach. W.H. Freeman and Company, New York, England.
2. Stansfield, W.D. 1969. Theory and problems of Genetics. McGraw-Hill
3. Sinnott, E.W.Dunn, L.E and Dobzhansky, T. 1973. Principles of Genetics. McGraw-Hill.New York.
4. Chaudhari, H.K.1984. Elementary Principles of Plant Breeding. Oxford & IBH Publishing Company.
5. Brown, T.A. 1992. Genetics a Molecular Approach, 2nd Ed. Chapman and Hall.
6. Chahal, G.S and Gosal, S.S. 2018. Principles and Procedures of Plant Breeding Biotechnological and Conventional Approaches, Narosa Publishing House, New Delhi.
7. Singh, B.D. 2013. Plant Breeding: Principles and Methods, Kalyani Publishers, New Delhi
8. Singh, P. 2017. Fundamentals of Plant Breeding, Kalyani Publishers.
9. Chaudhary, R.C. 2017. Introductory principles of plant breeding, Oxford IBH Publishers, New Delhi.
10. Gupta, P.K. 2009. Genetics. Rastogi publications, Meerut, New Delhi.
11. Gupta, S.C. 2013. Fundamentals of statistics, Himalaya Publishers, Mumbai.
12. Kothari, C.R and Garg, G. 2014. Research methodology –Method and techniques. New

Age International (P) Ltd. New Delhi.
13. Gurumani, N. 2005. Biostatistics, 2nd edn. MJP publications, India.

Reference Books:

1. Watson, J.D. *et al.* 2003. Molecular Biology of the Gene. Fourth Edition. TheBenjamin Cummings Pub. Co.
2. Lewin, B. 2003. Genes VIII. Oxford University Press.
3. Friefelder, D. 2005. Molecular Biology. Second Edition. Narosa Pub. House.
4. Sobtir. C. and Gobe. 1991. Eukaryotic chromosomes. Narosa Publishing house.
8. Smith-Keary, P. 1991. Molecular Genetics. Macmillan Pub. Co. Ltd.London.
9. Acquaah, G.2007. Principles of Plant Genetics and Breeding. Blackwell Publishing.
10. William. S., Klug and Michael, R. Cummings, 2003. Concepts of Genetics. Seventh edition. Pearson Education (Singapore) Pvt. Ltd.
11. Simmonds, N.W. 1979. Principles of Crop improvement. Longman, London.
12. Lewin, B. 2000. Genes VII, Oxford University Press, USA.
13. Strickberger, M.W. 2005. Genetics (III Ed). Prentice Hall, New Delhi, India.
14. Allard, R.W. 2010. Principles of Plant Breeding. 2 nd ed. John Wiley and Sons, Inc. New Jersey, US.
15. Pillai, R.S.N and Bagawathi, V. 1987. Practical Statistics (For B.Com. and B.A., Students) S. Chand & Co. (Pvt.) Ltd., New York.
16. Sobl. R.R and Rohif, F.J. 1969. Biometry. The principles and Practice and Statistics in Biological Research. W.H. Freman and Co., San Francisco.
17. Zar, J.K. 2011. Biostatistical Analysis, Fourth Edition, Prantice-Hall International, New Jersey, USA.

Web Resources

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/evolution-scientific-theory
5. https://www.britannica.com/science/cell-biology
   https://medlineplus.gov/genetocs/understanding/basics/cell/

Mapping with Programme Outcomes:

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

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

CORE XII - RECOMBINANT DNA TECHNOLOGY AND INDUSTRIAL APPLICATIONS

Title of the Course		**RECOMBINANT DNA TECHNOLOGY AND INDUSTRIAL APPLICATIONS**					
Paper Number		**CORE XII**					
Category	**Core**	**Year**	**II**	**Credits**	**4**	**Course Code**	
		Semester	**III**				
Instructional Hours Per week		**Lecture**	**Tutorial**	**Lab Practice**		**Total**	
		3	**2**	**-**		**5**	
Pre-requisite		To acquire knowledge on genetic traits and plant breeding techniques for crop improvement.					
Learning Objectives		To understand the basis of genes and their interactions at population and evolutionary levels.					
		Students should be familiar with the basics of genetics and molecular biology.					
		To develop critical understanding of chemical basis of genes and their interactions at population and evolutionary levels.					
		To learn the applied aspects of molecular biology and recombination technology, gene insertion and production of recombined new plants.					
		To impart knowledge that leads to comprehensive understanding of the principles, tools and practices of rDNA technology.					

UNIT	CONTENTS
I	Recombinant DNA technology – Enzymes, vectors – properties and types, direct and indirect gene transfer. Detection of recombinants - Production of cloned gene products from GMO. Bioassay for target gene effect. Transfection.
II	Genome sequencing, Genome editing and CRISPR-Cas9, RNA interference, Genome library, cDNA library. Isolation of genomic and plasmid DNA - Transformation and recovery of plasmid clones - Preparation of competent *E. coli* cells. Agarose gel electrophoresis. Nucleic acid hybridization - Blotting techniques types.
III	Vitamin-C is produced on a large scale from *Saccharomyces cerevisiae* and *Zygosaccharomyces bailii* yeast and *Gluconobacter oxydans* bacteria. Production of antibiotic medicines: Human Deoxyribonuclease I, β-Glucocerebrosidase, L-Asparaginase, Deoxycytidine kinase Anti-bacterial molecules produced by microbes -Penicillins, tetracyclines produced from fungi and bacteria.
IV	Production of recombinant hormones**:** insulin (somatotrophin), erythropoietin - uses. Production of Hepatitis B vaccine, Interferons, anticancer drugs - uses; Interferon-alfa - hairy cell leukemia. Interferon-Beta-1b - role in treating relapsing multiple sclerosis and melanoma.
V	rDNA technology uses in animal husbandry and sericulture**:** milk production in cattle, cheese ripening, and reduction of lactose levels. Fungal α-amylase, silk production in sericulture. Production of Vitamin B12 produced by recombinant bacteria like *Paracoccus denitrificans, Propionibacterium shermanii, E. coli*

	bacteria on a large scale by fermentation.	
Course outcomes	**On completion of this course, the students will be able to:**	**Programme outcomes**
CO1	Understand the basics of recombinant DNA technology	K1
CO2	Demonstrate and to recollect the production of vitamins	K2
CO3	Analyze the production of antibiotics.	K3
CO4	Compare and contrast the recombined organism and natural organisms.	K4
CO5	Create and develop skills for rDNA techniques and in producing hybrids varieties.	K5 & K6
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/others to be solved (To be discussed during the Tutorial hour)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill	

Recommended Text:

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

Reference Books:

1. Watson, J.D. *et al.* 2003. Molecular Biology of the Gene. Fourth Edition. The Benjamin Cummings Pub. Co.
2. Lewin, B. 2003. Genes VIII. Oxford University Press.
3. Friefelder, D. 2005. Molecular Biology. Second Edition. Narosa Pub. House.
4. Sobtir. C. and Gobe. 1991. Eukaryotic chromosomes. Narosa Publishing house.
5. Smith-Keary, P. 1991. Molecular Genetics. Macmillan Pub. Co. Ltd. London

Web Resources

1. https://www.nature.com/scitable/topic/cell-biology
2. https://plato.stanford.edu/entries/molecular-biology/
3.https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/bioinformatics
4. https://onlinelibrary.wiley.com/doi/book/10.1002/9780470686522

Mapping with Programme Outcomes:

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

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

CORE XIII - LABORATORY COURSE - 5

Title of the Course		**LABORATORY COURSE- 5 COVERING CORE PAPERS X AND XII**					
Paper Number		**CORE XIII**					
Category	**Core**	**Year**	**II**	**Credits**	**2**	**Course Code**	
		Semester	**III**				
Instructional Hours Per week		**Lecture**	**Tutorial**	**Lab Practice**		**Total**	
		-	**-**	**2**		**2**	
Pre-requisite		Practical's pertaining to above subjects are important to get knowledge on overall cell structure, cellular organelles and staining procedures and fundamental principles of rDNA technology					
Learning Objectives		1. Observe the different stages of mitosis and chromosome behaviour and organization during various stages and to learn staining techniques of various plant tissues.					
		2. Understand the electron microscopic structure of cell organelles					
		3. Expose the students to gain recent advances in molecular biology.					
		4. Students able to differentiate the cell structure					
		5. Understand the principles of rDNA techniques.					

UNIT	**EXPERIMENTS**
I	**CELL AND MOLECULAR BIOLOGY** 1. Identification of different stages of mitosis from suitable plant material. (Onion root tips). 2. Identification of meiosis from suitable plant material (floral buds). 3. Acetocarmine staining (Nucleus) and light microscopic observation (Chloroplast)
II	4. Study of mitotic index from suitable plant material. 5. Study of cyclosis in cells of suitable plant material. 6. Measure the length and breadth of the stomata/trichome by using micrometer.
III	7. Study on Electron microscopic structure of cell organelles given in the syllabus 8. Comparative study of cell structure in onion cells, *Hydrilla* and *Spirogyra*. 9. Study of models on DNA and RNA, DNA replication structures,
IV	**rDNA TECHNOLOGY** 1. Isolation of genomic DNA 2. Isolation of plasmid DNA 3. Agarose Electrophoresis 4. Transformation and recovery of plasmid clones
V	**rDNA TECHNOLOGY** (spotters) 1. pBR 322, Ti Plasmid, cosmid 2. Microinjection, Electroporation, Liposome mediated gene transfer, gene gun 3. Blotting technique (Southern blot, Northern blot and Western blot)

Course outcomes	**On completion of this course, the students will be able to:**	**Programme outcomes**
CO1	Recall or remember the various aspects of cell biology, molecular biology, and r-DNA technology.	K1

CO2	Understand various concepts of cell biology, and molecular biology.	K2
CO3	Apply the theory knowledge gained into practical mode in order to acquire applied knowledge by day-to-day hands-on experiences	K3
CO4	Analyze or interpret the results achieved in practical session in the context of existing theory and knowledge.	K4
CO5	Evaluate the theory and practical skills gained during the course.	K5 & K6

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB /NET/UGC–CSIR/GATE/TNPSC/others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Text:

1. George M Malacinski. 2015. Freifelders Essentials of Molecular Biology (4th ed.). Jones & Bartlett.
2. Gupta P.K. 2017. Cell and Molecular Biology (5th ed.), Rastogi Publications, Meerut.
3. Gupta, P.K. 2018. Cytogenetics, Rastogi Publications, Meerut.
4. Kumar, H.D. 2007. Molecular Biology and Biotechnology, Vikas Publishing House, New Delhi.
5. Bharadwaj, D.N. 2012. Breeding of field crops (pp. 1-23). Agrobios (India).
6. Singh, R.J. 2016. Plant Cytogenetics. CRC press, US.
7. Jackson, S.A., Kianian, S.F., Hossain, K.G and Walling, J.G. 2012. Practical laboratory exercises for plant molecular cytogenetics. In Plant Cytogenetics (pp. 323-333). Springer, New York.
8. Shivakumar, S. 2002. Molecular analysis: Laboratory Manual. University press, Palkalai nagar, Madurai, India.

Reference Books:

1. Gardener, J, Simmons, H.J and Snustad, D.P. 2006. Principle of Genetics, John Wiley & Sons, New York.
2. De Robertis E.D.P. and De Robertis E.M.P. 2017. Cell and Molecular Biology (8thed.) (South Asian Edition), Lea and Febiger, Philadelphia, USA.
3. Jackson, S.A., Kianian, S.F., Hossain, K.G., and Walling, J. G. 2012. Practical laboratory exercises for plant molecular cytogenetics. In Plant Cytogenetics (pp. 323-333). Springer, New York, NY.
4. Glick, B.R and J.E. Thompson. 1993. Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boca Raton, Florida.
5. Glover, D.M and B.D. Hames (Eds). 1995. DNA cloning 1: A Practical Approach; Core Techniques, 2nd edition PAS, IRL press at Oxford University Press, Oxford.
6. Gunning, B.E.S and M. W. Steer. 1996. Plant Cell Biology: Structure and function. Jones and Bartlett Publishers, Boston, Massachusetts.
7. Hackett, P.B. and J.A. Fuchs, J.W. Messing. 1988. An Introduction to Recombinant DNA Techniques: Basic Experiments in Gene Manipulation. The Benjamin/ Cummings Publishing

Co., Inc Menlo Park, California. 8. Hall, RD. (Ed).1999. Plant Cell Culture Protocols. Humana Press, New Jersey.
8. Harris, N and K.J. Oparka. 1994. Plant cell Biology: A Practical Approach. IRL Press, At Oxford University Press, Oxford, UK.
9. Gelvin, S.B., Schilperoort, R.A. (Eds.). 2000. Plant Molecualr Biology Manual.
10. Henry, RJ. 1997. Practical applications of plant molecular biology, Chapman & Hall, London.
11. Krebs, J.E., Goldstein E.S. and Kilpatrick S.T. 2017. Lewin's GENES XII (12thed.). Jones & Bartlett Learning.

Web Resources

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

Mapping with Programme Outcomes:

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

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

CORE XIV - LABORATORY COURSE - 6

Title of the Course		**LABORATORY COURSE- 6 COVERING CORE PAPER XI**					
Paper Number		**CORE XIV**					
Category	**Core**	**Year**	**II**	**Credits**	**2**	**Course Code**	
		Semester	**III**				
Instructional Hours Per week		**Lecture**	**Tutorial**	**Lab Practice**		**Total**	
		-	**-**	**2**		**2**	
Pre-requisite		Practicals pertaining to above subjects are important to get knowledge on overall fundamental principles of genetics and plant breeding.					
Learning Objectives		2. Observe the problem-solving skills in Genetics and Biostatistics.					
		2. Explain the principles of linkage, crossing over and the hereditary mechanisms.					
		3. Expose the students to Chromosome mapping.					
		6. Understand the principles of plant breeding to apply crop improvement programmes					
		7. Understand the biostatistics problems.					

UNIT	**EXPERIMENTS**
I	1. Problem solving on dihybrid phenotypic, genotypic and test cross ratios. 2. Problem solving on incomplete dominance. 3. Modified dihybrid ratio problems based on the theory syllabus.
II	4. Problems on Multiple alleles in plants, blood group inheritance in human. 5. Problems on Sex linked inheritance in *Drosophila* and plants.
III	7. Chromosome mapping from three-point test cross data. Calculation of chiasmatic interference.
IV	**PLANT BREEDING** Plant Breeder's kit, Emasculation, Bagging Study of Floral Structure, Emasculation and Hybridization technique in cross pollinated and self-pollinated crops (availability of the specimens).
V	**BIOSTATISTICS** Measures of central tendency (Mean, Median, Mode) Measures of dispersal - standard deviation & standard errors t-test and Chi-square test

Course outcomes	**On completion of this course, the students will be able to:**	**Programme outcomes**
CO1	Recall or remember the various aspects of cell biology, genetics, molecular biology, plant breeding and tissue culture.	K1
CO2	Understand various concepts of cell biology, genetics, plant breeding and tissue culture.	K2
CO3	Apply the theory knowledge gained into practical mode in order to acquire applied knowledge by day-to-day hands-on experiences	K3
CO4	Analyze or interpret the results achieved in practical session in the context ofexisting theory and knowledge.	K4

CO5	Evaluate the theory and practical skills gained during the course.	K5 & K6
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/others to be solved (To be discussed during the Tutorial hour)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill	

Recommended Text:

1. George M Malacinski. 2015. Freifelders Essentials of Molecular Biology (4th ed.). Jones & Bartlett.
2. Gupta P.K. 2017. Cell and Molecular Biology (5^{th} ed.), Rastogi Publications, Meerut.
3. Gupta, P.K. 2018. Cytogenetics, Rastogi Publications, Meerut.
4. Kumar, H.D. 2007. Molecular Biology and Biotechnology, Vikas Publishing House, New Delhi.
5. Bharadwaj, D.N. 2012. Breeding of field crops (pp. 1-23). Agrobios (India).
6. Singh, R.J. 2016. Plant Cytogenetics. CRC press, US.
7. Jackson, S.A., Kianian, S.F., Hossain, K.G and Walling, J.G. 2012. Practical laboratory exercises for plant molecular cytogenetics. In Plant Cytogenetics (pp. 323-333). Springer, New York.
8. Shivakumar, S. 2002. Molecular analysis: Laboratory Manual. University press, Palkalai nagar, Madurai, India.

Reference Books:

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2. De Robertis E.D.P. and De Robertis E.M.P. 2017. Cell and Molecular Biology (8thed.) (South Asian Edition), Lea and Febiger, Philadelphia, USA.
3. Jackson, S.A., Kianian, S.F., Hossain, K.G., and Walling, J. G. 2012. Practical laboratory exercises for plant molecular cytogenetics. In Plant Cytogenetics (pp. 323-333). Springer, New York, NY.
4. Glick, B.R and J.E. Thompson. 1993. Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boca Raton, Florida.
5. Glover, D.M and B.D. Hames (Eds). 1995. DNA cloning 1: A Practical Approach; Core Techniques, 2nd edition PAS, IRL press at Oxford University Press, Oxford.
6. Gunning, B.E.S and M. W. Steer. 1996. Plant Cell Biology: Structure and function. Jones and Bartlett Publishers, Boston, Massachusetts.
7. Hackett, P.B. and J.A. Fuchs, J.W. Messing. 1988. An Introduction to Recombinant DNA Techniques: Basic Experiments in Gene Manipulation. The Benjamin/ Cummings Publishing Co., Inc Menlo Park, California. 8. Hall, RD. (Ed).1999. Plant Cell Culture Protocols. Humana Press, New Jersey.
8. Harris, N and K.J. Oparka. 1994. Plant cell Biology: A Practical Approach. IRL Press, At Oxford University Press, Oxford, UK.
9. Gelvin, S.B., Schilperoort, R.A. (Eds.). 2000. Plant Molecualr Biology Manual.
10. Henry, RJ. 1997. Practical applications of plant molecular biology, Chapman & Hall, London.

11. Krebs, J.E., Goldstein E.S. and Kilpatrick S.T. 2017. Lewin's GENES XII (12thed.). Jones & Bartlett Learning.

Web Resources

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

Mapping with Programme Outcomes:

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

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

CORE XV- INDUSTRIAL BOTANY

Title of the Course		**INDUSTRIAL BOTANY**					
Paper Number		**Core –XV**					
Category	**Core**	**Year**	**II**	**Credits**	**4**	**Course Code**	
		Semester	**III**				
Instructional Hours Per week		**Lecture**	**Tutorial**	**Lab Practice**		**Total**	
		2	**3**	**-**		**5**	
Pre-requisite		The course will equip students to either obtain employment in the field or start their own business there, depending on the needs of the industry.					
Learning Objectives		1. To learn the applied aspects of industrial application of algae, fungi, bacteria, plants, molecular biology and recombination technology.					
		2. The student would be competent to work in industries.					
		3. To educate people about the widespread commercial uses of fungi.					
		4. To know about the economic importance of plants.					
		5. To acquire knowledge on *in vitro* cultivation techniques to develop protocols targeted towards commercialization.					

UNIT	**CONTENTS**
I	**ALGAE IN INDUSTRIES:** Fertilizer industry-Seaweeds, pharmaceutical industry – antibiotics, agar, carageenin, alginin, diatomate earth, mineral industry, cosmetics, fodder industry
II	**FUNGI IN INDUSTRIES:** Beneficial use of yeast, Fermentation of alcohol, preparations of enzyme (amylase, protease, cellulase), organic acid preparation (oxalic and citric acid), cheese production, protein manufacture, vitamins, fats.
III	**PLANT PRODUCTS:** Fibres and Fibre-Yielding Plants, wood and cork, tannins and dyes, rubber, fatty oils and Vegetable fats, sugars and starches, pulp and paper, gums, resins, beverages and spices.
IV	**BACTERIA IN INDUSTRY:** Food industry, dairy products, bioleaching, biogas production**,** bioremediation, production of alcoholic beverages, enzymes, antibiotics, Interferons, vaccines.
V	**RECOMBINANT PLANTS:** Tissue culture: Micropropagation, somatic seeds, cell culture. Hairy root cultures - methods, applications; Biotransformation; Role of tissue culture in production of pathogen - free plants and "synthetic seeds"; Transgenic plants for crop improvement- Herbicide tolerant - Basta, Dhara Mustard Hybrid**,** glyphosate. Insect resistant crops - Bt-cotton, BT-brinjal, Biofortification - golden rice. Flaour save tomato etc. barnase and barstar. Transgenic plants for molecular farming

Course outcomes	**On completion of this course, the students will be able to:**	**Programme outcomes**
CO1	Understand the basics of algae in industrial applications.	K1
CO2	Demonstrate and to recollect the uses in fungi in industries	K2

CO3	Explain bacterial role in industries.	K3
CO4	Compare and contrast the use of plants in industries.	K4
CO5	Discuss and develop skills for working in industries specializing in biomolecules.	K5 & K6

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Text:

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

Reference Books:

1. Becker. E.W. 1994. Micro algae Biotechnology and Microbiology. Cambridge University press.
2. Borowitzka, M.A. and Borowizka, L.J. 1996. Microalgal Biotechnology. Cambridge University Press, Cambridge,
3. Sahoo, D. 2000. Farming the ocean: seaweed cultivation and utilization. Aravali International, New Delhi.
4. Mahendra Rai. 2009. Advances in Fungal Biotechnology. I.K. International Publishing House, New Delhi.
5. Street, H.E. 1978. Essay in Plant Taxonomy, Academic Press, London, UK.
6. Alexander N. Glazer and Hiroshi Nikaido. 1994. Microbial Biotechnology.
7. Pandey, B.P. 2005. College Botany I: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. S Chand & Company.
8. Chichister, U.K.J. 1999. Cultivation and Processing of Medicinal Plants, Wiley & Sons
9. William Charles Evans.1989. Pharmacognosy, 14th ed. Harcourt Brace & Company.
10. Kumar,H.D. 1999. Introductory Phycology. Affiliated East-WestPress, Delhi.
11. Das, Sand Saha, R. 2020. Microbiology Practical Manual. CBS Publishers and Distributors (P) Ltd., New Delhi, India.
12. Willie, J and Sherwood, L. 2016. Prescott's Microbiology McGraw-Hill Education; 10th Edition, ISBN: 978-1259281594
13. Reinert, J. Bajaj. T.P.S. 1977. Applied and Fundamental Aspects of Plant cell, tissue and

organ Culture. Springer – Verlaug.
Web Resources
1. https://www.elsevier.com/books/algal-biotechnology/ahmad/978-0-323-90476-6 2. https://www.amazon.in/Fungi-Biotechnology-Prakash-ebook/dp/B07PBF2R3D 3. https://www.amazon.in/Plant-Based-Natural-Products-Derivatives-Applications-ebook/dp/B07438N1CJ 4. https://link.springer.com/book/10.1007/978-981-16-5214-1 5. https://link.springer.com/book/10.1385/0896031616

Mapping with Programme Outcomes:

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

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

ELECTIVE-V: 1. SECONDARY PLANT PRODUCTS AND FERMENTATION BIOTECHNOLOGY

Title of the Course		**SECONDARY PLANT PRODUCTS AND FERMENTATION BIOTECHNOLOGY**					
Paper Number		**ELECTIVE V**					
Category	**Elective**	**Year**	**II**	**Credits**	**2**	**Course Code**	
		Semester	**III**				
Instructional Hours Per week		**Lecture**	**Tutorial**	**Lab Practice**		**Total**	
		3	**-**	**-**		**3**	
Pre-requisite		To know about the microbial culture in the manufacture of value-added products.					
Learning Objectives		1. To familiar with the basics of biochemistry and fermentation.					
		2. Understand secondary metabolites.					
		3. To enhance the knowledge and skills needed for self-employment using the microbial derived products.					
		4. Apply the microbial culture in the manufacturing of value-added products.					
		5. Critically analyze the types of bioreactors and the fermentation process.					

UNIT	CONTENTS
I	**SECONDARY METABOLITES:** A brief account of acetate malonate, acetate mevalonate and shikimic acid pathways. Categories of phytochemicals – Phenols, alkaloids, flavonoids, terpenoids, steroids, glycosides, pigments and vitamins.
II	**MICROBIAL GROWTH:** Microbial growth curve, Factors affecting microbial growth; Stoichiometry: mass balances; Stoichiometry: energy balances; Growth kinetics; Measurement of growth.
III	**BIOREACTORS:** Introduction to bioreactors; Batch and Fed-batch bioreactors, Continuous bioreactors; Immobilized cells; Bioreactor operation; Sterilization; Aeration; Sensors; Instrumentation; Culture-specific design aspects: plant cell culture reactors. Membrane-based techniques; Extraction; Adsorption and Chromatography. Industrial Processes: Description of industrial processes; Process flow sheeting; Process economics.
IV	**DOWNSTREAM PROCESSING:** Biomass removal and disruption; Centrifugation; sedimentation; Flocculation; Microfiltration; Sonication; Homogenizers; Chemical lysis; Enzymatic lysis; Membrane based purification: Ultrafiltration; Reverse osmosis; Dialysis: Diafiltration; Pervaporation; Adsorption and chromatography: size, charge, shape, hydrophobic interactions, Biological affinity; Process configurations (packed bed, simulated moving beds); Precipitation (Ammonium Sulfate, solvent); Electrophoresis (capillary); Crystallization; Extraction (solvent, aqueous two phase,

	super critical),	
V	**IMPORTANT PRODUCTS THROUGH FERMENTATION:** Organic acids: citric acid and acetic acid, enzymes – amylase, lipase, antibiotics – penicillin, vitamins – B12, amino acids – glycine, glutamic acid, organic solvents – ethanol, acetone, alcoholic beverages – wine, beer, biomass – baker's yeast, biopesticides, biopolymers.	
Course outcomes	**On completion of this course, the students will be able to:**	**Programme outcomes**
CO1	Critically analyze the types of bioreactors and the fermentation process.	K1
CO2	Evaluate the role of microorganisms in industry	K2
CO3	Analyze the types of bioreactors.	K3
CO4	Create to understand the significance of intrinsic and extrinsic factors on growth of microorganism.	K4
CO5	Evaluate the concept of downstream processing	K5 & K6
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/others to be solved (To be discussed during the Tutorial hour)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill	

Recommended Text:

1. Shuler, M. L and F. Kargi. 2002. *Bioprocess Engineering*, Prentice Hall Inc.
2. Doran, P.M. 1995. *Bioprocess Engineering Principles*, Elsevier.
3. Kaufman, P.B. L. J. Cseke, S. Warler, J. A. Duke, and H. L. Brielmann. 1999. *Natural Products from Plants*, CRC Press LLC.
4. Casia, J.R.L.E. 2009. Industrial Microbiology. New Age International (P) Ltd. Publisher, New Delhi.
5. Stanbury, P. F., Whitaker, A. and Hall, S.J. 1979. Principles of Fermentation Technology. Aditya Books (P) Ltd., New Delhi.
6. Potter, N. N. 2007. Food Science. CBS Publishers.

Reference Books:

1. Rehm, H. J and G. Reed, Biotechnology-*A multi- Volume Comprehensive Treatise*, 2nd Ed, Vol 3, Wiley-VCH, 1993
2. Moo-Young, M. 2004. *Comprehensive Biotechnology*, Vol. 2, Pergamon Press,
3. Dicosmo, F and M. Missawa, 1996. *Plant Cell Culture Secondary Metabolism: Towards Industrial Application*. CRC LLC.
4. Frazier, W.C. and Weshoff, D.C. (2015). Food Microbiology (5th edition) McgrawHill.
5. Kumari, S. 2012. Basics of Food Biochemistry and Microbiology. Koros Press.
6. Whitaker. J.R. 2016. Handbook of Food Enzymology. CRC press
7. Shewfelt, R.L.2013. Introducing Food Science. CRC Press.
8. Smith, J.S and Hui, Y.H.2014. Food Processing. Wiley.
9. Varzakas, T and Tzia, C. 2016. Handbook of Food Processing. CRC Press.

Web Resources

1. https://link.springer.com/book/9783642673627
2. https://www.elsevier.com/books/secondary-plant-products/stumpf/978-0-12-675407-0
3. https://www.amazon.in/Secondary-Plant-Products-Comprehensive-Biochemistry-ebook/dp/B01E3II0E2
4. https://www.pdfdrive.com/principles-of-fermentation-technology-e40900163.html
5. https://link.springer.com/book/10.1007/978-3-030-16230-6

Mapping with Programme Outcomes:

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

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

ELECTIVE - V: 2. ENTREPRENEURIAL OPPORTUNITIES IN BOTANY

Title of the Course		**ENTREPRENEURIAL OPPORTUNITIES IN BOTANY**					
Paper Number		**ELECTIVE V**					
Category	**Elective**	**Year**	**II**	**Credits**	**2**	**Course Code**	
		Semester	**III**				
Instructional Hours Per week		**Lecture**	**Tutorial**	**Lab Practice**		**Total**	
		3	**-**	**-**		**3**	
Pre-requisite		To understand the importance of floriculture and nursery management.					
Learning Objectives		1. Understand the different classifications of horticultural crops, nursery management, and use of technology in horticulture.					
		2. Develop their competency on pre and post-harvest technology in horticultural crops.					
		3. Analyze the different methods of weed control and harvest treatments of horticultural crops.					
		4. Examine the economic implications of cultivation of tropical and sub-tropical vegetable crops.					
		5. Evaluate the importance of floriculture and contribution spices and condiments on economy.					

UNIT	**CONTENTS**
I	Organic manures and fertilizers. Composition of fertilizer, NPK content of various fertilizers. Common organic manures bone meal, cowdung, poultry waste, oil cakes, organic mixtures and compost. Preparation of compost, aerobic and anaerobic – advantages. Vermicompost preparation, vermiwash. Panchakaviyam.
II	Common garden tools. Methods of plant propagation by seeds. Vegetative propagation, cutting, grafting, budding and layering. Use of growth regulators for rooting.
III	Gardening – types of garden, ornamental, indoor garden, kitchen garden, terrace garden, vegetable garden for marketing. Rockery and artificial ponds. Ornamental garden designing, garden components flower beds, borders, hedges, edges, drives, paths, garden adornments.
IV	Packaging of fruits, vegetables. Preservation techniques drying, heat treatment, low temperature storage and by chemicals. Preparation of wine, vinegar and dairy products.
V	Significance of mushrooms. Types of mushrooms. Spawn isolation and preparation. Cultivation (button mushroom, oyster mushroom). Value added products from mushroom – pickles, candies and dried mushrooms.

Course outcomes	**On completion of this course, the students will be able to:**	**Programme outcomes**
CO1	Students can acquire knowledge about organic farming and their advantages.	K1
CO2	Analyze both the theoretical and practical knowledge in understanding various horticultural techniques	K2
CO3	To develop kitchen garden or terrace garden in their living area.	K3
CO4	Evaluate the horticultural techniques to students can develop self	K4

	employment and economical improvement	
CO5	Create and develop skills for mushroom cultivation.	K5 & K6
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/others to be solved (To be discussed during the Tutorial hour)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill	

Recommended Text:

1. Chmielewski, J. G and Krayesky, D. 2013.General Botany laboratory Manual. Author House, Bloomington, USA.
2. Russell, T. 2012. Nature Guide: Trees: The world in your hands (Nature Guides). Mukherjee D. Gardening in India, Oxford IBH publishing co, New Delhi.
3. Kumar, N. 1997. Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.
4. Webster J and Weber, R. 2007. Introduction to Fungi, 3rdEd.Cambridge University Press, Cambridge.
5. Bendre, M. Ashok and Ashok Kumar, A. 2020. Text Book of Practical Botany 1 10thed). Rastogi Publications, Meerut.
6. Singh, R and U.C. Singh 2020. Modern mushroom cultivation, 3rd Edition Agrobios (India), Jodhpur.

Reference Books:

1. Adams, C.R. Banford, K.M. and Early, M.P. 1993. Principles of Horticulture.
2. Sathe, T.V. 2004. Vermiculture and Organic farming, Daya Publishers.
3. Peter, K.V. 2017. Basic Horticulture.
4. Hartman, H.T. and D.F. Kestler. 1976. Plant propagation principles and practice. Prentice Hall of India, New Delhi.
5. Jules Janick, 1982. Horticulture Science. Surjeet publications, New Delhi.
6. Ignacimuthu, S.1998. Plant Biotechnology. Tata Mc Graw Hill Ltd., New Delhi.
7. Gupta. P.K., 1998. Elements of Biotechnology. Rastogi publications, Meerut.
8. Edmond Musser and Andres, Fundamentals of Horticulture, McGraw Hill Book Co., New Delhi.
9. Janick Jules. 1979. Horticultural Science. (3rd Ed.), W.H. Freeman and Co., San Francisco, USA

Web Resources

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

Mapping with Programme Outcomes:

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

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

ELECTIVE- V: 3. APPLIED PLANT CELL & TISSUE CULTURE

Title of the Course		**APPLIED PLANT CELL & TISSUE CULTURE**					
Paper Number		**ELECTIVE V**					
Category	**Elective**	**Year**	**II**	**Credits**	**2**	**Course Code**	
		Semester	**III**				
Instructional Hours Per week		**Lecture**	**Tutorial**	**Lab Practice**		**Total**	
		3	**-**	**-**		**3**	
Pre-requisite		The course will equip students to either obtain employment in the field or start their own business there, depending on the needs of the industry.					
Learning Objectives		1. To comprehend the basic principles and methodologies of plant tissue culture.					
		2. To acquire knowledge on *in vitro* cultivation techniques to develop protocols targeted towards commercialization.					
		3. To gain understanding of the various techniques of tissue culture for secondary metabolites production. .					
		4. To recognize the worth of traditional germplasm and receive training in preserving and enhancing crop varieties to meet consumer demand and global legal policies.					
		5. To impart practical information on plant tissue culture in order to produce labour suitable for the demands of the industry and research facilities					

UNIT	CONTENTS
I	**BASIC PLANT TISSUE CULTURE:** Totipotency and concepts of plant tissue culture – Laboratory organization – Design of different laboratories - 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.
II	**MICROPROPAGATION:** 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.
III	**CELL AND PROTOPLAST CULTURES AND HAPLOID PRODUCTION:** 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.
	METABOLIC ENGINEERING:

IV	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.	
V	**CRYOPRESERVATION AND BIOREACTORS:** 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, Biotransformation – Food vaccines, bioplastics, plantibodies, plantigens - Applications of tissue culture in agriculture, horticulture and forestry.	
Course outcomes	**On completion of this course, the students will be able to:**	**Programme outcomes**
CO1	Recall the principles and culture techniques of cells, callus, organs, pollen, anthers, embryos and protoplasts.	K1
CO2	Understand the techniques used in plant growth and regeneration under *in vitro* conditions.	K2
CO3	Apply the role plant tissue culture techniques in the production some secondary metabolites and planting stock in horticulture.	K3
CO4	Analyze the conditions that are suitable for direct and indirect plant regeneration.	K4
CO5	Evaluate the self-skills obtained during the course thorough internal and external assessment systems.	K5
CO6	Create idea to seek for suitable job in relevant industries/research centers or to become a potential entrepreneur based on knowledge achieved during the course.	K6
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/others to be solved (To be discussed during the Tutorial hour)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill	

Recommended Text:

1. Narayanaswamy, S. 1999. Plant cell and tissue culture. 8th edn.Tata McGraw Hill Publ. ISBN 0074602772.
2. Bhojwani, S.S and Razdan, M.K. 2004. Plant Tissue Culture, Read Elsevier India Pvt. Ltd. ISBN 818147 3256.
3. Trigiano, R.N and D.J. Gray (eds.). 2000. Plant tissue culture concepts and laboratory exercises. CRC Press. (Textbook). 2nd Edition.
4. Kyte, M and Kleyn, J. 1996. Plant from test tubes. Timber Press. Auge, R. et al., 1995. In vitro culture and its applications in horticulture. Science Publishers, Inc.
5. Auge, R. 1995. In vitro culture and its applications in horticulture. Science Publishers, Inc.
6. Gamborg, O.L. and G.C. Phillips (eds). 1995. Plant cell, tissue and organ culture. Springer Lab Manual.

7. Khasim, S.M. 2002. Botanical Microtechnique: Principles and Practice, Capital Publishing Company, New Delhi.
8. Srivastava, P.S. 1998. Plant Tissue Culture and Molecular Biology. N.R. Book Distributors, New Delhi.
9. Vinay Sharma and Afroz Alam. 2019. Plant Tissue Culture. Wiley.
10. Pullaiah, E., Rao, T., M.V. Subba, Sreedev. 2017. Plant Tissue Culture: Theory and Practicals. Scientific Publishers.
11. Chawla, H.S. 2009. Introduction to plant biotechnology, 3rd edition, Oxford and IBH publishing, New Delhi.
12. Gupta, S.D and Ibaraki, Y. 2006. Plant tissue culture engineering (Vol. 6). Springer Science & Business Media, Germany.
13. Razdan, M.K. 2015. Introduction to Plant Tissue Culture, 3rd edition. Oxford and IBH publishing, New Delhi.
14. Rober, H. Smith. 2013. Plant Tissue Culture: Techniques and Experiments, Academic Press, Elsevier.
15. Robert, N. Trigiano and Dennis, J and Gray (Eds.). 2011. Plant Tissue Culture, Development, and Biotechnology, CRC Press, Taylor & Francis Group.

Reference Books:

1. Bhojwani, S. S and Dantu, P.K. 2013. Plant tissue culture: an introductory text (Vol. 318). New Delhi, India: Springer.
2. Vasil, I.K. and Thorpe, T.A. 1994. Plant Cell and Tissue Culture, Kluwer Academic Press, The Netherlands.
3. Loyola-Vargas, V.M. Ochoa-Alejo, N. 2016. Somatic embryogenesis: Fundamental aspects and applications, Springer international publishing, Switzerland.
4. Elhiti, M., Stasolla, C and Wang, A. 2013. Molecular regulation of plant somatic embryogenesis. In Vitro Cellular & Developmental Biology-Plant, 49(6), 631-642
5. Collins, H.A. and Edwards, S. 1998. Plant Cell Culture, Bios Scientific Publishers, Oxford, UK.
6. Hall, R.D. (Ed.). 1999. Plant Tissue Culture: Techniques and Experiments, Academic Press, New York.
7. Kartha, K.K. 1985. Cyropreservation of plant cells and organs. CRC Press, Boca Raton, Florida.
8. Rihan, H.Z., Kareem, F., El-Mahrouk, M.E., and Fuller, M.P. 2017. Artificial seeds (principle, aspects and applications). Agronomy, 7(4), 7.
9. Pullaiah, T. 2009. Plant Tissue Culture: Theory and Practicals, Scientific Publishers Journals Dept.Timir Baran Jha and Biswajit Ghosh. 2016. Plant Tissue Culture: Basic and Applied, Platinum Publishers; 2nd Edn.
10. Anis Mohammad and Ahmad Naseem. 2016. Plant Tissue Culture: Propagation, Conservation and Crop Improvement, Springer. Singapore**.**
11. Loyola-Vargas, V.M and Vázquez-Flota, F. 2006. Plant cell culture protocols (Vol. 318). USA: Humana Press, New Jersey.
12. Mba, C., Afza, R., Bado, S., and Jain, S.M. 2010. Plant Cell Culture: Essential Methods, John Wiley & Sons, UK.
13. Abdin, M.Z., Kiran, U., Kamaluddin, M., Ali, A. (Eds.). 2017. Plant Biotechnology: Principles and Applications, Springer publishers.
14. Fett-Neto, Arthur Germano (Ed.). 2016. Biotechnology of Plant Secondary Metabolism:

Methods and Protocols, Springer publishers.
15. Smith, R.H. 2012. Plant tissue culture: techniques and experiments. Academic Press, UK.
16. Trigiano, R. N., and Gray, D. J. 2011. Plant tissue culture, development, and biotechnology. CRC Press, US
17. Kartha, K.K. 1985. Cryopreservation of Plant Cells and Organs. CRC Press, Boca Raton, Florida, USA.

Web Resources

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

Mapping with Programme Outcomes:

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

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

ELECTIVE – V: 4. SILVICULTURE AND COMMERCIAL LANDSCAPING

Title of the Course		**SILVICULTURE AND COMMERCIAL LANDSCAPING**					
Paper Number		**ELECTIVE V**					
Category	**Elective**	**Year**	**II**	**Credits**	**2**	**Course Code**	
		Semester	**III**				
Instructional Hours Per week		**Lecture**	**Tutorial**	**Lab Practice**		**Total**	
		3	**-**	**-**		**3**	
Pre-requisite		Students should know about the fundamental concepts of gardening and landscaping.					
Learning Objectives		1. To understand the basic concepts of horticulture.					
		2. To learn the various methods of plant propagation.					
		3. To know the art of fruit crop and vegetable crop cultivation.					
		4. To know about the fundamental concepts of gardening and landscaping.					
		5. To provide an overview of various gardening styles and its scope in recreation and bio-aesthetic planning.					

UNIT	CONTENTS
I	Silviculture – definition, objectives and scope. Classification of forest, forest composition and structure, Forest ecosystem, Forest types of Tamil Nadu and their distribution, Role of forests. Silviculture techniques for some important species - *Tectona grandis, Melia dubia, Eucalyptus.* Plant Adaptations – Desert, Grasslands, Tropical and Temperate Rain Forest, Tropical and Temperate Deciduous Forest, Tundra.
II	Plant propagation: 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.
III	Fruit crops: 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.
IV	Flower and vegetable crops: 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. Classification of vegetables – Cultivation of important vegetables - Tomato, Potato, Onion, Cabbage and Snake guard – Layout for a model kitchen garden.
V	Landscape designing: 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.	
Course outcomes	**On completion of this course, the students will be able to:**	**Programme outcomes**
CO1	To understand the importance and divisions of horticulture.	**K1**
CO2	Demonstrate the art of floriculture and landscape gardening.	**K2**
CO3	Explain plant propagation and fruit crop cultivation.	**K3**
CO4	Compare and contrast the vegetable cultivation and kitchen gardening.	**K4**
CO5	Discuss and develop skills for effective understanding on landscaping and components of gardens.	**K5 & K6**
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/others to be solved (To be discussed during the Tutorial hour)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill	

Recommended Text:

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

Reference Books:

1. EdmentSenn 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).

	Web Resources
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

Mapping with Programme Outcomes:

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

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

SKILL ENHANCEMENT COURSE 2
SEMINAR PAPER (OPEN CHOICE)

Title of the Course		**SEMINAR PAPER (OPEN CHOICE)**					
Paper Number		**SKILL ENHANCEMENT 2**					
Category	**Skill enhancement**	**Year**	**II**	**Credits**	**2**	**Course Code**	
		Semester	**III**				
Instructional Hours Per week		**Lecture**	**Tutorial**	**Lab Practice**		**Total**	
		3	**-**	**-**		**3**	
Pre-requisite		Students should know about the fundamental concepts of seminar presentation.					
Learning Objectives		To learn about the presentation skills - Listening, Speaking, Reading and Writing					
		To provide an opportunity for participants to gain knowledge and skills through lectures, discussion, and other interactive activities.					
		To understand methodology of seminar preparation					
		To show the acquired knowledge in paper presentation in open choice platform					

UNIT	**CONTENTS**	
I	Seminar – define, benefits to students; Structure of seminar paper: Title, abstract, key words, introduction, objectives, scope of the study, list of literature, methodology, the text body/subject development, presentation of data, discussion, conclusion, references; Guide to conducting effective seminars.	
II	Electronic information products: e-books, e-journals, e-zines, e-reference sources. Literature collection and citation: impact factor, citation analysis, citation index, h index, i10 index. Concept of Plagiarism and its types, Digital Libraries - virtual reference service. Electronic Publishing: concept and categories.	
III	Structure and format of journal articles. Types of research papers. Writing an effective research paper, Seminar presentation skills, Types of seminars, Key elements of online seminar, Good presentation techniques.	
IV	E-learning tools –Visual aids: Microsoft Powerpoint, Canva, Google meet, Google Slides, Zoom. Word processors, Biology apps, softwares and Websites, Communication technologies used in E-learning, concept and types of E-learning, the role of E-learning, the advantages and disadvantages.	
V	Micro-teaching, Dos and Don'ts for an Effective Presentation, Guidelines on Research paper presentation in Seminars / Conferences. Webinars – how to create effective webinars. Creating posters for effective scientific communication	
Course outcomes	**On completion of this course, the students will be able to:**	**Programme outcomes**
CO1	The skills of writing will be developed and assessed based on the structure of seminar paper.	K1
CO2	Students are expected to gain knowledge about literature collection.	K2

CO3	Students are prepared to communicate their ideas effectively and coherently in various types of seminar platforms.	K3
CO4	The presenationskill will be developed via e-learning tools.	K4
CO5	Students are trained to proceed the effective micro teaching techniques.	K5 & K6

Web Resources

1. https://www.youtube.com/watch?v=C55e9mFzO4E
2. https://www.youtube.com/watch?v=S5c1susCPAE
3. https://www.youtube.com/watch?v=mwYRKPT1TgI
4. https://www.youtube.com/watch?v=gkNGtBlZOwo
5. https://www.youtube.com/watch?v=AdGJIehKjyw
6. https://www.youtube.com/watch?v=_ic5f9K9HpI

PROFESSIONAL COMMUNICATION SKILL

Title of the Course		**PROFESSIONAL COMMUNICATION SKILL**					
Paper Number		**SKILL ENHANCEMENT 2**					
Category	**Skill enhancement**	**Year**	**II**	**Credits**	**2**	**Course Code**	
		Semester	**III**				
Instructional Hours Per week		**Lecture**	**Tutorial**	**Lab Practice**		**Total**	
		3	**-**	**-**		**3**	
Pre-requisite		Students should know about the fundamental concepts of gardening and landscaping.					
Learning Objectives		To teach the four language skills - Listening, Speaking, Reading and Writing; critical thinking skills to students.					
		To enable students, comprehend the concept of communication.					
		To help students cultivate the habit of Reading and develop their critical reading skills					
		Develop vocabulary and language skills.					
		Analyze, interpret and effectively summarize a variety of textual content.					

UNIT	**CONTENTS**
I	Communication: An Introduction - Definition, Scope of Communication, importance of Communication, Process and types of Communication. Barriers to communication - overcome barriers of communication, Perspectives in communication, communication styles, effective communication
II	Elements of Communication: Introduction, Face to Face Communication – Tone of voice, Body Language (Non-Verbal Communication), Verbal Communication, Visual Communication.
III	Listening Skills The process, importance and types of listening. Enhancing Listening Skills - Paraphrasing, Summarizing, Guidelines to increase listening, Activities to enhance listening
IV	Telephone Skills: Telephonic Communication: Do's and Don'ts. Speaking Skills: Introducing yourself, describing a person, place, situation and event, giving instruction, making inquiries – at a bank, post-office, air-port, hospital, reservation counter and role play, Asking Questions
V	Letter Writing: Informal Letter, (Formal) Business Letters: Essential and Occasional Parts of a letter, layout and Letter of Inquiry, Complaint and Adjustments, orders and replies of it. Report Writing: Format, Structure and Types, Technical Reports and Project Reports.

Course outcomes	**On completion of this course, the students will be able to:**	**Programme outcomes**
CO1	Students are trained to convert the conceptual understanding of communication into every day practice.	**K1**
CO2	Students are expected to be ready for placements.	**K2**
CO3	Students are prepared to communicate their ideas relevantly and	**K3**

	coherently in professional writing	
CO4	The skills of Speaking will be developed conducting various communicative Activities- Role play, conversations, extempore etc.	**K4**
CO5	The skills of Writing will be developed and assessed on Text based writing.	**K5 & K6**

Recommended Text:

1. Meenakshi Raman & Sangeetha Sharma. 2012. *Technical Communication.* New Delhi: OUP
2. Rizvi, M. A. 2005. *Effective Technical Communication.* New Delhi: Tata McGraw Hill
3. Sanjay Kumar & Pushphatha. 2012. *Communication Skills.* New Delhi: OUP
4. Er. A. K. Jain, Dr. Pravin S. R. Bhatia & Dr. A. M. Sheikh. 2013. *Professional Communication Skills*. S. Chand Publishers. New Delhi.
5. Farhathullah, T.M. 2009. *English for Business Communication.* Bangalore: Prism Publishers
6. Bikram K Das. 2011. Functional Grammar and Spoken and Written Communication in English. Kolkata: Orient Blackswan
7. Kiranmai Dutt, P *et al. 2011. A Course in Communication Skills. New Delhi: CUP India*
8. Krishnaswamy, N. 2000. *Modern English – A Book of Grammar, Vocabulary and Usage.* Macmillan India Pvt. Ltd
9. Ramachandran, K K. *et al.* 2007. *Business Communication.* New Delhi: Macmillan
10. Taylor, Ken. 2011. *50 ways to improve your Business English*. Hyderabad: Orient Blackswan

Reference Books:

1. Andreja. J. Ruther Ford, Basic communication skills for Technology, 2nd Edition, Pearson Education, 2011
2. Aubrey Daniels, Bringing out the best in people, 2nd Edition, Mc Graw Hill, 1999
3. Stephen.P. Robbins Organizational Behaviour, 1st Edition, Pearson, 2013
4. Gill Hasson, Brilliant- Communication skills, 1st Edition, Pearson Life, 2011
5. Gopala Swamy Ramesh, The Ace of Soft Skills: Attitude, Communication and Etiquette for success, 5th Edition, Pearson, 2013
6. Deborah Dalley, Lois Burton, Margaret Developing your influencing skills, , Greenhall, 1st Edition Universe of Learning LTD, 2010
7. Konar nira, Communication skills for professionals, 2nd Edition, New arrivals –PHI, 2011
8. Barun K Mitra, Personality development and soft skills, 1st Edition, Oxford Press, 2011
9. Butter Field, Soft skill for everyone, 1st Edition, Cengage Learning India pvt. ltd, 2011
10. Francis Peters SJ, Soft skills and professional communication, 1st Edition, McGraw Hill Education, 2011
11. John Adair, Effective communication, 4th Edition, Pan Mac Millan, 2009

Web Resources

7. https://library.ku.ac.ke/wp-content/downloads/2011/08/Bookboon/Career%20and%20Personal%20Development/effective-communication-skills.pdf
8. https://agrimoon.com/communication-skills-pdf-book-free-download/
9. https://ncert.nic.in/vocational/pdf/kees101.pdf
10. https://ncert.nic.in/vocational/pdf/kees101.pdf
11. https://baou.edu.in/assets/pdf/BCADES_201_slm.pdf
12. https://mrcet.com/downloads/MBA/Professional%20Communication%20Skills.pdf

Mapping with Programme Outcomes:

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

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

INTERNSHIP / FIELD VISIT / INDUSTRIAL VISIT / RESEARCH KNOWLEDGE UPDATING ACTIVITY

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">Skill Enhancement – II</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">SKILL ENHANCEMENT</td><td>Year</td><td>II</td><td>Credits</td><td>2</td><td>Course Code</td><td></td></tr>
<tr><td>Semester</td><td>III</td><td colspan="4"></td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>-</td><td colspan="2">-</td><td colspan="2">-</td><td>-</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7">The Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity programme will give students the chance to experience real-world organisational situations, learn about processes and rules, and grasp the operations of the industry.</td></tr>
<tr><td colspan="9">Learning Objectives</td></tr>
<tr><td>C1</td><td colspan="8">The main goal of the Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity programme is to give students exposure to industry and help them comprehend current management techniques by having them work for at least fifteen days in an industry/institution over the summer.</td></tr>
<tr><td>C2</td><td colspan="8">To comprehend how theoretical ideas are applied in many sectors and industries.</td></tr>
<tr><td>C3</td><td colspan="8">To create a foundation for industry-integrated education, as well as to give students better practical knowledge and hands-on experience, improve their leadership qualities, and sharpen their problem-solving and management skills.</td></tr>
<tr><td>C4</td><td colspan="8">The Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity must focus on practice. The college will require the students to visit the offices of the research lab/industry/institution it has a memorandum of understanding (MOU) with in order to receive on-the-job training in the many different areas of those businesses' operations.</td></tr>
<tr><td>C5</td><td colspan="8">Internship / Field Visit / Industrial Visit / Research Knowledge Updating activities provide students with practical experience in a variety of fields, including manufacturing, productivity, development, and quality analysis. These experiences prepare students for competitive hiring processes in reputable MNC industries.</td></tr>
<tr><td>UNIT</td><td colspan="8">CONTENTS</td></tr>
<tr><td>I</td><td colspan="8">Guidelines for Internship/ Field Visit / Industrial Visit / Research Knowledge Updating Activity Programme:
1. To give students the opportunity to spend few days on their own during the II Semester vocation / in order to acquire exposure to research labs, industry, and respected institutions and comprehend contemporary research procedures.
2. Individual instruction is provided for the Internship / Field Visit / Industrial Visit /</td></tr>
</table>

	Research Knowledge Updating activity. The Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity programme must be completed in order to receive a credential. 3. Students are required to identify a research labs /industry/ recognized institution for their ***Internship / Field Visit / Industrial Visit / Research Knowledge Updating Activity Programme Coordinator in consultation with and approval of their faculty guide***. The choice of the research labs/industry/recognized institution should be intimated to the Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity coordinator before commencement of the Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity. Simultaneously, students should also have identified a guide within the research labs/industry/recognized institution (industry guide) under whose supervision and guidance they would carry out their Internship / Field Visit / Industrial Visit / Research Knowledge Updating Activity Program. 4. Students are expected to learn about the history of the research labs, industry, and recognized institution during their time. They must also learn about its founders or shareholders, the nature of business, organizational structure, reporting relationships, and how the various management functions (such as finance, HR, marketing, sales, and operations) operate. This list is merely illustrative and not comprehensive. Students should collect and gather as much as possible of written materials, published data, and related matter. *5.* Before leaving the research labs/industry/recognized institution, obtain the Internship / Field Visit / Industrial Visit / Research Knowledge Updating Activity Programme completion certificate on the letterhead of a research lab/industry/, or ***an accredited institution.*** 6. Maintain Internship / Field Visit / Industrial Visit / Research Knowledge Updating Activity Programme record with details on activities and personal learning during their project period. ***7. The department head and the coordinator of the Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity programme form a committee to ensure that the Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity is followed.*** 8. ***At least two copies of the report*** must be prepared by the intern at the conclusion of the Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity programone for submission to the college and one copy for the student. If the organization, the guide, or both request additional copies, more copies may be made. The sources from which the information was gathered should be made crystal apparent in the report. *Every page needs to have a number, which should be centred at the bottom of the page. All tables, figures, and appendices must be appropriately labelled and consecutively numbered or lettered. The report must be printed, bound*

	(ideally with soft binding), and contain at least 25 pages. 9. The Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity training report should be submitted to the department within a month from the date of commencement of third semester. However, such submission shall not be accepted after the end of third semester Examinations.
2	**Guidelines to field visits (during Third semester)** 1. Students are required to complete at least three field visits from the following options i. One - Central Research Institute/ State Agriculture Research Institute ii. One – Nationally recognized Herbarium/Botanical Garden/ Museum relevant to Botany iii. One – Sanctuary/ Biosphere reserve/National Park The field visit completion certificate should be signed by the Principal, HOD and Programme Coordinator.
3	**Guidelines to industrial visits (during Third semester)** ➢ Students are required to complete at least three industrial visits ➢ The visiting companies shall be relevant and suitable ones according to the specialization and academic requirements. ➢ Industrial visit shall fall within the stipulated period set by the Department. ➢ Students should apply to HoD well in advance to enable to go through a diligent process including communicating to the potential companies and obtaining permission to visit. ➢ Participating students must be given an undertaking that they will abide by the rules and guidelines throughout the industrial visit. ➢ Students undergoing Industrial visit should compulsorily carry college ID card. ➢ The heads of department should also ensure prior permission for the industrial visit and gain written permission from one of the parents or the local guardian for each student. ➢ It is compulsory that all students must submit a detailed report to the department. After the completion of the visit, the signed Letter of Intent and the report of the visit with a GIS photograph needs to be submitted to the Industrial Visit Coordinator.
4	**Guidelines for Research Knowledge Updating Activity Programme** ➢ Students should undergo training in any research topic for a specific field of interest relevant to Botany. Student does some research work on the topic. ➢ Based on his/her training/knowledge obtained, the student should publish a paper in a reputed journal and present one paper at the national/international seminar. ➢ Students should participate at least two national/international level seminars/conferences/workshops. The Research knowledge updating activity programme completion certificate should be

	signed by the Principal, HOD and faculty in-charge.
II	**Evaluation of the Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity:** i. The Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity program will be assessed by the assigned Internship / Field Visit / Industrial Visit / Research Knowledge Updating Activity Programme Coordinator from the host institute. ii. Evaluation will be done by the Internship / Field Visit / Industrial Visit / Research Knowledge Updating Activity Programme Coordinator of the host institute and through seminar presentation/viva-voce. iii. The presentation should be specific, clear and well analyzed, and indicate the specific sources of information. According to the statement of the draft the evaluation of the interns will be done as per the sincerity and research output of the students. In addition, the evaluation will also be assessed according to the activity of the log book, format of presentation, quality of the report made by the interns, uniqueness, skill sets and evaluation report of the Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity coordinator.
III	**College Guide Manual – Summer Internship / Field Visit / Industrial Visit / Research Knowledge Updating Activity Program** 1. The Internship / Field Visit / Industrial Visit / Research Knowledge Updating Activity Programme Coordinator should give proper procedures to the intern before and after the Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity. 2. The Internship / Field Visit / Industrial Visit / Research Knowledge Updating Activity Programme Coordinator should interact with the research labs/industry/recognized institution at least once before completion of the Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity. The weekly report submitted by the student should be reviewed and reported to the Internship / Field Visit / Industrial Visit / Research Knowledge Updating Activity Programme coordinator.
IV	**Internal:**50 marks Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity Programme Completion certificate -10 marks Attendance/ documentation in field/observation note book –10 marks Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity report - 10 marks Basic knowledge and Presentation Skills - assessed by group discussion with their classmates - 10 marks Topic of Interest/ lab involvement and record/ Experimentation/data collection- 10 marks

	External: 50 Marks Powerpoint presentation – 20 marks Knowledge, Attitude - 10 marks Completion certificate and report with GIS photographs – 10 marks Discussion/Viva-voce - 10 marks
V	**CONTENTS OF THE REPORT** Title page Page for Supervisory Committee Declaration by student Acknowledgement Internship / Field Visit / Industrial Visit / Research Knowledge Updating Activity Certificate **Executive Summary** Introduction of the Report Overview of the Organization What I have Learned Analyses (GPS Photographs showing date and time should attached) Summary Recommendations and Conclusion References Appendices

Course outcomes: On completion of this course, the students will be able to: **CO**	**Programme outcomes**
1. For students in those pertinent core areas, the Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity is preparing them to become professionals after graduation.	K1
2. Compile data and familiarize yourself with techniques for planning and carrying out tests.	K2
3. Collect data and educate yourself on how to analyze the results of your scientific studies.	K3& K5
4. This in-the-moment industrial exposure helps them become more knowledgeable and skilled in the latest technology.	K4
5. Improving communication skills and coming up with creative ideas are crucial components of training that help someone become an entrepreneur.	K5 & K6

Extended Professional Component (is a part ofinternal component only,not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/TRB/NET/UGC–CSIR/ GATE/TNPSC/others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Text:
1. Dawson, C. 2002. Practical research methods. UBS Publishers, New Delhi. 2. Stapleton, P., Yondeowei, A., Mukanyange, J., Houten, H. 1995. Scientific writing for agricultural research scientists – a training reference manual. West Africa Rice Development Association, Hong Kong.

Mapping with Programme Outcomes:

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

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

II YEAR – IV SEMESTER

CORE XVI - PLANT PHYSIOLOGY AND PLANT METABOLISM

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">PLANT PHYSIOLOGY AND PLANT METABOLISM</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">CORE - XVI</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours Per week</td><td>Lecture</td><td colspan="3">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>3</td><td colspan="3">2</td><td colspan="2">-</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7">Basic knowledge on physiological processes in plants.</td></tr>
<tr><td colspan="2" rowspan="5">Learning objectives</td><td colspan="7">1. To acquire knowledge on the functional aspects of plants.</td></tr>
<tr><td colspan="7">2. To understand the biophysical and biochemical processes of plants.</td></tr>
<tr><td colspan="7">3. To study the metabolism of plants.</td></tr>
<tr><td colspan="7">4. To learn the plant growth regulations.</td></tr>
<tr><td colspan="7">5. To know the adaptive mechanisms of plants in adverse environmental conditions.</td></tr>
<tr><td>UNIT</td><td colspan="8">CONTENTS</td></tr>
<tr><td>I</td><td colspan="8">Water Relations: Physical and chemical properties of water – Components of water potential - Plasmolysis - Apoplast and Symplast concept - water transport through the xylem — Transpiration - stomatal structure and function – mechanism of stomatal movement – antitranspirants - mineral nutrition – essential nutrients – macro and micro nutrients – deficiencies and plant disorders –translocation of solutes – pathways and mechanisms. Phloem loading and unloading</td></tr>
<tr><td>II</td><td colspan="8">Photosynthesis: The physical nature of light – the absorption and fate of light energy – absorption and action spectra- Ultrastructure of Chloroplast; Photosynthetic Electron Transport and Photophosphorylation (cyclic and noncyclic): Light Harvesting complexes - Photosystem I & II and Oxidation of Water; Chemiosmosis theory - Carbon metabolism: C3, C4 and CAM pathways and their distinguishing features - photorespiration and its significance.</td></tr>
<tr><td>III</td><td colspan="8">Plant respiration – Glycolysis – TCA cycle– Electron Transport – oxidative phosphorylation and ATP synthesis - Pentose Phosphate Pathway – Respiration and its significance in crop improvement. Nitrogen fixation (Biological - symbiotic and non-symbiotic), Physiological role of nitrogen fixation</td></tr>
<tr><td>IV</td><td colspan="8">Growth and development – Phases of plant growth – growth types- Growth substances - Auxins, gibberellins, cytokinins, abscisic acid, ethylene, brassinosteroids - physiological effect and mechanism of action in agricultural and horticultural crops –Photoperiodism – classification of plants and mechanism of flowering – Phytochrome and their action on flowering – Vernalization- Mechanism and its practical application, biological rhythms. Movements in plants. Seed dormancy and causes and seed germination and their biochemical changes. Plant senescence –Types and mechanism of senescence-</td></tr>
<tr><td></td><td colspan="8">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</td></tr>
</table>

V	salinity- Adaptive mechanism to various stresses (avoidance, escape, tolerance)– stress responsive proteins – anti-oxidative mechanism.

Course Outcomes

CO	Course outcomes – on completion of this course, the students will be able to	Programme outcomes
CO 1	Relate understand properties and importance of water in biological system, nutrients and its translocation.	K1, K2 K3
CO 2	Demonstrate the importance of light in plant growth and the harvest of energy.	K1, K2 K5, K6
CO 3	Explain the energy requirement and nitrogen metabolism.	K1, K2 K3, K4
CO 4	Compare the various growth regulators that influence plant growth.	K1, K2 K3, K4
CO 5	Discuss the senescence and plant response to environmental stress.	K1, K2 K3, K5
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill	

Recommended texts

1. Gauch, H.G.1972. Inorganic Plant Nutrition. Hutchinson & Dowd. New York.
2. Govindji. 1982. Photosynthesis. AP. New York.
3. Jacob, W.P. 1979. Plant Hormones and Plant Development. Cambridge University Press. Cambrigde
4. Khan, A.A. 1982. The Physiology and Biochemistry of Seed development, Dormancy and Germination. Elesiver. Amsterdam.
5. Salisbury, F. B.C.W. Ross.1991. Plant Physiology. Wassworth Pub. Co. Belmont.
6. Ting, I.P. 1982.Plant Physiology. Addison Wesley Pb. Philippines.
7. Sage, R and R.K. Monson (eds). 1999. The Biology of C4 Plants AP New York.
8. Postgate, J. 1987. Nitrogen Fixation. 2nd Edition Cassel, London.
9. Lincoln Taiz, Eduardo Zeiger, Ian Max Moller and Angus Murphy. 2015. Plant Physiology. 6th Ed., Sinauer Associates.
10. Stacey, G.R.H. Burris and Evans, H.J. 1992. Biological Nitrogen Fixation. Chapman and Hall, New York
11. Mann, J. 1987. Secondary Metabolism Clarendron Press, Oxford.
12. Jain, V.K. 2017. Plant Physiology, S.Chand & Company Ltd. New Delhi.

13. Lincoln, T, Eduardo, Z, Ian Max, M, and Angus, M. 2018. Fundamentals of Plant Physiology. Sinauer Associates Inc., US.
14. Pandey, N.S and Pandey, P. 2016. Textbook of Plant Physiology. Daya Publishing House, New Delhi.
15. Taiz, L. Zeiger, E., Moller, I.M and Murphy, A. 2015. Plant Physiology and Development 6th Edition. Sinauer Associates, Sunderland, CT.
16. Guowei Li Veronique Santoni ChristopheMaurel. 2014. Plant aquaporins: Roles in plant physiology. Biochimica et al. Biophysica Acta (BBA) - General Subjects Volume 1840, Issue 5, Pages 1574-1582.

Reference Books

1. Bidwell, R.G.S. 1974. Plant Physiology, Macmillan Publisher, Boston.
2. Devlin, R.M. 1996. Plant Physiology, PWS publisher, Boston.
3. Jain, V.K. 2017. Fundamentals of Plant Physiology. Chand & Company Ltd., New Delhi.
4. Gontia. 2016. A textbook of Plant Physiology. Satish Serial publishing House, New Delhi.
5. Leopold, A.C, 1994. Plant Growth and Development, McGraw Hill, New York.
6. Lincoln Taiz et al., 2014. Plant Physiology and Development. Sinauver Associates Inc. Publishers, Sunderland, Massachusetts.
7. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (2nd Edition). SpringerVerlag, New York, USA.
8. Noggle, R.G and Fritz, G.J. 2010. Introductory Plant Physiology, PHI Learning Pvt Ltd, New Delhi.
9. Park S. Nobel. 2005. Physicochemical and Environmental Plant Physiology. Elsevier Academic Press, New York.
10. Panda, S.K, 2005. Advances in Stress Physiology of Plants. Scientific Publishers India, Jodhpur.
11. Salisbury, F.B and Cleon Ross, 2007. Plant Physiology, Wadsworth Publishing Company, Belimont.
12. Shinha. R.K. 2007. Modern Plant Physiology. Ane Books India, New Delhi.
13. William G. Hopkins, 1999. Introduction to Plant Physiology, John Wiley and sons, INC, New York.
14. Heldt, H.W. 2005. Plant Biochemistry, 3rd Edition. Elsevier Academic Press

Web resources

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

Mapping with Programme Outcomes:

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

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

CORE XVII - BIOCHEMISTRY & APPLIED BIOTECHNOLOGY

Title of the Course		**BIOCHEMISTRY & APPLIED BIOTECHNOLOGY**					
Paper Number		**Core - XVII**					
Category	**Core**	**Year**	**II**	**Credits**	**5**	**Course Code**	
		Semester	**IV**				
Instructional Hours Per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		3	**2**		**-**	**5**	
Pre-requisite		Basic knowledge on primary and secondary plant metabolites and enzymes. To empower students recognize and appreciate the basic principles that sustain biotechnology as an interdisciplinary domain of learning and research.					
Learning Objectives		1. To study the fundamentals and significance of Plant Biochemistry.					
		2. To know the structure and properties of plant biomolecules.					
		3. To learn the fundamental and applications of Plant Biotechnology.					
		4. To study the mechanism of enzyme action and inhibition.					
		5. To expose the students on the fundaments of genetic transformation.					

UNIT	CONTENTS
I	Atomic structure: chemical bonds - ionic bond, covalent bond, coordinate covalent bond, hydrogen bond, hydrogen ion concentration (pH), buffers, acids and bases. Thermodynamics principle, First Law of Thermodynamics a) energy (b) Enthalpy (ii) second law of thermodynamics (a) Spontaneity and disorder (b) entropy (c) free energy, redox potential, dissociation and association constant, activation energy, binding energy. Electromagnetic spectrum, Fluorescence, Phosphorescence, Bioluminescence.
II	Classification of carbohydrates; Structure and properties of monosaccharides, Oligosaccharides, Polysaccharides – Glycoproteins. Protein and Amino acids: Structure, Classification and properties; Peptides - Structure: Primary, secondary, tertiary and quaternary structures. Classification of Lipids: Structure and properties of fatty acids, phospholipids, glycolipids, lipoproteins, cholesterol - functions.
III	Enzymes- Classification and nomenclature chemical nature of enzymes – factors affecting enzyme action – Michaelis – Menton constant, MM equation, Enzyme inhibition, co enzymes- mechanism of enzyme action, isoenzymes. Secondary metabolites: Structure, classification and properties of alkaloids, steroids, terpenoids, flavonoids, glycosides - their role.
IV	Selection and characterization of transgenic plants using selectable and reportable markers; PCR; qRT-PCR; Southern, Northern, ELISA and Western techniques; *Agrobacterium tumefaciens* mediated and biolistic plant transformation; Virus and Bacteria based transient gene expression systems. Virus induced gene complementation, induced gene silencing. Cytoplasmic male sterility and fertility restoration, terminator Seed technology, antisense technology for delayed fruit ripening, Plants as factories for useful products and pharmaceuticals.
	Screening of Biotransformants - Fermentation techniques - Types. Industrial production

V	of enzymes-amylase, protease & lipase and their applications. Immobilization for enzymes production. Antibiotic Penicillin production. Amino acid - Glutamic acid production. Production of Alcohol and Xanthan Gum. Bioreactors for culturing plant cells and production of secondary metabolites. Bioremediation - *In situ* and *ex situ*.

Course Outcomes

CO	on completion of this course, the students will be able to	**Programme outcomes**
CO 1	Knowledge on the fundamentals and significance of Plant Biochemistry	K1
CO 2	Understanding on the structure and properties of plant biomolecules.	K2
CO 3	Explain the role of enzymes in plants.	K3
CO 4	Compare and contrast the methods of transgenic plants production and natural plants.	K4
CO 5	Discuss and develop skills for effective utilization of microbial/plant enzymes and their role in biological cells	K5 & K6
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill	

Recommended Text:

1. Satyanarayana, U and chakrapani, U. 2005. Biochemistry, Books and Allied (P) Ltd. Calcutta.
2. A.L. Lehninger, D.L. Nelson & M.M. Cox. 1993. Principles of Biochemistry. Worth Publishers, New York.
3. Stryer, L. 1994. Biochemistry. Freeman & Co, New York.
4. Zubay, G. 1988. Biochemistry. 1988 Macmillan Publishing Co, New York.
5. Harold, F.M. 1986. The vital force: A study of Bioenergetics. Freeman & Co, New York.
6. Jain, J.L. 2005. Fundamentals of Biochemistry. S. Chand & Co. New Delhi.
7. Lehninger, A.L. 1982. Principles of biochemistry, CBS Publication. Halford, N. 2015. Plant Biotechnology: Current and Future Applications of Genetically Modified crops, John Wiley and Sons.
8. Kumar, Pradeep. 2018. Advances in Microbial Biotechnology: Current Trends and Future Prospects. 10.1201/9781351248914.

Reference Books

1. Bonner, J. and Warner, W.H. 1961. Plant Biochemistry. Academic Press. Inv. New York.
2. Gupta, S.N. 2016. Biochemistry Rastogi Publications, Meerut.
3. Satyanarayana, U. and Chakkrapani, U. 2013. Biochemistry. Elsevier India Pvt. Ltd & Books Allied Pvt. Ltd, New Delhi.

4. Nelson, D.L. and Cox, M.M. 2017. Lehninger's Principles of Biochemistry, Prentice Hall, International N.J, 7th Edition.
5. Heldt, H-W. 2005. Plant Biochemistry, 3rd Edition. Elsevier Academic Press.
6. Buchanan, B.B., Grissem, W. and Jones, R.L. 2000. Biochemistry and molecular biology of plants. 5th Edition. Wiley-Blackwell.
7. Jain, J.L., Jain, S. and Jain, N. 2016. Fundamentals of Biochemistry. Chand Publishing, New Delhi.
8. Chawla, H.S. 2009. Introduction to Biotechnology, 2nd edn. Oxford IBH, ISBN:978-81-204-1732-8.
9. Halford, N. 2015. Plant Biotechnology: Current and Future Applications of Genetically Modified Crops, John Wiley and Sons.

Web sources:

1. http://priede.bf.lu.lv/grozs/AuguFiziologijas/Augu_biokimija/Plant%20Biochemistry 204.pdf
2. http://www.brainkart.com/subject/Plant-Biochemistry_257/
3. https://swayam.gov.in/nd2_cec20_bt12/preview
4. https://www.biorxiv.org/content/10.1101/660639v2
5. https://www.scribd.com/document/378882955/
6. https://nptel.ac.in/courses/102/107/102107075/
7. https://plantae.org/plant-physiology-top-articles-of-2020-based-on- altmetric-scores/
8. https://britannica.com/technology/biotechnolog/
9. https://manavrachna.edu.in/blog/scope-of-biotechnology/

Mapping with Programme Outcomes:

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

S-Strong (3) M-Medium (2) –Low (1)

CORE XVIII - LABORATORY COURSE 7

Title of the Course		**LABORATORY COURSE 7 Covering Core paper XVI**					
Paper Number		**CORE XVIII**					
Category	**Core**	**Year**	**II**	**Credits**	**2**	**Course Code**	
		Semester	**IV**				
Instructional Hours Per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**		
		-	**-**	**2**	**2**		
Pre-requisite		Practicals pertaining to above subjects are important to get knowledge on various physiological functions of plants.					
Learning Objectives		1. Extract bimolecule of diverse nature from different sources so that they will be able to assess the metabolic profile of their source material.					
		2. Recognize the role that water plays in several physiological processes in plants.					
		3. To learn the fundamental and applications of Plant Biotechnology.					
		4. Learn about chromatographic techniques.					
		5. Expose the students to gain recent advances in molecular biology.					

UNIT	EXPERIMENTS
I	1, Determination of water potential using gravimetric method. 2. Effect of pH on protoplasmic membrane. 3. Effect of detergent on protoplasmic membrane.3.
II	1. Separation of chloroplast pigments using column chromatographic technique. 2. Experiment to study the rate of Hill activity of isolated chloroplast by dye-reduction. 3. Extraction and determination of chlorophyll a /chlorophyll b ratio in C3 and C4 plants.
III	1. Colorimetric estimation of starch 2. Estimation of proline in stressed and non-stressed leaf samples 3. *In vivo* assay for nitrate reductase in C3 and C4 leaf tissues
IV	**Demonstration experiments** 1. Dilatometer 2. Potato Osmoscope 3. Measurement of root pressure 4. Four leaf experiment 5. Thistle funnel experiment 6. Arc auxanometer
V	**Spotters –** Photographs/diagrams 1. Avena curvature test, Bolting effect, Munch hypothesis, Emerson red drop/ enhancement effect, action and absorption spectrum 2. Movements in plants – Thigmotropism, Phototropism, Seismonastic, Thigmonastic, Photonastic

Course outcomes

CO	on completion of this course, the students will be able to	Programme outcomes
CO 1	Perform quantitative tests for photosynthetic pigments	K1
CO 2	Develop skill on the plant physiology experimental analysis	K2
CO 3	Understanding on the basic principles of physiology by doing demonstration experiments	K1 & K3
CO 4	Got hands on training on the chromatographic technique	K4
CO 5	Evaluate the theory and practical skills gained during the course and create idea to seek for suitable job in relevant industries	K5 & K6

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended texts

1. Bendre, A.M. and Ashok Kumar, 2009. A textbook of practical Botany. Vol.I & II. Rastogi Publication. Meerut. 9th Edition.
2. Manju Bala, Sunita Gupta, Gupta NK. 2012. Practicals in Plant Physiology and Biochemistry. Scientific Publisher.
3. 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.
4. Singh, A.K Anand Kumar Pandey and Ankit Singh 2020 Laboratory Manual of Plant Physiology AkiNik Publications, 169, C-11, Sector-3, Rohini-110085, New Delhi, India.
5. Samaiya Subrata Sharma R. K., Gyanendra Tiwari, R. Shivraj krishnan, Sunil Pandey, Preeti Sagar Nayak 2022 A Practical Manual on Fundamentals of Plant Physiology BFC Publications Pvt. Ltd CP – 61, Viraj Khanad, Gomti Nagar, Lucknow, UP 226010.

Reference books:

1. Rajesh Kumar Asok Kumar Bera, Bandana Bose (2023) PG Practical Manual Experimental Plant Physiology and Biochemistry Manual Jain Brothers 16/873, East Park Road, Karol Bagh, Near Dr. N.C. Joshi Hospital, New Delhi-110 005
2. Bala, M., Gupta, S., Gupta, N.K and Sangha, M.K. 2013. Practicals in plant physiology and biochemistry. Scientific Publishers (India).
3. Bendre, A. M and Ashok Kumar. 2009. A textbook of Practical Botany. Vol. I & II. Rastogi Publication. Meerut. 9th Edition.

Web resources

1. https://www.amazon.in/Laboratory-Manual-Physiology-Mukesh-Amaregouda/dp/6133993502
2. https://www.kopykitab.com/A-Laboratory-Manual-of-Plant-Physiology-Biochemistry-and-Ecology-by-Akhtar-Inam
3. https://www.srcollege.edu.in/temp/lms/Manuals/Practical-IV.pdf
4. https://www.rlbcau.ac.in/pdf/Forestry/FBT-111%20%20Plant%20Physiology.pdf
5. https://jru.edu.in/studentcorner/lab-manual/agriculture/Fundamentals%20of%20Crop%20Physiology.pdf
6. https://www.google.com/search?q=plant+physiology+practical+manual+pdf&oq=PLANT+PHYSIOLOGY+PAFACTICA%3B&aqs=chrome.1.69i57j0i13i512l3j0i13i30j0i8i13i30j0i390i512i650l4.15177j0j15&sourceid=chrome&ie=UTF-8#ip=1

Mapping with Programme Outcomes:

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

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

CORE XIX - LABORATORY COURSE 8

Title of the Course		**LABORATORY COURSE - 8 Covering Core paper XVII**					
Paper Number		**CORE XIX**					
Category	**Core**	**Year**	**II**	**Credits**	**2**	**Course Code**	
		Semester	**IV**				
Instructional Hours Per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		-	**-**		**2**	**2**	
Pre-requisite		Practicals pertaining to above subjects are important to get knowledge on various physiological functions of plants.					
Learning Objectives		1. Extract bimolecule of diverse nature from different sources so that they will be able to assess the metabolic profile of their source material.					
		2. Recognize the role that water plays in several physiological processes in plants.					
		3. To learn the fundamental and applications of Plant Biotechnology.					
		4. Learn about chromatographic techniques.					
		5. Expose the students to gain recent advances in molecular biology.					

UNIT	EXPERIMENTS
I	1. Preparation of normal (NaOH), percentage (NaCl, HCl), ppm (NaCl) and molar (NaOH, Sucrose) solutions 2. Preparation standard graph for protein, sugar and amino acids 3. Estimation of protein content by Lowry method 4. Estimation of amino acids by ninhydrine method
II	1. Estimation of sugar by anthrone method 2. Estimation of total phenol content by Folin Ciocalteu Method 3. Estimation of flavonoid 4. Estimation of ascorbic acid
III	1. Extraction of caffeine from coffee 2. Separation of amino acids using paper chromatographic technique. 3. Separation of lipids by TLC 4. Determination of saponification number of edible oil
IV	**Spotters** 1. Ssecondary, tertiary and quaternary structures of protein 2. Michaelis–Menten kinetics, pH scale 3. Images of chemical bonds, Fluorescence, Phosphorescence 4. Mechanism of enzyme action – lock and key hypothesis, induced fit theory
V	**Spotters** 1. Study of basic equipments used in biotechnology laboratory – Hot air oven, Laminar air flow chamber, PCR, Refrigerated centrifuge, Transilluminator, Autoclave, Gel-Doc, Fermenter 2. *Agrobacterium tumefaciens* mediated transformation of plants 3. Biolistic gene gun method of plant transformation

	4. Cytoplasmic male sterility, antisense technology.

Course outcomes

CO	on completion of this course, the students will be able to	Programme outcomes
CO 1	Knowledge on the fundamentals and significance of Plant Biochemistry	**K1**
CO 2	Understanding on the structure and properties of plant biomolecules.	**K2**
CO 3	Explain the role of enzymes in plants.	**K1&K3**
CO 4	Compare and contrast the methods of transgenic plants production and natural plants.	**K4**
CO 5	Discuss and develop skills for effective utilization of microbial/plant enzymes and their role in biological cells	**K5 & K6**

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Text:

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

Reference books

1. Bala, M., Gupta, S., Gupta, N.K and Sangha, M.K. 2013. Practicals in plant physiology and biochemistry. Scientific Publishers (India).
2. Wilson, K and J. Walker (Eds). 1994. Principles and Techniques of Practical Biochemistry (4^{th} Edition) Cambridge University Press, Cambridge.
3. Bendre, A. Mand Ashok Kumar. 2009. A textbook of practical Botany. Vol.I & II. Rastogi Publication. Meerut. 9^{th}Edition.
4. Wilson, K and J. Walker. 2005. Principles and Techniques of Practical Biochemistry, 5^{th} Edition. Cambridge University press, New York.
5. Rodney Boyer. 2000. Modern Experimental Biochemistry, 3^{rd} Edition. Published by Addison Wesley Longman. Singapore.
6. Glick, B.R and J.E. Thompson. 1993. Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boca Raton, Florida.
7. Glover, D.M and B.D. Hames (Eds). 1995. DNA cloning 1: A Practical Approach; Core Techniques, 2nd edition PAS, IRL press at Oxford University Press, Oxford.
8. Hackett, P.B. and J.A. Fuchs, J.W. Messing. 1988. An Introduction to Recombinant DNA Techniques: Basic Experiments in Gene Manipulation. The Benjamin/ Cummings Publishing Co., Inc Menlo Park, California. 8. Hall, RD. (Ed).1999. Plant Cell Culture Protocols. Humana Press, New Jersey.
9. Gelvin, S.B., Schilperoort, R.A. (Eds.). 2000. Plant Molecualr Biology Manual.

Web resources:

1. file:///C:/Users/User/Downloads/2021%20Botany%20Syllabus%20after%20BoS%20formatted1%20(1).pdf
2. https://kau.in/document/laboratory-manual-biochemistry
3. https://www.amazon.in/Practical-Manual-on-Plant-Biochemistry/dp/6200539790
4. https://www.kopykitab.com/A-Laboratory-Manual-of-Plant-Physiology-Biochemistry-and-Ecology-by-Akhtar-Inam
5. https://www.kopykitab.com/Cell-And-Molecular-Biology-A-Lab-Manual-by-K-V-Chaitanya

Mapping with Programme Outcomes:

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

CO4	3	3	3	3	3	2	3	3	3	3
CO5	3	3	2	3	2	3	3	3	3	3

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

CORE XX – PROJECT with VIVA-VOCE

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">PROJECT with VIVA-VOCE</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE XX</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours Per week</td><td colspan="6">Total</td></tr>
<tr><td colspan="6">8</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">To allow students to demonstrate the personal abilities and skills required to produce and present an extended piece of work and as well as to practice writing thesis.</td></tr>
<tr><td colspan="2" rowspan="5">Learning Objectives</td><td colspan="6">1. To recognize the concept of research and its various forms in the context of botany.</td></tr>
<tr><td colspan="6">2. To improve abilities relating to scientific experiments.</td></tr>
<tr><td colspan="6">3. To become proficient in data collection and the documentation of scientific findings.</td></tr>
<tr><td colspan="6">4. To prepare students for entry-level positions or professional training programmes in any field of Botany.</td></tr>
<tr><td colspan="6">5. Compare the various reporting and writing styles used in science.</td></tr>
<tr><td></td><td colspan="7">GENERAL GUIDELINES</td></tr>
<tr><td></td><td colspan="7">1. Each student will be allotted a Project Guide from the faculty of the department concerned by lot method.
2. The topic of the dissertation shall be assigned to the candidate before the beginning of third semester.
3. After the completion of the project work, the student has 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.
4. Project work will be evaluated by both the external and the internal (Project Guide) examiners for the maximum of 100 marks in total on the scale of the maximum of 50 marks for the internal and the external each.
5. 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 50 marks for the internal and the external each.</td></tr>
<tr><td></td><td colspan="7">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.
PROJECT EVALUATION GUIDELINES:
The project is evaluated on the basis of following heads:
For Viva-Voce maximum is 50 marks which will be conducted by both the internal and external examiners during end semester university practical examinations.
Internal: 50 marks
I Review – Selection of the field of study, topic and literature collection - 15 marks</td></tr>
</table>

	II Review – Research design and data collection - 20 marks III Review – Analysis and conclusion, preparation of rough draft – 15 marks **External:** 50 marks ***Evaluation of project report (30 marks)*** Originality of the approach - 10 marks Neat presentation of report – 10 marks Results and Discussion – 10 marks ***Division of marks for viva (20 marks)*** Knowledge on the content - 10 marks Viva-voce - 10 marks
	Suggested areas of work: 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.
	Methodology: **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

Course outcomes

CO	on completion of this course, the students will be able to	Programme outcomes
CO 1	For students in those pertinent core areas, the project is preparing them to become professionals after graduation	K1
CO 2	Compile data and familiarize yourself with techniques for planning and carrying out tests	K2
CO 3	Collect data and educate yourself on how to evaluate the analyzed results of your scientific studies	K3 & K5
CO 4	In-the-moment industrial exposure helps them become more knowledgeable and skilled in the latest technology.	K4
CO 5	Improving communication skills and coming up with creative ideas are crucial components of training that help someone become an entrepreneur	K5 & K6
Extended Professional Component (is a part of internal component only, Not to be	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET /	

included in the External Examination question paper)	UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Text:

1. Wilson, Kand J. Walker (Eds). 1994. Principles and Techniques of Practical Biochemistry (4th Edition) Cambridge University Press, Cambridge.
2. Bendre, A. M and Ashok Kumar. 2009. A textbook of practical Botany. Vol. I & II. Rastogi Publication. Meerut. 9th Edition.
3. Manju Bala, Sunita Gupta, Gupta, N.K. 2012. Practicals in Plant Physiology and Biochemistry. Scientific Publisher.
4. Wilson, K and J. Walker. 2005. Principles and Techniques of Practical Biochemistry, 5th Edition. Cambridge University press, New York.
5. Rodney Boyer. 2000. Modern Experimental Biochemistry, 3rd Edition. Published by Addison Wesley Longman. Singapore.

Reference Books:

1. Dawson, C. 2002. Practical research methods. UBS Publishers, New Delhi.
2. Stapleton, P., Yondeowei, A., Mukanyange, J., Houten, H. 1995. Scientific writing for agricultural research scientists – a training reference manual. West Africa Rice Development Association, Hong Kong.
3. Ruzin, S.E. 1999. Plant microtechnique and microscopy. Oxford University Press, New York, U.S.A.
4. Wilson and Goulding. 1987. Principles of biochemical techniques, Oxford University Press.
5. Mukherji, S. and Ghosh, A.K. 2005. Plant Physiology. First Central Edition, New Central Book Agency (P) Ltd., Kolkata.
6. Taiz, L and Zeiger, E. 2010. Plant Physiology. 5th Edition. Sinauer Associates, USA.
7. Heldt, H.W and Piechulla, B. 2010. Plant Biochemistry, 4th Edition. Academic Press, NY.
8. Wilson, K and Walker, J. 2010. Principles and Techniques of Biochemistry and Molecular Biology, Seventh edition, Cambridge University Press, USA.

Web resources:

1. https://handbook.monash.edu › units › BIO3011
2. https://www.amazon.in/Practical-Manual-on-Plant-Biochemistry/dp/6200539790
3. https://www.amazon.in/Laboratory-Manual-Physiology-Mukesh-Amaregouda/dp/6133993502
4. https://www.kopykitab.com/A-Laboratory-Manual-of-Plant-Physiology-Biochemistry-and-Ecology-by-Akhtar-Inam

5. https://kau.in/document/laboratory-manual-biochemistry

Mapping with Programme Outcomes:

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

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

ELECTIVE-VI: 1. ORGANIC FARMING

Title of the Course		**ORGANIC FARMING**					
Paper Number		**ELECTIVE VI**					
Category	**Elective**	**Year**	**II**	**Credits**	**2**	**Course Code**	
		Semester	**IV**				
Instructional Hours Per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		2	**2**		**-**	**4**	
Pre-requisite		To understand the students about the organic farming.					
Learning Objectives		1. To study various aspects of organic farming.					
		2. To understand the relevance of organic farming, its advantages and short comings against conventional high input agriculture.					
		3. To know the importance of organic farming in the present scenario and its impact on environment and soil health.					
		4. Awareness on the importance of organic farming in the present scenario and its impact on environment and soil health.					
		5. Expose the students to about quality aspect and grading.					

UNIT	CONTENTS
I	**AGRONOMY:** Organic farming- concept, characteristics, significance, scope of organic farming in India - Principles and types of 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
II	**SOIL SCIENCE:** Organic farming for sustainable agriculture; Manures- compost, methods of composting - green manuring, vermicompost and biofertilizer Harmful 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
III	**FUNDAMENTAL OF ORGANIC FARM MANAGEMENT:** Land management in organic farming - Water management in organic farming. Organic insect disease management - Organic pest disease management. Preventive and cultural methods for insects and pest control - Identification of different fungal and bacterial biocontrol agents' Indigenous technical knowledge for insects-pest, disease - Weed and nutrient management in organic farming
IV	**POST HARVEST MANAGEMENT:** Processing, labelling of organic produce - Storage and transport of organic produce. Post harvest pest and diseases management
V	**ORGANIC QUALITY CONTROL STANDARDS:** Certification- types, process & procedure and agencies. Quality aspect and grading - Packaging and handling. Economic considerations and viability of organic products - Export of organic product and marketing

Course outcomes

CO	on completion of this course, the students will be able to	Programme outcomes
CO 1	Knowledge on various aspects of organic farming	K1
CO 2	Understand the relevance of organic farming, its advantages	K2
CO 3	Explain the short comings against conventional high input agriculture	K3
CO 4	Compare the packaging methods of harvest	K4
CO 5	Discuss and develop skills for post-harvest management	K5 & K6

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Text:

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

Reference books:

1. Reddy, S.R. 2019. Fundamentals of Agronomy Kalyani Publications, Uttar Pradesh
2. Tolanur, S. 2018. Fundamentals of Soil Science IInd Edition, CBS Publishers, New Delhi
3. Reddy, S.R. 2017. Principles of Organic Farming Kalyani Publishers, New Delhi
4. Dongarjal, R.P and Zade, S.B. 2019. Insect Ecology and Integrated Pest Management Akinik Publications, New Delhi.
5. Ahmad Mehraban. 2013. The Basis of Organic Fertilizers, LAP LAMBERT Academic Publishing.

Web resources

1. https://www.amazon.in/Healthy-earth-organic-Hari-prasad-ebook/dp/B08L5KFKDV
2. https://www.kobo.com/in/en/ebook/organic-farming-for-sustainable-agriculture
3. https://www.elsevier.com/books/organic-farming/chandran/978-0-12-813272-2
4. https://link.springer.com/book/10.1007/978-3-030-04657-6
5. https://www.afrimash.com/product-category/livestock-section/book/organic-farming-ebooks/

Mapping with Programme Outcomes:

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

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

ELECTIVE – VI: 2. FORESTRY AND WOOD TECHNOLOGY

Title of the Course		**FORESTRY AND WOOD TECHNOLOGY**					
Paper Number		**ELECTIVE VI**					
Category	**Elective**	**Year**	**II**	**Credits**	**2**	**Course Code**	
		Semester	**IV**				
Instructional Hours Per week		**Lecture**		**Tutorial**	**Lab Practice**	**Total**	
		2		**2**	**-**	**4**	
Pre-requisite		Prior knowledge on trees, forests and their importance.					
Learning Objectives		1. To study various aspects of Forest Botany.					
		2. To understand the importance and different forests and plants species.					
		3. To know the ecological significance of forests.					
		4. To enable the students to information on forests laws.					
		5. To raise student awareness of the need to create a sustainable way of living and the current Global issues with forestry caused by human interference.					

UNIT	CONTENTS
I	**Introduction and scope of Forest Botany** - General introduction to forests, natural and manmade. Types of forests tropical, temperate, evergreen, semi evergreen, deciduous, monoculture, multipurpose, social and industrial. Forest and climate - Forest and Biodiversity - Forest and gene conservation - Forest and ecosystem - Forest and civilization. Geographical history of the forest vegetation - natural vs. artificial. Special emphasizes on social forestry, Industrial forestry and multi-purpose forestry. Preservation of natural forestry - Pollution control.
II	**Forest genetics**, Forest physiology, forest ecology – strong interrelationships. Macro-dynamic ecosystem reserves, hydrological cycles, balance. Identification of timber plants based on vegetative features. Branching pattern - architectural models of trees. Major and minor forest products, use and misuse of forests by man, direct and indirect forest wealth, forest policies, forest protection through peoples committee.
III	**Silviculture:** 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; water cycles of forest. Photosynthetic processes in forest: nitrogen and mineral nutrition in forests.
IV	**Seed dynamics in forest:** 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.
V	**Measurement:** 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. Progress to be achieved in

	social forestry, industrial forestry and multiple forestry. Forest Laws- Indian Forest Act, 1927; Forest conservation Act. Wild Life Protection Act, 1972.

Course outcomes

CO	on completion of this course, the students will be able to	Programme outcomes
CO 1	Knowledge on various aspects of Forest Botany	**K1**
CO 2	Understand the importance and of different forests.	**K2**
CO 3	Analyze the ecological significance of forests	**K3**
CO 4	To understand the dynamics of the forest.	**K4**
CO 5	Understanding on various Indian forests laws and acts	**K5 & K6**

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

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. Natraj Publishers, 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.
8. Tiwari, K.M. 1983. Social forestry in India. Nataraj Publishers, Dehra Dun.
9. WWF. 2007. Timber identification manual. TRAFFIC, New Delhi.
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. Rao, K.R. and Juneja, K.B.S. 1992. Field identification of 50 important timbers of India. ICFRE Publi. Dehradun 123 p.
5. Avery, T.E. 1967. Forest Measurements. Mc Grand Hill Book Company, New York.
6. Manikandan K, Prabhu S. 2018. Indian Forestry A Breakthrough Approach To Forest Services, Jain Brothers.
7. Pathak, P.S, Ram Newaj. 2012. Agro forestry: Potentials and Opportunities. India Agrobios.
8. Powell, Baden B.H. 2004. Manual of Forest Law. New Delhi: Biotech.
9. Uthappa, A.R. 2015. Sangram Bhanudas Chavan, Competitive Forestry, New Vishal Publications, 1st ed.
10. Chaturvedi, A.N. and Khanna, L.S. 2015. Hand Book of Forestry (5th Edition).
11. Frederick Franklin Moon, 2018. The Book of Forestry. Repro Books.
12. Parthiban, K.T. 2018. Introduction to Forestry & Agroforestry.

Web resources:

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

Mapping with Programme Outcomes:

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

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

ELECTIVE-VI: 3. GENE CLONING AND GENE THERAPY

Title of the Course		**GENE CLONING AND GENE THERAPY**					
Paper Number		**ELECTIVE VI**					
Category	**Elective**	**Year**	**II**	**Credits**	**2**	**Course Code**	
		Semester	**IV**				
Instructional Hours Per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		2	**2**		**-**	**4**	
Pre-requisite		To know about the gene cloning and gene therapy.					
Learning Objectives		1. To give a clear knowledge of genetic engineering, cloning vectors, enzymes involved in cloning.					
		2. To understand the procedure involved in recombinant DNA technology and restriction mapping.					
		3. To focus on the application of gene cloning in plants and animals.					
		4. To enable the students to information onGene Therapy.					
		5. To raise student to create transgenic plants for hybrid seed production and molecular farming.					

UNIT	CONTENTS
I	Definition of genetic engineering, gene cloning and recombinant DNA cloning vectors: plasmids, bacteriophages, plant and animal vectors. Restriction enzymes; DNA modifying enzymes: nucleases, polymerases, phosphatases and ligases. Construction of genomic and c-DNA libraries
II	Gene cloning in prokaryotes and eukaryotes, Isolation of DNA to be cloned, insertion of DNA fragments into vector. Use of Restriction Linkers: use of Homopolyer tails, Transfer of recombinant DNA into Bacteria cell. Selection of clones.
III	Gene Therapy: Definition, Germ cell and Somatic cell. Amniocentesis in human; patient therapy, embryo therapy, Recombinant DNA technology for human insulin, Hepatitis B vaccine, Tissue plasminogen activator, clotting factor VIII
IV	Types and uses of molecular markers- RFLP; PCR based markers like RAPD, SCAR, SSR, STS, CAPS, AFLP, SNP. DNA finger printing; Gene Tagging. Physical methods of gene delivery. Gene transfer techniques. Genetic counselling – Eugenics, Euthenics.
V	Genomics: Structural genomics, microsatellite maps, cyotogenetic maps, physical maps, positional cloning, chromosome walks and jumps, Genome sequencing, genome databases, human genome sequencing project. Functional genomics. transcriptome, proteome and metabolome, Microarrays and gene-chips. Metabolomics: Identification and quantification of cellular metabolites in biological samples. Pharmacogenomics and drug designing.

Course outcomes

CO	on completion of this course, the students will be able to	Programme outcomes
CO 1	Recollect the basic concepts of gene cloning	**K1**

CO 2	Demonstrate and to identify the selection of clones	**K2**
CO 3	Acquire knowledge on the gene therapy.	**K3**
CO 4	Compare and understand the concept of gene therapy.	**K4**
CO 5	Discuss and develop skills for hybrid seed production and molecular farming.	**K5 & K6**
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill	

Recommended Text:

1. Das, H.K. 2010. Textbook of Biotechnology (4th edition). Wiley India Pvt. Ltd. New Delhi
2. Gamborg, O.L and G.C. Phillips (eds). 1995. Plants, genes and agriculture. Jones and Bartlett Publishers.
3. Verma, P.S and Agarwal V.K. 2009. Genetic Engineering. S. Chand & Co. Ltd. New Delhi
4. Kreuzer, H and A. Massey. 1996. Recombinant DNA and biotechnology. A guide for teachers. ASM Press.
5. Ramavat, K.G. 2006. Plant Biotechnology. S. Chand and Co. Ltd., New Delhi.
6. Chawla, H.S. 2009. Introduction to Biotechnology. 2nd edn. Oxford IBH, ISBN: 978-81-204-1732-8.
7. Halford, N. 2015. Plant Biotechnology: Current and Future Applications of Genetically Modified crops, John Wiley and Sons.
8. Kumar, Pradeep. 2018. Advances in Microbial Biotechnology: Current Trends and Future Prospects. 10.1201/9781351248914.
9. Thieman. 2014. Introduction to Biotechnology 3rd Edition. Pearson Education India.
10. Khan. I.A. and A. Khanum .2004. Fundamentals of Biotechnology – Forensic Science Genetic Engineering. Ukaaz publication, Hyderabad.
11. Gupta. P.K. 1998. Elements of Biotechnology. Rastogi publications, Meerut.

Reference books:

1. Smith. J.K. 1996. Biotechnology – 3rd Ed. Cambridge Univ. Press, Cambridge.
2. Slater, A. Scott, N and Fowler, M. 2008. Plant Biotechnology: The Genetic Manipulation of Plants. Oxford University Press Inc.
3. Reynolds, P.H.S. 1999. Inducible Gene Expression in Plants. CABI Publishing, U.K.
4. Chawla, H.S. 2009. Introduction to Biotechnology, 2nd edn. Oxford IBH, ISBN: 978-81-204-1732-8.
5. Halford, N. 2015. Plant Biotechnology: Current and Future Applications of Genetically Modified Crops, John Wiley and Sons.
6. Brown T.A. 2001. Gene Cloning and DNA Analysis- An Introduction (4th edition). Blackwell Science. Oxford.

7. Clark, D.P and Pazdernik, N.J. 2009. Biotechnology- Applying the Genetic Revolution. Elsevier Academic Press. USA.
8. Glick B.R and J. J. Pasternak. 2009. Molecular Biotechnology, Panima Publication Co.
9. Harisha, S. 2007. Biotechnology Procedures and Experiments Handbook. Infinity Science Press Llc. Hingham. MA.
10. Mosier N.S and Ladisch M.R. 2009. Modern Biotechnology- Connecting Innovations in Microbiology and Biochemistry to Engineering Fundamentals. John Wiley & Sons Inc. New Jersey.
11. Primrose S., Twyman R. and Old B. 2001. Principles of Gene Manipulation (6th ed.). Blackwell Science. Oxford.
12. Ignacimuthu, S.1998. Applied Plant Biotechnology. Tata Mc Graw Hill, publishing company Ltd., New Delhi.
13. Neal Stewart, Jr. 2008. Plant Biotechnology and Genetics: Principles, Techniques and Applications. JohnWiley & sons Inc.

Web resources:

1. https://www.amazon.in/Gene-Cloning-Manipulation-Christopher-Howe-ebook/dp/B000SK4YLI
2. https://www.amazon.in/Gene-Cloning-Steve-Minchin-ebook/dp/B000SHTUT2
3. https://www.futuremedicine.com/doi/book/10.2217/9781780842134
4. https://www.researchgate.net/publication/51144570_Introduction_to_Gene_Therapy_A_Clinical_Aftermath
5. https://link.springer.com/book/10.1007/978-88-470-1643-9

Mapping with Programme Outcomes:

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

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

ELECTIVE-VI: 4. FARM SCIENCES- GREEN WEALTH

Title of the Course		**FARM SCIENCES- GREEN WEALTH**					
Paper Number		**ELECTIVE VI**					
Category	**Elective**	**Year**	**II**	**Credits**	**2**	**Course Code**	
		Semester	**IV**				
Instructional Hours Per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		2	**2**		**-**	**4**	
Pre-requisite		To understand the concept of fertilizers in crop production.					
Learning Objectives		1. Understand the concept of agronomy and sustainable agriculture.					
		2. Evaluate the importance of crop management technology.					
		3. To develop their understanding on the concept of fertilizers.					
		4. Develop the integrated management for better crop production by using fertilizers.					
		5. Develop the skills for cultivation of plants and their value added processing/storage/quality control.					

UNIT	CONTENTS
I	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.
II	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.
III	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.
IV	Seed germination and viability test, Numerical exercises on fertilizer requirement, 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.
V	Harvesting, storage, physiological disorders of important vegetable crops like solanaceous fruit vegetables (brinjal & tomato), tuber crops (Potato), cucurbits (pumpkin & cucumber), pod vegetables (pea & bean), cole crops (cabbage &

	cauliflower), bulb crops (onion & garlic), root crops (radish & carrot), common leafy vegetables, spices (ginger & black pepper).

Course outcomes

CO	on completion of this course, the students will be able to	Programme outcomes
CO 1	To identify the importance of agronomy and its scope	**K1**
CO 2	Demonstrate both the theoretical and practical knowledge in weed management principles	**K2**
CO 3	Explain the methods of herbicide and fertilizer application.	**K3**
CO 4	Compare and contrast the yield estimation and water management	**K4**
CO 5	Discuss and develop skills for hybrid seed production and molecular farming.	**K5 & K6**

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Text:

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

References books:

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

Web resources:

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

Mapping with Programme Outcomes:

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

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

PROFESSIONAL COMPETENCY SKILL / SKILL ENHANCEMENT COURSE III

1. BOTANY FOR COMPETITIVE EXAMINATIONS

Title of the Course		**BOTANY FOR COMPETITIVE EXAMINATIONS** (NET/UGC-CSIR/SET/TRB/UPSC/TNPSC/other competitive examinations)					
Paper Number		**Skill enhancement 3**					
Category	**Skill Enhancement**	**Year**	**II**	**Credits**	**2**	**Course Code**	
		Semester	**IV**				
Instructional Hours Per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		2	**2**		**-**	**4**	
Pre-requisite		To understand the concept of skill enhancement.					
Learning Objectives		1. Competitive examinations syllabus shall introduce the concepts of breadth and depth in learning.					
		2. Shall produce competent plant biologists who can employ and implement their gained knowledge in basic and applied aspects that will profoundly influence competitive ability.					
		3. Will increase the ability of critical thinking, development of scientific attitude, handling of problems and generating solutions.					
		4. Students will make them competent enough for doing jobs in Govt. and private sectors of academia, research and industry along with preparation for national competitive examinations					
		5. Students will be able to contribute research in the field of plant sciences.					

UNIT	CONTENTS
I	**Microbiology:** Structure and reproduction of viruses, bacteria and fungi. Applications of microbes in agriculture, industry, medicine and in control of water pollution. **Plant Pathology:** Important crop diseases caused by viruses, bacteria, mycoplasma, fungi and nematodes with special reference to India; Classification of Plant Diseases Structural and biochemical host defense mechanisms; **Economic Botany** (Botanical name, family, useful part and uses): cereals, fibre yielding plants, plantation crops, sugar yielding plants, narcotics, vegetables, oil yielding plants, pulses, beverages and minor forest products - resins, gums, tannin and rubber yielding plants,
II	**Cryptogams:** Algae, fungi, lichens, bryophytes, pteridophytes - structure and reproduction and economic importance. **Phanerogams:** Gymnosperms: structure, reproduction and economic importance; Geological time scale; Type of fossils and their study techniques. Angiosperms: International Code of Botanical Nomenclature; Origin and evolution of angiosperms, natural and phylogenetic systems of classification.
III	**Cell Biology:** Ultrastructure of cell - cell wall, plasma membrane, chloroplast, endoplasmic reticulum, mitochondria, lysosomes, flagella and nucleus. Cell division – mitosis, meiosis and their significance; Chromosome – morphology, fine structure, Types – giant chromosome, Isochromosome **Bio-chemistry:** Chemistry of carbohydrates, proteins, amino acids and lipids - structure, properties and classification. Nucleic acids – structure and properties, types

	of DNA – different types of RNA, properties and functions. Enzymes – Properties, mode of action, nomenclature and classification.
IV	**Plant Physiology:** Photosynthesis – Light reaction and carbon fixation pathways; C3, C4 and CAM pathways; Mechanism of phloem transport; Respiration - Glycolysis, Krebs cycle, Electron Transport. Nitrogen fixation – symbiotic and non-symbiotic. Auxins, cytokinins. Gibberellins, phytochromes – role and mode of action. **Genetics:** Mendelian and non-mendelian inheritance – linkage and crossing over. Mutation – Mutagenic agents; Chromosomal aberrations. Nucleic acids as genetic material – Replication of DNA – Methods and models in DNA repair mechanism – split genes –Jumping and mobilic genes – concepts of gene – Cistron, Muton and recon.
V	**Ecology:** Ecological factors – their classification and interaction. Synecology – classification of plant communities. Raunkiaer's life – forms – Ecological succession – causes and effects climax concept. Eco system – components and inter relationship. Bio-geo-chemical cycles. Major sanctuaries, National parks in Tamil Nadu. **Plant Geography**: Principles of Plant Geography Dispersal and migration – Types – Age and Area hypothesis – continuous range, cosmopolitan, circum polar, circum boreal and circum austral, pantropical Discontinuous distribution – Wegner's theory of continental drift.

Recommend text Books

1. Pulliah T, Varalakshmi Narayana D, and P Suresh 2021 Botany for Competitive Examinations: (Useful for UPSC-Indian Forest Service, Civil Services, PCS, ASRB CSIR - NET, ICAR-NET and Other Competitive Exams) Astal crackers publication
2. Sunit Mitra 2017 Botany for Competitive Examinations Edition 1 Academic Publishers
3. Pullaiah T 2021 Objective Botany: Question Bank for Civil Service Examinations NET, SET, Ph.D. And Allied Examination**:** Regency Publications
4. Mitra, S. 2016. Botany for competitive examinations, Academic Publishers.
5. Mohd Akil Shahezad. 2018. M.C.Qs. in Botany, Library Book House.
6. Sharma, P.C. 2017. Text Book of Plant Anatomy. Arjun Publishing House, New Delhi.
6. Sharma, O.P. 2017. Plant Taxonomy. (II Edition). The McGraw Hill Companies Taxonomy: Nair Datta
7. Thieman. 2014. Introduction to Biotechnology 3rd Edition. Pearson Education India.

Reference Books

1. De Robertis and De Robertis. 1990. Cell and Molecular Biology, Saunders College, Philadelphia, USA.
2. Gardner, E.J., Simmons, M.J and Snustad, D. 1991. Principles of Genetics, John Wiley Sons Inc., 8th Edn., New York.
3. Salisbury, F. B.C.W. Ross.1991. Plant Physiology. Wassworth Pub. Co. Belmont.
4. Sharma, P.D. 2017. Ecology and Environment- Rastogi Publication, Meerut.
5. Vardhana, R. 2009. Economic Botany. 1st ed. Sarup Book Publishers Pvt Ltd. New Delhi.
6. Power, C.B and Daginawa, H.F. 2010. General Microbiology: Himalaya Publishing House Pvt Ltd,

7. Rangasamy, G. 2006. Disease of crop plants in India (4th edition). Tata Mc Graw Hill New Delhi.
8. Singh, V., Pande, P.C and Jain, D.K. 2021. A Text Book of Botany. Rastogi Publications, Meerut.
9. Bhojwani, S.S. Bhatnagar, S.P and Dantu, P.K. 2015. The Embryology of Angiosperms (6th revised and enlarged edition). Vikas Publishing House, New Delhi.

Web resources

1. https://www.amazon.in/BOTANY-COMPETITIVE-EXAMINATIONS-SUNIT-MITRA/dp/9383420898
2. https://www.amazon.in/Botany-Competitive-Examinations-UPSC-Indian-Competive/dp/B08VWB64BC
3. https://www.ssclatestnews.com/botany-book-pdf-free-download-for-competitive-exams/
4. https://sscstudy.com/botany-for-competitive-exams-pdf/
5. https://www.amazon.in/Botany-Entrance-Examination-Anupam-Rajak-ebook/dp/B089S1GLMP

Mapping with Programme Outcomes:

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

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

PROFESSIONAL COMPETENCY SKILL / SKILL ENHANCEMENT COURSE III

2. BOTANY FOR ADVANCED RESEARCH

Title of the Course		**BOTANY FOR ADVANCED RESEARCH**					
Paper Number		**Skill enhancement 3**					
Category	**Skill Enhancement**	**Year**	**II**	**Credits**	**2**	**Course Code**	
		Semester	**IV**				
Instructional Hours Per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		2	**2**		**-**	**4**	
Pre-requisite		Students should to improve their career prospects, or pursuing a passion.					
Learning Objectives		1. To be familiar with the basic concepts and principles of plant systematics.					
		2. Learn the importance of plant anatomy in plant production systems.					
		3. To expose the students a fundamental of the various techniques used in molecular studies.					
		4. To learn about the physiological processes that underlie plant metabolism.					
		5. To know the energy production and its utilization in plants.					

UNIT	CONTENTS
I	**Molecular trends in Biosystematics**: techniques used in molecular taxonomy, molecular systematics in crop evolution, Serology in relation to plant taxonomy. Cladistics and Phenetics, Chemotaxonomy **Molecular trends in Reproductive Biology**: Apomixis – Types, cytogenetic basis and induction of apomixes, applications. Biochemistry and genetics of incompatibility, methods to overcome incompatibility. Sterility – Male sterility, CMS, GMS, CGMS, transgenic male sterility, female sterility and zygotic sterility **Palynology**: Sporopollenin, Pollenkit, NPC system
II	**Cell Biology**: Microscopy- Principles of Light, Phase contrast, Interference, Fluorescent, SEM, TEM. molecular cytogenetics- FISH, GISH, SKY **Plant Physiology** Photoperiodism General principles, florigen concept, Circadian rhythms, Phytochrome genes and their expression, control of photo-morphogenic responses. Plant growth and development Patterns of growth and differentiation, ABCD model in *Arabidopsis* flower.
III	**Molecular Biology**: DNA isolation, chromosome walking, chromosome jumping, principles and applications of recombinant DNA technology, DNA fingerprinting, DNA foot printing, DNA sequencing, PCR, RFLP, RAPD, AFLP, ISSR, Southern, Northern and Western blotting techniques. Exon shuffling, exon trapping, protein isolation.
IV	**Extraction and separation techniques**- Cell fractionation- Chromatography-principle and classification, Paper chromatography-, TLC, Column chromatography, Adsorption- Gel filtrationIon exchange- Affinity chromatography- GC, HPTLC. Electrophoresis Principle, type, paper, starch gel, polyacrylamide, agarose, immuno electrophoresis. Centrifugation.

V	**Spectroscopy**-nature of Electromagnetic Radiation.– UV and visible spectroscopy, IR spectroscopy. Spectroflurometry. Electron spin Resonance- NMR-Mass spectrometry and spectrophotometry. Enzyme assay and kinetics, ELISA, RIA, calorimetric studies, Karyotype and pachytene analysis, acetolysis, banding techniques, scoring of chromosomal aberrations

Course outcomes

CO	on completion of this course, the students will be able to	Programme outcomes
CO 1	1.Understand of the basic principles of systematics, including identification, nomenclature, classification, and the inference of evolutionary patterns from data	K1, K2 & K5
CO 2	2. Learn the structures, functions and roles of apical *vs* lateral meristems in monocot and dicot plant growth.	K1,K3 & K5
CO 3	3. Understand the organization of nuclear genome	K3 & K5
CO 4	4. Understand the various steps involved in the basic functioning of plant growth and the nutritive value of food.	K2, K3 & K5
CO 5	5. Gain awareness about the various process involved in the energy production in plants and metabolic pathways.	K1, K5 & K6

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Text:

1. Sharma, O.P. 2017. Plant Taxonomy. (II Edition). The McGraw Hill Companies.
2. Maheshwari, P. 1963. Recent Advances in Embryology of Angiosperms. Intl. Soc. Plant Morphologists, New Delhi.
3. Sharma, P.C. 2017. Text Book of Plant Anatomy. Arjun Publishing House, New Delhi.
4. Jain, V.K. 2017. Plant Physiology, S.Chand & Company Ltd. New Delhi.
5. Lincoln, T, Eduardo, Z, Ian Max, M, and Angus, M. 2018. Fundamentals of Plant Physiology. Sinauer Associates Inc., US.
6. Becker, W.M., Kleinsmith L.J. & Hardin J. 2005. The World of the Cell (6th edition). Benjamin/Cummings Pub. Co. New York.
7. Brooker, R. J. 1999. Genetics Analysis and Principles. Addison Wesley Longman Inc., New York.
8. Bruce, A. et. al. 2002. Molecular Biology of the Cell. Garland Publishing. New York.

Reference books:

1. Mabberley, J.D. 2014. Mebberley's Plant-Book: A portable dictionary of plants, their classification and uses, 3rd ed. Cambridge University Press, Cambridge, U.K. 1021pp.
2. Pandey.B.P. 1999. Economic Botany. S. Chand Limited, New Delhi.
3. Bhojwani, S.S. and Soh, W.Y. 2013. Current trends in the embryology of angiosperms. Springer Science & Business Media, Germany.
4. Cutler, D. F., Botha, T and Stevenson, D.W. 2008. Plant Anatomy: An Applied Approach. Blackwell Publishing, Malden, USA.
5. Steward, F.C. 2012. Plant Physiology Academic Press, US.
6. Hopkins, W.G and Huner, N.P. 2009. Introduction to Plant Physiology (4th ed.). John Wiley & Sons. U.S.A.
7. Noggle G.R and G.J. Fritz. 2002. Introductory Plant Physiology. Prentice Hall of India, New Delhi.
8. Anthony J. F. G .2000. An Introduction to Genetic Analysis. W. H. Freeman &Co. New York.
9. Hartl,. D.L & Jones E. W. 2000. Genetic analysis of Genes and Genomes Jones and Bartlett Pub, Boston.
10. Klug.S.W. & Cummings, M.R. 2003. Concepts of Genetics. Pearson Education Pvt. Ltd., Singapore. Kreezer et al. 2001. Recombinant DNA and Biotechnology. American Society for Cell Biology, New York.
11. Lodish Harvey. 1999. Molecular Cell Biology. W.H. Freeman &Co. New York.
12. Russell, P.J. 2005. Genetics: A Molecular Approach (2nd edition). Pearson/Benjamin Cumming, San Francisco.
13. Snustad, D. P. & Simmons M.J. 2003.Principles of Genetics. John Hailey & Sons Inc. U.S.A.

Web resources:

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

Mapping with Programme Outcomes:

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

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

EXTENSION ACTIVITY

Title of the Course		**Extension Activity**					
Paper Number		**SKILL ENHANCEMENT - III**					
Category	**Part - C**	**Year**	II	**Credits**	1	**Course Code**	
		Semester	IV				
Instructional Hours Per week		**Lecture**	**Tutorial**	**Lab Practice**		**Total**	
		-	-	-		-	
Learning Objectives		To arouse social consciousness of the students by providing them opportunities to work with and among the people.					
		To develop an awareness and knowledge of social realities to have concern for the well-being of the community and engage in creative and constructive social action.					
		To provide with rich and meaningful educational experiences to them in order to make their education complete and meaningful.					
		To give them the opportunities for their personality development					
		Identify the needs and problems related to environment and involve them in problem solving process.					

A. GUIDELINES FOR THE EXTENSION ACTIVITY COURSE

1. Campus Work (30 hours/semester) (group activity – each group maximum number of students - 5)

   Development & maintenance of Botanical Garden, Lawn, Green house, Herbal Garden, Kitchen Garden / preparation and maintenance of a museum / seed bank (30 specimens) etc. on the college campus

2. Adopted Village – (Near the College) (20 hours / semester)

   Activities including

a) Plantation of tree saplings, Medical Camps, Rallies, and any activity relating to environmental awareness, Disposal of garbage & composting, Environmental sanitation, Swachh Bharat Mission scheme program, Plastic and Waste Collection Drive, Celebration / observation of Important days in villages, etc.

At the end of the semester each student should submit a report and data sheet of the events with GIS photographs.

Data sheet (Model) – Continuous Internal Assessment

Extension Activity **Data Sheet** Name of student: Reg. No.: Class: Academic year:						
Date	**Time**	**Name of the activity**	**Name of the village / college**	**Details about the activity done**	**Signature by teacher in-charge**	**Signature by the HOD**

b) Survey on Environmental awareness/ environmental issues/ climate change /pollution/conservation etc.

Students should prepare a questionnaire about any one theme related to the environment/traditional knowledge/ conservation etc. The questionnaire contains a minimum of 20 questions to reflect the purpose of their specific subject. The survey will be conducted with a minimum of 30 participants. During data collection, participants were requested to fill out the questionnaire completely. Data analysis focuses on organizing information and making logical or statistical inferences; interpretation, and drawing conclusions. Prepare and submit a report for external valuation. Report should include title, certificate by teacher in-charge, introduction, results, analysis, conclusions and action required.

B. SCHEME OF EVALUATION

Internal

Evaluation Criteria	**Maximum marks for each category**
Active participation in the campus work	15
Active participation in the village work	15
Plan of work and calendar of operations, Follow through plan of work	10
Preparation and submission of questionnaire, data sheet and report with GIS photos	10
Total	**50**

External

Evaluation Criteria	Maximum Marks for Each Category
PowerPoint presentation of activities done with GIS photos	20
Viva - Knowledge, Attitude	10
Questionnaire report	10
Data sheet and report with GIS photos	10
Total	**50**