



**MANONMANIAM SUNDARANAR UNIVERSITY
TIRUNELVELI – 12**

**MODIFIED AND CORRECTED SYLLABUS
(RECEIVED FROM CHAIRPERSON ON 16.10.2023.)**

M.Sc BOTANY

**TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION,
CHENNAI – 600 005**

FROM THE ACADEMIC YEAR 2023 – 2024

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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.

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

	<p>decisions and actions.</p> <p>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.</p> <p>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.</p> <p>PSO4 – Contribution to Business World To produce employable, ethical and innovative professionals to sustain in the dynamic business world.</p> <p>PSO 5 – Contribution to the Society To contribute to the development of the society by collaborating with stakeholders for mutual benefit.</p>
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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
Summer Internship / Industrial training	-	-	2	-	02
Part C	-	-	-	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

- Testing Pattern (25 +75)**
Internal - 25 marks
External - 75 marks
- 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 TANSCHÉ 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 Elective – VI (Industry / Entrepreneurship) 20% Theory 80% Practical	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/ Industrial 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/ Industrial 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	Credits
		1 contact hour = 1 credit	
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)	5	3
	1. Microbiology, immunology and plant pathology		
	2. Conservation of natural resources and policies		
	3. Mushroom cultivation		
Elective II (Generic Discipline-Centric)	ED1: (One from each Group B)	5	3
	1. Algal Technology		
	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 property rights	5	4
	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) (4) 1. Secondary Plant Products and Fermentation Biotechnology 2. Entrepreneurial Opportunities in Botany 3. Applied plant cell & tissue culture 4. Silviculture and Commercial Landscaping (4)	3	2
Skill Enhancement	SEC2 Seminar paper (Open Choice) Professional Communication Skill (2)	3	2

Course II			
	Internship/Industrial Activity (Carried out in Summer Vacation at the end of I year– 30 hours)	-	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 or Discipline-Centric)	EG3: (One from Group F) (4) 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. Training for Competitive Examinations 2. Botany for NET/UGC-SIR/SET/TRB competitive examinations (2 hours) 3. General Studies for UPSC/TNPSC/other competitive examinations (2 hours) or 4. Botany for Advanced Research (4 hours) 5. Naan Mudhalvan Scheme	4	2
	Extension activities	.	1
Total		30	23
Total Credits			91

M.Sc. BOTANY CURRICULUM
CORE I - PLANT DIVERSITY – I: ALGAE, FUNGI, LICHENS AND BRYOPHYTES

Title of the Course		PLANT DIVERSITY – I: ALGAE, FUNGI, LICHENS AND BRYOPHYTES					
Paper Number		CORE I					
Category	Core	Year	I	Credits	5	Course Code	
		Semester	I				
Instructional Hours Per week	Hours	Lecture	Tutorial	Lab Practice		Total	
		5	2	--		7	
Pre-requisite		Students should be familiar with the basics of algae, fungi, lichens and Bryophytes.					
Learning Objectives		<ol style="list-style-type: none"> 1. To learn about the classification, distinguishing traits, geographic distribution, and reproductive cycle of algae, fungi, lichens, and bryophytes. 2. To gain knowledge about the ecological and economic importance of algae, fungi, lichens and bryophytes. 3. To spark interest in the evolutionary roots of plant development. 4. To study the biodiversity by describing and explaining the morphology and reproductive processes of algae, fungi, bryophytes and microorganisms. 5. To expose the beneficial and harmful viewpoint. 					
UNIT	CONTENTS						
I	<p>ALGAE: General account of algology, Contributions of Indian Phycologist (T.V. Desikachary, V. Krishnamurthy and V.S. Sundaralingam), Classification of algae by F.E. Fritsch (1935-45). Salient features of major classes: Cyanophyceae, Chlorophyceae, Xanthophyceae, Chrysophyceae, Cryptophyceae, Dinophyceae, Chloromonadineae, Euglenophyceae, Charophyceae, Bacillariophyceae, Phaeophyceae and Rhodophyceae. Range of thallus organization, algae of diverse habitats, reproduction (vegetative, asexual and sexual) and life cycles. Origin and evolution of sex in algae. Structure, reproduction and life histories of the following genera: <i>Oscillatoria</i>, <i>Scytonema</i>, <i>Ulva</i>, <i>Codium</i>, <i>Diatoms</i>, <i>Dictyota</i> and <i>Gracilaria</i></p>						
II	<p>FUNGI: General Characteristics, occurrence and distribution. Mode of nutrition in fungi. Contributions of Indian Mycologists (C.V. Subramanian), Classification of Fungi by Alexopoulos and Mims (1979) & Recent trends in the classification of fungi - Phylogeny and inter-relationships of major groups of fungi. General characters of major classes: Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina. Heterothallism in fungi, sexuality in fungi, Parasexuality in fungi. Structure, reproduction and life histories of the following genera: <i>Plasmodiophora</i>, <i>Phytophthora</i>, <i>Rhizopus</i>, <i>Polyporus</i> and <i>Colletotrichum</i>.</p>						
	<p>LICHENS: Introduction and Classification (Hale, 1969). Occurrence and inter-relationship of</p>						

III	phycobionts and mycobionts, structure and reproduction in Ascolichens, Basidiolichens and Deuterolichens.
IV	BRYOPHYTES: General characters and Classification of Bryophytes by Watson (1971). Distribution, Structural variations and evolution of gametophytes and sporophytes in Haepaticopsida, Anthoceroopsida and Bryopsida, General characters of major groups - Marchantiales, Jungermaniales, Anthocerotales, Sphagnales, Funariales and Polytrichales. Reproduction - Vegetative and sexual, spore germination patterns in bryophytes. Structure, reproduction and life histories of the following genera: <i>Targionia</i> , <i>Lunularia</i> , <i>Porella</i> and <i>Polytrichum</i> .
V	ECONOMIC IMPORTANCE: Algae - Economic importance in Food and feed - Single cell protein, Industrial products (Agar-Agar, Carrageenan, Alginic acid, Iodine, biofertilizers, Vitamins and biofuel), Medicinal value and Diatomaceous earth. Fungi – Economic importance in food, industries and medicine. Lichen –economic importance and as indicator pollution. Bryophytes – Ecological and economic importance – industry, horticulture and medicine.

Course Outcomes

CO	Course outcomes – on completion of this course, the students will be able to	Programme outcomes
CO 1	Relate to the structural organizations of algae, fungi, lichens and bryophytes	K1
CO 2	Demonstrate both the theoretical and practical knowledge in understanding the diversity of basic life forms and their importance	K2
CO 3	Explain life cycle patterns in algae, fungi, lichens and Bryophytes	K3
CO 4	Compare and contrast the mode of reproduction in diverse groups of basic plant forms.	K4
CO 5	Discuss and develop skills for effective conservation and utilization of lower plant forms	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. Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi.
2. Barsanti, L. and Guadriani, P. 2014. Algae: Anatomy, Biochemistry and Biotechnology, 2nd Edition, CRC Press, ISBN: 1439867321.

3. Sharma, O.P. 2011. Fungi and Allied Microorganisms, Mc Graw Hill, ISBN:9780070700383, 0070700389
4. Kevin K. 2018. Fungi biology and Application, 3rd Edition, Wiley Blackwell.
5. Pandey, P.B. 2014. College Botany-1: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. Chand Publishing, New Delhi.
6. Singh, Pandey and Jain. 2020. A text book of Botany, 5th Edition, Rastogi Publication, Meerut.
7. Sharma, O.P. 2014. Bryophyta, Mcgraw Hill, ISBN: 9781259062872, 1259062872

Reference Books

1. Sundaralingam, V. 1991. Marine algae. Bishen Singh and Mahendra Pal Singh Publishers, Dehradun.
2. Edwardlee, R. 2018. Phycology, 5th Ed., CambridgeUniversityPress, London.
3. Nash, T.H. 2008. Lichen Biology, Cambridge University press.
4. Johri, R.M., Lata, S. and Tyagi, K. 2012. A Textbook of Bryophyta. Dominant Publishers & Distributors Pvt., Ltd., New Delhi. ISBN: 9789384207335.
5. Alexopoulos, C.J. and Mims, M. 2007. Introductory Mycology. 4th Edition, Wiley Publishers, ISBN: 9780471522294

Web resources

1. <https://www.britannica.com/science/algae>
2. <https://en.wikipedia.org/wiki/Bryophyte>
3. <https://www.britannica.com/plant/bryophyte/Ecology-and-habits>
4. <https://www.livescience.com/53618-fungus.html>
5. http://www.uobabylon.edu.iq/eprints/paper_11_20160_754.pdf
6. <https://www.youtube.com/watch?v=vcYPI6y-Udo>
7. https://www.youtube.com/watch?v=XQ_ZY57MY64
8. <http://www-plb.ucdavis.edu/courses/bis/1c/text/Chapter22nf.pdf>

Mapping with Programme Outcomes:

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

S - Strong (3)

M - Medium (2)

L - Low (1)

CORE II- PLANT DIVERSITY – II : PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY

Title of the Course		PLANT DIVERSITY – II : PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY					
Paper Number		CORE II					
Category	Core	Year	I	Credits	5	Course Code	
		Semester	I				
Instructional Hours Per week		Lecture	Tutorial	Lab Practice		Total	
		5	2	--		7	
Pre-requisite		Students should know about the fundamentals of Pteridophytes, Gymnosperms and fossil records					
Learning Objectives	<ol style="list-style-type: none"> 1. To investigate the classification, distinctive traits, distribution and reproduction and lifehistory of the various classes and major types of Pteridophytes and Gymnosperms. 2. To identify and characterize diversity of lower vascular plants in order to comprehend the dynamics of diversity to realize the importance of diversity. 3. To research the classification, phylogeny and economic importance of Pteridophytes and Gymnosperms. 4. To study and understand the phylogeny and Paleontology of Pteridophytes and Gymnosperms. 5. To learn about the concept of fossils and process of fossilization; distinctive characteristics of fossil records of Pteridophytes and Gymnosperms 						
UNIT	CONTENTS						
I	PTERIDOPHYTES: General characteristics and classification (Reimer, 1954). Range of structure, reproduction and evolution of the gametophytes, Gametophyte types – sex organs. Apogamy and Apospory. Life cycles. Stellar evolution. Heterospory and seed habit, Telome theory, Economic importance of Pteridophytes.						
II	PTERIDOPHYTES: Structure, anatomy, reproduction and life histories of the following genera: <i>Selaginella</i> , <i>Isoetes</i> , <i>Equisetum</i> <i>Angiopteris</i> , <i>Pteris</i> , <i>Azolla</i> and <i>Marselia</i> .						
III	GYMNOSPERMS: General characters - A general account of distribution of Gymnosperms. Morphology, anatomy, reproduction, phylogeny and classification (K.R. Sporne, 1965). Economic importance of Gymnosperms.						
IV	GYMNOSPERMS: Structure (Exomorphic and endomorphic), anatomy, reproduction and life histories of the following genera: <i>Thuja</i> , <i>Cupressus</i> , <i>Araucaria</i> , <i>Podocarpus</i> , <i>Gnetum</i> and <i>Ephedra</i> .						
V	PALEOBOTANY: Geological Scale; Radiocarbon dating; Contribution of Birbal Sahni to Paleobotany. Gondwana flora of India. Study of fossils in understanding evolution. Fossilization and fossil types. Economic importance of fossils – fossil fuels and industrial raw materials and uses. Study of organ genera: <i>Rhynia</i> , <i>Lepidocarpon</i> , <i>Calamites</i> , <i>Cordaites</i> and <i>Lyginopteris</i> .						

Course Outcomes

CO	Course outcomes – on completion of this course, the students will be able to	Programme outcomes
CO 1	Recall on classification, recent trends in phylogenetic relationship, General characters of Pteridophytes and Gymnosperms.	K1 & K4
CO 2	Learn the morphological/anatomical organization, life history of major types of Pteridophytes and Gymnosperms	K2
CO 3	Comprehend the economic importance of Pteridophytes, Gymnosperms and fossils.	K3
CO 4	Understanding the evolutionary relationship of Pteridophytes and Gymnosperms.	K5
CO 5	Awareness on fossil types, fossilization and fossil records of Pteridophytes and Gymnosperms.	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. Vashishta, P.C. Sinha, A.K and Anil Kumar. 2016. Botany for Degree students. Gymnosperms. S. Chand and Company Ltd., New Delhi.
2. Singh, V., Pande, P.C and Jain, D.K. 2021. A Text Book of Botany. Rastogi Publications, Meerut.
3. Bhatnagar, S.P and Alok Moitra. 2020. Gymnosperms, New Age International (P) Ltd., Publishers, Bengaluru.
4. Sharma, O.P. 2017. Pteridophyta, McGraw Hill Education, New York.
5. Vashishta. P.C., A.K. Sinha and Anil Kumar.2018. Botany for Degree students- Gymnosperms. S. Chand and Company Ltd., New Delhi.
6. Johri, R.M, Lata, S, Tyagi, K. 2005. A text book of Gymnosperms, Dominate pub and Distributer, New Delhi.

Reference Books

1. Parihar, N.S. 2019. An Introduction to Embryophyta Pteridophytes. 5th Edition, Surjeet Publication, Delhi.
2. Pandey, S.N and Trivedi, P.S. 2015. A Text Book of Botany Vol. II- 12 th edition (Paperback), Vikas Publishing.
3. Rashid, A. 2013. An introduction to Pteridophyta – Diversity, Development and differentiation (2nd edition), Vikas Publications.
4. Arnold A.C. 2005. An Introduction to Paleobotany. Agrobios (India).Jodhpur.

5. Sporne, K.R. 2017. The morphology of Pteridophytes (The structure of Ferns and Allied Plants) (Paperback), Andesite Press.
6. Sporne, K.R. 1967. The Morphology of Gymnosperms. Hutchinson & Co., London.
7. Taylor, E, Taylor, T, Krings, M. 2008. Paleobotany: The Biology and Evolution of Fossil Plants, 2nd Edition, Academic Press.

Web resources

1. <https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/>
2. http://www.bsienvi.nic.in/Database/Pteridophytes-in-India_23432.aspx
3. https://books.google.co.in/books?hl=en&lr=&id=Pn7CAAAQBAJ&oi=fnd&pg=PA1&dq=Introduction+to+Gymnosperms&ots=sfYSzCL02&sig=ysX1KRvetV0bAza4Sq6RWau4XU8&redir_esc=y#v=onepage&q=Introduction%20to%20Gymnosperms&f=false
4. https://books.google.co.in/books/about/Botany_for_Degree_Gymnosperm_Multicolor.html?id=HTdFYFNxnWQC&redir_esc=y
5. <https://books.google.co.in/books/about/Gymnosperms.html?id=4dvyNckni8wC>
6. <https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine-cones-an-introduction-to-gymnosperms.pdf>
7. <https://www.palaeontologyonline.com/>
8. <https://books.google.co.in/books/about/Paleobotany.html?id=HzYUAQAIAAJ>
9. <https://trove.nla.gov.au/work/11471742?q&versionId=46695996>

Mapping with Programme Outcomes:

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

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

CORE III - LABORATORY COURSE – 1

Title of the Course	Laboratory course - 1 COVERING CORE PAPER I						
Paper Number	CORE III						
Category	Core	Year	I	Credits	2	Course Code	
		Semester	I				
Instructional Hours Per week	Lecture	Tutorial			Lab Practice	Total	
		--			3	3	
Pre-requisite	Students should be familiar with the fundamentals of algae, fungi, lichens, Bryophytes, in addition to essential laboratory techniques.						
Learning Objectives	1. To learn how to employ the use of instruments, technologies and methodologies related to thallophytes plant groups.						
	2. To enhance information on the identification of each taxonomical group by developing the skill-based detection of the morphology and microstructure of algae, and fungi.						
	3. To comprehend the fundamental concepts and methods used to identify Bryophytes, through morphological changes and evolution, anatomy and reproduction.						
	4. To develop the technical abilities in staining, sectioning, sterilizing, and characterizing. thallophytes, and other varieties of non-flowering plants.						
	5. To compare the structural diversity of fossil and extant plant species.						
UNIT	EXPERIMENTS						
I	ALGAE Study of algae in the field and laboratory of the genera included in theory. Algal collection trip and submission of five herbarium sheets. External morphology and internal anatomy of the vegetative and reproductive structures of the following living forms: <i>Oscillatoria</i> , <i>Scytonema</i> , <i>Ulva</i> , <i>Codium</i> , <i>Diatoms</i> , <i>Dictyota</i> and <i>Gracilaria</i>						
	To record the local algal flora – Study of their morphology and structure. Identification of algae to species level (at least One). Identification of micro algae (green / blue green) in the given algal mixtures.						
III	FUNGI Study of morphological and reproductive structures of the following living forms: <i>Puccinia</i> , <i>Phytophthora</i> , <i>Rhizopus</i> , <i>Taphrina</i> , <i>Polyporus</i> and <i>Colletotrichum</i> (depending on the availability of the specimens)						
IV	Isolation and identification of fungi from soil. LICHENS: Study of morphological and reproductive structures of the genera <i>Parmelia/ Usnea</i> .						
V	BRYOPHYTES External morphology and internal anatomy of the vegetative and reproductive organs of the following living forms: <i>Targionia</i> , <i>Lunularia</i> , <i>Porella</i> and <i>Polytrichum</i>						

(depending on the availability of the specimens).

Course Outcomes

CO	Course outcomes – on completion of this course, the students will be able to	Programme outcomes
CO 1	Recall and applying the basic keys to distinguish at species level Identification of important algae and fungi through its structural organizations	K1 & K4
CO 2	Demonstrate practical skills in thallophytes.	K2
CO 3	Describe the structure of algae, fungi, lichens and bryophytes	K3
CO 4	Determine the importance of structural diversity in the evolution of plant forms.	K5
CO 5	Formulate techniques to isolate and culture of alga and fungi as well as to understand the diversity of plant forms	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. Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi.
2. Das, S and Saha, R. 2020. Microbiology Practical Manual. CBS Publishers and Distributors (P) Ltd., New Delhi, India.

Reference Books

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

Web resources

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

4. <https://www.amazon.in/Manual-Practical-Bryophyta-Suresh-Kumar/dp/B0072GNFX4>

Mapping with Programme Outcomes:

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

S - Strong (3)

M - Medium (2)

L – Low (1)

CORE IV - LABORATORY COURSE – 2

Title of the Course	Laboratory course - 2 COVERING CORE PAPER II						
Paper Number	Core IV						
Category	Core	Year	I	Credits	2	Course Code	
		Semester	I				
Instructional Hours Per week	Lecture		Tutorial		Lab Practice		Total
			--		3		3
Pre-requisite	Students should be familiar with the fundamentals of Pteridophytes, Gymnosperms, Paleobotany in addition to essential laboratory techniques.						
Learning Objectives	1. To learn how to employ the use of instruments, technologies and methodologies related non-flowering plant groups.						
	2. To enhance information on the identification of each taxonomical group by developing the skill-based detection of the morphology and microstructure of algae, and fungi.						
	3. To comprehend the fundamental concepts and methods used to identify Pteridophytes and Gymnosperms through morphological changes and evolution, anatomy and reproduction.						
	4. To develop the technical abilities in staining, sectioning, sterilizing, and characterizing varieties of non-flowering plants.						
	5. To compare the structural diversity of fossil and extant plant species.						
UNIT	EXPERIMENTS						
I	PTERIDOPHYTES External morphology and internal anatomy of the vegetative and reproductive organs of the following living forms: <i>Selaginella</i> , <i>Isoetes</i> , <i>Equisetum</i> <i>Angiopteris</i> , <i>Pteris</i> and <i>Marselia</i> / <i>Azolla</i> (depending on the availability of the specimens).						
II	PTERIDOPHYTES <i>Fossil slides observation: Rhynia, Lepidocarpon, Calamites.</i>						
III	GYMNOSPERMS External morphology and internal anatomy of the vegetative and reproductive organs of the following living forms: <i>Thuja</i> , <i>Cupressus</i> , <i>Araucaria</i> , <i>Podocarpus</i> , <i>Gnetum</i> and <i>Ephedra</i> (depending on the availability of the specimens).						
IV	<i>Fossil slides observation: Cordaites and Lyginopteris.</i>						

Course Outcomes

CO	Course outcomes – on completion of this course, the students will be able to	Programme outcomes
CO 1	Recall and applying the basic keys to distinguish at species level Identification of important algae and fungi through its structural organizations	K1 & K4
CO 2	Demonstrate practical skills in thallophytes.	K2
CO 3	Describe the structure of algae, fungi, lichens and bryophytes	K3
CO 4	Determine the importance of structural diversity in the evolution of plant forms.	K5
CO 5	Formulate techniques to isolate and culture of alga and fungi as well as to understand the diversity of plant forms	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. Sharma, O.P. 2012. Pteridophyta, Tata McGraw-Hills Ltd, New Delhi.
2. Sharma O.P and S, Dixit. 2002. Gymnosperms. Pragati Prakashan.
3. Johri, R.M, Lata, S, Tyagi, K. 2005. A text book of Gymnosperms, Dominate pub and Distributer, New Delhi.

Reference Books

1. Chmielewski, J.G and Krayesky, D. 2013. General Botany laboratory Manual. Author House, Bloomington, USA.
2. Ashok, M. Bendre and Kumar. 2010. A text book of Practical Botany, Algae, Fungi, Lichen, Bryophyta, Pteridophyta, Gymnosperms and Palaeobotany. Revised edition. Published by Rakesh Kumar Rastogi publication.
3. Gangulee, H.C and A.K. Kar. 2013. College Botany. Vth Edition. S. Chand

Web resources

1. <https://www.amazon.in/Practical-Manual-Pteridophyta-Rajan-Sundara/dp/8126106883>
2. <https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm8C?hl=en&gbpv=1&q=gymnosperms&printsec=frontcover>
3. <https://www.amazon.in/Paleobotany-Biology-Evolution-Fossil-Plants/dp/0123739721>

Mapping with Programme Outcomes:

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

S - Strong (3)

M - Medium (2)

L - Low (1)

ELECTIVE I
1. MICROBIOLOGY, IMMUNOLOGY AND PLANT PATHOLOGY

Title of the Course	MICROBIOLOGY, IMMUNOLOGY AND PLANT PATHOLOGY						
Paper Number	ELECTIVE I						
Category	Elective	Year	I	Credits	3	Course Code	
		Semester	I				
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total		
		3	2	--	5		
Pre-requisite	1. The goal of the course is to provide students with basic understanding of microbiology, immunology, plant pathology and the etiology of specific plant diseases.						
Learning Objectives	2. To provide comprehensive knowledge about microbes and its effect on man and environment.						
	3. To provide comparative analysis of major groups of microbes.						
	4. To study the principles of immune system, immunizing agents like antibodies and vaccines and gene therapy methods.						
	5. To enhance the knowledge and skills needed for self-employment using the microbial derived products.						
	6. To appreciate the role of immune system in conferring disease resistance.						
UNIT	CONTENTS						
I	BACTERIA: Types of microorganisms. General characteristic of bacteria – Outline classification of Bergey’s manual of 9th edition. Classification of bacteria based on Morphological, cultural, physiological and molecular characteristics. Bacterial growth – batch culture and continuous culture. Growth Curve. Factors affecting growth. Determination of bacterial growth – Direct method: Haemocytometer, Viable plate count; Indirect method: Turbidity. Nutritional types. Reproduction - Fission and sporulation. Genetic recombination- Transformation, Transduction and Conjugation. Isolation and cultivation of bacteria. Maintenance of bacterial culture.						
II	VIRUSES: General characters, Classification, Structure, Multiplication. Overview of Phycoviruses and Mycoviruses. Viruses of Eukaryotes – Animal & Plant viruses. Cultivation of viruses – in embryonated egg and in plants. Control of viral infections. Bacteriophages- classification, replication of DNA and RNA phages -Lytic and Lysogenic cycle. Viroids and prions. Mycoplasma: Structure and classification.						
	FOOD MICROBIOLOGY: Beneficial role of microbes – yoghurt, Olives, Cheese, Bread, Wine, Tempeh, Miso & Fermented green tea. Spoilage of fruits, vegetables, meats,						

III	<p>poultry, eggs, bakery products, dairy products and canned foods. Microbial toxins - Exotoxin, Endotoxin & Mycotoxin. Action of Enterotoxin, Cytotoxin & Neurotoxin. Food Preservation – temperature, drying, radiation and chemicals. Soil Microbiology: Importance of Microbial flora of soil and factors affecting the microbial community in soil. Interaction among soil microbes (positive and negative interactions) & with higher plants (rhizosphere & phyllosphere). Microorganisms in organic matter decomposition. Environmental Microbiology: Microbiology of water and air. Water borne diseases - diphtheria, chicken pox. Air borne diseases - Swine flu and Measles. Microbial degradation of chemical pesticides and hydrocarbon.</p>	
IV	<p>IMMUNOLOGY: Introduction; Immune System; Types of Immunity - Innate and Acquired. Immune Cells - Hematopoiesis, B and T lymphocytes - Maturation, NK cells. Introduction to inflammation, Adaptive immune system, Innate Immune system. Antigen: Definition, Properties and types. Antibody – Structure, types and function. Generation of antibody diversity. Antigen - Antibody interactions: definition, types- Precipitation, Agglutination, Complement fixation. Immune Response – Humoral and Cell Mediated. Vaccines – history, types and recombinant vaccines. Immunodiagnosis – Blood Grouping, Widal test, Enzyme-Linked Immunosorbent Assay (ELISA), Immunoelectrophoresis and Immunodiffusion.</p>	
V	<p>PLANT PATHOLOGY: History and significance of plant pathology. Classification of plant diseases, Symptomology (important symptoms of plant pathogens). Principles of plant infection –Inoculum, inoculum potential, Pathogenicity. Disease triangle. Host parasite interrelationship and interaction. Causal agents of plant diseases - biotic causes (fungi, bacteria, virus, mycoplasma, nematodes, parasitic algae, angiospermic parasites - Abiotic causes (Physiological, deficiency of nutrients & minerals and pollution). Mechanism of penetration- Disease development of pathogen (colonization) and dissemination of pathogens. Role of enzymes and toxins in disease development. Defence mechanism of host – structural and biochemical defences. Important diseases of crop plants in India - Sheath blight of rice, Late blight of potato, Little leaf of Brinjal and Red rust of tea. Principles of disease management – Cultural practices, physical, chemical and biological methods, disease controlled by immunization. Biocontrol - merits and demerits; Plant quarantine and legislation. Integrated Pest Management system. Diagnostic technique to detect pest/pathogen infection - Immunofluorescence (IF).</p>	
Course outcomes:		
CO	On completion of this course the student will be able to	Programme outcomes
CO1	Recognize the general characteristics of microbes, plant defense and immune cells	K1

CO2	Explain about the stages in disease development and various defense mechanisms in plants and humans.	K2
CO3	Elucidate concepts of microbial interactions with plant and humans.	K3
CO4	Analyze the importance of harmful and beneficial microbes and immune system	K4
CO5	Determine and interpret the detection of pathogens and appreciate their adaptive strategies.	K5 & K6
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:
<ol style="list-style-type: none"> 1. Singh, R.S. 2018. Introduction to Principles of Plant Pathology, 4th Edition. 2. Bilgrami, K.S and H.C. Dube. 2010 A text book of Modern Plant Pathology – Vikas Publishing House (P) Ltd., New Delhi 3. Mehrotra, R.S. and Aggarwal, A. 2017. Plant Pathology. McGraw Hill Publisher. 4. Dube, H.C. 2010. A text Book of Fungi, Bacteria and Viruses, 3rd Edition, Agrobios India, ISBN: 8188826383. 5. Vaman Rao, C. 2006. Immunology. 2nd Edition. Narosa Publisher. 6. Kenneth, M. 2017. Janeway's Immunobiology. 9th Edition. Garland Publisher.
Reference Books:
<ol style="list-style-type: none"> 1. Agrios, A.G. 2007. Plant Pathology, Elsevier. ISBN: 9780120445653. 2. Jeffery, C., Pommerville. 2014. Alcamos Fundalmedals of Microbiology. 10th Edition. Johnsand Bartlett Learning. 3. Pelczar, M. J. 2007. Microbiology. 35th Edition, Tata-McGraw Hill Publications, New York, ISBN: 0074623260. 4. Ravi Chandra, N.G. 2013. Fundamentals of Plant Pathology, Phi Learning, ISBN: 812034703X. 5. Willie, J. and Sherwood, L. 2016. Prescott's Microbiology McGraw-Hill Education; 10th Edition, ISBN: 978-1259281594 6. Chaube, H.S. and Singh, R. 2015. Introductory Plant Pathology CBS Publishers, ISBN: 978-8123926704. 7. Rangasamy, G. 2006. Disease of crop plants in India (4th edition). Tata Mc Graw Hill New Delhi. 8. Mishra, A., A. Bohra and A, Mishra. 2011. Plant Pathology-Disease and Management. Agro Bios, Jodhpur.
Web resources:
<ol style="list-style-type: none"> 1. https://www.wileyindia.com/a-textbook-of-plant-pathology.html

2. [https://www.britannica.com/science/plant-disease.](https://www.britannica.com/science/plant-disease)
3. <https://www.planetatural.com/pest-problem-solver/plant-disease/>
4. <https://www.elsevier.com/books/plant-pathology/agrios/978-0-08-047378-9>
5. <https://www.elsevier.com/life-sciences/immunology-and-microbiology/books>
6. <https://www.amazon.in/INTRODUCTION-IMMUNOLOGY-RAFIA-IMRAN-ebook/dp/B09B66SD3J>

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low (1)

ELECTIVE - I: 2. CONSERVATION OF NATURAL RESOURCES AND POLICIES

Title of the Course	CONSERVATION OF NATURAL RESOURCES AND POLICIES					
Paper Number	ELECTIVE I					
Category	Elective	Year	I	Credits	3	Course Code
		Semester	I			
Instructional Hours per week		Lecture	Tutorial		Lab Practice	Total
		3	2		--	5
Pre-requisite		To create awareness of environmental problems and their consequences.				
Learning Objectives		1. Explain the term natural resources.				
		2. Describe the reasons for degradation of natural resources and suggest measures to prevent these.				
		3. List the various endangered species of animals and plants.				
		4. State the various environmental laws passed to conserve the natural resources.				
		5. Explain sustainable development and justify its need; and describe the various conventional as well as non-conventional sources of energy.				
UNIT	CONTENTS					
I	NATURAL RESOURCES: Definition – Importance – Classification – Human physiological socio-economic and cultural development – Human Population Explosion – Natural Resource Degradation – Concept of conservation – Value system – Equitable resource use for sustainable life system.					
II	FOREST RESOURCES: Forest cover in India and the World – Importance – Desertification – Forest Wealth – Afforestation – Vanasamrakshna Samithi – Agroforestry – Social Forestry – Joint Forest Management Strategy for Forest Conservation. Wild Life: Resources – Importance – Benefits – Wild life Extinction – Causes for Extinction – List of Endanger species in India and in the World – Ecological approach in wild life management – Eco Tourism – Wild Life projects in India – Sanctuaries and National Parks In India – Man and Bio sphere Programme.					
III	LAND AND SOIL RESOURCES: Soil, Complexity of soil nature, regional deposits, Land use and capability classification systems, Land use Planning models and their limitations. Impacts of natural and man-made activities on land characteristics and land use planning– Soil Erosion – Loss of Soil Nutrients – Restoration of Soil Fertility – Soil Conservation Methods and Strategies in India. Wet Land Conservation and Management – Ecological Importance of wet lands in India – Conservation Strategy and ecological Importance. Water Resources: Rivers and Lakes In India – Water Conservation and ground water level increase - Watershed Programme.					

IV	MINERAL RESOURCES: Use and exploitation – Environmental effects of extracting and using mineral resources – Restoration of mining lands – Expansion of supplies by substitution and conservation. Food Resources: World Food Problems – Changes caused by agriculture – overgrazing effects of modern agriculture – Fertilizer-Pesticide problems – Water Logging – Salinity – Sustainable agriculture, life stock breeding and farming.	
V	ENVIRONMENTAL POLICY IN INDIA: Need for policies- Public Policy – Economic policies – Relationship between economic development and environment – Implementing Environmental Public Policy Strategies in pollution control – Constitutional provisions in India regarding environment – Public Awareness and Participation in Environmental Management – National Land Use Policy 1988 – Industrial Policy 1991.	
Course outcomes:	On completion of this course the student will be able to	Programme outcomes
CO1	Understand the concept of different natural resources and their utilization.	K1
CO2	Critically analyze the sustainable utilization land, water, forest and energy resources	K2 & K6
CO3	Evaluate the management strategies of different natural resources	K3
CO4	Reflect upon the different national and international efforts in resource management and their conservation.	K4
CO5	State the various environmental policy passed to conserve the natural resources.	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 Text:
<ol style="list-style-type: none"> 1. Trivedi R.K.1994. Environment and Natural Resources Conservation. 2. Murthy J.V.S.1994. Watershed Management in India. 3. Raymond, F Dasmann. 1984. Environmental Conservation, John Wiley. 4. Nalini, K.S. 1993. Environmental Resources and Management, Anmol Publishers, New Delhi. 5. Shyam Divan and Armin Rosencranz. 2001. Environmental Law and Policy in India, Oxford Uni.Press.
Reference Books:
<ol style="list-style-type: none"> 1. Haue, R and Freed V.H. 1975. Environmental Dynamics of Pesticides, Menum Press, London

2. Singh, B. 1992. Social Forestry for Rural Development, Anmol Publishers, New Delhi.
3. Shafi. R. 1992. Forest Ecosystem of the World.
4. Stacy Keach. 2016. Natural Resources Management. Syrawood Publishing House.
5. Rathor B.S. 2013. Management of Natural Resource for Sustainable Development. Daya Publishing House, New Delhi.

Web resources:

1. <https://www.amazon.in/conservation-natural-resources-Gifford-Pinchot-ebook/dp/B07HX76TVN>
2. https://books.google.co.in/books/about/Natural_Resource_Conservation_and_Enviro.html?id=T2SRuhxpUW8C&redir_esc=y
3. <https://www.kobo.com/ww/en/ebook/natural-resources-conservation-law>
4. <https://www.scribd.com/book/552185119/Natural-Resources-Conservation-and-Advances-for-Sustainability>
5. <https://www.scribd.com/document/354699536/Conservation-of-Natural-Resources>

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	M	S	M	S	M	S
CO2	S	S	S	S	M	M	L	S	L	S
CO3	S	S	S	M	M	M	L	S	L	S
CO4	S	S	S	M	M	M	L	S	L	S
CO5	S	S	S	M	M	M	L	S	L	S

S-Strong (3)

M-Medium (2)

L-Low (1)

ELECTIVE-I: 3. MUSHROOM CULTIVATION

Title of the Course	MUSHROOM CULTIVATION						
Paper Number	ELECTIVE I						
Category	Elective	Year	I	Credits	3	Course Code	
		Semester	I				
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total		
		3	2	--	5		
Pre-requisite	Basic knowledge on structure and function of various groups of mushrooms.						
Learning Objectives	1. To teach the identification of mushrooms.						
	2. To differentiate the edible mushrooms with toxic and hallucinating fungi.						
	3. To study the cultivation technique of mushrooms						
	4. To learn the economic importance of mushroom in various fields.						
	5. To study how to establish mushroom cultivation as business enterprise.						
	6. To teach the identification of mushrooms.						
UNIT	CONTENTS						
I	INTRODUCTION: Mushroom, Edible Mushroom, commercial production, medicinal value of mushrooms, nutraceuticals and dietary supplements						
II	MORPHOLOGICAL AND MICROSCOPICAL IDENTIFICATION OF EDIBLE AND POISONOUS MUSHROOMS: Keys for identification of edible mushrooms: <i>Agaricus bisporus</i> , <i>Pleurotus sajorcaju</i> , <i>Volvariella volvcea</i> and <i>Calocybe indica</i> . Key for identifying hallucinogenic mushroom (<i>Psilocybe</i> sp.) Medicinal Mushroom – <i>Cordyceps</i> , <i>Ganoderma lucidum</i> and <i>Lentinus edodes</i> .						
III	CULTIVATION: Substrate sterilization, bed preparation, cropping room and maintenance, raising of pure culture and spawn preparation, factors effecting button mushroom production (Temp, pH, air and water management, competitor moulds and other disease).						
IV	POST-HARVEST MANAGEMENT: Harvest, storage, quality assurance of mushrooms. Pestmanagement.						
V	World production edible mushroom, Legal and regulatory issues of introducing the medicinal mushrooms in different countries. Developing small scale industry and Government schemes. Mushroom Research Centres – International and National levels.						
Course Outcomes:	On completion of this course the student will be able to					Programme outcomes	

CO		
CO1	Knowledge on identification of edible and toxic mushrooms belonging to Ascomycota and Basidiomycota.	K1, K3
CO2	Outline the nutraceutical properties of edible mushrooms.	K2, K4
CO3	Knowledge on cultivation techniques of edible and medicinal mushrooms.	K3, K6
CO4	Understand the harvest and post-harvest techniques of mushroom crops.	K4
CO5	Knowledge on the production and marketing strategies for mushrooms.	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 Text:
<ol style="list-style-type: none"> Cheung, P. C.K. 2008. Mushrooms as functional food. A John Wiley & Sons, Inc., Publication. Dijksterhuis, J. and Samson, R.A. 2007. Food Mycology: A multifaceted approach in fungi and food. CRC press, Newyork. Hall., R.I., Stepheson, S.L., Buchanan, P.K., Yun, W. and Cole, A.L.J. 2003. Edible and poisonous mushrooms of the world. Timber Press, Portland, Cambridge. Ting, S. and Miles, P.G. 2004. Mushrooms: Cultivation, nutritional value, medicinal effect and nutritional environmental impact. CRC press, Newyork. Verma, 2013. Mushroom: edible and medicinal: cultivation conservation, strain improvement with their marketing. Daya Publishing House.
Reference books:
<ol style="list-style-type: none"> Tiwari., SC., Pandey K. 2018. Mushroom cultivation. Mittal publisher, New Delhi. Philips, G., Miles, Chang, S-T. 2004. Mushrooms: Cultivation, nutritional value, medicinal effect and environmental effect. 2nd ed. CRC Press. Diego, C.Z., Pando-Gimenez, A. 2017. Edible and medicinal mushrooms: Technology and Application. Wiley-Blackwell publishers. Nita Bahl. 2002. Handbook on Mushroom 4th edition Vijayprimlani for oxford & IBH publishing co., Pvt., Ltd., New Delhi. Dr.C. Sebastian Rajesekaran Reader in Botany Bishop Heber College, Trichy – 17. Suman. 2005. Mushroom Cultivation Processing and Uses, M/s. IBD Publishers and Distributors, New Delhi.
Web resources:

1. <https://www.amazon.in/Mushroom-Cultivation-India-B-C/dp/817035479X>
2. <http://nrcmushroom.org/book-cultivation-merged.pdf>
3. http://agricoop.nic.in/sites/default/files/ICAR_8.pdf
4. <http://www.agrimoon.com/mushroom-culture-horticulture-icar-pdf-book/>
5. https://books.google.co.in/books/about/Mushroom_Cultivation_in_India.html?id=6AJx99OGTKEC&redir_esc=y

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low (1)

ELECTIVE I – 4. PHYTOPHARMACOGNOSY

Title of the Course	PHYTOPHARMACOGNOSY						
Paper Number	ELECTIVE I						
Category	Elective	Year	I	Credits	3	Course Code	
		Semester	I				
Instructional Hours per week	Lecture		Tutorial		Lab Practice	Total	
	3		2		--	5	
Pre-requisite	Students should aware of traditional use of plant derived drugs in world.						
Learning Objectives	1. To learn the traditional knowledge on plant derived drugs and their conventional classification.						
	2. To elucidate the biosynthetic pathway of major classes of secondary metabolites.						
	3. To study the general pharmacological mode of action of crude drugs of few medicinal plants.						
	4. To elucidate the isolation and characterization of plant derived drugs using modern biotechniques.						
	5. Knowledge on pharmacological action of drugs.						
	6. To learn the traditional knowledge on plant derived drugs and their conventional classification.						
UNIT	CONTENTS						
I	General introduction – History and scope of Pharmacognosy including indigenous system of medicine. Various systems of classification of drugs. Pharmacological action of plant drugs. Significance of Pharmacopoeial standards.						
II	MORPHOLOGICAL AND MICROSCOPICAL Biosynthetic pathway of secondary metabolites: Acetate pathway (fatty acids and polyketides), mevalonate and deoxyxylulose phosphate pathway (terpenoids and steroids), shikimate pathway (phenols, amino acids etc.).						
III	Characterization of Therapeutic drugs: Extraction, separation, isolation (Chromatographic techniques) and characterization of secondary metabolites (Spectroscopic techniques). Quality control of plant drugs: Classical and modern approaches of drugs. Significance of Pharmacopoeial standards.						
IV	Pharmacological action of Plant Drugs: Anti-cancer, Bitter tonic, Carminatives and G.I.regulators, Cardiotonics, CNS-Stimulant, Expectorant, Laxatives, Purgatives. Outline of pharmacogenomics functions.						
V	Hallucinogenic, allergenic and other toxic plants, poisonous plants - biopesticides - biocides – biofungicides.						

Course outcomes: CO	On completion of this course the student will be able to	Programme outcomes
CO1 derived	Review on the traditional knowledge and classification of plant drugs.	K1
CO2	Knowledge on biosynthetic pathway of different classes of plant metabolites.	K2
CO3	Knowledge on modern instrumentation on characterization of plant metabolites.	K3,K6
CO4	Discuss various aspects of Pharmacological action of herbal drugs.	K4, K5
CO5	Understanding medical and non-medical potential of plant derived in various sectors.	K6

Recommended Text:
<ol style="list-style-type: none"> 1. Dewick P.M., 2002. Medicinal Natural Products: A biosynthetic approach, John Wiley & Sons Ltd. 2. Evans W.C., 2002, Trease and Evan's Pharmacognosy, W.B. Saunders. 3. Harborne, J.B., 1998. Phytochemical Methods, Chapman and Hall. 4. Harborne, J.B., 1998. Phytochemical Methods, Chapman and Hall. 5. Vickery M.L. and B. Vickery, 1981. Secondary Plant Metabolism, The MacMillan Press Ltd.
Reference books:
<ol style="list-style-type: none"> 1. Bruneton, J. 1999. Pharmacognosy, Phytochemistry, Medicinal Plants, Intercept Ltd., Paris. 2. Evans W.C. 2002, Trease and Evan's Pharmacognosy, W.B. Saunders. 3. Harborne, J.B. 1998. Phytochemical Methods, Chapman and Hall. 4. Vickery M.L and B. Vickery, 1981. Secondary Plant Metabolism, The MacMillan Press Ltd. 5. Wagner H., S. Bladt and E.M. Zgainski (Translated by A. Scott) 1984, Plant Drug Analysis, Springer-Verlag.
Web resources:
<ol style="list-style-type: none"> 1. https://pharmabookbank.files.wordpress.com/2019/03/14.2.pharmacognosy-by-biren-shahavinash-seth-1.pdf 2. https://www.pdfdrive.com/pharmacognosy-books.html 3. https://www.amazon.in/Textbook-Pharmacognosy-Phytochemistry-Kumar-Jayaveera-ebook/dp/B06XKSY76H 4. https://www.amazon.in/Pharmacognosy-Dr-C-K-Kokate-ebook/dp/B07JHNNMWB 5. https://www.amazon.in/EXPERIMENTAL-PHYTOPHARMACOGNOSY-Comprehensive-Guide-Khadabadi-ebook/dp/B07ZFMYQK8

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low (1)

ELECTIVE II - 1. ALGAL TECHNOLOGY

Title of the Course	ALGAL TECHNOLOGY						
Paper Number	ELECTIVE II						
Category	Elective	Year	I	Credits	3	Course Code	
		Semester	I				
Instructional Hours per week	Lecture	Tutorial		Lab Practice	Total		
	3	2		--	5		
Pre-requisite	Students should be familiar with the basic and applied knowledge on algal biotechnology.						
Learning Objectives	<ol style="list-style-type: none"> 1. To provide a basic overview of algae cultivation techniques and resource potentials. 2. To educate people about the widespread commercial uses of algae. 3. To educate people about the therapeutic uses of algae. 4. To enrich the current knowledge of how algae are used in basic research and technological applications. 5. To spread awareness of the value of algae biotechnology and its applications in diverse industries. 						
UNIT	CONTENTS						
I	SCOPE OF ALGAL TECHNOLOGY Scope of algal technology – Commercial potential and utility of algae. Algae as sources for food, feed, pigments, Pharmaceuticals and nutraceuticals, fine chemicals, fuel, biofertilizers and hormones. Economic importance of algae in India.						
II	ALGAL PRODUCTS Industrial application of algae - fuel, algal lipids - transesterification to ester fuel - substitutes for petroleum derived fuel. Algal products - Spirulina mass cultivation and its applications. Mass cultivation of micro-algae as source of protein and as feed. Liquid seaweed fertilizers - method of preparation, applications and its advantages over inorganic fertilizers.						
III	ALGAL PRODUCTION AND UTILIZATION Algal production systems; Strain selection; Algal growth curve; Culture media; cultivation methods – small scale and Large-scale cultivation of algae. Harvesting and packing. Therapeutic uses - antioxidant, anti-ulcerogenic, antifungal, antibiotics, antitumor and antiviral compounds. Production of pigments and their utilization.						
IV	IMMOBILIZATION AND RDNA TECHNOLOGY IN ALGAE Algal immobilization and its applications - culturing for metabolite production and natural compounds. Methods of immobilization - alginate beads-extraction of compounds. Recombinant DNA technology in algae - Transformation systems in algae. Isolation of protoplasts, regeneration of fusion of macro algae. Role of algae						

	in nanobiotechnology.	
V	ROLE OF ALGAE IN ENVIRONMENT MANAGEMENT Role of algae in environmental health - Sewage treatment, treating industrial effluent, Phytoremediation- heavy metal removal, algae as indicators in assessing water quality and pollution; Saprobic index; Monitoring, assessment, restoration and management of coastal and marine ecosystem environment. Algal culture collection centers in India and abroad and their importance.	
Course outcomes: CO	On completion of this course, the students will be able to:	Programme outcomes
CO1	Understand the applied facet of botany and acquire a complete knowledge about the cultivation methods in algae.	K1& K3
CO2	Realization of the commercial potential of algal products.	K5
CO3	Analyze emerging areas of algal biotechnology for identifying therapeutic importance of algal products and their uses.	K2 & K4
CO4	Gain more information about algae genetics.	K4
CO5	Translate various algal technologies for the benefit of the ecosystem.	K3 & 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:
<ol style="list-style-type: none"> 1. Trivedi, P.C. 2001. Algal Biotechnology. Point publisher, Jaipur. India. 2. Bold, H.C and Wynne, M.J. 1978. Introduction to the Algae: Structure and Function. Prantice Hall of India New Delhi. 3. Sahoo, D. 2000. Farming the ocean: seaweed cultivation and utilization. Aravali International, New Delhi. 4. Bast, F. 2014. An Illustrated Review on Cultivation and Life History of Agronomically Important Sea plants. In Seaweed: Mineral Composition, Nutritional and Antioxidant Benefits and Agricultural Uses, Eds. Vitor Hugo Pomin, 39-70. Nova Publishers, New York. ISBN: 978-1-63117-571-8.

5. Rapouso, M.F.J., Morais, R.M.S.C., Morais, A.M.M.B. 2013. Bioactivity and applications of sulphated polysaccharides from marine microalgae. *Marine Drugs*, 11, 233-252.
6. Bajpai, Rakesh, K., Prokop, Ales, Zappi, Mark, E. 2014. *Algal Biorefineries Volume 1*:

Reference Books:

1. Kumar H.D and H.N. Singh. 1982. A text Book on Algae. Affiliated East- West Press Pvt. Ltd
2. Suganya, T and Renganathan, S. 2015. Biodiesel production using algal technology. Academic Press. ISBN: 0128009713.
3. Bajpai, Rakesh K., Prokop, Ales, Zappi, Mark E. 2014. *Algal Biorefineries Volume 1: Cultivation of Cells and Products*. Springer. ISBN: 9400774931.
4. Hojnacka, K., Wiczorek, P.P., Schroeder, G., Michalak, I. (Eds.). 2018. *Algae Biomass: Characteristics and Applications*. Developments in Applied Phycology.
5. Aziz, Farhad and Rasheed, Rezan. 2019. *A Course Book of Algae*. Publisher: University of Sulaimani. ISBN: 978-9922-20-391-1.
6. Dinabandhu, S and Kaushik. B.D. 2012. *Algal Biotechnology and Environment*. I.K. International, New Delhi.
7. Trivedi, P.C. 2001. *Algal Biotechnology*. Point publisher, Jaipur. India.
8. Becker. E.W. 1994. *Micro algae Biotechnology and Microbiology*. Cambridge University press.
9. Borowitzka, M.A. and borowizka, L.J. 1996. *Microalgal Biotechnology*. Cambridge University Press, Cambridge,
10. Bast, F. 2014. Seaweeds: Ancestors of land plants with rich diversity. *Resonance*, 19(2) 1032-1043 *ISSN*: 0971-8044.
11. Faizal, Band Yusuf, C. 2016. *Algal biotechnology: Products and processes*. Springer.
12. Gouveia, L. 2011. *Microalgae as a feedstock for biofuels*. Springer Briefs in Microbiology, London.

Web resources:

1. <https://www.springer.com/gp/book/9783319123332>
2. https://www.researchgate.net/publication/318449035_Algae_Biotechnology
3. https://www.energy.gov/sites/prod/files/2015/04/f21/algae_marrone_132100.pdf
4. <https://www.amazon.in/Prospects-Challenges-Algal-Biotechnology-Tripathi-ebook/dp/B0779BF366>
5. <https://www.degruyter.com/view/product/177050>
6. <https://www.amazon.in/Algal-Biotechnology-Mihir-Kumar-Das/dp/B0072I61LA>
7. <https://www.elsevier.com/books/algal-biotechnology/ahmad/978-0-323-90476-6>
8. <https://www.appleacademicpress.com/phycobotechnology-biodiversity-and-biotechnology-of-algae-and-algal-products-for-food-feed-and-fuel/9781771888967>

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low (1)

ELECTIVE – II: 2. ETHNOBOTANY, NATUROPATHY AND TRADITIONAL HEALTHCARE

Title of the Course	ETHNOBOTANY, NATUROPATHY AND TRADITIONAL HEALTHCARE						
Paper Number	ELECTIVE II						
Category	Elective	Year	<i>I</i>	Credits	3	Course Code	
		Semester	<i>I</i>				
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total		
		3	2	--	5		
Pre-requisite		The training imparts the knowledge and abilities required to conduct field studies on how humans use plants.					
Learning Objectives		1. Understand the concept of ethnobotany and the life style and traditional practices of plants by Indian tribals.					
		2. Emphasize the importance of non-timber forest products for Indian tribal people livelihoods.					
		3. Evaluate the various research techniques to gather tribal knowledge of ethnobotany.					
		4. Use strategies to turn ethno botanical knowledge into goods with value additions.					
		5. To save and document ethno botanicals in order to use plant resources sustainably.					
UNIT	CONTENTS						
I	ETHNOBOTANY: Concept, important landmarks in the development, scope, sub disciplines of ethno botany. Interdisciplinary approaches. Knowledge of following sociological and anthropological terms: culture, values and norms, institutions, culture diffusion and ethnocentrism. History of ethnobotany: A brief history of ethno botanical studies in the world and in India.						
II	PLANTS USED BY TRIBALS OF INDIA: Distribution of tribes in India. Basic knowledge of following tribes of Tamil Nadu: Irulas, Kanis, Paliyars Badagas, Kurumbres, Thodas and Malayalis. Plants used by tribals of Tamil Nadu.						
III	SOURCES OF ETHNOBOTANICAL DATA: Primary - archeological sources and inventories, Secondary - travelogues, folklore and literary sources, herbaria, medicinal texts and official records. Methods in ethnobotanical research. Prior Informed Consent, PRA techniques, interviews and questionnaire methods, choice of resource persons. Folk taxonomy – plants associated with culture and socio- religious activities. Non – timber forest products (NTFP) and livelihood – Sustainable harvest and value addition.						

IV	<p>NATUROPATHIC MEDICINE: Role of plants in naturopathy- Importance and relevance of medicinal drugs in India. Indian Systems of Medicine (Ayurveda, Siddha, Allopathy, Homeopathy, Unani, Tibetan, Yoga and Naturopathy). Disease diagnosis, treatment, and cure using natural therapies including dietetics, botanical medicine, homeopathy, fasting, exercise, lifestyle counseling, detoxification, and chelation, clinical nutrition, hydrotherapy, naturopathic manipulation, spiritual healing, environmental assessment,</p> <p>TRADITIONAL HEALTH CARE: Health practices, approaches, knowledge and beliefs incorporating plant, animal and mineral based medicines, spiritual therapies, manual techniques and exercises, applied singularly or in combination to treat, diagnose and prevent illnesses or maintain well-being.</p>	
V	<p>BIOPROSPECTING AND VALUE ADDITION: Bioprospecting of drug molecules derived from Indian traditional plants; Methods for bioprospecting of natural resources; From folk Taxonomy to species confirmation - evidences based on phylogenetic and metabolomic analyses; Ethno botanical databases and Traditional knowledge Digital Library (TKDL).</p>	
Course outcomes:	On completion of this course, the students will be able to:	Programme outcomes
CO1	Recall or remember concept of ethnobotany.	K1
CO2	Understand the life style and traditional practices of plants by Indian tribals.	K2 & K6
CO3	Highlight the role of Non-Timber Forest products for livelihood of tribal people of India	K3
CO4	Assess the methods to transform ethnobotanical knowledge into value added products.	K4
CO5	Build idea to make digitization of ethnobotanical knowledge.	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 Text:
<ol style="list-style-type: none"> 1. Subramaniam, S.V and V.R. Madhavan (Eds,). 1983. Heritage of the Tamil Siddha Medicine. International Institute of Tamil Studies. Madras. 2. Jain, A. and Jain, S.K. 2016. Indian Ethno botany - Bibliography of 21st Century Scientific Publishers (India). 3. Gokhale, S.B., Kokate, C.K and Gokhale, A. 2016. Pharmacognosy of Traditional Drugs. 1st ed. NiraliPrakashan, Pune. 4. Gringauz. 2012. Introduction to Medicinal Chemistry: How Drugs Act & Why? Wiley India Pvt Ltd. Noida. 5. Joshi, S.G. 2018. Medicinal Plants. Oxford & IBH Publishing C., Pvt., Ltd., New Delhi.
Reference Books:
<ol style="list-style-type: none"> 1. CSIR. 1940-1976. Wealth of India. A Dictionary of Raw Materials and Industrial Products - Raw Materials. Vol.1-11. CSIR Publication & Information Directorate. New Delhi. 2. Gokhale, S.B., Kokate, C.K and Gokhale, A. 2016. Pharmacognosy of Traditional Drugs. 1st ed. Nirali Prakashan, Pune. 3. Laird, S.A. 2002. Biodiversity and Traditional knowledge equitable partnerships in Practice. Earthscan Publications Ltd., London. 4. Ministry of Environment and Forests. 1994. Ethno biology in India. A Status Report. All India Coordinated Research Project on Ethno biology. Ministry of Environment and Forests. New Delhi. 5. Kumar, N. 2018. A Textbook of Pharmacognosy. Aitbs Publishers, India. 6. Premendra Singh. 2013. Medicinal Plants: Conservation, Cultivation and Utilization. Daya Publishing House, New Delhi. 7. Albuquerque, U.P., Ramos, M.A., Júnior, W.S.F., and De Medeiros, P.M. 2017. Ethnobotany.
Web resources:
<ol style="list-style-type: none"> 1. file:///C:/Users/HP/Downloads/8-Vol.-5-Issue-3-March-2014-IJPSR-1178-A-Paper-81.pdf 2 2. http://www.plantsjournal.com/archives/2017/vol5issue3/PartB/5-3-8-217.pdf 3 3. https://shodhganga.inflibnet.ac.in/bitstream/10603/116454/7/07_chapter%201.pdf 4 4. https://www.cell.com/action/showPdf?pii=S1360-1385%2817%2930001-8 5 5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3465383/pdf/pnas.201202242.pdf 6 6. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4151377/pdf/1746-4269-10-48.pdf 7 Jain, S. K. 1994. http://www.worldcat.org/identities/lccn-n85-4353/ 7. http://www.frlht.org/

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low (1)

ELECTIVE – II: 3. HORTICULTURE

Title of the Course	HORTICULTURE						
Paper Number	ELECTIVE II						
Category	Elective	Year	I	Credits	3	Course Code	
		Semester	I				
Instructional Hours per week		Lecture		Tutorial		Lab Practice	Total
		3		2		--	5
Pre-requisite		Students should know fundamental knowledge on horticulture applications.					
Learning Objectives		1. Know about the brief history, divisions, classification and structure of horticultural plants.					
		2. Acquire knowledge on plant growth processes and stages of plant growth.					
		3. Understand the plant growth environment in relation to soil, nutrients, fertilizers, and bio inoculants.					
		4. Study the sexual and vegetative propagation methods including propagation through specialized vegetative structures.					
		5. Develop practical skills in micro propagation techniques and soil-less production of horticultural crops.					
UNIT	CONTENTS						
I	INTRODUCTION TO HORTICULTURE Definition; Brief History, Divisions of Horticulture, Classification of horticultural plants, Structure of Horticultural Plants –Cell and Tissue systems, Anatomy of stem root and leaf, Morphological structures, Plant growth processes-A brief account of Photosynthesis, Respiration, Transpiration and Translocation, Stages of plant growth.						
II	FACTORS AFFECTING PLANT GROWTH Plant Growth Environment: Abiotic factors, Soil –Profile structure, Primary and Secondary nutrients and their functions, Organic matter, Fertilizers –organic, Inorganic and Potting Media, Bio inoculants, Methods of fertilizer application, Directing Plant growth-Training -Pruning and thinning.						
III	PLANT PROPAGATION Plant propagation: Seeds –Advantages, Viability, Mechanism of Dormancy and Dormancy Breaking: Methods of Direct and Indirect Seedling Production in Nurseries and Transplantation; Propagation through specialized underground structures –Corm, Tuber, Sucker, Bulb, Bulbil, Rhizome; Vegetative Propagation –Cutting, Layering, Grafting and Budding.						
IV	MICROPROPAGATION TECHNIQUES Stages, multiplication by shoot tip, Nodal culture and Callus culture-Application and Limitations, Somatic embryogenesis, Synthetic seeds –Preparation and Potential uses of artificial seeds, Embryo Rescue, Soil-less						

	Production of Horticultural crops –Hydroponics, sand culture, gravel culture.	
V	AESTHETICS OF HORTICULTURE Design: Elements and Principles of Design, Flower Arrangement, Terrarium Culture, Bonsai and Growing Plants Indoors, Turf Production, Landscaping-Principles, Types of Parks, Xeriscaping. Postharvest handling of Horticultural Products –Harvesting, Storage, Processing, Elements of Marketing. Robotics in Horticulture.	
Course outcomes:	On completion of this course, the students will be able to: CO	Programme outcomes
CO1	Identify and categorize various horticultural plants and the conditions that affect their growth and productivity.	K1
CO2	Explain the various structures and growth processes of horticultural plants.	K2
CO3	Demonstrate the propagation, growth, and maintenance of plants in horticulture systems.	K3
CO4	Correlate the soil characteristics and fertility to good plant growth.	K4
CO5	Utilize the role plant tissue culture techniques in the production of quality planting stock in horticulture.	K5
CO6	Apply horticultural skills and knowledge to explore career opportunities in horticulture industry.	K6
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:
<ol style="list-style-type: none"> 1. Acquaah, G. 2011. Horticulture: Principles and Practices. (4th ed), Pearson Education, London, UK. 2. Janik, J. 1972. Horticultural Science. W.H. Freeman & Company, San Francisco. 3. Kumar, N. 1994. Introduction to Horticulture, Rajalakshmi Publication, India. 4. Manibhushan Rao, K. 2005. Text Book of Horticulture. (2nd ed), Macmillan India Ltd., New Delhi. 5. Schilleter, J. C. and Richey, H. W. 2005. Text Book of general Horticulture. 2nd ed.

Biotech Books, Delhi.
6. Sharma, R.R. 2016. Propagation of horticultural crops. Kalyani Publishers, New Delhi.
7. Subba Rao, N.S. 1997. Biofertilizers in Agriculture and Forestry. India Book House Limited, Oxford and IBH publishing Co. Pvt. Ltd, New Delhi.
Reference Books:
1. Acquaah, G. 2002. Horticulture Principles and Practices. 2nd ed. Pearson Education (Singapore) Pvt. Ltd.
2. Ashman, M.A. and Puri, G. 2002. Essential soil science-A clear and concise introduction to soil science. Blackwell scientific publishers, London.
3. Denisen, E.L. 1979. Principles of Horticulture. MacMillan Publishing co, Inc. New York.
4. Dirr, M. and Heuser, C.W. 2009. The Reference Manual of Woody Plant Propagation: From Seed to Tissue Culture. Timber Press, Oregon, USA.
5. Thomson, L.M. and Troen, F.R. 1975. Soils and soil fertility Tata, McGraw Hill Publication Co. Ltd. New Delhi.
6. Tolanus, S. 2006. Soil fertility, Fertilizer and Integrated Nutrient management. CBS Publication, Delhi, India.
Web resources:
1. https://www.kobo.com/in/en/ebooks/horticulture
2. https://www.gale.com/gardening-and-horticulture
3. https://www.iaritoppers.com/p/horticulture-icar-ecourse-pdf-books.html
4. https://www.amazon.in/Introduction-Horticulture-N-Kumar-ebook/dp/B08M4289M6
5. https://www.researchgate.net/publication/316438576_Polyembryony_in_Horticulture_and_its_significance

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low (1)

ELECTIVE – II: 4. HERBAL TECHNOLOGY

Title of the Course	HERBAL TECHNOLOGY					
Paper Number	ELECTIVE II					
Category	Elective	Year	I	Credits	3	Course Code
		Semester	I			
Instructional Hours per week	Lecture		Tutorial		Lab Practice	Total
	3		2		--	5
Pre-requisite	To understand the importance of herbal technology.					
Learning Objectives	1. To understand various plants based drugs used in ayurvedha, unani, homeopathy, siddha etc.					
	2. To apply the knowledge to cultivate medical plants.					
	3. To know the pharmacological importance of medicinal plants.					
	4. To enlist phytochemicals and secondary metabolites of market and commercial value.					
	5. To design and develop their own business prepositions such as the in the making of herbal insecticides.					
UNIT	CONTENTS					
I	PHARMACOGNOSY Pharmacognosy scope and importance - source - Crude Drugs – Scope and Importance, Classification (Taxonomical, Morphological Chemical, Pharmacological); Cultivation, Collection and processing of crude drugs. Cultivation and utilization of medicinal and aromatic plants in India.					
II	PLANT TISSUE CULTURE AS SOURCE OF MEDICINES Plant tissue culture as source of medicines, Role of plant tissue culture in enhancing secondary metabolite production (<i>Withania somnifera</i> , <i>Rauwolfia serpentina</i> , <i>Catheranthus roseus</i> , <i>Andrographis paniculata</i> and <i>Dioscorea sp</i>) - Elicitation - Biotransformation, Hairy root culture. Factors affecting secondary metabolites production. Biogenesis of phytopharmaceuticals.					
III	PLANT PROPAGATION ANALYSIS OF PHYTOCHEMICALS Methods of Drug evaluation (Morphological, microscopic, physical and chemical). Phytochemical investigations – standardization and quality control of herbal drugs. Preliminary screening, Assay of Drugs - Biological evaluation/assays, Microbiological methods - Chemical Methods of Analysis, Detection of Adulterants: Chemical estimations, Spectrophotometry and fluorescence analysis. Drug adulteration - Types of adulterants.					
IV	GENERAL METHODS OF PHYTOCHEMICAL AND BIOLOGICAL SCREENING Carbohydrates and derived products: Glycosides - extraction methods (<i>Digitalis</i> , <i>Dioscorea</i>); Tannins (Hydrolysable and Condensed types); Volatile					

	oils - extraction methods (Clove, Mentha). Study of some herbal formulation techniques as drug cosmetics.	
V	TYPES OF PHYTOCHEMICALS Alkaloids - extraction methods (<i>Taxus, Cinchona</i>); Flavonoids- extraction methods, Resins- extraction method: Application of phytochemicals in phytopharmaceuticals; Biocides, Biofungicides, Biopesticides. Women entrepreneurship development – marketing cultivated medicinal plants – National Medicinal Plants Board of India.	
Course outcomes: to: CO	On completion of this course, the students will be able	Programme outcomes
CO1	Recollect the importance of herbal technology.	K1
CO2	Understand the classification of crude drugs from various botanical sources.	K2
CO3	Analyze on the application of secondary metabolites in modern medicine.	K3
CO4	Create new drug formulations using therapeutically valuable phytochemical compounds for the healthy life of society.	K4
CO5	Comprehend the current trade status and role of medicinal plants in socio economic growth.	K5 & K6
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:
<ol style="list-style-type: none"> 1. Kokate, C.K., Purohit, A.P and S.B. Gokhale. 1996. Pharmacognosy. NiraliPrakashan, 4th Ed. 2. Roseline, A. 2011. Pharmacognosy. MJP publishers, Chennai. 3. Tilgner, Sharol Marie. 2018. Herbal ABC's: The Foundation of Herbal Medicine. 4. Natural Products in medicine: A Biosynthetic approach. 1997. Wiley. Hornok, L. (ed.). 5. Chichister, U.K.J. 1999. Cultivation and Processing of Medicinal Plants, Wiley & Sons. Treaseand Evans.

6. Mukherjee, P.K. 2008. Quality control of herbal drugs. 3rd edition. Business Horizons Pharmaceutical Publishers, New Delhi, India.
7. Kirthikar and Basu. 2012. Indian Medicinal Plants. University Bookstore, Delhi. India
8. Biswas, P.K. 2006. Encyclopedia of Medicinal plants (Vol. I-VII). Dominant Publishers, New Delhi.
9. Chaudhuri, A.B. 2007. Endangered Medicinal Plants. Daya Publishing House, New Delhi.
10. Tilgner, Sharol Marie. 2018. Herbal ABC's: The Foundation of Herbal Medicine.

Reference Books:

1. Wallis, T.E. 1999. Text book of Pharmacognosy. CBS Publishers and Distributors, New Delhi.
2. Kumaresan, V and Annie Regland. 2004. Taxonomy of Angiosperms systematic Botany, Economic Botany, Botany & Ethnobotany.
3. Anonymous, 2004. Cultivation of Selected Medicinal Plants. National Medicinal Plants Board, Govt. of India, New Delhi.
4. Vallabh. 2000. Practical Pharmacognosy, Kolkata. New Delhi.
5. Acharya Vipul Rao. 2000. Herbal cure for common diseases. Diamond books, Pvt. Ltd.
6. Dey, A.C. 1998. Indian medicinal plants used in Ayurvedic preparations, Bishen Singh Mahendra Pal Singh.
7. Sathya, S., Jaiganesh, K.P and Sudha, T. 2019. Current Trends in Herbal Drug Technology. Pharmacy Council of India New Delhi.
8. Lewis, W.H and M.P.F. Elwin Lewis. 1976. Medical Botany. Plants affecting Man's Health. A Wiley Inter Science Publication. John Wiley and Sons, New York.

Web resources:

1. <https://www.kopykitab.com/Herbal-Science>
2. https://kadampa.org/books/free-ebook-download-howtotyl?gclid=CjwKCAiA6vXwBRBKEiwAYE7iS5t8yenurCIUCTdV9oIKo9TbyAh4fs0FqPYWGs5qBTbytD22z7lo0BoCYnUQAvD_BwE
3. https://www.barnesandnoble.com/b/free-ebooks/nook-books/alternative-medicine-natural-healing/herbal-medicine/_/N-ry0Z8qaZ11iu
4. <http://cms.herbalgram.org/heg/volume8/07July/HerbalEBooks.html?t=1310004932&ts=1579066352&signature=1dd0d5aef818b19bcdcd6c063a78e404>
5. <https://www.dattanibookagency.com/books-herbs-science.html>
6. <https://www.springer.com/gp/book/9783540791157>

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low (1)

CORE V - TAXONOMY OF ANGIOSPERMS AND ECONOMIC BOTANY

Title of the Course		PLANT TAXONOMY OF ANGIOSPERMS AND ECONOMIC BOTANY					
Paper Number		CORE V					
Category	Core	Year	I	Credits	4	Course Code	
		Semester	II				
Instructional Hours Per week		Lecture	Tutorial		Lab Practice	Total	
		3	2		-	5	
Pre-requisite		Prior knowledge on morphological, anatomical characteristics and uses of plants.					
Learning Objectives		1. To be familiar with the basic concepts and principles of plant systematics.					
		2. To develop a suitable method for correct characterization and identification of plants.					
		3. To understand the importance of taxonomic relationships in research of plant systematics.					
		4. To provide information on various classification systems					
		5. To know about the economic importance of plants.					
UNIT	CONTENTS						
I	TAXONOMY AND SYSTEMATICS Botanical Exploration and Contribution with special reference to India by William Roxburgh, J. D. Hooker, Robert Wright, Nathaniel Wallich and Gamble, J. S. Principles of classification as proposed – Artificial – Linnaeus, Natural – Bentham and Hooker, Phylogenetic system - Hutchinson, Modern – Takhtajan. Botanical gardens and herbaria of world, preparation and maintenance of Herbarium, Botanical survey of India – its organization and role.						
II	MODERN TRENDS IN TAXONOMY Modern trends in Taxonomy, Chemotaxonomy, Numerical Taxonomy, Biosystemics. ICBN uninominal systems - genesis binomial nomenclature, importance and principle. Important articles, typification, principles of priority, effective and valid publication, author citation, recommendations and amendments of code. Glossories and dictionaries, Taxonomic Literature (Index Kewensis).						
III	SYSTEMATIC ANALYSIS OF PLANTS-I Polypetalae, Nymphaeaceae, Sterculiaceae, Portulacaceae, Rhamnaceae, Vitaceae, Sapindaceae, Combretaceae and Apiaceae.						
IV	SYSTEMATIC ANALYSIS OF PLANTS-II Gamopetalae, Sapotaceae, Oleaceae, Boraginaceae, Scrophulariaceae, Bignoniaceae, Convolvulaceae, Acanthaceae, Verbenaceae. Monochlamydeae, Nyctaginaceae, Aristolochiaceae, Casuarinaceae. Monocots – Orchidaceae, Amaryllidaceae, Liliaceae, Commelinaceae, Cyperaceae.						
V	ECONOMIC BOTANY General account on utilization of selected crop plants: (i) Cereals (rice and wheat) – (ii) Pulses (red gram and black gram), (iii) Drug yielding plants (<i>Withania somnifera</i> and <i>Coleus aromaticus</i>) (iv) Oil yielding plants (Groundnut, sunflower). (v) Sugar						

	yielding plants (sugarcane and sugar beet), (vi) Spices and condiments (<i>Cardamom</i> , <i>Cinnamon</i>). (vii) Commercial crops - fibre (jute), (viii) Timber (Teak and red sanders wood), (ix) Resins and gums (<i>Asafoetida</i> and Gum arabic) – (x) Essential oils (lemon grass and menthol), (xi) Beverages (tea, coffee), (xii) Plants used as avenue trees for shade, pollution control and aesthetics (xiii) Energy plantation - uses of <i>Casuarina</i> .
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Course Outcomes

CO	Course outcomes – on completion of this course, the students will be able to	Programme outcomes
CO 1	Recollect the basic concepts of morphology of leaves, flowers. Identify the types of compound leaves, inflorescence and fruits Describe their characteristic features	K1, K2 K3
CO 2	Explain the principles of taxonomy. Summarize the taxonomic hierarchy. Define Binomial nomenclature. Group Activity –Construct key preparation	K1, K2 K5, K6
CO 3	Explain the various types of classification. Distinguish its advantages and disadvantages Construction of floral formula and floral diagram.	K1, K2 K3, K4
CO 4	Illustrate and explain the characteristic features and list out the economic importance of the families Field trip to local botanical garden and regional botanical garden.	K1, K2 K3, K4
CO 5	Illustrate and explain the characteristic features and list out the Economic importance of the families.	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. Pandey, B.P. 2013. Taxonomy of Angiosperms, S. Chand Publishing, New Delhi.
2. Sharma, O.P. 2017. Plant Taxonomy. (II Edition).The McGraw Hill Companies.
3. Singh, G. 2007. Plant systematics theory and practices. Oxford and IBH Publishing Co.
4. Jain, S.K and Rao R.R. 1993. A handbook of field and herbarium methods. Today and Tomorrow Publ.
5. Pandurangan, A.G., Vrinda, K.B and Mathew Dan. 2013. Frontiers in plant taxonomy. JNTBGRI, Thiruvananthapuram, Kerala.
6. Vardhana, R. 2009. Economic Botany. 1st ed. Sarup Book Publishers Pvt Ltd. New Delhi.
7. Subramaniam, N.S. 1997. Modern plant taxonomy. Vikas Publishing House, New Delhi.

Reference Books

1. Wallis, T.E. 1999. Text book of Pharmacognosy. CBS Publishers and Distributors, New Delhi.
2. Kumaresan, V and Annie Regland. 2004. Taxonomy of Angiosperms systematic Botany, Economic Botany, Botany & Ethnobotany.
3. Anonymous, 2004. Cultivation of Selected Medicinal Plants. National Medicinal Plants Board, Govt. of India, New Delhi.
4. Vallabh. 2000. Practical Pharmacognosy, Kolkata. New Delhi.
5. Acharya Vipul Rao. 2000. Herbal cure for common diseases. Diamond books, Pvt. Ltd.
6. Dey, A.C. 1998. Indian medicinal plants used in Ayurvedic preparations, Bishen Singh Mahendra Pal Singh.
7. Sathya, S., Jaiganesh, K.P and Sudha, T. 2019. Current Trends in Herbal Drug Technology. Pharmacy Council of India New Delhi.
8. Mohamad Ali. 2009. Pharmacognosy and Phytochemistry. CBS Publications & Distribution, New Delhi, Volume.1.
9. Lewis, W.H and M.P.F. Elwin Lewis. 1976. Medical Botany. Plants affecting Man's Health. A Wiley Inter Science Publication. John Wiley and Sons, New York.

Web resources

1. <https://www.ipni.org/>
2. <http://www.theplantlist.org/>
3. <https://www.amazon.in/PLANT-TAXONOMY-Sharma/dp/0070141592>
4. <https://www.tropicos.org/home>
5. <http://apps.kew.org/herbcat/gotoHerbariumGrowthPage.do>
6. <https://www.absbooksindia.com/shop/science/botany/textbook-of-economic-botany>

Mapping with Programme Outcomes:

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

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

CORE VI: PLANT ANATOMY AND EMBRYOLOGY OF ANGIOSPERMS

Title of the Course		PLANT ANATOMY AND EMBRYOLOGY OF ANGIOSPERMS					
Paper Number		CORE VI					
Category	Core	Year	I	Credits	4	Course Code	
		Semester	II				
Instructional Hours Per week		Lecture	Tutorial		Lab Practice	Total	
		3	2		--	5	
Pre-requisite		1. To acquire knowledge on the anatomical structure and reproductive phase of angiosperms.					
Learning Objectives		2. Learn the importance of plant anatomy in plant production systems.					
		3. Classify meristems and identify their structures, functions and roles in monocot and dicot plants growth and secondary growth of woody plants.					
		4. Understand the mechanism underling the shift from vegetative to reproductive phase.					
		5. Trace the development of male and female gametophyte.					
		6. Understand the recent advances in palynology.					
UNIT	CONTENTS						
I	CELL WALL: Morphological and physico-chemical changes; Plasmodesmata- types of pits – growth of cell wall – formation of intercellular spaces; Meristems: Classifications: Theories of shoot and root apices, Cytological zonation in shoot apex. Vascular Cambium: Composition and organization – multiplicative and additive divisions. Xylem: Primary and secondary xylem – tracheary elements and vessels – vesselless dicots – xylem rays and axial parenchyma of angiosperm wood; Dendrochronology – grain, texture and figure in wood; reaction wood; ring porous and diffuse porous wood. Phloem: Ultra structure and ontogeny of sieve tube elements and companion cell. Evolution of tracheary elements.						
II	PERIDERM: Structure, organization and activity of phellogen. Polyderm and Rhytiderm – wound periderm. Normal secondary thickening in Dicots; Anomalous secondary growth in Dicots (Amaranthaceae, Aristolochiaceae, Bignoniaceae, Piperaceae, Nyctaginaceae) and arborescent Monocots. Primary thickening in palms; Ontogeny of leaf, Structure and types of Stomata; Leaf abscission; Major nodal types; Kranz anatomy and its significance. Microtechnique: Principle of killing and fixation, dehydration and rehydration of botanical specimens. Stains: Principle of double staining (fast-green and light green) of free hand sections; Protocol for serial sectioning of paraffin wax impregnated specimens; Mounting and mounting media.						
III	MICROSPORANGIUM AND MALE GAMETOPHYTE: Structure and development of Anther; Ultrastructure and physiology of anther tapetum; Male gametophyte; Palynology: Morphology and ultrastructure of pollen wall, pollen kitt, pollen analysis, pollen storage, pollen sterility and pollen						

	physiology.
IV	MEGASPORANGIUM AND FEMALE GAMETOPHYTE: Structure and development of Megasporangium; Types of ovules, Endothelium, obturator and nucellus. Megasporogenesis: Female gametophyte: Structure, types, haustorial behavior and Nutrition of embryo sacs. Fertilization: Double fertilization and triple fusion; Endosperm: Development of endosperm, types, physiological efficiency of endosperm haustoria and functions; Ruminant endosperm. Embryogeny: Development of monocot (Grass) and dicot (Crucifer) embryos.
V	POLYEMBRYONY: Causes of Polyembryony, classification, induction and practical application. Apomixis and its significance. Seed and Fruit development and role of growth substances. Parthenocarpy and its importance.

Course outcomes

CO	Course outcomes – on completion of this course, the students will be able to	Programme outcomes
CO1	Learn the structures, functions and roles of apical vs lateral meristems in monocot and dicot plant growth.	K1 & K2
CO2	Study the function and organization of woody stems derived from secondary growth in dicot and monocot plants.	K1 & K4
CO3	Apply their idea on sectioning and dissection of plants to demonstrate various stages of plant development.	K2 & K6
CO4	Understand the various concepts of plant development and reproduction.	K3 & K6
CO5	Profitably manipulate the process of reproduction in plants with a professional and entrepreneurial mindset.	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. Bhojwani, S.S. Bhatnagar, S.P and Dantu, P.K. 2015. The Embryology of Angiosperms (6th revised and enlarged edition). Vikas Publishing House, New Delhi.
2. Maheshwari, P. 1963. Recent Advances in Embryology of Angiosperms. Intl. Soc. Plant Morphologists, New Delhi.
3. Sharma, P.C. 2017. Text Book of Plant Anatomy. Arjun Publishing House, New Delhi.
4. Pandey. S.N and Ajanta Chandha. 2006. Plant Anatomy and Embryology. Vikas Publishing House Pvt. Ltd, New Delhi.

- Narayanaswamy, S. 1994. Plant Cell and Tissue Culture. Tata McGraw Hill Ltd. New Delhi.

Reference Books

- Krishnamurthy, K.V. 1988. Methods in Plant Histochemistry. S. Viswanathan & Co., Madras.
- Swamy, B.G.L and Krishnamurthy. K.V 1990. From flower to fruits, Tata – McGraw Hill publishing Co Ltd, New Delhi.
- Pullaiah, T., Lakshiminarayana, K and Hanumantha Rao, B. 2006. Text book of Embryology of Angiosperms. Regency Publications, New Delhi.
- Bierhorst, D.W. 1971. Morphology of Vascular Plants. Macmillan publishers, New York.
- Crang, R., Lyons-Sobaski, S and Wise, R. 2018. Plant Anatomy: A Concept-Based Approach to the Structure of Seed Plants. Springer International Publishing.
- Cutler, D. F., Botha, T and Stevenson, D.W. 2008. Plant Anatomy: An Applied Approach. Blackwell Publishing, Malden, USA.
- Eames, A.J and Mac Daniels, L.H. 2013. Introduction to Plant Anatomy, 3rd Edition. McGraw-Hill Inc., US.

Web resources

- <https://www.ipni.org/>
- <http://www.theplantlist.org/>
- https://faculty.etsu.edu/liuc/plant_anatomy_sites.htm
- http://aryacollegeludhiana.in/E_BOOK/Botany/plant_anatomy.pdf
- <https://www.uou.ac.in/sites/default/files/slm/BSCBO-202.pdf>
- http://greenlab.cirad.fr/GLUVED/html/P1_Prelim/Bota/Bota_typo_014.html
- <https://www.askiitians.com/>

Mapping with Programme Outcomes:

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

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

CORE VII - ECOLOGY, PHYTOGEOGRAPHY, CONSERVATION BIOLOGY & INTELLECTUAL PROPERTY RIGHTS

Title of the Course		ECOLOGY, PHYTOGEOGRAPHY, CONSERVATION BIOLOGY & INTELLECTUAL PROPERTY RIGHTS					
Paper Number		CORE VII					
Category	Core	Year	I	Credits	4	Course Code	
		Semester	II				
Instructional Hours Per week		Lecture	Tutorial		Lab Practice	Total	
		3	2		-	5	
Pre-requisite		Understanding the environmental factors impacting biodiversity is crucial after taking this course and Basic understanding of how laws are structured and interpreted.					
Learning Objectives		1. To analyze and comprehend the fundamental ideas of plant ecology as a scientific study of environment.					
		2. To study the plant communities and plant succession stages.					
		3. To be aware of the causes, impacts and control measures of pollution.					
		4. To study biodiversity management and conservation.					
		5. To enhance the knowledge of the students and equip them in evaluate and protecting invaluable components of nature and interactions with the environment.					
UNIT	CONTENTS						
I	ECOLOGICAL PRINCIPLES: Introduction – History, scope, concepts. Diversity of plant life; growth form, life form. Basic concepts of population ecology– population dynamics – Regulation of population density. Basics concepts of community–characteristics, composition, structure, origin and development – community dynamics –t rends of succession.						
II	ECOSYSTEM ECOLOGY AND RESOURCE ECOLOGY: Introduction – kinds – major types – functional aspects of ecosystem: Food chain and food web, energy flow, laws of thermodynamics. Productivity–primary and secondary productivity –GPP & BPP. Resource Ecology: Energy resources; renewable and non-renewable. Soil: Formation, types and profile-erosion and conservation, Water resources – conservation and management. Environment Deterioration: Climate change – Greenhouse effect and global warming, ozone depletion and acid rain. Waste management - Solid and e-waste, recycling of wastes. Eco-restoration/remediation ecological foot prints - carbon foot print - ecolabeling - environmental auditing.						
III	PHYTOGEOGRAPHY: Phytogeographical Zones - Vegetation types of India and Tamil Nadu, Distribution: Continuous, Discontinuous and Endemism. Theories of discontinuous distribution: Continental drift, Age and area hypothesis. Geographical Information System (GIS) Principles of remote sensing and its applications.						

IV	BIODIVERSITY AND CONSERVATION ECOLOGY: Definition, types of biodiversity – values of biodiversity – Hot spots – Threats to biodiversity: habitat loss. Poaching of wild life – Invasion of exotic species, man and wild life conflicts-endangered and endemic plants species of India, Red list categories of IUCN, Biotechnology assisted plant conservation- <i>insitu</i> and <i>exsitu</i> methods.
V	INTELLECTUAL PROPERTY RIGHTS: Intellectual Property Rights – Introduction, Kinds of Intellectual Property Rights- Patents, Trademarks, Copyrights, Trade Secrets. Need for intellectual property right, Advantages and Disadvantages of IPR. International Regime Relating to IPR – TRIPS, WIPO, WTO, GATTs. IPR in India genesis and development. Geographical Indication – introduction, types. Patent filing procedure for ordinary application.

Course Outcomes

CO	Course outcomes – on completion of this course, the students will be able to	Programme outcomes
CO 1	Understand the scope and importance of population ecology, plant communities and ecosystem ecology	K1 & K2
CO 2	Understand the applied aspect of environmental botany.	K1 & K4
CO 3	Identify different plant communities, categorize plant biomes and identify threatened, endangered plant species and create awareness program in protection of biodiversity.	K2 & K6
CO 4	Illustrate and explain the characteristic features and list out the economic importance of the families Field trip to local botanical garden and regional botanical garden.	K3 & K6
CO 5	Analyze insight into the vegetation types, species interaction and their importance and the factors influencing the environmental conditions.	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. Sharma, P.D. 2017. Ecology and Environment- Rastogi Publication, Meerut.
2. Pushpa Dahiya and Manisha Ahlawat. 2013. Environmental Science- A New Approach, Narosa Pub. House, New Delhi.pp.2.1-2.60.
3. Eugene Odum, 2017. Fundamentals of Ecology 5th Ed. Cengage, Bengaluru.
4. Sharma P.D. 2019. Plant ecology and phytogeography, Rastogi Publications, Meerut.
5. Neeraj Nachiketa. 2018 Environmental & Ecology A Dynamic approach. 2nd Edition GKP Access Publishing.
6. Chandra, A.M and Ghosh, S.K. 2010. Remote sensing and Geographical Information System, Narosa Publishing House Pvt. Ltd. New Delhi.

Reference Books

1. Keddy, P.A. 2017. Plant Ecology: Origins, processes, consequences. 2nd ed. Cambridge University Press. ISBN. 978-1107114234.
2. Krishnamurthy, K.V. 2004. An Advanced Text Book of Biodiversity- Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi.
3. Ahuja, V.K. 2017. Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.
4. Nithyananda, K.V. 2019. Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.
5. Venkataraman M. 2015. An introduction to Intellectual property rights. Create space Independent Pub.North Charleston, USA.
6. Kormondy, E.J. 2017. Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.
7. Gillson, L. 2015. Biodiversity Conservation and Environmental Change, Oxford University Press, Oxford.

Web resources

1. <https://www.intechopen.com/chapters/56171>
2. <https://plato.stanford.edu/entries/biodiversity/>
3. <https://sciencing.com/four-types-biodiversity-8714.html>.
4. <https://www.iaea.org/topics/plant-biodiversity-and-genetic-resources>
5. http://www.bsienvi.nic.in/Database/Status_of_Plant_Diversity_in_India_17566.aspx
6. <https://www.youtube.com/watch?v=qtTLiQoYTyQ>
7. <https://www.youtube.com/watch?v=208B6BtX0Ps>
8. <https://www.youtube.com/watch?v=6p1TpVJYTds>
9. <https://www.amazon.in/Intellectual-Property-Rights-Vijay-Durafe-ebook/dp/B08N4VRQ86>

Mapping with Programme Outcomes:

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

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

CORE VIII- LABORATORY COURSE – 3

Title of the Course		LABORATORY COURSE – 3 COVERING CORE PAPER V					
Paper Number		CORE VIII					
Category	Core	Year	I	Credits	2	Course Code	
		Semester	II				
Instructional Hours Per week		Lecture	Tutorial	Lab Practice	Total		
		-	1	2	3		
Pre-requisite		Theoretical understanding of plant taxonomy, ecology and phytogeography, plant anatomy and embryology as well as basic laboratory skills for the relevant core course.					
Learning Objectives		1. Understand and develop skill sets in plant morphological, floral characteristics and artificial key preparation.					
		2. Expedite skilled workers to carry out research in frontier areas of plant science.					
		3. Classify meristems and identify their structures, functions and roles in monocot and dicot plants growth and secondary growth of woody plants					
		4. Learn the importance of plant anatomy in plant production systems.					
		5. Know about different vegetation sampling methods.					
UNIT	EXPERIMENTS						
I	TAXONOMY AND ECONOMIC BOTANY OF ANGIOSPERMS Preparation of dichotomous key						
II	Description of a species, live specimens of the families mentioned in the theory.						
III	Study the products of plants mentioned in the syllabus of economic botany with special reference to the morphology, botanical name and family.						
IV	Workout nomenclatural problems regarding priority and author citations. Identification of Binomial using flora (J.S. Gamble).						
V	Identification of common plants in the families mentioned in the theory						
Field trip: A field trip at least 2-3 days to a floristically rich area to study plants in nature and field report submission of not less than 10 herbarium sheets representing the families studied.							

Course Outcomes

CO	Course outcomes – on completion of this course, the students will be able to	Programme outcomes
CO 1	To gain recent advances in plant morphological and floral characteristics.	K1
CO 2	Understand about different floral characteristics and artificial key preparation which employed for plant identification and conservation.	K2
CO 3	Identification of genus and species of locally available wild plants.	K4 & K5
CO 4	Familiarize immense knowledge on economic importance of higher plants.	K3
CO 5	Gain hands on experience on herbarium preparation techniques.	K3

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. Subramaniam, N.S. 1996. Laboratory Manual of Plant Taxonomy. Vikas Publishing House Pvt. Ltd., New Delhi.
2. Gokhale, S.B., Kokate, C.K. and Gokhale, A. 2016. Pharmacognosy of Traditional Drugs. NiraliPrakashan, 1st Edition. ISBN: 9351642062.
3. Joshi, S.G. 2018. Medicinal Plants. Oxford & IBH Publishing C., Pvt., Ltd., New Delhi. ISBN: 9788120414143.

Reference Books

1. Aler Gingauz.2001. Medicinal Chemistry. Oxford University Press & Wiley Publications.
2. Mann J. Davidson, R. Sand J.B. Hobbs, D.V. Banthorpe, J.B .Harborne. 1994. *Natural Products*.Longman Scientific and Technical Essex.
3. Gopalan,C., B.V. Ramasastriand S.C. Balasubramanian. 1985. Nutritive Value of Indian Foods. National Institute of Nutrition, Hyderabad.
4. Harborne. J.B. 1998. Phytochemical methods. A guide to modern techniques of Plant Analysis, Chapman and Hall publication, London.
5. Traditionalplantmedicinesassourcesofnewdrugs.P.JHoughtoninPharmacognosy.Treaseand Evan's.16Ed.2009.

Web resources

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

Mapping with Programme Outcomes:

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

S - Strong (3)

M - Medium (2)

L – Low (1)

CORE IX - LABORATORY COURSE - 4

Title of the Course		LABORATORY COURSE – 4 COVERING CORE PAPERS VI AND VII					
Paper Number		CORE IX					
Category	Core	Year	I	Credits	1 + 1	Course Code	
		Semester	II				
Instructional Hours Per week		Lecture	Tutorial	Lab Practice		Total	
		-	-	1 + 2		3	
Pre-requisite		Theoretical understanding of plant taxonomy, ecology and phytogeography, plant anatomy and embryology as well as basic laboratory skills for the relevant core course.					
Learning Objectives		1. Classify meristems and identify their structures, functions and roles in monocot and dicot plants growth and secondary growth of woody plants					
		2. Expedite skilled workers to carry out research in frontier areas of plant science.					
		3. Learn the importance of plant anatomy in plant production systems.					
		4. Know about different vegetation sampling methods.					
		5. Know about the remote sensing techniques					
UNIT	EXPERIMENTS						
I	ANATOMY 1. Study of shoot apex of <i>Hydrilla</i> 2. Observation of cambial types. 3. Sectioning and observation of nodal types. 4. Study of anomalous secondary growth of the following STEM - <i>Nyctanthus</i> , <i>Bignonia</i> , <i>Piper</i> and <i>Mirabilis</i> . ROOT: <i>Acyranthus</i> 5. Observation of stomatal types by epidermal peeling. 6. Maceration of wood and observation of the components of xylem. 7. Double staining technique to study the stem anomali.						
II	EMBRYOLOGY 1. Observation of T.S. of anther. 2. Observation of ovule types. 3. Observation of mature embryo sacs. 4. Dissection and observation of embryos (globular and cordate embryos). 5. Study of pollen morphology 6. Study of <i>in vitro</i> pollen germination. 7. Observation of endosperm types.						
III	ECOLOGY, 1. Determination of the quantitative characters of a plant community by quadrat method, line transect method (abundance, density, dominance, species diversity, frequency), Raunkiaer's life forms method, Shannon-Weiner Index in vegetative lands.						

	2. Estimation of above ground and below ground biomass in a grazing land employing minimum size of quadrat.
IV	ECOLOGY, 1. To determine soil moisture, porosity and water holding capacity of soil collected from varying depth at different locations. 2. Estimation of organic carbon (Walkley - Black method). 3. Determination of dissolved oxygen. 4. Estimation of carbonate. 5. Estimation of bicarbonate.
V	PHYTOGEOGRAPHY, CONSERVATION BIOLOGY & INTELLECTUAL PROPERTY RIGHTS 1. Mapping of world vegetation 2. Mapping of Indian vegetation. 3. Remote sensing – Analysing and interpretation of Satellite photographs-Vegetation/ weather. 4. Visit to remote sensing laboratory (Regional Meteorological Centre).

Course Outcomes

CO	Course outcomes – on completion of this course, the students will be able to	Programme outcomes
CO 1	Recall or remember the information including basic and advanced in relation with plant anatomy and embryology.	K1 & K2
CO 2	Apply their idea on sectioning and dissection of plants to demonstrate various stages of plant development.	K1 & K4
CO 3	Know about different vegetation sampling methods.	K2 & K6
CO 4	Know about the water and soil analysing technique	K3 & K6
CO 5	Gain knowledge about the remote sensing and mapping	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. Cutler, D.F., Botha, C.E.J., Stevenson, D.W., and William, D. 2008. Plant anatomy: an applied approach (No. QK641 C87). Oxford: Blackwell, UK.
2. Sundara, R. S. 2000. Practical manual of plant anatomy and embryology. Anmol Publ. PVT LTD, New Delhi.
3. Panshin, A.J and C. de Zeeuw.1980.Textbook of wood technology. Structure, identification and uses of the commercial woods of the United States and Canada. Fourth Edition. New York: McGraw-Hill Book Company.

- Sharma, H.P. 2009. Plant Embryology: Classical and Experimental, Bombay Popular Prakashan, ISBN-8173199698, 9788173199691

Reference Books

- Harborne. J.B. 1998. Phytochemical methods. A guide to modern techniques of Plant Analysis, Chapman and Hall publication, London.
- Traditional plant medicines as sources of new drugs. P.J. Houghton in Pharmacognosy. Trease and Evan's. 16 Ed. 2009.
- Sundara Rajan, S, 2003. Practical Manual of Plant Anatomy and Embryology 1st ed, Anmol Publications, ISBN-812610668.
- Katherine Esau. 2006. Anatomy of Seed Plants. 2nd edition, John Wiley and Sons.

Web resources

- <https://studyfrnd.com/pharmacognosy-and-phytochemistry-book/>
- <https://www.youtube.com/watch?v=Inm5oE1U8qw>
- <https://www.youtube.com/watch?v=GlCOQijkIKc>
- <https://www.jove.com/science-education/11090/basic-plant-anatomy-roots-stems-and-leaves>

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low (1)

ELECTIVE III – 1. MEDICINAL BOTANY

Title of the Course		MEDICINAL BOTANY						
Paper Number		ELECTIVE III						
Category	Elective	Year	I	Credits	2	Course Code		
		Semester	II					
Instructional Hours Per week		Lecture	Tutorial		Lab Practice	Total		
		2	1		--	3		
Pre-requisite		Understanding the uses of medicinal plants and its conservation.						
Learning Objectives		1. To understand the uses and effects of medicinal plants and herbal supplements.						
		2. To gain knowledge about the historical and modern uses of plants in medicine.						
		3. To gain insights into the perspectives of ethnobotanical research.						
		4. To know the various methods of harvesting, drying and storage of medicinal herbs.						
		5. To create new strategies to enhance growth and quality check of medicinal herbs.						
UNIT	CONTENTS							
I	HISTORY AND TRADITIONAL SYSTEMS OF MEDICINE: Scope and Importance of Medicinal Plants; Traditional systems of medicine - Definition and Scope. Classical health traditions - Naturopathy, Siddha, Ayurveda, Homeopathy, Unani and Materia Medica. Ayurveda: History, origin, panchama habhutas, saptadhatu and tridosha concepts, Rasayana, plants used in Ayurvedic treatments, Siddha: Origin of Siddha medicinal systems, Basis of Siddha system, plants used in Siddha medicine. Unani: History, concept: Umoor-e-tabiya, tumors treatments/ therapy, polyherbal formulations.							
	II	PHYTOCHEMISTRY AND PHARMACOGNOSY: Phytochemistry, important phytoconstituents, their plant sources, medicinal properties. Histochemistry – definition, principles, staining methods. Biological stains – bright field dyes and fluochromes, detection and localization of phytochemicals. Raw drugs, authenticity, study through physical, microscopic and analytical methods. Different types of formulations. Adulteration and Admixtures.						
		III	ACTIVE PRINCIPLE & DRUG DISCOVERY: Brief description of selected plants, Active principles, biochemical properties and medicinal uses of Guggul (<i>Commiphora</i>) for hypercholesterolemia, <i>Boswellia</i> for inflammatory disorders, Arjuna (<i>Terminalia arjuna</i>) for cardio protection, turmeric (<i>Curcuma longa</i>) for wound healing, antioxidant and anticancer properties, Kutaki (<i>Picrorhiza kurroa</i>) for hepatoprotection, Opium Poppy for analgesic and antitussive, <i>Salix</i> for analgesic, <i>Cinchona</i> and <i>Artemisia</i> for Malaria, <i>Rauwolfia</i> as tranquilizer, <i>Belladonna</i> as anticholinergic, <i>Digitalis</i> as cardiotoxic, <i>Podophyllum</i> as antitumor, <i>Stevia rebaudiana</i> for antidiabetic, <i>Catharanthus roseus</i> for anticancer. Bioprospecting, drug discovery from plants with reference to diabetes and cancer. Product development and quality control.					

IV	<p>CONSERVATION AND AUGMENTATION: Significance of Cultivation, management, policies for conservation and sustainable use of medicinal plants. Conservation of endemic and endangered medicinal plants, Red list criteria; <i>In situ</i> conservation: Biosphere reserves, sacred groves, National Parks; <i>Ex situ</i> conservation: Botanic Gardens, Ethno medicinal plant Gardens. Propagation of Medicinal Plants: seeds, cuttings, layering, grafting and budding.</p>
V	<p>ETHNO BOTANY AND FOLK MEDICINE: Concepts and definition of Ethno botany and folk medicines. A brief history of ethnobotanical studies – globally & locally. Methods to study ethno botany; Applications of Ethno botany: Folk medicines of ethno botany, ethno medicine, ethno ecology, ethnic communities of India. Understanding the traditions of tribes in Tamil Nadu – Irulas and Kanis. Repository of Ethnobotanical data – Archeology, inventories, folklore and literature. Traditional Knowledge Sharing - Prior information consent, interviews, questionnaires and knowledge partners. Plants associated with culture, social, religious and medicinal purposes. Commercial use of traditional knowledge – ethics, IPR, biopiracy, equitable benefits sharing models.</p>

Course Outcomes

CO	Course outcomes – on completion of this course, the students will be able to	Programme outcomes
CO 1	Recognize plants and relate to their medicinal uses.	K1
CO 2	Explain about the phytochemistry, pharmacognosy and bioprospecting of medicinal plant extracts.	K2
CO 3	Apply techniques for conservation and propagation of medicinal plants.	K3
CO 4	Analyze and decipher the significance of various methods of harvesting, drying and storage of medicinal herbs.	K4
CO 5	Develop new strategies to enhance growth and quality check of medicinal herbs considering the practical issues pertinent to India.	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. AYUSH (www.indianmedicine.nic.in). 2014. *About the systems — An overview of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy*. New Delhi: Department of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy (AYUSH), Ministry and Family Welfare, Government of India.
2. Bhat, S.V., Nagasampagi, B.A., & Meenakshi, S. 2009. *Natural Products – Chemistry and Applications*. Narosa Publishing House, India Ltd.

3. CSIR- Central Institute of Medicinal and Aromatic Plants, Lucknow. 2016. *AushGyanya: Handbook of Medicinal and Aromatic Plant Cultivation*.
4. Kapoor, L. D. 2001. Handbook of Ayurvedic medicinal plants. Boca Raton, FL: CRC Press.
5. Saroya, A.S. 2017. Ethno botany. ICAR publication.
6. Sharma, R. 2003. Medicinal Plants of India-An Encyclopedia. Delhi: Daya Publishing House.
7. Sharma, R. 2013. Agro Techniques of Medicinal Plants. Daya Publishing House, Delhi.
8. Thakur, R. S., H. S. Puri, and Husain, A. 1989. *Major medicinal plants of India*. Central Institute of Medicinal and Aromatic Plants, Lucknow, India.

Reference Books

1. Akerele, O., Heywood, V and Synge, H. 1991. The Conservation of Medicinal Plants. Cambridge University Press.
2. Evans, W.C. 2009. Trease and Evans Pharmacognosy, 16th edn. Philadelphia, PA: Elsevier Saunders Ltd.
3. Jain, S.K. and Jain, Vartika. (eds.). 2017. Methods and Approaches in Ethnobotany: Concepts, Practices and Prospects. Deep Publications, Delhi
4. Amruth. 1996. The Medicinal plants Magazine (All volumes) Medicinal plant Conservatory Society, Bangalore.
5. Bhattacharjee, S.K. 2004. Hand Book of Medicinal plants. Pointer Publishers, Jaipur.
6. Handa, S.S and V.K. Kapoor. 1993. Pharmacognosy. Vallabh Prakashan, New Delhi.

Web resources

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

Mapping with Programme Outcomes:

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

S - Strong (3)

M - Medium (2)

L – Low (1)

ELECTIVE III – 2. PHYTOCHEMISTRY

Title of the Course		PHYTOCHEMISTRY					
Paper Number		ELECTIVE II					
Category	Elective	Year	I	Credits	2	Course Code	
		Semester	I				
Instructional Hours Per week		Lecture	Tutorial	Lab Practice		Total	
		2	1	--		3	
Pre-requisite	Basic understanding of plant metabolites						
Learning Objectives	1. To comprehend the various classes of phytochemicals present in the plant kingdom.						
	2. To understand the biosynthetic processes through which diverse phytochemicals are synthesized and to study their structural and functional characteristics.						
	3. To learn about the isolation of different phytochemicals using the state-of-the-art techniques.						
	4. To learn about the application of different phytochemicals to cure diseases in human and animals.						
	5. To understand the information of the traditional system of medicine.						
UNIT	CONTENT						
I	SECONDARY METABOLITES AND CLASSIFICATION Phytochemistry: Definition, history, principles. Secondary metabolites: definition, classification, occurrence and distribution in plants, functions, chemical constituents. Alkaloids, terpenoids, flavonoids, steroids, and coumarins.						
II	ISOLATION AND QUANTIFICATION OF PHYTOCHEMICALS Techniques for isolation of medicinally important biomolecules: solvent extraction, chemical separations, steam distillation, soxhlet extraction. Purification, concentration, determination and quantification of compounds (TLC, Column, HPLC). Characterization of phytochemicals: spectroscopic methods.						
III	BIOSYNTHETIC PATHWAYS AND APPLICATION OF PHYTOCHEMICALS Biosynthetic pathways of secondary compounds: Shikimic pathway; Mevalonic Acid Pathway; Pathways for commercially important phytochemicals: Taxol and <i>Vinca</i> alkaloids. Applications of phytochemicals in medicine, pharmaceuticals, food, flavour and cosmetic industries.						
IV	HERBALISM AND ETHNOBOTANY Herbs and healing: Historical perspectives: local, national and global level; Herbal cultures: origin and development of human civilizations; Ethnobotany and Ethno medicine; Development of European, South and Central American, African, Indian, Chinese, and South East Asian Herbal Cultures.						
	TRADITIONAL SYSTEM OF MEDICINE Classical health traditions: Systems of medicine: origin and development of biomedicine; Indian Systems of Medicine (Ayurveda, Siddha, Unani, Tibetan, Yoga						

V	and Naturopathy) Ayurveda: Historical perspective, <i>Athuravritta</i> (disease management and treatment which involves eight specialties including Internal medicine and surgery); Fundamental principles of Ayurveda: Panchabhootha theory, Thridosha theory, Saptadhatu theory and <i>Mala</i> theory; Ayurvedic Pharmacology Ayurvedic Pharmacopoeia; <i>Vrikshayurveda</i> .
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Course Outcomes

CO	Course outcomes – on completion of this course, the students will be able to	Programme outcomes
CO 1	Understand the role of plants in the survival of human beings and other Organisms.	K1
CO 2	Recognition of the contribution made by primitive people in exploration of plant knowledge to alleviate common diseases and development of systems of medicine	K2
CO 3	Gaining knowledge on different classes of phytochemicals present in higher and lower plants species.	K3
CO 4	Demonstrate the various aspects of extraction, isolation and characterization of secondary metabolites	K4 & K5
CO 5	Know the methods of screening of secondary metabolites for various biological properties.	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. Kokate, C.K., Purohit, A.P and Gokhale, S.B. 2010. Pharmacognosy. Vol. I & II. NiraliPrakashan, Pune.
2. Mohamed Ali. 2012. Textbook of Pharmacognosy. CBS Publishers & Distributors Pvt. Ltd., New Delhi.
3. Gokhale, S.B., Kokate, C.K. and Gokhale, A. 2016. Pharmacognosy of Traditional Drugs. NiraliPrakashan, 1st Edition. ISBN: 9351642062. 2.
4. Joshi, S.G. 2018. Medicinal Plants. Oxford & IBH Publishing C., Pvt., Ltd., New Delhi.
5. Kumar, N. 2018. A Textbook of Pharmacognosy. Aitbs Publishers, India.

Reference Books

1. Shah, B.N. 2005. Textbook of Pharmacognosy and Phytochemistry. CBS Publishers & Distributors, New Delhi.

- Harshal A and Pawar. 2018. Practical book of Pharmacognosy and Phytochemistry-Everest Publishing house.
- Varsha Tiwari and Shamim Ahmad. 2018. A practical book of Pharmacognosy and phytochemistry. Nirali prakashan advancement of knowledge.
- Braithwaite, A and F.J. Smith. 1996. *Chromatographic Methods* (5th Edition) Blackie Academic & Professional London.
- Wilson, K and J. Walker (Eds). 1994. Principles and Techniques of Practical Biochemistry (4th Edition) Cambridge University Press, Cambridge.
- Harborne. J.B. 1998. Phytochemical methods. A guide to modern techniques of Plant Analysis, Chapman and Hall publication, London.

Web resources

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

Mapping with Programme Outcomes:

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

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

ELECTIVE III - 3. RESEARCH METHODOLOGY, COMPUTER APPLICATIONS & BIOINFORMATICS

Title of the Course		RESEARCH METHODOLOGY, COMPUTER APPLICATIONS & BIOINFORMATICS					
Paper Number		ELECTIVE III					
Category	Elective	Year	I	Credits	2	Course Code	
		Semester	II				
Instructional Hours Per week		Lecture	Tutorial		Lab Practice	Total	
		2	1		--	3	
Pre-requisite		To impart expertise about analysis and research.					
Learning Objectives		1. To equip students to collect, analyze and evaluate data generated by their own inquiries in a scientific manner.					
		2. To provide an overview on modern equipments that they would help students gain confidence to instantly commence research careers and/or starts entrepreneurial ventures.					
		3. To develop interdisciplinary skills in using computers in botany to learn about the biological database.					
		4. Students aware with the most recent technologies for sequencing and bioinformatics analysis and is able to apply them to the structural and functional genomics of plants.					
		5. Operate various software resources with advanced functions and its open office substitutes.					
UNIT	CONTENTS						
I	Literature collection and citation: bibliography — bibliometrics (scientometrics): definition-laws — citations and bibliography - *biblioscape— plagiarism— project proposal writing — dissertation writing – paper presentation (oral/poster) - E-learning tools- monograph — introduction and writing-Standard operating procedure (SOP) – introduction and preparation — Research Institutions - National and International.						
II	Basic principles and applications of pH meter, UV-visible spectrophotometer, centrifuge, lyophilizer, chromatography- TLC, Gas chromatography with mass spectrum (GC/MS), and HPLC-Scanning electron microscopy-Agarose gel Electrophoresis — Polyacrylamide Gel Electrophoresis – Polymerase Chain Reaction.						
III	Introduction to computers and Bioinformatics. Types of hardware and software operating systems. Fundamentals of networking, operation of networks, telnet, ftp, www, Internet. Biological Research on the web: Using search engines, finding scientific articles.						
IV	Public biological databases, searching biological databases. Use of nucleic acid and protein data banks.						
V	NCBI, EMBL, DDBJ, SWISSPORT, Protein prediction and Gene finding tools. Techniques in Bioinformatics - BLAST, FASTA, Multiple Sequence Analysis.						

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Course Outcomes

CO	Course outcomes – on completion of this course, the students will be able to	Programme outcomes
CO 1	Realize the need of centrifuges and chromatography and their uses in research.	K1
CO 2	Learn the principles and applications of electrophoresis	K2
CO 3	Construct the phylogenetic trees for similar characteristic feature of \ plant genomes and study <i>de novo</i> drug design through synthetic biology.	K3
CO 4	Understand the concept of pairwise alignment of DNA sequences using algorithms.	K4 & K5
CO 5	Interpret the features of local and multiple alignments.	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. Veerakumari, L. 2017. Bioinstrumentation. MJP Publisher, India. p578.
2. SreeRamulu, V.S.1988. Thesis Writing, Oxford& IBH Pub. New Delhi.
3. Kothekar, V and T.Nandi. 2009. An introduction to Bioinformatics. Panima publishing crop, New Delhi.
4. Mani, K and N. Vijayaraj. 2004. Bioinformatics – A Practical Approach.1st Edn. Aparna publication, Coimbatore.
5. Gurumani, N. 2019. Research Methodology: For Biological Sciences, MP. Publishers.

Reference Books

1. Jayaraman, J. 2000. Laboratory manual of Biochemistry, Wiley Eastern Limited, New Delhi 110 002.
2. Pevsner, J. 2015. Bioinformatics and functional genomics. Hoboken, NJ:Wiley-Blackwell.
3. Arthur Conklin W.M and Greg White, 2016. Principles of computer security. TMH. McGraw-Hill Education; 4 edition.
4. Irfan Ali Khan and Attiya Khanum (eds.). 2004. Introductory Bioinformatics. Ukaaz Publications, Hyderabad.
5. Arthur Conklin W.M., and Greg White. 2016. Principles of computer security. TMH., McGraw-Hill Education; 4th edition

6. Mishra Shanthi Bhusan. 2015. Handbook of Research Methodology - A Compendium for Scholars & Researchers, Ebooks2go Inc.
7. Narayana, P.S.D. Varalakshmi, T. Pullaiah. 2016. Research Methodology in Plant Science, Scientific Publishers, Jaipur, Rajasthan.

Web resources

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

Mapping with Programme Outcomes:

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

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

ELECTIVE III – 4. BIOPESTICIDE TECHNOLOGY

Title of the Course		BIOPESTICIDE TECHNOLOGY				
Paper Number		ELECTIVE III				
Category	Elective	Year	I	Credits	2	Course Code
		Semester	II			
Instructional Hours Per week		Lecture	Tutorial	Lab Practice	Total	
		2	1	--	3	
Pre-requisite		Prior knowledge on impact of chemical pesticides on environment and biopesticides.				
Learning Objectives		1. To understand the value and applications of biopesticides.				
		2. To comprehend the various issues related to the use of chemical pesticides in horticulture, forestry, and agriculture.				
		3. To gain knowledge about several biopesticides (bio-insecticides, bio-fungicides, bio-bactericides, bio-nematicides and bio-herbicides).				
		4. To gain knowledge of the techniques for mass production of selected biopesticides.				
		5. To be aware of the application strategies and weeds, nematodes, and disease targets.				
UNIT	CONTENTS					
I	INTRODUCTION Introduction of biopesticides. Biological control, History and concept of biopesticides. Importance, scope and potential of biopesticide. Advantages for the use of biopesticides.					
II	TYPES OF BIOPESTICIDES Classification of biopesticides, botanical pesticides and biorationales. Mass production technology of bio-pesticides. Major classes-Properties and uses of Bioinsecticides, biofungicides, biobactericides, bionematicides and bioherbicides. Importance of neem in organic agriculture.					
III	IMPORTANT BIOINSECTICIDES <i>Bacillus thuringiensis</i> , NPV, entomopathogenic fungi (<i>Beauveria</i> , <i>Metarhizium</i> , <i>Verticillium</i> , <i>Paecilomyces</i>). Biofungicides: <i>Trichoderma</i> , <i>Gliocladium</i> , non-pathogenic <i>Fusarium</i> , <i>Pseudomonas</i> spp., <i>Bacillus</i> spp. Biobactericides: <i>Agro bacterium radiobacter</i> . Bionematicides: <i>Paecilomyces</i> , <i>Trichoderma</i> , Bioherbicides: <i>Phytophthora</i> , <i>Colletotrichum</i> .					
IV	STANDARDIZATION OF BIOPESTICIDES Target pests and crops of important biopesticides and their mechanisms of action. Testing of quality parameters and standardization of biopesticides.					
V	FORMULATION Mass multiplication and formulation technology of biopesticides. Prospects and problems in commercialization and efficiency of biopesticides. Commercial products of biopesticides.					

Course Outcomes

CO	Course outcomes – on completion of this course, the students will be able to	Programme outcomes
CO 1	Understand the issues in use of chemical pesticides and their harmful effects on life.	K1& K2
CO 2	Aware the significance of biopesticides and their beneficial role in controlling insect pests, diseases, nematodes and weeds.	K1 & K4
CO 3	Knowledge on identification of promising biopesticides and their mechanisms of action against insect pests, diseases, nematodes and weeds.	K2 & K6
CO 4	Learn the mass production and formulation technology of selected biopesticides using algorithms.	K3 & K6
CO 5	Knowledge on product development for commercialization of biopesticides.	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)

Recommended texts

1. Johri, J. 2020. Recent Advances in Biopesticides: Biotechnological Applications. New India Publishing Agency (NIPA), New Delhi.
2. Kaushik, N. 2004. Biopesticides for sustainable agriculture: prospects and constraints. TERI Press, New Delhi.
3. Sahayaraj, K. 2014. Basic and Applied Aspects of Biopesticides. Springer India, New Delhi.
4. Tebeest, D. O.2020. Microbial Control of Weeds. CBS Publishers and Distributors, New Delhi.
5. Joshi, S.R. 2020. Biopesticides: A Biotechnological Approach. New Age International (P) ltd. New Delhi.

Reference Books

1. Ainsworth, G.C. 1971. A Dictionary of the Fungi. Commonwealth Mycological Institute, Kew, Surrey, England.
2. Carlile, M.J., Watkinson, S.C and Gooday, G.W. 2001. The Fungi. 2nd Edition. Academic Press, San Diego
3. Manoj Parihar, Anand Kumar. 2021. Biopesticides. Volume 2: Advances in Bio-inoculants. Elsevier.
4. Bailey, A., Chandler, D., Grant, W. P., Greaves, J., Prince, G., Tatchell, M. 2010. Biopesticides: pest management and regulation.Plumx.
5. Manoharachary, C., Singh, H.B., Varma, A. 2020. Trichoderma: Agricultural Applications and Beyond. Springer International Publishing, New York, USA.

6. Nollet, L.M.L and Rathore, H.S. 2019. Biopesticides Handbook. CRC Press, Florida, USA.
7. Anwer, M.A. 2021. Biopesticides and Bioagents: Novel Tools for Pest Management. Apple Academic Press, Florida, USA.
8. Awasthi, L.P. 2021. Biopesticides in Organic Farming: Recent Advances. CRC Press, Florida, USA.
9. Bailey, A., Chandler, D., Grant, W., Greaves, J., Prince, G., Tatchell, M., 2012. Biopesticides: Pest Management and Regulation. CABI, Surrey, UK.
10. Glare, T.R and Moran-Diez, M.E. 2016. Microbial-Based Biopesticides: Methods and Protocols. Humana Press, New Jersey, USA.
11. Gnanamanickam, S.S. 2019. Biological Control of Crop Diseases. CRC Press, Florida, USA.

Web resources

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

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low (1)

ELECTIVE IV- 1. APPLIED BIOINFORMATICS

Title of the Course		APPLIED BIOINFORMATICS					
Paper Number		ELECTIVE IV					
Category	Elective	Year	I	Credits	2	Course Code	
		Semester	II				
Instructional Hours Per week		Lecture	Tutorial		Lab Practice	Total	
		2	1		--	3	
Pre-requisite		Basic knowledge in molecular biology. Familiarity with operations of computers and MS office tools.					
Learning Objectives		1. To learn about the bioinformatics databases, databanks, data format and data retrieval from the online sources.					
		2. To explain the essential features of the interdisciplinary field of science for better understanding biological data.					
		3. To outline the types of biological databases.					
		4. To demonstrate different online bioinformatics tools.					
		5. To summarize the strong foundation for performing further research in bioinformatics.					
UNIT	CONTENTS						
I	BIOINFORMATICS AND INTERNET: Internet Basics – File Transfer Protocol – The World Wide Web –Internet Resources – databases – types – Applications - NCBI Data Model – SEQ – Ids –Biosequences - Biosequence sets – Sequence annotation – Sequence description.						
II	GENBANK SEQUENCE DATABASE: Introduction- Primary And Secondary Databases - Format Vs .Content-Genbank Flatfile – Submitting DNA Sequences to the Databases - DNA/RNA -Population, Phylogenetic, and Mutation Studies - Protein-Only Submissions - Consequences of DNA Model -EST/STS/GSS/HTG/SNP and Genome Centers -Contact points for submission of sequence data to DBJ/EMBL/Genbank.						
III	STRUCTURE DATABASES: Introduction to Structures- Protein Data Bank (PDB) – Molecular Modeling Database at NCBI Structure File Formats - Visualizing Structural Information –Database Structure Viewers – Advanced Structure Modeling – Structure Similarity Searching.						
IV	SEQUENCE ALIGNMENT AND DATABASE SEARCHING: Introduction - Evolutionary Basis of Sequence Alignment – Modular Nature of Proteins – Optimal Alignment Methods – Substitution Scores and Gap Penalties -Database Similarity Searching – FASTA – BLAST (BlastP, BlastN, etc.,) –Position Specific Scoring Matrices, Spliced Alignments.						
V	PREDICTIVE METHODS: Using Protein Sequences Protein Identity Based on Composition – Physical Properties Based on Sequence - Motifs and Patterns - Secondary Structure and Folding Classes – Specialized Structures or Features - Tertiary Structure.						

Course Outcomes

CO	Course outcomes – on completion of this course, the students will be able to	Programme outcomes
CO 1	Familiarize with the tools of DNA sequence analysis.	K1& K2
CO 2	Use and explain the application of bioinformatics.	K1 & K4
CO 3	Master the aspects of protein – protein interaction, BLAST and PSI - BLAST	K2 & K6
CO 4	Describe the features of local and multiple alignments	K3 & K6
CO 5	Interpret the characteristics of phylogenetic methods and Bioinformatics applications.	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. Baxevanis, A.D. & Ouellette, B.F. 2001. Bioinformatics: A practical guide to the analysis of genes and proteins. New York: Wiley-Interscience.
2. Bourne, P.E., & Gu, J. 2009. Structural bioinformatics. Hoboken, NJ: Wiley-Liss.
3. Lesk, A.M. 2002. Introduction to bioinformatics. Oxford: Oxford University Press.
4. Mount, D.W. 2001. Bioinformatics: Sequence and genome analysis. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.
5. Pevsner, J. 2015. Bioinformatics and functional genomics. Hoboken, NJ: Wiley-Blackwell.

Reference Books

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

Web resources

1. Bioinformatics: Algorithms & Applications by Prof. M. Michael Gromiha IIT - Madras. <https://nptel.ac.in/courses/102/106/102106065/#>.

2. Christopher Burge, David Gifford, and Ernest Fraenkel. 7.91. J Foundations of Computational and Systems Biology. Spring 2014. Massachusetts Institute of Technology: MIT Open Course Ware, <https://ocw.mit.edu>
3. <https://link.springer.com/book/10.1007/978-3-540-72800-9>.
4. <https://www.amazon.in/Applied-Bioinformatics-Paul-Maria-Selzer-ebook/dp/B001AUOYY2>.
5. https://books.google.co.in/books/about/Applied_Bioinformatics.html?id=PXZZDwAAQB-AJ&redir_esc=y

Mapping with Programme Outcomes:

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

S - Strong (3)

M-Medium (2)

L-Low (1)

ELECTIVE IV – 2. BIOSTATISTICS

Title of the Course		BIOSTATISTICS					
Paper Number		ELECTIVE IV					
Category	Elective	Year	I	Credits	2	Course Code	
		Semester	II				
Instructional Hours Per week		Lecture	Tutorial	Lab Practice	Total		
		2	1	--	3		
Pre-requisite		Fundamental knowledge on using in statistical tools and apply the tools to interpret the results.					
Learning Objectives		1. To provide the student with a conceptual overview of statistical methods.					
		2. To emphasis on usefulness of commonly used statistical software for analysis, research, and experimentation.					
		3. To understand and evaluate critically the acquisition of data and its representation.					
		4. To gain the knowledge about the probability and statistical inference are all topics that will be taught in order to obtain knowledge about the graphical representation of data.					
		5. To learn more about how to organize, create, and carry out the distribution of scientific knowledge.					
UNIT	CONTENTS						
I	INTRODUCTION TO STATISTICS Introduction to biostatistics, basic principles, variables - Collection of data, sample collection and representation of Data - Primary and Secondary - Classification and tabulation of Data – Diagrams, graphs and presentation.						
II	DESCRIPTIVE STATISTICS Mean, median and mode for continuous and discontinuous variables. Measures of dispersion: Range of variation, standard deviation and standard error and coefficient variation.						
III	PROBABILITY Basic principles - types - Rules of probability - addition and multiplication rules. PROBABILITY DISTRIBUTION Patterns of probability distribution; binomial - Poisson and normal.						
IV	HYPOTHESIS TESTING Chi-square test for goodness of fit; Null hypothesis, level of Significance - Degrees of Freedom. Student ‘t’ test – paired sample and mean differences ‘t’ tests. ANOVA. Basic introduction to Multivariate Analysis of Variance (MANOVA).						
V	CORRELATION AND REGRESSION Correlation - types of correlation - methods of study of correlation - testing the significance of the coefficients of correlation. Regression and types. Sampling and experimental designs of research-Randomized block design and split plot design.						

Course Outcomes

CO	Course outcomes – on completion of this course, the students will be able to	Programme outcomes
CO 1	Create and interpret visual representations of quantitative information, such as graphs or charts.	K5 & K6
CO 2	Solve problems quantitatively using appropriate arithmetical, algebraic, or statistical methods	K3 & K5
CO 3	Know the latest version using in statistical tools and apply the tools to interpret the results	K2
CO 4	To develop their competence in hypothesis testing and interpretation	K4
CO 5	Understand why biologists need a background in statistics	K1
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. Gurumani, N. 2005. Biostatistics, 2nd edn. MJP publications, India.
2. Datta, A.K. 2006. Basic Biostatistics and Its Applications. New Central Book Agency. ISBN 8173815038.
3. Pillai, R.S.N and Bagavathi, V.S. 2010. Statistics theory and practice. Chand & Co. Ltd, New Delhi.
4. Mahajan, B.K. 1984. Methods in Biostatistics for Medical students and Research works. Smt. Indu Mahajan, New Delhi.
5. Pillai, R.S.N and Bagavathi, V.S. 2010. Statistics theory and practice. Chand & Co. Ltd, New Delhi.
6. Khan, I.D and Khanum, A. 2004. Fundamentals of Biostatistics, Ukasz Publications, Hyderabad, India.
7. Gupta, S.C. 2013. Fundamentals of statistics, Himalaya Publishers, Mumbai.
6. Kothari, C.R and Garg, G. 2014. Research methodology –Method and techniques. New Age International (P) Ltd. New Delhi.

Reference Books

1. Milton, J.S. 1992. Statistical method in Biological and Health Sciences. McGraw Hill Inc., New York.
2. Scheffler, W.C. 1968. Statistics for biological sciences, Addison- Wesley Publication Co., London.
3. Spiegel, M.R. 1981. Theory and Problems of statistics, Schaum's Outline series McGraw-Hill International Book Co., Singapore.

4. Pillai, R.S.N and Bagawathi, V. 1987. Practical Statistics (For B.Com. and B.A., Students) S. Chand & Co. (Pvt.) Ltd., New York.
5. Sobl. R.R and Rohif, F.J. 1969. Biometry. The principles and Practice and Statistics in Biological Research. W.H. Freeman and Co., San Francisco.
6. Zar, J.K. 2011. Biostatistical Analysis, Fourth Edition, Prantice-Hall International, New Jersey, USA.

Web resources

1. nu.libguides.com/biostatistics
2. <https://newonline.courses.sciences.psu.edu/>
3. <https://bookauthority.org/books/beginner-biostatistics-ebooks>
4. <https://www.amazon.com/dp/1478638184?tag=uuid10-20>
5. <https://hastie.su.domains/ElemStatLearn/>

Mapping with Programme Outcomes:

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

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

ELECTIVE IV – 3. INTELLECTUAL PROPERTY RIGHTS

Title of the Course		INTELLECTUAL PROPERTY RIGHTS					
Paper Number		ELECTIVE IV					
Category	Elective	Year	I	Credits	2	Course Code	
		Semester	II				
Instructional Hours Per week		Lecture	Tutorial		Lab Practice	Total	
		2	1		--	3	
Pre-requisite		Intent to understand the legal systems governing the knowledge economy. Basic understanding of how laws are structured and interpreted.					
Learning Objectives		<ol style="list-style-type: none"> 1. 1. Cater to the needs of the stakeholders of knowledge economy is designed for those interested in managers and similar individuals. 2. Create awareness of current IPR and innovation trends. 3. Disseminate information on patents, patent system in India and overseas and registration related issues. 4. Pursue a career in IPR, which offers chances for IP consultants and Attorneys. 5. Develop skill sets to enable you to comprehend and assess the methods used in knowledge based economy and innovation ecosystems. 					
UNIT	CONTENTS						
I	INTRODUCTION TO IPR History and Development of IPR. Theories on concept of property: Tangible vs Intangible. Subject matters patentable in India. Non patentable subject matters in India. Patents: Criteria of Patentability, Patentable Inventions - Process and Product. Concept of Copyright. Historical Evolution of Copyright Ownership of copyright, Assignment and license of copyright.						
II	UNIT II OVERVIEW OF THE IPR REGIME AND DESIGN International treaties signed by India. IPR and Constitution of India. World Intellectual Property Organization (WIPO): Functions of WIPO, Membership, GATT Agreement. Major Conventions on IP: Berne Convention, Paris Convention. TRIPS agreement. Industrial Designs – Subject matter of Design – Exclusion of Designs – Novelty and originality – Rights in Industrial Design.						
III	TRADE MARK, LEGISLATIONS AND PATENT ACT History of Indian Patent Act 1970. Overview of IP laws in India. Major IP Laws in India. Patent Amendment Act 2005. WTO-TRIPS – Key effect on Indian Legislation. Organization of Patent System in India. Concept of Trademarks, Different kinds of marks, Criteria for registration, Non Registrable Trademarks, Registration of Trademarks. Infringement: Remedies and Penalties.						
IV	PRIOR ART SEARCH AND DRAFTING Overview of Patent Search. Advantages of patent search. Open source and paid databases for Patent Search. International Patent classification system. Types of specifications: Drafting of Provisional specifications. Drafting of complete specifications. Drafting of claims.						

V	<p>GI AND PATENT FILING PROCEDURES</p> <p>Geographical Indications of Goods (Registration and Protection) Infringement – Offences and Penalties Remedies. Plant Variety and Farmers Right Act (PPVFR). Plant variety protection: Access and Benefit Sharing (ABS). Procedure for registration, effect of registration and term of protection. Role of NBA. Filing procedure for Ordinary application. Convention application. PCT National Phase application. Process of Obtaining a Patent. Infringement and Enforcement.</p>
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Course Outcomes

CO	Course outcomes – on completion of this course, the students will be able to	Programme outcomes
CO 1	Recall the history and foundation of Intellectual Property.	K1
CO 2	Understand the differences of Property and Assets and Various Categories of Intellectual Creativity.	K2
CO 3	Apply the methods to protect the Intellectual Property.	K3
CO 4	Differentiate if the Said Intangible property be protected under law or protected by strategy.	K4
CO 5	Create a recommendation document on the methods and procedures of protecting the said IP and search documents to substantiate them.	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. Kalyan, C.K.2010. Indian Patent Law and Practice, India, Oxford University Press.
2. Ahuja, V.K. 2017. Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.
3. Arthur Raphael Miller, Micheal Davis H. 2000. Intellectual Property: Patents, Trademarks and .Copyright in a Nutshell, West Group Publishers.
4. Margreth, B. 2009. Intellectual Property, 3nd, New York Aspen publishers.
5. Nithyananda, K.V. 2019. Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.
6. Venkataraman M. 2015. An introduction to Intellectual property rights. Create space Independent Pub.North Charleston, USA.

Reference Books

1. World Intellectual Property Organization. 2004. WIPO Intellectual property Handbook. Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf Journal of Intellectual Property Rights (JIPR): NISCAIR.

2. Anant Padmanabhan. 2012. Intellectual Property Rights: Infringement and Remedies Lexis Nexis Butterworths Wadhwa.
3. Intellectual Property Law in the Asia Pacific Region. 2009. Kluwer Max Planck Series,
4. Pradeep, S. Mehta (ed.). 2005. Towards Functional Competition Policy for India, Academic Foundation, Related.
5. Ramakrishna B and Anil Kumar, H.S. 2017. Fundamentals of Intellectual Property Rights: For Students, Industrialist and Patent Lawyers, Notion Press, Chennai.
6. James Boyle, Jennifer Jenkins. 2018. Intellectual Property: Law & the Information Society—Cases and Materials, Create space Independent Pub. North Charleston, USA.
7. Damodar Reddy, S.V. 2019. Intellectual Property Rights -- Law and Practice, Asia Law House, Hyderabad.

Web resources:

1. <http://cipam.gov.in/>
2. <https://www.wipo.int/about-ip/en/>
3. <http://www.ipindia.nic.in/>
4. https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf.
5. https://swayam.gov.in/nd2_cec20_ge04/preview

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low (1)

ELECTIVE IV – 4. NANOBIO TECHNOLOGY

Title of the Course		NANOBIO TECHNOLOGY					
Paper Number		ELECTIVE IV					
Category	Elective	Year	I	Credits	2	Course Code	
		Semester	II				
Instructional Hours Per week		Lecture	Tutorial		Lab Practice	Total	
		2	1		-	3	
Pre-requisite	To provide an insight into the principles of nanotechnology in biological and medical research.						
Learning Objectives	1. To introduce the learners to the basic concepts in the emerging frontiers of nanotechnology.						
	2. To give perspective to researchers and students who are interested in nanoscale physical and biological systems and their applications in medicine.						
	3. To introduce the concepts in nanomaterials and their use with biocomponents to synthesize and interact with larger systems.						
	4. To impart knowledge on the most recent molecular diagnostic and therapeutic tools used to treat various diseases.						
	5. Incorporate sustainability in to account when you develop nanotechnology responsibly.						
UNIT	CONTENTS						
I	BASIC CONCEPTS IN NANOBIOLOGY History of Nanotechnology, Difference between Nanoscience and Nanotechnology, Green nanotechnology, Bottom up and top down approaches.						
II	UNIT II DIVERSITY IN NANOSYSTEMS Carbon based nanostructures - fullerenes, nanotubes, nanoshells, buckyballs – biomolecules and nanoparticles, nanosensors, nanomaterials - Classification based on dimensionality quantum dots, wells and wires – metal based nano materials (gold, silver and oxides) - Nanocomposites- Nanopolymers – Nanoglasses–Nano ceramics.						
III	METHODS OF NANOBIO TECHNOLOGY Optical tools – Nanoforce and imaging – Surface methods – Mass spectrometry – Electrical Characterization and Dynamics of Transport – Microfluidics: Concepts and applications to the Life Sciences.						
IV	NANOBIO TECHNOLOGY Nanodevices and nanomachines based on biological nanostructures - Protein and DNA nanoarrays, tissue engineering, and luminescent quantum dots for biological labeling.						
V	APPLICATIONS OF NANOBIO TECHNOLOGY Real Time PCR – Biosensors : From the glucose electrode to the Biochip – DNA Microarrays – Protein Microarrays – Cell Biochips – Lab on a chip – Polyelectrolyte multilayers – Biointegrating materials – Pharmaceutical applications of nanoparticles carriers.						

Course Outcomes

CO	Course outcomes – on completion of this course, the students will be able to	Programme outcomes
CO 1	Recall the essential features of biology and nanotechnology that are converging to create the new area of bionanotechnology.	K1
CO 2	Formulate procedures for the synthesis of nanoparticles which are of medical importance which could be used to treat specific diseases.	K2
CO 3	Characterize the various types of nano particle synthesis and advocate promotes the use of nano materials and anno composites.	K3
CO 4	Analyze and apply the important of nanoparticles in plant diversity.	K4
CO 5	Construct various types of nanomaterial for application and evaluate the impact on environment.	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. Dupas, C, Houdy, P., Lahmani, M. 2007. Nanoscience: —Nanotechnologies and Nanophysics, Springer-Verlag Berlin Heidelberg.
2. Sharon, M and Sharon, M. 2012. Bio-Nanotechnology- Concepts and Applications, CRC Press.
3. Atkinson, W.I.2011. Nanotechnology. Jaico Book House, New Delhi.
4. Nalwa, H.S. 2005. Handbook of Nanostructured Biomaterials and Their Applications in Nanobiotechnology. American Scientific Publ.
5. Lindsay, S.M. 2011. Introduction to Nanoscience, Oxford universal Press, First Edition.
6. Jain K.K. 2006. Nanobiotechnology molecular diagnostics: Current techniques and application (Horizon Bioscience).Taylor & Francis 1st edition.
7. Pradeep, T. 2012. Textbook of Nanoscience and Nanotechnology, McGraw Hill Education (India) Private Limited.
8. Xiu Mei Wang, Murugan Ramalingam, Xiangdong Kongand Lingyun Zhao. 2017. Nanobiomaterials: Classification, Fabrication and Biomedical Applications, Wiley-VCH Verlag GmbH & Co. KGa A.

Reference Books:

1. Claudio Nicolini. 2009. Nanotechnology Nanosciences, Pon Stanford Pub.Pvt.Ltd,
2. Robert, A and Ferias, Jr. 1999.Nanomedicine, Volume I: Basic capabilities,Landes Bioscience.

3. Barbara Panessa-Warren. 2006 Understanding cell-nanoparticle interactions making nanoparticles more biocompatible. Brookhaven National Laboratory.
4. European Commission, SCENIHR. 2006. Potential risks associated with engineered and adventitious products of nanotechnologies, European Union.
5. Gysell Mortimer, 2011. The interaction of synthetic nanoparticles with biological systems PhD Thesis, School of Biomedical Sciences, Univ.of Queensland.
6. Murty, B.S., Shankar, P., Raj, B., Rath, B.B., Murday, J. 2013. Textbook of Nanoscience and Nanotechnology. Spirnger Publication.
7. Prashant Kesharwani. 2019. Nanotechnology-Based Targeted Drug Delivery Systems for Lung Cancer. Academic Press. An imprint of Elsevier.

Web resources:

1. <https://onlinelibrary.wiley.com/doi/book/10.1002/3527602453>
2. <https://www.elsevier.com/books/nanobiotechnology/ghosh/978-0-12-822878-4>
3. <https://www.routledge.com/Nanobiotechnology-Concepts-and-Applications-in-Health-Agriculture-and/Tomar-Jyoti-Kaushik/p/book/9781774635179>
4. https://www.nanowerk.com/nanotechnology/periodicals/ebook_a.php
5. <https://phys.org/news/2014-10-endless-possibilities-bio-nanotechnology.html>
6. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC419715/>
7. <https://phys.org/news/2014-10-endless-possibilities-bio-nanotechnology.html>
8. <http://www.particle-works.com/applications/controlled-drug-release/Applications>

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low (1)

**SKILL ENHANCEMENT COURSE 1
AGRICULTURE AND FOOD MICROBIOLOGY**

Title of the Course		AGRICULTURE AND FOOD MICROBIOLOGY					
Paper Number		Skill Enhancement 1					
Category	Skill Enhancement	Year	I	Credits	2	Course Code	
		Semester	II				
Instructional Hours Per week		Lecture	Tutorial		Lab Practice	Total	
		2	1		--	3	
Pre-requisite		1. To understand the benefits of microbes in agriculture and food industry.					
Learning Objectives		2. To provide comprehensive knowledge about plant – microbe interactions.					
		3. To provide basic understanding about factors affecting growth of microbes					
		4. To appreciate the role of microbes in food preservation.					
		5. To understand about the benefits of microbes in agriculture and food industry.					
		6. To gain knowledge about practices involved in food industry.					
UNIT	CONTENTS						
I	ROLE OF MICROORGANISMS IN AGRICULTURE Role of symbiotic and free-living bacteria and cyanobacteria in agriculture. Mycorrhiza, Plant Growth Promoting Microorganism (PGPM) and Phosphate Solubilizing Microorganism (PSM).						
II	BIOCONTROL AND BIOFERTILIZATION Biocontrol of plant pathogens, pests and weeds, Restoration of waste and degraded lands, Biofertilizers: Types, technology for their production and application, vermi-compost.						
III	FOOD MICROBIOLOGY Intrinsic and extrinsic factors influencing growth of microorganisms in food, Microbes as source of food: Mushrooms, single cell protein.						
IV	FOOD MICROBIOLOGY Microbial spoilage of food and food products: Cereals, vegetables, prickles, fish and dairy products. Food poisoning and food intoxication. Food preservation processes. Microbes and fermented foods: Butter, cheese and bakery products.						
V	PREDICTIVE METHODS: Using Protein Sequences Protein Identity Based on Composition – Physical Properties Based on Sequence - Motifs and Patterns - Secondary Structure and Folding Classes – Specialized Structures or Features - Tertiary Structure.						

Course Outcomes

CO	Course outcomes – on completion of this course, the students will be able to	Programme outcomes
CO 1	Recognize the general characteristics of microbes and factors affecting its growth	K1
CO 2	Explain the significance of microbes in increasing soil fertility	K 2
CO 3	Elucidate concepts of microbial interactions with plant and food.	K 3
CO 4	Analyze the impact of harmful microbes in agriculture and food Industry.	K 4
CO 5	Determine and appreciate the role of microbes in food preservation and as biocontrol.	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. Pelczar M.J., Chan E.C.S. and Krieg N.R. 2003. Microbiology. 5th Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.
2. Subba Rao, N. S. 2000. Soil microbiology. 4th Edition, Oxford and IBH publishing Co. Pvt. Ltd., Calcutta, New Delhi, India.
3. Rangaswami, G. and Bagyaraj, D.J. 2006. Agricultural Microbiology. 2nd Unit 2nd Edition, PHI Learning, New Delhi, India.
4. Prescott, L.M., Harley J.P., Klein D. A. 2005. Microbiology, McGraw Hill, India. 6th edition.
5. Goldman, E. and Green, L.H. 2015. Practical Handbook of Microbiology (3rd Ed.). CRC Press

Reference Books:

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

Web resources:

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

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)**



**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. Preamble
2. Structure of Course
3. Learning and Teaching Activities
4. Assessment Activities
 - 4.1 Assessment principles
 - 4.2 Assessment Details

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.

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

	<p>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.</p> <p>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.</p> <p>PSO4 – Contribution to Business World To produce employable, ethical and innovative professionals to sustain in the dynamic business world.</p> <p>PSO 5 – Contribution to the Society To contribute to the development of the society by collaborating with stakeholders for mutual benefit.</p>
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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 TANSCHÉ 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 interdisciplinary 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	Credits
		1 contact hour = 1 credit	
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)	5	3
	1. Microbiology, immunology and plant pathology		
	2. Conservation of natural resources and policies		
	3. Mushroom cultivation		
	4. Phytopharmacognosy		
Elective II (Generic Discipline-Centric)	ED1: (One from each Group B)	5	3
	1. Algal Technology		
	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/UGC/SIR/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 its 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:		
<ol style="list-style-type: none"> Roy, S.C and Kumar, K.D.C. 1977. Cell Biology, New Central Book Agency, Calcutta. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons. Aminul, I. 2011. Text Book of Cell Biology. Books and Allied (P) Ltd, Kolkata, India. Geoffrey M. Cooper. 2019. The Cell: A Molecular Approach, Oxford University Press. Turner, P.C., Mclennan, A.G., Bates, A.D. and White, M.R.H. 2001. Instant notes on molecular biology. 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. Snustad Peter, D. Michael J. Simmons. 2015. Principles of Genetics, John Wiley Sons. Clark, D. 2010. Molecular Biology. Academic Press Publication. David Freifelder. 2008. Essentials of Molecular Biology. Narosa Publishing house. New Delhi. 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:		
<ol style="list-style-type: none"> 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. Karp, G. 1999. Cells and Molecular Biology: Concepts & Experiments. John Wiley and Sons, Inc., USA. Lodish S, Baltimore B, Berk, C and Lawrence K, 1995, Molecular Cell Biology, 3rd edn, Scientific American Books, N.Y 		

<p>4. De Robertis and De Robertis, 1988, Cell and Molecular Biology, 8th edn, Info-Med, Hongkong.</p> <p>5. Lewin, B. 2000. GENE VII. Oxford University Press, New York, USA</p> <p>7. Cooper G M and Hausman R E, 2007, The Cell: Molecular Approach 4th Edn, Sinauer Associates, USA.</p> <p>6. Genes X– Benjamin Lewin, Jones and Bartlett, 2011</p> <p>4. Molecular Biology of the Cell – Alberts, B, Bray, D, Raff, M, Roberts, K and Watson JD, Garland Publishers, 1999</p> <p>7. Principles of Biochemistry – Lehninger, W.H. Freeman and Company, 2002</p>
<p>Web Resources</p>
<p>1. https://www.pdfdrive.com/cell-biology-books.html</p> <p>2. http://www.bio-nica.info/Biblioteca/Bolsover2004CellBiology.pdf</p> <p>3. https://www.e-booksdirectory.com/listing.php?category=549</p> <p>4. https://www.elsevier.com/books/molecular-biology/clark/978-0-12-813288-3 https://www.kobo.com/in/en/ebooks/molecular-biology</p>

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 <i>Zea mays</i> . 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:		
<ol style="list-style-type: none"> 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. 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.
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. 2nd 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. Freeman and Co., San Francisco.
17. Zar, J.K. 2011. Biostatistical Analysis, Fourth Edition, Prentice-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 recombinant 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 <i>E. coli</i> cells. Agarose gel electrophoresis. Nucleic acid hybridization - Blotting techniques types.						
III	Vitamin-C is produced on a large scale from <i>Saccharomyces cerevisiae</i> and <i>Zygosaccharomyces bailii</i> yeast and <i>Gluconobacter oxydans</i> 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 <i>Paracoccus denitrificans</i> , <i>Propionibacterium shermanii</i> , <i>E. coli</i>						

	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:		
<ol style="list-style-type: none"> 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:		
<ol style="list-style-type: none"> 1. Watson, J.D. <i>et al.</i> 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		
<ol style="list-style-type: none"> 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).						
II	3. Acetocarmine staining (Nucleus) and light microscopic observation (Chloroplast)						
	4. Study of mitotic index from suitable plant material.						
	5. Study of cyclosis in cells of suitable plant material.						
III	6. Measure the length and breadth of the stomata/trichome by using micrometer.						
	7. Study on Electron microscopic structure of cell organelles given in the syllabus						
	8. Comparative study of cell structure in onion cells, <i>Hydrilla</i> and <i>Spirogyra</i> .						
IV	9. Study of models on DNA and RNA, DNA replication structures,						
	rDNA TECHNOLOGY						
	1. Isolation of genomic DNA						
V	2. Isolation of plasmid DNA						
	3. Agarose Electrophoresis						
	4. Transformation and recovery of plasmid clones						
VI	rDNA TECHNOLOGY (spotters)						
	1. pBR 322, Ti Plasmid, cosmid						
	2. Microinjection, Electroporation, Liposome mediated gene transfer, gene gun						
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:		
<ol style="list-style-type: none"> 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:		
<ol style="list-style-type: none"> 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 Molecular 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 <i>Drosophila</i> 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 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:		
<ol style="list-style-type: none"> George M Malacinski. 2015. Freifelders Essentials of Molecular Biology (4th ed.). Jones & Bartlett. Gupta P.K. 2017. Cell and Molecular Biology (5th ed.), Rastogi Publications, Meerut. Gupta, P.K. 2018. Cytogenetics, Rastogi Publications, Meerut. Kumar, H.D. 2007. Molecular Biology and Biotechnology, Vikas Publishing House, New Delhi. Bharadwaj, D.N. 2012. Breeding of field crops (pp. 1-23). Agrobios (India). Singh, R.J. 2016. Plant Cytogenetics. CRC press, US. 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. Shivakumar, S. 2002. Molecular analysis: Laboratory Manual. University press, Palkalai nagar, Madurai, India. 		
Reference Books:		
<ol style="list-style-type: none"> Gardener, J, Simmons, H.J and Snustad, D.P. 2006. Principle of Genetics, John Wiley & Sons, New York. 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. 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. Glick, B.R and J.E. Thompson. 1993. Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boca Raton, Florida. 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. Gunning, B.E.S and M. W. Steer. 1996. Plant Cell Biology: Structure and function. Jones and Bartlett Publishers, Boston, Massachusetts. 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. Hall, RD. (Ed).1999. Plant Cell Culture Protocols. Humana Press, New Jersey. Harris, N and K.J. Oparka. 1994. Plant cell Biology: A Practical Approach. IRL Press, At Oxford University Press, Oxford, UK. Gelvin, S.B., Schilperoort, R.A. (Eds.). 2000. Plant Molecular Biology Manual. 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.

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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 <i>in vitro</i> 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. Flavour 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:		
<ol style="list-style-type: none"> 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:		
<ol style="list-style-type: none"> 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 – Verlag.

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:		
<ol style="list-style-type: none"> 1. Shuler, M. L and F. Kargi. 2002. <i>Bioprocess Engineering</i>, Prentice Hall Inc. 2. Doran, P.M. 1995. <i>Bioprocess Engineering Principles</i>, Elsevier. 3. Kaufman, P.B. L. J. Cseke, S. Warler, J. A. Duke, and H. L. Brielmann. 1999. <i>Natural Products from Plants</i>, CRC Press LLC. 4. Casia, J.R.L.E. 2009. <i>Industrial Microbiology</i>. New Age International (P) Ltd. Publisher, New Delhi. 5. Stanbury, P. F., Whitaker, A. and Hall, S.J. 1979. <i>Principles of Fermentation Technology</i>. Aditya Books (P) Ltd., New Delhi. 6. Potter, N. N. 2007. <i>Food Science</i>. CBS Publishers. 		
Reference Books:		
<ol style="list-style-type: none"> 1. Rehm, H. J and G. Reed, <i>Biotechnology-A multi- Volume Comprehensive Treatise</i>, 2nd Ed, Vol 3, Wiley-VCH, 1993 2. Moo-Young, M. 2004. <i>Comprehensive Biotechnology</i>, Vol. 2, Pergamon Press, 3. Dicosmo, F and M. Missawa, 1996. <i>Plant Cell Culture Secondary Metabolism: Towards Industrial Application</i>. CRC LLC. 4. Frazier, W.C. and Weshoff, D.C. (2015). <i>Food Microbiology</i> (5th edition) McgrawHill. 5. Kumari, S. 2012. <i>Basics of Food Biochemistry and Microbiology</i>. Koros Press. 6. Whitaker. J.R. 2016. <i>Handbook of Food Enzymology</i>. CRC press 7. Shewfelt, R.L.2013. <i>Introducing Food Science</i>. CRC Press. 8. Smith, J.S and Hui, Y.H.2014. <i>Food Processing</i>. Wiley. 9. Varzakas, T and Tzia, C. 2016. <i>Handbook of Food Processing</i>. 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:		
<ol style="list-style-type: none"> 1. Chmielewski, J. G and Kraysky, 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, 3rd Ed. Cambridge University Press, Cambridge. 5. Bendre, M. Ashok and Ashok Kumar, A. 2020. Text Book of Practical Botany 1 10th ed). Rastogi Publications, Meerut. 6. Singh, R and U.C. Singh 2020. Modern mushroom cultivation, 3rd Edition Agrobios (India), Jodhpur. 		
Reference Books:		
<ol style="list-style-type: none"> 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		
<ol style="list-style-type: none"> 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 <i>in vitro</i> 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 <i>in vitro</i> system.	
V	CRYOPRESERVATION AND BIOREACTORS: Germplasm storage and conservation – Methods of <i>in vitro</i> 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 <i>in vitro</i> 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:		
<ol style="list-style-type: none"> 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. Cryopreservation 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 - <i>Tectona grandis</i> , <i>Melia dubia</i> , <i>Eucalyptus</i> . 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, <i>Chrysanthemum</i> , <i>Crossandra</i> , <i>Anthurium</i> 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:		
<ol style="list-style-type: none"> 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:		
<ol style="list-style-type: none"> 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 presentationskill will be developed via e-learning tools.	K4
CO5	Students are trained to proceed the effective micro teaching techniques.	K5 & K6
Web Resources		
<ol style="list-style-type: none"> 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**

Title of the Course		Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity					
Paper Number		Skill Enhancement – II					
Category	SKILL ENHANCEMENT	Year	II	Credits	2	Course Code	
		Semester	III				
Instructional Hours per week		Lecture	Tutorial		Lab Practice	Total	
		-	-		-	-	
Pre-requisite		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.					
Learning Objectives							
C1	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.						
C2	To comprehend how theoretical ideas are applied in many sectors and industries.						
C3	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.						
C4	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.						
C5	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.						
UNIT	CONTENTS						
I	Guidelines for Internship/ Field Visit / Industrial Visit / Research Knowledge Updating Activity Programme: <ol style="list-style-type: none"> 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. Individual instruction is provided for the Internship / Field Visit / Industrial Visit / 						

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*

	<p><i>(ideally with soft binding), and contain at least 25 pages.</i></p> <p>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.</p> <p>However, such submission shall not be accepted after the end of third semester Examinations.</p>
2	<p>Guidelines to field visits (during Third semester)</p> <p>1. Students are required to complete at least three field visits from the following options</p> <ol style="list-style-type: none"> 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 <p>The field visit completion certificate should be signed by the Principal, HOD and Programme Coordinator.</p>
3	<p>Guidelines to industrial visits (during Third semester)</p> <ul style="list-style-type: none"> ➤ 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. <p>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.</p>
4	<p>Guidelines for Research Knowledge Updating Activity Programme</p> <ul style="list-style-type: none"> ➤ 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. <p>The Research knowledge updating activity programme completion certificate should be</p>

	signed by the Principal, HOD and faculty in-charge.
II	<p>Evaluation of the Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity:</p> <ol style="list-style-type: none"> 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. <p>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.</p>
III	<p>College Guide Manual – Summer Internship / Field Visit / Industrial Visit / Research Knowledge Updating Activity Program</p> <ol style="list-style-type: none"> 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. <p>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.</p>
IV	<p>Internal:50 marks</p> <p>Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity Programme Completion certificate -10 marks</p> <p>Attendance/ documentation in field/observation note book –10 marks</p> <p>Internship / Field Visit / Industrial Visit / Research Knowledge Updating activity report - 10 marks</p> <p>Basic knowledge and Presentation Skills - assessed by group discussion with their classmates - 10 marks</p> <p>Topic of Interest/ lab involvement and record/ Experimentation/data collection-10 marks</p>

	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:		Programme outcomes
On completion of this course, the students will be able to: CO		
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 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. 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

Title of the Course		PLANT PHYSIOLOGY AND PLANT METABOLISM					
Paper Number		CORE - XVI					
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 physiological processes in plants.					
Learning objectives		1. To acquire knowledge on the functional aspects of plants.					
		2. To understand the biophysical and biochemical processes of plants.					
		3. To study the metabolism of plants.					
		4. To learn the plant growth regulations.					
		5. To know the adaptive mechanisms of plants in adverse environmental conditions.					
UNIT	CONTENTS						
I	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						
II	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.						
III	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						
IV	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-						
	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						

V	salinity- Adaptive mechanism to various stresses (avoidance, escape, tolerance)– stress responsive proteins – anti-oxidative mechanism.
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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. Cambridge
4. Khan, A.A. 1982. The Physiology and Biochemistry of Seed development, Dormancy and Germination. Elsevier. 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 Clarendon 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. Sinauer 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, Belmont.
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 fundamentals 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; <i>Agrobacterium tumefaciens</i> 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 - <i>In situ</i> and <i>ex situ</i> .
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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 Chakrapani, 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/groz/AuguFiziologijas/Augu_biokimija/Plant%20Biochemistry 204.pdf](http://priede.bf.lu.lv/groz/AuguFiziologijas/Augu_biokimija/Plant%20Biochemistry%20204.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 biomolecule of diverse nature from different sources so that they will be able to assess the metabolic profile of their source material.					
		2. Recognize the role that water plays in several physiological processes in plants.					
		3. To learn the fundamental and applications of Plant Biotechnology.					
		4. Learn about chromatographic techniques.					
		5. Expose the students to gain recent advances in molecular biology.					
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. <i>In vivo</i> 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%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.1.69i57j0i13i512i3j0i13i30j0i8i13i30j0i390i512i650i4.15177j0j15&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	
		-		-		2	
Pre-requisite		Practicals pertaining to above subjects are important to get knowledge on various physiological functions of plants.					
Learning Objectives		1. Extract biomolecule of diverse nature from different sources so that they will be able to assess the metabolic profile of their source material.					
		2. Recognize the role that water plays in several physiological processes in plants.					
		3. To learn the fundamental and applications of Plant Biotechnology.					
		4. Learn about chromatographic techniques.					
		5. Expose the students to gain recent advances in molecular biology.					
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. Secondary, 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. <i>Agrobacterium tumefaciens</i> mediated transformation of plants 3. Biolistic gene gun method of plant transformation						

4. Cytoplasmic male sterility, antisense technology.
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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. Wiley 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 Plant Physiology and Biochemistry. Scientific Publisher.
6. Joy, P.P., Surya, S and Aswathy, C. 2015. Laboratory Manual of Biochemistry, Agricultural University, Pineapple Research Station, Ernakulam, Kerala.
7. 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 (4th Edition) Cambridge University Press, Cambridge.
3. Bendre, A. Mand Ashok Kumar. 2009. A textbook of practical Botany. Vol.I & II. Rastogi Publication. Meerut. 9th Edition.
4. Wilson, K and J. Walker. 2005. Principles and Techniques of Practical Biochemistry, 5th Edition. Cambridge University press, New York.
5. Rodney Boyer. 2000. Modern Experimental Biochemistry, 3rd Edition. Published by Addison Wesley Longman. Singapore.
6. 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 Molecular Biology Manual.

Web resources:

1. [file:///C:/Users/User/Downloads/2021%20Botany%20Syllabus%20after%20BoS%20formatted1%20\(1\).pdf](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

Title of the Course		PROJECT with VIVA-VOCE					
Paper Number		CORE XX					
Category	Core	Year	II	Credits	4	Course Code	
		Semester	IV				
Instructional Hours Per week		Total					
		8					
Pre-requisite		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.					
Learning Objectives		1. To recognize the concept of research and its various forms in the context of botany.					
		2. To improve abilities relating to scientific experiments.					
		3. To become proficient in data collection and the documentation of scientific findings.					
		4. To prepare students for entry-level positions or professional training programmes in any field of Botany.					
		5. Compare the various reporting and writing styles used in science.					
GENERAL GUIDELINES							
		<ol style="list-style-type: none"> Each student will be allotted a Project Guide from the faculty of the department concerned by lot method. The topic of the dissertation shall be assigned to the candidate before the beginning of third semester. After the completion of the project work, the student 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. 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. 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. 					
		<p>All the candidates of M.Sc. (Botany) are required to undergo a major project and submit the following:</p> <ol style="list-style-type: none"> Dissertation/Thesis based on the work done by the student. Soft copy of the project on CD / DVD. <p>PROJECT EVALUATION GUIDELINES:</p> <p>The project is evaluated on the basis of following heads:</p> <p>For Viva-Voce maximum is 50 marks which will be conducted by both the internal and external examiners during end semester university practical examinations.</p> <p>Internal: 50 marks</p> <p>I Review – Selection of the field of study, topic and literature collection - 15 marks</p>					

	<p>II Review – Research design and data collection - 20 marks</p> <p>III Review – Analysis and conclusion, preparation of rough draft – 15 marks</p> <p>External: 50 marks</p> <p>Evaluation of project report (30 marks)</p> <p>Originality of the approach - 10 marks</p> <p>Neat presentation of report – 10 marks</p> <p>Results and Discussion – 10 marks</p> <p>Division of marks for viva (20 marks)</p> <p>Knowledge on the content - 10 marks</p> <p>Viva-voce - 10 marks</p>
	<p>Suggested areas of work:</p> <p>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.</p>
	<p>Methodology:</p> <p>Each project should contain the following details:</p> <ol style="list-style-type: none"> 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.
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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://www.wds.worldbank.org/external/default/WDServer/WDSP/IB/2006/10/19/000112742_20061019150049/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 on Gene 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 Homopolymer 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, cytogenetic 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. Gamburg, 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 Acquaaah. 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	<p>Microbiology: Structure and reproduction of viruses, bacteria and fungi. Applications of microbes in agriculture, industry, medicine and in control of water pollution.</p> <p>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;</p> <p>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,</p>						
II	<p>Cryptogams: Algae, fungi, lichens, bryophytes, pteridophytes - structure and reproduction and economic importance.</p> <p>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.</p>						
III	<p>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</p> <p>Bio-chemistry: Chemistry of carbohydrates, proteins, amino acids and lipids - structure, properties and classification. Nucleic acids – structure and properties, types</p>						

	of DNA – different types of RNA, properties and functions. Enzymes – Properties, mode of action, nomenclature and classification.
IV	<p>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.</p> <p>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 mobile genes – concepts of gene – Cistron, Muton and recon.</p>
V	<p>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.</p> <p>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.</p>

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 Shahezaad. 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 Dagainawa, 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	<p>Molecular trends in Biosystematics: techniques used in molecular taxonomy, molecular systematics in crop evolution, Serology in relation to plant taxonomy. Cladistics and Phenetics, Chemotaxonomy</p> <p>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</p> <p>Palynology: Sporopollenin, Pollenkit, NPC system</p>						
II	<p>Cell Biology: Microscopy- Principles of Light, Phase contrast, Interference, Fluorescent, SEM, TEM. molecular cytogenetics- FISH, GISH, SKY</p> <p>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 <i>Arabidopsis</i> flower.</p>						
III	<p>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.</p>						
IV	<p>Extraction and separation techniques- Cell fractionation- Chromatography-principle and classification, Paper chromatography-, TLC, Column chromatography, Adsorption- Gel filtration Ion exchange- Affinity chromatography- GC, HPTLC. Electrophoresis Principle, type, paper, starch gel, polyacrylamide, agarose, immuno electrophoresis. Centrifugation.</p>						

V	Spectroscopy -nature of Electromagnetic Radiation.– UV and visible spectroscopy, IR spectroscopy. Spectrofluometry. 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
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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:

<ol style="list-style-type: none"> 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. Mabberley'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](http://www.ornl.gov).
2. [http:// ash. gene. ncl.ac.uk](http://ash.gene.ncl.ac.uk).
3. [http://tor. cshl. org](http://tor.cshl.org). [http://www.gdb. org](http://www.gdb.org).
4. [http://www. neg r. org](http://www.neg.r.org).
5. [http:// www. genetics. wustl.edu](http://www.genetics.wustl.edu).
6. [http:// genome. imb- jena. dc](http://genome.imb-jena.de).

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