

(Affiliated Colleges)**405 - M.Sc. Botany**

Programme Structure and Scheme of Examination (under CBCS)

(Applicable to the candidates admitted from the academic year 2023 -2024 onwards)

Part	Course Code	Study Components & Course Title	Credit	Hours/ Week	Maximum Marks		
					CIA	ESE	Total
		SEMESTER – I					
A	23PBOTC11	Core - I: Plant Diversity - I: Algae, Fungi, Lichens and Bryophytes.	5	7	25	75	100
	23PBOTC12	Core - II: Plant Diversity - II: Pteridophytes, Gymnosperms and Paleobotany.	5	7	25	75	100
	23PBOTP13	Core - III: Practical – I Covering Core Papers - I and II	4	6	25	75	100
	23PBOTE14-1	Elective – I : Microbiology, immunology and plant pathology (or) Conservation of natural resources and policies (or) Mushroom cultivation	3	5	25	75	100
	23PBOTE14-2						
	23PBOTE14-3						
	23PBOTE15-1	Elective-II : Horticulture (or) Ethnobotany, naturopathy and Traditional Healthcare (or) Algal Technology	3	5	25	75	100
	23PBOTE15-2						
	23PBOTE15-3						
		Total	20	30			500
		SEMESTER – II					
A	23PBOTC21	Core - IV: Plant Anatomy and Embryology of angiosperms	5	6	25	75	100
	23PBOTC22	Core - V: Taxonomy of Angiosperms and Economic Botany	5	6	25	75	100
	23PBOTP23	Core - VI: Practical - II Covering Core Papers - IV and V	4	6	25	75	100
	23PBOTE24-1	Elective – III Medicinal Botany (or) Research Methodology, Computer Applications & Bioinformatics (or) Biopesticide Technology	3	4	25	75	100
	23PBOTE24-2						
	23PBOTE24-3						
	23PBOTE25-1	Elective – IV: Applied bioinformatics (or) Biostatistics (or) Intellectual Property Rights	3	4	25	75	100
	23PBOTE25-2						
	23PBOTE25-3						
B (i)	23PBOTS26	Skill Enhancement Course (SEC-I): Floriculture and Medicinal Plant Cultivation	2	4	25	75	100
		Total	22	30			600

		SEMESTER – III					
A	23PBOTC31	Core VII- Plant Physiology and Plant metabolism	5	6	25	75	100
	23PBOTC32	Core VIII- Ecology, phytogeography, Conservation Biology and Intellectual property rights	5	6	25	75	100
	23PBOTC33	Core IX- Genetics, Plant Breeding & Biostatistics	5	6	25	75	100
	23PBOTP34	Core X:Practical – III - Covering Core Papers – VII, VIII and IX	4	6	25	75	100
	23PBOTE35-1	Elective – V: Secondary Plant Products and Fermentation Biotechnology (or) Entrepreneurial Opportunities in Botany (or) Silviculture and Commercial Landscaping	3	3	25	75	100
	23PBOTE35-2						
	23PBOTE35-3						
B (i)	23PBOTS36-1 23PBOTS36-2	Skill Enhancement Course (SEC-II): Mushroom cultivation /(or) Organic farming	2	3	25	75	100
B (ii)	23PBOTI37	Summer Internship*	2	-	25	75	100
		Total	26	30			700
		SEMESTER – IV					
A	23PBOTC41	Core -XI: Cell and Molecular Biology	5	6	25	75	100
	23PBOTP42	Core – XII: Biochemistry & Applied Biotechnology	5	6	25	75	100
	23PBOTD43	Project with Viva Voce	7	10	25	75	100
	23PBOTE44-1 23PBOTE44-2	Elective – VI: Forestry and Wood Technology (or) Farm Sciences- Green Wealth	3	4	25	75	100
B (i)	23PBOTS45						
C	23PBOTX46	Skill Enhancement Course (SEC-III): Nursery and Gardening	2	4	25	75	100
		Extension Activity	1	-	-	100	100
		Total	23	30			600

* Students should complete two weeks of internship before the commencement of III semester.

Credit Distribution

Study Components	Papers	Total Credits	Marks/Sub	Total Marks
Core Theory	9	45	100	900
Core Electives	6	18	100	600
Core Practical	3	12	100	300
Skill Enhancement Courses SEC1, SEC2, SEC3	3	6	100	300
Internship/Industrial Activity (Carried out in Summer Vacation at the end of I Year – Two Weeks Period)	1	2	100	100
Project	1	7	100	100
Extension Activity	1	1	100	100
	24	91		2400

Credit Distribution for PG Science Programme

Part	Course Details	No. of courses	Credit per course	Total Credit
A	Core Theory	9	4-5	45
	Core Practical	3	4	12
	Elective Course	6	3	18
	Project Work with VIVA-VOCE	1	7	7
B(i)	Skill Enhancement Course	3	2	6
B(ii)	Summer Internship	1	2	2
C	Extension Activity	1	1	1
		24		91

Component-wise Credit Distribution

Part	Courses	Sem I	Sem II	Sem III	Sem IV	Total
A	Core (including Practical and Project)	14	14	19	17	64
	Elective	6	6	3	3	18
B(i)	Skill Enhancement Course	-	2	2	2	6
B(ii)	Summer Internship	-	-	2	-	2
C	Extension Activity	-	-	-	1	1
						91

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

Programme Outcomes (Pos)	PO1: Problem Solving Skill Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context. PO2: Decision Making Skill Foster analytical and critical thinking abilities for data-based decision-making. PO3: Ethical Value Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities. PO4: Communication Skill Ability to develop communication, managerial and interpersonal skills. PO5: Individual and Team Leadership Skill Capability to lead themselves and the team to achieve organizational goals. PO6: Employability Skill Inculcate contemporary business practices to enhance employability skills in the competitive environment. PO7: Entrepreneurial Skill Equip with skills and competencies to become an entrepreneur. PO8: Contribution to Society Succeed in career endeavors and contribute significantly to society. PO 9 Multicultural competence Possess knowledge of the values and beliefs of multiple cultures and a global perspective. PO 10: Moral and ethical awareness/reasoning Ability to embrace moral/ethical values in conducting one's life.
Programme Specific Outcomes (PSOs)	PSO1 – Placement To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions. PSO 2 - Entrepreneur To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations. PSO3 – Research and Development Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development. PSO4 – Contribution to Business World To produce employable, ethical and innovative professionals to sustain in the dynamic business world. PSO 5 – Contribution to the Society To contribute to the development of the society by collaborating with stakeholders for mutual benefit.

Semester	23PBOTC11: CORE - I	H/W	C
I	CORE COURSE-I- PLANT DIVERSITY - I ALGAE, FUNGI, LICHENS AND BRYOPHYTES	7	5

Pre-requisite	Students should be familiar with the basics of algae, fungi, lichens and Bryophytes.
Learning Objectives	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 understand 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	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) & Silva (1982). Salient features of major classes: Cyanophyceae, Chlorophyceae, Xanthophyceae, Chrysophyceae, Cryptophyceae, Dinophyceae, Chloromonadineae, Euglenophyceae, Charophyceae, Bacillariophyceae, Phaeophyceae and Rhodophyceae. Range of thallus organization, algae of diverse habitats, reproduction (vegetative, asexual and sexual) and life cycles. Phylogeny and inter-relationships of algae, origin and evolution of sex in algae. Structure, reproduction and life histories of the following genera: <i>Oscillatoria</i> , <i>Scytonema</i> , <i>Ulva</i> , <i>Codium</i> , <i>Diatoms</i> , <i>Dictyota</i> and <i>Gelidium</i> .
II	FUNGI: General Characteristics, occurrence and distribution. Mode of nutrition in fungi. Contributions of Indian Mycologists (C.V.Subramanian), Classification of Fungi by Alexopoulos and Mims (1979) & Recent trends in the classification of fungi - Phylogeny and inter-relationships of major groups of fungi. General characters of major classes: Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina. Heterothallism in fungi, sexuality in fungi, Para sexuality, sex hormones in fungi. Structure, reproduction and life histories of the following genera: <i>Plasmodiophora</i> , <i>Phytophthora</i> , <i>Rhizopus</i> , <i>Taphrina</i> , <i>Polyporus</i> and <i>Colletotrichum</i> .
III	LICHENS: Introduction and Classification (Hale, 1969). Occurrence and inter-relationship of 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 Bryopsida, Anthoceropsida and Mosses. General characters of major groups - Marchantiales, Jungermaniales, Anthocerotales, Sphagnales, Funariales and Polytrichales. Reproduction - Vegetative and sexual, spore dispersal mechanisms in bryophytes, spore germination patterns in bryophytes. Structure, reproduction and life histories of the following genera: <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. Culturing and cultivation of mushrooms <i>Pleurotus</i> . Lichen –economic importance and as indicator pollution. Bryophytes – Ecological and economic importance – industry, horticulture and medicine.	
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
	2. Demonstrate both the theoretical and practical knowledge in understanding the diversity of basic life forms and their importance.	K2
	3. Explain life cycle patterns in algae, fungi, lichens and Bryophytes.	K3
	4. Compare and contrast the mode of reproduction in diverse groups of basic plant forms.	K4
	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 Guadtieri, 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, 5thEd., Cambridge UniversityPress, 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)**

Semester	23PBOTC12 :CORE -II- PLANT DIVERSITY - II	H/W	C
I	PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY	7	5

Pre-requisite	Students should know about the fundamentals of Pteridophytes, Gymnosperms and fossil records.
Learning Objectives	- To investigate the classification, distinctive traits, distribution and reproduction and life history of the various classes and major types of Pteridophytes and Gymnosperms. - To identify and characterize diversity of lower vascular plants in order to comprehend the dynamics of diversity to realize the importance of diversity. - To research the classification, phylogeny and economic importance of Pteridophytes and Gymnosperms. - To study and understand the phylogeny and Paleontology of Pteridophytes and Gymnosperms. - 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, morphogenesis, Economic importance of Pteridophytes.
II	PTERIDOPHYTES: Structure, anatomy, reproduction and life histories of the following genera: <i>Isoetes</i> , <i>Equisetum</i> , <i>Angiopteris</i> , <i>Osmunda</i> , <i>Pteris</i> and <i>Azolla</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>Cordaitea</i> and <i>Lyginopteris</i> .

Course Outcomes: On successful completion of this course the student will be able to

1. Recall on classification, recent trends in phylogenetic relationship, general characters of Pteridophytes and Gymnosperms.	K1 & K3
2. Learn the morphological/anatomical organization, life history of major types of Pteridophytes and Gymnosperms.	K3 & K4
3. Comprehend the economic importance of Pteridophytes, Gymnosperms, and fossils.	K3 & K5
4. Understanding the evolutionary relationship of Pteridophytes and Gymnosperms.	K2
5. Awareness on fossil types, fossilization and fossil records of Pteridophytes and Gymnosperms.	K1 & K3

K1-Remember; K2-Understand; K3-Apply;K4-Analyze;K5 -Evaluate; K6 –Create.	
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/other 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 Transferable Skill.

Recommended Text:

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

Reference books:

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

Web resources:

1. <https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/>
2. http://www.bsienviis.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>
<https://trove.nla.gov.au/work/11471742?q&versionId=46695996>

MappingwithProgrammeOutcomes:

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	3	3	3	3
CO3	2	3	3	3	3	1	3	3	3	3
CO4	3	3	2	3	3	3	3	2	3	2
CO5	3	2	2	2	2	2	2	1	2	1

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

Semester	23PBOTP13 : CORE -III- LABORATORY / PRACTICAL -I	H/W	C
I	COVERING THEORY PAPERS I AND II	6	4

Pre-requisite	Students should be familiar with the fundamentals of algae, fungi, lichens, Bryophytes, Pteridophytes, Gymnosperms, Paleobotany and microbes in addition to essential laboratory techniques.
Learning Objectives	1. To learn how to employ the use of instruments, technologies and methodologies related to thallophytes and non-flowering plant groups.
	2. To enhance information on the identification of each taxonomical group by developing the skill-based detection of the morphology and microstructure of algae, and fungi.
	3. To comprehend the fundamental concepts and methods used to identify Bryophytes, Pteridophytes and Gymnosperms through morphological changes and evolution, anatomy and reproduction.
	4. To develop the technical abilities in staining, sectioning, sterilizing, and characterizing thallophytes, and other varieties of non-flowering plants.
	5. To compare the structural diversity of fossil and extant plant species.
UNIT	EXPERIMENTS
I	ALGAE Study of algae in the field and laboratory of the genera included in theory. External morphology and internal anatomy of the vegetative and reproductive structures of the following living forms: <i>Oscillatoria</i>, <i>Scytonema</i>, <i>Ulva</i>, <i>Codium</i>, <i>Diatoms</i>, <i>Dictyota</i> and <i>Gelidium</i> (depending on availability of the specimen). To record the local algal flora—Study of their morphology and structure. Identification of algae to species level (at least One). Preparation of culture media and culture of green algae and blue green algae in the laboratory (Demonstration).
II	FUNGI Study of morphological and reproductive structures of the following living forms: <i>Plasmodiophora</i>, <i>Phytophthora</i>, <i>Rhizopus</i>, <i>Taphrina</i>, <i>Polyporus</i> and <i>Colletotrichum</i> (depending on availability of the specimen). Isolation and identification of fungi from soil, air, and Baiting method. Preparation of culture media. Cultivation of mushroom in the laboratory (Demonstration). LICHENS Study of morphological and reproductive structures of the genera <i>Parmelia</i>.
III	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 availability of the specimen).

IV	PTERIDOPHYTES External morphology and internal anatomy of the vegetative and reproductive organs of the following living forms: <i>Isoetes</i> , <i>Equisetum</i> , <i>Angiopteris</i> , <i>Osmunda</i> , <i>Pteris</i> and <i>Azolla</i> (depending on availability of the specimen). Fossil slides observation: <i>Rhynia</i> , <i>Lepidocarpon</i> , <i>Calamites</i> .	
V	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 availability of the specimen). Fossil slides observation: <i>Cordaites</i> and <i>Lyginopteris</i> .	
Course outcomes: On completion of this course, the students will be able to:		Programme outcomes
CO		
1	Recall and applying the basic key to distinguish at species level identification of important algae and fungi through its structural organizations.	K1 & K4
2.	Demonstrate practical skills in thallophytes, Pteridophytes and Gymnosperms.	K2
3.	Describe the structure of algae, fungi, lichens, Bryophytes, Pteridophytes and Gymnosperms.	K3
4.	Determine the importance of structural diversity in the evolution of plant forms.	K5
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/other 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 Transferable Skill
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 Transferable Skill

Recommended Text:

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

Reference Books:

1. Chmielewski, J.G and 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>
5. <https://www.amazon.in/Practical-Manual-Pteridophyta-Rajan-Sundara/dp/8126106883>
6. <https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm8C?hl=en&gbpv=1&dq=gymnosperms&printsec=frontcover>
7. <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)

Semester	23PBOTE14-1:	H/W	C
I	ELECTIVE-I MICROBIOLOGY, IMMUNOLOGY AND PLANT PATHOLOGY	5	3

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.
III	FOOD MICROBIOLOGY: Beneficial role of microbes – yoghurt, Olives, Cheese, Bread, Wine, Tempeh, Miso & Fermented green tea. Spoilage of fruits, vegetables, meats, 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.

IV	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.	
V	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).	
Course outcomes: On completion of this course, the students will be able to:		Programme outcomes
CO		
1	Recognize the general characteristics of microbes, plant defense and immune cells.	K1
2.	Explain about the stages in disease development and various defense mechanisms in plants and humans.	K2
3.	Elucidate concepts of microbial interactions with plant and humans.	K3
4.	Analyze the importance of harmful and beneficial microbes and immune system	K4
5.	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/other 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 Transferable Skill	
Recommended Text:		
1. Singh, R.S. 2018. Introduction to Principles of Plant Pathology, 4th Edition. 2. Bilgrami, K.S and H.C. Dube. 2010 A text book of Modern Plant Pathology – Vikas Publishing House (P) Ltd., New Delhi 3. Mehrotra, R.S. and Aggarwal, A. 2017. Plant Pathology. McGraw Hill Publisher. 4. Dube, H.C. 2010. A text Book of Fungi, Bacteria and Viruses, 3rd Edition, Agrobios India, ISBN: 8188826383. 5. Vaman Rao, C. 2006. Immunology. 2nd Edition. Narosa Publisher. 6. Kenneth, M. 2017. Janeway’s Immunobiology. 9th Edition. Garland Publisher.		

Reference Books:

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

Web resources:

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

Mapping with Programme Outcomes:

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

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

Semester	23PBOTE14-2:	H/W	C
I	ELECTIVE-I CONSERVATION OF NATURAL RESOURCES AND POLICIES	5	3

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	III FOOD MICROBIOLOGY: 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.
	ENVIRONMENTAL POLICY IN INDIA: Need for policies- Public Policy – Economic policies – Relationship between economic development and environment – Implementing

V	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 students will be able to: CO	Programme outcomes	
1. Understand the concept of different natural resources and their utilization.	K1	
2. Critically analyze the sustainable utilization land, water, forest and energy resources	K2 & K6	
3. Evaluate the management strategies of different natural resources	K3	
4. Reflect upon the different national and international efforts in resource management and their conservation.	K4	
5. 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/other 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 Transferable Skill	

Recommended Text:

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:

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)

Semester	23PBOTE14-3:	H/W	C
I	ELECTIVE–I MUSHROOM CULTIVATION	5	3

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 volvacea</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 affecting button mushroom production (Temp, pH, air and water management, competitor moulds and other disease).	
IV	POST-HARVEST MANAGEMENT: Harvest, storage, quality assurance of mushrooms. Pest management.	
V	World production of 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 students will be able to: CO		Programme outcomes
1. Knowledge on identification of edible and toxic mushrooms belonging to Ascomycota and Basidiomycota.		K1, K3
2. Outline the nutraceutical properties of edible mushrooms.		K2, K4

3. Knowledge on cultivation techniques of edible and medicinal mushrooms.	K3, K6
4. Understand the harvest and post-harvest techniques of mushroom crops.	K4
5. 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/other 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 Transferable Skill

Recommended Text:

1. Cheung, P.C.K. 2008. Mushrooms as functional food. A John Wiley & Sons, Inc., Publication.
2. Dijksterhuis, J. and Samson, R.A. 2007. Food Mycology: A multifaceted approach in fungi and food. CRC press, New York.
3. Hall, R.I., Stephenson, S.L., Buchanan, P.K., Yun, W. and Cole, A.L.J. 2003. Edible and poisonous mushrooms of the world. Timber Press, Portland, Cambridge.
4. Ting, S. and Miles, P.G. 2004. Mushrooms: Cultivation, nutritional value, medicinal effect and nutritional environmental impact. CRC press, New York.
5. Verma, 2013. Mushroom: edible and medicinal: cultivation conservation, strain improvement with their marketing. Daya Publishing House.

Reference books:

1. Tiwari, S.C., Pandey K. 2018. Mushroom cultivation. Mittal publisher, New Delhi.
2. Philips, G., Miles, Chang, S-T. 2004. Mushrooms: Cultivation, nutritional value, medicinal effect and environmental effect. 2nd ed. CRC Press.
3. Diego, C.Z., Pando-Gimenez, A. 2017. Edible and medicinal mushrooms: Technology and Application. Wiley-Blackwell publishers.
4. Nita Bahl. 2002. Handbook on Mushroom 4th edition Vijayprimalani for oxford & IBH publishing co., Pvt., Ltd., New Delhi. Dr. C. Sebastian Rajesekaran Reader in Botany Bishop Heber College, Trichy – 17.
5. 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](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)

Semester	23PBOTE15- 1:	H/W	C
I	ELECTIVE–II HORTICULTURE	5	3

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, 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
1. Identify and categorize various horticultural plants and the conditions that affect their growth and productivity.	K1
2. Explain the various structures and growth processes of horticultural plants.	K2
3. Demonstrate the propagation, growth, and maintenance of plants in horticulture systems.	K3
4. Correlate the soil characteristics and fertility to good plant growth.	K4
5. Utilize the role plant tissue culture techniques in the production of quality planting stock in horticulture.	K5
6. 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/other 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 Transferable Skill

Recommended Text:

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)

Semester	23PBOTE15- 2:	H/W	C
I	ELECTIVE–II ETHNOBOTANY, NATUROPATHY AND TRADITIONAL HEALTHCARE	5	3

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 botanicalsin 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	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, 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.
	BIOPROSPECTING AND VALUE ADDITION: Bioprospecting of drug molecules derived from Indian traditional plants; Methods

V	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).
Course outcomes: On completion of this course, the students will be able to: CO	Programme outcomes
1. Recall or remember concept of ethnobotany.	K1
2. Understand the life style and traditional practices of plants by Indian tribals.	K2 & K6
3. Highlight the role of Non-Timber Forest products for livelihood of tribal people of India	K3
4. Assess the methods to transform ethnobotanical knowledge into value added products.	K4
5. 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:

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:

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:

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)

Semester	23PBOTE15- 3:	H/W	C
I	ELECTIVE-II ALGAL TECHNOLOGY	5	3

Pre-requisite	Students should be familiar with the basic and applied knowledge on algal biotechnology.
Learning Objectives	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: On completion of this course, the students will be able to: CO	Programme outcomes
1. Understand the applied facet of botany and acquire a complete knowledge about the cultivation methods in algae.	K1& K3
2. Realization of the commercial potential of algal products.	K5
3. Analyze emerging areas of algal biotechnology for identifying therapeutic importance of algal products and their uses.	K2 & K4
4. Gain more information about algae genetics.	K4
5. 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/T RB/NET/UGC– CSIR/GATE/TNPSC/other 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 Transferable Skill

Recommended Text:

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/phycobiotechnology-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)

Semester	CORE-IV - 23PBOTC21 :	H/W	C
II	PLANT ANATOMY AND EMBRYOLOGY OF ANGIOSPERMS	6	5

Pre-requisite	To acquire knowledge on the anatomical structure and reproductive phase of angiosperms.
Learning Objectives	1.Learn the importance of plant anatomy in plant production systems.
	2.Classify meristems and identify their structures, functions and roles in monocot and dicot plants growth and secondary growth of woody plants.
	3.Understand the mechanism underling the shift from vegetative to reproductive phase.
	4.Trace the development of male and female gametophyte.
	5.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: On completion of this course, the students will be able to: CO	Programme outcomes
1. Learn the structures, functions and roles of apical vs lateral meristems in monocot and dicot plant growth.	K1& K2
2. Study the function and organization of woody stems derived from secondary growth in dicot and monocot plants.	K1&K4
3. Apply their idea on sectioning and dissection of plants to demonstrate various stages of plant development.	K2& K6
4. Understand the various concepts of plant development and reproduction.	K3& K6
5. 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/other to be resolved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferable Skill

Recommended Text:

1. Bhojwani, S.S. Bhatnagar, S.P and Dantu, P.K. 2015. The Embryology of Angiosperms (6th revised and enlarged edition). Vikas Publishing House, New Delhi.
2. Maheshwari, P. 1963. Recent Advances in Embryology of Angiosperms. Intl. Soc. Plant Morphologists, New Delhi.
3. Sharma, P.C. 2017. Text Book of Plant Anatomy. Arjun Publishing House, New Delhi.

4. Pandey.S.N and Ajanta Chandha. 2006. Plant Anatomy and Embryology. Vikas Publishinf House Pvt. Ltd, New Delhi.
5. Narayanaswamy, S. 1994. Plant Cell and Tissue Culture. Tata McGraw Hill Ltd. New Delhi.

Reference Books:

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

Web resources:

1. <https://www.ipni.org/>
2. <http://www.theplantlist.org/>
3. https://faculty.etsu.edu/liuc/plant_anatomy_sites.htm
4. http://aryacollegeludhiana.in/E_BOOK/Botany/plant_anatomy.pdf
5. <https://www.uou.ac.in/sites/default/files/slm/BSCBO-202.pdf>
6. http://greenlab.cirad.fr/GLUVED/html/P1_Prelim/Bota/Bota_typo_014.html
7. <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)

Semester	CORE-V - 23PBOTC22 :	H/W	C
II	TAXONOMY OF ANGIOSPERMS AND ECONOMIC BOTANY	6	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, Turneraceae.
IV	SYSTEMATIC ANALYSIS OF PLANTS-II Gamopetalae – Sapotaceae, Oleaceae, Boraginaceae, Scrophulariaceae, Bignoniaceae, Convolvulaceae, Acanthaceae, Verbenaceae. Monochlamydeae – Nyctaginaceae, Aristolochiaceae, Casuarinaceae. Monocots – Orchidaceae, Amarylidaceae, 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 (cardamom, cinnamon). (vii) Commercial crops - fibre (jute), (viii) Timber (Teak and red sanders wood), (ix) Resins and gums (Asafoetida and gum arabic) – (x) Essential oils (lemon grass and menthol), (xi) Beverages (tea, coffee), (xii) Plants used as avenue trees for shade, pollution control and aesthetics (xiii) Energy plantation - uses of <i>Casuarina</i> .

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
2. Explain the principles of taxonomy. Summarize the taxonomic hierarchy. Define Binomial nomenclature. Group Activity -Construct key preparation		K1, K2 K5, K6
3. Explain the various types of classification. Distinguish its advantages and disadvantages Construction of floral formula and floral diagram.		K1, K2 K3, K4
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
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/other 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 Transferable Skill	

Recommended Text:

- Pandey, B.P. 2013. Taxonomy of Angiosperms, S. Chand Publishing, New Delhi.
- Sharma, O.P. 2017. Plant Taxonomy. (II Edition). The McGraw Hill Companies.
- Singh, G. 2007. Plant systematics theory and practices. Oxford and IBH Publishing Co.
- Jain, S.K and Rao R.R. 1993. A handbook of field and herbarium methods. Today and Tomorrow Publ.
- Pandurangan, A.G., Vrinda, K.B and Mathew Dan. 2013. Frontiers in plant taxonomy. JNTBGRI, Thiruvananthapuram, Kerala.
- Vardhana, R. 2009. Economic Botany. 1st ed. Sarup Book Publishers Pvt Ltd. New Delhi.
- Subramaniam, N.S. 1997. Modern plant taxonomy. Vikas Publishing House, New Delhi.

Reference Books:

- Wallis, T.E. 1999. Text book of Pharmacognosy. CBS Publishers and Distributors, New Delhi.
- Kumaresan, V and Annie Regland. 2004. Taxonomy of Angiosperms systematic Botany, Economic Botany, Botany & Ethnobotany.
- Anonymous, 2004. Cultivation of Selected Medicinal Plants. National Medicinal Plants Board, Govt. of India, New Delhi.
- Vallabh. 2000. Practical Pharmacognosy, Kolkata. New Delhi.
- Acharya Vipul Rao. 2000. Herbal cure for common diseases. Diamond books, Pvt. Ltd.
- Dey, A.C. 1998. Indian medicinal plants used in Ayurvedic preparations, Bishen Singh Mahendra Pal Singh.
- Sathya, S., Jaiganesh, K.P and Sudha, T. 2019. Current Trends in Herbal Drug Technology. Pharmacy Council of India New Delhi.
- Mohamad Ali. 2009. Pharmacognosy and Phytochemistry. CBS Publications & Distribution, New Delhi, Volume.1.
- 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>
5. <https://www.tropicos.org/home>
6. <http://apps.kew.org/herbcat/gotoHerbariumGrowthPage.do>
7. <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)

Semester	CORE-VI - 23PBOTP23 :	H/W	C
II	LABORATORY/ PRACTICAL COURSE-II- COVERING CORE PAPERS, IV AND V	6	4

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 artificial keys. Description of a species, based on virtual herbarium and live specimens of the families mentioned in the theory. Study the products of plants mentioned in the syllabus of economic botany with special reference to the morphology, botanical name and family. Solving nomenclature problems. Field trip: A field trip at least 3-4 days to a floristically rich area to study plants in nature and field report submission of not less than 20 herbarium sheets representing the families studied.
II	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>Bouerhavia</i> , <i>Aristolochia</i> , <i>Bignonia</i> , <i>Piper</i> petal 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 anomaly.
III	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 in vitro pollen germination. 7. Observation of endosperm types.

IV	ECOLOGY, 1. Determination of the quantitative characters of a plant community by random quadrat method (abundance, density, dominance, species diversity, frequency) in grazing land, forests. 2. Estimation of above ground and below ground biomass in a grazing land employing minimum size of quadrat. 3. To determine soil moisture, porosity and water holding capacity of soil collected from varying depth at different locations. 4. Determination of pH of soil and water by universal indicator (or) pH meter. 5. Determination of dissolved oxygen. 6. Estimation of carbonate. 7. Estimation of bicarbonate.
V	PHYTOGEOGRAPHY, CONSERVATION BIOLOGY & INTELLECTUAL PROPERTY RIGHTS 1. Mapping of world vegetation 2. Mapping of Indian vegetation. 3. Remote sensing – Analyzing and interpretation of Satellite photographs- Vegetation/ weather. 4. Visit to remote sensing laboratory (at Anna University, Regional Meteorological Centre at Nungambakkam).

Course outcomes: On completion of this course, the students will be able to: CO	Programme outcomes
1. To gain recent advances in plant morphological and floral characteristics.	K1
2. Understand about different floral characteristics and artificial key preparation which employed for plant identification and conservation.	K2
3. Recall or remember the information including basic and advanced in relation with plant anatomy and embryology.	K4 & K5
4. Apply their idea on sectioning and dissection of plants to demonstrate various stages of plant development.	K3
5. Know about different vegetation sampling methods.	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/other to be resolved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferable Skill
Recommended Text:	

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.
4. 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.
5. Sundara, R. S. 2000. Practical manual of plant anatomy and embryology. Anmol Publ. PVT LTD, New Delhi.
6. 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.
7. Sharma, H.P. 2009. Plant Embryology: Classical and Experimental, Bombay Popular Prakashan, ISBN-8173199698, 9788173199691.

Reference books:

1. Aler Gingauz.2001. MedicinalChemistry.OxfordUniversityPress&WileyPublications.
2. MannJ.Davidson,R.SandJ.B.Hobbs,D.V.Banthorpe,J.B.Harborne.1994.*NaturalProducts*.Longman Scientificand TechnicalEssex.
3. Gopalan,C., B.V.RamasastriandS.C.Balasubramanian.1985.NutritiveValueofIndianFoods. NationalInstituteofNutrition,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.
6. Sundara Rajan, S, 2003. Practical Manual of Plant Anatomy and Embryology 1st ed, Anmol Publications, ISBN-812610668.
7. Katherine Esau. 2006. Anatomy of Seed Plants. 2nd edition, John Wiley and Sons.

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>

MappingwithProgrammeOutcomes:

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

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

Semester	ELECTIVE –III: 23PBOTE24-1 :	H/W	C
II	MEDICINAL BOTANY	4	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: Historical Perspectives – European, African, American, Southeast Asian Practices. Scope and Importance of Medicinal Plants; Traditional systems of medicine - Definition and Scope. Classical health traditions - Naturopathy, Siddha, Ayurveda, Homeopathy, Unani and MateriaMedica. Ayurveda: History, origin, panchamahabhutas, 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 flurochromes, 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 cardiotonic, <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	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.
V	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 benefit sharing models.

Course outcomes: On completion of this course, the students will be able to: CO	Programme outcomes
1. Recognize plants and relate to their medicinal uses	K1
1. Explain about the phytochemistry, pharmacognosy and bioprospecting of medicinal plant extracts.	K2
2. Apply techniques for conservation and propagation of medicinal plants.	K3
3. Analyze and decipher the significance of various methods of harvesting, drying and storage of medicinal herbs.	K4
4. 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/other 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 Transferable Skill

RecommendedText:

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*. VallabhPrakashan, New Delhi.

Web resources:

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

Mapping with Programme Outcomes:

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

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

Semester	ELECTIVE –III: 23PBOTE24-2 :	H/W	C
II	RESEARCH METHODOLOGY, COMPUTER APPLICATIONS & BIOINFORMATICS	4	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 start 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 GelElectrophoresis –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 .

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 & K2
2. Learn the principles and applications of electrophoresis.	K2 & K3

3. Construct the phylogenetic trees for similar characteristic feature of plant genomes and study <i>de novo</i> drug design through synthetic biology.	K5 & K6
4 Understand the concept of pairwise alignment of DNA sequences using algorithms.	K3 & K4
5. Interpret the features of local and multiple alignments.	K4 & 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/other 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 Transferable Skill

Recommended Text:

1. Veerakumari, L. 2017. Bioinstrumentation. MJP Publisher, India. p578.
2. Sree Ramulu, 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)

Semester	ELECTIVE –III: 23PBOTE24-3 :	H/W	C
II	BIOPESTICIDE TECHNOLOGY	4	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 biorationals. Mass production technology of bio-pesticides. Major classes-Properties and uses of Bioinsecticides, biofungicides, biobactericides, bionematicides and bioherbicides. Importance of neem in organic agriculture.
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>Agrobacterium 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: 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
2. Aware the significance of biopesticides and their beneficial role in controlling insect pests, diseases, nematodes and weeds.		K1 & K4
3. Knowledge on identification of promising biopesticides and their mechanisms of action against insect pests, diseases, nematodes and weeds.		K2 & K6
4. Learn the mass production and formulation technology of selected biopesticides.		K3 & K6
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/other 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 Transferable Skill	

Recommended Text:

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)

Semester	ELECTIVE –IV: 23PBOTE25-1 :	H/W	C
II	APPLIED BIOINFORMATICS	4	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 bioinformatic 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–Biosequences sets–Sequence annotation–Sequencedescription.
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: On completion of this course, the students will be able to: CO	Programme outcomes
1. FamiliarizewiththetoolsofDNAsequence analysis.	K1&K2
2. Useandexplainthe applicationofbioinformatics.	K2&K3
3. Mastertheaspectsofprotein-proteininteraction,BLASTandPSI-BLAST.	K3&K4
4. Describethfeatures oflocaland multiplealignments.	K3&K4
5. Interpretthecharacteristicsofphylogeneticmethodsandbioinformaticsapplications.	K4&K5
ExtendedProfessionalComponent (is a part of internal component only,Not to be included in theExternalExamination questionpaper)	Questionsrelatedtotheabovetopics,from variouscompetitiveexaminationsUPSC/TRB/NET/UGC– CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill

RecommendedText:

1. Baxevanis,A.D.&Ouellette,B.F.2001.Bioinformatics:Apracticalguidetotheanalysisofgenesand proteins. NewYork: Wiley-Interscience.
2. Bourne,P.E.,&Gu,J.2009. Structuralbioinformatics.Hoboken, NJ:Wiley-Liss.
3. Lesk,A.M.2002. Introductiontobioinformatics.Oxford: Oxford UniversityPress.
4. Mount,D.W.2001.Bioinformatics:Sequenceandgenomeanalysis.ColdSpringHarbor,NY:ColdSpring HarborLaboratory Press.
5. Pevsner,J.2015.Bioinformaticsandfunctionalgenomics.Hoboken,NJ:Wiley-Blackwell.

ReferenceBooks:

1. Campbell,A.MandHeyer,L.J.2003.Discoveringgenomics,proteomics,andbioinformatics.SanFrancisco: Benjamin Cummings.
2. Green,M.RandSambrook,J.2012.Molecularcloning:Alaboratorymanual.ColdSpringHarbor,NY : Cold Spring HarborLaboratory Press.
3. Liebler,D.C.2002.Introductiontoproteomics:Toolsforthenewbiology.Totowa,NJ:HumanaPress.
4. Old,R.W.,Primrose,S.B.,andTwyman,R.M.2001.Principlesofgenemanipulation:Anintroduction to geneticengineering. Oxford:Blackwell ScientificPublications.
5. Primrose,S.B.,Twyman,R.M.,Primrose,S.B.,andPrimrose,S.B.2006.Principlesofgene manipulationandgenomics.Malden,MA:BlackwellPub.

Web resources:

1. Bioinformatics:Algorithms&ApplicationsbyProf.M.MichaelGromihaIIT-Madras.
<https://nptel.ac.in/courses/102/106/102106065/#>.
2. ChristopherBurge,DavidGifford,andErnestFraenkel.
7.91.JFoundationsofComputationalandSystemsBiology.
Spring2014.MassachusettsInstituteofTechnology:MITOpenCourseWare,<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=PXZZDwAAQBAJ&r

edir_esc=y

MappingwithProgrammeOutcomes:

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

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

Semester	ELECTIVE –IV: 23PBOTE25-2 : BIostatistics	H/W	C
II		4	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: On completion of this course, the students will be able to: CO	Programme outcomes
1. Create and interpret visual representations of quantitative information, such as graphs or charts.	K5 & K6
2. Solve problems quantitatively using appropriate arithmetical, algebraic, or statistical methods	K3 & K5

3. Know the latest version using in statistical tools and apply the tools to interpret the results	K2
4. To develop their competence in hypothesis testing and interpretation.	K4
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/other 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 Transferable Skill

Recommended Text:

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.
8. 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, Prentice-Hall International, New Jersey, USA.

Web resources:

1. nu.libguides.com/biostatistics
2. <https://newonlinecourses.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/>

MappingwithProgrammeOutcomes:

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)**

Semester	ELECTIVE –IV: 23PBOTE25-3 : INTELLECTUAL PROPERTY RIGHTS	H/W	C
II		4	3

Pre-requisite	Intent to understand the legal systems governing the knowledge economy. Basic understanding of how laws are structured and interpreted.
Learning Objectives	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	GI AND PATENT FILING PROCEDURES 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.

Course outcomes: On completion of this course, the students will be able to: CO	Programme outcomes
1. Recall the history and foundation of Intellectual Property.	K1
2. Understand the differences of Property and Assets and Various Categories of Intellectual Creativity.	K2
3. Apply the methods to protect the Intellectual Property.	K3
4. Differentiate if the Said Intangible property be protected under law or protected by strategy.	K4
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 Transferable 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, 3rd, 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
2. Anant Padmanabhan. 2012. Intellectual Property Rights: Infringement and Remedies LexisNexis 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)

Semester	Skill Enhancement : 23PBOTS26 : Floriculture and Medicinal Plant Cultivation	H/W	C
II		4	2

UNIT I

Nursery Management and Routine Garden Operations. Sexual and vegetative methods of propagation. Soil sterilization; Seed sowing; Pricking; Planting and transplanting; Shading; Stopping or pinching; Defoliation; Wintering; Mulching; Topiary. Role of plant growth regulators. Flowering annuals; Herbaceous perennials; Divine vines; Shade and ornamental trees. Ornamental bulbous and foliage plants; Cacti and succulents; Palms and Cycads; Ferns and Selaginellas.

UNIT II

Cultivation of plants in pots; Indoor gardening; Bonsai. Principles of Garden Designs: English, Italian, French, Persian, Mughal and Japanese Gardens. Features of a garden (Garden wall, Fencing, Steps, Hedge, Edging, Lawn, Flower beds, Shrubbery, Borders, Water garden. Some Famous gardens of India)

UNIT III

Landscaping Places of Public Importance: Landscaping highways and Educational institutions. Techniques of Commercial Floriculture. Factors affecting flower production; Production and packaging of cut flowers; Flower arrangements; Methods to prolong vase life. Cultivation of Important cut flowers (Carnation, Aster, Chrysanthemum, Dahlia, Gerbera, Gladiolous.

UNIT IV

History, Scope and Importance of Medicinal Plants. Indigenous Medicinal Sciences. Definition and Scope-Ayurveda: History, origin, panchamahabhutas, 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.

UNIT V

Conservation of endangered and endemic medicinal plants. Definition: endemic and endangered medicinal plants, Red list criteria. In situ conservation: Biosphere reserves, sacred groves, National Parks; Ex situ conservation: Botanic Gardens and Ethnomedicinal plant Gardens. Propagation of Medicinal Plants: Objectives of the nursery, its classification, important components of a nursery, sowing, pricking, use of green house for nursery production, propagation through cuttings, layering, grafting and budding.

Suggested Readings :

1. S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.
2. S.K. Jain (ed.) Glimpses of Indian. Ethnobotany, Oxford and I B H, New Delhi – 1981
3. S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India.
4. S.K. Jain, 1990. Contributions of Indian ethnobotany. Scientific publishers, Jodhpur.
5. Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons – Chichester
6. Rama Ro, N and A.N. Henry (1996). The Ethnobotany of Eastern Ghats in Andhra Pradesh, India. Botanical Survey of India. Howrah.
7. Rajiv K. Sinha – Ethnobotany The Renaissance of Traditional Herbal Medicine – INA – SHREE Publishers, Jaipur-1969.
8. Faulks, P.J. 1958. An introduction to Ethnobotany, Moredale pub. Ltd. Men.
9. Swaminathan, M. (1990) Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.
10. Trivedi P C, 2006. Medicinal Plants: Ethnobotanical Approach, Agrobios, India.
11. Purohit and Vyas, 2008. Medicinal Plant Cultivation: A Scientific Approach, 2nd edn. Agrobios, India.

Semester	23PBOTC31: CORE -VII: PLANT PHYSIOLOGY AND PLANT METABOLISM	H/W	C
III		6	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 - water absorption by roots – Apoplast and Symplast concept - water transport through the xylem — Transpiration and evapotranspiration- stomatal structure and function – mechanism of stomatal opening and closing – mineral nutrition – essential nutrients – macro and micro nutrients – deficiencies and plant disorders – absorption of solutes – translocation of solutes – pathways and mechanisms. phloem loading and unloading - translocation of photosynthates – source- sink relationship – partitioning of assimilates and harvest index
II	Photosynthesis: The physical nature of light – the absorption and fate of light energy – absorption and action spectra- photoreceptors- Ultrastructure and biochemical compartmentation of Chloroplast; Photosynthetic Electron Transport and Photophosphorylation (cyclic and noncyclic): Photosystems and reaction centres - Light Harvesting complexes - Photosystem I & II and Oxidation of Water; Carbon metabolism: C3, C4 and CAM pathways and their distinguishing features - photorespiration and its significance. Biochemistry and Molecular Biology of RUBISCO.
III	An overview of plant respiration – Glycolysis – TCA cycle– Electron Transport – oxidative phosphorylation and ATP synthesis – Chemiosmotic Theory - Pentose Phosphate Pathway– Respiration and its significance in crop improvement. Cyanide resistant respiration; Nitrogen fixation (Biological - symbiotic and non-symbiotic), Physiology and Biochemistry of nitrogen fixation State Integrated Board of Studies – Botany PG 40.
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 and movements. Seed dormancy and causes and Seed germination and their biochemical changes.
V	Plant senescence –Types and Mechanism of senescence- Abscission: Morphological and biochemical changes – Significance. Fruit ripening- Biochemical, Physiological changes and control of fruit ripening. Plant response to environmental stress: Biotic and Abiotic stress – Water, temperature, light and salinity- Adaptive mechanism to various stresses (avoidance, escape, tolerance)–stress responsive proteins – anti-oxidative mechanism.

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
2. Demonstrate the importance of light in plant growth and the harvest of energy.		K2
3. Explain the energy requirement and nitrogen metabolism.		K3
4. Compare the various growth regulators that influence plant growth.		K4
5. Discuss the senescence and plant response to environmental stress.		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. 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. Wadsworth 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 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, Belimont.
12. Shinha. R.K. 2007. Modern Plant Physiology. Ane Books India, New Delhi.
13. William G. Hopkins, 1999. Introduction to Plant Physiology, John Wiley and sons, INC, New York.
14. Heldt, H.W. 2005. Plant Biochemistry, 3rd Edition. Elsevier Academic Press.

Web resources:

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

Mapping with Programme Outcomes:

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

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

Semester	23PBOTC32: CORE -VIII: ECOLOGY, PHYTOGEOGRAPHY, CONSERVATION BIOLOGY & INTELLECTUAL PROPERTY RIGHTS	H/W	C
III		6	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. Basic concepts of community–characteristics, composition, structure, origin and development–community dynamics– trends 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 –Green house 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 plant 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: 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
2. Understand the applied aspect of environmental botany.		K1&K4
3. Students will spot the sources and pollution and seek remedies to mitigate and rectify them.		K2& K6
4. Identify different plant communities, categorize plant biomes and identify threatened, endangered plant species and create awareness program in protection of biodiversity.		K3& K6
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 Text:		
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.bsienvnis.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)

Semester	23PBOTC33: CORE -IX: GENETICS, PLANT BREEDING & BIOSTATISTICS	H/W	C
III		6	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. Quantitative inheritance. Sex determination in plants and theories of sex determination. Sex linked characters. Structure of Gene, Operon , inducible operon , Operator site, Promoter, Polycistronic m RNA, Regulator, regulator constitutive,Regulator super repressor, repressor, super repressor, inducer. Gene function and regulation in prokaryotes with reference to Lac operon and trp operon. Producer gene, structural gene and integrator gene. Gene Regulation 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, simple transposon, composite transposon, Is element. Transposons in <i>Zea mays</i> . Transposable elements in prokaryotes. UV induced mutation and its repair mechanism. Mismatch DNA repair mechanism. Mutation types- frame shift mutation, addition, deletion, substitution, transition and transversion. Xeroderma pigmentosum.
III	ABO blood group in humans. QTL mapping, Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers , mapping by using somatic cell hybrids. Extra chromosomal inheritance, maternal inheritance. Organelle genomes: Organization and functions of chloroplast and mitochondrial DNA.
IV	PLANT BREEDING: Objectives of plant breeding, characteristics improved by plant breeding, Genetic basis of breeding self and cross – pollinated crops. Pure line theory, pure line selection and mass selection, clonal selection methods. Hybridization, Genetics and physiological basis of heterosis.
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); sampling distribution; difference between parametric and non-parametric statistics; confidence interval; errors; levels of significance; regression and correlation; t-test; analysis of variance; X2 test;; basic introduction to Multivariate statistics, etc.

Course outcomes: On completion of this course, the students will be able to:		Programme outcomes
CO		
1. Understand the Mendal's Law of inheritance and gene interactions.		K1
2. Analyze the various factors determining the heredity from one generation to another.		K2
3. Explain Gene mapping methods: Linkage maps.		K3
4. Compare and contrast the genetic basis of breeding self and cross – pollinated crops.		K4
5. Discuss and develop skills for statistical analysis of biological problems.		K5 & K6
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC/ TRB/ NET/ UGC–CSIR/ GATE/ TNPSC/ others to be solved (To be discussed during the Tutorial hour)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill	
Recommended Text:		
1. Benjamin, A. Pierce. 2012. Genetics- A conceptual Approach. W.H. Freeman and Company, New York, England. 2. Stansfield, W.D. 1969. Theory and problems of Genetics. McGraw-Hill 3. Sinnott, E.W. Dunn, L.E and Dobzhansky, T. 1973. Principles of Genetics. McGraw-Hill. New York. 4. Chaudhari, H.K. 1984. Elementary Principles of Plant Breeding. Oxford & IBH Publishing Company. 5. Brown, T.A. 1992. Genetics a Molecular Approach, 2nd Ed. Chapman and Hall. 6. Chahal, G.S and Gosal, S.S. 2018. Principles and Procedures of Plant Breeding Biotechnological and Conventional Approaches, Narosa Publishing House, New Delhi. 7. Singh, B.D. 2013. Plant Breeding: Principles and Methods, Kalyani Publishers, New Delhi 8. Singh, P. 2017. Fundamentals of Plant Breeding, Kalyani Publishers. 9. Chaudhary, R.C. 2017. Introductory principles of plant breeding, Oxford IBH Publishers, New Delhi. 10. Gupta, P.K. 2009. Genetics. Rastogi publications, Meerut, New Delhi. 11. Gupta, S.C. 2013. Fundamentals of statistics, Himalaya Publishers, Mumbai. 12. Kothari, C.R and Garg, G. 2014. Research methodology –Method and techniques. New Age International (P) Ltd. New Delhi. 13. Gurumani, N. 2005. Biostatistics, 2nd edn. MJP publications, India.		
Reference Books:		
1. Watson, J.D. <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. 6. Acquaah, G. 2007. Principles of Plant Genetics and Breeding. Blackwell Publishing. 7. William, S., Klug and Michael, R. Cummings, 2003. Concepts of Genetics. Seventh edition. Pearson Education (Singapore) Pvt. Ltd. 8. Simmonds, N.W. 1979. Principles of Crop improvement. Longman, London. 9. Lewin, B. 2000. Genes VII, Oxford University Press, USA. 10. Strickberger, M.W. 2005. Genetics (III Ed). Prentice Hall, New Delhi, India. 11. Allard, R.W. 2010. Principles of Plant Breeding. 2nd ed. John Wiley and Sons, Inc. New Jersey, US.		

13. Pillai, R.S.N and Bagawathi, V. 1987. Practical Statistics (For B.Com. and B.A., Students) S.Chand& Co. (Pvt.) Ltd., New York.
14. 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.
15. 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>
6. <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)

Semester	23PBOTP34 : CORE X: PRACTICAL -III- COVERING CORE PAPERS VII, VIII & IX	H/W	C
III		6	4

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	PLANT PHYSIOLOGY 1. Determination of osmotic potential by plasmolytic method. 2. Determination of water potential using gravimetric method. 3. Determination of water potential using dye method (Chardakov's method). 4. Effect of Monochromatic light on apparent photosynthesis. 5. Effect of CO₂ concentration on apparent photosynthesis. 6. Effect of temperature on protoplasmic membrane. 7. Separation of chloroplast pigments using paper chromatographic technique. 8. Estimation of chlorophyll content using Arnon's method. 9. Rice coleoptile growth test for Indole Acetic Acid. 10. Effect of Auxin on root initiation 11. Experiments to show the herbicidal action of Auxin (2-4D). 12. Effect of synthetic cytokinin on the destruction of chlorophyll. 13. Estimation of Proline content 14. Estimation of Glycinebetaine content 15. Estimation of Ascorbic Acid
II	ECOLOGY, 1. Construction of a meter quadrat 2. Determination of the number of species by list quadrat method 3. Determination of minimum size of the quadrat by the species area method 4. Determination of number of Individuals by the count quadrat method 5. Determination of abundance, frequency, and relative frequency by count quadrat method 6. Ranunkiaer's normal frequency method 7. Determination of density and relative density by count quadrat method 8. Determination of basal area and relative dominance by count quadrat method 9. Determination of Important value index and polygraph charting 10. Effect of industrial effluents on seed germination 11. Estimation of dust pollution on plants. 12. Ecological Instruments- Thermohygrograph, Lux meter, Maximum and Minimum thermometer, anemometer, altimeter

	13. Ecological adaptation of plants. 14. Estimation of EC,pH, turbidity and TDS. 15. Estimation of sulphate and nitrate 16. Analysis of Na, K, Ca and Cl in pond water 17. Estimation of EC,pH 18. Soil moisture content
III	PHYTOGEOGRAPHY, CONSERVATION BIOLOGY & INTELLECTUAL PROPERTY RIGHTS 4. Mapping of world vegetation 5. Mapping of Indian vegetation. 6. Remote sensing – Analyzing and interpretation of Satellite photographs-Vegetation/ weather. 7. Visit to remote sensing laboratory 8. Intellectual property rights – Farmers rights, Copy rights, Patens,Trade Marks, Geographical indicators.
IV	GENETICS 1) Karyotype analysis – Idiogram preparation 2) Study of special types of chromosomes 3) Genetics problems in Mendelian inheritance, gene interaction, quantitative inheritance, multiple alleles, and sex linkage 4) Construction of genetic maps
V	PLANT BREEDING 1) Methods of vegetative propagation – Layering, Budding and Grafting 2) Intergeneric hybrids. 3) Hybridization techniques including Emasculation, Bagging. BIOSTATISTICS Mean, Mode, Median , Mean deviation , Standard deviation , Line Chart, Bar Diagram, Pie chart.
Course outcomes: On completion of this course, the students will be able to:	
CO	Programme outcomes
6. To gain recent advances in plant morphological and floral characteristics.	K1
7. Understand about different floral characteristics and artificial key preparation which employed for plant identification and conservation.	K2
8. Recall or remember the information including basic and advanced in relation with plant anatomy and embryology.	K4 &K5
9. Apply their idea on sectioning and dissection of plants to demonstrate various stages of plant development.	K3
10. Know about different vegetation sampling methods.	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 Text:

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.
4. 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.
5. Sundara, R. S. 2000. Practical manual of plant anatomy and embryology. Anmol Publ. PVT LTD, New Delhi.
6. 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.
7. Sharma, H.P. 2009. Plant Embryology: Classical and Experimental, Bombay Popular Prakashan, ISBN-8173199698, 9788173199691.

Reference Books:

1. Aler Gingauz.2001. Medicinal Chemistry. Oxford University Press & Wiley Publications.
2. Mann J. Davidson, R.S and J.B.Hobbs, D.V.Banthorpe , J.B.Harborne. 1994. *Natural Products*. Longman Scientificand Technical Essex.
3. Gopalan,C., B.V. Ramasastri and 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. Traditional plant medicines assources of new drugs. P.J Houghtonin Pharmacognosy. Trease and Evan's.16 Ed.2009.
6. Sundara Rajan, S, 2003. Practical Manual of Plant Anatomy and Embryology 1st ed, Anmol Publications, ISBN-812610668.
7. Katherine Esau. 2006. Anatomy of Seed Plants. 2nd edition, John Wiley and Sons.

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	S	3	3
CO2	3	3	2	3	3	2	1	2	3	2
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	1	2	3
CO5	3	2	2	3	3	3	3	2	3	3

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

Semester	23PBOTE35-1: ELECTIVE – V- SECONDARY PLANT PRODUCTS AND FERMENTATION BIOTECHNOLOGY	H/W	C
III		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, carbohydrates, proteins, amino acids, lipids, pigments, vitamins and other related compounds.
II	MICROBIAL GROWTH: 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/mammalian cell culture reactors. Bioseparations: Biomass removal; Biomass disruption; Membrane-based techniques; Extraction; Adsorption and Chromatography Industrial Processes and Process economics: Description of industrial processes; Process flow sheeting; Process economics.
IV	DOWNSTREAM PROCESSING: Biomass removal and disruption; Centrifugation; sedimentation; Flocculation; Microfiltration; Sonication; Bead mills; Homogenizers; Chemical lysis; Enzymatic lysis; Membrane based purification: Ultrafiltration ; Reverse osmosis; Dialysis ; Diafiltration ; Pervaporation; Perstraction; Adsorption and chromatography: size, charge, shape, hydrophobic interactions, Biological affinity; Process configurations (packed bed, expanded bed, simulated moving beds); Precipitation (Ammonium Sulfate, solvent); Electrophoresis(capillary); Crystallization; Extraction (solvent, aqueous two phase, super critical), Drying; Case studies
V	IMPORTANT PRODUCTS THROUGH FERMENTATION: Organic acids citric acid acetic acid, enzymes – amylase, protease, lipase, antibiotics – penicillin, vitamins – B12, amino acids – glycine, glutamic acid, organic solvenst – ethanol, butanol, acetone, alcoholic beverages – wine, beer, biomass – bakers yeast, biosurfactants, biopesticides, biopolymers.

Course outcomes:		Programme outcomes
On completion of this course, the students will be able to: CO		
1. Critically analyze the types of bioreactors and the fermentation process.		K1
2. Evaluate the role of microorganisms in industry.		K2
3. Analyze the types of bioreactors.		K3
4. Create to understand the significance of intrinsic and extrinsic factors on growth of microorganism.		K4
5. 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:		
- Shuler, M. L and F. Kargi. 2002. <i>Bioprocess Engineering</i>, Prentice Hall Inc. - Doran, P.M. 1995. <i>Bioprocess Engineering Principles</i>, Elsevier. - 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. - Casia, J.R.L.E. 2009. <i>Industrial Microbiology</i>. New Age International (P) Ltd. Publisher, New Delhi. - Stanbury, P. F., Whitaker, A. and Hall, S.J. 1979. <i>Principles of Fermentation Technology</i>. Aditya Books (P) Ltd., New Delhi. - Potter, N. N. 2007. <i>Food Science</i>. CBS Publishers.		
Reference books:		
- Rehm, H. J and G. Reed, <i>Biotechnology-A multi- Volume Comprehensive Treatise</i>, 2nd Ed, Vol 3, Wiley-VCH, 1993 - Moo-Young, M. 2004. <i>Comprehensive Biotechnology</i>, Vol. 2, Pergamon Press, - Dicosmo, F and M. Missawa, 1996. <i>Plant Cell Culture Secondary Metabolism: Towards Industrial Application</i>. CRC LLC. - Frazier, W.C. and Weshoff, D.C. (2015). <i>Food Microbiology</i> (5th edition) McgrawHill. - Kumari, S. 2012. <i>Basics of Food Biochemistry and Microbiology</i>. Koros Press. - Whitaker. J.R. 2016. <i>Handbook of Food Enzymology</i>. CRC press - Shewfelt, R.L.2013. <i>Introducing Food Science</i>. CRC Press. - Smith, J.S and Hui, Y.H.2014. <i>Food Processing</i>. Wiley. - Varzakas, T and Tzia, C. 2016. <i>Handbook of Food Processing</i>. CRC Press.		
Web resources:		
https://link.springer.com/book/9783642673627 https://www.elsevier.com/books/secondary-plant-products/stumpf/978-0-12-675407-0 https://www.amazon.in/Secondary-Plant-Products-Comprehensive-Biochemistry-ebook/dp/B01E3II0E2 https://www.pdfdrive.com/principles-of-fermentation-technology-e40900163.html 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)

Semester	23PBOTE35-2: ELECTIVE – V- ENTREPRENEURIAL OPPORTUNITIES IN BOTANY	H/W	C
III		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, cow dung, 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 (button mushroom, oyster mushroom). Spawn isolation and preparation. Cultivation. 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	
CO			
1.	Students can acquire knowledge about organic farming and their advantages		K1
2	Analyze both the theoretical and practical knowledge in understanding various horticultural techniques.		K2
3.	To develop kitchen garden or terrace garden in their living area.		K3
4.	Evaluate the horticultural techniques to students can develop self employment and economical improvement.		K4
5	Create and develop skills for mushroom cultivation.		K5 & K6
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)		Questions related to the above topics, from various competitive examinations UPSC/ TRB/ NET/ UGC–CSIR/ GATE/ TNPSC/ others to be solved (To be discussed during the Tutorial hour)	
Skills acquired from this course		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill	

Recommended Text:

1. Chmielewski, J.G and Krayeresky, 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, 3d Edition. Agrobios (India), Jodhpur.

Reference Books:

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

Web resources:

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

Mapping with Programme Outcomes:

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

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

Semester	23PBOTE35-3: ELECTIVE – V- SILVICULTURE AND COMMERCIAL LANDSCAPING	H/W	C
III		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	Basics of Horticulture: Importance and scope of Horticulture - Divisions of Horticulture – Climate, soil and nutritional needs – Manures and fertilizers – Organic manures – Inorganic fertilizers – Biofertilizers – Methods of applications of manures and fertilizers - Water irrigation – Surface irrigation – Sub irrigation – Special irrigation methods – Plant protection and pest control for horticulture crops.		
II	Plant propagation: Natural method: Propagation through seeds and specialized vegetative structures - Artificial methods: Cutting: types (root, stem, leaf cuttings), advantages and disadvantages - Layering: types (simple, compound, tip, trench, mound, air-layering) advantages and disadvantages - Grafting: types (inarching, side, splice, whip/tongue, veneer, cleft, bark, epicotyl, top-working) advantages and disadvantages - Budding: Types (T-budding, shield, patch, and ring budding) advantages and disadvantages - Stock – scion relationships – Micropropagation.		
III	Fruit crops: Training and pruning methods for fruit plants – Induction of flowering, flower thinning - fruit setting and fruit development – Seedlessness in horticultural fruits – Importance of plant growth regulators in fruit crops – Cultivation and harvesting methods of important fruit crops; Mango, Sapota, Pomegranate, Grapes and Guava.		
IV	Flower and vegetable crops: Floriculture – Cultivation of commercial flower crops – Rose, Jasmine, Chrysanthemum, Crossandra, Anthurium and Gerberas – Cut flowers – Vase life period – Packages for export of cut flowers - Flower decoration – Dry and wet decoration - State Integrated Board of Studies – Botany PG 32 Classification of vegetables – Cultivation of important vegetables - Tomato, Potato, Onion, Cabbage and Snake guard – Layout for a model kitchen garden.		
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: CO		On completion of this course, the students will be able to:	
1. To understand the importance and divisions of horticulture.		K1	
2. Demonstrate the art of floriculture and landscape gardening.		K2	
3. Explain plant propagation and fruit crop cultivation.		K3	
4. Compare and contrast the vegetable cultivation and kitchen gardening.		K4	
		Programme outcomes	

5. Discuss and develop skills for effective understanding on landscaping and components of gardens.		K5 & K6
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability Professional Competency, Professional Communication and Transferrable Skill	
Recommended Text:		
1. Edmond, J.B. 1977. Fundamentals of Horticulture. Tata McGraw Hill Publishers Co. Ltd., New Delhi. 2. Kumar, N. 2017. Introduction to Horticulture, Midtech Publisher. 3. Manibushan Rao, K. 1991. Textbook of Horticulture. Macmillan Publishing Co., New York. 4. Rao, K.M. 2000. Text book of Horticulture. Macmillan India Ltd, New Delhi. 5. George, A. 2002. Horticulture Principles and Practices. 2nd Edition. Pearson Education, Delhi. 6. Bohra, M.P.S. and Arora, 2017. Introduction to Horticulture, 2 nd Edition. 7. Singh, J. 2018. Fundamentals of Horticulture. Kalyani Publishers. 8. Acquaaah, J. 2009. Horticulture – principles and practices, 4th edition, PHI learning Pvt. Ltd. 9. Rao Manibhushan K. 1991. Textbook of horticulture. MaC Millan India Ltd. 10. Gangulee H. C. and Kar A. K. 2004. College Botany Vol II, New Central Book Agency 11. Sharma V. K. 1999. Encyclopaedia of Practical Horticulture, Vol I –IV, Deep And Deep Publ. Pvt. Ltd.		
Reference books:		
1. EdmentSenn Andrews. 1994. Fundamentals of Horticulture.Tata. McGraw Hill Publishing Co., Ltd., Delhi. 2. Adams, 2005. Principles of Horticulture. IVth Ed. Elsevier India Pv. Ltd 3. Antje Rugullis. 2008. 1001 Garden Plants and Flowers. Parragon Publishers. 4. Berry, F. and Kress, J. 1991. Heliconia: An Identification Guide . Smithsonian Books. 5. Butts, E. and Stensson, K. 2012.Sheridan Nurseries: One hundred years of People, Plans, and Plants. Dundurn Group Ltd. 6. Russell, T. 2012. Nature Guide: Trees: The world in your hands (Nature Guides).		
Web Resources:		
1.https://courses.opened.uoguelph.ca/contentManagement.do?method=load&code=CM000019 2.www.teachervision.com/gardening 3.https://pace.oregonstate.edu/catalog/master-gardener-series-oregon-master-gardener-program 4.https://www.amazon.in/Gardening-Landscape-Design-and-Botanical-Garden/s?rh=n%3A1318122031%2Cp_27%3Aand+Botanical+Garden 5.https://www.overdrive.com/subjects/gardening 6.https://www.scribd.com/book/530538456/Opportunities-in-Landscape-Architecture-Botanical-Gardens-and-Arboreta-Careers		

Mapping with Programme Outcomes:

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

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

Semester	23PBOTS36-1: SEC – II – MUSHROOM CULTIVATION	H/W	C
III		3	2

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 volvacea</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 affecting button mushroom production (Temp, pH, air and water management, competitor moulds and other disease).		
IV	POST-HARVEST MANAGEMENT: Harvest, storage, quality assurance of mushrooms. Pest management.		
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 students will be able to:		Programme outcomes	
CO			
1. Knowledge on identification of edible and toxic mushrooms belonging to Ascomycota and Basidiomycota.		K1, K3	
2. Outline the nutraceutical properties of edible mushrooms.		K2, K4	
3. Knowledge on cultivation techniques of edible and medicinal mushrooms.		K3, K6	
4. Understand the harvest and post harvest techniques of mushroom crops.		K4	
5. 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:	
1. Cheung, P.C.K. 2008. Mushrooms as functional food. A John Wiley & Sons, Inc., Publication. 2. Dijkster Huis, J. and Samson, R.A. 2007. Food Mycology: A multifaceted approach in fungi and food. CRC press, New York. 3. Hall, R.I., Stephenson, S.L., Buchanan, P.K., Yun, W. and Cole, A.L.J. 2003. Edible and poisonous mushrooms of the world. Timber Press, Portland, Cambridge. 4. Ting, S. And Miles, P.G. 2004. Mushrooms: Cultivation, nutritional value, medicinal effect and nutritional environmental impact. CRC press, New York. 5. Verma, 2013. Mushroom: edible and medicinal: cultivation conservation, strain improvement with their marketing. Daya Publishing House.	
Reference Books:	
1. Tiwari, S.C., Pandey K. 2018. Mushroom cultivation. Mittal publisher, New Delhi. 2. Philips, G., Miles, Chang, S-T. 2004. Mushrooms: Cultivation, nutritional value, medicinal effect and environmental effect. 2nd ed. CRC Press. 3. Diego, C.Z., Pando-Gimenez, A. 2017. Edible and medicinal mushrooms: Technology and Application. Wiley- Blackwell publishers. 4. Nita Bahl. 2002. Handbook on Mushroom 4th edition Vijayprimalani for Oxford & IBH publishing co., Pvt., Ltd., New Delhi. 5. Dr. C. Sebastian Rajesekaran Reader in Botany, Bishop Heber College, Trichy – 17. 6. 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=6AJx99OGTK_EC&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)

Semester	23PBOTS36-2: SEC – II – ORGANIC FARMING	H/W	C
III		3	2

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, organic ecosystem, scope of organic farming in India - Principles and types of organic farming. Choice of crops & varieties in organic farming - Initiative by Govt/NGOs/Other organizations for promotion of organic farming Operational structure of NPOP (National Programme for Organic Production) - Concept of dryland agronomy Organic nutrient resources & their fortification, restriction to nutrient use in organic farming - Organic production methods for cereals, vegetables and fruit crops
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, labeling of organic produce - Storage and transport of organic produce.
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: On completion of this course, the students will be able to:		Programme outcomes
CO		
1. Knowledge on various aspects of organic farming.		K1
2 Understand the relevance of organic farming, its advantages.		K2
3. Explain the short comings against conventional high input agriculture.		K3
4. Compare the packaging methods of harvest.		K4
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 IIndEdition , 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)				

Semester	23PBOTI37: SUMMER INTERNSHIP	H/W	C
III		-	2

Pre-requisite	The summer internship 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	1. The main goal of the internship 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. 2. To comprehend how theoretical ideas are applied in many sectors and industries. 3. 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. 4. The internship 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. 5. Internships 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.

CONTENTS

Guidelines for Internship Programme:

1. To give students the opportunity to spend at least fifteen days on their own during the II Semester vocation in order to acquire exposure to research labs, industry, and respected institutions and comprehend contemporary research procedures.
2. Individual instruction is provided for the internship. The internship programme must be completed in order to receive a credential.
3. Students are required to indentify a research labs/industry/recognized institution for their Internship 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 coordinator before commencement of the Internship. 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 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 Programme completion certificate on the letterhead of a research lab/industry/, or an accredited institution.

6. Maintain Internship Programme record with details on activities and personal learning during their project period.
7. The department head and the coordinator of the internship programme form a committee to ensure that the internship is followed.
8. At least two copies of the report must be prepared by the intern at the conclusion of the internship program—one 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 labeled and consecutively numbered or lettered. The report must be printed, bound (ideally with soft binding), and contain at least 25 pages.
9. The internship training report should be submitted to the department within a month from the date of commencement of third semester.

However, such submission shall not be accepted after the end of third semester Examinations.

Evaluation of the Internship:

- i. The internship program will be assessed by the assigned Internship Programme Coordinator from the host institute.
- ii. Evaluation will be done by the Internship 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.
- iv. 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 coordinator.

College Guide Manual – Summer Internship Program

1. The Internship Programme Coordinator should give proper procedures to the intern before and after the Internship.
2. The Internship Programme Coordinator should interact with the research labs/industry/recognized institution at least once before completion of the internship.
3. The weekly report submitted by the student should be reviewed and reported to the Internship Programme coordinator.

(Refer to the regulation for additional information)

	CONTENTS OF THE REPORT Title page Page for supervisory committee Table of Acknowledgement Internship Certificate Executive Summary Introduction of the Report Overview of the Organization What I have Learned Analyses Summary Recommendations and Conclusion References Appendices
Course outcomes: On completion of this course, the students will be able to: CO	Programme outcomes
1. For students in those pertinent core areas, the internship 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)**

Semester IV Core -XI	23PBOTC41: CELLAND MOLECULAR BIOLOGY	H/W	C
		6	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	The dynamic cells, Concept of prokaryote and Eukaryote. Structural organization of plant cell, specialized plant cell types chemical foundation. 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. Replication, transcription, translation in prokaryotes and eukaryotes. DNA damage and repair (Thymine dimer, photoreactivation, excision repair). 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 repair. DNA sequencing. Transcription, enzymes involved in transcription, post transcription changes, reverse transcription, Translation. overlapping genes.
V	DNA/gene manipulating enzymes: endonuclease, ligase, polymerase, phosphatase, transcriptase, transferase, topoisomerase. Gene cloning: cloning vectors, molecular cloning and DNA libraries. Molecular genetic elements, insertion elements, transposons. Recombinant DNA. Direct and indirect gene transfer. Detection of recombinant molecule, production of gene products from cloned genes. Genome library, cDNA library.

Course outcomes: On completion of this course, the students will be able to: CO		Programme outcomes
1.	Recall a plant cell structure and explain its function.	K1
2	Illustrate and explain the structure of various cell organelles.	K2
3.	Explain the structure and functional significance of nucleic acid.	K3
4.	Compare and contrast the DNA replication (prokaryotes and eukaryotes), enzymes involved in replication, DNA repair	K4
5	Discuss and develop skills for DNA / gene manipulating and the enzymes involved.	K5 & K6
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)		Questions related to the above topics, from various competitive examinations UPSC/ TRB/ NET/ UGC–CSIR/ GATE/ TNPSC/ others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text:		
1. Roy, S.C and Kumar, K.D.C. 1977. Cell Biology, New Central Book Agency, Calcutta. 2. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6 th edition. John Wiley & Sons. 3. Aminul, I. 2011. Text Book of Cell Biology. Books and Allied (P) Ltd, Kolkata, India. 4. Geoffrey M. Cooper. 2019. The Cell: A Molecular Approach, Oxford University Press. 5. Turner, P.C., Mclennan, A.G., Bates, A.D. and White, M.R.H. 2001. Instant notes on Molecular Biology. 6. Watson, J.D, Baker T.A., Bell S.P., Gann A., Levine M., Losick R. 2014. Molecular Biology of the Gene (7th edition), Pearson Press. 7. Snustad Peter, D. Michael J. Simmons. 2015. Principles of Genetics, John Wiley Sons. 8. David Freifelder. 2008. Essentials of Molecular Biology. Narosa Publishing house. New Delhi. 9. Geoffrey M. Cooper and Robert E. Hausman. 2015. The Cell: A Molecular Approach. 7 th edn. Sinauer Associates is an imprint of Oxford University Press.		
Reference Books:		
1. Alberts B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J. D. 1989. Molecular biology of the Cell (2nd edition). Garland Pub. Inc., New York. 2. Karp, G. 1999. Cells and Molecular Biology: Concepts & Experiments. John Wiley and Sons, Inc., USA. 3. Lodish S, Baltimore B, Berk, C and Lawrence K, 1995, Molecular Cell Biology, 3rd edn, Scientific American Books, N.Y 4. Lewin, B. 2000. GENES VII. Oxford University Press, New York, USA 5. Cooper G M and Hausman R E, 2007, The Cell: Molecular Approach 4th Edn, Sinauer Associates, USA. 6. Genes X– Benjamin Lewin, Jones and Bartlett, 2011 7. Molecular Biology of the Cell – Alberts, B, Bray, D, Raff, M, Roberts, K and Watson JD, Garland Publishers, 1999 8. Principles of Biochemistry – Lehninger, W.H. Freeman and Company, 2000.		
Web resources:		
1. https://www.pdfdrive.com/cell-biology-books.html 2. http://www.bio-nica.info/Biblioteca/Bolsover2004CellBiology.pdf 3. https://www.e-booksdirectory.com/listing.php?category=549 4. https://www.elsevier.com/books/molecular-biology/clark/978-0-12-813288-3 5. https://www.kobo.com/in/en/ebooks/molecular-biology		

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)**

Semester IV Core - XII	23PBOTC42: BIOCHEMISTRY & APPLIED BIOTECHNOLOGY	H/W	C
		6	5

Pre-requisite	Basic knowledge on primary and secondary plant metabolites and enzymes. To empower students recognize and appreciate the basic principles that sustain biotechnology as an interdisciplinary domain of learning and research.
Learning Objectives	1. To study the fundamentals and significance of Plant Biochemistry. 2. To know the structure and properties of plant biomolecules. 3. To learn the fundamental and applications of Plant Biotechnology. 4. To study the mechanism of enzyme action and inhibition. 5. To expose the students on the fundaments of genetic transformation.
UNIT	CONTENTS
I	Atomic structure: chemical bonds - ionic bond, covalent bond, coordinate covalent bond, hydrogen bond, hydrogen ion concentration (pH), buffers. 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.
II	Photosynthesis: The physical nature of light – the absorption and fate of light energy – absorption and action spectra- photoreceptors- Ultra structure and biochemical compartmentation of Chloroplast; Biomolecules and Enzymes: Classification of carbohydrates; Structure and properties of monosaccharides, Oligosaccharides, Polysaccharides – Glycoproteins. Protein and Amino acids: Structure, Classification and properties; Peptides - Structure: Primary, secondary, Ramachandran plot, tertiary and quaternary structures. Classification of Lipids: Structure and properties of fatty acids, phospholipids, glycolipids, lipoproteins, cholesterol - structure and functions.
III	Enzymes- Classification and nomenclature chemical nature of enzymes – factors affecting enzyme action – Michaelis – Menton constant, MM equation, Lineweaver Burk plot, Enzyme inhibition, co enzymes- mechanism of enzyme action, isoenzymes. Secondary Metabolites: Structure, classification and properties of alkaloids, steroids, terpenoids, flavonoids. Glycosides - their chemical nature and role.
IV	Transgenic plants - pest resistance, herbicidal resistance, Disease resistant, abiotic and biotic stress tolerant, in improving crop yield, food quality- Golden rice, Edible vaccines, Virus and Bacteria based transient gene expression systems. Virus induced gene complementation, Virus State Integrated Board of Studies – Botany PG 42 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.
V	Screening of Biotransformants - Fermentation techniques- Types. Industrial Production 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, Super bug and its role in biodegradation. Bioremediation - <i>In situ</i> and <i>Ex situ</i> .

Course outcomes: On completion of this course, the students will be able to: CO		Programme outcomes
1. Knowledge on the fundamentals and significance of Plant Biochemistry		K1
2 Understanding on the structure and properties of plant biomolecules.		K2
3. Explain the role of enzymes in plants.		K3
4. Compare and contrast the methods of transgenic plants production and natural plants.		K4
5 Discuss and develop skills for effective utilization of microbial/plant enzymes and their role in biological cells.		K5 & K6
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill	
Recommended Text:		
1. Satyanarayana, U and chakrapani, U. 2005. Biochemistry, Books and Allied (P) Ltd. Calcutta. 2. A.L.Lehninger, D.L.Nelson & M.M.Cox. 1993. Principles of Biochemistry. Worth Publishers, New York. 3. Stryer, L. 1994. Biochemistry. Freeman & Co, New York. 4. Zubay, G. 1988. Biochemistry. 1988 Macmillan Publishing Co, New York. 5. Harold, F.M. 1986. The vital force: A study of Bioenergetics. Freeman & Co, New York. 6. Jain, J.L. 2005. Fundamentals of Biochemistry. S. Chand & Co. New Delhi. 7. Lehninger, A.L. 1982. Principles of biochemistry, CBS Publication. Halford, N. 2015. Plant Biotechnology: Current and Future Applications of Genetically Modified crops,John Wiley and Sons. 8. Kumar, Pradeep. 2018. Advances in Microbial Biotechnology: Current Trends and Future Prospects. 10.1201/9781351248914		
Reference Books:		
1. Bonner, J. and Warner, W.H. 1961. Plant Biochemistry. Academic Press. Inv. New York. 2. Gupta, S.N. 2016. Biochemistry Rastogi Publications, Meerut. 3. Satyanarayana, U. and Chakkrapani, U. 2013. Biochemistry. Elsevier India Pvt Ltd & Books Allied Pvt.Ltd, New Delhi. 4. Nelson, D.L. and Cox, M.M. 2017. Lehninger’s Principles of Biochemistry, Prentice Hall, International N.J, 7th Edition. 5. Heldt, H-W. 2005. Plant Biochemistry, 3rd Edition. Elsevier Academic Press. 6. Buchanan, B.B., Grissem, W. and Jones, R.L. 2000. Biochemistry and molecular biology of plants. 5th Edition. Wiley-Blackwell. 7. Jain, J.L., Jain, S. and Jain, N. 2016. Fundamentals of Biochemistry. Chand Publishing, New Delhi. 8. Halford, N. 2015. Plant Biotechnology: Current and Future Applications of Genetically Modified Crops, John Wiley and Sons.		

Web resources:

1. [http://priede.bf.lu.lv/grozs/AuguFiziologijas/Augu_biokimija/Plant%20Biochemistry 204.pdf](http://priede.bf.lu.lv/grozs/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)**

Semester	23PBOTD43 : Project with VIVA VOCE	H/W	C
IV		10	7

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.
UNIT	CONTENTS
I	1. Each student will be allotted a Project Guide from the faculty of the department concerned by lot method. 2. The topic of the dissertation shall be assigned to the candidate before the beginning of third semester. 3. After the completion of the project work, the student has to submit four copies of dissertation with report carrying his/her project report for evaluation by examiners. After evaluation, one copy is to be retained in the College Library. 4. Project work will be evaluated by both the external and the internal (Project Guide) examiners for the maximum of 50 marks in total on the scale of the maximum of 25 marks for the internal and the external each. 5. Viva-voce will be conducted by the panel comprising, External examiner and Internal Examiner for the maximum of 25 marks in total.
II	All the candidates of M.Sc (Botany) are required to undergo a major project and submit the following: 1. Dissertation/Thesis based on the work done by the student. 2. Submit the dissertation in Hard Copies (4 No's) & Soft copy of the project CD/DVD. PROJECT EVALUATION GUIDELINES: The project is evaluated on the basis of following heads: For Viva-Voce maximum is 25 marks which will be conducted by both the internal and external examiners during endsemester University practical examinations. Internal: 25 marks I Review – Selection of the field of study, topic and literature collection – 5 Marks II. Research design -5 Marks III Review – Data collection -5 marks IV Review – Analysis of data and conclusion, preparation of rough draft -5 marks IV. Attendance - 5 Marks

III	Suggested areas of work: Algae, fungi, microbiology, biocontrol agents, plant tissue culture, plant physiology, phytochemistry, biochemistry, anatomy, plant taxonomy, Ethnobotany, ecology, Weed Biology, Invasive Alien Species, Crop Weed competition, sustainable agriculture, Plant Diversity-Conservation, Sacred groves, herbal formulations, cytogenetics, molecular biology, Marine Ecosystem, Marine Plants, Phytoplanktons, biotechnology, bioinformatics, nanotechnology and applied botany.
IV	Methodology: Each project should contain the following details: 1. Brief introduction on the topic 2. Review of Literature 3. Materials and Methods 4. Results and Discussion – evidences in the form of figures, tables and photographs. 5. Summary 6. Bibliography
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. Wilson, K and 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. 9thEdition. 3. ManjuBala, Sunita Gupta,Gupta,N.K. 2012. Practicals in Plant Physiology and Biochemistry. ScientificPublisher. 4. Wilson, K and J.Walker. 2005. Principles and Techniques of Practical Biochemistry, 5th Edition. Cambridge University press, NewYork. 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)

Semester - IV Elective – VI	23PBOTE44-1: Forestry and Wood Technology	H/W	C
		4	3

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 - Merits of combining traditional Botany and Forestry practices. 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. Seedlings, leaves, bark branching pattern architectural models of trees. Major and minor forest products, use and misuse of forests by man, direct and indirect forest wealth, forest policies, forest protection through peoples committee.
III	Silviculture: concept and scope of study, forest in general form, composition, classification of world forests and Indian forests. Classification based on its quality density, tolerance, crown; water cycles of forest. Photosynthetic processes in forest: nitrogen and mineral nutrition in forests.
IV	Seed dynamics in forest: Seed production, dissemination, germination, establishment and mortality, growth of trees in general terms – height, diameter, volume, growth of stands – gross increment, net increment, stand reaction to varies types of cuttings.
V	Measurement: Definition, direct measurements, direct and indirect estimate, and prediction. Measurement of diameter – rules and methods, measurement of height – different rules, methods, instruments, total height and merchantable length. Measurement of volume – common units, different methods and procedures of volume measurements. Measurement of age: direct estimate, averages, standard error, and sampling, General concept of indirect estimate based on one or more independent variables. Forestry for social and national development. Progress to be achieved in social forestry, industrial forestry and multiple forestry. Forest Laws- Indian Forest Act, 1927; Forest conservation Act. Wild Life Protection Act, 1972.

Course outcomes: On completion of this course, the students will be able to: CO		Programme outcomes
1. Knowledge on various aspects of Forest Botany		K1
2 Understand the importance and of different forests		K2
3. Analyze the ecological significance of forests		K3
4. To understand the dynamics of the forest		K4
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. Agarwala,V.P.1990. Forests in India, Environmental and Protection Frontiers. Oxford IBH Publishing Co., New Delhi. 5. Rao, K.R. and Juneja, K.B.S. 1992. Field identification of 50 important timbers of India. ICFRE Publi. Dehradun 123 p. 6. Avery, T.E. 1967. Forest Measurements. Mc Grand Hill Book Company, New York. 7. Manikandan K, Prabhu S. 2018. Indian Forestry A Breakthrough Approach To Forest Services, Jain Brothers. 8. Pathak, P.S, Ram Newaj. 2012. Agro forestry: Potentials and Opportunities. India Agrobios. 9. Powell, Baden B.H. 2004. Manual of Forest Law. New Delhi: Biotech. 10. Uthappa, A.R. 2015. Sangram Bhanudas Chavan, Competitive Forestry, New Vishal Publications, 1st ed. 11. Chaturvedi, A.N. and Khanna, L.S. 2015. Hand Book of Forestry (5th Edition).		

12. Frederick Franklin Moon, 2018. The Book of Forestry. Repro Books.
13. Parthiban, K.T. 2018. Introduction to Forestry & Agroforestry.
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
6. 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)

Semester – IV Elective – VI	23PBOTE44-2: FARM SCIENCES - GREEN WEALTH	H/W	C
		4	3

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	Study of yield contributing characters and yield estimation, Seed germination and viability test, Numerical exercises on fertilizer requirement, plant population, herbicides and water requirement, Use of tillage implements-reversible plough, one way plough, harrow, leveler, seed drill, Study of soil moisture measuring devices, Measurement of field capacity, particle density, bulk density and infiltration rate, Measurement of irrigation water.
V	Harvesting, storage, physiological disorders of important vegetable crops like solanaceous fruit vegetables (brinjal, tomato & chilli), tuber crops (Potato), cucurbits (pumpkin, cucumber, watermelon & gourds), pod vegetables (pea & bean), cole crops (cabbage & cauliflower), bulb crops (onion, garlic), root crops (radish & carrot), common leafy vegetables, spices: turmeric and ginger, black pepper and cardamom.

Course outcomes: 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
2. Demonstrate both the theoretical and practical knowledge in weed management principles.		K2
3. Explain the methods of herbicide and fertilizer application.		K3
4. Compare and contrast the yield estimation and water management.		K4
5. Discuss and develop skills for effective conservation, harvesting and storage methods.		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)

**SKILL ENHANCEMENT COURSE or PROFESSIONAL COMPETENCY SKILL-
NURSERY AND GARDENING**

YEAR	II	SEMESTER	IV
COURSE CATEGORY	SKILL ENHANCEMENT COURSE/ PROFESSIONAL COMPETENCY SKILL-		
COURSE TITLE	SKILL ENHANCEMENT (SE2)-NURSERY AND GARDENING		
COURSE CODE	23PBOTS45		
Credits	2		

Instructional Hours per week	Lecture	Tutorial	Lab Practice	Total
	2	2	--	3
Pre-requisite	Students should know nursery and gardening practices.			
Learning Objectives	1.To recognize the importance of nursery and gardening			
	2.To gain an understanding of nursery management.			
	3.To develop skills necessary to manage a wholesale nursery.			
	4.To acquire knowledge regarding theory and practice of rising plants.			
	5.To develop an interest to become an entrepreneur.			
UNIT	CONTENTS			
I	NURSERY: Definition, objectives and scope and building up of infrastructure for nursery, planning and seasonal activities - Planting - direct seeding and transplants.			
II	SEED: Structure and types - Seed dormancy; causes and methods of breaking dormancy - Seed storage: Seed banks, factors affecting seed viability, genetic erosion - Seed production technology - seed testing and certification.			
III	VEGETATIVE PROPAGATION: Air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings - Hardening of plants - green house - mist chamber, shed root, shade house and glasshouse.			
IV	GARDENING: definition, objectives and scope - different types of gardening - landscape and home gardening - parks and its components - plant materials and design - computer applications in landscaping.			
V	GARDENING OPERATIONS: Soil laying, manuring, watering, management of pests and diseases and harvesting. Sowing/raising of seeds and seedlings: Transplanting of seedlings - Study of cultivation of different vegetables: cabbage, brinjal, lady's finger, onion, garlic, tomatoes, and carrots - Storage and marketing procedures.			

Course outcomes: On completion of this course, the students will be able to:		Programme outcomes
CO		
1. Recognize the basic process required for growing and maintaining plants in nurseries.		K1
2. Explain the different methods of plant propagation and various gardening styles.		K2
3. Apply techniques for effective hardening of plants and computer applications for creative gardening.		K3& K6
4. Compare and contrast cultivation of different vegetables and growth of plants in nursery and gardening.		K4
5. Develop new strategies to enhance growth and quality of nursery plants.		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/other 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 Transferable Skill	

Recommended Text:

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

Reference Books:

1. N.L. Patel, S.L. Chawla, T.R. Ahlawat: Commercial Horticulture, 2016, ASPEE College of Horticulture, Navsari Agricultural University, Navsari 396 450, Gujarat,
2. Prasad S & Kumar U. 2005. Greenhouse Management for Horticultural Crops. 2nd Ed. Agrobios.
3. George Acquaah, 2002, Horticulture-principles and practices. Prentice-Hall of India pvt. Ltd., New Delhi.
4. Abraham, A and Vatsala, P. 1981. Introduction to Orchids. Trop. Bot. Garden, Trivandrum.
5. Hartman, H.T and Kester, D.E. 1989. Plant propagation. Printice Hall Ltd., New Delhi.

Web resources:

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

Mapping with Programme Outcomes:

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

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