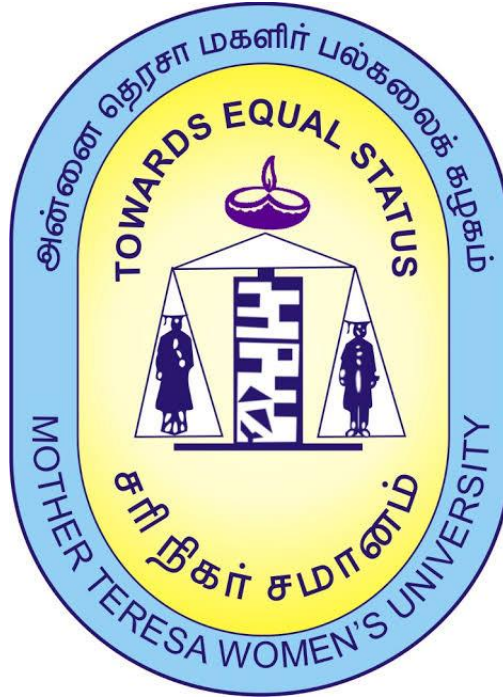


MOTHER TERESA WOMEN'S UNIVERSITY

KODAIKANAL – 624 101

**DEPARTMENT OF BIOTECHNOLOGY
M.Sc BOTANY**



**SYLLABUS TO BE IMPLEMENTED FROM THE ACADEMIC
YEAR
2021-2022
(CHOICE BASED CREDIT SYSTEM)**

**Curriculum Framework and Syllabus for
M.Sc. BOTANY**

Programme code: PG-MOB

(For the candidates to be admitted from the academic year 2021-2022 onwards)

(UNDER CHOICE BASED CREDIT SYSTEM- CBCS)

1. About the Programme:

M.Sc Botany is a 2 year post graduate programme divided into 4 semesters that deals with all aspects of plant biology, their origin and their impact on the environment. The programme incorporates core courses, electives and practicals. The programme syllabus includes all the subjects associated with plants, microbes, plant cells, genetics and other related topics. Students can get both practical, outdoor tours and theoretical hands on the subject. There are a number of jobs and career options available after this programme in both the public and private sectors, the opportunities await in areas like academics, Botanical garden, national park, agriculture and forest department, tissue culture labs, food industries, oil industries, seed companies, agricultural and biotechnology firms etc.

2. Programme Educational Objectives (PEOs)

1. Build up the ability for the application of acquired knowledge in different fields of life thereby make our country self-sufficient
2. Make the students skilled in practical experiments, laboratory equipments and to interpret the data correctly
3. Widen the ability for the application of obtained knowledge in various fields of life to make our country self-contained
4. Apply moral principles to biological science research, studies, and adopt recent pedagogical trends in education, including e-learning
5. Mold responsible citizen for nation-building and transforming the country towards future

3. Eligibility:

- A candidate who has passed Graduate in Botany and other Relevant Subject
- Candidate should have secured at least 55% in the above subject from any recognized university.

4. General Guidelines for PG Programme

- i. **Duration:** The programme shall extend through a period of 4 consecutive semesters and the duration of a semester shall normally be 90 days or 450 hours. Examinations shall be conducted at the end of each semester for the respective subjects.
- ii. **Medium of Instruction:** English
- iii. **Evaluation:** Evaluation of the candidates shall be through Internal Assessment and External Examination.

- **Evaluation Pattern**

Evaluation Pattern	Theory		Practical	
	Min	Max	Min	Max
Internal	13	25	13	25
External	38	75	38	75

- **Internal (Theory): Test (15) + Assignment (5) + Seminar/Quiz(5) = 25**
- **External Theory: 75**

- **Question Paper Pattern for External examination for all course papers.**

Max. Marks: 75

Time: 3

Hrs.

S.No.	Part	Type	Marks
1	A	10*1 Marks=10 Multiple Choice Questions(MCQs): 2 questions from each Unit	10
2	B	5*4=20 Two questions from each Unit with Internal Choice (either / or)	20
3	C	3*15=45 Open Choice: Any three questions out of 5 : one question from each unit	45
Total Marks			75

*** Minimum credits required to pass: 90**

- **Project Report**

A student should select a topic for the Project Work at the end of the third semester itself and submit the Project Report at the end of the fourth semester. The Project Report shall not exceed 75 typed pages in Times New Roman font with 1.5 line space.

- **Project Evaluation**

There is a Viva Voce Examination for Project Work. The Guide and an External Examiner shall evaluate and conduct the Viva Voce Examination. The Project Work carries 100 marks (Internal: 25 Marks; External (Viva): 75 Marks).

5. Conversion of Marks to Grade Points and Letter Grade (Performance in a Course/Paper)

Range of Marks	Grade Points	Letter Grade	Description
90 – 100	9.0 – 10.0	O	Outstanding
80-89	8.0 – 8.9	D+	Excellent
75-79	7.5 – 7.9	D	Distinction
70-74	7.0 – 7.4	A+	Very Good
60-69	6.0 – 6.9	A	Good
50-59	5.0 – 5.9	B	Average
00-49	0.0	U	Re-appear
ABSENT	0.0	AAA	ABSENT

6. Attendance

Students must have earned 75% of attendance in each course for appearing for the examination. Students with 71% to 74% of attendance must apply for condonation in the Prescribed Form with prescribed fee. Students with 65% to 70% of attendance must apply for condonation in the Prescribed Form with the prescribed fee along with the Medical Certificate. Students with attendance less than 65% are not eligible to appear for the examination and they shall re-do the course with the prior permission of the Head of the Department, Principal and the Registrar of the University.

7. Maternity Leave

The student who avails maternity leave may be considered to appear for the examination with the approval of Staff i/c, Head of the Department, Controller of Examination and the Registrar.

8. Any Other Information

In addition to the above mentioned regulations, any other common regulations pertaining to the PG Programmes are also applicable for this Programme.

9. PROGRAMME OUTCOMES (POs)

On completion of M.Sc., Botany Programme, the students will be able to

PO1	equip themselves with subject domain knowledge and technical skills pertaining to plants in a holistic manner
PO2	apply the knowledge of biology to make scientific queries and enhance the intellectual capacity
PO3	render beneficial contribution to the society through their knowledge acquired
PO4	build up the scientific analysis, interpretation of data and problem solving skills during experimentations and research projects.
PO5	inculcate the scientific temperament and execute it
PO6	apply contextual knowledge and modern tools of research for solving problems
PO7	enhance their capacity to obtain employment and higher studies in science
PO8	generate professional & ethical attitude, environmental consciousness, leadership quality, team workmanship with enormous responsibility in order to serve the society efficiently.

10. PROGRAMME SPECIFIC OUTCOMES (PSOs)

On completion of M.Sc., Botany Programme, the students will be able to

PSO1	acquire knowledge about various plant groups from primitive to highly evolve
PSO2	implement the concept of science and technology with traditional and modern techniques for solving the complex problems in plant biology
PSO3	develop skills in laboratory practices as well as field based studies
PSO4	make experts in cultivation, conservation and sustainable utilization of biodiversity
PSO5	know about the advanced techniques in plant sciences like tissue culture, Phytoremediation, plant disease management, formulation of new herbal drugs, nursery maintainance, mushroom cultivation, biofertilizer production, fruit preservation and horticultural practices

M.Sc., BOTANY CURRICULUM

Sl. No	Course Code	Course Title	Credits	Hours		(CIA)	(ESE)	Total
				L	P			
Semester I								
1.	P21BOT11	Core I- Plant Diversity I	4	5	-	25	75	100
2.	P21BOT12	Core II- Plant Diversity -II	4	5	-	25	75	100
3.	P21BOT13	Core III –Taxonomy of Angiosperms	4	5	-	25	75	100
4.	P21BOT14	Core IV – Plant Ecology and Phyto Geography	4	5	-	25	75	100
5.	P21BOP11	Core V - Practical- Plant diversity and Taxonomy of Angiosperms	4	-	6	25	75	100
6.	P21CSS11	Supportive Course I- Computer Skills for Web Designing and Video Editing	2	-	4	25	75	100
		Total	22	30		-	-	600
Semester II								
7.	P21BOT21	Core VI –Microbiology and Plant pathology	4	5	-	25	75	100
8.	P21BOT22	Core-VII – Anatomy and Embryology of Angiosperms	4	5	-	25	75	100
9.	P21BOT23	Core-VIII - Cell biology and Genetics	4	4	-	25	75	100
10.	P21BOT24	Core-IX- Phytochemistry and Pharmacognosy	4	4	-	25	75	100
11.	P21BOP22	Core-X- Practical- Microbiology & Plant pathology, Anatomy & Embryology of Angiosperms, Cell Biology and Genetics	4	-	6	25	75	100
12.		Non Major Elective	4	4	-	25	75	100
13.	P21BOS22	Supportive Course II (Skill) –Plant Tissue culture	2	2	-	25	75	100
		Total	26	30		-	-	700
Semester III								
14.	P21BOT31	Core XI – Plant Physiology and Biochemistry	4	4	-	25	75	100
15.	P21BOT32	Core- XII – Plant Molecular biology	4	5	-	25	75	100
16.	P21BOT33	Core- XIII – Plant Biotechnology	4	4	-	25	75	100
17.	P21BOT34	Core- XIV – Biodiversity Conservation and Management	4	4	-	25	75	100
18.	P21BOT35	Core – XV Bioinstrumentation, Research	4	5	-	25	75	100

		methodology and Biostatistics						
19.	P21BOP33	Core- XVI – Practical - Plant physiology & Biochemistry, plant Molecular biology & Plant Biotechnology	4	-	6	25	75	100
20.	P21WSS33	Supportive Course III - Women Empowerment	2	2	-	25	75	100
		Total	26		30			700
Semester IV								
21.	P21BOE411/ P21BOE412	Elective I* - Food Preservation and processing/Industrial Microbiology/ Any MOOC Courses ^{\$}	4	4	-	25	75	100
22.	P21BOE421/ P21BOE422	Elective II* -Mycology / Bio fertilizer and Organic farming/ Any MOOC Courses ^{\$}	4	4	-	25	75	100
23.	P21BOR41	Project	8	-	22	25	75	100
		Total	16		30			300
		Total	90		120			2300

Non Major Elective

The candidates, who have joined the PG programme, can also undergo Non Major Elective offered by other Departments

Non Major Electives (NME) offered by Botany:

1. NME I - Herbal Science-P21BON211
2. NME II - Economic Botany-P21BON212

Additional Credit Courses (Two Credit Courses)

1. P21BOV11-Value Added Program I-Two Credits (First Semester)
2. P21BOI21-Internship/Industrial Training – Two Credits- (End of Second Semester)
3. P21BOO31-Online Courses-Two Credits- (Third Semester)
4. P21BOV41-Value Added Program II-Two Credits (Fourth Semester)

Value Added Program (VAP)

1. VAP I - Hydroponics Culture- P21BOV11 (I Semester)
2. VAP II - Indian system of Medicine- P21BOV41 (IV Semester)

*Those who have CGPA 9 and want to do the project in industry/institution during 4th semester, those two elective papers in IV semester can be opted in third semester itself.

^{\$} For Elective –I/Elective-II, the students can also take either one 4-credit course or two 2-credit courses in MOOC, with the approval of Departmental Committee.

Outside class hours (Attendance compulsory, Certificate Mandatory)

- Health, Yoga and Physical Fitness
- Library Information access and utilisation
- Employability Training
- Students Social Responsibility

SEMESTER I

Course Code	P21BOT11	PLANT DIVERSITY - I	L	T	P	C
CORE- I			5	-	-	4
Cognitive Level	K1: Recall K2: Understand K3: Apply K5: Analyse					
Learning objective	<ul style="list-style-type: none"> To comprehend the classification, characteristic feature, distribution, reproduction and lifecycle of algae To know the classification, characteristic features, distribution, and reproduction cycle of algae To learn about the classification and characteristics features of Fungi and Lichens To gain deep knowledge on economic importance of algae, fungi and Lichen 					
Unit I	Algae classification					
Detailed study of classification by F.E.Fritsch; Storage products and cell wall composition - Classes of algae - Range of structure and reproduction of Chlorophyceae (<i>Chlorella</i> , <i>Caulerpa</i> , <i>Chara</i>), Xanthophyceae (<i>Vouheria</i>) Bacillariophyceae (Diatom), Phaeophyceae (<i>Ectocarpus</i> , <i>Padina</i>), Rhodophyceae (<i>Gelidium</i> , <i>Gracilaria</i>) and Cyanophyceae (<i>Microcystis</i> , <i>Spirulina</i>).						
Unit II	Algae structure & Economic importance					
Types of chloroplast, pigmentation and nutrition. Thallus organisation in algae – unicellular, colonial and multicellular. Algae in symbiotic association – Nitrogen fixation – Algal blooms- Beneficial and harmful, algae as an indicator of pollution. Culture and cultivation of fresh water and marine algae. Economic importance of algae						
Unit III	Fungi classification and Reproduction					
Detailed study of classification -Ainsworth, 1973; General characteristics of all classes of fungi; Flagellation, asexual and sexual reproduction and fruitification of fungi. Origin and life cycle patterns in main groups of Fungi – Myxomycotina, Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina. Distribution, habitat, reproduction (vegetative, asexual, sexual) and lifecycle of <i>Rhizopus</i> and <i>Agaricus</i>						
Unit IV	Fungi cell structure					
Range of thallus Organization in fungi; The architecture of fungal cells, cell walls, cell membrane, cell organelles. Homothallism and heterothallism in fungi; Homokaryon and heterokaryon. Reproduction – Life cycle types, parasexual cycle. Spore dispersal mechanism. Nutrition in fungi, Economic importance of fungi.						
Unit V	Lichen					
Detailed classification of Lichens by Miller; thallus structure, reproduction, ecological significance and Economic importance of Lichens. Thallus structure, reproduction and life cycle of <i>Parmelia</i> , <i>Graphis</i>						
Text Books						
1	Bilgrami, K.S. A Textbook of Algae. CBS Publisher & Distributors, New Delhi, ISBN: 978-8123900490. 2010.					

2	Pandey, P.B. College Botany - 1: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. Chand Publishing, New Delhi. 2014.
3	Johri, R.M., Smeh Lata, Kavitha Tyagi. A Text Book of Fungi, Dominant Publishers and Distributors Pvt. Ltd., New Delhi. 2011.
Reference Books	
1	Vashista B.R. , Algae, S.Chand & Co.Ltd., New Delhi. 2012.
2	Kevin K. 2018. Fungi biology and Application, 3 rd Edition, Wiley Blackwell. Vashista B.R. Algae, S.Chand & Co.Ltd., New Delhi. 2012.
E- Reference link	
1	http://www.uobabylon.edu.iq/eprints/paper_11_20160_754.pdf
2	Fungi YouTube Videos: https://www.youtube.com/watch?v=vcYPI6y-Udo
3	Lichen YouTube Videos https://www.youtube.com/watch?v=XQ_ZY57MY64
4	Bryophytes lecture Notes: http://www-plb.ucdavis.edu/courses/bis/1c/text/Chapter22nf.pdf
5	https://www.pdfdrive.com/microbiology-and-immunology-textbook-of-2nd-edition-e33405391.html
6	http://herba.msu.ru/shipunov/school/biol_154/textbook/intro_botany.pdf
7	https://www.moscomm.org/pdf/Ananthanarayan%20microbio.pdf
8	https://www.researchgate.net/publication/328589475_Books_on_biodiversity_and_conservation

Course outcome	Upon completion of this course, the students will be able to		
	CO	Course Outcomes	Knowledge Level
	CO1	learn the morphological feature and general structure of different classes of algae for identification of algae in field	K1, K3
	CO2	understand the culture and cultivation of various algal species	K2
	CO3	get the knowledge on frutification of fungi	K2
	CO4	understand the thallus organization and spore dispersal mechanism in algae	K2
	CO5	analyse the ecological significance of lichen	K5

Mapping of COs with POs & PSOs:

	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	M	S	M	S	S	S	M	S	S	S	S	S	S
CO2	S	M	S	S	S	S	S	M	S	S	S	S	S
CO3	S	S	S	S	S	S	M	S	S	S	S	S	S
CO4	S	M	S	M	M	M	S	S	S	S	S	S	M
CO5	S	S	S	S	S	S	S	M	S	M	S	S	S

Strongly Correlating (S) - 3 marks Moderately Correlating (M) - 2 marks
 Weakly Correlating (W) - 1 mark No Correlation (N) - 0 mark

Course Code	P21BOT12	PLANT DIVERSITY - II			
CORE - II		L	T	P	C
Cognitive Level	K2: Understand	K4: Evaluate	K5: Analyse		
Learning objective	<ul style="list-style-type: none"> To understand the classification, structure, reproduction and life cycle of Bryophytes To learn the classification, morphology, anatomy and reproduction of Pteridophytes, To gain knowledge on classification of Gymnosperms, distribution, morphology, anatomy, reproduction and phylogeny To attain knowledge on concepts of palaeobotany- geological time scale, fossilization, types of fossil, carbon dating, fossil pteridophytes 				
Unit I	Bryophytes classification, life cycle and Economic importance				
Classification of Bryophytes by W. Rothmaler; Origin and evolution of Bryophytes, General characteristics of major groups, Marchantiales, Jungermaniales, Anthocerotales, Sphagnales, Fumariales and Polytrichales. Comparative study of gametophytes and sporophytes of major classes of Bryophytes. Reproduction, life histories of <i>Marchantia</i> , <i>Porella</i> , <i>Fossombronia</i> , <i>Sphagnum</i> , <i>Anthoceros</i> and <i>Politrichum</i> ; Economic importance of Bryophytes.					
Unit II	Pteridophytes classification, life cycle and Economic importance				
Classification of Pteridophytes (Reimers, 1975); General characteristics and life cycle patterns of major classes of Pteridophytes, Psilophytopsida, Psilotopsida, Lycopsida, Sphenopsida and Pteropsida; Distribution, Morphology, anatomy, reproduction and lifecycle of <i>Selaginella</i> , <i>Marsilea</i> , <i>Psilotum</i> and <i>Adiantum</i> ; Phylogeny and Economic importance of Pteridophytes					
Unit III	Pteridophytes Evolution				
Origin and evolution of stele and sori.- Heterospory and seed habit, Telome theory, Evolution of gametophytes in Pteridophytes, Pteridophytes as ecological indicators.					
Unit IV	Gymnosperms classification, life cycle and Economic Importance				
Classification of Gymnosperms by K.R. Sporne; General characteristics of all classes of Gymnosperms; Distribution, vegetative, anatomy, reproduction and life cycle of <i>Cycas</i> , <i>Pinus</i> and <i>Gnetum</i> ; Phylogeny and Economic importance of Gymnosperms.					
Unit V	Paleobotany				
Brief account of process of fossilization, Geological time scale, type studies on <i>Aglaphyton</i> (<i>Rhynia</i>) and <i>Leginopteris</i> , Role of fossil in oil exploration and coal excavation, Economic importance of fossils – fossils for fuel and as industrial raw materials.					
Text Books					
1. Vashishta, Sinha A.K, Adarsh Kumar. Bryophytes, S.Chand & Company ltd., New Delhi. 2011.					
2. Parihar, N.S. An Introduction to Embryophyta Pteridophytes. 5 th Edition, Surjeet Publication, Delhi. 2019.					
3. Sharma, O.P. Pteridophyta. Tata McGraw-Hill Education, Delhi. 2012. Pteridophyta. S. Chand &Company ltd., New Delhi. 2016					
4. Singh V and D.K.Jain, Taxonomy of angiosperms, Rastogi Publication, Meerut.2012					

Reference Books

1. Panday, B.P. Taxonomy of angiosperms, S. Chand & Co., (P)Ltd., 2011.
2. Vasudevan Nair R. Taxonomy of Angiosperms, APH Publishing Corporation. 2011.
3. Vardhana, R. 2010. Economic Botany. 1st ed. Sarup Book Publishers Pvt Ltd., New Delhi.

E- Reference link

1. <https://www.biologydiscussion.com/pteridophytes/pteridophytes-origin-classification-and-importance-botany/73642>
2. <https://www.kopykitab.com/Botany-For-Degree-Students-Pteridophyta-by-P-C-Vasishta-A-K-Sinha-Anil-Kumar>
3. https://content.kopykitab.com/ebooks/2018/04/17759/sample/sample_17759.pdf
4. <https://www.pdfdrive.com/pteridophytes-e48778742.html>

Course outcome	Upon completion of this course, the students will be able to		
	CO	Course Outcomes	Knowledge Level
	CO1	compare the gametophyte and sporophyte of different classes of bryophytes	K2
	CO2	understand the phylogeny of pteridophytes	K2
	CO3	analyse the stellar evolution in pteridophytes	K5
	CO4	evaluate the phylogeny and evolutionary relationship in non-flowering plants.	K4
	CO5	understand the types of fossil plants and their conservation	K2

Mapping of COs with POs & PSOs:

CO	Pos								PSOs				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	M	M	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S	S	M	S
CO3	S	S	S	M	S	S	S	M	M	M	S	S	S
CO4	S	M	S	S	M	S	M	S	S	S	M	S	M
CO5	M	S	M	S	S	M	S	S	S	M	S	S	S

Strongly Correlating (S) - 3 marks Moderately Correlating (M) - 2 marks
 Weakly Correlating (W) - 1 mark No Correlation (N) - 0 mark

Course Code	P21BOT13	TAXONOMY OF ANGIOSPERMS			
CORE III		L	T	P	C
Cognitive Level	K1: Recall K3: Apply	K2: Understand K5: Analyse	5	-	- 4
Learning objective	<ul style="list-style-type: none"> To understand the system of classification in plant taxonomy To learn the basic concepts and principles of plant nomenclature To gain knowledge on the identification of plants and importance of taxonomy To enable students to gain knowledge on the salient features of selected angiosperm families To know the economic importance of plants 				
Unit I	Plant classification				
	History, Systems of classification: Artificial (Linnaeus), Natural (Bentham and Hooker), Phylogenetic system: (Bessey and Hutchinson) ; Angiosperm Phylogenetic Group: Brief outline on APG-IV (2016).				
Unit II	Botanical nomenclature				
	Brief history on the origin and development of nomenclature; Contents and major provisions of International Code of Nomenclature for algae, fungi and plants (ICN) - Author citation, Typification and different kinds of types, Effective and valid publication of names, Principle of priority and its limitations (ICBN) .				
Unit III	Phylogeny of Angiosperms				
	Taxonomic evidences obtained from Anatomy, Embryology and Palynology, Chemotaxonomy and Molecular taxonomy; Brief account on computer aided plant identification systems; e-floras; Virtual herbaria; Interactive keys.				
Unit IV	Angiosperm Families				
	Salient features, Vegetative and sexual characters of Magnoliaceae, Apocynaceae, Menispermaceae, Apiaceae, Meliaceae, Lythraceae, Onagraceae, Sapindaceae, Combretaceae, Vitaceae, Myrtaceae, Aizoaceae, Passifloraceae and Polygalaceae.				
Unit V	Angiosperm Families				
	Salient features, Vegetative and sexual characters of Rutaceae, Acanthaceae, Bignoniaceae, Lamiaceae, Verbenaceae, Loranthaceae, Rubiaceae, Commelinaceae, Orchidaceae, Cyperaceae and Poaceae.				
Text Books					
1. Gurcharan Singh, Plant Systematics Oxford & IBH Publishing Co Pvt, Ltd. 2015.					
2. B.P Pandey, Taxonomy of Angiosperms, S Chand Publishers. 2001					
Reference Books					
1. Singh V and D.K.Jain, Taxonomy of angiosperms, Rastogi Publication, Meerut.2012.					
2. Panday, B.P.Taxonomy of angiosperms, S. Chand & Co., (P)Ltd.,2011.					
E Reference link					
1. https://ebooks.schandpublishing.com/detail/a-textbook-botany-angiosperms/9788121904049					
2. https://www.researchgate.net/publication/274018210_Taxonomy_and_Classification					
3. http://faunaofindia.nic.in/PDFVolumes/spb/041/index.pdf					

Course outcome	Upon completion of this course, the students will be able to		
	CO	Course Outcomes	Knowledge Level
	CO1	understand the salient features of different system of classification	K1
	CO2	learn different types Angiosperms and its importance	K2
	CO3	know the advanced techniques which are used in the plant taxonomy	K2
	CO4	gain knowledge to identify different plant species by analysing its morphological characters	K5
	CO5	identify the selected plant families with their key characters	K3

Mapping of COs with POs & PSOs:

CO	Pos								PSOs				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	S	M	S	S	S	S	M	S	S	S	S	S
CO2	M	S	S	S	S	S	M	S	M	S	M	S	S
CO3	S	M	M	M	S	M	S	M	S	M	S	M	S
CO4	S	S	S	S	M	S	S	S	M	S	S	S	M
CO5	S	S	M	S	S	M	M	M	S	M	S	S	S

Strongly Correlating (S) - 3 marks Moderately Correlating (M) - 2 marks
 Weakly Correlating (W) - 1 mark No Correlation (N) - 0 mark

Course Code	P21BOT14	PLANT ECOLOGY AND PHYTOGEOGRAPHY					
CORE - IV		L	T	P	C		
Cognitive Level	K1: Recall	K2: Understand	K3: Apply	5	-	-	4
Learning objective	<ul style="list-style-type: none"> To know the principle of Ecology To get thorough knowledge on structure & function of the Ecosystem To learn about the population ecology To study the plant communities and stages of plant succession To understand the concept of continental drift and Phytogeography 						
Unit I	Scope and importance of Ecology						
Concept of habitat and niche; Niche width and overlap; Fundamental and realized niche; Food Chain, Food Web, Energy flow and Mineral cycling (C,N); Primary production and Methods of measurement of primary productivity; Resource partitioning; Character displacement- Allopatric and Sympatric. Edaphic factors – Components of soil.							
Unit II	Ecosystem						
Structure and function. Types of ecosystem (Grassland and Pond). Energy flow in ecosystem. Types of Interactions, Positive interactions- Mutualism, symbiosis, commensalism, Proto cooperation. Exploitation, Herbivores, Carnivores, antibiosis, competition. Interaction between plants and animals. Plant succession – causes of succession, climax concept; Kinds of succession (Hydrosere, Xerosere).							
Unit III	Study of different types of ecosystem						
Ecological energetic; Production ecology, measurement of primary productivity; Ecological adaptation of plants in different ecosystems; Environmental pollution (water, air and soil) and its consequences							
Unit IV	Autecology and Synecology						
Population ecology. Quantitative analysis of plant community structure (quadrat, transect and point methods). Habitat ecology (Fresh water, Marine and Estuary).							
Unit V	Continental drift						
Age and area hypothesis – endemism. – Continuous and discontinuous distribution of vegetation. Phytogeographical regions of India. Remote sensing – principle, tools and application in forestry							
Text Books							
1. P.D Sharma, Plant Ecology And Phytogeography, Rastogi Publications.2019.							
2. V.Kumaresan, N. Arumugam, Plant Ecology and Phytogeography. Saras Publication. 2016.							
Reference Books							
1. Sharma, P.D, Ecology and Environment, Rastogi Publications. 2010.							
2. Shukla, R.S and Chander I.P.S. Plant Ecology and Soil Science, S. Chand & Co Ltd. 2009.							
E- References							
1. https://www.intechopen.com/books/plant-ecology-traditional-approaches-to-recent-trends/introductory-chapter-plant-ecology							
2. https://www.plecevo.eu/index.php/plecev							
3. https://www.nature.com/articles/1421056a0							

Course Outcome	Upon completion of this course, the students will be able to		
	CO	Course Outcomes	Knowledge Level
	CO1	learn the concept of habitat and niche	K1
	CO2	understand the concepts of ecosystem - structure and function.	K2
	CO3	comprehend different types of environmental pollution and its consequences	K2
	CO4	learn quantitative analysis of plant community	K2
	CO5	gain adequate knowledge on phytogeographical regions of India for biodiversity conservation	K3

Mapping of COs with POs & PSOs:

CO	POs								PSOs				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	M	M	S	S	M	S	M	M	S	S	S	S	S
CO2	M	S	M	S	S	M	M	S	S	S	S	S	S
CO3	S	M	S	M	S	S	S	M	S	S	S	S	S
CO4	M	S	S	S	M	S	S	S	S	S	S	S	M
CO5	S	M	M	M	S	M	S	M	S	M	S	S	S

Strongly Correlating (S) - 3 marks Moderately Correlating (M) - 2 marks
 Weakly Correlating (W) - 1 mark No Correlation (N) - 0 mark

Course Code	P21BOP11	PRACTICAL- PLANT DIVERSITY AND TAXONOMY OF ANGIOSPERMS			
CORE-V		L	T	P	C
Cognitive Level	K1: Recall	K2: Understand	K3: Apply		
Learning objective	<ul style="list-style-type: none"> To acquire practical skills on identification of algae, fungi & lichen based on their morphological structures by using equipments and various staining methods To develop skills for the collection and identification of primitive to higher plants To develop skill for preparing herbarium To learn the technical skills in sectioning, staining and culturing of micro-organisms and other plants 				
Plant Diversity					
Morphology of vegetative characteristics of the following					
<u>Algae</u>					
A) Cyanobacteria-Spirulina, Microcystis					
B) Chlorophyceae-chlorella, chara					
C) Bacillriophyceae-Diatoms					
D) Phaeophyta-Padina, Ectocarpus					
E) Rhodophyceae-gelidium, Gracilaria					
<u>Fungi</u>					
A) Zygomycetes: Rhizopus					
B) Basidiomycetes: Agaricus					
<u>Lichens</u>					
A) Parmelia					
B) Graphis					
<u>Bryophytes</u>					
Sphagnum, Porella Anthoceros, Polytrichum.					
<u>Pteridophytes</u>					
Selaginella, Marsilea and Adiantum, Psilotum					
<u>Gymnosperms</u>					
Cycas, Pinus, Gnetum					
<u>Paleobotany</u>					
Fossil forms: Agalophyton (Rhynia) and Lyginopteris.					
<u>Taxonomy of Angiosperms:</u>					
<u>Salient features, vegetative and sexual characters of the following families</u>					
Magnoliaceae, Apocynaceae, Menispermaceae, Apiaceae, Meliaceae, Lythraceae, Onagraceae, Sapindaceae, Combretaceae, Vitaceae, Myrtaceae, Aizoaceae, Passifloraceae, Polygalaceae, Rutaceae, Acanthaceae, Bignoniaceae, Lamiaceae, Verbenaceae, Loranthaceae, Rubiaceae, Commelinaceae and Orchidaceae, Cyperaceae and Poaceae.					
Submission of Herbarium Specimens – 25.					
The students should undertake as part of their course a tour and field study of vegetation under the guidance of the staff for three to five days within the state and neighbouring states					
Reference Books					

1. Sivakumar, K. Algae- A Practical Approach. MJP Publishers, Chennai, India. 2016.
2. Gupta, V.K., Tuohy, M.G., Ayyachamy, M., Turner, K.M. and O'Donovan, A. Laboratory Protocols in Fungal Biology: Current Methods in Fungal Biology. Springer, London, UK. 2013.
3. Chmielewski, J. G. and Krayesky, D. General Botany laboratory Manual. AuthorHouse, Bloomington, USA. 2013.
4. Bendre, A. M. A Text Book Of Practical Botany – 1. Rastogi Publications, Meerut, India. 2010.
5. McMahon, K., Levetin, E. and Reinsvold, R. Laboratory Manual for Applied Botany. McGraw-Hill Education, New York, USA. 2001.

Course Outcomes	Upon completion of this course, the students will be able to		
	CO	Course Outcomes	Knowledge Level
	CO1	acquire clear idea about the morphological features of algae, fungi and lichens	K1
	CO2	gain skill for the identification of Pteridophytes, Bryophytes and Gymnosperms	K2,K3
	CO3	identify the fossil plants and classify them	K3
	CO4	prepare herbarium for future reference	K2
	CO5	gain knowledge on identification of selected angiosperm families by their key characters	K3

Mapping of COs with POs & PSOs:

CO	Pos								PSOs				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	M	S	M	S	S	S	M	S	S
CO2	M	S	M	M	S	S	M	M	S	M	S	M	S
CO3	M	S	S	S	S	M	S	M	S	S	M	S	S
CO4	S	M	M	M	M	M	S	S	S	S	S	S	M
CO5	S	S	S	S	S	S	S	S	S	M	M	S	S

Strongly Correlating (S) - 3 marks

Weakly Correlating (W) - 1 mark

mark

Moderately Correlating (M) - 2 marks

No Correlation (N) - 0

Course Code	P21CSS11	COMPUTER SKILLS FOR WEB DESIGNING AND VIDEO EDITING (100% practical)			
SUPPORTIVE COURSE - I		L	T	P	C
		-	-	4	2
Cognitive Level	K1: Recall K2: Understand K3: Apply				
Learning objective	<ul style="list-style-type: none"> To gain knowledge on effective web page creation using HTML tags To create a table within a web To gain knowledge on inserting heading levels within a web page To learn how to insert ordered and unordered lists within a web page To publish a web page To learn how to combine basic design principles in video editing To generate a video by applying her knowledge To present the edited video To record short clips by using camera 				
Unit I	Basics of Hardware and Software				
Basics of Windows Operating System – Windows Utilities. Internet: Concept of Internet, Applications of Internet, Connecting to the Internet, Troubleshooting – World Wide Web – Web Browsers – Search Engines: Accessing Web Browser, Downloading Web Pages, Printing Web Pages – Understanding URL – Surfing the Web: Using e-Governance Websites.					
Unit II	Hyper Text Markup Language (HTML)				
Structure of HTML Script – Components: Text, Table, Image, Hyperlinks, Types of Lists – Headers and Footers. Forms in HTML: Label – Text Field – Radio Group – Text Area – Buttons.					
Unit III	Open Element				
Introduction – Creating and Saving a Project - Basic User Interface Elements – Media Elements – Images – Carousels - Image Gallery – Videos – Project Preview in Browser. Containers and Groups: Accordion Group – Collapsible Panel – Group of Elements – Back-End and Full Stack Development.					
Unit IV	Video Recording				
Grabbing all computer activities like playing video games, browsing the net, making VoIP calls, and more - Record the desktop screen in custom or full-screen mode - Capture the computer screen with voice narrations, system audio, and PIP effects - Include annotations such as colorful texts, shapes, lines, arrows, and drawings - Edit the video by cropping, trimming, adding subtitles, applying watermarks - Conversion of Recorded Video to MP4, VOB, MTS, DV.					
Unit V	Video Editor				
New Video Project – Sort Video Projects – Store Board – Project Library – Video Editing Tools: Filters, Trim, Split, Text, Motion, 3D Effects, Speed - Screen Direction - Sound Design – Continuity – Titling - Picture Management - Color Correction - Special Effects					
Text Book					
<ol style="list-style-type: none"> Jennifer Sargunar. Introduction to Information Technology. edited by, Dorling Kindersley (India) Pvt. Ltd. 2011 Ravichandran. Fundamentals of Information Technology. Khanna Book Publishing Co. Pvt. Ltd., First Edition. 2010. Anne Boehm & Zac Ruvalcaba, HTML5 and CSS3, 4th Edition, 2018. Aaron Goold, Video Editing Handbook, 2017, ISBN : 1521721041. 					

Reference Books

1. Dennis P.Curtin, Kim Foley, Kunal Sen, Cathleen Morin and Tata McGraw. Information Technology-The Breaking Wave.Hill Publishing Company Limited, New Delhi.1998.
2. Anne Boehm & Zac Ruvalcaba, HTML5 and CSS3, 4th Edition, 2018.
3. Aaron Goold, Video Editing Handbook, ISBN : 1521721041.2017.

Course outcome	Upon completion of this course, the students will be able to		
	CO	Course Outcomes	Knowledge Level
	CO1	learn the basics of Hardware and Software, Windows operating System, web pages	K2
	CO2	develop an effective web page using HTML tags	K3
	CO3	execute the media elements, images, carousels, image gallery	K3
	CO4	apply knowledge to generate video	K3
	CO5	learn how to combine the basic design principles in video editing	K2

Mapping of COs with POs & PSOs:

CO	Pos								PSOs				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	M	S	S	S	M	S	M	M	S	M	S	S	S
CO2	S	S	M	M	M	S	S	M	M	S	M	M	S
CO3	M	M	S	S	S	S	M	S	S	M	S	S	S
CO4	S	S	M	S	M	S	M	S	M	S	S	S	M
CO5	S	M	S	M	S	M	M	S	S	M	M	S	S

Strongly Correlating (S) - 3 marks Moderately Correlating (M) - 2 marks
 Weakly Correlating (W) - 1 mark No Correlation (N) - 0 mark

SEMESTER II

Course Code	P21BOT21	MICROBIOLOGY AND PLANT PATHOLOGY			L	T	P	C
CORE- VI					5	-	-	4
Cognitive Level	K1: Recall K3: Apply	K2: Understand K4: Analyse K5 Evaluate						
Learning objective	<ul style="list-style-type: none"> To know the classification of Bacteria To learn the morphology and ultra-structure of bacteria To understand the various plant diseases and its causative agent To learn interaction of microbes with their associated host. To comprehend the role of microorganisms in the human welfare. 							
Unit I	Microbiology Classification							
Brief history of microbiology. Classification based on Bergey's Manual. Experiments of Pasteur and Tyndall, Koch's postulates. Bacteria - Significance of 16 S RNA in Bacterial identification. Methods of sterilization – Physical and Chemical methods of Sterilization. Types of culture media.								
Unit II	Bacteria							
Morphology and ultrastructure of bacterium. Growth and nutrition of bacteria. Continuous culture devices - Chemostat. Extremophiles – Acidophilic, Alkaliphilic, Thermophilic and halophilic bacteria. Isolation and identification of bacteria from Milk, Curd and Root nodules by gram staining method. Differential staining techniques- Gram stain, Acid fast stain								
Unit III	Microbial diseases							
Human diseases (Rickettsia), Virus (AIDS). Animal diseases: Anthrax (Bacteria); Microbes in Agriculture: Rhizosphere, Nitrogen fixation, Mycorrhiza, Cyanobacteria; Industrial Microbiology: Microbial fermentation-Major industrial products from microbes: Beverages, Antibiotics, Secondary metabolites, Recombinant products.								
Unit IV	Plant Pathology							
Classification of plant diseases – Symptoms – Defence mechanisms (structural and biochemical) - Integrated pest management. Host-pathogen interaction –Disease resistance - Histological and biochemical aspects - Metabolic changes during disease development. Chemical and biological control								
Unit V	Plant Diseases							
Study the following organisms with special reference to causative organisms, symptoms and control measures; Red rot of Sugarcane, Tikka disease of ground nut, Blast of Paddy, Rust disease of Wheat, Cotton Wilt, Blight of Beans, Bacterial canker, Late blight of Potato, Citrus canker. Viral disease - Bunchy top of Banana, Mosaic disease-TMV, Leaf roll of Potato. Mycoplasma – Little leaf disease of Brinjal.								
Text Books								
<ol style="list-style-type: none"> Mehrotra, R. S. and Aggarwal, A. Plant Pathology. McGraw Hill Publisher Co. Ltd., New Delhi. 2017. Singh, R.S. Introduction to Principles of Plant Pathology, 4th ed. Scientific International, Bengaluru, India. 2018. Adams, M.R and Moss, M.O. Food Microbiology. New Age International Private Limited, New Delhi. 2018. Kanungo, R. Ananthanarayan and Paniker's Textbook of Microbiology. 10th ed. Universities Press, Hyderabad, India. 2017. Joshi, R.D. Text Book of Industrial Microbiology. Oxford, Delhi. 2017. 								

6. Vasanthakumari, R. Textbook of Microbiology. 3rd Edition, Wolters Kluwer (India) Pvt., Ltd., Gurgaon. 2016.

Reference Books

1. Matthews, K.R., Montville, T. J. and Kniel, K. E. 2017. Food Microbiology: An Introduction. ASM Press, Washington.
2. Wilson, D.B., Sahm, H., Stahmann, K.-P. and Koffas, M. (2019) Industrial Microbiology. Wiley-VCH, Weinheim, Germany

E- References

1. https://www.freebookcentre.net/medical_books_download/Microbiology-Lecture-Notes-by-Joy-Marshall.html
2. <https://www.moscomm.org/pdf/Ananthanarayan%20microbio.pdf>
3. <https://www.britannica.com/science/plant-disease>

Course outcome	Upon completion of this course, the students will be able to		
	CO	Course Outcomes	Knowledge Level
	CO1	understand the different types of culture media which used in microbiological studies	K1
	CO2	know in detail about the isolation and the identification of bacteria	K2
	CO3	know the industrial products obtained from microbes for commercial production	K3
	CO4	understand the defence mechanism in plants	K2
	CO5	learn the various plant diseases and its control measures	K2

Mapping of COs with POs & PSOs:

CO	Pos								PSOs				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	M	S	S	M	M	M	S	M	S	S	S	M	M
CO2	S	M	M	S	S	S	M	S	M	S	S	S	S
CO3	M	S	S	M	S	S	M	S	S	M	M	M	M
CO4	S	S	M	M	M	M	S	M	S	S	S	M	M
CO5	M	M	S	S	S	M	M	M	S	M	S	S	S

Strongly Correlating (S) - 3 marks

Weakly Correlating (W) - 1 mark

Moderately Correlating (M) - 2 marks

No Correlation (N) - 0 mark

Course Code	P21BOT22	ANATOMY AND EMBRYOLOGY OF ANGIOSPERMS			
CORE -VII		L	T	P	C
Cognitive Level	K2: Understand	K3: Apply	K4: Evaluate	K5:Analyse	
Learning objective	<ul style="list-style-type: none"> To compare and distinguish the anatomy of monocot and dicot plants To understand the types and role of meristems To learn the origin and structure of vascular bundles. To know the development of anther and ovule To get knowledge on pollination and its significance 				
Unit I	Organization and types of Tissue				
Anatomy of root (Primary and Secondary Structure of Mono and Dicots). Anatomy of Stem (Primary, Secondary structure of Mono and Dicots; and Anomalous Structure of <i>Boerhaavia</i>). Anatomy of the leaf and petiole. Nodal Anatomy, Ecology in relation to Anatomy: brief note on adaptation of hydrophytes, xerophytes and halophytes					
Unit II	Plant morphogenesis				
Meristems – types; Organization of shoot apical meristem; Theories of organization of meristems; Vascular Cambium – Types, divisions, arrangement and seasonal activity, Factors affecting cambial activity. Seed Anatomy					
Unit III	Root - stem transition				
Origin, structure, development and ontogeny of phloem. Wood – structure, physical and mechanical properties. Heart wood and sap wood-strength, ability, grains, texture and defects					
Unit IV	Microsporogenesis				
Anther and pollen development - Physiological relationship of tapetum and sporogenous tissues, pollen fertility, sterility, pollen storage and pollen germination. Megasporogenesis; Female gametophyte development, structure of pistil.					
Unit V	Pollination				
Pollen - Pistil interaction, Double fertilization ; Endosperm types : Nuclear, cellular, helobial and ruminant endosperms. Development of monocot and dicot embryos Incompatibility; Methods to overcome incompatibility. Apomixis; genetics of Apomixis and polyembryony : Types and importance. Seed germination and Seedling growth					
Text Books					
<ol style="list-style-type: none"> Pandey, B.P. Plant Anatomy, S. Chand & Co., New Delhi. 2012. Pijush Roy., plant Anatomy and Embryology, New central Book Agency ,Pvt Lit, New delhi 2010. Bhojwani, S.S. and Bhatnagar, S.P.. The Embryology of Angiosperms. Vikas, Publishing House Pvt. Ltd., New Delhi. 2015. Maheswari, P. An introduction to the Embryology of Angiosperms. TATA McGraw-Hill Publishing Co., Ltd., New Delhi. 2020. 					
Reference Books					
<ol style="list-style-type: none"> Charles B.Beck. An Introduction to Plant Structure and development – plant anatomy for twenty first century, Cambride university Press. 2010. Johri, B.M.. Experimental Embryology of Vascular plants. 2012. 					
E-Reference links					
<ol style="list-style-type: none"> https://www.jove.com/science-education/11090/basic-plant-anatomy-roots-stems-and-leaves https://www.botanylibrary.com/plant-tissue/meristem/vascular-cambium-meaning-and-types-meristem-plant-tissue-botany/13707 					

Course outcome	Upon completion of this course, the students will be able to		
	CO	Course Outcomes	Knowledge Level
	CO1	analyse the anatomical structure of dicot and monocot plant.	K5
	CO2	get knowledge on meristems and its types	K2
	CO3	understand the root-stem transition in plants	K2
	CO4	evaluate the development of anther and pollen	K4
	CO5	understand the mechanism of pollination and fertilization	K2

Mapping of COs with POs & PSOs:

CO	Pos								PSOs				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	M	S	S	M	S	S	S	S	M	S	S	S	S
CO2	M	M	M	S	M	S	M	M	S	S	M	M	M
CO3	S	S	S	M	S	M	M	M	S	M	S	S	S
CO4	M	M	M	S	M	M	M	M	S	S	M	M	M
CO5	S	S	S	S	S	S	S	S	M	M	S	S	S

Strongly Correlating (S) - 3 marks Moderately Correlating (M) - 2 marks
 Weakly Correlating (W) - 1 mark No Correlation (N) - 0 mark

Course Code	P21BOT23	CELL BIOLOGY AND GENETICS-			L	T	P	C
CORE- VIII					4	-	-	4
Cognitive Level	K1: Recall	K2: Understand	K3: Apply					
Learning objective	<ul style="list-style-type: none"> To analyse the structure and function of cell organelles To understand the organisation of gene and chromosomes To gain the knowledge on Mendelian genetics To comprehend the concepts of mutation To know the extra chromosomal inheritance and its significance 							
Unit I	Structure of Prokaryotic and Eukaryotic cells							
Structural organization and functions of intracellular organelles- Cell wall, Nucleus, Mitochondria, Golgi body, Lysosome, Endoplasmic reticulum, Ribosome, Peroxisome, Plasmid, Vacuole, Chloroplast, structure & function of cytoskeleton and its role in motility. Cell Membrane, Structure and membrane transport.								
Unit II	Organization of genes and chromosomes							
operon, unique and repetitive DNA, interrupted genes, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons. Brief account on Cell division and cell cycle; Mitosis and meiosis, regulation and control of cell cycle.								
Unit III	Mendelian principles							
Laws of Dominance, segregation, independent assortment; Concept of gene: Allele, multiple alleles, pseudoallele, complementation tests; Extensions of Mendelian principles: Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters. Eugenics - human betterment; Sex determination and Sex linked inheritance.								
Unit IV	Mutation							
Classification of Mutation – Gene and chromosomal mutation: spontaneous and induced mutation – physical and chemical mutagens. Molecular basis of gene mutation, point, frame shift and suppressor mutation. Gene regulatory mechanisms- Extra-nuclear inheritance: cytoplasmic inheritance – chloroplast and Mitochondrial genome in higher plants. Transposable elements, brief account on Jumping genes- Population genetics- Genetic Map.								
Unit V	Extra chromosomal inheritance							
Inheritance of Mitochondrial and chloroplast genes. Cytoplasmic inheritance; Predetermination - Virus like inclusions and infective particles, milk factor, kappa particles, plastid inheritance, maternal inheritance. Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, ploidy and their genetic implications. Cell signaling: signaling through G-protein coupled receptors - signal transduction pathways - second messengers - regulation of signaling pathways.								
Text Book								
<ol style="list-style-type: none"> C.B.Pawar, Cell Biology, Himalaya Publishing House, Mumbai. 2019. E J Gardner, M J Simmons, D P Snustad, Principles of Genetics, Wiley India edition. 2010. Aminul, I. Text Book of Cell Biology. Books and Allied (P) Ltd, Kolkata, India. 2011. 								

Reference Books

1. Derobertis E.D. and De Robertis E.M.F. Cell and Molecular Biology 8th Edition. New York; Lippincott Williams & wilkins publication.2011.
2. Buchanan B.B. Gruissem W., Jones R.L. Biochemistry and Molecular Biology. 2015.
3. Klug, W. S. and Cummings, M. R. Concepts of Genetics. 12th ed. Pearson Education Pvt. Ltd., Singapore. 2018.
4. Paul, A. Text Book of Cell and Molecular Biology. 2nd ed. Books and Allied (P) Ltd, Kolkata, India. 2009.

E- Reference

1. <https://www.msmanuals.com/en-in/home/fundamentals/genetics/genes-and-chromosomes#:~:text=Genes%20are%20segments%20of%20deoxyribonucleic,are%20in%20the%20cell%20nucleus.>
2. <https://www.nature.com/scitable/topicpage/gregor-mendel-and-the-principles-of-inheritance-593>

Course outcome	Upon completion of this course, the students will be able to		
	CO	Course Outcomes	Knowledge Level
	CO1	compare and differentiate the prokaryote and eukaryote cell structure	K3
	CO2	understand the cell division and regulation of cell cycle	K1,K2
	CO3	acquire knowledge on sex determination and Sex linked inheritance	K2
	CO4	understand population genetics and genetic map	K2
	CO5	learn the cell signalling process	K2

Mapping of COs with POs & PSOs:

CO	Pos								PSOs				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	S	S	S	S	M	M	M	S	M	M	S	S
CO2	M	S	S	M	M	S	S	S	M	S	S	S	M
CO3	S	S	S	S	S	S	M	M	S	M	M	S	S
CO4	S	S	S	M	M	M	M	M	S	S	S	S	M
CO5	M	S	M	S	S	M	S	S	M	M	S	S	S

Strongly Correlating (S) - 3 marks

Weakly Correlating (W) - 1 mark

Moderately Correlating (M)

No Correlation (N)

- 2 marks

- 0 mark

Course Code	P21BOT24	PHYTOCHEMISTRY AND PHARMACOGNOSY			L	T	P	C
CORE- IX					4	-	-	4
Cognitive Level	K1: Recall K2: Understand K3: Apply K5:Analyse							
Learning objective	<ul style="list-style-type: none"> To learn the production of phytochemicals from medicinal plants To understand the preliminary phytochemical screening To gain the knowledge of Pharmacognosy To understand the significance of phytocompounds 							
Unit I	Scope and Importance of Phytochemistry							
Introduction to phytochemicals - Production of phytochemicals from medicinal plants-Extraction of phytochemicals-Developing new drugs from Ethnomedicines – Antioxidants-Alkaloids-Anthocyanins-Carotenoids-flavanoids-xanthophylls- plants with phytochemicals								
Unit II	Preliminary phytochemical screening							
successive solvent extraction –detection of different classes of phytoconstituents by qualitative method and TLC methods. Isolation of volatile oil by hydro distillation method. Methods of isolation, purification and characterization of some natural products: Podophyllin, Ginsenosides, Curcumin, Cordycepin,Lemon grass oil, Emitine, Artemisinin.								
Unit III	Plant Steroids							
Biological significance - Classification of Saponins in plants - Isolation, and biosynthesis of bioactive steroids such as cholesterol, diosgenin, estrone, estrodiol, <i>Terpenoids</i> in plants - Biological functions of terpenoids in plants - Bioactive alkaloids - Isolation and structure elucidation of alkaloids such as Atropine, Quinine, Papaverine, Uses of Reserpine, Quinine and Quinidine, Atropine, Hyoscyamine and Scopolamine.								
Unit IV	Pharmacognosy							
Scope and importance of pharmacognosy- Origin and History – Indian systems of medicine – Ayurveda, basic principles of Ayurveda, branches of Ayurveda – Siddha system of medicine Basic principles of Siddha system- Unani system of medicine- Homeopathy system of medicine – Naturopathy system of medicine – Acupuncture system of medicine- Yoga system of medicine.								
Unit V	Collection of herbal drugs							
Harvesting of herbal drugs – Drying of crude drugs: Natural drying, Artificial drying –Garbling- Packing and storage of crude drugs - Anticancer drug- Hepatoprotective drug - Cardiotonic drug- Antimalarial drug- Hypertensive drug. Classification of drugs of natural origin – Organized drugs- Unorganized drugs- Classification of crude drugs. Importance of Pharmacognosy.								
Text Books								
<ol style="list-style-type: none"> 1. Leninger A.C. Principles of Biochemistry, CBS Publishers and Distributers (Indian Reprint). 2016. 2. Gokhale, S.B., Kokate, C.K. and Gokhale, A. Pharmacognosy of Traditional Drugs. 1st ed. Nirali Prakashan, Pune. 2016. 3. Gringauz .Introduction to Medicinal Chemistry: How Drugs Act & Why? Wiley India Pvt Ltd., Noida. 2012. 4. Joshi, S.G. Medicinal Plants. Oxford & IBH Publishing C., Pvt., Ltd., New Delhi. 2018. 								
Reference Books								
<ol style="list-style-type: none"> 1. Kumar, N. A Textbook of Pharmacognosy. Aitbs Publishers, India. 2018. 2. Premendra Singh. Medicinal Plants: Conservation, Cultivation and Utilization. Daya Publishing House New Delhi. 2013. 								

E-Reference

1. http://priede.bf.lu.lv/grozs/AuguFiziologijas/Augu_biokimija/Plant%20Biochemistry%204.pdf
2. http://www.brainkart.com/subject/Plant-Biochemistry_257/
3. https://swayam.gov.in/nd2_cec20_bt12/preview
4. <https://www.biorxiv.org/content/10.1101/660639v2>
5. <https://www.scribd.com/document/378882955/Plant-Biochemistry-Lecture-Notes-Study-Materials-and-Important-questions-answers>

Course outcome	Upon completion of this course, the students will be able to		
	CO	Course Outcomes	Knowledge Level
	CO1	know the various methods for phytochemical extraction	K2
	CO2	gain knowledge on extraction and detection of phytocostituents	K2
	CO3	analyse the isolation and structure elucidation of alkaloids	K5
	CO4	understand the scope and importance of pharmacognosy	K2
	CO5	know the collection and harvesting of herbal drugs	K1,K2

Mapping of COs with POs & PSOs:

CO	Pos								PSOs				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	M	S	S	S	M	S	M	M	S	M	S	S	M
CO2	S	S	S	M	S	M	M	S	S	S	M	S	M
CO3	M	S	M	S	S	M	M	S	M	M	S	M	S
CO4	S	S	S	S	M	S	S	M	S	S	S	S	M
CO5	M	S	S	S	S	M	S	M	M	M	M	S	S

Strongly Correlating (S) - 3 marks

Weakly Correlating (W) - 1 mark

Moderately Correlating (M) - 2 marks

No Correlation (N) - 0 mark

Course Code	P21BOP22	PRACTICAL- MICROBIOLOGY & PLANT PATHOLOGY, ANATOMY & EMBRYOLOGY OF ANGIOSPERMS, CELL BIOLOGY & GENETICS	L	T	P	C
CORE-X			-	-	6	4
Cognitive Level	K1: Recall	K2: Understand	K3: Apply	K5: Analyse		
Learning objective	<ul style="list-style-type: none"> To get practical skills of various staining techniques to identify various microbes To develop the skill of microbial techniques for food quality assessment To learn the handling methods of Micro techniques - Microtomy and microtome sectioning To understand the organization of anthers and pollens To develop skill on the isolation of plant embryos and embryonic tissues techniques 					
<p><u>1. Microbiology</u></p> <p>1. Grams staining of bacteria found in Milk, curd , root nodule. 2. Isolation and identification of bacteria and fungi from spoiled food. 3. Testing quality of Milk by methylene blue reductase and phosphatase Test.</p> <p><u>2. Plant Pathology</u></p> <p>Study of the disease symptoms, causal organism, and transmission and control measures of the following plant diseases.</p> <ol style="list-style-type: none"> 1. Little leaf of Brinjal (Mycoplasma). 2. Bacterial Blight of Paddy. 3. Bunchy top of Banana (Virus). 4. Rust of wheat, Wilt of cotton, White rust of mustard, Anthracnose of mango – citrus canker, rice blight - Tobacco mosaic, Cucumber mosaic - Little leaf of brinjal. <p><u>3. Anatomy</u></p> <p>Preparation of hand sections, maceration and clearing.</p> <ol style="list-style-type: none"> 1. Temporary and permanent mounting of whole specimens and Sections using different types of mountants. 2. Calibration of microscope and micrometry. 3. Microtomy and microtome sectioning. 4. Examination of different cell and tissue types with help of techniques. 5. Secondary Anomalous growth. 6. Nodal anatomy- Uni, Tri and Multilacunar node. <p><u>4. Embryology</u></p> <ol style="list-style-type: none"> 1. Dissection of Endosperm haustoria – <i>cucumis</i>. 2. Dissection of Embryo- <i>Tridax</i> Organization of anthers . 3. Methods of testing pollen viability using (Terazolium chloride test). <p><u>5. Cellbiology</u></p> <ol style="list-style-type: none"> 1. Squash & Smear techniques- Onion root tip & Rheo flower buds. <p><u>6. Genetics</u></p>						

Solving problems involving

1. Dihybrid cross
2. Interactions of factors.
3. Chromosome mapping from test cross data. Calculation of interference.
4. Multiple alleles and blood group inheritance.
5. Calculation of gene frequency.

Reference Books

1. Sivakumar, K. Algae- A Practical Approach. MJP Publishers, Chennai, India. 2016.
2. Gupta, V.K., Tuohy, M.G., Ayyachamy, M., Turner, K.M. and O'Donovan, A. Laboratory Protocols in Fungal Biology: Current Methods in Fungal Biology. Springer, London, UK. 2013.
3. Chmielewski, J. G. and Krayesky, D. General Botany laboratory Manual. AuthorHouse, Bloomington, USA. 2013.
4. Bendre, A. M. A Text Book Of Practical Botany – 1. Rastogi Publications, Meerut, India. 2010.

Course outcome	Upon completion of this course, the students will be able to		
	CO	Course Outcomes	Knowledge Level
	CO1	learn microbial isolation and identification techniques	K2
	CO2	identify plant disease and causative organism	K3
	CO3	perform sectioning and microscope handling	K3
	CO4	analyse the pollen viability in research aspect	K5
	CO5	acquire skills to solve the problems in Mendelian genetics	K3

Mapping of COs with POs & PSOs:

CO	Pos								PSOs				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	M	M	S	S	M	M	S	M	S	S	S	S	S
CO2	S	S	M	S	S	M	S	S	S	S	S	S	S
CO3	S	M	S	M	M	S	M	M	S	S	S	S	S
CO4	M	S	S	S	M	S	S	M	S	S	S	S	M
CO5	S	S	S	M	S	M	S	S	S	M	S	S	S

Strongly Correlating (S) - 3 marks Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark No Correlation (N) - 0 mark

Course Code	P21BOS22	PLANT TISSUE CULTURE			
Supportive course Skill II		L	T	P	C
Cognitive Level	K2: Understand		K3: Apply		
Learning objective	<ul style="list-style-type: none"> To gain knowledge about the tissue culture To learn about the composition of commonly used culture media To know the procedures in plant tissue culture To gain knowledge of Anther and Embryo culture To be familiar with the genetic transformation and Germplasm conservation 				
Unit I	Media Preparation				
Introduction - History, Scope and Concepts of basic techniques in plant tissue culture. Laboratory requirements and organization. Sterilization - filter, heat, wet and chemical. Media preparation - inorganic nutrients, organic supplements, carbon source, vitamins, gelling agents, phytohormones and growth regulators; composition of commonly used culture media (MS and Gamborg's)					
Unit II	Procedure				
Basic steps of plant tissue culture – Procedures in plant tissue culture - Somatic embryogenesis - Process of somatic embryogenesis, structure, stages of embryo development, factors affecting embryogenesis.					
Unit III	Micropropagation				
Basic steps in Micropropagation - Multiplication by axillary buds and apical shoots, direct and indirect organogenesis - Factors affecting morphogenesis and proliferation rate. Organogenesis - formation of shoots and roots.					
Unit IV	Types of culture				
Seed, Embryo, Root, Callus, Organ. Protoplast culture- Haploid production – Anther and Embryo culture -Importance of Anther and Embryo culture. Production of artificial seeds; Cryopreservation					
Unit V	Gene transformation methods				
Methods of transformation for development of transgenic crops – Application of tissue culture in plant improvements – Herbicide tolerance, virus resistance, insect resistance.					
Text Books					
1. Halford N.2015.Plant Biotechnology: Current And Future Applications Of Genetically Modified Crops , Publisher Wiley					
2. Smith RH. 2013.Plant Tissue Culture. 3 rd Edition, Publisher Elsevier					
References Books					
1. Gresshoff Peter M.2020.Plant Biotechnology and Development. Publisher: Taylor & Francis Inc					
2. Chawla H S.2020.Introduction To Plant Biotechnology. Publisher Oxford & IBH publishing					
3. S. Umesha,2019.Plant Biotechnology. Publisher CRC Press					
4. Hiru Ranabhattach , Renu Kapur.2018.Plant Biotechnology. 1 st Edition, Publisher WPI Publishing.					
5. Abdin, M.Z., Kiran, U., Kamaluddin, M., Ali, A. 2017.Plant Biotechnology: Principles and Applications,Publisher Springer					

E- Reference

1. <https://www.onlinebiologynotes.com/micropropagation-stages-types-applications-and-limitations/>
2. <https://www.intechopen.com/books/endangered-plants/germplasm-conservation>
3. <https://www.pdfdrive.com/plant-cell-and-tissue-culture-a-tool-in-biotechnology-e20389188.html>
4. <https://www.pdfdrive.com/principles-of-plant-biotechnology-e33514134.html>
5. <https://www.pdfdrive.com/plant-genomics-e28703875.html>

Course outcome	Upon completion of this course, the students will be able to		
	CO	Course Outcomes	Knowledge Level
	CO1	understand the preparation of different types of media	K2
	CO2	perform the process of somatic embryogenesis	K3
	CO3	learn the basic steps in micropropagation	K2
	CO4	practice different types of tissue culture which is used for mass multiplication	K3
	CO5	know the application of tissue culture in plant improvements	K2

Mapping of COs with POs & PSOs:

CO	Pos								PSOs				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	M	M	S	M	M	M	M	S	S	S	S	S	M
CO2	S	S	M	S	S	M	M	S	M	M	S	M	S
CO3	M	M	S	S	S	S	S	M	S	M	M	S	S
CO4	M	S	M	S	M	M	S	S	M	S	S	S	M
CO5	S	M	S	M	S	S	M	M	S	M	S	M	S

Strongly Correlating (S) - 3 marks Moderately Correlating (M) - 2 marks
 Weakly Correlating (W) - 1 mark No Correlation (N) - 0 mark

SEMESTER III

Course Code	P21BOT31	PLANT PHYSIOLOGY AND BIOCHEMISTRY				L	T	P	C
CORE-XI						4	-	-	4
Cognitive Level	K1: Recall K2: Understand K4: Evaluate K5:Analyse								
Learning objective	<ul style="list-style-type: none"> To understand the concepts of water/mineral absorption To learn the mechanism of photosynthesis and biological nitrogen fixation To acquire knowledge on the Stress physiology To know the structure and function of biomolecules To study the function of enzymes 								
Unit I	Water relations of plants								
Physicochemical properties of water, chemical potential and water potential in the plant, translocation of water, ascent of sap, bulk movement of water, soil-plant atmosphere continuum (SPAC): Transpiration- movement and loss of water in plants; Evapotranspiration - stomatal physiology and regulation, Source and sink relationship. Modern concepts of mineral salt absorption									
Unit II	Photosynthesis								
Photophysical and photochemical phase; Light reactions; Electron Transport Chain, Photophosphorylation- Photo protective mechanisms,CO ₂ fixation,C ₃ , C ₄ and CAM pathways- Photorespiration and its significance. Pathways of CO ₂ fixation. Respiration: Glycolysis, Citric acid cycle and Oxidative Phosphorylation- plant mitochondrial electron transport couples ATP synthesis; alternate oxidase. Respiratory inhibitors – Cyanide resistant respiration.									
Unit III	Nitrogen fixation, Phytohormone and Stress physiology								
Mechanism of nitrogen fixation, Nitrogen uptake and assimilation. Biosynthesis and mode of action of phytohormones - auxins, gibberellins, cytokinins, ethylene, abscissic acid, Brassinosteroids. Phytochrome - properties and photochemical transformation. Movement - nastic and tropic movements. Seed dormancy - causes and methods to break seed dormancy - physiology of seed germination. Fruiting- mechanism of fruiting – hormonal control of fruiting . Abscission and Senescence. Stress physiology – Classification of stress –biotic and abiotic stress factors- response of plants to salt, drought, freezing, and heat.									
Unit IV	Biomolecules								
Structure of atoms, molecules and chemical bonds. Carbohydrates: Classification, structure and functions of carbohydrates a) monosaccharides b) oligo saccharides c) polysaccharides, storage polysaccharides, structural polysaccharides. Protein: Classification, structure and composition of protein. Enzymes classification, coenzymes, isoenzymes, mechanism of action, km value, Michaelis-Menten equation.									
Unit V	Lipids								
Classification, structure and properties of lipids. Biosynthesis of fattyacids, polyunsaturated fattyacids, lipoprotein. oxidation: beta oxidation, glyoxalate cycle, gluconeogenesis. Nucleic acids: Structure, composition. Nucleic acids: DNA and RNA structure – Watson and Crick model for DNA structure- RNA Secondary structure- Vitamins general characters, Classification, Structure and properties.									
Text Books									
<ol style="list-style-type: none"> Jain, J.L. Fundamentals of Plant Physiology 19th Edition. S Chand Publishing. 2017 Appling D. R., Anthony-Cahill S.J. & Mathews, C.K. Biochemistry. Concepts and Connections. Pearson Education Limited. 2016. 									

3. Sinha S.K. Modern Plant Physiology 2nd Edition. Narosa Publishers. 2013.
4. Noggle, R. and Fritz, G. I. Introductory Plant Physiology. 2nd ed. Prentice Hall New Delhi. 1989.

Reference Books

1. Nelson D. L. & Cox, M. M. Lehninger Principles of Biochemistry. 7th Edition. W H Freeman & Co.2017.
2. Berg, J. M., Tymozko. J. L. &Stryer, L. Biochemistry, 8th Edition. W. H. Freeman and Company.2015.
3. Taiz, L. &Zeiger, E. Plant Physiology. 5th Edition. Sinauer Associates Inc., Publishers.2010.
4. Jackson, S. A., Kianian, S. F., Hossain, K. G., and Walling, J. G. Practical laboratory exercises for plant molecular cytogenetics. In Plant Cytogenetics (pp. 323-333). Springer, New York, NY. 2012.
5. Bharadwaj, D. N. Breeding of field crops (pp. 1-23). Agrobios (India). 2012.
6. Bala, M., Gupta, S., Gupta, N. K., and Sangha, M. K. Practicals in plant physiology and biochemistry. Scientific Publishers (India). 2013.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. http://priede.bf.lu.lv/grozs/AuguFiziologijas/Augu_biokimija/Plant%20Bohemistry%204.pdf
2. http://www.brainkart.com/subject/Plant-Biochemistry_257/
3. https://swayam.gov.in/nd2_cec20_bt12/preview
4. <https://www.pdfdrive.com/textbook-of-biochemistry-e14983388.html>
5. <https://www.pdfdrive.com/lehninger-principles-of-biochemistry-5th-edition-e164892141.html>

Course outcome	Upon completion of this course, the students will be able to		
	CO	Course Outcomes	Knowledge Level
	CO1	understand the relationship between water and plants	K2
	CO2	comprehend the process of photosynthesis and plants respiration	K1,K2
	CO3	acquire knowledge on nitrogen fixation molecular mechanism	K2
	CO4	analyse the mechanism of Enzymes action	K5
	CO5	elucidate the structure and function of macromolecules	K4

Mapping of COs with POs & PSOs:

CO	Pos								PSOs				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	M	S	S	S	S	M	M	S	S	S	M	S	S
CO2	S	M	M	M	M	S	S	S	S	S	S	S	S
CO3	M	S	S	S	S	M	S	M	S	S	M	S	S
CO4	S	M	S	S	M	S	S	S	S	S	M	S	M
CO5	M	S	M	M	S	M	M	M	S	M	S	S	S

Strongly Correlating (S) - 3 marks Moderately Correlating (M) - 2 marks
 Weakly Correlating (W) - 1 mark No Correlation (N) - 0 mark

Course Code	P21BOT32	PLANT MOLECULAR BIOLOGY			L	T	P	C
CORE-XII					5	-	-	4
Cognitive Level	K2: Understand K3: Apply K5:Analyse K6: Create							
Learning objective	<ul style="list-style-type: none"> To understand the mechanism of carcinogenesis and apoptosis To comprehend the gene expression and central dogma of life. To know the post translational modification of protein To acquire knowledge on various cloning vectors used for genetic engineering To learn the process of DNA replication and its significance To learn the molecular biology techniques for crop improvement for the well being of society 							
Unit I	Ultra-Structure of Prokaryotic and Eukaryotic cells							
Cytoskeleton. Chromosomes and their structure -Euchromatin, Heterochromatin, DNA condensation and Nucleosome. Molecular events and Model systems. Biology of Cancer, Carcinogenesis, tumorigenesis, and Apoptosis.								
Unit II	Basic Organization of Nuclear Genes							
Promoters and Other regulatory sequences, Prokaryotic and Eukaryotic gene expression.								
Transcription								
Prokaryotic and Eukaryotic Transcription, RNA Polymerase, Transcription factors, Mechanism of Transcription. Post-Transcriptional modification, Modifications in RNA, 5'-Cap formation, termination, 3'end processing and Polyadenylation, Splicing and editing, Nuclear export of m- RNA Stability.								
Unit III	Translation							
Prokaryotic and Eukaryotic Translation, Translational machinery, initiation, Elongation and Termination, Post-Translation modification of Proteins.								
Restriction Enzymes								
Discovery, Types, Nomenclature and Role in Genetic Engineering.								
Cloning vectors								
Plasmids, Cosmids, Phagemids and Other Viral Vectors.								
Blotting Techniques (Southern, Northern, Western). Synthesis of cDNA,								
Genomic and cDNA Libraries								
YAC, BAC, Packaging, Transfection and Recovery of Clones. Molecular Markers in Genome Analysis.								
Unit IV	DNA Replication							
Units of Replication, Enzymology of DNA Replication, Discontinuous and Bidirectional Replication, Initiation, Elongation and Termination of Replication. Mutation: Molecular basis of mutation, Detection of mutation in Drosophila – DNA damage and repair mechanism.								
Unit V	Plant marker Gene							
Restriction Fragment Length Polymorphism (RFLP) and its application, RAPD and AFLP Analysis in crop improvement. Applications of r-DNA technology. Applications of genetic engineering in crops. Application of RFLP in Forensic and Disease Prognosis.								
Text Books								
1. Krebs, J. E., Goldstein, E. S. & Kilpatrick, S. T. LEWIN'S GENES XII. Jones & Bartlett Learning. 2018.								
2. Iwasa, J. & Marshall, W. KARP'S Cell And Molecular Biology John Wiley & Sons, Inc. 2017.								

3. Jones, R. L. The Molecular Life of Plants. Wiley-Blackwell. 2012.
4. Alberts et al., Molecular Biology of the Cell, Garland Publications.2012.

Reference Books

1. Becker, W. M. Hardin, J. & Bertoni G. Becker's World of the Cell. Pearson Education Ltd. 2018.
2. Lodish, H., Berk, A., Kaiser, C. A. & Krieger, M. Molecular Cell Biology. 7th Edition, W. H. Freeman, NY, USA.2012.
3. Gorge. M. Malacinski & Freifeilder. D. 2005. Essentials of Molecular Biology.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. https://www.youtube.com/watch?v=1LAKKvhVLms&list=PLKIDmFiIyAIE_WaNGQU0wAnectCOMvR1
2. <https://www.youtube.com/watch?v=G5Wo8dCivWs>
3. <https://www.youtube.com/watch?v=I4uaBXwaXXw>
4. <https://www.youtube.com/watch?v=47pkFey3CZ0>
5. <https://www.pdfdrive.com/biochemistry-genetics-molecular-biology-e18198970.html>

Course outcome	Upon completion of this course, the students will be able to		
	CO	Course Outcomes	Knowledge Level
	CO1	understand the structure and function chromosome	K2
	CO2	learn the mechanism of transcription	K2
	CO3	know the nomenclature and role of restriction enzymes in genetic engineering	K2
	CO4	analyse the molecular basis of mutation	K5
	CO5	apply various molecular techniques for crop improvement	K6

Mapping of COs with POs & PSOs:

CO	Pos								PSOs				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	M	M	S	M	M	M	M	M	S	S	S	S	S
CO2	S	S	M	S	S	M	S	S	S	S	S	S	S
CO3	SM	S	S	M	S	M	S	S	S	S	S	S	S
CO4	S	M	M	S	M	S	S	M	S	S	S	S	M
CO5	M	S	M	S	S	M	M	S	S	M	S	S	S

Strongly Correlating (S) - 3 marks Moderately Correlating (M) - 2 marks
 Weakly Correlating (W) - 1 mark No Correlation (N) - 0 mark

Course Code	P21BOT33	PLANT BIOTECHNOLOGY			
CORE- XIII		L	T	P	C
Cognitive Level	K1: Recall K3: Apply	K2: Understand K4: Evaluate	K5: Analyse	K6: Create	
Learning objective	<ul style="list-style-type: none"> To acquire theoretical knowledge regarding the techniques and applications of plant biotechnology and genetic engineering To understand the fundamentals of genome organisation in plants To learn the plant Genetic transformation techniques To gain knowledge on the modern research in metabolic engineering and plant molecular farming 				
Unit I	Basic concepts				
Scope of biotechnology, molecular tools. Genome organization in plants: Marker-aided Breeding: RFLP maps, linkage analysis, Microsatellites, SCAR, SSCP, AFLP, QTL, map based cloning, molecular marker assisted selection, Allele mining for crop improvement.					
Unit II	Plant cell and tissue culture				
embryo culture, anther culture, endosperm culture, embryogenesis, organogenesis and micropropagation. Protoplast isolation, culture and regeneration, methods of fusing protoplasts, somatic hybridization.					
Unit III	Plant Genetic Transformation Techniques				
Features of Ti and Ri plasmids and its use as vectors, binary vectors, viral vectors, 35S and other promoters, use of reporter genes and marker genes, gene transfer methods in plants: direct and indirect DNA transfer. Chloroplast transformation and its advantages.					
Unit IV	Transgenic plants				
Resistance to biotic stress –insect and pest resistance; Resistance from microorganisms. Resistance to Abiotic stress; herbicide, phosphinothricin, sulfonylureas and imidazolinones. Transgenic plants as Bioreactor: molecular pharming, therapeutic products. Transgenic rice with Vitamin A, transgenic plants with stress tolerance for drought and salinity, crop improvement.					
Unit V	Metabolic engineering and plant molecular farming				
Plant secondary metabolites, control mechanisms and manipulation of phenyl propanoid and shikimate pathway; alkaloids, industrial enzymes, biodegradable plastics, therapeutic proteins, lysosomal enzymes, antibodies, edible vaccines.					
Text Books					
<ol style="list-style-type: none"> Govil, C.M., Aggarwal, A. & Sharma, J. Plant Biotechnology and Genetic Engineering. PHI Learning, PVT Ltd., New Delhi. 2017. Dubey R.C. Advanced Biotechnology 1st Edition. S.Chand&Company Ltd., New Delhi. 2014 Gamborg, O.L and Phillips, G.C. Plant Cell, Tissue Organ Culture. Springer Science & Business Media. 2013. L N Nair. Methods of microbial and plant biotechnology. New Central Book agency (P) Ltd. 2010. 					
Reference Books					
<ol style="list-style-type: none"> Jaiswal S. Singh P. & Kumar K. Instant Biotechnology a competitive approach. New Vishal Publication. 2017. Abdin M.K., Kiran U. Kamaluddin& Ali, A. Plant Biotechnology: Principles and Applications. Springer. 2017. 					

3. Thieman, W. J. & Palladino, M. A. Introduction to biotechnology. 3rd Edition 53. Pearson Education, Inc. 2013.
4. Plant Biotechnology by Hammond, Mc Garvey and Yusibov Springer Verlag,
5. Plant Biotechnology and Transgenic Plants, Edited by Kirsi-Marja Oksman- Caldentey and Wolfgang Barz. Marcel Dekker, Inc. New York. 2002.
6. Plant Biotechnology: The genetic manipulation of plants by Slater, Scott and Fowler, Second edition, Oxford University press, UK. 2008.

E-Reference links

1. <http://www.freebookcentre.net/Biology/BioTechnology-Books.html>
<https://www.springer.com/gp/book/9789811029592>
2. <https://www.google.com/url?sa=t&source=web&rct=j&u rl=>
3. <https://www.pdfdrive.com/plant-cell-and-tissue-culture-a-tool-in-biotechnology-e20389188.html>
4. <https://www.pdfdrive.com/plant-biotechnology-and-genetics-principles-techniques-e15853574.html>
5. <https://www.pdfdrive.com/principles-of-plant-biotechnology-e33514134.html>

Course outcome	Upon completion of this course, the students will be able to		
	CO	Course Outcomes	Knowledge Level
	CO1	understand genome organization in plants	K1
	CO2	learn different types of tissues used for micropropagation	K2
	CO3	practice the gene transfer methods to create transgenic plants using the Techniques - Ti and Ri plasmids as vectors	K3,K6
	CO4	acquire knowledge and skills to make a new transgenic plant to harvest valuable pharmaceutical products needed for society	K6
	CO5	understand plant molecular farming	K2

Mapping of COs with POs & PSOs:

CO	Pos								PSOs				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	M	M	S	S	S	S	S	S	S
CO2	S	S	M	M	S	S	M	S	S	M	M	S	M
CO3	S	S	S	S	M	M	M	S	S	S	M	M	S
CO4	S	M	S	M	M	M	S	M	S	S	S	S	M
CO5	S	S	M	S	S	S	S	S	S	M	S	M	S

Strongly Correlating (S) - 3 marks Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark No Correlation (N) - 0 mark

Course Code	P21BOT34	BIODIVERSITY CONSERVATION AND MANAGEMENT		L	T	P	C
CORE-XIV				4	-	-	4
Cognitive Level	K1: Recall		K2: Understand	K3: Apply			
Learning objective	<ul style="list-style-type: none"> To know about the biogeography and major terrestrial biome To learn about afforestation To know about the principles and approaches of Biodiversity conservation To understand the effect of global climatic change on natural communities 						
Unit I	Categories of Biodiversity						
Species concepts: keystone, flagship, dominant and co-dominant species – Biogeography: Major terrestrial biomes – theory of island biogeography –Values of biodiversity-ecosystem services-Speciation- species area relationship: productivity- diversity relationship – Hot- spot of Biodiversity.							
Unit II	Principles and approaches of Biodiversity conservation						
Routledge Taylor & conservation application and technology, new agricultural and industrial products from the tropic - Screening plants for medicines – Identifying and protecting the origin of food crops. Endemism: types, endemic species of India. Biopiracy.							
Unit III	Extinction and Conservation						
The effect of global climatic change on natural communities- IUCN categories of extinction- red data book – causes for species extinction – impact of exotic species on native species – GMOs and biosafety – Intellectual property rights- GATT, WTO, farmers and breeders rights- Biodiversity act -2002.							
Unit IV	Afforestation programmes						
<i>In situ</i> conservation: National parks, Wildlife Sanctuaries, Biosphere reserves – <i>Ex-situ</i> conservation: Botanical and herbal gardens, zoological parks and gene banks. social forestry, chipko movement, Forest-wildlife management and its impact. Environmental monitoring and impact assessment. soil reclamation and principles, Rio, Kyoto summit, earth summit.							
Unit V	Sustainable management of Bio resources						
National Biodiversity Authority-Functions of State Biodiversity Board and Biodiversity Management committees-The role of WWF, FAO, UNESCO,UNDO, UNEP for Biodiversity conservation.							
Text Books							
<ol style="list-style-type: none"> Poul V.I. Biodiversity: Issues, Impact, Remediations and Significance 1st Edition. V L Media Solution.2013. Kochhar, S.L. Economic Botany in the Tropics. IV edition. Macmillan Publishers India Pvt. Ltd. New Delhi. 2011. Bawa K.S., Primack, R.V. and Oommen, M.A. Conservation biology: A Primer for South Asia, ATREE, Bangalore.2011 							
Reference Books							

1. Osborne P L. Tropical Ecosystems and Ecological Concepts, 2 nd edition. Cambridge University Press.2012.
2. Stiling, P. 2002. Ecology – Theory and applications. Prentice-Hall of India Pvt. Ltd., New Delhi.
3. Gurevitch, J, Scheiner S.M and Fox G.A. 2002. The Ecology of Plants. Sinauer Associates Inc Publishers, Massachusetts.
4. Agarwal, K.C. 2000 Biodiversity. Agrobios (India). Jodhpur

E-Reference links

1. <https://www.youtube.com/watch?v=qtTLiQoYTyQ>
2. <https://www.pdfdrive.com/plant-conservation-and-biodiversity-topics-in-biodiversity-and-conservation-e161970544.html>
3. <https://www.youtube.com/watch?v=208B6BtXOPs>

Course outcome	Upon completion of this course, the students will be able to		
	CO	Course Outcomes	Knowledge Level
	CO1	know the hot spots of biodiversity	K1
	CO2	acquire knowledge on endemic species and types of endemism	K2
	CO3	analyse the different categories of extinction	K3
	CO4	know about the environmental monitoring and the impact assessment	K2
	CO5	know about the role of WWF, FAO, UNESCO, UNDO, UNEP for Biodiversity conservation	K2

Mapping of COs with POs & PSOs:

CO	Pos								PSOs				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	M	S	M	S	M	M	M	M	S	S	S	S	S
CO2	S	M	S	M	S	S	M	S	S	S	S	S	S
CO3	M	S	M	S	S	M	S	M	S	S	S	S	S
CO4	S	M	S	S	M	S	S	M	S	S	S	S	M
CO5	M	M	M	M	S	M	S	S	S	M	S	S	S

Strongly Correlating

(S) - 3 marks

Moderately Correlating (M) - 2 marks

Weakly Correlating

(W) - 1 mark

No Correlation (N) - 0 mark

Course Code	P21BOT35	BIOINSTRUMENTATION, RESEARCH METHODOLOGY AND BIOSTATISTICS			L	T	P	C
CORE- XV					5	-	-	4
Cognitive Level	K1: Recall K3: Apply		K2: Understand K4: Evaluate					
Learning objective	<ul style="list-style-type: none"> To know fundamental principles and applications of basic instruments in biology To explore the use of statistical methodology in designing, analyzing, interpreting and presenting biological experiments and observations. To understand the most important and basic concepts, methods and tools used in Bioinformatics To learn the application of bioinformatics and biological databases to solve the real research problems 							
Unit I	Analytical techniques based on optical principles							
Photomicrography: Camera as the remote sensing device – types – shutter speed – aperture – depth of field – photographic techniques – printing (photographic emulsion, enlarger, developer and fixer) - Spectroscopy: Principles, components and working mechanism – Colorimeter, UV visible and Infra Red (IR), nuclear magnetic resonance (NMR), electron paramagnetic resonance (EPR), atomic absorption spectroscopy (AAS)..								
Unit II	Quantitative procedures based on physical principles							
Centrifugation: Principles, components, mechanism and application of clinical, refrigerated and ultra centrifuges – separation of organelles and macromolecules. Chromatography: Principles (absorption – partition – ion exchange – affinity), components, methodology and applications of the different types of chromatography – thin layer, GC, HPLC, qualitative and quantitative analysis of biomolecules. Radiometry: Isotopes, radioactivity, measurement of radioactivity-radioactive counters (scintillation counter), applications of radioisotopes, autoradiogram								
Unit III	Methods targeting the electrolytic behavior							
pH metry- pH concept, electrodes, standardization and buffers – acetate-phosphate-Tris Glycine, titration curve, pKa value. Electrophoresis: Principles, equipment, methodology and applications - PAGE, AGE, SDS- PAGE, 2 D- electrophoresis, iso electro focusing.								
Unit IV	Research methodology							
Choosing the problem for research –literature collection – Primary, secondary and tertiary sources – Bibliography – indexing and abstracting – Reporting the results of research in conferences – Oral and Poster presentation. Thesis writing – Research journals – National and International –monographs – reprints – proof correction – Full paper – Short Communication – Review paper.								
Unit V	Biostatistics							
Biostatistics – Scope – Collection – classification, Tabulation and presentation of data – mean – median and mode. Standard deviation – Standard error – probability analysis – test of significance - t ^{''} test – Chi-square test –permutation and combination – Skewness and kurtosis - correlation and regression analysis- ANOVA. Tests of statistical significance-chi square test, theories of probabilities. Analysis of variance								
Text Books								
1. Pillai, R.S.N. and Bagavathi,V. S. Statistics theory and practice. Chand & Co.Ltd, New Delhi. 2010.								

2. Gupta, S.P. Statistical Methods. S. Chand & Co. Ltd, New Delhi.2014.
3. Kothari,C.R. and Garg,G. Research methodology –Method and techniques. NewAge International (P) Ltd. New Delhi. 1990.
4. Vijay Upadhaya and Arvindshende. Research methodology. S. Chand and Company Pvt.Ltd. Newdelhi. 2014.

Reference Books

1. Kumar, R. Research Methodology. Sage Publishing; 4th Edition. 2014.
2. BijuDharmapalan. Scientific Research Methodology. NarosaPublising house2012.
3. BernardRosner. Fundamentals of Biostatistics. Brooks/cole, Boston, USA. 2012.
4. Rastogi, V.B. Fundamentals of Biostatistics. Ane Books Pvt.Ltd. India, New Delhi. 2015.

E-References

1. <https://handling-solutions.eppendorf.com/sample-handling/centrifugation/safe-use-of-centrifuges/basics-in-centrifugation/>
2. <https://files.eric.ed.gov/fulltext/ED407284.pdf>
3. <http://rijuebookbiostatistics.blogspot.com/2008/06/biostatistics-ebooks-free-download.html>

Course outcome	Upon completion of this course, the students will be able to		
	CO	Course Outcomes	Knowledge Level
	CO1	understand the principles of different spectroscopy	K1
	CO2	know the principles and mechanism of centrifuge	K2
	CO3	learn the principle and application of electrophoresis	K2
	CO4	present research findings in conferences and seminars	K3
	CO5	apply the Bio-statistical tools in appropriate places	K3

Mapping of COs with POs & PSOs:

CO	Pos								PSOs				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	S	M	M	S	M	S	M	S	S	M	S	S
CO2	M	S	M	S	S	M	S	S	M	M	S	M	S
CO3	S	M	S	M	S	M	S	S	M	S	M	S	S
CO4	M	S	S	S	M	S	M	S	S	S	S	S	M
CO5	S	M	M	S	M	S	M	M	M	M	M	M	S

Strongly Correlating (S) - 3 marks Moderately Correlating (M) - 2 marks
 Weakly Correlating (W) - 1 mark No Correlation (N) - 0 mark

Course Code	P21BOP33	PRACTICAL- PLANT PHYSIOLOGY & BIOCHEMISTRY, PLANT MOLECULAR BIOLOGY & PLANT BIOTECHNOLOGY	L	T	P	C
CORE-XVI				-	-	6
Cognitive Level	K2: Understand K3: Apply					
Learning objective	<ul style="list-style-type: none"> To understand the basic principles and protocols of Biochemistry techniques To gain the skill on molecular biology experiments To learn the tissue culture techniques 					
Experiments on						
<u>Plant Physiology</u>						
<ol style="list-style-type: none"> Determination of water potential in different tissues. Determination of chlorophyll-a, chlorophyll-b and total chlorophyll by the Arnon's method. Determination of carotenoids. 						
<u>Biochemistry</u>						
Quantitative Analysis						
<ol style="list-style-type: none"> Total free amino acids (Ninhydrin reagent method) Total soluble carbohydrates (Anthrone reagent method) Total phenolics Protein extraction from plant material seeds-purification. Separation of proteins by Electrophoresis (PAGE). 						
<u>Plant Molecular biology</u>						
<ol style="list-style-type: none"> Isolation of Plant-DNA Electrophoretic separation of DNA Agarose-gel electrophoresis-AGE Quantitative Estimation of DNA Quantitative Estimation of RNA 						
<u>Plant Biotechnology</u>						
<ol style="list-style-type: none"> Sterilization and inoculation of various explants in media Demonstration of Anther culture experiment 						
Reference						
<ol style="list-style-type: none"> Vargas.V. M. L, Plant Cell Culture Protocols 4th Edition, Publisher Springer. 2018. Madhavi Adhav. Practical Book of Biotechnology & Plant Tissue Culture.Publisher Chand,2010. Turksen, Kursad. Genome Editing. Publisher Springer.2016. Damodaran Geetha K. Practical Biochemistry. Jaypee Brothers Medical Publishers,2016. Gupta Prem Prakash. Essentials Of Practical Biochemistry. Jaypee Brothers Medical Publishers,2017. Advances in Molecular Techniques: Rakesh S. Sengar, Amit Kumar, Reshu Chaudhary, Ashu Singh, CRC Press, 1st Edition, 2018. Ralph Rapley, David White. House Molecular Biology and Biotechnology, Publisher Royal Society of Chemistry.2021 						

Course outcome	Upon completion of this course, the students will be able to		
	CO	Course Outcomes	Knowledge Level
	CO1	practice determination of chlorophyll-a, chlorophyll-b and total chlorophyll by the Arnon's method.	K2,K3
	CO2	experiment on the separation of proteins by Electrophoresis (PAGE).	K3
	CO3	perform the quantitative estimation of RNA	K3
	CO4	Gain hands on skill in sterilization and inoculation of various explants	K3
CO5	get practical knowledge on another culture	K2	

Mapping of COs with POs & PSOs:

CO	Pos								PSOs				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	M	S	S	S	M	S	M	S	S	S	S	S
CO2	M	S	S	M	S	M	M	M	S	S	M	S	S
CO3	S	M	S	M	S	S	M	S	S	S	S	S	S
CO4	M	M	S	S	M	S	M	M	S	S	M	S	M
CO5	S	S	S	S	S	M	S	S	S	M	S	S	S

Strongly Correlating (S) - 3 marks

Weakly Correlating (W) - 1 mark

Moderately Correlating (M) - 2 marks

No Correlation (N) - 0 mark

Course Code	P21WSS33	WOMEN EMPOWERMENT			L	T	P	C
SUPPORTIVE COURSE- III					2	-	-	2
Cognitive Level	K2: Understand		K3: Apply		K5:Analyse			
Learning objective	<ul style="list-style-type: none"> To know the objectives, types, determinants of women Empowerment. To learn the various national and international agencies for women empowerment. To uplift women socially, economically and politically as empowered. To make the students aware of women rights and enhance their life To be aware of women entrepreneurship development in India 							
Unit I	Fundamentals of Women's Studies							
<p>Meaning and Definition of the concept of Women's studies - Need and Scope - Women's studies as an academic discipline - Women's Studies – theories and Achievements- International Women's Year 1975 - International Women's Decade 1975 -1985; Towards Equal Status 1976 – Current trends-Importance of women's education – Efforts of various Committees –Life Skill Education to build capacity - Education as a tool of Women Empowerment - Obstacles to Women Education – Social, Economic, Cultural and other factors, limitations of Formal system of education-Role of educational institutions, Parents and Community</p>								
Unit II	Issues of Women							
<p>Girl Children and Women in Society: Social Networking- Influencing factors of Social Networking-Types of Social Networking- impact and consequences of networking- Remedial measures and strategies for solution- NCW: Initiatives to overcome Women's issues - Ministry of Home Affairs and Networking with State Women Commissions: Cyber Crime Prevention against Women and Children (CCPWC)-challenges - efforts & effective measures to prevent crime against women and children - create awareness for social issues. Motherhood - Single Parent - Widows – Multiple Roles of Women - Role conflict, Role change - Social Responsibility and Gender Empowerment</p>								
Unit III	Achievement and Rights of Women							
<p>Gender Equality: Achievement of Women - Educational, Political, Economic, Social - Panchayat Raj - Political role and participation - National and International Levels; Women's Rights - Property Rights - Redressal mechanism at different levels - Rights of Women with Disability: Case Studies on Women Achievers in the field of politics, education, arts science, law etc.</p>								
Unit IV	Empowerment of Women							
<p>Empowerment of Women: Alternative approaches - Women in Development (WID) - Women and Development (WAD) - Women's Development- Definition, Meaning and Scope, Gender and Development (GAD), Human Development Index (HDI) vs Gender Development Index (GDI). Types of Empowerment: Social, Educational, Political, Economical, Legal to Holistic levels-Role of Govt. and NGOs - Help line numbers in promoting women's empowerment - National and International Funding Agencies in promoting research on women.</p>								
Unit V	Women Entrepreneurship							
<p>Women Entrepreneurship:- Types of Entrepreneurs Opportunities and Risk – Push and Pull Factors –financial Assistance and credit facilities-Micro finance- Entrepreneurship Skill and Competencies - Women Entrepreneurship Development in India: TRYSEM – NABARD – NMEW - Support to STEP – TREAD – Rural Entrepreneurship Development Programme –</p>								

Gramia Bank –Mahila bank and supportive measures- Industrial Development Bank of India (IDBI) – Small Industries Development Bank of India-SHG and Entrepreneurship opportunities

Text Books

1. Rani Sandhya, “Development of Women – Issues and Challenges”, Discover Publishing House Pvt Ltd, New Delhi, 2012.
2. Anil Kumar Jha, “Gender Inequality and Women Empowerment”, Axis Books, New Delhi, 2012.
3. Nandal Santosh , “Women and Development”, A Mittal Publications, New Delhi, 2012

Reference Books

1. Rao Pulla, “Political Empowerment of Women in India – Challenges and Strategies”, ABD Publishers, New Delhi, 2012.
2. Jenny Edwards, Andrea Cornwall, et al., “Feminisms, Empowerment and Development: Changing Women’s Lives”, Kindle Edition, 2014.
3. Elson Diane, et al. “Gender Equality and Inclusive Growth: Economic Policies to Achieve Sustainable Development”, UN Women, 2019
4. Priyanka Sharma Gurnani, “Women Entrepreneurship – Emerging Dimension of Entrepreneurship in India” Educreation Publishing House, New Delhi, 2016

E- Reference links

1. <https://asiapacific.unwomen.org/en/focus-areas/governance/political-participation-of-women>

Upon completion of this course, the students will be able to

CO	Course Outcomes	Knowledge Level
CO1	gain knowledge about the concept, need and scope of women’s studies	K2
CO2	acquaint and analyze the issues of women in various contexts	K5
CO3	understand the changing role of women in society and issues related to it	K2
CO4	understand the importance of women's education.	K2
CO5	comprehend empowerment of women and their achievement	K3

Mapping of COs with POs & PSOs:

CO	Pos								PSOs				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	M	S	S	S	S	S	M	M	M	M	S	S	S
CO2	S	M	S	S	S	M	M	M	S	S	S	M	S
CO3	M	M	M	S	M	M	S	S	M	M	M	S	S
CO4	S	M	M	S	M	M	S	S	S	S	S	S	M
CO5	M	S	M	S	S	S	M	M	M	M	M	S	S

Strongly Correlating (S) - 3 marks Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark No Correlation (N) - 0 mark

SEMESTER-IV

Course Code	P21BOE411	CHOICE-1			L	T	P	C
ELECTIVE:I		FOOD PRESERVATION AND PROCESSING			4	-	-	4
Cognitive Level	K1: Recall	K2: Understand	K3: Apply					
Learning objective	<ul style="list-style-type: none"> To understand the general principles of preservation To know the principles of food freezing To comprehend the processing of food and its importance To learn the large-scale food processing technology 							
Unit I	Food preservation							
General principles of preservation - classification of methods used for preservation - need and importance of preservation at domestic and large scale - Causes of food spoilage; nature of harvested crop, plant and animal – moisture, pH and water activity of foods								
Unit II	Food spoilage mechanism							
Microbial contamination; Bacteria, fungi – Control of microbial contamination - Chemical deterioration – Enzymatic reactions – Enzymes that causes food spoilage – Autoxidation – Maillard reaction – Light-induced reactions - Low temperature preservation – Refrigeration – Freezing – The freezing process – Industrial freezers – Quality of frozen foods – Thermal processing – Canning; Presterilization procedures, Sterilization, Quality of canned food								
Unit III	Fermented food & preservation							
Blanching – Controlling water activity – Dehydration – Fermentation and pickling – Pickled fruits and vegetables, pickled meat – Deterioration of fermented and pickled products – Chemical preservation: Organic chemical preservatives, inorganic chemical preservatives – Food irradiation – Biological effects of irradiation; positive effects, negative effects, safety concerns – food packaging and storage								
Unit IV	Methods of food handling and storage							
Nature of harvested crop, plant and animal; storage of raw materials and products using low temperature, refrigerated gas storage of foods, gas packed refrigerated foods, sub atmospheric storage, gas atmospheric storage of meat, grains, seeds and flour, roots and tubers; freezing of raw and processed foods.								
Unit V	Large-scale food processing							
Milling of grains and pulses; edible oil extraction; Pasteurisation of milk and yoghurt; canning and bottling of foods; drying – Traditional and modern methods of drying, dehydration of fruits, vegetables, milk, animal products etc.; preservation by use of acid, sugar and salt; Pickling and curing with microorganisms, use of salt, and microbial fermentation; frying, baking, extrusion cooking, snack food.								
Text books								
<ol style="list-style-type: none"> Subbulakshmi, G., and Shobha A. Udipi “Food Processing and Preservation”.New Age Publications. 2006. HUi, Y.H. “Handbook of Vegetable Preservation and Processing”. Marcel Dekker. 2003. Karnal, Marcus and D.B. Lund “Physical Principles of Food Preservation”. Rutledge.2003. 								

References Books

1. Gould, G.W. "New Methods in Food Preservation". Springer, 1995.
2. VanGarde, S.J. and Woodburn. M "Food Preservation and Safety Principles and Practice". Surbhi Publications, 2001.
3. Sivasankar, B. "Food Processing & Preservation", Prentice Hall of India, 2002.
4. Khetarpaul, Neelam, "Food Processing and Preservation", Daya Publications, 2005.

E-Reference links

1. <http://www.cold.org.gr/library/downloads/Docs/Handbook%20of%20Food%20Preservation.PDF>
2. https://www.researchgate.net/publication/270099729_Handbook_of_Food_Preservation/link/549fe1990cf257a635fe8afe/download

Course outcome	Upon completion of this course, the students will be able to		
	CO	Course Outcomes	Knowledge Level
	CO1	learn the need and importance of preservation	K1,K2
	CO2	understand various microbial contamination in food	K2
	CO3	learn the deterioration of fermented and pickled food products	K1
	CO4	use the methods of food handling and storage	K3
	CO5	understand the pasteurisation of milk and yoghurt	K2

Mapping of COs with POs & PSOs:

CO	Pos								PSOs				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	M	S	S	S	M	S	M	S	S	S	S	S	S
CO2	M	M	S	M	S	M	S	S	S	S	S	M	S
CO3	S	S	M	S	S	M	S	M	S	S	M	S	S
CO4	S	M	S	S	M	S	S	S	S	S	S	S	M
CO5	M	S	M	M	S	M	M	M	S	M	M	S	S

Strongly Correlating (S) - 3 marks Moderately Correlating (M) - 2 marks
 Weakly Correlating (W) - 1 mark No Correlation (N) - 0 mark

Course Code	P21BOE412	CHOICE-2	L	T	P	C
ELECTIVE :I		INDUSTRIAL MICROBIOLOGY	4	-	-	4
Cognitive Level	K1: Recall K3: Apply	K2: Understand K4: Evaluate				
Learning objective	<ul style="list-style-type: none"> To identify the importance of microbes, fermenter design and types To know the uses of microbes in bio-conservation technology To gain knowledge about production methods and recovery of the fermented products 					
Unit I	Concept of Industrial Microbiology					
Introduction and scope of Industrial microbiology - Role of Microbial diversity (Bacteria, Fungi, Algae, Viruses and protozoa) in industrial production - Growth and Reproduction of Microbes - Role of Microorganisms in Industrial production.						
Unit II	Microorganisms in industry					
Sterilization - preparation of media - isolation methods for microorganisms - culture and preservation and stability - Principles and methods of storage of microbes, preparation of inoculum - Techniques of maintaining pure culture and preservation.						
Unit III	Fermentation					
Principals and types and fermentation - fermentor design - configuration of various types of fermenter - difference between biochemical and chemical processes - biochemical reactions, operational consideration - Types of fermenters - principle of operation characteristics of fermenters - batch fermentation vs continuous fermentation - Fermentation of Meat, vegetables, pickles, olives and sauce.						
Unit IV	Microbial industrial Products					
Industrial production of enzymes (cellulase, amylase and protease), amino acids (glutamic acid and L-Lysine), and organic acids (lactic acid and citric acid) - Microbial Food production (single cell protein) - Production of Dairy products, alcoholic beverages - beer, distilled liquors and wines.						
Unit V	Pharmaceutical production					
Production of vitamins, Enzymes, Antibiotics (penicillin, streptomycin, erythromycin, cephalosporin and griseofulvin), Steroids, Vaccines, human proteins - Mode of action of antibiotics (penicillin, streptomycin, erythromycin and cephalosporin).						
Text books						
<ol style="list-style-type: none"> Joshi, R.D. Text Book of Industrial Microbiology. Oxford, Delhi. 3 Kanungo, R. 2017. Ananthanarayan and Paniker's Textbook of Microbiology.10th ed. Universities Press, Hyderabad, India. 2017. Davis, B.D., Dulbecco, R., Eiser, H.N. and Grinsberh, H.S. Microbiology. Harber Row, New York. 1980. Matthews, K.R., Montville, T. J. and Kniel, K. E. Food Microbiology: An Introduction. ASM Press, Washington. 2017 						
References Books						
<ol style="list-style-type: none"> Moat, A.G. and Foster, J.W.. Microbial Physiology. John Wiley & Sons Inc., New York. 1988. Patel, A.H.. Industrial Microbiology. Macmillan India Ltd., New Delhi. 1999. Pelczar, M.H. and Cahn, E.C.S.. Microbiology. Tata-McGraw Hill Publishing Co. Ltd., New Delhi. 1993. Pommervi, J.C. Fundamentals of Microbiology (11th ed.). Jones & Bartlett Learning, 						

USA. 2018.

5. Vasanthakumari, R. Textbook of Microbiology. 3rd Edition, Wolters Kluwer (India) Pvt., Ltd., Gurgaon. 2016.

E- Reference links

1. <https://sciencing.com/role-microbes-industry-8044034.html>
2. http://lcwu.edu.pk/ocd/cfiles/Biotechnology/Maj/Biotech-402/Industrial-Microbiology-An-Introduction-0632053070-Wiley_compressed.pdf

Course outcome	Upon completion of this course, the students will be able to		
	CO	Course Outcomes	Knowledge Level
	CO1	understand the scope of industrial microbiology	K2
	CO2	learn the culture and preservation of microbes	K2
	CO3	apply the knowledge for designing fermentation and fermentor design	K3
	CO4	learn about the uses of microorganisms in industrial production of enzymes	K1
	CO5	learn and analyse the mode of action of antibiotics	K2

Mapping of COs with POs & PSOs:

CO	Pos								PSOs				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	M	S	S	M	M	M	M	S	S	M	S	S	S
CO2	M	S	M	S	S	S	M	S	M	S	S	S	S
CO3	S	M	M	M	S	S	M	M	S	M	S	S	S
CO4	S	M	S	S	M	M	S	M	S	S	S	S	M
CO5	S	S	M	S	S	S	S	M	S	M	S	S	S

Strongly Correlating (S) - 3 marks Moderately Correlating (M) - 2 marks
 Weakly Correlating (W) - 1 mark No Correlation (N) - 0 mark

Course Code	P21BOE421	CHOICE-1	L	T	P	C
ELECTIVE:II		MYCOLOGY	4	-	-	4
Cognitive Level	K1: Recall K3: Apply	K2: Understand K4: Evaluate				
Learning objective	<ul style="list-style-type: none"> To know about the structure and reproduction of fungi To be aware of lichens morphology and importance To comprehend the industrial uses of fungi in fermentation technology To gain knowledge on plant diseases caused by fungi. 					
Unit I	Mycology (Study of fungi)					
General mycology- Characteristics of fungi- Classification of fungi – Morphological classification of fungi – Systematic classification of fungi – Pathological classification of fungi – Biological taxonomy according to Strassburger						
Unit II	Distribution & Reproduction of Fungi					
Distribution, structural variation in fungi - development, modes of reproduction, patterns of life cycle in fungi - Specialized mycology – Dermatophytes – <i>Tinea pedis</i> , <i>Tinea favosa</i> , <i>Tinea capitis</i> - Careers in mycology						
Unit III	Lichen					
A general account of lichens - Structure, nutrition; reproduction, classification and economic importance of lichens. Mycorrhizae – Ectomycorrhizae, AM fungi & its use in agriculture						
Unit IV	Fungal Biotechnology					
Industrial uses of fungi in fermentation technology, enzyme production, Citric acid production. Commercial exploitation of fungal metabolites						
Unit V	Fungal plant diseases					
A general account of plant diseases caused by fungi. Causes, symptoms and identification of plant diseases. Host – parasite interaction - Defense mechanism in plants						
Text books						
<ol style="list-style-type: none"> A. V. S. S. Sambamurty, Textbook of Plant Pathology, Wiley publisher, 2011 Stefan Buczacki, Keith Harris, Pests, Diseases and Disorders of Garden Plants : 4th Edition, Publisher HarperCollins Publishers. 2014. 						
References Books						
<ol style="list-style-type: none"> Anne Marte Tronsmo, David B Collinge, Annika Djurle, Lisa Munk, Jonathan Yuen, Arne Tronsmo, Plant Pathology and Plant Diseases, CABI Publishing. 2020. Mechotra, R.S. Plant pathology. Tata McGraw Hill Publishing Company Ltd, New Delhi. 1990. 						
E-Reference						
<ol style="list-style-type: none"> https://link.springer.com/chapter/10.1007/978-981-13-0393- https://www.austincc.edu/ddingley/MLAB1331/LectureGuide/Mycology.pdf http://www1.mans.edu.eg/FacMed/dept/microbiology/pdf/10-Mycology.pdf https://www.microrao.com/micronotes/mycology.pdf 						

Course outcome	Upon completion of this course, the students will be able to		
	CO	Course Outcomes	Knowledge Level
	CO1	understand the biological taxonomy of fungi	K2
	CO2	know and to make use of the careers in mycological studies	K2
	CO3	apply AM fungi as bio-fertilizer	K3
	CO4	understand the commercial exploitation of fungal metabolites	K2
CO5	analyze the host parasite interaction mechanism	K1	

Mapping of COs with POs & PSOs:

CO	Pos								PSOs				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	M	S	S	M	M	M	S	M	M	S	S	M	M
CO2	S	M	M	S	S	M	S	M	S	S	M	S	S
CO3	M	S	S	M	S	S	S	S	M	S	S	M	S
CO4	S	M	M	S	M	S	M	S	S	S	M	S	M
CO5	S	S	S	S	S	S	M	M	S	M	S	S	S

Strongly Correlating (S) - 3 marks
 Weakly Correlating (W) - 1 mark

Moderately Correlating (M) - 2 marks
 No Correlation (N) - 0 mark

Course Code	P21BOE422	CHOICE-2	L	T	P	C
ELECTIVE:II		BIOFERTILIZER AND ORGANIC FARMING	4	-	-	4
Cognitive Level	K1: Recall K2: Understand K3: Apply K4: Evaluate					
Learning objective	<ul style="list-style-type: none"> To understand the classification of Bio-fertilizers To acquire knowledge on organic farming To know about benefits of green manuring 					
Unit I	Classification of Biofertilisers					
Introduction and classification of Biofertilizers –Microbes used as bio-fertilizer –Symbiotic N2Fixers: Rhizobium, isolation of green algae from azolla, application –large scale production.						
Unit II	Production of Biofertiliser					
Isolation, identification, large scale production, crop response, and field application of <i>Azospirillum</i> , <i>Azotobacter</i> , <i>Clostridium</i> , <i>Klebsiella</i> and <i>Anabaena</i> . Phosphate solubilizers: Isolation, characterization, mass inoculums production, field application of <i>Bacillus firmus</i> and <i>Pseudomonas</i> -Phosphate solubilisation mechanism.						
Unit III	Mycorrhizae					
Introduction, scope and general account on mycorrhizae –Classification- Ecto and Endo mycorrhizae. Method of Collection and isolation (Wed sieving and decanting method) – Culture of mycorrhizae in Modified Melin-Norkrans (MMN)-Field application of Ecto and Endo mycorrhizae.						
Unit IV	Organic farming					
Introduction, concept and development. Principle and types, benefits, conventional farming v/s organic farming. Requirements for organic farming: farm components						
Unit V	Organic manures					
Green manuring, composting- principles, stages, types and factors, composting methods, vermicomposting. Chemical fertilizers- types, methods of application, advantages and disadvantages, standards for organic inputs- fertilizer						
Text Books						
<ol style="list-style-type: none"> N.S. Subba Rao – Soil Microorganisms and Plant growth.1995 N.S. Subba Rao – Biofertilizers.2001 Alexander 1977- Introduction to soil microorganisms and plant growth. 						
Reference Books						
<ol style="list-style-type: none"> Tanuja S, S Purohit Singh. Biofertilizer Technology.Publisher BIO-GREEN Books,2018. Amit Kumar Jain. Organic Farming Scope and Uses of Biofertilizers. Publisher : New India Publishing Agency,2016. Bikas R. Pati, Santi M..Mandal. Recent Trends in Biofertilizers. I K International Publishing House,2016 Keshav Singh. Vermicompost: Vermiwash and Biopesticides,Publisher Biotech Books,2014. 						
E Reference links						
<ol style="list-style-type: none"> https://www.google.com/search?q=Rhizobium%2C+Isolation+of+Blue+green+algae+from+Azolla%2C+application+%E2%80%93large+scale+production.&aq=chrome..69i57.2538j0j15&sourceid=chrome&ie=UTF-8 https://books.google.co.in/books/about/The_Complete_Technology_Book_On_Bio_Fert.html?id=ID1u7mzd-nUC 						

https://www.k-3.https://www.k-state.edu/fungi/Greeting/Publications_files/2006%20Handbook.pdf

Course outcome	Upon completion of this course, the students will be able to		
	CO	Course Outcomes	Knowledge Level
	CO1	understand the symbiotic N ₂ fixers	K1
	CO2	gain adequate knowledge on phosphate solubilisation mechanism.	K1
	CO3	understand the method of collection and isolation of mycorrhizae	K4
	CO4	learn the concept and development of organic farming	K3
	CO5	understand the types and methods of composting	K2

Mapping of COs with POs & PSOs:

CO	Pos								PSOs					
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	M	S	M	S	S	M	S	S	S	S	S	S	S	S
CO2	S	M	S	M	S	M	S	M	S	S	S	S	S	S
CO3	M	S	M	S	S	S	M	M	S	S	S	S	S	S
CO4	S	S	S	M	M	M	S	S	S	S	S	S	S	M
CO5	M	M	S	M	S	S	M	S	S	M	S	S	S	S

Strongly Correlating (S) - 3 marks

Weakly Correlating (W) - 1 mark

Moderately Correlating (M) - 2 marks

No Correlation (N) - 0 mark

Course Code	P21BOR41	MAJOR PROJECT	L	T	P	C
					22	8

All the candidates of M.Sc (Botany) are required to undergo a Major project and submit the following: **22 hours**

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

Project Evaluation Guidelines.

The project is evaluated on the basis of following heads:

Presentation - 25% of total marks

Viva - 20% of total marks.

Thesis/ Dissertation - 30% of total marks.

Learning outcome: Empowering students to carryout individual research projects.

NON MAJOR ELECTIVES

Course Code	P21BON211	HERBAL SCIENCE			L	T	P	C
NON MAJOR ELECTIVE:I					4	-	-	4
Cognitive Level	K1: Recall K2: Understand K3: Apply							
Learning objective	<ul style="list-style-type: none"> • To understand the comprehensive overview of the basic principles, methodologies, and the usage of medicinal plants. • To gain knowledge on the usage of medicinal plants by various types of people • To contribute and to process the medicinal plants in India. 							
Unit I	Herbal medicines							
Concept, importance, history and scope - Indian medicinal system– Siddha, Ayurveda and Unani systems - Aroma therapy and cosmetology.								
Unit II	Indian syatem of Medicine							
Scope of Indian system of medicine compared with homeopathy and allopathic system of medicine - Indian Pharmacopoeia, traditionally used medicinal plants in India (<i>Justicia adatoda</i> , <i>Ocimum tenuiflorum</i> , <i>Nigella sativa</i> , <i>Piper nigrum</i> , <i>Lawsonia inermis</i> , <i>Cinnamomum verum</i> , <i>Phyllanthus embilica</i> , <i>Curcuma longa</i> , <i>Cinchona officinalis</i> , <i>Thymus vulgaris</i>) and their uses - Importance of sacred grooves and ethanomedicinal importance of any five sacred plants of India (Peepal, Banayan, Sandal wood, Bale and Neem)								
Unit III	Biogeographical Zone							
Different biogeographical zones in India, Eco distribution of Indian medicinal plants - Trade value and record of Indian medicinal drugs, medicinal Plants demand and supply, major importing countries and regions.								
Unit IV	Medicinal Plants							
Industrial contribution for the use of medicinal plants - methods of processing medicinal plants, constraints associated with medicinal plants; process technology [modern and traditional], value added products - Indian drugs preparation - General methods of extraction, isolation and purification of phyto-constituents.								
Unit V	Herbal plant protection & quality control							
Protection of plant varieties bill [PPV bill] - Role of plant quarantine centers - Quality Control and Quality Assurance of Herbal ingredients as per W.H.O.Guidelines - Methods involved in monoherbal and polyherbal formulations with their merits and demerits								
Text Books								
<ol style="list-style-type: none"> 1. Pullaiah, T. Medicinal plants in India. Regency Publications, New Delhi 2005. 2. Joshi, S.G. Medicinal Plants. Oxford and IBH publishing company Pvt.Ltd., New Delhi. 2000. 								
References Books								
<ol style="list-style-type: none"> 1. Pal, D.C. and Jain, S.K. Tribal Medicine, NayaProkash, Calcutta. 1998. 2. Rastogi, R.P. and Mehrotra, B. M. Compendium of Indian Medicinal Plants Vol. 1. Central Drug Research Institute, Lucknow, Publications and Information Directorate, New Delhi.2008. 3. Sharma, O.P. Hill's Economic Botany. Tata McGraw Hill Publishing 4. Company Ltd.,New Delhi. 1996. 5. Singh, R. Vedic Medicine, Anmol Publications Pvt. Ltd, New Delhi. 1998. 								

E-Reference links

https://read.oecd-ilibrary.org/commonwealth/trade/a-guide-to-the-european-market-for-medicinal-plants-and-extracts/processing-of-medicinal-plants_9781848597389-10-en#page3

Course outcome	Upon completion of this course, the students will be able to		
	CO	Course Outcomes	Knowledge Level
	CO1	know the concept and importance of herbal medicines	K3
	CO2	get knowledge on traditionally used medicinal plants in India	K1
	CO3	understand the ecological distribution of medicinal plants in India	K2
	CO4	process the industrial contribution for the use of medicinal plants	K2
	CO5	learn the methods which are used for the preparation of different formulations	K2

Mapping of COs with POs & PSOs:

CO	POs								PSOs				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	M	S	M	M	M	M	M	M	M	S	S	S	S
CO2	M	M	S	S	S	M	M	S	M	M	M	S	S
CO3	M	S	S	M	S	M	M	S	S	S	S	S	S
CO4	S	M	M	S	M	S	S	M	M	S	M	S	M
CO5	S	M	M	M	S	S	S	M	S	M	M	S	S

Strongly Correlating (S) - 3 marks Moderately Correlating (M) - 2 marks
 Weakly Correlating (W) - 1 mark No Correlation (N) - 0 mark

Course Code	P21BON212	ECONOMIC BOTANY			L	T	P	C
NON MAJOR ELECTIVE:2					4	-	-	4
Cognitive Level	K1: Recall		K2: Understand	K3: Apply				
Learning objective	<ul style="list-style-type: none"> To know the uses of cereals, pulses, plantation crops To learn the uses of medicinal plant, vegetables and fruits To gain the knowledge on the uses of timber yielding and drug yielding plants 							
Unit I	Detailed study of the Botanical name, family, morphology of the useful part and uses of the following crop plants a) Cereals and Crops: Wheat, Barley, Oats, Rye, Millets, Rice, Maize and Ragi b) Pulses: Soybean, Horse gram, c) Sugar yielding plants: Sugarcane d) Plantation crops: Coconut, Cocoa, Coffee, Tea and Rubber.							
Unit II	Detailed study of the Botanical name, family, morphology of the useful part and uses of the following crop plants e) Spices and condiments: Pepper, Ginger, Turmeric, Cardamom and Nutmeg. f) Tuber crops : Potato, Sweet potato, Taro and Tapioca g) Fiber yielding plants : Jute, Cotton, Coconut, and Sisal Hemp							
Unit III	Detailed study of the Botanical name, family, morphology of the useful part and uses of the following crop plants i) Medicinal plants: Sarpagandha, <i>Vinca</i> , <i>Glycyrrhiza</i> , <i>Adhatoda</i> and <i>Andrographis</i> . j) Drugs yielding plants: Cannabis, Opium. k) Timber yielding plants: Rose wood, Teak Wood.							
Unit IV	Detailed study of the Botanical name, family, morphology of the useful part and uses of the following fruits and vegetable crops l) Fruits and Nuts: Citrus, Apple, Mango, Bananas, Pineapple, Date Palms, Grapevine, Avacado, Cashew, Chestnuts, Walnut, Almond m) Vegetables: Potato, Irish Potato, Sweet Potato Cassava, Yams, Onion, Garlic, Ajo, Beetroot, Turnips.							
Unit V	Detailed study of the Botanical name, family, morphology of the useful part and uses of the following fruits and vegetable oils and fats Legumes or Pulses: Pigeon Pea, Red Gram, Chickpea, Bengal Gram, Cluster bean, Beans, Pea Vegetable Oils and Fats: Groundnut, Rape seeds, Coconut, Olive, Oil Palm, Castor, Sesame, Soya Bean							
Text books								
1. Rashtra Vardhana. Economic Botany. <i>Sarup Book Publishers Pvt. Ltd., New Delhi</i> , First Edn. 2009. 2. S.L. Kochhar. Economic Botany, Cambridge University Press, India. 2016. 3. Hill, A.F. Economic Botany; A Textbook of Useful Plants and Plant Products. <i>McGraw-Hill Book co., Inc., New York</i> , Second Edn. 1952.								
References Books								

1. Thompson, H.C. Vegetable Crops. *McGraw- Hill Book co., Inc., New York*, Fourth Edn. 1949.
2. Wallis, T.E. Text book of Pharmacognosy. *J. &A. Churchill Ltd., London*, 1946.
3. Pandey, B.P. Economic Botany, *S. Chand & Company Ltd. New Delhi*. Fourth Edn. 1990.

E-Reference links

1. <https://chembioagro.springeropen.com/articles/10.1186/s40538-016-0085-1>

Course outcome	Upon completion of this course, the students will be able to		
	CO	Course Outcomes	Knowledge Level
	CO1	acquire knowledge on morphology of useful part and uses of selected cereals and pulses	K1
	CO2	be aware of the botanical name and the uses of selected spices, tuber crops and fibre yielding plants	K2
	CO3	explain the uses of selected medicinal plants and its botanical name	K2
	CO4	recognize the botanical name and useful part of selected species of fruits, nuts and vegetables	K3
	CO5	understand the uses of pulses and vegetable oils	K2

Mapping of COs with POs & PSOs:

CO	Pos								PSOs				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	M	M	M	S	M	S	S	M	S	S	S	S	S
CO2	S	S	S	M	S	M	S	M	S	S	S	S	S
CO3	M	M	M	S	S	M	M	S	S	S	S	S	S
CO4	M	S	S	M	M	S	S	S	S	S	S	S	M
CO5	S	S	M	S	S	S	M	S	S	M	S	S	S

Strongly Correlating (S) - 3 marks Moderately Correlating (M) - 2 marks
 Weakly Correlating (W) - 1 mark No Correlation (N) - 0 mark

VALUE ADDED PROGRAM

Course Code	P21BOV41	HYDROPONICS CULTURE			L	T	P	C
Value added Course-1					30			2
Cognitive Level	K1: Recall K3: Apply	K2: Understand K4: Evaluate						
Learning objective	<ul style="list-style-type: none"> • To know about the techniques of hydroponics system • To understand about the solid media culture • To learn the hydroponics setup 							
Unit I	Hydroponics							
The techniques of hydroponics system: Circulating methods: Nutrient film technique, Deep flow technique - Non-circulating methods: Root dipping technique, Floating technique, Capillary action technique								
Unit II	Solid media culture							
Hanging bag technique, Grow bag technique, Trench or trough technique, Pot technique; Aeroponics: Root mist technique, Fog feed technique								
Unit III	Hydroponics setup							
infrastructure facilities required; hydroponics substrates-organic and inorganic; nutrient solutions-nutrients, water, filtration and treatments; management of nutrient solutions-temperature, pH, conductivity and change of solution								
Unit IV	Hydroponics plantation							
A step by step guide to hydroponics plantations-examples tomato, greens, any one of the fodders, any one of the medicinal plants any one of the flowers; good agricultural practices (GAP) and integrated pest management (IPM) for hydroponics cultivation technology								
Unit V	Harvesting and Marketing							
Harvesting, grading, storage and marketing process of crops grown under hydroponics system-global hydroponic market and commercial hydroponic production								
Text books								
<ol style="list-style-type: none"> 1. Winterborne, J. Hydroponics: indoor horticulture. Pukka Press.UK. 2005. 2. Asao, T. Hydroponics: A Standard Methodology for Plant Biological Researches. IntechOpen, UK. 2012 								
References Books								
<ol style="list-style-type: none"> 1. Hasan, M., Sabir, N., Singh, A.K., Singh, M.C., Patel, N., Khanna, M., Rai, T Pragnya,Hydroponics Technology for Horticultural Crops, Tech. Bull. TB-ICN 188/2018.Publ. by I.A.R.I., New Delhi, India. 2018. 2. Tripp, T. Hydroponics advantages and disadvantages: pros and cons of having a hydroponic garden. Speedy Publishing LLC.US. 2014. 3. Texier, W. Hydroponics for everybody, Mama publishing, France. 2016. 								
E-Reference links								
<ol style="list-style-type: none"> 1. https://www.gardeningknowhow.com/special/containers/basic-hydroponic-equipment.htm 2. https://www.especmic.co.jp/download/pdf/ENG_HYDROPONIC%20SYSTEM.pdf 3. http://adams.colostate.edu/hort/docs/Intro_Hydroponics.pdf 								

Course outcome	Upon completion of this course, the students will be able to		
	CO	Course Outcomes	Knowledge Level
	CO1	understand the various techniques of hydroponics	K4
	CO2	learn about solid media culture	K1
	CO3	set up hydroponics with proper infrastructure	K4
	CO4	explain hydroponics cultivation technology	K3
	CO5	apply the knowledge of harvesting, grading, storage and marketing process of crops grown under hydroponics system	K2

Mapping of COs with POs & PSOs:

CO	Pos								PSOs					
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	M	M	S	S	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO3	M	M	S	S	S	S	M	S	S	S	S	S	S	S
CO4	S	S	S	S	M	M	M	M	S	S	S	S	S	M
CO5	M	M	S	S	S	M	M	M	S	M	S	S	S	S

Strongly Correlating (S) - 3 marks Moderately Correlating (M) - 2 marks
 Weakly Correlating (W) - 1 mark No Correlation (N) - 0 mark

Course Code	P21BOV41	INDIAN SYSTEM OF MEDICINE		L	T	P	C
Value added Course-2				30		2	
Cognitive Level		K1: Recall K2: Understand					
Learning objective		<ul style="list-style-type: none"> • To know the Ayurvedic System of Medicine • To learn about Siddha System of Medicine • To comprehend Unani System of Medicine • To be aware of the tribal medicine 					
Unit I	Ayurvedic System of Medicine						
Introduction to various systems of Indigenous medicine. History and Development of Ayurvedic medicine. Principles and Concepts of Ayurveda. Methods of preparation of Ayurvedic medicines. Merits and demerits of Ayurvedic medicine							
Unit II	Siddha System of Medicine						
History and Development of Siddha medicine Principles and concepts of Siddha systems of medicine. Method of preparation of Siddha medicines. Merits and demerits of Siddha medicine							
Unit III	Unani System of Medicine						
Principles and Concepts of Unani systems of medicine. Introduction to different dosage forms and method of preparations of Unani medicines. Merits and demerits of Unani system. Merits and demerits of Unani system							
Unit IV	Homeopathy System of Medicines						
History, Origin and development of Homeopathy. Fundamentals, concepts and principles of Homeopathy. Method of preparation of Homeopathic medicines. Merits and demerits of Homeopathy medicines.							
Unit V	Tribal medicine						
Principles, Importance, Merits and Demerits of Tribal Medicines. Complimentary Medicines- Medicinal sources - Herbal sources, Mineral sources and their collection, purification and processing.							
Text books							
<ol style="list-style-type: none"> 1. Ayurvedic Formulary of India, the Indian Medical Practitioners Co-operative Pharmacy and Stores Ltd, IMPCOPS. 2. Hand Book on Ayurvedic Medicines, H.Panda National Institute of Industrial Research, Delhi-2017. 3. Ayurvedic system of medicine, 2nd edition, Kaviraj, Nagendranath Sengupata, vol. I & II. 2005 							
References Books							
<ol style="list-style-type: none"> 1. Indian Herbal Pharmacopoeia vol. I & II Indian Drug Manufacturer's association, Mumbai. 2006 2. British Herbal Pharmacopoeia British Herbal Medicine Association. vol. I. 1990 3. GMP for Botanicals - Regulatory and Quality issues on Phytomedicine, Business Horizons, New Delhi, First edition, Robert Verpoorte, Pulok K Mukharjee. 2003. 4. Screening methods of Pharmacology by Robert Turner. Toxicology and Clinical Pharmacology of Herbal Products, Melanie Johns Cupp. 2001 							
E-Reference link							
<ol style="list-style-type: none"> 1. https://www.hindawi.com/journals/ecam/2013/376327/ 2. https://www.researchgate.net/publication/41453693_Indian_Systems_of_Medicine_A_Brief_Profile 3. https://niimh.nic.in/ebooks/ayuhandbook/User%20Manual.pdf 							

Course outcome	Upon completion of this course, the students will be able to		
	CO	Course Outcomes	Knowledge Level
	CO1	understand thoroughly about Indian system of medicines	K1
	CO2	learn the Siddha System of Medicine	K2
	CO3	know about the concept of Unani system of medicine	K2
	CO4	gain knowledge on method of preparation of Homeopathic medicines and its merits and demerits	K2
	CO5	understand the principles and the importance of tribal medicine	K2

Mapping of COs with POs & PSOs:

CO	POs								PSOs				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	M	M	S	S	S	M	S	M	S	S	S	S	S
CO2	M	S	M	S	M	M	S	M	S	S	S	S	S
CO3	S	M	S	S	S	S	M	M	S	S	S	S	S
CO4	M	S	M	S	M	S	M	M	S	S	S	S	M
CO5	S	M	S	S	S	M	M	S	S	M	S	S	S

Strongly Correlating (S) - 3 marks
Weakly Correlating (W) - 1 mark

Moderately Correlating (M) - 2 marks
No Correlation (N) - 0 mark
