M.Sc. Botany

Syllabus

AFFILIATED COLLEGES

Program Code: 32E

2022 – 2023 onwards

BHARATHIAR UNIVERSITY

(A State University, Accredited with "A++" Grade by NAAC,
Ranked 21st among Indian Universities by MHRD-NIRF)

Coimbatore - 641 046, Tamil Nadu, India

Program Educational Objectives (PEOs)	
The **M. Sc. Botany** program describe accomplishments that graduates are expected to attain within five to seven years after graduation	
PEO1	The courses have been designed to benefit all Botany students to study various aspects of plant science including its practical applications.
PEO2	Keeping in mind that these students can take up teaching at different levels, research work in research institutes and or industry, doctoral work, florisitic study, ecological survey, environment impact assessment, biodiversity studies, entrepreneurship, scientific writing relevant topics have been included in the curriculum
PEO3	Students would be benefited with knowledge of core subjects like plant diversity, plant taxonomy, medicinal botany, physiology and biochemistry, molecular biology, cytogenetic and application of statistics etc. which are offered in these subjects modules. Analytical techniques, plant tissue culture and phyto chemistry would make to obtain skills in doing research.
PEO4	All the courses in this program are carefully designed to equip the students for competitive exams like CSIR NET, SET, UGC NET, UPSC, ARS, MPSC, GATE etc. and to write research proposals for grants.

Program Specific Outcomes (PSOs)	
After the successful completion of PG Botany program, the students are expected to	
PSO1	To gain knowledge about the classification of plants from cryptogams to phanerogams. Identification of the plants in the field. Study of biodiversity in relation to habitat correlate with climate change, land and forest degradation. Application of Botany in agriculture through study of plant pathology. Paleobotany to trace the evolution of plants.
PSO2	Preference is given to morphology, taxonomy, anatomy and embryology to know external and internal characters of plants for their identification and classification to involve plants for further in biochemical and pharmaceutical aspects
PSO3	To knows the fundamental of biostatistics, bioinformatics tools and biophysical principles for the analysis of relevant biological situations and for developing intellectual skills on biological data and databases.
PSO4	To acquire skills about the local, medicinal, rare, endangered, endemic plants and exotic plants in their original habitats, therapeutic values acquired through their physiological pathways and their cultivation practices for effective conservation and future use.
PSO5	To elucidate the molecular and physiological adaptations in plants in response to biotic and abiotic stress. Identifying genes responsible for stress tolerance and genetic engineering of plants. Through microbiological core concepts the students were able to inter-relate integral and ubiquitous role of microbes with their environment.

Program Outcomes (POs)	
On successful completion of the M. Sc. Botany program	
PO1	Maintain a high level of scientific excellence in botanical research with specific emphasis on the role of plants. Create, select and apply appropriate techniques, resources and modern technology in the plant sciences.
PO2	Logical thinking with the application of biotechnological innovations by implementing modern appropriate techniques and practical exposures in the field of Plant Molecular Biology, Plant Biotechnology and Plant Tissue Culture
PO3	Understand the issues of environmental contexts and sustainable development.
PO4	Enhance the therapeutic aspects of medicinal plants by traditional indigenous approaches and improved production of out supply on medicine, food and other plant products for the betterment of man's holistic development and welfare.
PO5	Students can acquire amplifying knowledge on basic scientific phenomena, fundamental, principles and applications of various mathematical tools and physical principles in relevant biological situations.
PO6	Ability to execute their ideas, knowledge and concepts in current scenario approaches in multidisciplinary ways

BHARATHIAR UNIVERSITY: COIMBATORE 641 046

M. Sc. BOTANY Curriculum (AFFILIATED COLLEGES)

(For the students admitted during the academic year 2022 – 23onwards)

Course Code	Title of the Course	Credits	Hours (wk)		Maximum Marks		
			Theory	Practical	CIA	ESE	Total
FIRST SEMESTER							
	Core Paper I- Microbiology	4	5		25	75	100
	Core Paper – II Phycology, Mycology and Lichenology	4	5		25	75	100
	Core Paper – III Bryophytes, Pteridophytes, Gymnosperms and Paleobotany	4	5		25	75	100
	Core Paper – IV Environmental Botany and Conservation Biology	4	5		25	75	100
	Elective – I Phytopathology (Without practical examination)	4	4		25	75	100
	Core Practical – I (Comprised of Paper I, II, III and IV)	4		6	40	60	100
	Total	**24**	**24**	**6**	**165**	**435**	**600**
SECOND SEMESTER							
	Core Paper – V Cell and Molecular Biology	4	5		25	75	100
	Core Paper – VI Genetics, Evolution and Plant Breeding	4	5		25	75	100
	Core Paper – VII Anatomy, Embryology and Morphogenesis	4	5		25	75	100
	Core Paper – VIII Plant Tissue culture	4	5		25	75	100
	Elective – II Horticulture (Without practical examination)	4	4		25	75	100
	Core Practical – II (Comprised of Paper V, VI,VII and VIII.	4		6	40	60	100

	Total	**24**	**24**	**6**	**165**	**435**	**600**
THIRD SEMESTER							
	Core Paper – IX Plant Taxonomy	4	5		25	75	100
	Core Paper – X Medicinal Botany	4	5		25	75	100
	Core Paper – XI Plant Physiology	4	5		25	75	100
	Core Paper – XII Phytochemistry	4	5		25	75	100
	Elective – III Bioinstrumentation and Biological techniques (Without practical examination)	4	4		25	75	100
	Core Practical – III (Comprised of Paper IX and X)	4		6	40	60	100
	Total	**24**	**24**	**6**	**165**	**435**	**600**
FOURTH SEMESTER							
	Core Paper – XIII Biotechnology & Genetic Engineering	4	6		25	75	100
	Elective – IV Bioinformatics, Industry and Biostatistics (Without practical examination)	4	6		25	75	100
	Core Practical – IV (Comprised of Paper XI, XII and XIII)	4		6	40	60	100
	* Project & *viva-voce* Examination	6	12		60	90	150
	Total	**18**	**24**	**6**	**150**	**300**	**450**
	Grand Total	**90**	**96**	**24**	**645**	**1605**	**2250**
ONLINE COURSES							
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*** Project report- 120 marks; *viva voce* 30 marks**

Method of implementation and evaluation of Project

- ✓ Based on the strength, students will be allotted to staff members by lot in the first week (3rd Semester) after reopening the college.
- ✓ Student should present the proposed project work before department council to get approval within one month of reopening the college.
- ✓ Students are permitted to collect relevant literature in the field concerned during working days without disturbing the normal classes.
- ✓ After making protocol, experiments in the respective fields will be conducted by students in the laboratory and field according to their need.
- ✓ Periodical review meetings will be conducted with the students by the faculty to assess the progress of the work.
- ✓ After getting the data of findings students will be guided to write the dissertation.
- ✓ The dissertation will be corrected thoroughly by the respective guides and then permitted to submit in the first day of practical examination.
- ✓ It should be duly signed by the research guide and the head of the Department and submitted for evaluation.

The dissertation to be submitted should include:

- Introduction
- Objectives
- Materials and methods
- Results and discussion
- Summary and conclusion
- References

The dissertation will be evaluated as follows:

1. Internal evaluation by guide - **60 marks**
2. External evaluation by external examiner - **60 marks**
3. PowerPoint presentation of work done for open *viva-voce* examination - **30 marks**

First Semester

Course code		MICROBIOLOGY	L	T	P	C
Core/Elective/Supportive		Core Paper I	73	2		4
Pre-requisite		Basic knowledge in Microbiology gained from undergraduate programme Classification, structure and application of certain microbes such as bacteria, fungi and virus.	Syllabus Version		2023-2024	

Course Objectives:

The main objectives of this course are to:

The objective of the core paper Microbiology is to equip the students to gain bimolecular knowledge and analytical skills at an advanced level.
The program emphasizes to apply knowledge acquired about prokaryotic and eukaryotic cellular processes, interaction of microorganisms among themselves, with physical and chemical agents and higher order organisms in environment and biological systems at various conditions.
The laboratory training in addition to theory is included so that the students will acquire the skills to qualify for a broad range of positions in research, industry, consultancy, education and public administration, or for further education in a doctoral program.
Students will be able to address broad range of fields including biopolymer chemistry, marine, biochemistry, environmental biotechnology, food science, microbiology, microbial genetics, molecular biology and systems biology

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understanding of research ethics involving microorganisms to contribute to application, advancement and impartment of knowledge in the field of microbiology and molecular biology globally. The laboratory training will empower them to prepare for careers in broad range fields.	K1
2	Knowledge of the leading edge in a chosen specialized area of Microbiology, based on own research experience from a master's project and international literature. Can compete in national level competitive exams such as NET-JRF or GATE or International exams such as GRE-TOEFEL and can pursue career in higher studies.	K2
3	Develop ability to independently carry out a complete scientific work process, including the understanding of theoretical background, hypothesis generation, collection and analysis of data, and interpretation and presentation of results	K3
4	Is able to evaluate and apply relevant theory, methods and analytic approaches within the specialized field of microbiology, including statistical methods.	K4
5	Has high competence and multidisciplinary project experience within selected topics related to microbiology and ability to contribute in a multidisciplinary team.	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	INTRODUCTION TO MICROBIOLOGY-VIROLOGY	15 hours

Five kingdom classification by Whittaker (1969) - Prokaryotic and Eukaryotic microbes - General features of Viruses - Classification, characteristics and ultrastructure. Isolation, purification, chemical nature, replication, transmission and economic importance of viruses. Studies on virions, prions, phytoplasma and mycoplasma.

Unit:2	BACTERIOLOGY	15 hours

Bacterial classification (Bergey's system). General account, ultrastructure, bacterial culture

technique and economic importance. Molecular taxonomy of bacteria. Species concept in bacteria - Eubacteria, Archaebacteria, Cyanobacteria and Actinomycetes.		
Unit:3	**INDUSTRIAL FERMENTATION**	**15 hours**
History and scope of industrial microbiology. Development of industrial fermentation process. Isolation, screening, production strains, production media, inoculum preparation and inoculum development, introduction to fermenter, industrial sterilization, scale up fermentations and downstream processing. Types of fermenters, agitator and cavitator. Product recovery.		
Unit:4	**INDUSTRIAL PRODUCTS**	**15 hours**
Industrial production of antibiotics: penicillin and streptomycin - organic acids: citric acid and lactic acid – enzymes: amylases and proteases – alcohol: acetone and butanol – aminoacids: L glutamic acid. Industrial production of vitamin B12. Immobilized cell technology. Industrial production of single cell proteins, biopolymers, bioplastics, biosurfactants, and biofertilizers.		
Unit:5	**ENVIRONMENTAL MICROBIOLOGY**	**13 hours**
Microorganisms in hydrocarbon system. Leaching methods - role of microorganism in bioleaching. Microbiology of rhizosphere and mycorrhizae. Types of microorganisms found on textile fibers. Textile Industry effluent treatment with fungi, bacteria and microalga.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**75 hours**

Text Book(s)

1	Carpenter, P. L. (1967). Microbiology. Saunders Co., Philadelphia, USA.
2	Davis, B. D., Dulbecco, R., Eiser, H. N. and Grinsberg, H. S. (1980). Microbiology.Harper & Row, New York.
3	Dubey, R. C. and Maheshwari, D. K. (2007). A Textbook of Microbiology. S. Chand and Co. Ltd., New Delhi.
4	Edmond, P. (1978). Microbiology: An Environment Perspective. Macmillan & Co., New Delhi.
5	Ketchum, P. A. (1988). Microbiology: Concepts and Applications. John Wiley & Sons,New York.
6	Pelczar, M. J., Chan, E. C. S. and Krieg, N. R. (1993). Microbiology. Tata McGraw Hill Publishing Co. Ltd., New Delhi.

Reference Books

1	Sharma, P. D. (1992). Microbiology. Rastogi & Co., Meerut.
2	Staley, J. T. *et al.*. (1991). Bergey's Manual of Systematic Bacteriology. Vol. I to IV.Williams & Wilkins, London.
3	Stanier, R. Y., Adelberg, E. A. and Ingram, J. L. (1978). General Microbiology. Mac Millan & Co., New Delhi.
4	Casida, IC, 1968. Industrial microbiology Wiley Eastern Ltd.
5	Chahal D.S. 1991. Food feed and fuel from Biomass, IBH. New Delhi.
6	Paul. A. Ketchum 1968. Microbiology, John Wiley & Sons USA.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	www.nos.org/media/documents/dmlt/microbiology
2	www.columbia.edu/itc/hs/medical/pathophys/id/2009
3	http://microbiologyinfo.com

Mapping with Programme Outcomes						
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	S	M	M	S	M	S
CO3	M	S	S	M	S	M
CO3	S	M	M	S	M	S
CO4	M	S	S	M	S	M
CO5	S	M	M	S	M	S

*S-Strong; M-Medium; L-Low

Course code		PHYCOLOGY, MYCOLOGY AND LICHENOLOGY	L	T	P	C
Core/Elective/Supportive		Core Paper II	73	2		4
Pre-requisite		Basic knowledge of Life Science	Syllabus Version		2023-2024	

Course Objectives:

The main objectives of this course are to:

To acquire knowledge on diverse groups of Thallophytes.
To gain knowledge on the diversity, structural organization and reproduction of algae, fungi and lichens.
To obtain knowledge on the life cycle patterns of Thallophytes and their significance

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Grasp the basic concepts of lower life forms	K1
2	Understand the diversity in habits, habitats and organization of various groups of lower plants	K2
3	Inherit knowledge on the exploitation of useful products from lower forms for the betterment of human welfare	K3
4	Apply their acquired knowledge to improve the economic quality of the lower life forms.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Classification And Characteristics of Algae	15 hours

Classification of algae (Smith, 1961). Salient features of major classes: Chlorophyta, Cyanophyta, Charophyta, Xanthophyta, Phaeophyta and Rhodophyta. Ultrastructure of prokaryotic and eukaryotic algal cells and their components. Economic importance of algae.

Unit:2	Ecology, Cultivation and Life Cycle Patterns of Algae	15 hours

Ecology of algae - algae as pollution indicators, algal blooms, algicides - culture and cultivation of fresh water and marine algae - Knop's solution and Chu-10 medium (1972). origin and evolution of sex in algae, phylogeny and interrelationships of algae. Lifecycle patterns in algae. Study of fossil algae.

Unit:3	Classification and Characteristics of Fungi	15 hours

Classification of fungi (Alexopoulos and Mims, 1979). Recent trends in classification of fungi. General characters of major classes: Mastigomycotina, Schizomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina. Phylogeny and interrelationships of major groups of fungi. Economic importance of fungi.

Unit:4	Organization and Reproductions of Fungi	15 hours

Thallus organization - reproduction, life cycle types, parasexual cycles, reduction in sexuality in fungi - physiological races in fungi - spore dispersal mechanisms and fungal genetics, study of fossil fungi.

Unit:5	Lichens	13 hours

Classification of Lichens (Hale, 1969). Occurrence and interrelationship of phycobionts and mycobionts, structure and reproduction in Ascolichens, Basiodiolichens and Deuterolichens.

Lichens as indicators of pollution. Economic importance of Lichens.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**75 hours**

Text Book(s)	
1	Round, F.E, (1973), The Biology of Algae.
2	Kumar, H.D, (1988), Introductory Phycology.
3	Fritsch, F.E. (1935-1945). Structure and reproduction of the Algae. Vol. II III & I.
4	Alexopoulos, C.J. and C.W. Mims (1985). Introductory Mycology
5	Smith, G.M. (1971). Cryptogamic Botany Vol. Algae and Fungi.
6	Hale, M.E. (1961). A Hand Book of Lichens.

Reference Books	
1	Bold. H.C. and H.J. Wyne (1978) Introduction to the Algal structure and reproduction,Prentice Hall, Englewood Cliffs, New Jersey.
2	Chapman. V.J and P.J. Chapman (1973). The algae. The English language book society and Macmillen.
3	Anisworth, S.C., Sparrow, F.E. and A.D. Sussman. 1965.The fungi and advanced treatise. Vol. I, II, III, IV A & IV B.
4	Bessey, E.A. (1950), Morphology and Taxonomy of Fungi.
5	Webster, J. (1985), Introduction to Fungi.
6	Hale, M.E. (1970). The Biology of Lichens.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://swayam.gov.in/nd2_cec20_bt11/preview
2	https://www.classcentral.com/course/swayam-plant-groups-19787

Mapping with Programme Outcomes						
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	S	M	M	S	M	S
CO3	M	S	S	M	S	M
CO3	S	M	M	S	M	S
CO4	M	S	S	M	S	M

*S-Strong; M-Medium; L-Low

Course code		BRYOPHYTES, PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY	L	T	P	C
Core/Elective/Supportive		Core Paper III	73	2		4
Pre-requisite		Basic knowledge of Life Science	Syllabus Version		2023-2024	

Course Objectives:

The main objectives of this course are to:

To earn knowledge on diverse groups of Bryophyes and Vascular plants
To procure knowledge on the diversity, structural organization and reproduction of Bryophytes, Pteridophytes and Gymnosperms.
To comprehend on the life cycle patterns of Bryophytes and Vascular plants with their import.
To know about that merits of Paleobotany

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Grasp the knowledge on phylogeny of Bryophytes, Pteridophytes and Gymnosperms.	K1
2	Assume the alternation of generations of Vascular Cryptogams and Phanerogams..	K2
3	Appeal the knowledge on identification of living fossils from the fossils and the role of fossils in oil exploration and coal excavation.	K3
4	Discriminate various kinds of fossilization process and Radio carbon dating.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Classification and Characteristics of Bryophytes	15 hours

Classification of Bryophytes (Smith 1964). Structure, reproduction and life cycle of Marchantiales, Jungermanniales, Anthocerotales and Bryopsida. Fossil bryophytes. Economic importance of Bryophytes. Bryophytes as indicators of water and air pollution.

Unit:2	Classification and Characteristics of Pterdiophytes	15 hours

General features and origin and evolution of Pteridophytes. Classification of Pteridophytes (Smith 1955). Structure, reproduction and life cycle of Rhyniales, Psilotales, Pteridales, Selaginellales, Isoetales and Calamitales.

Unit:3	Evolution and Economic Importance of Pteridophytes	15 hours

Structure and reproduction of the following orders: Ophioglossales, Marattiales, Osmundales, Filicales and Salviniales. Stelar evolution in Pteridophytes, Heterospory and seed habit. Spore germination patterns. Affinities of various classes of Pteridophytes. Economic importance of Pteridophytes.

Unit:4	Classification and Characteristics of Gymnosperms	15 hours

Classification of Gymnosperms (Bierhorst 1971) General account of Pteridospermales, Cycadales, Coniferales, Bennettitales, Pentoxylales and Ginkgoales. General account of Cordaitales, Taxales, Gnetales, Phylogenetic trends and affinities of various classes. Evolution of angiosperms. Economic importance of Gymnosperms.

Unit:5	Paleobotany	13 hours

Concepts of Paleobotany - A general account on Geological time scale. Techniques for

paleobotanical study. Fossil types - Age determination and methods of study of fossils. Systematic and Nomenclature of fossil plants. Paleoclimates and fossil plants. Role of fossil in oil exploration and coal excavation, Paleopalynology. Radio carbon dating.

Unit:6	**Contemporary Issues**	**2 hours**

Expert lectures, online seminars – webinars

	Total Lecture hours	**75 hours**

Text Book(s)

1	Shukla, A. C. and Mishra, S. P. (1982). Essentials of Paleobotany. 2nd ed. Vikas Publishing House Pvt. Ltd., New Delhi.
2	Eames, A. J. (1936). Morphology of Vascular Plants - Lower Groups. Tata McGraw Hill, New Delhi.
3	Parihar, N. S. (1985). The Biology and Morphology of Pteridophytes. Central Book Depot, Allahabad.
4	Rashid, A. (1986). An Introduction to Pteridophyta. Vani Educational Books, New Delhi.
5	Sharma, O. P. (1990). Text Book of Pteridophyta. Macmillan India Ltd., India.
6	Smith, G. M. (1971). Cryptogamic Botany. Vol. II. Bryophytes and Pteridophytes. Tata McGraw Hill, New Delhi.
7	Sundararajan, S. (2007). Introduction to Pteridophyta. New Age International Publishers, New Delhi.
8	Vashishta, P. C. *et al*. (2008). Botany for Degree Students: Pteridophyta. S. Chand and Co. Ltd., New Delhi.
9	Vasishta, P. C. *et al*. (2006). Botany for Degree Students: Gymnosperms. S. Chand and Co. Ltd., New Delhi.

Reference Books

1	Nikias, K. J. (1981). Paleobotany, Paleoecology and Evolution. PraegerPublishers, USA.
2	Seward, A. C. (1919). Fossil Plants. Vol. I, II, III and IV. Cambridge University Press,London.
3	Seward, A. C. (1931). Plant Life through the Ages. Cambridge University Press, London.
4	Ingold, C. T. (1939). Spore Discharge in Land Plants. Oxford, UK.
5	Coultar, J. M. and Chamberlin, C. J. (1967). Morphology of Gymnosperms. Central Book Depot, Allahabad.
6	Foster, A. S. and Gifford, E. M. (1965). Morphology and Evolution of Vascular Plants. W. H. Freeman & Co.
7	Maheswari, P. and Vasil, V. 1960. Gnetum: A Monograph. CSIR Publication, New Delhi.
8	Sporne, K. R. (1974). The Morphology of Gymnosperm. B.I. Publications, NewDelhi.
9	Sporne, K. R. (1972). The Morphology of Pteridophytes. B. I. Publications, Madras

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

1	https://swayam.gov.in/nd2_cec20_bt11/preview
2	https://www.classcentral.com/course/swayam-plant-groups-19787

Mapping with Programme Outcomes						
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	S	M	M	S	M	S
CO3	M	S	S	M	S	M
CO3	S	M	M	S	M	S
CO4	M	S	S	M	S	M

*S-Strong; M-Medium; L-Low

Course code		ENVIRONMENTAL BOTANY AND CONSERVATION BIOLOGY	L	T	P	C
Core/Elective/Supportive		Core Paper IV	73	2		4
Pre-requisite		To known about Ecology and Environment	Syllabus Version		2023-2024	

Course Objectives:

The main objectives of this course are to:

To recognize the concept of ecosystem and cyclic flow of elements between organism and environment.
To understand the effect of pollution
To obtain the knowledge on species conservation and their significance

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Comprise the concepts of ecosystem, biogeochemical cycle and species selection	K1
2	Realize the environmental deterioration and possible measures for their revival	K2
3	Appeal using modern techniques to conserve the species and natural resources. in modern techniques.	K3
4	Monitor and register the biodiversity changes through remote sensing	K4
5	Apply strategies for the conservation of Germplasm	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Ecology	15 hours

History and scope of ecology, concept of ecosystem. Synecology Modern concept of biotic community. Major and minor communities. Methods of studying plant community. Biogeochemical cycling. Reserve and cycling pattern in tropical and temperate regions. Ecological indicators. Genecology.

Unit:2	Environmental Pollution	15 hours

Environmental pollution. Plant Indicators of pollution. Radiation and noise pollution - effects and control measures. Environmental management and legislation in India. Environmental organization and agencies, MAB national organization.

Unit:3	Ecosystem Conservation	15 hours

Current practices in conservation. *In situ* and *ex situ* conservation. Forest conservation through laws, World conservation strategy (WCS) and National conservation strategy (NCS). Application of Remote sensing and GIS in Ecological Science.

Unit:4	Resource Management	15 hours

Basic principles, management and classification of resources. Sources of germplasm. Centres of genetic diversity. Concepts of de Candolle and Vavilov. Current biodiversity loss - concept of endemism, rare, endangered and threatened species (RET), keystone species, IUCN account of biodiversity, red data book and hot spots, reasons to stop extinction, methods to save species. Ecotourism- positive and negative impacts.

Unit:5	Germplasm Maintenance	13 hours

Germplasm maintenance of Rice and Sugarcane. The role of IBPGR (Rome, Italy) and NBPGR (New Delhi), in germplasm conservation. Plant germplasm resources. Intellectual Property Rights – Intellectual Property Protection Patent Systems - Plant Breeders Rights and Farmers Rights – A brief account on Geographical Indication (GI).		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**75 hours**

Text Book(s)	
1	Ambasht, R.S. (1988). A text books of plant ecology. Students, Friends & Co., Varanasi
2	Edward J. Kormondy, (1996). Concept of Ecology, Prentice Hill of India Pvt, Ltd.New Delhi
3	Sharma, P.D. (1991). Ecology and Environment, Rastogi Publishers, Meerut.
4	Micheal. P. (1984). Ecological methods for field and laboratory investigations, Tata Mc Graw Hill publishing company Ltd., New Delhi.
5	Misra, R. (1986). Ecology work book, Oxford and IBH publishing company, New Delhi
6	Krishnamurthy, K. V. (2004). An Advanced Textbook on Biodiversity: Principles and Practice. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
7	Odum E.P. (1971). Fundamentals of ecology, W.B. Saunders Co., Philadephia, London.
Reference Books	
1	Emil T. Charlett. 1973.Environmental protection Tata Mc graw Hill New Delhi.
2	George L. Clarke (1954). Elements of Ecology. John Wiley & sons. Inc., New York
3	Perkins H.C. (1974). Air pollution, Mc Graw Hill Kongotusta Ltd, Tokyo
4	Robert Smith, (1977). Elements of ecology and field biology, Harper and RawPublishers, New York, Londan
5	Frankel, O. H., Brown, A. H. D. and Burdon, J. J. (1995). The Conservation of Plant Diversity. Cambridge University Press, London
6	Meffe, G. K. and Carroll, C. R. (1994). Principles of Conservation Biology. Sinauer Associates. Sunderland, Mass, USA.
7	Joseph M. Moran, Micheal D. Morgan and jances H. Wiersing. 1980. Introduction to environmental science W.H. Freemar & Sam Francisco. U.S.A.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://swayam.gov.in/
2	https://swayam.gov.in/nd1_noc19_ge23/preview
3	https://www.classcentral.com/course/swayam-ecology-and-environment-14021

Mapping with Programme Outcomes						
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	S	M	S	S	M	S
CO3	M	S	S	M	S	S
CO3	S	M	S	S	S	S
CO4	S	S	S	M	S	M
CO5	S	M	S	S	M	S

*S-Strong; M-Medium; L-Low

Core Practical – I (Comprised of Paper I, II, III and IV)

(Microbiology, Phycology, Mycology and Lichenology, Bryophytes, Pteridophytes, Gymnosperms and Paleobotany and Environmental Botany and Conservation Biology)

Course code:

Syllabus Version: 2023-2024

Course Objectives:

The main objectives of this course are to:

- To investigate the microbial temperament
- To understand the diversity and distribution of lower life forms.
- To realize the diversity and organization of higher life forms.
- To analysis the physio-chemical nature of the soil.
- To prepare the biosphere reserves, National parks and sanctuaries location maps of India.

Expected Course Outcomes:		
On the successful completion of the course, student will be able to:		
1	Isolation, Analysation and measuring of microbes	K5
2	Acquire and analyze interrelationships between algae, fungi and Lichen	K4
3	Gain the knowledge about morphology and anatomy organizations of Bryophtes, Pteridophytes, Gymnosperms and Fossils	K2
4	To encourage the young minds to conserve the environment	K6
5	Expertise to create biodiversity map in India	K3
K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create		

Paper I – Microbiology

1. Isolation of microbes from soil - Serial dilution and Plating methods.
2. Gram's staining of Bacteria from curd and root nodule.
3. Microbial analysis of milk samples by methylene blue reduction test.
4. Isolation of VAM by wet sieving and decanting technique.
5. Spawn production technique for the cultivation of *Agaricus bisporus*.
6. Micrometry- Measure the average length of bacteria and fungal spores.

Paper II - Phycology, Mycology and Lichenology

Study of morphology, anatomy, vegetative and reproductive organs using clear whole mounts / sections of the following genera.

Phycology:

Algae:

Cyanophyta - *Gloeocapsa* and *Lyngbya*.
Chlorphyta- *Scenedesmus, Pediastrum, Pithophora, Bulbochaete* and *Nitella.*
Phaeophyta- *Padina* and *Turbinaria.*
Rhodophyta- *Batrachospermum, Ceramium, Amphiroa* and *Gelidium*.

Mycology:
Mastigomycotina:*Plasmodiophora* & *Peronospora*
Ascomycotina:*Phyllachora*
Basidiomycotina*: Ustilago.*
Deutromycotina*: Alternaria*

Slide culture technique for identification of fungi.
Fungal spore count using Haemocytometer.
Microscopical analysis of
(a) Spoiled food stuff – Bread
(b) Spoiled vegetables - Potato and Onion
(c) Spoiled fruits – Apple, Banana and Tomato.

Lichens:
Ascolichen: *Parmelia, Cladonia & Xanthoria*

Paper III - Bryophytes, Pteridophytes, Gymnosperms and Paleobotany

Bryophytes:
Marchantiales: *Lunularia , Targionia* and *Reboulia*
Jungermanniales: *Aneura*
Anthocerotales: *Anthoceros*
Sphagnidae: *Sphagnum*
Bryidae: *Bryum.*

Pteridophytes:
Psilotales*: Psilotum*
Isotales*: Isoetes*
Marattiales: *Angiopteris*
Osmundales*:* *Osmunda*
Schizeales*: Lygodium*
Hymenophyllales*: Trichomanes*
Cyatheales*: Alsophila*
Filicales*: Nephrolepis*
Salviniales*: Salvinia* and *Azolla.*

Gymnosperms
Coniferales: *Cupressus, Podocarpus, Araucaria*
Pinales: *Pinus*

Ephedrales: *Ephedra*.

Paleobotany

Anatomical study of the fossil specimens

Rhyniales: *Rhynia*
Drephanophycales: *Asteroxylon*
Lyginopteridales: *Lyginopteris*
Equisetales: *Calamites*
Medullosales: *Medullosa*

Paper IV. Environmental Botany and Conservation Biology

1. Forest soil analysis to determine soil texture.
2. Forest soil analysis to determine water holding capacity and field capacity.
3. Forest soil analysis to determine soil pH
4. Calculate the biomass of exotic and native trees and compare the results.
5. Identify and make a list of common forest plants with diagrams (Minimum 25).
6. Calculate plant frequency, abundance and biomass by quadrat method.
7. Estimate Alpha diversity, Evenness index and Beta diversity of a rare/ endangered species in MS XL sheet.
8. Find out "r- selection" and Disturbance Diversity Relationship of herbaceous plants in a forest ecosystem.
9. Find out "K-selection" and Disturbance Diversity Relationship of trees in a forest Ecosystem
10. Prepare a map of 18 Biosphere Reserves of India.
11. Prepare location maps of National Parks and Wildlife Sanctuaries in Tamilnadu.

Mapping with Program Outcomes						
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	S	S	M	S	S	S
CO2	M	S	S	S	S	S
CO3	S	S	S	S	M	S
CO4	S	M	S	S	S	S
CO5	S	M	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		PHYTOPATHOLOGY	L	T	P	C
Core/Elective/Supportive		Elective I	58	2		4
Pre-requisite		Fundamental knowledge about microbes and plant diseases	Syllabus Version		2023-2024	

Course Objectives:

The main objectives of this course are to:
To disperse knowledge on pathogenic group of organisms.
To obtain knowledge on disease forecasting and management.
To analyze the plant-pathogenic interaction.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Recognize the host and pathogen interaction	K1
2	Expertise through control of food and commercial crop pathogens	K2
3	Improve to handling disease free varieties.	K3
4	Implement the disease management techniques in the fields.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Concept and Classification of Plant diseases	12 hours

Plant pathology - its scope and relationships to other sciences. Concept of plant diseases; saprophytes and parasitism, pathogenicity. Classification of plant diseases, plant diseases control - Principles and methods. Plant disease forecasting.

Unit:2	Fungal Diseases	12 hours

Symptoms, causal organism, disease cycle and control of pathogenic diseases caused by pathogenic fungi with special reference to the following diseases. Club root of crucifers, Black wart of potato, Powdery mildews wheat, Brown spot of Rice, Early blight of Potato, Angular leaf spot and Black arm of Cotton, Bacterial blight of Paddy, Sandal spike. Grassy shoot disease of Sugarcane.

Unit:3	Mode and action of Diseases	12 hours

Pathogenesis penetration and entry, colonization of the host, factors affecting in infection, enzymes in plant diseases – Cell wall degrading enzymes. Toxins in relation to plant diseases: a general account, mode of action and types.

Unit:4	Plant responses against diseases	12 hours

Plant responses to post infectional agents; alteration in growth photosynthesis, respiration, nitrogen metabolism, aromatic compounds, and growth regulators-vascular transport.

Unit:5	Defense Mechanism	10 hours

Defense mechanism; Genetics of plant-pathogen interaction. Effect of environment on diseases development. Plant diseases, epidemiology, forms of epidemics and conditions governing some of the important crop diseases.

Unit:6	Contemporary Issues	2 hours

Expert lectures, online seminars – webinars

	Total Lecture hours	**60 hours**

Text Book(s)	
1	Bilgrani, KG and Dubey HC 1980 a Text book of modern plant pathology.
2	Butler EJ Jones 1986 Plant pathology periodical book agency, Delhi.
3	Ganulco HC and KAR, AK 1986 College botany volume11. central book depot, Calcutta.
4	Mehrotra, RS 1979, Plant pathology 2nd Edition. Tata McGraw hill Publi. New Delhi.
5	Singh, R.S.1975.Introduction to the Principles of plant pathology. Oxford and IBH Publishing company, New Delhi.
6	Rangaswamy, G. and Mahadevan, A. (1999). Diseases of crop plant in India 4thEdition.

Reference Books	
1	Agrios, Gergon, n 1988, Plant pathology academic press London
2	Boicer, F and Cook RJ 1974 Biological control of plant pathogens, Sanfrancisco.
3	Holliday, P, 1980 Fungal diseases of tropical crops. Cambridge University
4	Manners JG 1982 Principles of plant pathology Cambridge University Press Cambridge
5	Anega, KG, 1993, Experiments in microbiology, plant pathology, and tissue culture.Wishwz prakasam (willey esternlimited).
6	Ganulco HC and KAR, AK 1986 College botany volume11. central book depot, Calcutta.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://swayam.gov.in/nd2_cec20_bt13/preview
2	https://www.classcentral.com/report/swayam-moocs-course-list/
3	https://www.classcentral.com/course/swayam-plant-pathology-and-soil-health-14236

Mapping with Programme Outcomes						
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	S	M	S	S	M	S
CO3	M	S	S	M	S	S
CO3	S	M	S	S	S	S
CO4	S	S	S	M	S	M

*S-Strong; M-Medium; L-Low

Second Semester

Course code		CELL AND MOLECULAR BIOLOGY	L	T	P	C
Core/Elective/Supportive		Core Paper V	73	2		4
Pre-requisite		Familiarity with cell organelles, genetics, biochemistry and molecular biology and its application gained during undergraduate course.	Syllabus Version		2023 - 2024	

Course Objectives:

The main objectives of this course are to:

To understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles.
To understand how these cellular components are used to generate and utilize energy in cells.
To understand the cellular components processes underlying mitotic cell division.
Students will apply their knowledge of cell biology to selected examples of changes or losses in cell function. These can include responses to environmental or physiological changes, or alterations of cell function brought about by mutation.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	The course will facilitate the adequate knowledge about the cell biology and basic concept of genetics, structure of organisms and advanced molecular techniques.	K1
2	To understand the structure and function of basic components of prokaryotic and eukaryotic cells, especially its membrane organization and organelles	K2
3	To introduce to rapid contemporary changes witnessed in plant molecular biology.	K3
4	Basic organization of genetic material and the realms of events associated with replication and gene expression will be examined	K4
5	The subject provides knowledge about different techniques of biology and Gene.	K5
6	Students will gain knowledge about the basic and fundamental organization of life and genetic material and their applications.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	STRUCTURAL ORGANIZATION OF CELL	13 hours

Structural organization and function of intracellular organelles. Structure and function of cytoskeleton and its role in motility. Membrane structure and function- model membrane, lipid bilayer and membrane proteins. Diffusion, osmosis, ion channels, active transport.

Unit:2	MOLECULAR ORGANIZATION	15 hours

Molecular organization of chromosomes and genes. Cell cycle - Stages in cell cycle, regulation and control of cell cycle - Cyclins and Cyclin dependent kinases. Cell division- Mitosis, mitotic apparatus and its physiochemical characteristics and biochemical composition. Theories and process of meiosis. Chromosomal aberrations.

Unit:3	DNA STRUCTURE AND FUNCTION	15 hours

Nucleic acid - physical and chemical structure of DNA, Types of DNA. DNA as genetic material. DNA replication in prokaryotes and eukaryotes. Semi conservative mode of replication. Messelson – Stahl experiment. System and mechanism of DNA replication. Enzymes and inhibitors in DNA replication.

Unit:4	**GENE TRANSCRIPTION**	**15 hours**
Transcription of DNA in prokaryotes and eukaryotes. Organization of transcriptional units. RNA synthesis and processing. TATA box. Pribnow box. Role of DNA binding by transcription factors. Sigma factor. Promoters – important features of class I, II, & III promoters. Enhancers and silencers. Britten and Davidson model for eukaryotic gene regulation. Post transcriptional silencing, RNA editing, MicroRNAs, RNA inhibition.		
Unit:5	**GENE TRANSLATION**	**15 hours**
Translation: Important features of mRNA – ORF, RBS. Fine structure, composition and assembly of prokaryotic and eukaryotic ribosomes. Stages in translation (prokaryotes and eukaryotes): Initiation – Elongation – Process of termination. Inhibitors of protein synthesis. Important features of the genetic code. Protein sorting and translocation. Post-translational modification of proteins. Protein folding.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**75 hours**

Text Book(s)	
1	Freifelder, D. (1983).2nd Ed. Marosa publishing house.
2	C.P. Swanson, T.Merz, W.J. Young. (1988). Cytogenetics. 2nd Ed. Prentice hall India. Pvt. Ltd.,
3	Archana Sharma. (1985). 2nd Ed. Chromosomes. Oxoford and IBH Publishing Company.
4	Arthur korengerg, W.H.1976. DNA Synthesis. Freeman and Company.
5	David Freifelder (2000). Molecular Biology. 2nd ed. Narosa Publishing House, New Delhi.
6	De Robertis, E. D. P. and De Robertis, E. M. F. (1980). Cell and Molecular Biology. Saunders International Education, Philadelphia.
7	Verma, P. S. and Agarwal, V. K. (1998). Concept of Molecular Biology. S. Chand and Co. Ltd., New Delhi

Reference Books	
1	Gustafson, J. P. (1984). Gene Manipulation in Plant Improvement. Plenum Press, New York.
2	Leadbetter, M. C. (1970). Introduction to the Fine Structure of Plant Cells. Springer Verlag.
3	Levin, B. (1974). Gene Expression. Vol. I. Bacterial Genomes. Vol. II. Eucaryotic Chromosomes. Wiley Interscience. London.
4	Levin, B. (1998). Genes. VI. Oxford University Press, London.
5	Rastogi, S. C., Sharma, V. N. and Anuradha Tandon, V. N. (1993). Concepts in Molecular Biology. Wiley Eastern Ltd., New Delhi.
6	Rost, T. L., Gifford, Jr. and Ernest, M. (1977). Mechanism and Control of Cell Division. Academic Press, New York.
7	Segal, H. L. and Doyle, D. J. (1978). Protein Turnover and Lysosomal Functions. Academic Press, New York.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	http://www.cellmolbiol.org
2	https://cmbl.biomedcentral.com
3	https://www.omicsonline.org
4	Cellbiol.com

5	https:mcb.asm.org
6	https://www.unom.ac.in
7	https://publon.com
8	https://www.nature.com
9	https://cell.uark.edu

Mapping with Programme Outcomes						
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	S	M	M	S	M	S
CO3	M	S	S	M	S	M
CO3	S	M	M	S	M	S
CO4	M	S	S	M	S	M
CO5	S	M	M	S	M	S
CO6	S	M	M	S	M	S

*S-Strong; M-Medium; L-Low

Course code		GENETICS, EVOLUTION AND PLANT BREEDING	L	T	P	C
Core/Elective/Supportive		Core Paper VI	73	2		4
Pre-requisite		Basic knowledge on Mendelian inheritance, structure of chromosome, origin and evolution of prokaryotes and eukaryotes, plant breeding methods and mutation gained during undergraduate course.	Syllabus Version		2023 - 2024	

Course Objectives:

The main objectives of this course are to:

Apply quantitative problem-solving skills to genetics problems and issues.
Describe the chromosome theory, molecular genetics and quantitative and evolutionary genetics.
Describe the theory of natural selection.
Explain how new species arise.
Construct a phylogenetic tree.
Explain the mechanisms which underlie evolution at the molecular level.
Describe major evolutionary lineages of plants and their defining characteristics.
Discuss plants in the context of broader environmental concerns, such as climate change, habitat destruction, pollution, invasive species, and agriculture.
Plant breeding methods and role of molecular markers in plant breeding

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Students will demonstrate an understanding of Mendelian and molecular genetics, cell structure, cell physiology, and molecular processes of cells.Understanding of the principles of evolution.	K1
2	To understand the role of genetic technologies in industries related to biotechnology, pharmaceuticals, energy, and other fields.Understanding the role of genetic mechanisms in evolution. Understanding the different methods of plant breeding for the improvement of crop	K2
3	The ability to recognize the experimental rationale of genetic studies as they are described in peer-reviewed research articles and grant proposals to federal and other funding agencies.	K3
4	Students will demonstrate the ability to work effectively with molecular, computational, mathematical, and statistical approaches to acquire, analyze, and model experimental datasets. The ability to evaluate conclusions that are based on genetic data.	K4
5	Communication skills required in the discipline including oral presentations of research data, published research articles, grant proposals, and poster presentations at conferences	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	INTRODUCTION TO GENETICS	15 hours

Mendel's Law of inheritance. Sex determination in plants and theories of sex determination. Sex linked characters. Chromosome theory of inheritance. Multiple alleles and pseudoalleles. Extrachromosomal inheritance. Uniparental inheritance in *Chlamydomonas*. Male sterility. Population genetics – Hardy Weinberg principle.

Unit:2	**GENE CONCEPT AND MUTATION**	**15 hours**
Gene concept - Benzer's concepts. Brief description of the following types of genes - smart genes, housekeeping genes, transposons, overlapping genes, split genes, homeotic genes, pseudogenes, orphan genes, selfish genes, gene cluster and gene families. Fine structure and analysis of the gene. Benzer's experiment in the rII locus of T4 phage. Gene mutation - Molecular basis of mutation and their mode of action. Detection of mutation by CLB Method.		
Unit:3	**LINKAGE AND GENETIC RECOMBINATION**	**15 hours**
Bateson's concept of coupling and repulsion. Morgan's concept of linkage, linear arrangement of genes, linkage groups, complete and partial linkage, linkage maps, three point test crosses, interference coefficient of coincidence and negative interference. Recombination in fungi (tetrad analysis in *Neurospora*) Molecular mechanism of recombination. Molecular markers and construction of linkage maps. Microbial genetics (outline only). Complementation tests.		
Unit:4	**EVOLUTION**	**15 hours**
Lamarck - Darwin–concepts. The origin and evolutionary synthesis. Concept of Oparin and Haldane, Experiment of Miller. Origin and evolution of prokaryotes and eukaryotic cells, Concepts of neutral evolution, molecular divergence and molecular clocks. Origin of new genes and proteins; Gene duplication and divergence. Homology, orthology, paralogy and xenology.		
Unit:5	**PLANT BREEDING**	**13 hours**
Methods of plant breeding in plants. Breeding plants for improving agronomic parameters. Plant breeding work in India with special reference to Rice, cotton and Sugar cane. Role of polyploidy and distant hybridization in plant improvement. Induced mutations in crop improvement. Breeding in plants, including marker assisted selection. QTL mapping.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**75 hours**

Text Book(s)

1	Gardener, E.J. (1975). 5th Ed. Principles of Genetics, Johanwiley, New York.
2	Gupta, P.K. (1994). Genetics. Rastogi Publication, Meerut, India.
3	King, R.C. (1975). A Hand book of Genetics, Plenium Press, New York.
4	Arnold, R.W. (1960). Principles of Plant Breeding. Jolin Wily & Sons, Inc, New York.
5	Benjamin A Pierce (2008). *Genetics: A conceptual approach* (IV Edn). W H Freeman and Company.
6	David R Hyde (2010). *Genetics and molecular biology*. Tata McGraw Hill.
7	Daniel L Hartl, Elizabeth W Jones (2012). *Genetics: Analysis of genes and genomes* (VII Edn). Jones and Bartlett publishers.
8	Sharma J R (1994). *Principles and practices of Plant Breeding*. Tata McGraw-Hill Publishers Company Ltd.

Reference Books

1	William S Klug, Michael R Cummings (2004). *Concepts of Genetics* (VII Edn). Pearson.
2	Roderic D M Page, Edward C Holmes (1998). *Molecular Evolution: A phylogenetic approach*.Blackwell Science Ltd.

3	Maxtoshi Nei, Sudhir Kumar (2000). *Molecular Evolution and phylogenetics*. Oxford University Press.
4	Gurbachan S Miglani (2002). *Modern Synthetic theory of evolution*.
5	Allard R W (1995). *Principles of Plant Breeding*. John Wiley and Sons, Inc.
6	Ghahal G S and Gosal S S (2002). *Principles and procedures of Plant Breeding*. Narosa Publishing House.
7	Singh B D (1996). *Plant Breeding: Principles and methods*. Kalyani Publications.
8	Singh, B.D. 2009.Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi.

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

1	https://blog.feedspot.com/genetics_blogs
2	https://en.wikipedia.org/wiki/Genetic_linkage
3	https://www.khanacademy.org/.../a/linkage-mapping
4	https://www.biologydiscussion.com/human-genetics/..
5	https://www.biologydiscussion.com/genetics/linkage
6	https://www.classcentral.com/report/swayam-moocs-course-list
7	https://swayam.gov.in/nd1_noc19_bt15/preview
8	https://www.classcentral.com/report/list-of-mooc-based-microcredentials
9	https://www.classcentral.com/tag/genetics
10	https://swayam.gov.in/nd2_cec20_bt06/preview
11	https://www.classcentral.com/course/swayam-bio...
12	https://nptel.ac.in/course.html
13	https://www.researchgate.net/publication/320038196
14	https://www.classcentral.com/course/swayam-plant-developmental-biology-14235
15	https://www.classcentral.com/course/best-practice-farming-sustainable-2050-9575
16	https://www.plantbreeding.org/content/online.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	M	M	S	M	S
CO3	M	S	S	M	S	M
CO3	S	M	M	S	M	S
CO4	M	S	S	M	S	M
CO5	S	M	M	S	M	S

*S-Strong; M-Medium; L-Low

Course code		ANATOMY, EMBRYOLOGY AND MORPHOGENESIS	L	T	P	C
Core/Elective/Supportive		Core Paper VII	73	2		4
Pre-requisite		Basic knowledge about the structure and functions of plant growth	Syllabus Version		2023 - 2024	

Course Objectives:

The main objectives of this course are to:

To classify meristems and to identify their structures, functions and roles of apical vs lateral meristems in plant growth.
To describe the function and organization of woody stems derived from secondary growth in dicot and monocot plants.
To highlight the physiological role of endosperm in the morphogenesis of embryo.
To assess the process of seed setting.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the intricacies involved in the reproduction of plants.	K1
2	Gain awareness about the various process of compatibility involved in plant reproduction	K2
3	To explain the importance of secondary growth and to state the location of tissues involved in secondary growth in dicot and monocot plants	K3
4	To state the types of growth and to compare their structure and functions and processes of floral development.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Organization of Meristem	15 hours

General account and theories of organization of meristem. Structural diversity and phylogenetic trends of specialization of xylem and phloem. Cambium - origin, cellular structure, cell division, storied and non-storied types. Cambium in budding and grafting - wound healing. Trichomes, periderm and lenticels.

Unit:2	Anatomical characterization	15 hours

Anatomical characteristics and vascular differentiation in primary and secondary structure of root and stem in Dicot and Monocot. Anomalous secondary growth in *Achyranthus, Mirabilis, Pepper* and *Dracena*. Origin of lateral roots - Root stem transition. Anatomy of Dicot and Monocot leaves. Leaf abscission, stomatal types, nodal anatomy, petiole anatomy, vascularisation of flower.

Unit:3	Embryology	15 hours

Microsporangium - Microsporogenesis, Microspores – arrangement, morphology and ultrastructure. Microgametogenesis – Pollen, stigma incompatibility. Methods to overcome incompatibility. Megasporangium, Megagametogenesis. Female gametophyte – Monosporic - Bisporic and Tetrasporic - Nutrition of embryo sac and fertilization.

Unit:4	Embryo Development	15 hours

Endosperm - Types - Endosperm haustoria - Cytology and physiology of endosperms, functions of endosperms - Embryo development in Dicot and Monocot, Nutrition of embryo - Polyembryony - Causes, Apomixis - Causes, Apospory - Their role in plant improvement programmes and seed development.		
Unit:5	**Morphogenesis**	**13 hours**
Definition - Morphogenesis - Morphogenetic factors - growth regulators - genetic and environment - polarity. Molecular and cellular basis of morphogenesis. Nuclear transplantation experiments with *Acetabularia* - Sach's and Errer's laws - Asymmetric divisions and their significance. Plant galls and their importance in morphogenesis. Leaf development and phyllotaxy; floral meristems and floral development in *Arabidopsis* and *Antirrhinum.*		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**75 hours**

Text Book(s)	
1	Pandey, B. P. (1989). Plant Anatomy. S. Chand and Co. Ltd., New Delhi.
2	Singh, V., Pande, P. C. and Jain, D. K. (1987). Anatomy of Seed Plants. Rastogi Publications, Meerut.
3	Easu, K. (1953). Plant Anatomy. John Wiley & Sons Inc., New York.
4	Agarwal, S. B. (1990). Embryology of Angiosperms - a fundamental approach. Sahitya Bhawan, Agra
5	Bhojwani, S. S. and Bhatnagar, S. P. (1981). Embryology of Angiosperms. Vikas Publishing House Pvt. Ltd., New Delhi
6	Maheswari, P. (1963). An Introduction to Embryology of Angiosperms. International Society of Plant Morphologies, University of Delhi.
7	Bonner, J. T. (1965). Morphogenesis. Oxford & IBH Publications, Bombay.
8	Burgess, J. (1985). An Introduction to Plant Cell Development. Cambridge University Press, London.
9	Murphy, T. M. and Thompson, W. F. (1988). Molecular Plant Development. Prentice Hall of India Pvt. Ltd., New Jersey
Reference Books	
1	Clowers, F. A. L. (1961). Apical Meristems. Blackwell Scientific Publication, Oxford
2	Cutter, E. G. (1978). Plant Anatomy. Edward Arnold Publishers Ltd., London.
3	Fahn, A. (1989). Plant Anatomy. Maxwell Pvt. Ltd., Singapore.
4	Metcalfe and Chalk (1950). Anatomy of the Dicotyledons and Monocotyledons. Vol. I and II. Clarendon Press, Oxford, UK.
5	Dwivedi, J. N. (1998). Embryology of Angiosperms. Rastogi and Co., Meerut.
6	Raghavan, V. (1976). Experimental Embryogenesis in Vascular Plants. Academic Press, London.
7	Bard, J. (1990). Morphogenesis. Cambridge University Press, London.
8	Brouder, L. W. (1986). Development Order: A Comprehensive Treatise. Vol.2. The Cellular Basis of Morphogenesis. Plenum Press, New York.
9	Bryant, J. A. and Francis, D. (1985). The Cell Division Cycle in Plants. Cambridge University Press, London

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://swayam.gov.in/nd1_noc20_bt35/preview
2	https://www.researchgate.net/publication/318394791_Plant_Anatomy_and_Embryology
3	http://www.uou.ac.in/sites/default/files/slm/BSCBO-202.pdf

Mapping with Programme Outcomes						
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	M	S	M	S	M	S
CO3	S	M	S	M	S	M
CO3	M	S	M	S	M	S
CO4	S	M	S	M	S	M

*S-Strong; M-Medium; L-Low

Course code		PLANT TISSUE CULTURE	L	T	P	C
Core/Elective/Supportive		Core Paper VIII	73	2		4
Pre-requisite		Course is intended to known certain fundamental knowledge, principles and practical considerations of plant cell and tissue culture.	Syllabus Version		2023-2024	

Course Objectives:

The main objectives of this course are to:

Successfully maintain cultures of plant cells and established cell culture with good viability, minimal contamination and appropriate documentation.
Perform supportive tasks relevant to cell culture, including preparation and evaluation of media, cryopreservation and recovery, and assessment of cell growth/health.
Recognize and troubleshoot problems common to routine cell culture.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	The lecture time is used to introduce key concepts of cell biology as they relate to manipulating cells in culture, to demonstrate the specific skills used by tissue culture technicians, and to provide the student with information on the applications of tissue culture in modern laboratory settings.	K1
2	Students will simultaneously begin basic plant micropropagation in tissue culture, with attention to differences in culture requirements for different plants	K2
3	Apply the technique of micropropagation such as somatic embryogenesis, organogenesis and protoplast culture for ex situ conservation and mass multiplication of endangered and economically important plants	K3
4	Analyze and relate morphological, physiological and somaclonal variations for crop improvement	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Basic concepts of Plant Tissue Culture	15 hours

Introduction to plant tissue culture. Laboratory requirements and organisation. Sterilization - Media preparation - inorganic nutrients, organic supplements, carbon source, gelling agents, growth regulators and composition of important culture media (MS, Whites and Gamborg's media).

Unit:2	Cell growth requirements	15 hours

Cell, tissue and organ culture - Isolation of single cells, selection and types of cells, tissue explants and organs for culture - Paper, raft nurse technique, Plating method, Microchamber techniques, cell suspension cultures, bioreactor culture. Cytological, cytochemical and vascular differentiations - Totipotency of epidermal and crown – gall cells.

Unit:3	Behavior of cells in Culture	15 hours

Micropropagation - Clonal propagation of elite germplasm, factors affecting morphogenesis and proliferation rate, technical problems in micropropagation. Organogenesis - Role of growth regulators and other factors, somaclonal and gametoclonal variations. Somatic embryogenesis -

synthetic seeds.		
Unit:4	**Methods for generation of haploid plants**	**15 hours**
Haploid production - Androgenesis, gynogenesis. *In vitro* pollination - ovule and ovary culture, importance, embryo rescue. Protoplast culture: Isolation of protoplasts - mechanical and enzymatic sources, culture of protoplasts, viability. Protoplast fusion techniques.		
Unit:5	**Application of plant tissue culture**	**13 hours**
Classification of secondary metabolites, *In vitro* production of secondary metabolities, immobilized cell cultures and biotransformation, elicitors and hairy root culture. Cryopreservation and gene bank - Methods of preservation. Application of tissue culture.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**75 hours**

Text Book(s)	
1	Johri, B. M. (1982). Experimental Embryology of Vascular Plants. Narosha Publishing House, New Delhi
2	Kalyan Kumar, De. (1992). An Introduction to Plant Tissue Culture. New Central Book Agency, Calcutta.
3	Ramawat, K. G. (2000). Plant Biotechnology. S. Chand & Co., New Delhi
4	Razdan, M. K. (2004). Introduction to Plant Tissue Culture. 2nd ed. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
5	Reinert, J. and Bajaj, Y. P. S. (1977). Plant Cell Tissue and Organ Culture: A Laboratory Manual, Narosa Publishing House, New Delhi.
Reference Books	
1	Bhojwani, S. S. and Razdan, M. K. (1983). Plant Tissue Culture: Theory and Practice. Elsevier Science Publishers, Netherlands.
2	Dodds, J. H. and Roberts, I. W. (1985). Experiments in Plant Tissue Culture. Cambridge University Press, UK.
3	Fowler, M. W. (1986). Industrial Application of Plant Cell Culture. In: Yeoman, M. M.(ed.). Plant Cell Culture Technology. Blackwell, Oxford, London.
4	Vasil, I. K. (1986). Cell Culture and somatic Cell Genetics of Plants. 3 Volumes. Academic Press Inc.
5	Hammoond, J., McGarvey, P. and Yusibov, V. (2000). Plant Biotechnology. Springer Verlag, New York.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	http://ugcmoocs.inflibnet.ac.in/ugcmoocs/spoc.php?coordinator=574
2	https://nptel.ac.in/courses/102/103/102103016/
3	https://swayam.gov.in/nd2_cec19_bt01/preview
4	https://swayam.gov.in/nd1_noc19_bt33/preview

Mapping with Programme Outcomes						
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	S	S	S	S	M	S
CO3	S	M	S	M	S	S
CO3	S	S	M	S	S	S
CO4	M	S	S	S	S	M

*S-Strong; M-Medium; L-Low

PRACTICAL - II
(Theory Papers V, VI, VII & VIII)

(Cell and Molecular Biology, Genetics, Evolution and Plant Breeding, Anatomy, Embryology and Morphogenesis and Plant Tissue culture)

Course Objectives:

The main objectives of this course are to:

- To understand the structural and functional organization of an cell and molecule.
- To know genetic analysis at gene, genome and population level
- To sense the variations in the internal structural organization among plants.
- To grasp the knowledge about plant tissue culture

Expected Course Outcomes:		
On the successful completion of the course, student will be able to:		
1	Find out the cell organelles and various stages of the nucleus	K1
2	Apply the basic principles of genetics and plant breeding for genetic improvement of plants.	K4
3	Understand the primary and secondary structure of plants.	K2
4	Acquire and analyze the plant tissue culture techniques	K3
K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create		

Paper V- Cell and Molecular Biology

1. Plant cell, Cell wall, Cell organelles and Nucleus.
2. Root squash in *Allium* and *Chlorophytum* to find out Metaphase and Anaphase stages of mitosis.
3. Pollen mother cell smear in *Allium* and *Rheo* to find out Prophase, Metaphase and Anaphase stages of meiosis I.
4. Karyotyping and chromosome banding techniques in *Allium*.

Paper VI- Genetics, Evolution and Plant Breeding

1. Dihybrid phenotypic, genotypic and testcross ratios.
2. Incomplete dominance in plants.
3. Interactions of factors and modified dihybrid ratios.
4. Multiple alleles in plants, blood group inheritance in human.
5. Sex linked inheritance in *Drosophila* and plants.
6. Quantitative inheritance in plants.
7. Tetrad analysis in *Neurospora*.
8. Complementation analysis to find out complementation groups.
9. Recombination mapping in bacteria.
10. Calculation of recombination frequency.
11. Chromosome mapping from three point test cross data. Calculation of chiasmatic Interference - coefficient of coincidence.
12. Calculate gene and genotypic frequency by Hardy- Weinberg equation.
13. Emasculation; preparation of the inflorescence for crossing.

Paper VII – Anatomy, Embryology and Morphogenesis

1. Shoot apices by dissection using aquatic plants such as *Ceratophyllum* and *Hydrilla*.
2. Anomalous structures of types mentioned in the syllabus
3. Nodal anatomy of dicot stem to find out unilacunar and multilacunar nodes.
4. Root-stem transition in *Mirabilis*, *Cucurbita* and *Lathyrus.*
5. Maceration of herbaceous and woody stems- separation of different cell types.
6. Wood elements in members of Nympheaceae and Araceae.
7. Sclereids in *Nymphea* leaf, Sapota fruit and Bean testa
8. Preparation of double stained free hand sections and identification of the tissues with reasons (Normal or Anomalous secondary thickening). Submission of double stained 5 hand section slides.

Embryology:

1. Microsporogenesis in sections of anthers.
2. Estimation of pollen sterility and fertility percentage.
3. Pollen germination: *in vitro* and *in vivo* viability tests.
4. Embryo sac development through examination of permanent, stained serial sections.
5. Dissection of Embryo - *Abelmoschus, Cyamopsis, Tridax*
6. Mature embryos of monocot and dicot.
7. Dissection of endosperm haustoria - *Cassia, Cucumis, Peltophorum*

Morphogenesis

1. Morphology and anatomy of fungal gall (Club - Root of Cabbage)
2. Morphology and anatomy of insect gall (*Syzygium* and *Pongamia* leaf -gall).

Paper VIII- Plant Tissue Culture

1. Preparation of stock solutions for tissue culture
2. Preparation of solid and liquid media for test tube cultures and petri plate
3. Callus induction and suspension culture.
4. Encapsulation of embryos using sodium alginate Techniques of hardening
5. Visit to commercial tissue culture R&D green houses.

Mapping with Program Outcomes						
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	S	S	S	S	S	S
CO3	S	M	S	S	S	S
CO3	M	S	S	S	M	S
CO4	S	S	M	S	S	S

*S-Strong; M-Medium; L-Low

Course code		HORTICULTURE	L	T	P	C
Core/Elective/Supportive		Elective Paper II	58	2		4
Pre-requisite		Basic knowledge on horticultural crop plants regarding classification, cultivation, propagation and its applications gained during undergraduate course	Syllabus Version		2023 - 2024	

Course Objectives:

The main objectives of this course are to:

To develop understanding of growth and development of horticultural crops which have implication in their management.
To impart knowledge about the principles and practices in canopy management of horticultural crops.
Familiarization with principles and practices of propagation and nursery management for fruits and vegetable crops.
To impart comprehensive knowledge about the principles and practices of breeding of horticultural crops.
To facilitate deeper understanding on principles and practices of postharvest management of crops.
To develop understanding of organic horticulture production.
To understand the principles of biodiversity and strategies in germplasm conservation of horticultural crops.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Imparting quality education.	K1
2	Understanding the principles, theoretical aspects and developing skills in biotechnology of horticultural crops.	K2
3	Development of technical manpower to cater the need of government, corporate, quasi government and research organizations both in India and abroad in horticulture.	K3
4	To update knowledge on the recent research trends in the field of breeding of fruit crops with special emphasis on tropical, subtropical and temperate crops grown in India.	K4
5	To update knowledge on the recent research trends in the field of biotic and abiotic stress management in horticultural crops.	K4
6	The subject provides knowledge about different techniques of biology and Gene level.	K5
7	Vital step to sustain the Golden Revolution in India.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	INTRODUCTION TO HORTICULTURE	12 hours

Scope and importance of horticulture - Divisions of horticulture. Climate, soil and nutritional needs – types of irrigation; Chemical fertilizers, organic fertilizers and bio fertilizers. Plant propagation method - Stock - scion relationship, micropropagation by induction of rooting.

Unit:2	GARDENING	12 hours

Principles and methods of designing indoor and outdoor garden - Lawn making and maintenance;

Water garden - cultivation of water plants. Layout for a model college garden - Bonsai technique - Training and pruning of garden plants.		
Unit:3	**CULTIVATION OF CROP PLANTS - I**	**12 hours**
Floriculture - cultivation of commercial flower crops - Tuberrose, Lilium and Chrysanthemum, Flower decoration - Dry and wet decoration. Pomology – cultivation fruit crops– Pineapple, Grapes and Guva - spacing, irrigation, field disease control.		
Unit:4	**CULTIVATION OF CROP PLANTS – II**	**10 hours**
Fruit crops - Induction of flowering, flower thinning, fruit setting, and fruit development. Olericulture – classification of vegetables– Drumstick, Ginger, Potato, Cabbage, Dolichos lab lab and Snake guard. Layout for a model kitchen garden. Cultivation of tree species - Eucalyptus and Teak. Erosion control.		
Unit:5	**CROP MANAGEMENT**	**12 hours**
Pest and weed management - Weed problem and ecological perspective, biological control of weeds in Indian region. Glass houses – growth regulators in horticulture, growth retarders, sex modification, flower induction, parthenocarpy, harvesting, seed storage, preservation of fruits and vegetables.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**60 hours**

Text Book(s)

1	Arora, J. S. (1992). Introductory Ornamental Horticulture. Kalyani Publishers, New Delhi.
2	J. B. *et al*. (1977). Fundamentals of Horticulture. Tata McGraw Hill Publishers Co. Ltd., New Delhi.
3	Kumar, N. (1987). Introduction to Horticulture., Rajalakshmi Publishers, Nagercoil.
4	ManibushanRao, K. (1991). Textbook of Horticulture. Macmillan Publishing Co., New York.
5	ao, K. M. (2000). Text Book of Horticulture. Macmillan India Ltd., New Delhi.
6	lanibushanRao .2005. Text of Horticulture. Second edition. Macmillan India Ltd., New Delhi
7	Nanda and Kochar. 1984. Vegetative propagation of plants.kalyani publishers.
8	Randhava G. S.2004. Floriculture in India.Allied publishers Pvt.Ltd.
9	SubbaRao.1988. Bio fertilizers in Agriculture. Oxford &IBH publisher.

Reference Books

1	Al David. 1987. A complete guide to gardens. TFH publications.
2	Schegal, H. E. (1986). General Microbiology. Cambridge University, London.
3	Sharma, P. D. (1992). Microbiology. Rastogi& Co., Meerut.
4	Vishnu Swarup .2003. Garden flowers.National BookTrust,India.
5	Readers digest – Complete library of gardens (3 volumes) Kissan world.
6	Borthkur S. and Ghen – Studies on weeds and their control. Reinert and Bajaj 1977 – Plant cell, tissue and org an culture, Narosa publication. New Delhi.
7	Arnold, R.W. (1960). Principles of Plant Breeding. Jolin Wily & Sons, Inc, New York.

8	Swaminathan, M.S. And Jana.S (1992). Biodiversity. Mac Millan, India Press, Madras.
9	George Acquaah. (2002). Horticulture Principles and Practices. 2nd ed. Pearson Education, Delhi.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	http:nptel.ac.in
2	https://swayam.gov.in
3	Agriicarjrf.com
4	tnhorticulture.tn.gov.in

Mapping with Programme Outcomes						
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	S	S	S	S	M	S
CO3	S	S	S	M	S	M
CO3	S	S	S	S	M	S
CO4	M	S	S	M	S	M
CO5	S	S	S	S	S	S
CO6	S	S	S	S	S	S
CO7	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Third Semester

Course code		PLANT TAXONOMY	L	T	P	C
Core/Elective/Supportive		Core Paper IX	73	2		4
Pre-requisite		Known about the biosystematics position of plant	Syllabus Version		2023 - 2024	

Course Objectives:

The main objectives of this course are to:

To study about the classification and nomenclature of Angiosperms
To understand the theory and practices involved in plant systematics
To learn the striking affinities of different plant families

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Classify Plant taxonomy and recognize the importance of herbarium	K1
2	Evaluate the Important herbaria and botanical gardens	K2
3	Interpret the rules of ICN in botanical nomenclature	K3
4	Assess terms and concepts related to Phylogenetic Systematics	K4
5	Generalize the characters of the families according to Bentham & Hooker's system of classification	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	OUTLINES OF MORPHOLOGICAL CHARACTERS	13 hours

Historical account of the classification of angiosperms. Systems of plant classification- Bentham and Hooker system of classification, Engler and Prantl Classification, Takhtajan classification and APG IV classification (outline only). General evolutionary trends in all aspects. Herbarium techniques. Flora and Monograph. Construction of taxonomic keys (indented and bracketed). A brief account of BSI and its role. Botanical gardens. Source of taxonomic information

Unit:2	BIOSYSTEMATIC	15 hours

International code of Botanical Nomenclature, Typification, Effective and Valid publication. Scientific names. Biosystematic- its aim and scope; its categories. Turrreson's work. Population concept. Modern concepts and trends in plant taxonomy. Molecular taxonomy – DNA Bar-coding and molecular phylogeny. Phenetic methods in taxonomy. principles, construction of taxonomic groups, OTU(Operational Taxonomic Unit) characters- coding, measurement of resemblances, cluster analysis, phenons and ranks, discrimination, nomenclature and numerical taxonomy, applications, merits and demerits. Cladistics and cladogram, parsimony analysis, cladastics.

Unit:3	SYSTEMATIC POSITION OF PLANTS	15 hours

Morphological variations, systematic position, Interrelationships, phylogeny and economic Importance of following families: Ranunculaceae, Nymphaceae, Menispermaceae, Cruciferae, Caryophyllaceae, Oxalidaceae, Combretaceae, Aizoaceae.

Unit:4	SYSTEMATIC POSITION OF PLANTS	15 hours

Morphological variations, systematic position, Interelationships, phylogeny and economic Importance of following families: Oleaceae, Gentianaceae, Scorphulariaceae, Bignoniaceae,

Verbanaceae, Boraginaceae.		
Unit:5	**SYSTEMATIC POSITION OF PLANTS**	**15 hours**
Morphological variations, systematic position, Interelationships, phylogeny and economic Importance of following families: Moraceae, Nyctaginaceae, Chenopodiaceae, Loranthaceae, Amaryllidaceae, Zingiberaceae, Aroideae, Cyperaceae. Economic importance of families mentioned. Special emphasis should be given on morphological and phylogenetic interrelationships, recent revisions and rearrangements between and within the families, and its critical analysis.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**75 hours**

Text Book(s)

1	An introduction to plant Nomenclature. 1979.S.S.R. Bennet international Book distribution India.
2	Principles of angiosperm Taxonomy. 1973.Devis & Hey wood Krieger publication Co.
3	Plant Taxonomy and Biosystematics. 1989.Stace Clive. A Edward Arnold.
4	Plant Systematics. 2012.Gurucharan Singh. Oxford & IBH Pvt. Company.
5	Bhattacharyya, B. (2005). Systematic Botany. Narosa Publishing House, New Delhi.
6	Dahlgren, R. (1984). The Families of Monocotyledons: Structure, Evolution and Taxonomy. Springer Verlag
7	Gamble, J. S. (1933). Flora of the Presidency of Madras. Botanical Survey of India, Calcutta
8	Heywood, V. H. (ed.) (1968). Modern Methods in Plant Taxonomy. Academic Press,New York.
9	Lawrence, G. H. M. (1944). Taxonomy of Vascular Plants. Oxford & IBH Publications,New Delhi
10	Pandey, B. P. (2007). Economic Botany. S. Chand & Co. Ltd., New Delhi.
11	Pandey, B. P. (2007). Taxonomy of Angiosperms. S. Chand and Co. Ltd., New Delhi
12	Porter, C. L. (1967). Taxonomy of Flowering Plants. Euasia Publishing House,NewDelhi.
13	Sambamurthy, A. V. S. S. and Subramanian, N. S. (1989). A Text Book of EconomicBotany. Wiley Eastern Ltd., New Delhi.
14	Samuel, B. Jones Jr. and Arlene E. Luchsinger (1987). Plant Systematics. 2nd ed. McGraw Hill Publishing Co. Ltd., New Delhi.
15	Singh, V. and Jain, K. K. (1989). Taxonomy of Angiosperms. Rastogi Publications,Meerut

Reference Books

1	A classification of flowering plants.1938. Vol. I & II Rendle A.R. Cambridge University press.
2	Taxonomy of vascular plants.1951. Lawerance.H.M. Mac Millan & Co.

3	Plant Taxonomy.1967.Hey wood, V.H. English hand book society
4	Principles of Numerical Taxonomy. 1973.Sokal, S.R and Sneath P.H, N.H Fremen &Co.
5	New concepts in flowering plants taxonomy. 1960. Heslop. J. Herrison.Heinemann publishers
6	Principles and methods of Plant Biosystematics.1970.Solbrig. The Mac Millian Company
7	An aid to the International code of Botanical. 1980.Hentry A.N. Today & Tomorrow Pvt. Ltd.
8	Introduction to Principles of Plant Taxonom. 1984. Sivarajan. Oxford & IBH Pvt.cpy.
9	A hand book of field and Herbarium methods.1978.Jain S.K. and Rao R.R. Today and Tomorrow Publications
10	Davis, P. H. and Heywood, V. H. (1967). Principles of Angiosperm Taxonomy. Oliver and Boyd, London.
11	Greuter, W. *et al*. (1989). International Code of Botanical Nomenclature. International Association of Plant Taxonomy, Leiden
12	Hutchinson, J. (1969). The Genera of Flowering Plants. Clarendon Press, Oxford, UK.
13	Jeffery, C. (1969). An Introduction to Plant Taxonomy - J & A Churchill Ltd., London.
14	Takhtajan, A. L. (1969). Flowering Plants: Origin and Dispersal. Oliver & Boyed, UK.
15	Vashista, P. C. (2006). Taxonomy of Angiosperms. S. Chand and Co. Ltd., New Delhi.

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

1	https://courses.botany.wisc.edu/botany_400/PlantSystematics.html
2	https://www.youtube.com/embed/SNV9omPCo0U
3	https://www.swayamprabha.gov.in/index.php/program/archive/9
4	https://www.britannica.com/plant/angiosperm
5	https://en.wikipedia.org/wiki/Flowering_plant
6	https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book:_Concepts_in_Biology_%28OpenStax%29/14:_Diversity_of_Plants/14.4:_Seed_Plants:_Angiosperms
7	https://basicbiology.net/plants/angiosperms

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	S	S	S	S	S
CO3	S	S	S	S	S	S
CO3	S	S	S	S	S	S
CO4	S	S	S	S	S	S
CO5	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		MEDICINAL BOTANY	L	T	P	C
Core/Elective/Supportive		Core Paper X	73	2		4
Pre-requisite		Basic knowledge on Medicinal plants and its applications gained during undergraduate course.	Syllabus Version		2023 - 2024	

Course Objectives:

The main objectives of this course are to:

To promote good health by teaching the students about diet and nutrition.
To create employment facilities.
To educate Intellectual Property Rights of Herbs and Herbal Medicines.
To identity rare / endangered Medicinal Plants.
Documentation of the drugs and methods used by traditional healers.
To develop awareness for utilization of herbal medicines for home remedies.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	On the successful completion of this course students will able to know recent trends in plant science and its applications.	K1
2	Be able to navigate the current healthcare environment, empower clients to make informed choices and refer when appropriate.	K2
3	To know the marketing level and self-help entrepreneurship.	K3
4	This supportive course is exposure knowledge about important chemicals of medicinal plants and their significant role in drug discovery.	K4
5	Gain knowledge about nutritive diet for different age groups.	K5
6	Acquire knowledge about healthy food for normal person and patient.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	INTRODUCTION TO MEDICINAL BOTANY	15 hours

Historical background, Present status, Scope of medicinal botany. Indigenous medicinal system – Bioprospecting, Indigenous knowledge system, Ayurveda, Siddha, Unani, Homeopathy. Traditional and Folklore system of medicine. Need to preserve knowledge system. Ethnobotany – definition, its significance within the limits of the state and nation. Conservation of rare heritage from global point of view.

Unit:2	ETHNOBOTANY	15 hours

Landmarks in history of ethnobiology – relation between geology, phytogeography and ethnobotany. Linkage of Ethno botany with other sciences and disciplines in biology – food and nutrition, medicine, sociological and cultural practices, religions and social costumes and economic relations, archaeology, history and politics. Major tribes of South India and their ethnobotanical and ethno-biological heritage – Parayar, Kurichiar, Paniyar, Mulla, Karuman, Kanikkars, Naikas, Shola Naikas, Thodas, Kothas, Kurumbas, Irullas, Kattu Naikas.

Unit:3	PHARMACOGNOSY	15 hours

Introduction and History of Pharmacognosy. Natural source of Drugs- Crude drugs,

Classification of Crude drugs, Collection and Processing of Crude drugs. Phytoconstituents of therapeutic value, Histochemical tests for phytochemicals. Analytical Pharmacognosy – Anatomical features of selected medicinal plants (Senna leaf, Datura leaf, Cinchona bark, Nuxvomica seed). General methods of phytochemicals and biological screening, Natural sources, Extraction, isolation and purification of Primary and Secondary metabolites. Study of some herbal formulation techniques as drug cosmetics.		
Unit:4	**POST HARVEST MANAGEMENT**	**15 hours**
Post harvest technology of medicinal plants. Importance of post harvest technology in medicinal crops. Factors responsible for deterioration of medicinal plants. Pre and post harvest factors. Systems of storage of harvested produce, packing principles and method of processing. Important medicinal products- Essential oils, volatile and non-volatile oils, oleo resins-active principles.		
Unit:5	**CONSERVATION OF MEDICINAL PLANTS**	**13 hours**
Distribution of Indian medicinal plants; Introduction and important of medicinal plants, eco distribution, mapping distribution in different biogeographic zones. Ethnobotany and conservation of plants with special reference to India. Conservation of ecosystems, sacred groves, forestry and unique ecosystems and their ethnobiolgical values, plants and animals in art, tradition and ethnography: methodologies in ethno-botanical research. Centers of medicinal plant conservation in India- IBPGRI, CIMAP, CDRI, NBPGR, MSSRF, KFRI, TAMPCOL, TBGRI, TKDL and FRLHT.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**75 hours**

Text Book(s)

1	"Ethnobiology in human welfare: - abstracts publish ed symposium volume under print – IV international Congress of Ethnobilogy – 1994. organized by society of Ethnobotanists, national botanical research institute, Lucknow – 226001.
2	Murthy A.V.S & N.S. Subramanian, 1989. "The Book of economic botany"' Wiley Easterns, New Delhi
3	Sivarajan V.V. and Indira Balachandran. 1994. "Ayurvedic drugs and their plant sources", Oxford – IBH, Bangalore.
4	Swain, T.1963. Plant Taxonomy and Biosytematics, Edward, Arnold, London.
5	Akerele, O.O. Heywood, V. and Singe, H.1991. Conservation of medicinal plants. Cambridge University Press, U.K.
6	Cutler, S.J. and Cutler , S.H.G. 2000. Biologically active natural Products- Pharmaceuticals. CRC Press, USA.
7	Swaminathan, M.S and Kochar, S.L. 1989. Plants and Society. McMillan Publisher, London.

Reference Books

1	Ariyar, Yegna Narayana A.K. 1980. "Field crops of I ndia", Bangalore – Printing and Publishing company – Bangalore.
2	Manilal K.S. 1990. "Linkages of ethnobotany with ot her sciences and disciplines", ethnobotany 1(1):14-23.
3	Manilal K.S. 1981. "Hortus malabaricum, Indian ethn obotany and Carmelite Missionaries", in The Christian heritage of Kerela, Ed. K.J ohn, Fr.G.

4	Burkil I.H. 1965. “Chapters on the history and bota ny in India”. Botanical Survey of India, Calcutta.
5	Natesh, S. 2001. The changing scenario of herbal drugs: Role of Botanist. Phytomorphology. (Golden Jubilee Issue). Pp.75-79.
6	Muthchelian, K. 2013. Yuirviriman. Monisha Publisher, Madurai, (Tamil Version).
7	Ariyar, Yegna Narayana A.K. 1980. “Field crops of I ndia”, Bangalore – Printing and Publishing company – Bangalore.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	libguides.com/bio108online
2	https://swayam.gov.in
3	http://nptel.ac.in
4	https://www.fs.fed.us
5	https://nmpb.nic.in
6	https://medicinalplants.insightconferences.com
7	https://en.m.wikipedia.org
8	https://researchguides.uic.edu>c.php
9	https://www.loc.gov>herbalmedicine

Mapping with Programme Outcomes						
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	S	M	M	S	M	S
CO3	M	S	S	M	S	M
CO3	S	M	M	S	M	S
CO4	M	S	S	M	S	M
CO5	S	S	M	S	M	S
CO6	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Course code		PLANT PHYSIOLOGY	L	T	P	C
Core/Elective/Supportive		Core Paper XI	73	2		4
Pre-requisite		To Known Basic Physiological Conditions Of Plants	Syllabus Version		2023 - 2024	

Course Objectives:

The main objectives of this course are to:

To know about the physiology of plants
To obtain knowledge on metabolism of plants
To analyze the seed dormancy

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Recognize the plant, water and mineral interaction	K1
2	Understand the remarkable metabolic pathway in plants.	K2
3	Improve to phytohormones in plants.	K3
4	Estimate the stress resistance mechanism for the better yield of thecrops.	K4
5	Implement the seed dormancy in the fields.	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Particles Movements in Plants	13 hours

Diffusion, Osmosis, Physicochemical properties of water, chemical potential and water potential in the plant, bulk movement of water, Imbibition, soil-plant atmosphere continuum, Transpiration, stomatal mechanism and regulation. A General account of absorption and translocation of water - assimilates. Modern concepts of mineral absorption and translocation.

Unit:2	Photosynthesis	15 hours

Photosynthesis - pigment systems. Electron carriers – photophosphorylation - Carbon fixation in C_3 and C_4 plants - CAM pathway - Photorespiration . Respiration- Aerobic and Anaerobic; Cycles of respiration - Glycolysis - TCA cycle - electron transport system coupled with Oxidative phosphorylation.

Unit:3	Metabolisms and Hormones	15 hours

Nitrogen metabolism - Nitrate and ammonium assimilation; amino acid biosynthesis. Mechanism of nitrogen fixation, Nitrogen uptake and assimilation. Plant growth regulators, their mode of action and effects- Auxin, Gibberellins, Cytokinin, Ethylene, ABA. Phytochrome and hormones in movements and flowering. Physiology of dormancy break. Senescence and aging. Effect of water and salt stress on crop production.

Unit:4	Photobiology and Stress	15 hours

Sensory photobiology - Structure, function and mechanisms of action cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks. Solute transport and photoassimilate translocation – uptake, transport and translocation of water, ions, solutes and macromolecules; transpiration; mechanisms of loading and unloading of photoassimilates. Stress physiology – Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature

and salt) stresses		
Unit:5	**Seed Physiology**	**15 hours**
Physiology of seed/ grain development-phases of growth and growth curves. Synthesis and accumulation of starches in developing cereal grains; proteins in developing legume seeds; fatty acids, lipids/ oils in developing oily seeds. Physiology of seed dormancy and germination, types of seed dormancy; physical and chemical methods to overcome seed dormancy. Seed germination- role of hydrolytic enzymes in degradation of starches, storage protein and lipids/oils in storage organs and translocation of hydrolysed products to the developing embryonal axis.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**75 hours**

Text Book(s)	
1	Verma, V. 2007. Text book of plant physiology. Ane books pvt. Ltd.
2	Malick, C. P. 2010. Text book of plant physiology. Kalyani publisher
3	Mukherji, S. 1995. Text book of plant physiology. Tata McGraw-hill education private Ltd.
4	Singh, Sp. 2001. Text book of plant physiology. Academic internet publishers.
5	Srivastava, H. S. 2005. Text book of plant physiology. Rastogi Publications
6	Srivastava, H. S. 2005. Text book of plant physiology. Rastogi Publications.
7	Verma, V. 2006. Text book of plant physiology. Ane books pvt. Ltd.
8	Jain, V. K. 2005. Fundamentals of plant physiology. S. Chand and company Ltd
9	Jain, V. K. (2007). Fundamentals of Plant Physiology. S. Chand & Co., New Delhi.
10	Leopold, A. C. (1973). Plant Growth and Development. Tata McGraw Hill Publishing Co. Ltd., New Delhi.
11	Noggle, R. and Fritz, G. I. (1989). Introductory Plant Physiology. 2nd ed. Prentice Hall, New Delhi.
12	Verma, S. K. (1999). Plant Physiology. S. Chand & Co., New Delhi.

Reference Books	
1	Devlin, R. M. (1969). Plant Physiology. Van Nostrand, Reinhold Co., New York.
2	Fang, F. K. (1982). Light Reaction Path of Photosynthesis. Vol. 35. Molecular Biology, Biochemistry and Biophysics. Springer Verlag
3	Meyer, Anderson and Bonning (1965). Introduction to Plant Physiology. D. Van Nostrand
4	Norton, G. (1978). Plant Proteins. Butterworth, London..
5	Palmer, J. M. (ed.). (1984). The Physiology and Biochemistry of Plant Respiration.Cambridge University Press, UK
6	Salisbury, F. B. and Ross, E. (1992). Plant Physiology. Wadsworth, Belmont, California, USA.
7	Bewley, J.D and M. Black (1978). Seed biology Vol. I & II Academic press, New York.
8	Bewley, J.D and M. Black (1985). (Eds.) Seeds; Physiology of development and

	germination plenum Press: New York.
9	Murray, D.R. (1984). (Ed.) Seed physiology Vol I & II Academic Press: Sydney –New York-London
10	Fang, F. K. (1982). Light Reaction Path of Photosynthesis. Vol. 35. Molecular Biology, Biochemistry and Biophysics. Springer Verlag.
11	Well J.H. (1990). (Ed.) General Biochemistry Wiley Eastern Limited, New Delhi.
12	Metha S.L. Lodha, M.L. and Sane P.V. (1993). (Eds.) Recent advances in Plant Biochemistry. Publication and information division ICAR, New Delhi.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://swayam.gov.in/nd2_cec19_bt09/preview
2	https://learn.careers360.com/biology/plant-physiology-chapter
3	https://www.youtube.com/watch?v=OW2nOkf3f9w
4	https://youtu.be/EycfjSrI7Tc
5	https://youtu.be/OW2nOkf3f9w
6	swayamprabha course in plant physiology

Mapping with Programme Outcomes						
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	S	S	M	S	S	S
CO3	S	S	S	M	S	M
CO3	S	M	S	S	S	S
CO4	S	S	S	M	S	S
CO5	S	S	S	S	M	S

*S-Strong; M-Medium; L-Low

Course code		PHYTOCHEMISTRY	L	T	P	C
Core/Elective/Supportive		Core Paper XII	73	2		4
Pre-requisite		Students Known the Nomenclature of macromolecules and Biological Pathway	Syllabus Version		2023 - 2024	

Course Objectives:

The main objectives of this course are to:

Biochemical organization of cell and different types of macromolecules, their structure and function.
The student is able to understand different metabolic pathways
Practical exercises are designed to make the student relate the theoretical aspects to enzymes, their nomenclature, kinetics and functions
To learn the student known the application and acquire laboratory skills Biological significance of co-enzymes and minerals.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Explain basic metabolic pathways of plants and formation of different secondary metabolites through various biosynthetic pathways in plants	K1
2	Utilization of radioactive isotopes in the investigation of biosynthetic pathways	K2
3	Acquire knowledge on properties and nature of macromolecules	K3
4	Apply current biochemical techniques to plan and carry out their experiments.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	MACROMOLECULES	15 hours

Structure of atoms, molecules and chemical bonds. Chemical bonds: Ionic bond, Covalent bond, Vander Vaal's forces, hydrogen bonding and hydrophobic interactions. Bonding in organic molecules. Effect of bonding on reactivity. Polarity of bonds. Bond length. Bond angle. Dissociation and association constant. Bioenergetics: Concepts of free energy, Thermodynamic principles in Biology. Energy rich bonds. Coupled reactions and group transfers. Biological energy transducers. Chemistry of biological molecules. Carbohydrates- Classification and structure.

Unit:2	METABOLIC PATHWAYS	15 hours

Amino acids- Classification, structure and composition, Metabolism of amino acid. Proteins: Classification, structure (Primary structures – Peptide bond, N and C terminals), secondary (types of Bonding in secondary structures) and tertiary structures (types of bonding in tertiary structure). Conformation of proteins (Ramachandran plot, secondary structure, domains, motif and folds). Physical and chemical properties of proteins.

Unit:3	NOMENCLATURE OF ENZYMES	15 hours

Nomenclature, classification and properties of Enzymes. Mechanism of enzyme action (Lock and key & induced fit model) and factors affecting enzyme activity (substrate, pH and temperature). Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes.

Unit:4	**METABOLIC PATHWAY**	**15 hours**
Classification of lipids, saturated and unsaturated lipids. Structure of simple lipids (Fats and Oils), compound Lipids (Phospholipids) and derived Lipids (carotenoids). Oxidation and biosynthesis of any one fatty acid. Structure, composition and metabolism of Nucleic acids. Structure, importance, source, deficiency and symptoms of water soluble and fat soluble vitamins.		
Unit:5	**BIOSYNTHETIC PATHWAY**	**13 hours**
Secondary metabolites- A general account. Biosynthesis and function of lignins, suberins, terpenes, phenols, alkaloids, flavonoids. Biologically important phenolic compounds (phenols, tannins & flavonoids), terpenoids (essential oils, gibberellins and steroids), alkaloids and glycosides. Integration of metabolic pathways.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**75 hours**

Text Book(s)

1	Campbell, M.K. 1999. Biochemistry, Saunders College Publishing, New York.Harborne, J.B. 1999. Plant Biochemistry. Chapman & Hall, New Delhi
2	Jain, J.L. 2005. Fundamentals of Biochemistry. S. Chand & Co. New Delhi
3	Satyanarayana, U. 2005. Biochemistry. Books and Allied (P) Ltd. Calcutta.
4	Conn E.E. and P.K. Stumpf. 1987. – Outlines of Bioc hemistry, Wiley Eastern Ltd, Chennai.
5	Lehninger, A.I. 1987. Biochemistry, Kalyani Publishers, New Delhi
6	Veerakumari, I. 2004. Biochemistry, MJP Publishers, Chennai
7	Blonstein, A. B. and King, P. J. (1987). A Genetic Approach to Plant Biochemistry.Narosa, New Delhi.

Reference Books

1	Plummer, D.T. 1996. An introduction to practical biochemistry. McGraw Hill.
2	Brett, C. T. and Hillman, J. R. (ed.) (1985). Biochemistry of Plant Cells Walls. Cambridge University Press, UK.
3	Cohn, E. E. and Stumpf, P. K. (1994). Outlines of Biochemistry. Wiley Eastern Ltd.,New Delhi
4	Goodwin, F. W. and Mercer, F. I. (1983). Introduction to Plant Biochemistry. 2nd ed. Pergamon Press, New York.
5	Keshav Trehan (1987). Biochemistry. Wiley Eastern Ltd., New Delhi.
6	Lehinger, A. L. *et al.* (1993). Principles of Biochemistry. CBS Publishers, New Delhi.
7	Stryer, L. (1995). Biochemistry. 4th ed. W. H. Freeman Co., New York.

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

1	https://www.swayam.gov.in/nd1_noc20_cy33/preview
2	https://www.swayam.gov.in/nd1_noc20_cy22/preview
3	https://www.google.com/url?sa=i&url=https%3A%2F%2Fswayam.gov.in%2Fnd2_cec20_bt12%2Fpreview

Mapping with Programme Outcomes						
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	S	M	M	S	S	S
CO3	S	S	S	M	S	S
CO3	S	M	S	S	M	S
CO4	M	S	S	S	S	M

*S-Strong; M-Medium; L-Low

PRACTICAL - III

(Theory Papers IX & X)

(Plant Taxonomy and Medicinal Botany)

Course Objectives:

The main objectives of this course are to:

- To identify selected taxa using taxonomic keys.
- To understand the medicinal plants with their potential

Expected Course Outcomes:		
On the successful completion of the course, student will be able to:		
1	Obtain knowledge identification and external morphology of plants.	K2
2	To expertise the ethnobotany investigation and pharmacognosy analysation and conservation of medicinal plants	K5
K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create		

Paper IX – Plant Taxonomy

1. Diagnostic characters and Economic importance of families included in the syllabus.
2. Preparation of artificial key for any 5 families mentioned in the syllabus.
3. Submission of 50 herbarium sheets with binomial, family and economic importance.
4. Submission of 30 herbarium specimens with field note book and tour report.
5. The students should undertake as part of their course a tour and field study of botanical gardens, research institutes and natural vegetation under the guidance of the staff for three to five days within the state and neighboring states.

Paper X. Medicinal Botany

1. Collection and identification of 100 medicinal plant parts used in different systems of medicine.
2. Submission of 20 medicinal plant herbarium sheets specifically used by tribal medicine. Mention the name of tribe, vernacular and botanical name of plant, name of ailment, mode of preparation of drug and application.

Mapping with Programme Outcomes						
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	S	S	S	M	S	S
CO2	S	M	S	S	S	M

*S-Strong; M-Medium; L-Low

Course code		BIOINSTRUMENTATION AND BIOLOGICAL TECHNIQUES	L	T	P	C
Core/Elective/Supportive		Elective III	58	2		4
Pre-requisite		To know the principles and operational techniques of bioinstruments	Syllabus Version	2023-2024		

Course Objectives:

The main objectives of this course are to:

The course is aimed to acquaint the students with various techniques used in biological sciences
The emerging areas of biotechnology along with underlying principles
To make students learn about modern instruments for various analytical works.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	To apply the concepts of bioanalytical techniques in biotechnology research	K1
2	To handle these bioanalytical techniques in industry	K2
3	To operate and optimize the experimental conditions of different analytic techniques	K3
4	To implement knowledge for the separation of bioentities.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Microscopy and Mounting	12 hours

Microscopy- light microscopy, scanning and transmission microscopes, different fixation and staining techniques for EM, Flurocytometry and immune fluorescence microscopy, detection of molecules in living cells, in situ localization by techniques such as FISH and GISH.

Unit:2	Bioinstrumentation	12 hours

Principle and applications of pH meter , Centrifugation (Clinical, High speed, Micro and Ultra centrifuges), Colorimetry - UV visible - Spectrophotometer , Photometry - Flame photometer, Infrared Spectrophotometry (IR), Atomic Absorption Spectroscopy (AAS), Nuclear Magnetic Resonance (NMR) and MASS. Molecular analysis using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy.

Unit:3	Chromatography	12 hours

Chromatography - principles and applications of Thin Layer Chromatography (TLC), High Performance Thin Layer Chromatography (HPTLC), Column Chromatography, Ion-Exchange Chromatography, Affinity Chromatography, Gel Permeation Chromatography or Gel Filtration, Gas Chromatography (GC), Liquid Chromatography (LC), Liquid Chromatography and Mass Spectrum (LC-MS), Gas Chromatography and Mass Spectrum (GC-MS), High Performance Liquid Chromatography (HPLC).

Unit:4	Electrophoresis techniques	12 hours

Principles and applications of Moving Boundary Electrophoresis, Zone Electrophoresis, Paper Electrophoresis, Gel Electrophoresis (Starch gel Electrophoresis, Agar Gel Electrophoresis, Agarose Gel Electrophoresis, Submarine Gel Electrophoresis, Preparative Electrophoresis, Pulse Field Electrophoresis, Field Inversion Gel Electrophoresis, Polyacrylamide Gel Electrophoresis, Isoelectric Focusing, Continuous Flow Electrophoresis, Capillary Electrophoresis, Immuno

Electrophoresis, Analysis of Bands, Direct Photometric Scanning, Staining methods, Gel Documentation System, Autoradiography, Enzyme assay, Immunological methods and Blotting techniques.		
Unit:5	**Radiolabeling techniques**	**10 hours**
Radiolabeling techniques- Detection and measurement of different types of radioisotopes normally used in biology, incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material, safety guidelines. Definition, history, components and types of Biosensors.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**60 hours**

Text Book(s)

1	M.Daniel (2003). Basic Biophysics for Biologist. Agrobios (India), Jodhpur.
2	L.Veerakumar (2006). Bioinstrumentation. MJP Publisher, Chennai
3	Dwivedi, J. N. and Singh, R. B. (1985). Essential of Plant Technique. Scientific Publications, Jodhpur.
4	Jayaraman, J.1981. Laboratory Manual in Biochemistry. Wiley Eastern Ltd., New Delhi
5	Krishnamurthy, K. V. (1988). Methods in Plant Histochemistry. S. Viswanathan & Co.,Madras
6	Sass, J. E. (1967). Botanical Microtechnique. 3rd ed. Oxford & IBH Publishing Co.,New Delhi

Reference Books

1	Christian, G. D. (1979). Atomic Absorption Spectroscopy - John Fredric, J. Fieldman Wiley & Sons, New York.
2	Jensen, W. A. (1962). Botanical Histochemistry: Principles and Practice. W. H. Freeman and Co., San Francisco, USA.
3	Johansen, D. A. (1940). Plant Microtechnique. McGraw Hill, New York.
4	Skoog, A. and West, M. (1980). Principles of Instrumental Analysis - W. B. Saunders Co., Philadephia, USA.
5	Wilard, H. H., Meritt, L. L. Jr. and Dean, J. A. (1965). Instrumental Methods of Analysis. 4th ed. Van Nostrand Inc. Princeton, New Jersey.
6	Williams, B. L. and Wilson, K. (1983). A Biologist's Guide to Principles Techniques of Practical Biochemistry. Edward Arnold, London

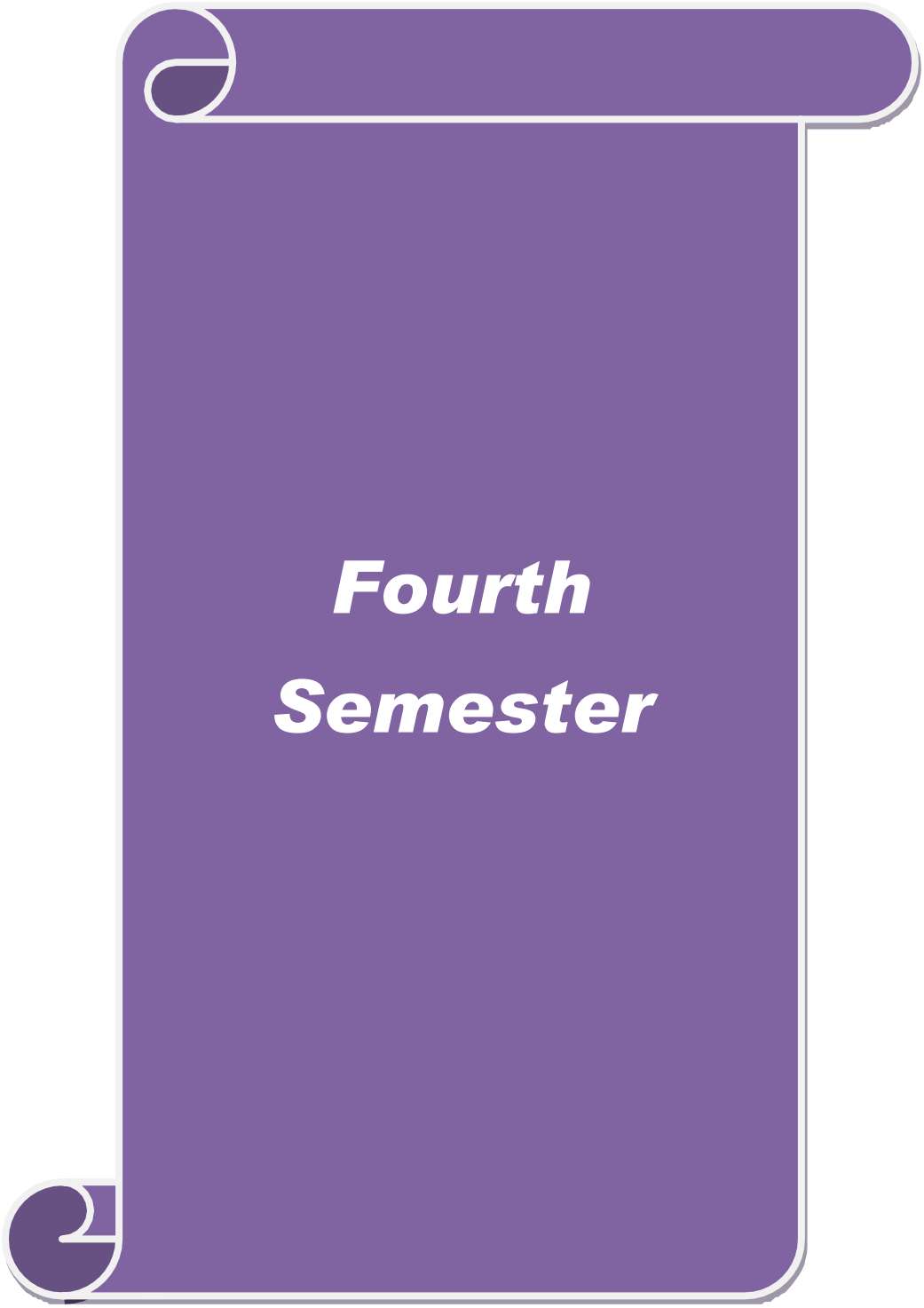
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://swayam.gov.in/nd2_cec20_bt22/preview
2	https://www.swayam.gov.in/explorer?category=BIO_TECH
3	https://swayam.gov.in/nd1_noc20_bt31/preview
4	https://swayam.gov.in/nd1_noc20_bt31/preview

5	https://swayam.gov.in/NPTEL

Mapping with Programme Outcomes						
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	S	S	S	S	S	S
CO3	M	S	S	S	S	S
CO3	S	S	S	S	S	S
CO4	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low


Fourth
Semester

Course code		BIOTECHNOLOGY AND GENETIC ENGINEERING	L	T	P	C
Core/Elective/Supportive		Core Paper XIII	88	2		4
Pre-requisite		Students learn about basic techniques of recombinant DNA technology such as molecular cloning, gene manipulation and producing GMOs	Syllabus Version	2023-2024		

Course Objectives:

The main objectives of this course are to:

To understand the structure and function of cell and cell membranes and macromolecular components of cells and their functions.
To general principles of gene organization and expression in prokaryotic and eukaryotic organisms.
Basic pathways and mechanisms in biological energy transduction and cell cycle control and relate properties of cancerous cells to mutational changes in gene function.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	To apply the basic concepts of cell and molecular biology in modern biology	K1
2	To correlate between genotypic and phenotypic attributes of an organism	K2
3	To perform genetic manipulations using types of cloning and expression vectors	K3
4	To explain how genetic engineering involves the use of recombinant DNA technology for crop improvement and to identify the molecular markers for selection of superior genotypes.	K4
5	To acquire fundamental knowledge on the application of various molecular tools and techniques for improvement of microbes and higher plants	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Molecular biology	18 hours

Scope and importance of Biotechnology and genetic engineering. Isolation of RNA, DNA (genomic and plasmid). Quantification of isolated nucleic acids. Radiolabelling of nucleic acids- End labelling, nick translation, Isolation of specific genes from plant tissue. Restriction Enzymes; DNA ligase, Klenow enzyme, T4 DNA polymerase, Polynucleotide kinase, Alkaline phosphatase; Cohesive and blunt end ligation; Linkers; Adaptors; Homopolymeric tailing. Gene cloning vectors. General characteristics of vectors. Brief account of naturally occurring plasmids. Promoter, MCS, Ori, and marker genes-lac Z. Construction of pBR 322 and pUC 18 vectors. Expression vectors. E.coli promoters, lac promoter, trp promoter. Lambda based vectors, Cosmids, Phagemids, BACs, YACs, Shuttle vectors.

Unit:2	Molecular Cloning	18 hours

Cloning of eukaryotic genes in prokaryotic vectors. Synthesis of cDNA. Cloning cDNA in plasmid vectors, cloning cDNA in bacteriophage vectors.. Polymerase Chain Reaction (PCR) - methodology, essential features of PCR, primers, Taq polymerases, reverse transcriptase-PCR, types of PCR-Nested, inverse, RT-PCR (real time PCR), Applications of PCR. Sequencing of genes- Sanger's method and Maxam and Gilbert method and automatic DNA sequencing. Artificial synthesis of DNA fragments. Phosphodiester, phosphotriester and Phosphite ester methods, principles and strategies. Oligonucleotide syntesis and application, synthesis of

complete gene.		
Unit:3	**Genomic and cDNA Libraries**	**18 hours**
Purification of vector DNA, restriction digestion, end modification, cloning of foreign genes from mRNA, genomic DNA, synthetic DNA. Transformation and transfection techniques, preparation of competent cells of bacteria, chemical methods- calcium phosphate precipitation method, liposome mediated method, physical methods- Electroporation, gene gun method. Agrobacterium mediated gene transfer in plants. Cloning and transfer of Nod gene, nif gene and Hup genes to Eukaryotes. In vitro mutagenesis and deletion techniques. Gene silencing techniques; siRNA technology; Micro RNA; Construction of siRNA vectors; Principle and application of gene silencing, gene knock out in bacterial and eukaryotic organisms. CRISPR-Cas9 technique.		
Unit:4	**Genomic and cDNA Libraries**	**18 hours**
Screening of recombinant clones. Direct antibiotic resistance screening. Blue white colour screening. Identification of the clone from a gene library by Nucleic acid hybridization. Functional screening methods. Colony immunoassay. Reporter gene based screening. Positive selection vector method. Diagnostic restriction digest method. Colony PCR method. Sequencing method.		
Unit:5	**Applications of Genetic Engineering**	**16 hours**
Chloroplast and Mitochondrion engineering. Transgenic plants, Genetically modified (GM) plants (Bt cotton, Bt Brinjal) Edible vaccines from plants. Plants as bioreactor. Molecular breeding. Ethical issues associated with GM crops and GM food; labeling of GM plants and products. RNAi and antisense RNA technology for extending shelf life of fruits and flowers (ACC synthase gene and polygalactoronase); delay of softening and ripening of fleshy fruits (tomato, banana, watermelons). Gene pollution. Environmental impact of herbicide resistance crops and super weeds		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**90 hours**

Text Book(s)	
1	Dubey, R.C. (1999). A Text Book of Biotechnology. S. Chand & Company.
2	Gupta, P.K. (1998). Elements of Biotechnology. Rastogi Publication.
3	Ignachimithu, S.(1995). Basic biotechnology. TaTa Mc Graw-Hill Publishing Company Ltd., Madras
4	Santharam, S. and Montgomery, J.F. (1999). Biotechnology, Biosafety and Biodiversity. Oxford and IBH Publishing Co., New Delhi.
5	Dubey, R. C. (2008). A Textbook of Biotechnology. S. Chand & Co. Ltd., New Delhi.
6	Gupta, P. K. (1994). Elements of Biotechnology. Rastogi and Co., Meerut.
7	Satyanarayana, V. (2005). Biotechnology. Books and Allied (P) Ltd., Kolkata.
8	Singh, B. D. (1998). Biotechnology. Kalyani Publishers, New Delhi.
Reference Books	
1	Callow, J.A., Ford Lloyd, B.V. and Newbury, H.J. (1997). Biotechnology and Plant Genetic Resources; Conservation and Use. CAB International, Oxon, UK.
2	Glazer, A.N. and Nikaido, H. (1995). Microbial Biotechnology. W.H. Freeman & Company,

	New York, USA.
3	Kartha, K.K. (1985). Cryopreservation of Plant cells and organs. CRC Press, Boca Ration, Florida, USA
4	Hammaond, J., McGarvey, P. and Yusibov, V. (2000). Plant Biotechnology. Springer Verlag.
5	Primrose, S. B. (1994). Molecular Biotechnology. Blackwell Scientific Publishing, Oxford.
6	Primrose, S. B., Twyman, R. M. and Old, R. W. (2001). Principles of Gene Manipulation. Blackwell Science, London.
7	Sambrook, J., Fritsch, E. F. and Maiatis, T. (2000). Molecular Cloning: A Laboratory Manual. Spring Harbor Laboratory Press, New York.
8	Slater, A., Scotta, N. and Fowler, M. (2003). Plant Biotechnology. Oxford University Press.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/102/103/102103013/
2	https://nptel.ac.in/courses/102/103/102103074/
3	https://nptel.ac.in/
4	https://nptel.ac.in/content/storage2/courses/102103013/pdf/mod7.pdf
5	https://nptel.ac.in/content/storage2/courses/102103013/pdf/mod1.pdf

Mapping with Programme Outcomes						
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	S	M	M	S	M	S
CO3	M	S	S	M	S	M
CO3	S	M	M	S	M	S
CO4	M	S	S	M	S	M
CO5	S	M	M	S	M	S

*S-Strong; M-Medium; L-Low

PRACTICAL - IV

(Theory Papers XI, XII & XIII)

(Plant Physiology, Phytochemistry and Biotechnology & Genetic Engineering)

Course Objectives:

The main objectives of this course are to:

- To procure the knowledge on physiological functions of the plant
- To compute the biochemical contents present in a given plant sample
- To demonstrate the genetic engineering techniques

Expected Course Outcomes:		
On the successful completion of the course, student will be able to:		
1	Determine the metabolic process of plants using standard procedures	K4
2	Apply the principles of reagents to estimate the macromolecular contents of the plant samples.	K5
3	Gain the proficiency skills of isolation and estimation of genetic materials	K3
K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create		

Paper XI- Plant Physiology

1. Calculate OP of cell sap by plasmolytic method.
2. Find out DPD of plant tissue by weight change method.
3. Measure the rate of transpiration at different light intensities using simple potometer.
4. Determine the rate of photosynthesis under different CO_2 concentrations with Wilmot's bubbler.
5. Find out the rate of photosynthesis under different light intensities with Wilmot's bubbler.
6. Hill reaction of photosynthesis with isolated chloroplast and 2,6- Dichlorophenolindophenol.
7. Determine the respiratory quotient with ganong's respirometer.
8. Find out seed viability by tetrazolium chloride method.
9. Determination of electrical conductivity of seed leachates.
10. Determine the activity of amylase in germinating wheat grains.

Paper XII- Phytochemistry

1. Quantitative estimation of starch in the given material by Iodine method.
2. Quantitative estimation of total protein in plant material by Biurete test.
3. Quantitative estimation of lipid in the given plant material.
4. Quantitative estimation of amino acids by Ninhydrin method.
5. Separation of plant pigments by Thin layer Chromatography.
6. Separation of aminoacids by Thin layer Chromatography.
7. Determination of peroxidase enzyme activitity.
8. Qualitative estimation of phenols in the given plant part.

9. Qualitative estimation of terpenoids in the given plant part.
10. Qualitative estimation of alkaloids in the given plant part.
11. Qualitative estimation of flavonoids in the given plant part.

Paper XIII- Biotechnology and Genetic Engineering

1. Isolation of genomic DNA from plant leaf.
2. Estimate quantity of isolated DNA by spectrophotometric method.
3. Agarose gel electrophoresis of genomic DNA.
4. Restriction digestion of genomic DNA.
5. Isolation of plasmid DNA from bacteria.
6. Agarose gel electrophoresis of plasmid DNA.
7. Identify transgenic fruits and vegetables.
8. PCR amplification of DNA from two cultivars with RAPD primers.

Mapping with Programme Outcomes						
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	S	S	S	S	S	S
CO2	S	S	S	S	S	S
CO3	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		Bioinformatics, Industry and Biostatistics	L	T	P	C
Core/Elective/Supportive		Elective IV	88	2		4
Pre-requisite		Should known the basics knowledge about the computer applications	Syllabus Version			2023 - 2024

Course Objectives:

The main objectives of this course are to:

To know about the knowledge of bioinformatics in different fields of science
To equip on knowledge of proteomics and genomics
To analyze the utility of biostatistics in plant science

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	To acquire the knowledge of biological databases	K1
2	Assess the knowledge of biological tools to manipulate unknown biolmolecules to known.	K2
3	Prepare the students with computational skills towards Industry 4.0	K3
4	To execute appropriate algorithms to identify the similarities and dissimilarities in biological samples.	K4
5	Practice with idea generation techniques, Learn how to manage the creative process	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Biological databases	18 hours

Introduction to Bioinformatics: Definition and History of Bioinformatics. Computational Biology and Bioinformatics. Biological databases- Types of data and databases, Nucleotide sequence database (EMBL, GENBANK, DDBJ)- Protein sequence database (PIR, SWISS-PROT, TrEMBEL), Secondary Databases (PROSITE, PRINTS, BLOCKS), Protein Structure Database (PDB) . Information retrieval from databases – search concepts, Tools for searching, homology searching and finding Domain and Functional site homologies.

Unit:2	Proteomics	18 hours

Structural Bioinformatics – Molecular structure viewing tool – RasMol. Protein structure prediction – Secondary structure prediction by Chou Fasman method and Tertiary structure prediction by Comparative modeling. Abinitio prediction, Homology modeling. Prediction of domain, motifs and profiles of proteins. Sequence alignment – global vs local alignment. Substitution matrics: BLOSUM and PAM. Scoring methods: gap introduction in alignment and gap penalties. Similarity searching tools: FASTA and BLAST. Multiple sequence alignment and phylogenetic analysis. Phylogenetic trees.

Unit:3	Genomics and Drug Discovery	18 hours

Genomics - Types (Structural and Functional), Gene Finding in prokaryotes and eukaryotes. Genome Annotation, Comparative genomics, Single nucleotide Polymorphism Gen-SNIP. Drug discovery process. Target identification and validation, lead optimization and validation. Methods and Tools in Computer-aided molecular Design, Analog Based drug design:- Pharmacophores, QSAR. Structure based drug design: - Docking, De Novo Drug Design. Virtual screening.

Unit:4	**Basics of Computing for Industry readiness**	**16 hours**
Introduction to IoT, Technologies for IoT, Applications of IoT- Education, Agriculture. Data Summarization & Visualization - Mean – Median – Mode - Variablity Measures - Variance – Range - IQR – Standard Deviation – Sum of Squares –Identifying Outliers using IQR. Data Visualization – Introduction – Datasets – Exploratory Data Analytics – Univariate Analysis – Histogram - Bivariate Analysis - Box Plot – Multivariate Analysis - Scatter Plot - MASS Package - Categorical Variable –Bar Chart – Mosaic Plot. Descriptive Data Analytics, Skewness– Kurtosis. **Artificial Intelligence in Biology research:** AI in drug design – AI in Phylogeny – AI in next generation sequencing – AI in protein structure prediction – AI in protein folding analysis.		
Unit:5	**Biostatistics**	**18 hours**
Probability - Definition, mutually exclusive events, independent events – product rule. Tests of significance - t-test, Chi square test, F-test, ANOVA. Correlation and Regression -Linear regression and correlation. Design of experiments- Principles - replication and randomization. Common designs in biological experiments- Completely randomized, randomized block, Latin square and Factorial.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**90 hours**

Text Book(s)

1	Bioinformatics. A practical guide to analysis of genes and proteins. 1998. Baxevanis and Quellette.
2	Bioinformatics for beginners. 2002 K.Mani and Vijayaraj
3	Introduction to Bioinformatics. 2002. S.SundaraRajan and R.Balaji.
4	Palanichami, S. and Manokaran, M. (1994), Statistical Methods for Biologists.
5	V. Bhuvaneswari, “Data Analytics with R Step by Step”, Scitech Publication, ISBN – 978-81- 929131-2-4, Edition 2016.
6	Emmanuel Paradis, “R for Beginners”, 2005
7	P. Kaliraj, T. Devi, Higher Education for Industry 4.0 and Transformation to Education 5.0, 2020

Reference Books

1	Bioinformatics: A biologist’s guide to biocomputing and the internet. 2000. Stuart M.Brown
2	Mount, D.W. (2001).Bioinformatics – Sequence and GenomeAnalysis, 1st Edition, Cold Spring Harbor Laboratory Press, New York, USA.
3	Introduction to Bioinformatics. 2002. Arthur M.Lesk.
4	Introduction to Bioinformatics. 1999. T.K.Attwood and Parry-Smith.
5	Bioinformatics: Sequence and genome analysis. 2001. David W. Mount
6	Khan, J.D and Khanum, A. (1994), Fundamentals of Biostatistics.
7	Zar, J.K. 1984, Biostatistical analysis, Prentice-Hall International, INC, Engleword chiffs, New Jersey.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://swayam.gov.in/nd1_noc20_bt10/preview
2	https://swayam.gov.in/nd1_noc20_bt28/preview
3	https://www.classcentral.com/course/swayam-bioinformatics-algorithms-and-applications-10031
4	https://nptel.ac.in/courses/102/106/102106065/
5	www.ideou.com
6	www.creativeconfidence.com
7	www.swyam.gov.in
8	www.nptel.ac.in
9	www.videolectures.net

Mapping with Programme Outcomes						
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	S	S	M	S	S	S
CO3	S	S	S	M	S	S
CO3	S	M	M	S	M	S
CO4	M	S	S	M	S	S
CO5	S	S	S	S	M	S

*S-Strong; M-Medium; L-Low

PROJECT WORK & VIVA – VOCE

COURSE OBJECTIVES

- To obtain knowledge related to the practical problems in various fields.
- To understand the analytical skills to solve the selected problems.
- To get confidence by solving the selected problems through proper execution.

COURSE OUTCOME

Expected Course Outcomes:		
On the successful completion of the course, student will be able to:		
1	Employing theoretical knowledge in real field.	K1
2	Inspect the importance of the task to collect the related necessary data.	K2
3	Evaluating relationships existing between the theories and the fields.	K3
4	Implementing appropriate statistical tools to get the correct interpretation to present the results.	K4
K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create		

Individual project work will be allotted to individual student under the supervision and guidance of the Faculty members during the IV Semester. Project works will be given based on the Field of Specialization of the supervisors under whom the students are allotted. The Fields of specialization are Systematic Botany, Microbiology and Phytopathology, Ethanobotany , Ecology and Conservation Biology, etc., The students shall do their projects under their supervisors and submit at the end of the IV Semester. Both the Internal and External Examiners shall jointly evaluate the project works submitted by the students and marks will be awarded on the basis as mentioned below.

Guidelines to the Distribution of Marks:

CIA	Project Review	**30**	**60**
	Regularity	**30**	
ESE	Project Report Present	**60**	**90**
	Viva – Voce	**30**	
	Grand Total		**150**

Mapping with Programme Outcomes						
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	S	S	M	S	S	S
CO3	S	S	S	M	S	S
CO3	S	M	M	S	M	S
CO4	M	S	S	M	S	S
CO5	S	S	S	S	M	S

BHARATHIAR UNIVERSITY
COIMBATORE - 641 046
PG MODEL QUESTION PAPER (PRACTICALS)
End semester Examination Question Paper Pattern
(For the candidates admitted from the academic year **2023-2024** onwards)

Time: 4 Hours **Max. Marks: 60**

Core Practical: I - (Microbiology, Phycology, Mycology and Lichenology, Bryophytes, Pteridophytes, Gymnosperms and Paleobotany and Environmental Botany and Conservation Biology)

1. Stain the given bacterial culture 'A' by Gram staining method. Write the procedure, identify the bacteria and submit the slide for valuation. - 7 mark
2. Analyze the algal mixture 'B' and 'C'. Identify any two genera. - 6 mark
3. Make suitable micro preparations of 'D', 'E' and 'F'. Identify by giving salient features. Draw labeled sketches, submit the slides for valuation. -15 marks
4. Calculate abundance, density and frequency of plants in the Quadrat method 'G'. -10 marks
5. Spotters 'H, I, J, K, L and M' - 12 marks

Practical	- 50 marks
Record	- 10 marks
Total	- 60 marks

Key

1. A - Gram Staining (Slide – 2 mark, Identification – 2 mark, Reason – 3mark)
2. B & C - Algal Mixture (Identification – 1mark, Reason and Sketch – 2mark)
3. D – Fungi/ Bryophyta
   E- Pteridophyta
   F- Gymnosperm (Identification – 1mark, Slide – 2 mark, Reason and Sketch – 2mark)
4. G- Ecology (Identification – 2mark, Notes, tabulation and Graph – 8mark)
5. H- Microbiology
   I – Fungi/Bryophyta
   J – Pteridophyta
   K- Gymnosperm
   L – Lichen
   M- Paleobotany (Identification – 1mark, Reason – 1mark)

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PG MODEL QUESTION PAPER (PRACTICALS)
End semester Examination Question Paper Pattern
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Time: 4 Hours **Max. Marks: 60**

Core Practical: II- (Cell and Molecular Biology, Genetics, Evolution, Plant Breeding, Anatomy, Embryology, Morphogenesis and Plant Tissue culture)

1. Take T.S. of **A** and **B** identify by giving reasons / Salient features. Draw labeled sketches and submit the slide for valuation 2x5=10marks
2. Dissect and display any one stage of the developing embryo in the given material **C**. Submit the slide for valuation 1x5=5 mark
3. Identify the given material **D**. 1x4=4 mark
4. Make an acetocarmine squash preparation of the given material **E.** Find out two stages. Write the procedure, draw diagrams and submit the slide for valuation. 1x5=5 mark
5. Solve the given problem **F** 1x5=5 mark
6. Writes notes on **G**, **H**, **I**, **J**, **K**, **L** and **M**. Identify by giving reasons and draw labeled sketches 7 x 3 =21marks

Practical	- 50 marks
Record	- 10 marks
Total	- 60 marks

Key

1. A – Anatomy
   B – Anatomy (Identification – 1mark, Slide – 2 mark, Reason and Sketch – 2mark)
2. C – Embryology (Identification – 1mark, Slide – 2 mark, Reason and Sketch – 2mark)
3. D – Nodal Anatomy (Identification – 1mark, Reason and Sketch - 3mark)
4. E – Cell and Molecular Biology (Identification – 1mark, Slide – 2 mark, Reason and Sketch – 2mark)
5. F – Genetics Problem
6. G – Cell and Molecular Biology
   H – Genetics
   I – Plant Breeding
   J – Embryology
   K – Morphogenesis
   L – Plant Tissue Culture
   M – Plant Tissue Culture (Identification – 1mark, Reason and Sketch – 2mark)

BHARATHIAR UNIVERSITY
COIMBATORE - 641 046
PG MODEL QUESTION PAPER (PRACTICALS)
End semester Examination Question Paper Pattern
(For the candidates admitted from the academic year **2023-2024** onwards)

Time: 4 Hours **Max. Marks: 60**

Core Practical: III- (Plant Taxonomy and Medicinal Botany)

1. Write the binomial of **A & B** with the aid of Gamble's Flora 5 x2 = 10 marks
2. Refer the specimens **C & D** to their respective families give the floral characters and draw the floral diagram and floral parts. 5 x2 = 10 marks
3. Construct an artificial key from the comparison chart for the plants **E, F, G, H & I** using the vegetative and floral characters. 1 x5 = 5 marks
4. Give the binomial and family name of **J & K** 2 x 2 = 4marks
5. Writes notes on **L, M** and **N**. 3x 2= 6marks

Practical - 35 marks
Record - 10 marks
Taxonomy herbarium (50sheets) - 10 marks
Medicinal botany herbarium (20sheets) & Plant parts - 5 mark

Total - 60 marks

Key

1. A - Taxonomy
   B – Taxonomy (Identification – 2mark, Reason – 3mark)
2. C – Taxonomy
   D – Taxonomy (Reason – 1mark, Notes – 1mark, floral character, formula and floral diagram – 3 mark)
3. E to I – Taxonomy (Identification – 2mark, Reason – 3mark)
4. J – Medicinal Botany
   K – Medicinal Botany (Identification – 1mark, Reason – 1mark)
5. L – Medicinal Botany
   M – Medicinal Botany
   N – Medicinal Botany (Identification – 1mark, Reason – 1mark)

BHARATHIAR UNIVERSITY
COIMBATORE - 641 046
PG MODEL QUESTION PAPER (PRACTICALS)
End semester Examination Question Paper Pattern
(For the candidates admitted from the academic year **2023-2024** onwards)

Time: 4 Hours **Max. Marks: 60**

Core Practical: IV- (Plant Physiology, Phytochemistry, Biotechnology and Genetic Engineering)

1. Write Procedure, apparatus required for the experiment '**A'**. Give the inference from the experiment and leave the setup for valuation. 1 x 15 = 15 marks

2. Estimate the amount of Phytochemical analysis in the given sample '**B'.** Give the inference from the experiment and leave the setup for valuation. 1 x 15 = 15 marks

3. Write notes on interest of **'C, D, E, F and G'.** 5 x 4 = 20 marks

Practical	- 50 marks
Record	- 10 marks
Total	- 60 marks

Key

1. A - Plant Physiology (Requirements-4, Procedure-4, Result-4, Set up – 3marks)
2. B – Phytochemistry (Requirements-4, Procedure-4, Result-4, Set up – 3marks)
3. C - Plant physiology
4. D - Phytochemistry
5. E - Biotechnology and Genetic Engineering
6. F - Biotechnology and Genetic Engineering
   G - Biotechnology and Genetic Engineering (Identification – 1mark, Reason and sketch– 3mark)

BHARATHIAR UNIVERSITY
COIMBATORE - 641 046
PG MODEL QUESTION PAPER (Theory)
End semester Examination Question Paper Pattern
(For the candidates admitted from the academic year **2023-2024** onwards)

Time: 3Hours **Max. Marks: 75**

Section A (1 x 10 = 10 marks)
Choose the best answer pattern

1.
a. b. c. d.
2.
a. b. c. d.
3.
a. b. c. d.
4.
a. b. c. d.
5.
a. b. c. d.
6.
a. b. c. d.
7.
a. b. c. d.
8.
a. b. c. d.
9.
a. b. c. d.
10.
a. b. c. d.

Section B (5 x 4= 20 marks)
Open Choice pattern

11.
12.
13.
14.
15.
16.
17.
18.

Section B (3 x 15= 45 marks)
Open Choice pattern

19.
20.
21.
22.
23.

Annexure

M. Sc., BOTANY

Affiliated College Syllabus

(With effect from 2023 -2024 ONWARDS)

Program Code :

DEPARTMENT OF BOTANY
Bharathiar University
(A State University, Accredited with "A"Grade by NAAC and
13th Rank among Indian Universities by MHRD-NIRF)
Coimbatore 641 046, INDIA

BHARATHIAR UNIVERSITY: COIMBATORE 641046

DEPARTMENT OF BOTANY

MISSION

Our mission is to apply traditional as well as scientific attempt to be aware of plants, improvement of human resource with skill on knowledge in the frontier areas of Plant Sciences.