THIRUVALLUVAR UNIVERSITY

MASTER OF SCIENCE
M.Sc. BOTANY
(CBCS Pattern)

(With effect from 2020-2021)

The Course of Study and the Scheme of Examination

Sl. No.	*Study Components*		*ins. hrs / week*	*Credit*	*Title of the Paper*	*Maximum Marks*		
	Course Title					*CIA*	*Uni. Exam*	*Total*
SEMESTER I								
1.	Core	Paper 1	5	4	Phycology and Bryology	25	75	100
2.	Core	Paper 2	5	4	Mycology, Lichenology Bacteriology, Virology and Plant Pathology	25	75	100
3.	Core	Paper 3	5	4	Pteridophytes, Gymnosperms and Paleo-Botany	25	75	100
4.	Practical	Paper-1	5	3	Practical-I, covering Papers I, II & III	0	0	0
Internal Elective for same major students								
5.	Core Elective	Paper-1	5	3	**(to choose one out of 2)** A. Microbiology B. Pharmacognosy	25	75	100
External Elective for other major students (Inter/multidisciplinary papers)								
6.	Open Elective	Paper-1	5	3	**(to choose one out of 2)** A. Mushroom Cultivation B. Horticulture and Landscaping	25	75	100
			30	**21**		**125**	**375**	**500**
SEMESTER II						*CIA*	*Uni. Exam*	*Total*
6	Core	Paper 4	5	4	Anatomy and Embryology of Angiosperms	25	75	100
7	Core	Paper 5	5	4	Cell and Molecular Biology	25	75	100
8	Core	Paper 6	5	4	Genetics,Plant Breeding and Evolution	25	75	100
9	Practical	Paper-1	0	0	Practical-I, covering Theory Papers I, II & III	25	75	100
10	Practical	Paper-2	5	3	Practical-II, covering Theory Papers IV, V & VI	25	75	100
Internal Elective for same major students								
11	Core Elective	Paper-2	4	3	**(to choose one out of 2)** A. Techniques in Botany B. Industrial Microbiology	25	75	100
External Elective for other major students (Inter/multidisciplinary papers)								
12	Open Elective	Paper-2	4	3	**(to choose one out of 2)** A. Organic farming B. Herbal Sciences	25	75	100

13	*Field Study		-	2		100	-	100
14	Compulsory Paper		2	2	**Human Rights**	25	75	100
			30	**25**		**300**	**600**	**900**
SEMESTER III						***CIA***	***Uni. Exam***	***Total***
	Core	Paper 7	5	5	Morphology and Taxonomy of Angiosperms and Economic Botany	25	75	100
	Core	Paper 8	5	4	Biotechnology and Genetic Engineering	25	75	100
	Core	Paper 9	5	4	Ecology and Conservation Biology	25	75	100
	Practical	Paper-3	5	0	Practical-III, covering Theory Papers VII, VIII & IX	0	0	0
Internal Elective for same major students								
	Core Elective	Paper-3	5	3	**(to choose one out of 2)** A. Plant Tissue Culture B.Nanobiotechnology	25	75	100
External Elective for other major students (Inter/multidisciplinary papers)								
	Open Elective	Paper-3	5	3	**(to choose one out of 2)** A. Ethnobotany B. Forestry and Carbon Management	25	75	100
	**MOOC Courses		-	-		-	-	100
			30	**19**		**125**	**375**	**600**
SEMESTER IV						***CIA***	***Uni. Exam***	***Total***
	Core	Paper-10	5	4	Plant Physiology and Plant Biochemistry	25	75	100
	Core	Paper-11	5	4	Research Methodology	25	75	100
	Practical	Paper-3	0	3	Practical-III, covering Theory Papers VII, VIII & IX	25	75	100
	Practical	Paper-4	5	3	Practical-IV, covering Papers X & XI	25	75	100
	Core	Project	5	5	Project with *viva voce* **(Compulsory)**	100 (75 Project +25 viva)		100
Internal Elective for same major students								
	Core Elective	Paper-4	5	3	**(to choose one out of 2)** A. Bioinformatics and IPR Patenting B. Wood Sciences and Technology	25	75	100
External Elective for other major students (Inter/multidisciplinary papers)								
	Open Elective	Paper-4	5	3	**(to choose one out of 2)** A. Biodiversity and Conservation B. Biological Invasion	25	75	100
			30	**25**		**150**	**450**	**700**
			120	**90**				

*** Field Study**

There will be field study which is compulsory in the first semester of all PG courses with 2 credits. This field study should be related to the subject concerned with social impact. Field and Topic should be registred by the students in the first semester of their study along with the name of a mentor before the end of the month of August. The report with problem identification and proposed solution should be written in not less than 25 pages in a standard format and it should be submitted at the end of second semester. The period for undergoing the field study is 30 hours beyond the instructional hours of the respective programme. Students shall consult their mentors within campus and experts outside the campus for selecting the field and topic of the field study. The following members may be nominated for confirming the topic and evaluating the field study report.

(i). Head of the respective department
(ii). Mentor
(iii). One faculty from other department

****Mooc Courses**

Inclusion of the Massive Open Online Courses (MOOCs) with zero credits available on SWAYAM, NPTEL and other such portals approved by the University Authorities.

SEMESTER III
PAPER - 7

MORPHOLOGY AND TAXONOMY OF ANGIOSPERMS AND ECONOMIC BOTANY

Objectives

- To familiarize with technical terms related to angiosperms, as to cope up in tune with recent advances of biomes being viewed from plant functional traits.
- To develop skill in species recognition, identify them using pertinent floras, familiarize with diagnostic features of families included in syllabus and
- To acquire knowledge on cultivation and utilization of plant resources as food crops, commercial crops and drug yielding plants.

Unit I Morphology

Stem: Forms, buds, modification of stem, bark texture and sap color with examples. Leaf: Type- simple and compound, phyllotaxy, terms related to shape apex, base and margin, texture and surface, venation and stipules.Inflorescence types – racemose, cymose and special.Flower: Sexuality, symmetry, brackets, calyx, corolla, androecium, gynoecium, placentation.Fruits: Types and classification.Seeds: Parts, types and classification.

Unit II Nomenclature and Classification of Angiosperms

Classification of Linnaeus, Bentham and Hooker, Engler and Prantl,Takhtajan and Arthrur Cronquist. Detailed account of APG3 classification. Biosystematics and Molecular Taxonomy, DNA barcode, Chemotaxonomy and Numerical taxonomy.Principles of ICBN-Typification, Principles of priority and their limitations Citation, key for identification of plants, General indexes, Monographs, Periodicals, Floras and Manuals, Data banks, use of molecular tools in taxonomy, Use of Cladistics methodology in Taxonomy.Floras and their usage: Emphasis on Asian Floras.Plant preservation techniques; Herbaria, digital herbaria; world and regional herbaria; Botanic gardens – role in *ex situ* conservation of plants, details on Botanic Garden Conservation International, and Botanical Survey of India.

Unit III Families of Angiosperms

Study of the following plant families, with details on (i) distribution (ii) diagnostic features (iii) description and their interrelationship and phylogeny (iv) economic importance of at least six species in each family.

Nymphaeaceae, Menispermaceae, Sterculiaceae, Meliaceae elastraceae, Rhamnaceae, Sapindaceae, Myrtaceae, Portulacaceae Sapotaceae Combretaceae, Lythraceae, Passifloraceae, Apiaceae.

Unit IV Families of Angiosperms

Boraginaceae, Bignoniaceae, Lamiaceae, Acanthaceae, Lauraceae, Araceae, Commelinaceae Typhaceae. Casuarinaceae Cyperaceae Arecaceae Levels and types of Biodiversity, Status and values of the Biodiversity, hot spots, Endemism, IUCN, Red-list categories, National Biodiversity Act.

Unit V Plants in Human Welfare

Cultivation and utilization of food crop, Cereals (Paddy and Ragi), pulses (Black gram and green gram). Spices – Pepper and cardomum; Edible oils – Sesame and Groundnut Aromatic oils, Eucalyptus and Citronella oil. Commercial crops—Sugarcane, Rubber, Tea, Fibers- Cotton, Jute; Timbers- Teak and Dalbergia. Drug yielding plants –*Phyllanthus amarus* and *Solanum trilobatum*; Adulteration in drugs.

Outcome of the Course

Upon completion of this course students are expected to be familiar with technical terms of angiosperm plants, acquire ability to identify species using floras utilizing the knowledge gained on diagnostic features of plant families and knowledge on economically important various plant resources.

Text Books

1. Mabberley, D. J., 2014. Mabberley's Plant Book. Cambridge University Press.
2. Pandey B. P., 2009. Taxonomy of Angiosperms. S. Chand & Co. Ltd. New Delhi.
3. Kochhar, S. L., 2012. Economic Botany in the Tropics. Laxmi Publications; Fourth edition.

Reference books

1. Dutta, S. C., 2003 Systematic Botany, New Age International (P) Ltd, Publication, New Delhi.
2. Naik, V. N., 2002. Taxonomy of Angiosperms, Tata McGraw-Hill, New York.
3. Subramanyam, N. S., 1995. Modern Plant Taxonomy. Vikas publishing House, New Delhi.
4. Lawrence, G. H. M., 1964, Taxonomy of Vascular plants, Oxford & IBH Publishing company (P) Ltd, New Delhi.
5. Sivarajan, V. V., 1999. Principles of plant taxonomy, Oxford and IBH.

PAPER - 8

BIOTECHNOLOGY AND GENETIC ENGINEERING

Objectives

- To better understanding of all aspects of the plant transgenic/genetic engineering process, for enhancing efficiency, precision, and proper expression of the added genes or nucleic acid molecules.
- To learn and familiarizes Genetic engineering, also called genetic modification, to direct manipulation of an organism's genome using biotechnology.
- To train the students in the aspects of innovative applications and techniques in tissue culture to conserve endemic, endangered plants and improve the quality of the economically important plants/crops.
- To learn the recent advances in genetic engineering and production of transgenic plants

UNIT I General Biotechnology

Introduction and history of Biotechnology, Scope, Potentialities and constraints of biotechnology. Fermentation Process –traditional and modern biotechnology; General requirements of fermentation processes.: Various types of fermentor and design of fermentors. Algal biotechnology. Fungal biotechnology.Recent trends in genomics and Genetics of Arabidopsis thaliana, Biofertilizers – cultivation and applications of biofertilizers (Nitrogeous and phosphatic biofertilizers).

UNIT II Industrial Biotechnology

Production of industrial enzymes - amylases, lipases, cellulases and protease. Methods of enzyme immobilization and applications. Production of biogas, and alcohol. Production of Single cell protein, biopesticides and biofertilizers. Production of biopolymers. Pants as bioreactors: Edible vaccines - Production of antibiotics, viral antigens and peptide hormones in plants, biodegradable plastics in plants. Applications of secondary metabolites: Isolation and characterization – drug development, Biopesticides, growth regulators, Biofertilizers. Value addition via bio transformation. Biocatalyst, Bio remediation, Bio fuels.

UNIT III Application of Plant Biotechnology

Transgenic plants: Resistance to biotic stress – insect and pest resistance: resistance from microorganisms. Resistance to abiotic stress: herbicide, glyphosate, phosphinothricin, sulfonylureas and imidazolinones. Transgenic plants as bioreactor- molecular pharming,

therapeutic products. Biotechnology of nitrogen fixation: Nitrogenase - Nif genes and their organization - Genetic engineering of nif genes in yeast cells.Conventional methods of crop improvement, selection, mutation, polyploidy and clonal selection.

UNIT – IV Gene Cloning

Basic principles: Restriction endonucleases - Cloning vectors–plasmids, phages and cosmids, Transposans, primary vectors and plasmidsexpression vectors. Methods of gene transfer – transformation, conjugation, electroporation, liposome mediated gene transfer, transduction, direct transfer of DNA, viral vectors, particle gun method and microinjection; Intergenomic interaction, Agrobacterium and crown gall tumors:Tiand Ri plasmid mediated transfer –*Agrobacterium tumifaciens*. Gene cloning strategies.Mechanism of T-DNA transfer to plants, Agro infection. Plant viral vectors. Direct transformation of plants by physical methods. Genetic engineering in plants:Selectable markers, Reporter genes and Promoters used in plant vectors. Genetic engineering of plants for bacteria, fungi, virus, pest and herbicide resistance.

UNIT – V Genomics, IPR and Bioethics

Genomics: Definition--Preparation of genetic maps: Molecular genetic maps – cereals, legumes, and forest trees - Genomics for evolutionary studies. Gene cloning: Genomic and c-DNA libraries - Choice of host organisms for cloning- bacteria, plants and yeast. Gene addition and deletion approach in genetic engineering. Human genome project. Gene theraphy. IPR – patents, Trade secrets, Copy rights and Trademarks, Geographical indications, ethical issues of patenting.rDNA Technology, chromosome walking, screening expression libraries – immunological, Southern, Western and Northern blotting, Dot blots, in-situ hybridization.

Outcome of the course

Students are expected to be educated from the systematic training given in the different branches of applied biotechnology will enhance the confidence in students to take up entrepreneurial ventures in developing bio tagged products, and provide services in national and multinational industries dealing with bio utility and bio resource management.

Text Books

1. Dubey, R.C., 2008. A Text Book of Biotechnology, S.chand and Co. Ltd., New Delhi.
2. Smith, R.H., 2000.Plant tissue culture – techniques and Experiments., Acagemic press, New York.
3. Huang, P.C., 2012. Genetic Engineering Techniques: Recent Developments., Elsevier.
4. Suresh kumarGahlawat, Raj kumarsalar, Priyanka Siwach, Joginder singhDuhan, Suresh kumar, Pawan kaur., 2017. Plant Biotechnology: Recent Advancements and developments., S pringer.
5. Slata, A., N.W. Scott and M.R. Flower, 2010. Plant Biotechnology: The genetic manipulation of plants, 2nd Edition, Oxford University press.

6. Plant Biotechnology: An Introduction to Genetic Engineering by Adrian Slater, Nigel W. Scott, Mark R. Fowler. Oxford University Press, 2008.

Reference Books

1. Satyanarayana, U., 2008. Biotechnology, Books and Allied (p) Ltd., Kolkata.
2. Smith, J.E., 2009. Biotechnology, 5th Edition, Cambridge University Press India Pvt. Ltd., New Delhi.
3. Primrose, S.R., Twynman and old,P., 2005.Principles of gene manipulation, Black well science Ltd., New Delhi.
4. Isil AksanKurnarz, 2015. Techniques in Genetic Engineering, CRC Press.
5. Arie Altman and Paulmichaelhasegaua, 2012. Plant Biotechnology and Agriculture prospects for the 21st century, Academic Press.
6. C. Neal Stewart, Jr., 2016. Plant Biotechnology and Genetics, Principles, Techniques and Applications. John Wiley and Sons.
7. C.M. Govil, Ashok Aggarwal and Jitender Sharma, 2017. Plant Biotechnology and Genetic Engineering, PHI, Learing Pvt. Ltd.

PAPER- 9

ECOLOGY AND CONSERVATION BIOLOGY

Objectives

- To acquire knowledge on the biotic and abiotic components of the environment, biodiversity, structure of global terrestrial and aquatic biomes, natural resources, environmental protection and conservation aspects.

Unit I Ecosystem and energy cycle

The Environment: Biotic and abiotic components. Ecosystem: Concept, structure and function, producer, consumers, decomposers, Energy flow – ecological succession. Food chain, food web and ecological pyramids. Biogeochemical cycling – basic types: the water, Carbon, Phosphorous and Nitrogen cycles.Introduction, types characteristics features, structure and functions of the following Ecosystem: Tundras, temperate coniferous and deciduous forest, temperate grassland, tropical rain forest, tropical moist and dry deciduous forest, tropical savannas, desert and aquatic (ponds, lakes, rivers, estuaries, oceans).

Unit II Study of Vegetation and phytogeography

Autecology and Synecology. Ecological life cycle – species interaction – types – Population Ecology and its characteristics – density, Mortality, Natality. Survival and r and k selection. Ecological Niche – ecotone and edge effect Methods of studying vegetation – Qualitative and Quantitative characters – Quadrat studies. Density, Abundance, frequency and IVI, Polygraph charting – Raunkiaer's Life forms. Principles of plant phytogeography, floristic regions of the world, phytogeographical zones of India, endemism – endemic plants.

Unit III Evolution of Ecosystem

Development and evolution of ecosystems – Ecological succession-causes – migration – ecesis – aggregation- colonization and stabilization of plant communities—Climax and sub climax—concepts of climax and stability of ecosystem. Succession in pond, rocks bogs and sand dunes, mechanism, changes involved in succession and theories of succession. Plant indicators.

Unit IV Environmental pollution and abatement

Types of pollution; causes of pollution, major pollution- air pollution – sources, oxides of Carbon, Sulphur, Nitrogen—PAN, hydrocarbons; water pollution, soil, noise, thermal, nuclear pollution - effects and control measures of all the above pollution types; liquid and solid waste and E-wastes management.Photochemical smog, Greenhouse effect, Ozone layer depletion and Acid rain; Bioaccumulation, Bioabsorption, Biotranslocation, Eutrophication - algal bloom. Phytoremediation.

UnitV Conservation Biology

Biodiversity hotspots; Principles of Conservation: Natural resources—types--Conservation of Natural Resources - alternative resources. Global Environmental changes: Deforestation its role in Global warming and Climate change. El Nino—its role in climate change. Public Awareness - Environmental Protection Act and Environment movements.

Outcome of the Course

Students are expected to be familiar with components of the environment, major species composition, structure and functional ecology of terrestrial and aquatic ecosystems and conservation aspects

Text Books

1. Singh, J.S., Singh, S.P & Gupta, S.R. 2017. Ecology, Environmental Science and Conservation. S. Chand (G/L) & Company Ltd.
2. Dash, M.C, 2004. Fundamentals of Ecology, Tata McGraw, Hill, New Delhi.
3. Shukla, R.S and P.S. Chandel, 2007. A text book of Plant Ecology. S. Chand & Co, New Delhi

Reference books

1. Odum, E.P. Gary W. Barrelt, 2004. Fundamentals of Ecology – 15th edition, Thomson Asia Pvt., Ltd.,
2. Russell K. Monson, 2014. Ecology and the Environment. Springer Dordrecht, Heidelberg, New York.
3. Archibold, O.W. 1995. Ecology of World Vegetation. Chapman & Hall, London
4. Richards, P.W. 1996. Tropical rain forests. Cambridge University Press, Cambridge.

CORE ELECTIVE
PAPER - 3
(Choose either A or B)
A. PLANT TISSUE CULTURE

Objectives

- To understand and the production of exact copies of plants that produce particularly good flowers, fruits, or have other desirable traits.
- To quickly produce mature millions of plants.
- To acquire knowledge on the production of multiples of plants in the absence of seeds or necessary pollinators to produce seeds.
- Toimprove the state of health of the planted material and to increase the number of desirable germplasms available to the plant breeder.

UnitI : Basics of Tissue culture

Concepts of Totipotency – Conditions of aseptic culture – Laboratory equipment – Culture vessels and different types of culture - Sterilization methods: Physical and chemical – Sterilization of Tools, Water, Vessels, Nutrient Media, Working Area, Methods of the surface disinfections - Inoculation and initiation of tissue culture – Acclimatization

UnitII : Methods and media Preparations

Explant preparation, callus initiation, growth and maintenance, Multiplication and Organogenesis – Media preparation: MS and Root media - Embryogenesis, Somaclonal variation, Germiclonal variation establishment, growth and maintenance of cell suspension culture, Methods of sub culturing and transfer of regenerated plants to the field.

UnitIII : Micro Propagation

Tissue and organ culture; Cellular differentiation and regulation of morphogenesis - Somatic embryogenesis - Control of organogenesis and embryogenesis - Single cell culture - Establishment of suspension cultures - Meristem and Nodal culture – Synthetic seed technology.

UnitIV : Haploids and variation in Tissue culture

Haploid production – Androgenesis: Anther and microspore culture - Gynogenesis: Embryo culture - Protoplast isolation: Culture – regeneration - Somatic hybrid-cybrids – *In vitro* selection of mutants – mutants for salts, disease, cold, drought, herbicide and other stress conditions - Meristem culture and virus elimination - Shoot tip culture.

UnitV : Application of Tissue culture

Industrial application: Secondary metabolite production and single cell proteins by cell culture – Bioreactors – Genetic transformation using Ti plasmid Manipulation of gene expression in plants – Tissue culture as a tool for Biotechnology: Production of marker free transgenic plants - Developing insect-resistance, disease-resistance, herbicide resistance; stress and senescence tolerance in plants – Rapid propagation of Banana, Rose and orchids

Outcome of the Course

The students are educatedto plant tissue culture is a collection of techniques used to maintain or grow plant cells, tissues or organs under sterile conditions on a nutrient culture medium of known composition. It is widely used to produce clones of a plant in a method known as micropropagation.These techniques have certain advantages over traditional methods of propagation. They produce exact copies of plants required that have desirable traits. They produce mature plants quickly. Multiple plants are produced in the absence of seeds,

Text Books

1. Bhojwani, SS. and MK Razdan. 1996. Plant tissue Culture: Theory and Practice (a revised edition). Elsevier science publishers, New York.
2. U Satyanarayana, 2008. Biotechnology, Books & Allied Ltd.
3. Razdan M K 2019 Introduction to Plant Tissue Culture 3rdEdn. Oxford & IBH Publishing
4. Roberta Smith. 2012. Plant Tissue Culture - Techniques and Experiments, Elsevier, 3rd Edn.
5. Timir Baran Jha and Biswajit Ghost. 2005. Plant tissue culture (Basic and Applied). University Press, Hyderabad.
6. Thorpe, T.A. 1981. Plant tissue culture methods and application in agriculture, Elsevier.

Reference Books

7. Reinert.J and Yeoman, M.M. 1983. Plant cell and Tissue culture - Laboratory manual, Narosa publishing house, New Delhi.
8. Razdan.M.K. 2003. Introduction to Plant Tissue Culture. Oxford & IBH Publishing C.Pvt.Ltd, New Delhi.
9. Kalyan Kumar D.E.1992. Plant tissue culture, Agrobios, New Delhi.
10. T. Pullaiah, 2009. Plant Tissue Culture: Theory and Practicals, Scientific Publishers Journals Dept.
11. Timir Baran Jha and Biswajit Ghosh, 2016. Plant Tissue Culture : Basic and Applied, Platinum Publishers; 2nd Edn.
12. **Anis** Mohammad and **Ahmad** Naseem. 2016. Plant Tissue Culture: Propagation, Conservation and Crop Improvement, Springer.

CORE ELECTIVE
PAPER - 3
B. NANOBIOTECHNOLOGY

Objectives

- To the student's activities will markedly speed the development of nanotechnology-based products for cancer patients, reduce the risk of doing and encourage private-sector investment in this promising area of technology development.
- To developing new tools, such as peptides nanosheets, for medical and biological purposes is another primary objective in nanotechnology
- To advance research in the cutting-edge areas of Nano biotechnology, foster innovations and promote translational

UNIT I Introduction, History & Applications

1) Various definitions and Concept of Nano-biotechnology & Historical background. 2) Fundamental sciences and broad areas of Nanobiotechnology. 3) Various applications of Nano-biotechnology 4) Cell – Nanostructure interactions

Unit II Protein-based Nanostructures, Nanobio- machines &Signaling

1) Overview, chemistry and structure, Genetics & Secondary cell-wall polymers 2) Self-assembly in suspension, Re-crystallization at solid supports, Formation of regularly arranged Nano-particles 3) Cell as Nanobio-machine, link between the signaling pathways & molecular movements as well as neuron function 4) Concepts in nanobio-machines for information processing and communications

UNIT III Microbial Nanoparticle Production

1) Overview and concept of microbial nano-particle production 2) Methods of microbial nano-particle production 3) Applications of microbial nano-particles 4) Bacteriorhodopsin and its potential in technical applications – overview, structure, photoelectric applications, photochromic applications and applications in energy 10 20.83% conversion

Unit IV DNA-Protein Nanostructures

1) Overview and introduction 2) Oligonucleotide-Enzyme conjugates 3) DNA conjugates of binding proteins 4) Non-covalent DNA-Streptavidin conjugates 5) DNA-Protein conjugates in microarray technology

Unit V Biomaterials & Bio-electronics

1) Biomaterials- types, properties and applications 2) Biomaterial nano-particle systems for bio-electronic & biosensing applications 3) Biomaterial-based Nano-circuitry 4) Protein-based Nano-circuitry 5) DNA as functional template for Nano-circuitry

Course Outcome

After learning the course, the students should be able to: Develop a fundamental understanding of basic concepts of nano-biotechnology and its uses in the field of life sciences. ¬ Evaluate applications of various concepts & techniques of nano-biotechnology to facilitate biotechnological advancement and innovations.

Text Books

1. Nanobiotechnology: Concepts, Applications and Perspectives, Christof M. Niemeyer (Editor), Chad A. Mirkin (Editor), Wiley Publishers, April 2004.
2. Nanobiotechnology in Neurodegenerative Diseases. Mahendra Rai, Alka Yadav. 2019.
3. Nanobiotechnology for Sustainable Bioenergy and Biofuel Production 1st Editionby Madan L. Verma (Editor) 2020. ISBN-13: 978-0367085872; ISBN-10: 0367085879

Reference Books

1. Nanotechnology: A Gentle Introduction to Next Big Idea, Mark Ratner and Daniel Ratner, Low Price edition, Third Impression, Pearson Education. 2006.
2. Nanotechnology, William Illsey Atkinson, JAICO Publishing House, Second Impression-2008. 4) Bio molecular computation for Bio nanotechnology, Liu and Shimohara, Artech House-London, 2007.

OPEN ELECTIVE
PAPER - 3
(Choose either A or B)
A. ETHNOBOTANY

Objectives

- To conserve the indigenous knowledge of the region and create awareness in the young generation.

- To develop new products for food, herbal, and pharmaceutical companies and assist in managing biological resources

UNIT I Introduction

Ethnobotany: Introduction, concept, scope and objectives. its significance within the limits of the state, the nation and the conservation of rare heritage from global point of view. The loss of mankind, if the heritage is not preserved and reached by present generation. Landmarks in history of ethnobiology- relation between geology, phyto geography and ethnobotany.

UNIT II Methodology of Ethnobotany

Methodology of Ethno botanical studies. a) Field work b) Herbarium c) Ancient Literature d) Temples and sacred places. Plants used by the tribal: a) Food plants b) intoxicants and beverages c) Resins and oils and miscellaneous uses. Indigenous societies and interactions with plants- a global view. Relationship between man and plants- for benefit of both and developmental strategies of both. Relationship between man and plants-mutually destructive approaches.

UNIT III Ethnobotany Practices

Linkage of ethnobotany 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. Plants and Tribal medicine: Significance of the following plants in ethno botanical practices (along with their habitat and morphology) a) *Azadiracthaindica* b) *Ocimum sanctum c) Vitex negundo. d) Gloriosa superba e) Tribulus terrestris f) Pongamiapinnata g) Cassia auriculata h) Indigoferatinctoria.*

UNIT IV Ethnobotany in Modern Medicine

Role of ethnobotany in modern medicine with special example Rauvolfiasepentina., Trichopuszeylanicus. Major tribes of south India and their ethnobotanical and ethno-biological heritage- Paayar, Kurichiar, Paniyar, Mulla, Karuman, Naikas, Shola Naikas, Thodas, Kothas, Kurumbas, Irulas, Mayalali, KattuNaikas

UNIT V Applications and Conservation of Ethnobotany

Ethnobotany and conservation of plants with special reference to India- Mythology and conservation of ecosystems, conservation of selected medicinal plant species: scared groves, forestry and unique ecosystems, and their ethnobiological values, plants and animals in art, tradition and ethnography: methodologies in ethno-botanical research. Ethnobotany as a source of drug.

Outcome of the course

At the end of the course students should have increased: Your capacity to think critically; your ability to design and execute an experiment; your confidence and ability in communicating ideas. This will serve as a lasting and practical basis for a career, for example, in research - whether industry or academia - as well as teaching, media, law, commerce, government or management.

Text Books

1. Das, A.P. and Pandey, A.K. (2007). Advances in Ethnobotany. Bishen Singh and Mahendra Pal Singh, Dehradun.
2. Sahu, T.R. (2007). Indigenous Knowledge: An application. Scientific Publishers. Jodhpur.
3. Gary J Martin, 2008. Ethnobotany A Methods manual, Earth scan, London.

Reference Books

1. Jain, S.K. (1995). Manual of Ethnobotany, Scientific Publishers, Jodhpur.
2. Jain, S.K. (ed.) (1981). Glimpses of Indian. *Ethnobotny*, Oxford and I B H, New Delhi
3. Journal of Ethnobotany. Deep Publishers, Lucknow
4. Jain, S.K. (ed.) (1989). Methods and Approaches in Ethnobotany. Society of Ethnobotanists, Lucknow, India.
5. Jain, S.K. (1990). Contributions of Indian Ethnobotany. Scientific publishers, Jodhpur.
6. Jain and Mudgal. Dictionary of Ethnobotany. Deep Publication, Delhi.
7. Cotton, C.M. (1997). Ethnobotany – Principles and Applications. John Wiley and Sons – Chichester.
8. Journal of Ethnopharmacology. International Society of Ethnopharmacology.
9. S. K. Jain. (1996). Ethnobotany in Human Welfare.Deep Publications. Lucknow.
10. Schultes and Reiss von (1995). Ethnobotany: Evolution of a Discipline. Chapman & Hall.

OPEN ELECTIVE
PAPER - 3
B. FORESTRY AND CARBON MANAGEMENT

Objectives

- The objective of this study is to bring the concept of normal forest into forest carbon management in India.
- To understand the maintaining or enhancing ecosystem carbon storage is increasingly becoming an important goal for forest management.
- To considering carbon in the context of land management activities, it is necessary to consider the overall management

UNIT I Introduction to Forests

Importance of forest, major forest types of India. Forest influences and protection, conservation strategies of forest, Exoties and its significance. Factors influencing resource availability. Locality factors of forest-climate, physiography, geology and soil condition, biotic factors, influence of plant completion, parasites, epiphytes, climber, weeds on forests. Forest resources and utilization – forest products, forest laws and policies, People and forest, social and community forestry, forest industries. Genetic Engineering and its application in forest, Remote sensing and GIS in forestry.

UNIT II Forestry Management

Forest resource inventory, tending operation in forestry – Weeding, cleaning, thinning, improvement felling, pruning and climber cutting. Forest regeneration – natural and artificial, their significance. Forest management system – Silviculture and Silvicultural system – clear felling system, shelter wood system, selection system, coppice system. Production forestry – concept of forest growth, growing stock – increment, rate of growth, rotation and yield and its regulation. Concept of forest working plan its purpose and salient features and micro plan.

UNIT III Approaches and Planning Forestry Management

Afforestation and reforestation, Plantation in various types of ecosystems. Sustainable Forest Management (SFNT), Criteria and indicators of forest management. Ecological, social and economic dimension of forest resource management. Approaches to forest conservation. Forestry organization – role and functions of various forestry wings. Participatory forestry – Joint forest management – approaches, methods and present status.

UNIT IV Energy issues and climate change

Climate change, global warming and greenhouse effect, green-house gases (GHGS) and their sources, quantifying Co_2 and methane emissions, global warming potential (GWP), the radiative balance, earth's carbon reservoirs and carbon cycle.Controlling Carbon dioxide: Efforts to restrict carbon dioxide levels – Kyoto Protocol, methods to increase carbon dioxide absorption in power and agricultural production, forestry and industry, Copenhagen summit and its implications. Carbon trading – concept of carbon credits, standard and branded credits (European, Indian), global and Indian Scenarios.

UNIT V Carbon Sequestration

Carbon management through abiotic sequestration, geologic injection, conventional and non-conventional techniques, carbon sequestration in vegetation, deep saline aquifers deposit, ocean carbon absorption, alternatives and risks, carbon farming and carbon trading, carbon auditing methane source and sinks, methane emissions from rice (paddy) and wetlands.Strategic management of carbon emissions – best management Practices, types of certification, studies related to global warming and its control in different ecosystem, REDD and REDD+ mechanism.

Outcome of the Course

The students are able to forests sequester (or absorb) and store carbon dioxide from the atmosphere, helping reduce greenhouse gas emissions.Carbon sequestration is the process by which atmospheric carbon dioxide is taken up by trees, grasses, and other plants through photosynthesis and stored as carbon in biomass (trunks, branches, foliage, and roots) and soils.

Text Books

1. De Vere Burton L. 2000. Introduction to Forestry Science, Delmar Publications, New York.
2. Montagnini, Florencia, Jordan, Carl F, 2007. Tropical Forest Ecology: The Basis for conservation and Management. Springer Publication.
3. Brohe, Arnaud, Nick Eyre, and Nicholas Howarth, 2009. Carbo Markets: An International Business Guide (Environmental Insights), Routledge.

Reference Books

1. West, P.W. 2004. Trees and Forest Management. Springer Publication.
2. James P. Kimmins, 2006. Forest Ecology, Pearson Publication.
3. A.P. Mitra et.al. 2004. Climate change and India: Uncertainly Reduction in Greenhouse Gas Inventory Estimates, Universities Press (India) Pvt. Ltd.
4. Labatt, Sonia and Robert, R. White, 2007. Carbon Finance: The Financial Implications of climate change (Wiley Finance). Wiley Finance.
5. Egbert Boeker and Rienk Van Grondella. 2013. Environmental science – Physical Principles and Applications.
6. Adrian Newton, 2007. Forest Ecology and conservation: A hand book techniques. Oxford University Press.
7. Lal, J.B. 2007. Forest Ecology. NatarajPublication.

8. Bhattacharya, P., Kandya, A.K, and Krishna Kumar, 2008. Joint Forest Management in India, Aavishkar Publisher, Jaipur. Vol I and II.

SEMESTER IV
PAPER-10

PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY

Objectives

- To understand water and nutrient translocation in plant
- To study the process and mechanism involved in photosynthesis and respiration
- To understand the stress and growth development
- To understand the mechanism and application on biochemistry and plant functions

Unit I Water relations

Physical and chemical properties of water- water in soil -water absorption by roots - water transport system- Transpiration types , factors affecting and significance – stomata structure and function– opening and closing of stomata mechanism – mineral nutrition – essential nutrients -macro and micro nutrients mineral nutrition – essential nutrients – macro and micro nutrients –diffusion- absorption of solutes translocation of solutes

Unit II Photosynthesis, Respiration and Nitrogen metabolism

Photosynthesis Chloroplast - ultra structure, photosynthetic pigments – structure and function, Emerson enhancement effect- mechanism of electron transport – photophosphorylation (PS-I & PS-II) – proton transport –Z- scheme –electron flow and ATP synthesis. C_3, C_4 and CAM pathways and features photorespiration and its significance, RuBISCO. Respiration –types, Glycolysis – TCA cycle – electron transport and ATP synthesis– respiration and its significance. Secondary metabolism in plants. Nitrogen Metabolism, Amino acid biosynthesis.

Unit III Plant growth development and Stress Physiology

Plant growth- definition – growth factors –growth dynamics and growth analysis – Growth regulators (auxin, gibberellins, cytokinins, abscisic acid, ethylene), photoperiodism – classification of plants and mechanism of flowering in photoperiodic sensitive plants – phytochrome – vernalization mechanism and application –photo-trophism – geo-trophism. Stress - Biotic stresses and mechanism of resistance. Water stress – water deficits and plant growth - physiology and biochemical functions affected by water stress. salt stress injury – mechanism of salt tolerance in halophytes. Seed dormancy.

Unit IV Plant Biochemistry

Atomic structure—Nature and different types of chemical bonds are important in plant physiology, Vander Waals interactions. Hydrogen concentration, Buffers—Biological buffer systems, Carbohydrates classification—properties of mono, oligo and polysaccharides. Amino acids structure and functions- proteins classification - primary, secondary, tertiary and quaternary structure of protein. Ramachandran plot - denaturation of proteins, pH, Biomolecules—Lipids metabolisms-structure—phospholipids, glycolipids, steroids. Nucleic acids—Chemistry of nucleic acids – denaturation and renaturation.

Unit V Thermodynamics and Enzymology

Bio-energetics—Laws of thermodynamics—entropy, enthalpy and free energy. Exergonic and endergonic reactions, Redox potential, Structure and hydrolysis of ATP, high energy compounds. Enzymes—Nomenclature, Classification and properties; Factors affecting enzyme activity—Activation energy—enzyme kinetics—enzyme inhibition—enzyme regulation. General principles of extraction and purification of enzymes. Enzyme immobilization. Michaelis-Menten equation. Application of enzymes in industry and medicine.

Outcome of Course

Students will understand the (i) phenomena of carbohydrate synthesis in plants and use of the carbon to generate energy to maintain plant functions; and (ii) control of plant functions through growth regulators. (iii) phenomena of protein synthesis in plants and use of the nitrogen to generate energy to maintain plant function.

Text Books

1. Buchanan, B. B., W. Gruissem and R. L. Jones. 2000. Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists, Maryland.
2. Salisbury, F. B. and C. W. Ross. 1992. Plant Physiology (4th edition). Wadsworth Publishing Co., California. Taiz, L., Zeiger, E., 2010. Plant Physiology, Fifth edition, Sinauer Associates, Massachusetts, USA.
3. Lincoln Taiz, Eduardo Zeiger, Ian Max Møller, Angus Murphy. 2018. Fundamental of Plant Physiology, Oxford University Press, 2018; ISBN: 1605357901, 9781605357904.
4. Jain, V.K. 2017 (19th Edition) Fundamentals of Plant Physiology. S. Chant&co, New Delhi.

Reference Books

1. Nelson DL and Cox MM. (2004) Leininger Principles of Biochemistry, 4th Edition, W.H. Freeman and Company, New York, USA.
2. Davies P J. (2004) Plant Hormones: Biosynthesis, Signal Transduction, Action. 3rd Edition, Kluwer Academic Publisher, Dordrecht, The Netherlands.
3. Dennis,D.T., Turpin,D.H., Lefebver,D.D. and Layzell,D.B. 1997.Plant metabolism. Longman Essex, England.

4. S.K.2006 A text book of Plant Physiology S. Chant&co, New Delhi.
5. Panda, S.K, 2005. Advances in Stress Physiology of plants, Scientific publishers India, Jodhpur.
6. Devlin, R.M. and Baker, N.R. 1973. Photosynthesis, Reinhold Affiliated EastWest Press Pvt. Ltd, New Delhi.
7. Hewitt, E.J. and Cutting, C.V. 1979. Nitrogen metabolism of plants, Academic Press, London.
8. Roberts, E.A. 1987. Plant growth regulators. Kluwer Academic publishers, London.

PAPER-11

RESEARCH METHODOLOGY

Objectives

- To understand the importance research writing
- To study the importance of instrumentation in Plant Science field
- To understand the basic biostatistics and research tools
- To understand the computer application in plant biology

UNIT I Research Methodology

Meaning and scope of research; Research design—Choice of the problem—Scientific writing – Characteristics, Logical format for writing thesis and papers. Abstracts preparation. Introduction – components. Review of literature – Primary and secondary references. Materials and methods –collection, selection and preparation. Result-Tables and graphs model, Discussions-Summary-Reference-types of styles –proof correction. Reporting the results in conference by oral and poster presentation—reports writing.

UNIT II Instruments

Principles and application of Clinical centrifuge, High speed centrifuge, Radioactive Isotopes and half-life of Isotopes uses —Autoradiography, Scintillation counter, GM counter. Chromatography – types and uses. Electrophoresis techniques; Principle and applications of Colorimeter, Principle and applications of spectrophotometer, UV- visible spectrophotometer and Atomic absorption spectrophotometer.

UNIT III Basic Biostatistics

Biostatistics- aims and scope, Data- collection of data, classification and tabulation of data—primary and secondary data. Frequency distribution-types, Graphical or diagrammatic representation of data- types and uses. Measures of central tendency —

characters, merits and demerits - mean, median mode, harmonic mean and geometric mean. Measures of dispersion- range, quartile deviation, mean deviation, standard deviation, coefficient of variations, Standard error.

UNIT IV Research tools of Statistics

Probability – types, rules of probability, normal and binomial distribution. Test of significance, level of significance. 't' – test, 'F' test, Z-test, Chi-square test, ANOVA- one way and two way. simple and multiple correlation- types. Simple regression-types-. Sampling and experimental designs of research—Randomized block design and Split plot design.

Unit V Computer Application

Computer in biological science, scope and prospects– Classification-Input and output devices. Operation system- function and components. MS windows – MS-Word-folders, files, MS Excel – Data storage – Data analysis – MS Power point – creating slides – templates – animation and transitions. Online publications: Electronic journals – Email, e-access. Biostatistics packages, Data base preparation, Graphic applications in biology.

Outcome of course

Students will understand the basics of bioanalytical instruments, analysis of bioactive ingredients using conventional and advanced instruments, and analyze the data statistically and the ethical guidelines to be followed during experimental and research work.

Text Books

1. Kothari, C.R and Gaurav Garg, 2019 (4th Edition). Research Methodology—Methods and Techniques. New Age International Publisher, New Delhi. ISBN 10: 9386649225 ISBN 13: 9789386649225.
2. Keith Wilson and John Walker, 2010 (7th Edition). Principles and Techniques of Biochemistry and Molecular Biology 7th Edition. Publisher: Cambridge University Press. ISBN-10: 9780521516358.

Refence Books

1. Balagurusamy, E. 1985. Programming in Basic. Tata Mac Graw Hill. Pub, Co, U.K.
2. Connor and Peter Woodford, 1979. Writing Scientific paper in English. Pitman Publ. Co, U.K.
3. Deenadayalu, R. 987. Computer Science Vol I. Tata MacGraw Hill. Pub, Co, U.K.
4. Prasa, SW. 2007. Elements of Biostatistics. Rastogi publications, Meerut.

5. Rangasamy, R.A, 1995. A text book of Agricultural Statistics. New Age International publications, Chennai,
6. Scholkopf, Isuda and Vent Kernel, 2005. Methods in Computational Biology. Ane Books, New Delhi.
7. SreeRamalu, V.S, 1988. Thesis writing. Oxford & IBH publ, New Delhi.
8. Singh, R. 2006. Research Methodology in plant science. M.J.P. Publications, New Delhi.
9. Pranab Kumar Banerjee. 2015. Introduction to Biostatistics (A text book of biometry). S. CHANT & CO. New Delhi.

CORE ELECTIVE
PAPER - 4
(Choose either A or B)

A. BIOINFORMATICS AND IPR PATENTING

Objectives

- To provide the knowledge on bioinformatics and its applications.
- To familiarize the students on protein and nucleic acid data bases and genomics and proteomics. The basic objective introduces the newly emerging and rapidly evolving field that integrates biological data and computer calculations.
- To get the skill in phylogenetic tree construction.
- To impart information of computer aided drug designing and practice of molecular docking using suitable online tools and software.

UNIT I Basic Principles of Computing in Bioinformatics

Introduction of Bioinformatics - Definition and History of Bioinformatics - Scope of Bioinformatics - Need and Potential of Bioinformatics. Computational Biology and Bioinformatics, Sequence of Software in Bioinformatics, Bioinformatics and the Internet - World Wide Web - Internet Protocols - Internet Browser - Search Engines – e- books, e – journals and e – mail. Applications of Internet. Human Genomic Project and relevant genes. Pharmacoinformatics.

UNIT II Biological Databases

Types of Data and Databases, Nucleotide Sequence Databases – GenBank, EMBL and DDBJ, Protein Sequence Databases – SWISSPROT and TrEMBL, Secondary Databases – PROSITE, PRINTS and BLOCKS, Protein Structure Databases – PDB, CATH and CSD, Literature Databases – PubMed and Scopus, Databases and Analysis tools – BLAST and FASTA. Information retrieval from databases – Search Concepts, Tools for Searching, Homology Searching, Finding Domain and Functional site homologies.

UNIT III Structural Bioinformatics

Molecular structure viewing tool – Rasmol, Protein structure. Prediction – Secondary structure prediction (Chou Fasman Method and other bioinformatics tools for seconfary structure prediction) and Tertiary structure prediction (Comparative Modelling, Abinitio Prediction, Homology Modeling). Genomics – Types (Structural and Functional), Single Nucleotide Polymorphism, Gen – SNIP. Proteomics – Protein Expression Analysis, Mass Spectrometry in Protein Identification, Protein sorting, Metabolomics, KEGG.

UNIT IV Techniques in Bioinformatics

An introduction Sequence Analysis, Global and Local Alignment, Pair wise analysis, Scoring Matrices. Multiple Sequence Alignment Methods and Significance – Molecular Visualization – JS Mol / RasMol. Prediction of activity spectra – PASS. Molecular

Phylogeny – Gene and species, trees. Molecular Evolution and Kimuras Theory. Phylogenetic tree – Cladogram and Phylogram. Significance of Molecular Phylogeny, Computer aided. Drug design and Molecular docking. Brief study about docking tools.

UNIT V IPR and Patenting

Intellectual Property (IP) – Definition – Intellectual Property Rights (IPR). Intellectual Property Protection (IPP), Choice of Intellectual Property Protection. Plant Genetic Resources – Patent Systems – Sources of Patent Information – Patenting Methods – Patenting of higher plants. Patenting of transgenic organisms and isolated genes, Patenting of genes and DNA sequences – Plant Breeders Rights and Farmers Rights. Patenting of Life forms, Ethical issues of patenting, International Conventions and Corporations with Patwnt Applications, A brief account on Geographical Indication (GI).

Outcome of the Course

After completion of this course students can explore the information on biological data collection, comparison and analyses to find the interrelation between them for solving structural, functional and evolutionary problems using computational tools, various software's, databases and technologies.

Text Books

1. Teresa, K., Attwood and David J. Parry – Smith, SamironPhukan, 2011.Introduction of Bioinformatics, Dorling Kindersley Pvt. Ltd., India.
2. Ignacimuthu, S. 2012. Basic Bioinformatics, Narosa Publishing House., New Delhi.
3. Xiong, J., 2006. Essential Bioinformatics, Cambridge University Press.

References

1. Rocha, M. and Fereisa, P.G., 2018. Bioinformatics Algorithms, Ist Edition, Academic Press.
2. Momand, J. and Mc Curdy, M., 2017. Concepts in Bioinformatics and Genomics. Oxford University Press.
3. Jereny, R., 2015. Bioinformatics: An Introduction, Springer Publishing Co.
4. Hyde William Cornish., 2011. Intellectual Property Rights, Global Vision Publishing House., New Delhi.
5. Primrose, S. R., Twynman and P. Old., 2005. Principles of gene manipulation, Black Well Science Ltd., New Delhi.
6. Narayanan, P., 2006. Patent Law, Eastern Law House., New Delhi.
7. Bryan Bergeron, 2006. Bioinformatics Computing, Prantice Hall of India., New Delhi.
8. Westhead, D.R., Parish, J.H. and Twyman, R. M., 2008. Bioinformatics, Ist Edition, Bios Scientific Publisher Ltd., Oxford, UK.
9. Mount, D. W., 2001. Bioinformatics – Sequences and Genome Analysis, Ist Edition, Cold Springer, Harbor Laboratory Press., New York.

CORE ELECTIVE
PAPER - 4

B. WOOD SCIENCE and TECHNOLOGY

Objectives

- This course equips students with the knowledge of the macro and micro-structure of softwoods and hardwoods and their relation with properties of wood. The course exposes students to wood identification skills and practices.
- To explain the effect of silvicultural practices on wood quality, anatomical aspects of plantation timber and application of ultra-structure of wood.

UNIT I: WOOD CHEMISTRY

Chemical constituents of wood and bark, Cellulose: structure, chemical properties, effect of acids and bases. Hemi-cellulose: structure, chemical properties, effect of acids and bases. Lignin: structure and chemical properties. Extractives in some prominent timber species and their importance. Resins, oleo resins, gum oleo resins in some characteristic woods.

UNIT II: PHYSICAL PROPERTIES OF WOOD

Density and specific gravity. Variation in density of early sap wood and late wood constituents.Effect of growth rings on density. Physical properties of wood asinfluenced by moisture content and maximum moisture content of wood. Specificgravity of wood substance. Anisotropy in Wood.

UNIT III: THERMAL PROPERTIES OF WOOD

Dimensional changes on heating green wood. Effect of dry and wet heat and heatingin presence or absence of air on strength and dimensional stability**.** Thermal expansion, specific heat, thermal conductivity and diffusivity. Change oftemperature in wood under heating. Effect of moisture on thermal properties. Thermal properties of wood.

UNIT IV: ECONOMICS OF SAWN MATERIAL

Economic conversion of logs, various interacting parameters and decision making. Timber scale. Comparison of sawing for logs of forest and plantation origin. Various associated systems relating to sawn material including scriber deck and auto stacking.

UNIT V: WOOD DURABILTY

Natural durability, durability of heartwood and sapwood. Causes for naturaldurability. Classification of timbers on the basis of natural durability. Nature andconditions Estimate of losses of wood by bio-degradation in storage, processing and service. Importance of wood preservation.

Outcome of the Course

The students are able to gain comprehensive knowledge in Wood Science and Technology. Wood technology in broad sense combines the disciplines of wood anatomy, biology, chemistry, physics and mechanical technology.possess right professionalism, value, attitudes and ethics. It possesses social accountability. They have skills as manager and entrepreneur

Text Books

1. Bodig, J. and Jayne, B.A. (1982). Mechanics of Wood and Wood Composites. Van Nostrand Reinhold Company, New York, London, Melbourne
2. Desch, H.E. and Dinwoodie , J.M. (1996) Timber - Structure, Properties, Conversion and Use. 7th edn, Macmillan, Basingstoke, England.
3. Dinwoodie, J.M. (2000) . Timber: Its nature and behavior. 2th edn, E & FN Spon, London
4. Fengel, D. and Wegener, G. (1984). Wood: Chemistry, Ultrastructure, Reactions. Walter de Gruyter, Berlin
5. Haygreen, J.G. and Bowyer, J.L. (1989). Forest Products and Wood Science. Iowa State Univ. Press
6. Kollmann , F.F.P. and Côté, W.A. Jr. (1968) Principles of Wood Science and Technology. Springer-Verlag, Berlin Heidelberg New York

Reference books

7. Panshin, A.J. and de Zeeuw, C. (1980) Textbook of Wood Technology, 4th ed. , McGraw-Hill, New York.
8. Timell, T.E. Springer Series in Wood Science. Books on Wood Anatomy, Transport Processes, Growth Stresses, Wood-Water Relations, Biomass, Natural Products, Fibers a.o.
9. Tsoumis, G. (1991). Science and Technology of Wood: Structure, Properties, Utilization. Van Nostrand Reinhold, New York.
10. Walker, J.C.F. et al (1993). Primary Wood Processing: Principles and Practice. Chapman & Hall, London.
11. Zobel, B.J. and van Buijtenen, J.P. (1989). Wood Variation. Springer-Verlag Berlin Heidelberg New York.

Wood Chemistry

12. Fengel, D. and Wegener, G (1984). Wood: Chemistry, Ultrastructure, Reactions. Walter de Gruyter, Berlin.
13. Lin, S.Y. and Dence, W.(Eds) (1992) .Methods in Lignin Chemistry Springer-Verlag Berlin Heidelberg New York.

14. Rowell, R. (1984). The Chemistry of Solid Wood. American Chemical Society,Washington, D.C.

OPEN ELECTIVE
PAPER - 4
(Choose either A or B)

A. BIODIVERSITY AND CONSERVATION

Objectives

- To understand the level of biodiversity from biomes species to genetic levels, values of biodiversity, biodiversity hotspots, threats to biodiversity and modes of biodiversity conservation.

UNIT I: Introduction about Biodiversity

Biodiversity – ecosystem, species and genetic diversity, magnitude and global, national and local levels of accumulation of species diversity in plants and animals;Levels of biodiversity study: alpha, beta and gamma biodiversity;Ecosystems diversity: brief account of Earth's major terrestrial and aquatic ecosystems and their characteristic features – forests, grasslands, deserts, pons, lakes, estuaries and oceans.

UNIT II: Values of Biodiversity

Values of biodiversity – consumptive and productive uses – as sources of food, fodder, timber, medicinal and ornamental plants, social, ethical, aesthetic and option values. Biodiversity hot spots – the presently recognized 36 global hotspots, eight hottest hot spots, mega diversity countries, centers of plant diversity and endemism.

UNIT III: Agro-Biodiversity

Agro-biodiversity and wild relatives of cultivated plants, transgenic organisms and environmental issues – importance of agro-biodiversity, global food security; plant quarantine wing – need and importance of it in protecting regional biodiversity.

UNIT IV: Ecosystem and Convention Biodiversity

Biodiversity and various ecosystem services; Biodiversity prospecting and indigenousknowledge systems, community biodiversity registers. Regulation of biodiversity: Convention onBiological Diversity, National Biodiversity Authority, CITES. Problems in biodiversity regulation

UNIT V: Threats to and loss of biodiversity, deforestation – causes and consequences.IUCN categories endangered, threatened, vulnerable, Red Data Books.Endangered plants of India – *In situ* and *ex situ* modes of conservation of biodiversity, Biodiversity Act of India, IPR and farmers' rights, Patenting system in India.

Outcome

Students are expected to gain knowledge on the extend of biodiversity at various levels,ecosystem services of biodiversity and modes of biodiversity conservation.

Text books

1. Krishnamurthy KV (2003) An Advanced Textbook on Biodiversity – Principles and Practice, Oxford and IBH Publishing, New Delhi.
2. Singh, J.S., Singh, S.P & Gupta, S.R. 2017. Ecology, Environmental Science and Conservation. S. Chand (G/L) & Company Ltd.
3. Dadhich LK and Sharma AP (2002) Biodiversity –Strategies for Conservation, APH Publishing Corporation, New Delhi.

Reference books

1. Berlatsky (2013) Biodiversity – Global Viewpoints. Gale Cengage Publishers. ISBN: 9780737769050.
2. Gillespie A (2012) Conservation, Biodiversity and International Law. Edward Elgar Publishing ISBN: 9780857935151.
3. Levin, S., 2013. Encyclopedia of Biodiversity. 2nd Edition.
4. Michael P. Marchetti, Peter B. Moyle 2010. Protecting Life on Earth: An Introduction to the Science of Conservation. University of California Press.
5. Groombridge, B. (Editor). 1992. Global Biodiversity Status of the Earth's Living Resources. Springer.

OPEN ELECTIVE
PAPER - 4

B. BIOLOGICAL INVASIONS

Objectives

- To understand the nature and ability of invasive plant species, their impact on native biodiversity, case studies on terrestrial and aquatic invasive plants and control measures of biological invasions.

UNIT I: Biological Invasions

Biological invasions: Introduction- attributes of invasive plant species, Reproductive capacity allelopathy effects – Phenotypic plasticity- plant fitness to the new environment. Hypotheses related to invasive species – natural enemy and empty niche hypotheses. World's worst 100 invasive species- Databases for biological invasions.

UNIT II: Terrestrial Ecosystem

Plant invasion in terrestrial ecosystem – Examples and case studies of invasive plant species – biology, ecology of the following species and impact of invasion on native biodiversity – *Lantana camara, Parthenium hysterophorus, Chromolaenaodorata*and *Mikania micrantha.*

UNIT III: Freshwater Environment

Freshwater environment water hyacinth invasion – biology and ecology of *Echhorniacrassipes* its invasiveness and impact on freshwater biodiversity and problems on environment and wiser management. Marine bio invasions: Introduction- Natural and climate change mediatedinvasions-vectors of marine invasions- Biofouling- Ballest water management – establishment of marine invasive species examples and case study of the sea weed *Kappaphycusalvarezii*in coastal marine ecosystem.

UNIT IV: Management of Invasion

Management of Invasions: Impacts of exotics on plant productivity;Biological control of invasive plant species- Mechanical, chemical and biological control measures- Positive resource use - Quarantine and EIA assessments.

UNIT V: Global Climate Changes and Bioinvasions

Global climate change and bio-invasions – Economic loss caused by invasive species;Case study of one terrestrial and aquatic invasive plant species from the local environment and preparation of report for submission with a review of literature on these two selected species.

Outcome of Course

Students will acquire knowledge on plant invasiveness, attributes and impact of invasive species on biodiversity and productivity of native ecosystem and control measures of plant invasions.

Text books

1. Singh, J.S., Singh, S.P & Gupta, S.R. 2017. Ecology, Environmental Science and Conservation. S. Chand (G/L) & Company Ltd.
2. Kohli, R. K., Batish, D. R., Singh, J. S., Singh, H. P., Bhatt, J. R. 2012. Invasive alien plants: an ecological appraisal for the Indian subcontinent. CAB International.

Reference books

1. GISP – Global Invasive Species Programmehttps://www.gisp.org/
2. E., Russel, L., Zern, J., Aquino, T. and Tsomondo, T. 2001. Economic and environmental threats of alien plants, animal, and microbe invasions. Agriculture, Ecosystems and Environment, 84: 1-20.
3. Rilov, G. and Crooks. (2009). Biological invasions in marine ecosystems-ecological, Managemant and Geographic Perspectives. Springer-Verlag, Berlin Heideberg.
4. Singh, S.P., Biological Suppression of Weeds. Biological Control Centre, Bangalore, 1989.
5. Williamson, M. 1996. Biological Invasion, Chapman & Hall, London.

SEMESTER III
Core Practical– III

Morphology and Taxonomy of Angiosperm, Economic Botany, Plant Biotechnology and Genetic Engineering, Ecology and Conservation Biology

Core Practical **No. of Practical hours: 5**
Credits: 3 **Marks (Ex.75+In.25=100)**

Morphology and Taxonomy of Angiosperm

1. Detailed study of the families mentioned in the theory with two representative species from the local area.
2. Familiarity of the binomial nomenclature of the available species from the local flora using Gamble's flora with volume and page numbers.
3. Herbarium preparation.

Economic Botany

1. Identification of family, genus, species and morphology of the useful different organs of plants mentioned in the theory paper.

Plant Biotechnology and Genetic Engineering

1. Isolation of single cell protein (*Spirulina*).
2. Demonstration of Immobilization of yeast cells.
3. Preparation of plasmid DNA.
4. Demonstration of PCR technique with known primers.
5. Bio control of plant insects using *Bacillus thuringianensis.*

Ecology: Methods of studying vegetation

1. Quadrat method: List quadrat, count-quadrat and minimum size of quadrat for given vegetation.
2. Find the density, abundance and frequency of given vegetation by meter quadrat method.
3. Transect method: Line transect, belt transect and bisect method.
4. Find the Relative frequency, relative density and relative dominance for given vegetation. Important value index and polygraph charting.
5. Phenology study: Each student has to select a plant and prepare a report on the phenology.
6. Ecological adaptation of plants.
7. Ecological instruments.

Conservation Biology

1. Estimation of the dust pollution on plants and environment.
2. Ex-situ conservation and In-situ conservation methods
3. Estimation of pH, BOD and COD of organisms in the Environmental condition.

SEMESTER IV

Core Practical – IV

Plant Physiology, Biochemistry and Research Methodology

Core Practical **No. of Practical hours: 5**
Credits: 3 **Marks (Ex.75+In.25=100)**

Plant Physiology

1. Determination of osmotic potential by plasmolytic method.
2. Determination of water potential using gravimetric method.
3. Determination of water potential using dye method.
4. Effect of monochromatic light on apparent photosynthesis
5. Effect of CO_2 concentration on apparent photosynthesis
6. Effect of temperature on photosynthetic membrane
7. Estimation of chlorophyll content by Arnon's methods.

Plant Biochemistry

1. Test for Starch, Amino acids and Proteins in Plants
2. Estimation of Carbohydrates by anthrone reagent method.
3. Estimation of starch by Lugol's iodine method
4. Estimation of proteins by Lowry's or Bradford's method.
5. Estimation of amino acids by ninhydrin method

Research Methodology

1. Demonstration of Microtomy techniques.
2. Demonstration of Column and Thin Layer Chromatography techniques.

3. Demonstration of pHmeter/paper, Colorimeter, UV-Visible Spectrophotometer, Ultra and Micro Centrifuge and Horizontal and Vertical Gel Electrophoresis techniques.
4. Tabulation, calculation and Graphical representation of Statistical data in Plant Science field.
5. Application of Computer in the field of Plant Biology

Core Practical - I

Phycology, Bryology, Mycology, Lichenology,Bacteriology, Virology, Plant Pathology,Pteridophytes,Gymnosperms and Palaeo-botany

Time; 4 Hours
Max. Marks: 100
External Practical: 65
Record: 10
Internal: 25

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1. Cut the transverse/ longitudinal sections of the given material **A** and **B.** Identify by giving reasons. Draw labeled sketches. Submit the slide for valuation. (2x6= 12)

2. Take transverse/ longitudinal sections of the given materials **C, D** and **E** stain it and mount in glycerin. Submit the slides for valuation. Identify by giving reasons. Draw labeled sketches. (3x6= 18)

3. Identify the fossil slides **F** and **G**. Give reasons. Draw labeled diagrams. (2x5= 10)

4. Identify the given pathological specimen **H.** Write the causal organism, Symptoms and controlmeasures. Draw labeled diagrams. (7)

5. Write critical notes about the given spotters **I, J, K, L, M** and **N**. Identify and Draw label sketches. (6x3 = 18)

Core Practical – I

Phycology, Bryology, Mycology, Bacteriology, Lichenology, Plant Pathology,Pteridophytes,Gymnosperms and Palaeo-botany

Key

Q. NO	Material	Identification	Reason	Diagram	Slide	Total
1.	A Algae	1	2	½+½= 1	2	6
	B Fungi	1	2	½+½= 1	2	6
2.	C Bryophytes	1	2	½+½= 1	2	6
	D Pteridophytes	1	2	½+½= 1	2	6
	E Gymnosperms	1	2	½+½= 1	2	6
3.	**Fossil slides**	**Identification**	**Era**	**Reason**	**Diagram**	**Total**
	F Pteridophytes	1	1	2	½+½= 1	5
	G Gymnosperms	1	1	2	½+½= 1	5
4.	**Pathological specimen**	**Name of the Disease**	**Causal organism**	**Symptoms**	**Control measures**	**Total**
	H	1	1	3	2	7
5.	**Spotters**	**Identification**	**Reason**	**Diagram**		
	I Algae/Fungi	1	1	**½+½= 1**	-	3
	J Bryophytes	1	1	**½+½= 1**	-	3
	K Pteridophytes	1	1	**½+½= 1**	-	3
	L Gymnosperms	1	1	**½+½= 1**	-	3
	M Lichens	1	1	**½+½= 1**	-	3
	N Bacteria	1	1	**½+½= 1**	-	3
	Total Marks					65

	Record Note Book	10
	External Total Marks	**75**

Core Practical - II

Anatomy, Embryology, Cell & Molecular Biology, Genetics, Plant Breeding and Evolution

Time: 4 Hours
Max. Marks: 100
External Practical: 65
Record: 10
Internal: 25

1. Cut the transverse/ longitudinal section of the given material **A.** Identify by giving reasons. Draw labeled sketches. Submit the slide for valuation. (6)

2. Take the transverse section of the given material **B.** Stain it and mount in glycerin. Submit the slides for valuation. Identify by giving reasons. Draw labeled sketches of ground plan and a sector enlarged. (8)

3. Dissect and display any one developmental stage of **C.** Leave the slide for valuation. Draw labeled sketches. (6)

4. Make a suitable Squash preparation of **D.** Show any two phase of the mitosis. Draw labeled diagrams and leave the slide for valuation. (8)

5. Write the Protocol for **E** and describe the procedure. (10)

6. Find out the solution for the Genetics problem **F.** Find out the ratio. (5)

7. Work out the Genetic problem **G.** Find out the order of genes and the distance between them. Construct a chromosome map. (10)

8. Write critical notes about the given spotters **H, I, J** and **K.** Identify and Draw labeled sketches. (4x3=12)

Core Practical – II

Anatomy, Embryology, Cell & Molecular Biology, Genetics, Evolution and Plant Breeding

Key

Q. NO	Material	Identification	Reason	Diagram	Slide	Total
1.	A Anatomy	1	2	1	2	6
2.	B Anatomy (Anamolous)	1	2	2	3	8
3.	C Embryology	-	-	2	4	6
4.	D Cell Biology	2	2	2	2	8
		Aim	**Requirements**	**Procedure**	**Result**	
5.	E Molecular Biology	1	2	5	2	10
6.	**F Genetics**					5
7.	**G Genetics**					10
8.	**Spotters**	**Identification**	**Reason**	**Diagram**		
	H Anatomy	1	1	1	-	3
	I Embryology	1	1	1	-	3
	J Cell Biology	1	1	1	-	3
	K Plant breeding	1	1	1	-	3
	Total Marks					65
	Record Note Book					10
	External Total Marks					**75**

Core Practical - III

Morphology and Taxonomy of Angiosperm, Economic Botany, Plant Biotechnology, Genetic Engineering, Ecology and Conservation Biology

Time: 4 Hours
Max.Marks:100
External Practical: 60
Herbarium: 05
Record:10
Internal: 25

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1. Find the Binomial of **A** and **B** using Gamble's Flora. (2x2=4)

2. Refer **C** and **D** to their respective families based on their characters and indicate their taxonomical hierarchy. (2x5=10)

3. Prepare an artificial key (Intended key) based on the vegetative and reproductive characters of specimens given in **E, F, G, H** and **I.** (5x1=5)

4. Spot at the site **J** and **K**. Write the Family, Genus and species name and the useful part of the given spotters. (2 x4= 8)

5. Write the protocol for **L**. (1x7= 7)

6 Calculate the given parameters based on the given Quadrate **M**. (1x10=10)

7. Take the transverse section of **N**. Identify, draw diagrams and write notes. Submit the slide for valuation. (1 x7=7)

8. Identify and write critical notes of **O**, **P** and **Q**. (3x3= 9)

Core Practical- III

Morphology and Taxonomy of Angiosperm, Economic Botany, Plant Biotechnology, Genetic Engineering, Ecology and Conservation Biology

Key

Q. No.	Material	Genus & Species		Volume/Page No.		Total
1	**A Binomial**	**½+½= 1**		**½+½= 1**		2
	B Binomial	**½+½= 1**		**½+½= 1**		2
2	**Taxonomy description & Hierarchy**	**Characters**	**Diagram**	**Hierarchy**		
	C	**2**	**2**	**1**		5
	D	**2**	**2**	**1**		5
3	**Taxonomic key**	**Intended**				
	E	1				1
	F	1				1
	G	1				1
	H	1				1
	I	1				1
4	**Economic Botany**	**Genus**	**Species**	**Family**	**Useful part**	
	J	1	1	1	1	4
	K	1	1	1	1	4
5	**Biotechnology**	**Aim**	**Requirements**	**Procedure**	**Result**	
	L	**1**	**2**	**3**	**1**	7
6	**Ecology Quadrat**	**Aim & Procedure**	**Tabulation & Calculation**	**Result & Graph**		
	M	1+3 = 4	4	2		10
7	Ecology	Identification	Reason	Diagram	Slide	
	N	1	2	2	2	7
8	**Spotters**	**Identification**	**Reason**		**-**	
	O Biotechnology	1	2		-	3
	P Ecology	1	2		-	3
	Q Conservation Biodiversity	1	2		-	3
	Total Marks with Herbarium Record					**65 10**

	External Total Marks	**75**

Core Practical - IV

Plant Physiology, Biochemistry and Research Methodology

Time: 4 Hours
Max. Marks: 100
External Practical: 65
Record: 10
Internal: 25

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1. Set up the experiment **A** assigned to you. Record your observations and interpret your results. (15)

2. Analyses the given biochemical content of the plant material **B**. Record your observations and interpret your results. (10)

3. Comment on the experimental set up **C**. (6)

4. Analyses the given problem **D.** Tabulate, calculate and find out the result. Draw a graph based on the results. (10)

5. Identify the given spotters **E, F, G, H, I** and **J**. Draw diagrams and explain its mode of operation. (6x 4 =24)

Core Practical - IV
Plant Physiology, Biochemistry and Research Methodology

KEY

Q. No.	Material	Experimental Set up	Materials & Methods & Procedure	Tabulation & Calculations	Result	Graph	Total
1	A Physiology	**2**	**5**	**4**	**2**	**2**	**15**
2	B Biochemistry	**2**	**3**	**2**	**1**	**2**	**10**
3			Procedure	Diagram	Result		
	C Physiology/ Biochemistry		**2**	**2**	**2**		**6**
4		Formula	Tabulation	Calculations	Result	Graph	
	D Biostatistics	**1**	**1**	**3**	**2**	**3**	**10**
5	**SPOTTRES**	Identification	Diagram	Notes			
	E, F, G, H, I & JPhysiology/ Biochemistry/ Research Methodology	**1**	**1**	**2**			**6x4 = 24**
	Total **Record**						**65** **10**
	External Total Marks						**75**

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