

THIRUVALLUVAR UNIVERSITY

MASTER OF SCIENCE

DEGREE COURSE

M.Sc. PLANT BIOLOGY AND PLANT BIOTECHNOLOGY

UNDER CBCS

[with effect from 2008-2009]

The Course of Study and the Scheme of Examinations

Year / Semester	Subject	Paper	Title of the Paper	Ins. Hrs/ Week	Credit	Exam hrs	Max.Marks		
							IA	Uni. Exam.	Total
I Year I Semester	Core	Paper I	Algology, Bryology and Lichens	5	5	3	25	75	100
	Core	Paper II	Microbiology and Plant Pathology	5	5	3	25	75	100
	Core	Paper III	Pteridophytes, Gymnosperms and Paleobotany	5	5	3	25	75	100
	Core Practical			12	3	-	-	-	-
	Elective (a) Disciplinary or	Paper I	Seed Technology	3	4	3	25	75	100
	Elective (b) Inter Disciplinary		Microbiology						
I Year II Semester	Core	Paper IV	Taxonomy of Angiosperms and Economic Botany	5	5	3	25	75	100
	Core	Paper V	Anatomy and Embryology	5	5	3	25	75	100
	Core	Paper VI	Cell and Molecular Biology	5	5	3	25	75	100
	Core Practical	Practical I		-	-	6	40	60	100
	Core Practical	Practical II		10	3	6	40	60	100
			Human Rights	2	2	3	25	75	100
	Elective (a) Disciplinary or	Paper II	Herbal Botany	3	4	3	25	75	100
	Elective (b) Inter Disciplinary		Application of Plant Tissue Culture in Biotechnology						

M.Sc. Plant Biology and Plant Biotechnology: Syllabus (CBCS)

Year / Semester	Subject	Paper	Title of the Paper	Ins. Hrs/ Week	Credit	Exam hrs	Max.Marks		
							IA	Uni. Exam.	Total
II Year III Semester	Core	Paper VII	Plant Physiology	5	5	3	25	75	100
	Core	Paper VIII	Biotechnology - Tissue Culture and Genetic Engineering	5	4	3	25	75	100
	Core	Paper IX	Microbial Biotechnology	5	4	3	25	75	100
	Core Practical			8	3	-	-	-	-
	Elective (a) Disciplinary or	Paper III	Ecology	3	4	3	25	75	100
	Elective (b) Inter Disciplinary		Immunotechnology						
	Elective IV (Non-Major Subject)	Paper IV	Mushroom Production and Vermiculture Technologies	4	4	3	25	75	100
II Year IV Semester	Core	Paper X	Research Methodology	5	5	3	25	75	100
	Core Practical	Practical III		-	-	3	40	60	100
	Core Practical	Practical IV		4	1	3	40	60	100
	Core		Project/Dissertation with <i>viva voce</i>	18	10				200
	Elective (a) Disciplinary or	Paper V	Bioremediation Technologies	3	4	3	25	75	100
	Elective (b) Inter disciplinary		Bioinformatics						
Total				120	90				2200

THIRUVALLUVAR UNIVERSITY

M.Sc. PLANT BIOLOGY AND PLANT BIOTECHNOLOGY

SYLLABUS

UNDER CBCS

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I SEMESTER

PAPER I

ALGOLOGY, BRYOLOGY AND LICHENS

UNIT-I

A general account on Phycology. Criteria used in the classification of algae (F. E. Fritsch) Phylogeny and interrelationships among algae. Green algae - ancestors of higher plants.

UNIT-II

Structure reproduction and life histories of the following: *Anabaena*, *Nostoc*, *Cyclotella*, *Sargassum*, *Gracilaria*, *Chlorella* and *Nitella*.

UNIT-III

Algae as sources of nutraceutical, food, animal feed, hydrocarbon, and biofertilizers. Algae as indicators of pollution - Algae and sewage treatment. Techniques for fresh water and marine algal culture and cultivation - *Spirulina*, *Chlorella*, *Gracilaria*, *Kappaphycus*.

UNIT-IV

General account on habit, habitat, ecology and distribution of Bryophytes. Classification of Bryophytes. Characteristic features of Hepaticopsida, Anthocerotopsida and Bryopsida. Range of vegetative and reproductive structures,

modes of reproduction in **liverworts** (Sphaerocarpaceae, Marchantiales, Monocleales, Haplomitriales, Takakiales, Metzgeriales and Jungermanniales); **hornworts** (Anthocerotales); and **mosses** (Sphagnales, Andreaeales and Bryales).

UNIT-V

Alteration of generations. Adaptations for land habit. Fossil bryophytes. Phylogeny and interrelationships of bryophytes. Importance of bryophytes in experimental physiology. Economic importance.

Lichens: Structure, types, reproduction and uses.

PAPER II

MICROBIOLOGY AND PLANT PATHOLOGY

UNIT-I

Brief outline of microbial diversity - classification of microorganisms - What is microbial taxonomy - Classification and identification of bacteria - Bergey's system of bacterial classification (Bergey's 9th edition). Bacteria - morphology, ultrastructure, nutrition and reproduction. Viruses - general characters, morphology and classification - Structure of TMV and Bacteriophages - multiplication of bacteriophages

UNIT-II

General feature and classification of some group of microorganism - Rickettsias - Mycoplasma - Archaeobacteria - Actinomycetes - Protozoa - Brief outline of methods in microbiology - isolation and culture of microorganism - methods of isolation and maintenance of pure culture - methods for cultivation of anaerobes - culture characteristics. Microbial growth - growth curve of bacteria - measurement of growth - culture media (characterization, type and preparation) - staining of microbes

UNIT-III

FUNGI - Classification (ALEXOPOULOUS) - mycelial structure and its modification - nutrition - life cycle - fruitbodies - phylogeny and ultrastructure of various groups of fungi. Structure, reproduction and lifecycle of Plasmodiophora, Albugo, Penicillium, Peziza, Puccinia, Agaricus and Fusarium.

UNIT-IV

Environmental and Industrial Microbiology: Microbial flora of soil - influence of environmental factors viz. pH, light, organic matter, moisture, and temperature

Nitrogen cycle, Carbon cycle and Phosphorous cycle - Interaction of microbes - Waste water treatment . Microbial leaching of minerals. General design and application of biofermentor.

UNIT-V

Classification of plant diseases - symptoms of bacterial, viral and fungal disease. Dissemination of plant pathogen - Control of plant disease (cultural, physical, chemical and biological methods). Study of selected plant diseases; Blight of Paddy, Black arm of Cotton, Little leaf of Brinjal , Bunchy top of Banana, Red rot of Sugarcane and Tikka disease of Groundnut.

PAPER III

PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY

UNIT-I

General characteristics and classification of Pteridophytes (Reimer, 1954). Stelar and soral evolution. Phylogeny of Pteridophytes. Apospory and Apogamy.

UNIT-II

Structure, reproduction and life histories of the following genera: *Psilotum*, *Isoetes*, *Angiopteris*, *Pleopeltis*, *Azolla*, *Alsophila*, *Osmunda*, *Pteris*.

UNIT-III

General characteristics and classification of Gymnosperms (K.R. Sporne, 1954). Structure, reproduction and life histories of the following genera: *Araucaria*, *Podocarpus*, *Gnetum*, *Ephedra*. Economic importance of Gymnosperms.

UNIT-IV

Fossilization and its types. Contribution of Birbal Sahni to Paleobotany. Study of fossils in understanding evolution. Economic importance of fossil: fuel and industrial raw material.

UNIT-V

Study of form genera: *Lepidodendron*, *Calamostachys*, *Lyginopteris*, *Lagenostoma*, *Cordaites*.

ELECTIVE

PAPER I

(Choose either A or B)

A) SEED TECHNOLOGY

UNIT-I

Dicot and Monocot Seeds. Morphology and Types. Seed Reserves. Internal and External structures:- their functional significance. Albuminous and ex-albuminous seeds. Large and small seeds.

UNIT-II

Seed Dormancy: Types of dormancy - physical, physiological, morphological, chemical and mechanical. Primary and secondary dormancy. Skoto and photo dormancy. Methods to overcome dormancy. Ecological significance of seed dormancy.

UNIT-III

Seed Germination: Epigeal and hypogeal germination. Germination mechanism. Brief account of a). Germination value (Czabator) b). Germination rate (Bartellete). Total germination percent and plant percent. Germination ecology: Environmental factors and germination behaviour.

UNIT-IV

Seed Viability: Viability tests-their significance and importance. Orthodox and recalcitrant seeds. Critical role of seed moisture content and environmental factors on viability. Viability periods of selected Indian Forestry species.

UNIT-V

Seed Storage and Longevity: Seed germplasm and storage in different conditions. Cryopreservation. Static conservation of seeds. Clonal seed orchards. Seed certification; seed banks.

B) MICROBIOLOGY

UNIT-I

Classification of microbes. General characteristics of bacteria, Viruses. Algae, Fungi, Protozoa and Viruses. Methods of identification of microbes. Microbial nutrition. Nutritional types. Growth requirements. Influence of temperature, pH and oxygen.

UNIT-II

Microbial control, Methods of physical control (heat, cold, desiccation, radiation, sound waves). Sterilization by filtration. Chemical agents-disinfectants, antiseptics and antibiotics.

UNIT-III

Viruses, Classification, Viral components. Capsids, nucleocapsids, envelopes. Modes of viral multiplication and transmission. Techniques in cultivation of virus and purification. Virus like infectious agents (viriods and prions). Interferons.

UNIT-IV

Bacteria - Ultra structure, differential staining - Gram positive and Gram negative, Methods of isolation and identification multiplication and economic importance. Microbial ecology, Biogeochemical cycles. Microbiology of soil. Nitrogen fixing organisms. Mycorrhizae. Aquatic microbiology and soil borne pathogens. Microbiology of sewage and potable water. Microbiology of air.

UNIT-V

Microbes in food spoilage and food poisoning. Food preservation. Microorganisms as food. Probiotics. Genetically modified foods. Industrial products of microorganisms.

II SEMESTER

PAPER IV

TAXONOMY OF ANGIOSPERMS AND ECONOMIC BOTANY

UNIT-I

System of classification: Artificial System: John Ray, Linnaeus: Natural Systems: Jussie, de Candolle, Bentham and Hooker Phylogenetic systems: Engler and Prantle, Hutchinson; Takhtajan.

UNIT-II

ICBN - Typification - Principles of priority and their limitations - Effective and valid publications - Citations - Retention, Choice and rejection of name - Problems in Nomenclature, Herbarium and its potential role in teaching and research. Preparation of keys - Types, Floras - Monographs - Botanical gardens.

UNIT-III

Bio-chemical taxonomy - Micromolecules (Primary and secondary metabolites), Macromolecules (Proteins, nucleic acids, polysaccharides) - Numerical taxonomy - Biosystematics - Anatomy, Embryology, Palynology, Ecology, Cytology and Serology in relation to Taxonomy (each 3 examples) - Molecular Taxonomy - RFLP, 18S ribosomal RNA.

UNIT-IV

Study of the following families: Merispermaceae, Polygalaceae, Caryophyllaceae, Rhamnaceae, Vitaceae, Combretaceae, Onagraceae, Aizoaceae, Apiaceae, Gentianaceae, Boraginaceae, Verbenaceae, Nyctaginaceae, Loranthaceae, Aristolochiaceae, Liliaceae, Amaryllidaceae, Commelinaceae, Typhaceae, Cyperaceae

UNIT-V

Economic Botany - Fibre types: Fibre yielding plants, Principal woods of India. Medicinal plants: Drugs obtained from roots, underground stems, barks, stems, leaves, flowers, fruits, seeds and entire plants. Spices and condiments: Spices obtained from roots, underground stems, barks, flower buds and flower, fruits, seed and leaves - Fatty oils: Drying and semidrying oils, Non-drying oils, Vegetable fats - Essential oils: Types, oil yielding plants.

PAPER V

ANATOMY AND EMBRYOLOGY

UNIT-I

Microscopy - Phase contrast, Dark field, Polarising, Transmission Electron Microscopy, Scanning Electron Microscopy. Organization and theories of root, shoot and reproductive meristems. Vascular cambium - origin, development and types. Cambial activity - normal and anomalous cambium, periderm, polyderm, rhytidome, lenticels. Anomalous secondary thickening (any two examples).

UNIT-II

Xylem - differentiation, xylem elements - tracheids, vessels, fibre and parenchyma. Patterns of secondary wall. Tyloses - reaction wood, heart wood and sap wood, growth rings. Phloem - primary and secondary elements - ontogeny - differentiation. Structural variations and characteristics of phloem components. Nodal anatomy - uni, tri & multilacunar.

UNIT-III

Microsporangium - structure, development - structure and functions of wall layers, ultrastructure of tapetum. Microsporogenesis - pollen wall morphogenesis and structural variability. Pollen fertility and sterility, germination. Ovule - types, megasporogenesis - Embryosac types, ultrastructure of egg, synergids and antipodals. Nutrition of embryosac.

UNIT-IV

Fertilization - Heterospermy, differential behaviour of male gamete, discharge and movement of sperms. Syngamy and triple fusion, post-fertilization changes. Heterofertilization.

UNIT-V

Endosperm - types, endosperm haustoria, Embryogeny - Laws of Embryogeny - Classification - mono and dicot embryos - variations and differences in development. Apomixis. Polyembryony.

PAPER VI

CELL AND MOLECULAR BIOLOGY

UNIT-I

General account on Prokaryotes and Eukaryotes. Cell organelles and inclusions. Plasma membrane molecular structure, chemical nature, function, endoplasmic reticulum, dictyosomes, lysosomes, glyoxysomes and peroxisomes. Mitochondria occurrence ultrastructure, chemical composition and function. Plastid classification, morphology, ultrastructure, origin, development chemistry and function. Mitochondrial and chloroplast DNA - semi autonomy of the organelles.

UNIT-II

Nucleus - structure and chemistry - cell division - mitosis, meiosis; cell cycle - significance, mitotic inducers and inhibitors. Nucleolus - structure and function. Chromosomes - morphology, fine structure - telomere - types; lamp brush, polytene, isochromosomes - heterochromatin and euchromatin, chromosome identification - banding techniques.

UNIT-III

Nucleic acids - Base pairing and variations in base composition. Types of DNA. Chargaff's rule - DNA size - fragility - melting curves - hydrophobic interactions - denaturation renaturation - circular and superhelical DNA - topoisomerase - special base sequence - Repeated sequence - Single stranded DNA - DNA methylation, structure of RNA.

UNIT-IV

DNA replication - basic rule of replication - enzymology - DNA polymerase - ligase, helicase - Termination of DNA replication - mismatch repair - Replication of eukaryotic chromosomes. Transcription - Enzymology - RNA polymerase - classes of RNA molecules - transcription in Pro Eukaryotes - splicing mechanisms - Reverse transcriptions. Translation: Outline of translation, overlapping genes - Genetic code of mitochondria - exception to universal code.

UNIT-V

Gene regulation - Operon concept - control systems in Lac, Lac repress - Amp, ara and trp operons - gene expression in eukaryotes - Britten and Davidson model. Recombinant DNA and genetic engineering - plasmids - vector. Insertion of a particular DNA molecule into a vector, technique in rDNA technology. Detection of recombinant molecules - Genomic library - Production of gene products from cloned genes - Application of genetic engineering - RFLP - PCR.

CORE PRACTICAL I

Study of Algae in the field and Laboratory of the genera included in the theory. Identification at generic level using algal monographs.

Morphological studies of the representative forms using clear whole mounts, dissection and sectioning, permanent slides and herbarium sheets of the forms mentioned in theory.

Study of the morphological and reproductive structures of the genera mentioned in theory. Isolation and identification of the bacteria and fungi from soil, air and Baiting method. Isolation and identification of pathogenic bacteria and fungi from infected plants around their area; with special reference to Bacterial blight of rice, Black arm of cotton, Little leaf of brinjal, Bunchy top of banana, Red rot disease of sugarcane and Tikka disease of groundnut.

External morphology and internal anatomy of the vegetative and reproductive organs of the genera given in the theory.

External morphology and internal anatomy of the vegetative and reproductive organs of the species of Gymnosperms.

Paleobotany: Materials observed i.e. Fossil slides

CORE PRACTICAL II

Description of species based on herbarium and live specimen. Identification (Families and binomials) of specimens belonging to the families mentioned in theory. Preparation and use of keys at generic and species levels. Problems in Nomenclature. Field visit for 5-7 days to collect specimens in and out side the state. Submission of 20 herbarium sheets representing the families studied.

Study of dividing cells - squash and smear techniques. Study of induced aberrations in onion root tips employing chemical and plant extracts. Demonstration of salivary gland chromosomes of *Drosophila*. Chromosome mapping.

Estimation of nucleic acids, Isolation of plant DNA, plasmid DNA, Preparation of competent *E. coli*. Demonstration of Southern and Northern blots. Encapsulation of cells in alginate beads. Genetics problems based on the theory.

Calculation of various patterns in fruits/leaves/seeds - standard deviation - standard error, based on the data given. Chi square test.

HUMAN RIGHTS

COMPULSORY PAPER

UNIT-I

Definition of Human Rights - Nature, Content, Legitimacy and Priority - Theories on Human Rights - Historical Development of Human Rights.

UNIT-II

International Human Rights - Prescription and Enforcement upto World War II - Human Rights and the U.N.O. - Universal Declaration of Human Rights - International Covenant on Civil and Political Rights - International Covenant on Economic, Social and Cultural Rights and Optional Protocol.

UNIT-III

Human Rights Declarations - U.N. Human Rights Declarations - U.N. Human Commissioner.

UNIT-IV

Amnesty International - Human Rights and Helsinki Process - Regional Developments - European Human Rights System - African Human Rights System - International Human Rights in Domestic courts.

UNIT-V

Contemporary Issues on Human Rights: Children's Rights - Women's Rights - Dalit's Rights - Bonded Labour and Wages - Refugees - Capital Punishment.

Fundamental Rights in the Indian Constitution - Directive Principles of State Policy - Fundamental Duties - National Human Rights Commission.

Books for Reference:

1. International Bill of Human Rights, Amnesty International Publication, 1988.
2. Human Rights, Questions and Answers, UNESCO, 1982
3. Mausice Cranston - What is Human Rights
4. Desai, A.R. - Violation of Democratic Rights in India
5. Pandey - Constitutional Law.
6. Timm. R.W. - Working for Justice and Human Rights.

7. Human Rights, A Selected Bibliography, USIS.
8. J.C.Johari - Human Rights and New World Order.
9. G.S. Bajwa - Human Rights in India.
10. Amnesty International, Human Rights in India.
11. P.C.Sinha & K. Cheous (Ed) - International Encyclopedia of Peace, Security Social Justice and Human Rights (Vols 1-7).
12. Devasia, V.V. - Human Rights and Victimology.

Magazines:

1. The Lawyer, Bombay
2. Human Rights Today, Columbia University
3. International Instruments of Human Rights, UN Publication
4. Human Rights Quarterly, John Hopkins University, U.S.A.

ELECTIVE

PAPER II

(Choose either A or B)

A) HERBAL BOTANY

UNIT-I

Importance and relevance of herbal drugs in Indian system of medicine. Pharmacognosy - Aim and scope; branches of Pharmacognosy and phytochemicals - reserve materials; Secretory materials; Excretory materials.

UNIT-II

Medicinal gardening - Gardens in the Hills and plains; house gardens; plants for gardening. Poisonous plants - Types of plant poison; action of poisons; treatment of poisons; some poisonous plants; their toxicity and action.

UNIT-III

Adulteration of crude drugs and its detection - methods of adulteration; types of adulteration. Medicinal plants of exports values; Rejuvenating herbs; medicinal uses of non flowering plants.

UNIT-IV

Botanical description and active principle of root drugs; rhizome woods and bark drugs

UNIT-V

Botanical description and active principle of leaves; flowers; fruits; seeds and entire plants as drugs. Taxonomy study of some selected herbals.

B) APPLICATION OF PLANT TISSUE CULTURE IN BIOTECHNOLOGY

UNIT-I

Tools, techniques and procedures of Tissue culture: Media for *in vitro* culture - minerals, vitamins, and natural adjuvants like coconut milk and fruit juice. Requirements for auxin, cytokinin and other growth regulators. Solid and liquid media. Commercial prepacked media. Design of laboratory and commercial tissue culture facility.

Procedures in Tissue Culture: Fumigation, wet and dry sterilization, ultraviolet sterilization, ultrafiltration and surface sterilization. Laminar flow hood. Maintenance of axenic cultures.

Explants for Tissue Culture: Shoot tip, axillary buds, leaf discs, cotyledons, inflorescence and floral organs. Callus culture - initiation and maintenance of callus.

UNIT-II

Principles of Micropropagation: Direct and indirect morphogenesis, somatic embryogenesis, caulogenesis, rhizogenesis, acclimatization. Synthetic seed production.

UNIT-III

Tissue culture and Biotechnology: Mericlone for virus-free plants, selection of plantlets tolerant to biotic and abiotic stresses. Use of techniques of genetic engineering for obtaining transgenic plants resistant to diseases, insect pests, abiotic stress and herbicides.. Introduction of desired genes from microbes, plants and animals. Modifying the expression of resistant gene by antisense RNA technique. *In vitro* mutagenesis. Genetic engineering with protoplast and haploid cells.

UNIT-IV

Applications in Agriculture, Horticulture and Forestry: Achievements and current trends in improvement of cereals, vegetable crops, oil yielding plants, ornamental plants and forest trees.

UNIT-V

Tissue culture in Industrial and Medical Biotechnology: Suspension Culture systems, isolation of single and aggregate of cells. Immobilization of cells and use of bioreactors.

Protoplast Culture: Isolation of protoplast and transformation. Bioprocessing for active principles. *In vitro* production of secondary metabolites, pharmaceuticals and aromatic chemicals. Edible vaccine.

Tissue Culture in Germplasm Conservation: Introduction to in vitro conservation. Storage techniques, equipment, cryopreservation and tissue culture components used for storage. Achievements and current trends.

III SEMESTER

PAPER VII

PLANT PHYSIOLOGY

UNIT-I

Water relations of plants: Physico-chemical properties of water - water potential. Mechanism of absorption of water - active and passive transport - Apoplast and symplast concept. Stomatal mechanism and transpiration. Antitranspirants. Ascent of sap. Mineral nutrition - criteria for essentiality. Macro and micro nutrients, their role and deficiency symptoms. Absorption of solutes - passive, active diffusion and facilitated diffusion antiport - translocation of solutes - pathways and mechanism.

UNIT-II

Photosynthesis - Properties of light - Interaction between radiant energy and phosphorescence. Ultrastructure of chloroplast - Biosynthesis of chlorophyll - Van Niel Hill Reaction - Red drop phenomenon - Emerson enhancement effect, two pigment system - Light harvesting systems. Reaction center, P680, P700, water oxidation complex, electron transport system - Z - scheme - cyclic - non cyclic - pseudocyclic electron flow - photophosphorylation cyclic - non cyclic mechanism - photosynthetic carbon reduction pathways in C₃, C₄ and CAM plants - Biochemical variants of C₄ pathway. C₃-C₄ intermediates. Biochemistry and Genetics of RUBISCO. Carbon dioxide concentration mechanism in C₄ plants - photorespiration and its significance.

UNIT-III

Respiration - RQ - Glycolysis - Oxidative pentose phosphate pathway - Krebs's cycle - significance - Electron transport system and oxidative phosphorylation - mechanism - Energetics - Respiratory inhibitors - Cyanide resistant respiration. Amphibolic role of respiration. Plant lipid metabolism - function and utilization - Biosynthesis of fatty acids. Oxidative acids. Glyoxalate pathway - Gluconeogenesis. Secondary metabolites. Biosynthesis and flavanoids, terpenoids, alkaloids, steroids. Anthocyanin and lignin. Importance of secondary metabolites in pharmaceuticals.

UNIT-IV

Nitrogen metabolism - Source of soil nitrogen. Range of nitrogen fixing organisms - Legume - *Rhizobium* symbiosis, biochemistry and physiology. Nitrogenase, characteristics and functions of Leghaemoglobin. Genetics of nitrogen fixation. Nitrate reduction - Biochemistry and characteristics of NR and NiR - assimilation of ammonia. GDH and GS - GOGAT pathways - Transamination, Reductive amination. Amino acid families. Synthesis of amino acids. Aspartate synthesis, aromatic amino acid synthesis. Interaction between photosynthesis and nitrogen metabolism.

UNIT-V

Growth and development: Growth kinetics - Biosynthesis and mode of action of Plant Growth Regulators - auxins, gibberellins, cytokinins, abscisic acid. Phytochrome - properties and phytochemical transformation movement - nastic and tropic movements. Seed dormancy - causes and methods of break seed dormancy - physiology of seed germination - abscission - senescence. Stress physiology.

PAPER VIII

BIOTECHNOLOGY TISSUE CULTURE AND GENETIC ENGINEERING

UNIT-I

Plant tissue culture - Laboratory organization - Methods of sterilization - medium composition and preparation - culture initiation and incubation of culture. Callus induction and establishment. Callus sub-culture and maintenance. Cell suspension culture - characteristics. Somatic embryogenesis - somatic embryo development and synthetic seed production. Somaclonal variation and applications. Experimental androgenesis and gynogenesis - Factors controlling - Physical and chemical.

UNIT-II

Micropropagation: methods - axillary and adventitious budding - advantages. Plant protoplast isolation, culture and fusion. Call wall regeneration from protoplasts - application of protoplast hybridization. Biotransformation and immobilization of plant cells. Hairy root clones. Production of secondary metabolic compounds using cell and tissue culture. Molecular farming and immuno-protective drugs.

UNIT-III

Biotechnology - Scope, potentialities and constraints, host controlled restrictions, gene cloning vectors - Plasmids, Phages, Cosmids, Transposons, Primary vectors and plasmids - expression vectors. Enzymes in genetic engineering - exonucleases, endonucleases, restriction endonucleases, S I nucleases, DNA ligases, reverse transcriptase and alkaline phosphatase, Recombinant DNA technology.

UNIT-IV

Selection of genes, Gene libraries, Genomic and cDNA library - Gene transfer methods, Genetic organization of Ti plasmids, Ti plasmid mediated transfer - *Agrobacterium tumefaciens*, DNA mediated transfer. Calcium phosphate, PEG, DEAE, via liposomes - Microinjection - Macroinjection, microprojectile, and electroporation, - Selection of clones, marker and reporter genes in screening methods.

UNIT-V

Selection of recombinants - direct selection - selection for correct promoter sequence - CAT system - Importance of promoters for the programmed expression of alien genes - Indirect screening - Immunological techniques - hybridization techniques - gene addition and subtraction approach in genetic engineering - Expression of eukaryotic gene in *E. coli*. Antisense RNA.

PAPER IX

MICROBIAL BIOTECHNOLOGY

UNIT-I

General account of microbes used as biofertilizers, and P solubilizers and mobilizers. Mass inoculum production of *Rhizobium*, *Azospirillum*, *Azotobacter*. P solubilizers bacteria. Mycorrhizal inoculants, Blue green algae, *Azolla*.

UNIT-II

Fermentation technology - Principles of fermentation, media requirements - separation procedures - Solid state fermentation - Culture system - batch culture, fed back culture, semi continuous and continuous culture - Fermentor and types of fermentors. Large scale production of fungal enzymes - extraction and purification methods involved. Application of fungal enzymes in different industries - Immobilization of enzymes - Biofuel, ethanol, biogas, biodiesel and hydrogen production - uses.

UNIT-III

Biological monitoring of environmental pollution. Biosensors and Biochips. Ecological aspects of biodeterioration. Control of biodeterioration. Biological waste treatment and reuses and wastes. Bioremediation of Xenobiotic pollutants. Biomining - methodology and advantages. Biodegradable plastics. Removal of metals from water. Genetic engineering for biotic stress tolerant plants - insects, fungi, bacteria, viruses, weeds. Genetic engineering for abiotic stress tolerant plants - drought, flooding, salt and temperature. Marker-assisted selection of qualitative and quantitative traits.

UNIT-IV

Introduction; Computers in Biology - Windows, searches on MEDLINE, CD, FTP and WWW. Visualization techniques - Software and hardware requirements. Data base - concept - Accessing database on internet - Searching a database - Query and response. Protein Data Bank, Cambridge small molecular crystal structure data bank, Genbank, EMBL nucleotide sequence data bank, SWISSPROT. Docking of Molecules.

UNIT-V

Privatization of scientific knowledge - International policy issues - role of transnational corporation - Privatization of biotechnology - Intellectual property rights - private/public sector issues - physical property and intellectual property - farmers rights - plant breeders right - trade secret. Patents - Patenting of biological materials - obligation with patent applications - patenting of life forms - patents for higher plants and microbes - Patenting transgenic organisms, isolated genes, DNA sequences. Threat of gene escape via hybridization. Ethical concerns about transgenic plants.

ELECTIVE

PAPER III

(Choose either A or B)

A) ECOLOGY

UNIT-I

Ecosystem ecology: Structure, function and dynamics. Terrestrial and aquatic ecosystems with special reference to: Tropical moist forests, grasslands, mangroves and deserts. Global habitat classification: World ecosystems (Olsons); Ecoregions of the continents (Bailey), Biogeographical biomes (Udvardy), and Life zone classification (Holridge).

UNIT-II

Human modification of ecosystem processes: Interference with food chains and nutrient cycling. Relationship between human perturbations to global cycling of carbon, nitrogen, sulfur and phosphorous and environmental pollution.

UNIT-III

Community ecology: Forest community as an interacting system. Synusia in a forest community and their relationship with forest environment. Microclimate and macroclimate. Patterns of species richness in forests and their ecological implications. The concept of climax.

UNIT-IV

Population Ecology: Growth forms. Human population growth -demographic transition and demographic trap. re-selection and k-selection in species populations. Demography and survivorship curves. Competition exclusion principle - evidences. Plant pollinator guilds and plant-herbivore co-evolution. Secondary metabolites and population structure. Keystone mutualisms.

UNIT-V

Plants and Environment: Plant responses to low and high temperature. The principle of limiting factor. Photoenergetic, photocybernetic and photodestructive effects on plants. Global climate change and biodiversity. Habitat fragmentation and mechanism of loss of species. Biodiversity hotspots.

B) IMMUNOTECHNOLOGY

UNIT-I

Basic concepts in Immunology: Antigen, isolation, purification and characterization of various antigens and haptens from pathogens and other biological molecules by biophysical and chemical and affinity separation methods.

UNIT-II

Production of antibodies, purification of antibodies – Quantification of immunoglobulin by RID, EID and nephelometry.

UNIT-III

Hybridoma and monoclonal antibody production; Immunodiagnosis and applications of monoclonal antibodies in biomedical research; human monoclonal antibodies; Catalytic antibodies; complement fixation test; assessment of immune complexes in tissues.

UNIT-IV

Purification of mononuclear cells from peripheral blood; isolation and characterization of T cell subsets; B cells and macrophages; Fluorescent Activated Cell Sorter (FACS); Mitogen and antigen induced Lympho-proliferation assay; cell mediated lympholysis; Mixed lymphocyte reaction; Assessment of delayed hypersensitivity reactions; Macrophage cultures; Assay for macrophage activation; Isolation of dendritic cells; In situ & In vivo characterization of cells from tissues; Generation of T cell clones; HLA typing.

UNIT-V

Biology and assay of cytokines; Vaccine technology including DNA vaccines; Identification of T & B epitopes for vaccine development; immunotechnology and infectious diseases. Immuno screening of recombinant library

ELECTIVE

PAPER IV

(NON MAJOR SUBJECT)

MUSHROOM PRODUCTION AND VERMICULTURE TECHNOLOGIES

UNIT-I

Introduction and Importance of mushrooms; History of Mushroom's cultivation; Present status of mushroom industry in India; Cultivable edible mushroom; Biology of mushroom; food value of edible mushrooms; Uses of mushrooms, Poisonous mushrooms, and Medicinal mushrooms.

UNIT-II

Mushrooms farm structure; design and layout; Spawn principles and techniques of spawn production; Principle and techniques of compost and composting; Cultivation techniques of White button mushroom, oyster mushroom; Management of fungal, bacterial and viral diseases in mushroom; Competitors, pests and nematodes in mushrooms; Post harvesting techniques and Economics of mushroom cultivation.

UNIT-III

Vermiculture Technology: Introduction ; organic farming, soil fertility -Distribution and Ecology of Earthworms - Earthworm taxonomy - Morphological and Anatomical characteristics of Earthworm - Food habits, excretion and life cycle. Earthworm as farmer's friend. Types of Earthworms- Exotic and native species, South Indian and North Indian species used for vermin composting.

UNIT-IV

Collection and preservation of earthworms for vermicomposting and culturing techniques of earthworms. Preparation of vermicompost requirement, different methods of Vermicomposting(Heap method, Pot method, and Tray method). Changes during vermin composting, Nutrient value of Vermicomposting, and worm cast and its importance, Problems in vermicompost preparation

UNIT-V

Role of earthworm in soil fertility; Use of vermin compost for crop production; Use of earthworms in land improvement and reclamation; Economics of Vermicompost and Vermi wash production and uses. Role of earthworm in solid waste, sewage and faecal waste management and Vermi filters. Earthworm as bioreactors. Interaction of earthworm with other organisms. Influence of chemical inputs on earthworms activities. Large scale manufacture of Vermicompost, packaging Vermicompost and its marketing, financial supporting (government and NGOs for vermi culture work).

IV SEMESTER

PAPER X

RESEARCH METHODOLOGY

UNIT-I

Research design - Choosing the problem for research - Review of Literature. Primary, secondary and tertiary sources. Bibliography - indexing and abstracting - Reporting the results of research in conference - Oral presentation - Poster presentation - Written reports - Planning and preparing a thesis - Proof correction.

UNIT-II

Principles and applications of light, dark field, phase contrast, fluorescence, polarization, Scanning and Electron Microscopy - Fixation and staining of materials for Electron Microscopy.

UNIT-III

Principles and application only. pH meter - Clinical centrifuge - High speed centrifuge and microfuge - Techniques in Biology - Radio active isotopes and half life of isotopes - Autoradiography - Scintillation counter, GM counter - Chromatography (Types and uses) - Calorimeter, U.V. Visible spectrophotometer - Flame photometer - Atomic Absorption Spectrophotometer - NMR and ESR - Electrophoresis - Cell disruption by various techniques (Pestle and mortar, Blender & Sonicator).

UNIT-IV

Scope of biostatistics - Probability analysis - variables in biology - collection, tabulation, classification of data - Graphical diagrammatic representation - Mean, Median, Mode - Standard deviation - Standard error - Test of significance - 't' test, chi square test, two way ANOVA, simple correlation and simple linear regression.

UNIT-V

Basic knowledge of computers and Bioinformatics. Organization of a computer (CPU), input devices, output devices and memory- Internet basics, Internet Browsing - web sites and web pages-links. Website addresses - information in the web - Internet

file types - saving internet text - E. mail - Attaching files - searching the net. Date Bases: Primary sequence - Data bases. Nuclei acid sequence Data Base (EMBL. Gen. Book, DDBT). Protein sequence Data bases (PIR, MIPS, SWISS PORT, TrEMBL), Secondary Data bases (PROSITE), Tools for sequence alignment - FASTA, BLAST, CLUSTAL.

CORE PRACTICAL III

Determination of solute particles in plant tissues
Effect of temperature , detergent and solvents on membrane permeability
Study of hill reaction with isolated chloroplast
Estimation of soluble sugar
Estimation of starch
Estimation of amino acids
Estimation of proteins
Estimation of total lipids-gravimetric method
Estimation of Photosynthetic pigments from the given leaf(chlorophyll a and total chlorophyll)
Estimation of xanthophylls and carotene from the given material
Finding out the absorption maximum of chlorophyll from the given material
Study of respiratory quotient of plant material
Media Preparation(White's and M S)
Sterilization of explants and inoculation
Protoplast isolation
Meristem culture
Suspension culture
Somatic embryogeny
Isolation of Anabaena azollae from Azolla
Mass cultivation of Azolla-demonstration
Mass cultivation of BGA-demonstration
Isolation and identification of Rhizobium and Azospirillum
Isolation of P-solubilizing microbes
Isolation and identification of VAM
Seed application of bioinoculants
Immobilization techniques
Estimation of BOD
Accessing information from database using computer(Eg: Retrieving Nucleic acid sequence, Protein sequence etc.,)

CORE PRACTICAL IV

Selected techniques in light microscopy, Microtomy

Staining starch, cell wall, lipids, proteins and nucleic acids using bright field dyes

Paper and Thin Layer Chromatography

Demonstration of pH meter, colorimeter, spectrophotometer, centrifuge and electrophoresis

Graphical representation of data.

ELECTIVE

PAPER V

(Choose any 1 out of 3)

A) BIOREMEDIATION TECHNOLOGIES

UNIT-I

Introduction to Bioremediation - constraints and priorities of Bioremediation, Bioaugmentation of naturally occurring microbial activities:- Environmental modification- use of co substrates, oxygen supplementation (Composting and aerobic bioreactors, in situ aeration) - Nutrients and fertilizers (N & P, Soil fertilization and land treatment for disposal of oily wastes, aquifer nutrition, oleophilic fertilizers). Types of Bioremediation - Bioremediation of surface soil and sludges, Bioremediation of subsurface material, bioventing, plumes treatment.

UNIT-II

Alteration of microorganisms for biotreatment: Genetics Aspects:- Structure of DNA - Chromosomal and plasmid DNA - DNA replication - RNA synthesis - protein synthesis - Gene regulation in procaryotes - operon concept - lac and tryptophan operons.

Conventional Methods: Adaptation-molecular mechanisms of genetic adaptation to xenobiotics- enrichment-mutagenesis and screening - transposon mutagenesis - use of natural genetic processes - transformation, conjugation - transduction - protoplast fusion. Molecular technologies: Restriction endonucleases, techniques of restriction mapping-vectors-plasmid PBR 322 and Lamda phage, cosmid- construction of chimeric DNA, ligases, gene cloning-Southern, nortghern and wasteren blotting, dot and slot blos-construction of Genomic and cDNA libraroes-PCR (polylmerase chain reaction) and gene closing - use of genetically altered microorganisms for field biodegradation of hazardous materials.

UNIT-III

Biotechnology for hazardous waste management: Introduction -xenobiotic compounds, recalcitrance- hazardous wastes-biodegradation of xenobiotics- biological detoxification-market for hazardous wastes management-biotechnology applications to hazardous wastes management-cyanide detoxification -detoxification of oxalate, urea etc. - petrochemical industry effluents -toxic organics-phenols.

UNIT-IV

Industrial process and waste biotechnology with reference to paper and pulp, pesticide and tannery industries: Paper and pulp industry: Bio-pulping-biobleaching-effluent treatment - lignocellulose degradation - deinking of newspapers- recycling. Pesticide Industry: Pesticide Pollution problem- Pesticide degradation pattern-general classification of microbial metabolism of pesticides-biotechnological applications for pesticides waste disposal. Tannery Industry: Eco-friendly chemicals and technology-effluent treatment and biotechnological applications.

UNIT-V

Phytoremediation and Phycoremediation: *Phytoremediation* - Principles, factors, techniques (Phytoextraction, phytotransformation, phytodegradation, phytovolatilization, rhizofiltration and rhizodegradation) - advantages - limitations - utilization of biomass

Phycoremediation - Principles - factors - techniques (HRAP, Slope tanks, using algae with special attributes, immobilization) - advantages - limitations - utilization of Biomass

B) BIOINFORMATICS

UNIT-I

Introduction to computers and Bioinformatics. Types of hardware and software operating systems. Fundamentals of networking, operation of networks, telnet, ftp, www. Internet.

UNIT-II

Biological Research on the web:- Using search engines, finding scientific articles, public biological databases searching biological databases. Use of nucleic acid and protein data banks - NCBI, EMBL, DDBJ, SWISSPORT multiple sequence alignment.

UNIT-III

Sequence analysis, pair wise alignment and Database search. Phylogenetic analysis, profiles and motifs. Protein structures-visualizing, predicting and function from a sequence.

UNIT IV

Chemical composition - Bio-molecules. DNA, RNA. Structure of DNA, development of DNA sequence methods. Gene finder and feature detection in DNA. .

UNIT-V

Gene finding, pairwise sequence comparison, sequence queries in Biological databases - drug designing.

PROJECT/DISSERTATION

WITH *VIVA VOCE*

Reference Books for I Semester

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