

MCC, Department of Botany

M. PHIL. BOTANY

TISSUE CULTURE

PAPER II & III

PAPER - II

BIOCHEMISTRY AND MOLECULAR BIOLOGY

UNIT - I

Biomolecules - Mineral components of biomolecules and mineral absorption and nutrition. Secondary metabolites - alkaloids, terpenoids, phenolics and flavanoids.

UNIT - II

Nucleic acids - Classification, structure, property and molecular biology of nucleic acids.

UNIT - III

Enzymes - Classification, structure, reaction kinetics, inhibition and regulation of enzyme activity. Interpretation of enzyme kinetics using Michaelis-Menten plots. Molecular Biology of Enzymes.

UNIT - IV

Plant Membranes. Molecular biology and function, transport across membrane. Membrane and ATP synthesis. Hormone receptors and cellular communication, role of calmodulin.

UNIT - V

Photosynthesis: History and evolutionary importance of photosynthesis. Nature of light and its absorption by plant pigments. Chlorophyll-a fluorescence. Molecular biology of chloroplast proteins. Organization of pigments and proteins in membranes. Photosystems I and II. Light reaction, electron flow, cyclic and non-cyclic photophosphorylation and generation of NADPH. Pathways of carbon fixation C_3 , C_4 and CAM. Photorespiration. C_4 photosynthetic subtypes. Molecular biology of Rubisco.

UNIT - VI

Respiration: Molecular biology of mitochondria, importance of glycolysis and Krebs cycle in biosynthesis of molecules and chemiosmotic ATP synthesis. Anaerobic respiration, respiration of pentose and lipids and cyanide resistant respiration.

UNIT - VII

Regulation of Plant Growth: Measurement and analysis of growth. Control of vegetative and reproductive growth. Molecular biology of floral development - organogenesis. Plant growth regulators - auxins, gibberellins, cytokinins, ethylene, ABA, brassins, methyl jasmonate, triacontanol, and synthetic PGRs. Molecular biology of plant hormone physiology.

UNIT - VIII

Senescence and Programmed cell Death: Types of cell death. PCD in plant life cycle. Pigment metabolism, protein metabolism, nucleic acid degradation, regulation of metabolic activity and role of endogenous plant growth regulators in senescence.

PAPER - III

PLANT BIOTECHNOLOGY AND CROP IMPROVEMENT

Theory

UNIT - I

Introduction to Biotechnology : Definition, history, current demands from biological resources for food, fodder, feed, timber, oil, perfumes, pigments, biofertilizers, therapeutic agents, fermentation products etc. Bioprospecting. Ethical issues in biotechnology and safety and consumer issues of LMO/GMO.

UNIT - II

Introduction to Recombinant DNA Technology: Restriction enzymes, vectors, cloning, gene library, reverse transcription and cDNA. Artificial chromosome, DNA probes, RFLP, PCR, LCR, antisense technology. DNA delivery systems. Bioinformatics.

UNIT - III

Tissue culture: Early attempts in tissue culture of plants. Concept of totipotency. Media for *in vitro* culture - minerals, vitamins, 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.

UNIT - IV

Sterilization Procedures: Fumigation, wet and dry sterilization, ultraviolet sterilization, ultrafiltration and surface sterilization. Maintenance of axenic cultures.

UNIT - V

Explants for Tissue Culture: Shoot tip, axillary buds, leaf discs, cotyledons, inflorescence and floral organs. Callus culture - initiation and maintenance of callus. Micropropagation - direct and indirect morphogenesis, somatic embryogenesis and synthetic seed production.

UNIT - VI

Cell and Protoplast Culture: Culture systems, isolation of single and aggregate of cells and regeneration of plants. *In vitro* production of useful chemicals. Immobilization of cells and use of bioreactors. - Isolation of protoplast, somatic cell hybridization, selecting desired hybrids and their regeneration into plants. Use of protoplast in genetic engineering.

UNIT - VII

Embryo and Anther Culture: Embryo rescue technique. Isolation of sperms and egg cells. Culture of zygote/endosperm obtained through *in vitro* fertilization. Production of haploid plants through anther and pollen culture.

UNIT - VIII

Tissue Culture in Crop Improvement: Mericlone for virus-free plants, selection of plantlets tolerant to biotic and abiotic stresses. Improvement of forest trees, cryopreservation and germplasm storage. Use of protoplasts in obtaining transgenic plants.

UNIT - IX

Crop Improvement: Emerging trends using techniques of genetic engineering. Plant genome mapping (RFLP, RAPD, DNA finger printing), molecular cytogenetics and molecular markers. Mapping of quantitative traits loci (QTL). Marker assisted selection. Pyramiding of resistant genes.

UNIT - X

Transgenic Plants: Introduction of desired genes from microbes, plants and animals. Modifying the expression of resistant gene by antisense RNA technique. Enhanced expression through incorporation of strong promoter or *in vitro* modification of coding sequences. Transgenic plants resistant to diseases, insect pests, abiotic stress and herbicides. Improving nutritional quality of storage organs. Control of floral organogenesis. Selected examples of crop improvement through genetic engineering in rice, wheat, millet, cotton, pulses and oil crops.