

P.G. 2nd Semester

Paper: BOT801C (Core) Analytical Techniques and Molecular Biology Credits: 4 = 3+1+0 (48 Lectures)

Unit-1: Cytochemical and histochemical techniques Lectures - 06

- Fixatives, dyes and stains: Principles, types, procedures and application; mounting media, fixations, embedding, staining methods. Histochemical detection of phytochemicals (secondary metabolites), biomolecules (nucleic acids, lipids, starch, enzymes) and microbes in plant tissues.

Unit-2: Basic culture techniques: Lectures -06

- Basic plant and microbe culture media –Types, preparation and methods of sterilization; Somatic embryogenesis.

Unit-3: Microscopy and spectroscopy techniques : Lectures - 08

- Principle, methods and application in plant science of Phase-Contrast, Fluorescence, Electron, Confocal Microscopy; Spectroscopic Techniques - Principle, instrumentation and application of Visible, UV, IR Spectrophotometry, fluorimetry & ESR Spectroscopy, atomic absorption and mass spectrometry.

Unit-4: Separation Techniques: Lectures - 08

- Principle & applications in plant sciences; One and two dimensional Chromatography, Column chromatography, HPLC, Ion-exchange chromatography; Molecular sieve chromatography; Affinity chromatography.

Unit -5: Nucleic Acid Lecture-10

- Structure, function and replication of DNA and RNA, DNA damage & repair, DNA topoisomerase and DNA polymerase. DNA isolation, amplification (PCR and Real time PCR) and Cloning techniques, sequencing techniques including NGS; DNA transfer techniques in plant.

Unit-6: Gene expression: Lecture-10

- Genetic code, decoding system translational machinery, post translational modification of Protein, Non covalent interaction and folding of polypeptide chain, regulation of gene expression in prokaryote ('Lac' & 'Trp' operon) and eukaryotes.

Suggested Readings

- Plummer, D.T.(1996). An Introduction to Practical Biochemistry. TataMcGraw-Hill Publishing Co. Ltd. New Delhi. 3rd edition.
- Ruzin, S.E. (1999). Plant Micro-technique and Microscopy, Oxford University Press, New York. U.S.A.
- Sheehan D (2009). Physical biochemistry: Principles and applications (2nd Edition), A John Wiley & Sons, Ltd, Publication

- Wilson, K. & Walkar, J. (Eds) (2010) *Practical Biochemistry: Principles & Techniques* (7th Edition, Cambridge University Press.
- David Freieder (2015) *Molecular Biology*- Narosa Publishing House.
- Jocelyn E. Krebs, Elliott S. Goldstein & Stephen T. (2013) *Lewin's Genes*- Kilpatrick, Jones and Bartlett Publishers.

Paper: BOT802C (Core)
Plant Physiology and Biochemistry
Credits: 4 = 3+1+0 (48 Lectures)

PLANT PHYSIOLOGY:

Unit-1: Water Relation and mineral nutrition in plants: Lectures-08

- Water potential in plant, transpiration, stomatal regulation and signalling and physiology of water stress and its adaptation in plant
- Mineral Nutrition: Criteria of essentiality, detection of mineral elements by chemical analysis; uptake, role and deficiency of essential mineral elements in plants.

Unit-2: Photosynthesis and Solute Transport: Lectures-06

- Photosynthetic pigments, Photosystems, Photochemical reactions and light harvesting complexes, carbon fixation pathways in plants
- Solute transport in plants, Uniport, Symport, Antiport channels, ATP driven active transport Source and sink relationship (Phloem loading and unloading): Pressure flow model; Polymer trapping model.

Unit-3: Respiration: Lectures-06

- Different types of respiration. Glycolysis, TCA cycle, Pentose Phosphate Pathways, Cyanide resistance pathway, Gluconeogenesis, ATP synthesis.-Mitochondrial electron transport system coupled with oxidative phosphorylation, High energy compounds: Synthesis and utilization, Inhibitors of electron transport system.

Unit-4: Photobiology and plant growth regulators Lectures-12

- Structure, function and mechanisms of action of phytochromes, plant morphogenesis- Physiology of flowering, florigen concept, circadian rhythms, photoperiodism and its regulation, vernalization, fruit ripening. Dormancy (bud and seed), seed germination- metabolic changes during seed germination, and senescence.
- Physiological effect, biosynthesis and mechanism of action of plant growth regulators: Auxins, Gibberellins, (GA), Cytokinins, Ethylene, Abscisic Acid, Brassinosteroids, Jasmonic acid and Salicylic acid.
- Role of PGR's in agriculture, floriculture, horticulture and biotic and abiotic stress adaptation in plants.

PLANT BIOCHEMISTRY:

Unit-5: Enzymology: Lectures-06

- General classification, mechanism of enzyme action, Cofactor and Coenzymes, Isozymes and factors affecting enzyme activity, enzyme inhibition, regulation of Enzyme action, allosteric enzymes, Enzyme kinetics, Industrial application of enzymes.

Unit-6: Metabolism in plant: Lectures-10

- Structure, function, classification, synthesis and break down of carbohydrates, (starch and sucrose).
- Mechanism of N₂ fixation and assimilation
- Structure, classification, synthesis, properties and oxidation of amino acids and proteins.
- Structure, function, classification, synthesis, oxidation and regulation of lipids in plants. Lipids as signal molecules, cofactors and pigments

Suggested Readings:-

- Buchanan B.B, Gruissem W. and Jones R. L (2000). *Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists, Maryland, USA.*
- Dennis D. T., Turpin, D. H. Lefebvre D. D. and Layzell D. B.(eds)(1997). *Plant Metabolism (Second Edition) Longman, Essex, England*
- William G Hopkins, Norman P Hunar (2009) *Introduction To Plant Physiology, Wiley.*
- Taiz, L., Zeiger, E., Moller, I.M. and Murphy, A (2015). *Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.*
- David L Nelson and Michael M. Cox (2017) (seventh edition), *Leninger*
- *Principles of Biochemistry, W. H. Freeman and Company*

Paper: BOT803C
Microbiology and Plant Pathology
Credits: 4 = 3+1+0 (48 Lectures)

Unit-1: Microbial Taxonomy and Diversity: Lectures-08

- Molecular approaches to microbial taxonomy. Bergy's manual and its importance, general properties of bacterial groups, Archea and their broad classification; Viruses and their classification; Nature of virus, replication in virus.

Unit-2: Microbial Growth and nutrition: Lectures-06

- Definition of growth; growth curve; Mathematical expression of exponential growth phase; Measurement of growth and growth yields; Synchronous growth; Continuous culture; strategies of cell division, stress response.
- Microbial nutrition and metabolism: autotrophy, photoautotrophy and bacterial photosynthesis Chemoautotrophy and heterotrophic metabolism

Unit-3 Microbial Interactions: Lectures-08

- Microbes and plant interactions – Rhizosphere, Phyllosphere and Mycorrhizae; Plant growth promoting microorganisms (PGPM): Plant growth promoting rhizobacteria (PGPR): Direct and Indirect mechanisms of plant growth promotion. Cell signalling in microbial interactions.

Unit-4: Pathogen and Plant Defence: Lecture-10

- Historical and developmental aspects of plant pathology. Symptoms,
- Epidemiology and disease forecasting.
- **Mode of infection:** Mode of infection and role of enzymes and toxins in plant disease.
- **Defense mechanisms:** Defense mechanisms of plants against infection: Pre-existing structural and chemical defense, induced structural and chemical defense, hypersensitive reaction, role of phytoalexins and other phenolic compounds.

Unit-5: Molecular plant pathology and disease control: Lecture-08

- **Molecular aspects of host pathogen interactions:** PR proteins, phytoalexins, systemic resistance mechanism; application of molecular biology to plant disease control ; transgenic approach for crop protection.
- **Management of Plant Diseases:** Cultural, chemical, biological, bio pesticides, breeding for resistant varieties, plant quarantine and integrated pest management.

Unit-6: Study of plant diseases: Lecture-08

- Symptomology, causal organism, etiology and management of diseases in: Rice, Wheat, Sugarcane, potato, Pea, Coconut, Tea, Citrus, Banana, Papaya, Tobacco.

Suggested Readings:

- Agrios, G. N. 1978 : Plant Pathology
- Aneja, K. R. 1993. : Experiments in Microbiology, plant pathology and Tissue culture
- Cooke, A. A. 1981. Diseases of Tropical and Subtropical field, Fiber and oil plants
- Dubey, R. C & D.K. Maheswari: A Text Book of Microbiology.
- Mahadevan, A. and R. Shridhar, 1982. Methods in physiological plant pathology
- Mishra, R. R. 1996. Soil Microbiology. CBS Publ.
- Nyvall, R. F. 1979 : Field Crop Diseases Handbook
- Paul Khurana, S. M. 1998: Pathological Problems of Economic crop plants and their management
- Pelczar, M.J. (2001) *Microbiology, 5th edition*, Tata McGraw-Hill Co, New Delhi.
- Planke, J. E. Vander. 1963 : Plant Diseases Epidemics and control
- Presscott, L. Harley, J. and Klein, D. (2005) *Microbiology, 6th edition*, Tata McGraw-Hill Co. New Delhi.
- Rangaswamy G. and Mahadevan A. 1999. Diseases of crop plants in India (Fourth Edition) Prentice Hall of India Pvt. Ltd. New Delhi.

Paper: BOT804C
Cytogenetics and Plant Breeding
Credits: 4 = 3+1+0 (48 Lectures)

Unit -1: Eukaryotic Chromosome: Lecture-10

- Molecular organization of eukaryotic chromosomes, euchromatin and heterochromatin and its significance, synaptonemal complex, Karyotype and Idiogram, chromosome banding , special types of chromosomes, Genome editing and genome plasticity

Unit-2: Gene and Inheritance pattern: Lecture-06

- Nuclear, cytoplasm, quantitative and sex linked inheritance, gene interactions, Multiple alleles.

Unit-3: Linkage and crossing over: Lecture-10

- Linkage : Introduction and definition and types of Linkage, Coupling and Repulsion hypothesis, Linkage group- Drosophila, maize and man, Factors affecting linkage.
- Crossing over: definition and types of crossing over, Cytological basis of crossing over, Mechanism of crossing over, Holiday model, construction of genetic maps

Unit-4: Chromosomal aberrations: Lecture-06

- Chromosomal aberrations:
- Numerical- Euploidy Polyploidy and aneuploid
- Structural- Deletions, Duplication, Translocation and Inversions.
- Evolutionary significance of chromosomal aberrations

Unit-5: Plant breeding: Lecture-08

- Plant Introduction, domestication and selection(self & cross pollinated plants), hybridization, heterosis& inbreeding depression, male sterility, breeding for stress (biotic & abiotic) and mutation breeding (Special emphasis on Polyploid), Molecular markers, MAS

Unit-6: Plant type concept: Lecture-08

- Plant type concept in plant improvement
- Breeding methods and improved varieties of Rice, Wheat, Maize, legumes and pulses.

Suggested Readings:

- Chaudhury, R. C(1989) ,Introduction to Plant Breeding, Oxford and IBH publishing PVT. LTD
- Elrod S. & Stansfield W. (2004) Genetics, Tata McGraw Hill.
- Frailer, D. (2007) Molecular Biology-, Narosa Publishing House.
- Gupta, P. K (2009), Biotechnology and Genomics, Rastogi Publications.
- Jocelyn E. Krebs,E., S.Goldstein & Kilpatrick, S. T., Jones(2013) Lewin's Genes-Xi Bartlett Publishers.
- Singh, B. D. (2007)Plant Breeding , Kalyani Publishers
- Strickberger M. W (2008), Genetics, PHI learning Pvt. Ltd.
- Tamarin R. H. (2006) , Principles of Genetics- Tata McGraw Hill

Paper: BOT805L (Lab)

A: Analytical Techniques & Molecular Biology and Plant Physiology & Biochemistry (2 Cr)

B: Microbiology & Plant Pathology and Cytogenetics & Plant Breeding (2 Cr)

Credits: 4 = 0+0+4

A: Analytical Techniques & Molecular Biology and Plant Physiology and Biochemistry

ANALYTICAL TECHNIQUES & MOLECULAR BIOLOGY

- Study of basic laboratory biosafety measures
- Preparation of buffers (phosphate/ citrate buffer/TAE/ TBE)
- Preparation & sterilization of plant culture media.

- Callus culture from plant materials
- To separate sugars by thin layer chromatography
- To estimate total sugar using spectrophotometer
- To estimate amino acid concentration in plant.
- Isolation of plant genomic DNA
- To separate protein using SDS PAGE
- To analyse soil physicochemical properties.

PLANT PHYSIOLOGY AND BIOCHEMISTRY:

- Determination of water potential in different plant tissue.
- Determination of chlorophyll a & chlorophyll b and total chlorophyll from different types of plant tissue by solvent method.
- Determination of chlorophyll a/b ratio from different types of plant tissue (i.e. C3 C4 plant)
- Determination of reducing sugar in plant species
- Estimation of total soluble protein by Bradford's and Lowry's methods.
- Estimation of total sugar from plant by anthrone methods.
- Spot identification of proline, sulphur-containing amino acids and amino acids with aromatic rings
- Extraction and estimation of amylase activity from plant samples
- Determination of isoelectric point of protein.
- Study of enzyme kinetics for effect of time/enzyme & substrate concentration/pH.
- Paper chromatographic technique to separate sugars, amino acids, chloroplast pigments.

Visit to research institute/laboratories of national repute and submission of report

B. Microbiology & Plant Pathology and Cytogenetics & Plant Breeding

MICROBIOLOGY AND PLANT PATHOLOGY:

- Principles & working of tools, equipments and other requirements in the Microbiology, Mycology & Plant Pathology laboratory.
- Introduction to basic techniques and Lab. safety; methods of sterilization, media preparation and culturing.
- Isolation and pure culture of microbes from soil, air, seed and water
- Identification and characterization of isolated pure cultures and determination of microbial population by haemocytometer
- Drawing of Camera Lucida diagrams and knowledge of computer based photomicrography and image processing.
- Study of plant pathogenic fungi from diseased specimens (symptoms, causal organism and their morphological & reproductive characters)
- Demonstration of Koch's Postulate.
- Study of Gram positive and Gram negative bacteria.

CYTOGENETICS AND PLANT BREEDING:

- Important techniques of cytogenetics and plant breeding
- Study of mitosis in locally available plant species.
- Study of meiosis in locally available plant species

- Study of karyotype and to find out the evolutionary status of the species.
- Study of natural chromosomal aberration in plant species.
- Variation of chromosome number in plant species (natural and induced).
- Demonstration of emasculation
- To work out some genetical problems on gene interactions, linkage, crossing over and construction of genetic map based on three point cross.