

Semester-VII

[MBTCR 7152 T+P]: Advanced Plant Biology and Plant Biology Practical

Theory: [CIA:10 Marks; End-Sem: 60 Marks], **Practical:** 30 Marks

Advanced Plant Biology (Theory)

Module A: (30 Marks)

(2 Classes per Week)

UNIT I: Plant cell signaling and molecular genetics: Synaptonemal complex organization; plant cell vacuole; plant two-component signaling systems; application of FISH and GISH in plants; floral developmental genes in Arabidopsis and their role; extrachromosomal inheritance in plants; applications of polyploids in crop improvement; genetic regulation of embryogenesis; introduction to abiotic stress

UNIT II: Plant toxicology: toxins produced by plant pathogens; classifications; mode of actions; mycotoxin and aflatoxin; plant programmed cell death and immune response

UNIT III: Plant behavior and distribution: Characteristics of plant behavior; Concept of plant intelligence and memory with examples; mimicry and circadian rhythm; center of origin and diversity; phytogeographic zones and endemism

Module B: (30 Marks)

(2 Classes per Week)

UNIT IV: Taxonomy and Systematics: Taxa and taxonomic hierarchy (ranks, categories and taxonomic groups), ICBN principles and rules, Classification systems with merits and demerits, Herbarium and Botanical gardens; Flora and Monographs; Numerical taxonomy, Molecular taxonomy, chemotaxonomy and serotaxonomy, Salient features of dicotyledons and monocotyledons (with examples)

UNIT V: Ethnomedicine; Primary and secondary data sources; Tribal medicine – methods of disease diagnosis and treatment – Plants in folk religion; Detection of drug adulteration, Biological testing of herbal drug, Natural compound based drug discovery with insights from pharmacokinetics, pharmacodynamics and Computer Aided Drug discovery (CADD)

UNIT VI: Plant Pathology: Disease and Disease cycle concept; Symptoms; Etiology and causal complex; Primary and secondary inocula; Infection, Pathogenicity and Pathogenesis; Endemic, Epidemic, Pandemic and Sporadic disease: concepts with examples. Host pathogen interaction: Pre-penetration, Penetration and Post Penetration; Concept of gene for gene concept and Zig Zag model, Role of viral silencing suppressors in plant diseases. Defense mechanisms; Resistance - Systemic acquired resistance and Induced systemic resistance; Plant disease management - Quarantine, Chemical, Biological and Integrated

Teachers involved: Dr. Aryadeep Roy Choudhury (Module A), Dr. Sayak Ganguly (Module B)

Reading and Reference List:

Module A:

Unit I:

1. Plant Physiology – Taiz & Zeiger
2. Review papers

Unit II:

3. Plant Pathology - George N Agrios; Academic Press. 5th Edition

4. Introduction to Principles of Plant Pathology by R.S. Singh; 5th Edition (MedTech Publishers)

5. Review papers

Unit III:

1. Ecology – Verma and Agarwal

2. Review papers

Module B:

Unit IV:

1. Introduction to the Principles of Plant Taxonomy by V.V. Sivarajan and N.K.P. Robson; Cambridge University Press (2nd Edition)

2. Plant Systematics - An Integrated Approach - Gurcharan Singh; CRC Press (4th Edition)

3. Plant Systematics - Michael G Simpson - Academic Press; (2nd Edition)

4. Taxonomy – O.P. Sharma

5. Research and Review Articles

Unit V:

1. Indian Medicinal Plants - An Illustrated Dictionary by C.P. Khare; Springer; 1st Edition

2. Nature's Pharmacopeia: A World of Medicinal Plants by Dan Choffnes; Columbia University Press (1st Edition)

3. Trease and Evans' Pharmacognosy by William Evans; 16th Edition.

4. Fundamentals of Pharmacognosy and Phytotherapy by Michael Heinrich, Joanne Barnes, Simon Gibbons, Elizabeth M. Williamson; Elsevier Press; 2nd Edition

5. In silico drug discovery and design : theory, methods, challenges, and applications; Claudio N Cavasotto; CRC Press; 1st Edition.

6. Research and Review Articles

Unit VI:

6. Plant Pathology - George N Agrios; Academic Press. 5th Edition

7. Introduction to Principles of Plant Pathology by R.S.Singh; 5th Edition (MedTech Publishers)

8. Plant Pathology by R.S. Mehrotra and A. Agarwal 2nd Edition; Tata McGraw Hill Publishers.

9. Research and Review Articles

Plant Biology Practical (30 marks)

(2 classes per Week)

1. Identification of vegetative and reproductive structures of algae, bryophytes and pteridophytes from temporary or permanent mounts.

2. Identification of representative families of angiosperms, based on diagnostic characters and/or morphological descriptions.

3. Organoleptic evaluation of plant-derived crude drugs.

4. Virtual Screening and studying the interactions of plant-based natural compounds with target proteins using CADD techniques (Computer Lab required).

5. Survey of plant groups through field trip.

Teachers involved: Dr. Aryadeep Roy Choudhury, Dr. Sayak Ganguly

MBTCR 7161T: Advanced Molecular Biology

Theory: [CIA: 20 Marks; End-Sem: 80 Marks]

Module A: (65 Marks)

(5 Classes per Week)

UNIT I: Post-transcriptional gene regulation and Nuclear transport:

RNA processing enzymes, post transcriptional modification of RNA: 5'-cap, 3'end processing and polyadenylation; mRNA Splicing, Alternative splicing, Editing, regulation of pre-mRNA processing, Different modes of splicing of rRNA and tRNA, Nuclear export of mRNA (outline)

UNIT II: Chromatin structure-function and Epigenetic regulation during nuclear processes

Concept of chromatin structure (nucleosome structure and function, higher order compaction, histone proteins). Chromatin modifications: histone modifications (acetylation, methylation, phosphorylation, ubiquitination); chromatin remodelers; histone variants and histone chaperones; DNA methylation; miRNA mediated regulation (outline). Epigenetic regulation during nuclear processes like transcription, DNA damage repair (nucleosome mapping, DNase I and MNase assay; restriction enzymes accessibility assay; ChIP; ChIP on chip).

Module B: (15 Marks)

(1 Class per Week)

UNIT III: Eukaryotic Replication: Differences from prokaryotic replication; DNA polymerases: types; PCNA; ARS; control and regulation; end replication problem; telomeres and telomerase; replication mechanism in Caulimoviruses, Gemini viruses and plant RNA viruses (outline)

Teacher involved: Dr. Ronita Nag Chaudhuri (Module A), Dr. Aryadeep Roy Choudhury (Module B)

Texts & Reading/Reference Lists:

Module A: (1) Chromatin & Gene Regulation- Bryan Turner, Chapters- 3,4,5,6,8;

(2) Epigenetics- C. David Allis et al., Chapters 3, 4;

(3) Molecular Biology (Weaver) Chapters-14-16;

(4) Molecular and Cell Biol. (Lodish 6th Ed.); Relevant review papers

Module B:

(5) Genes X / XI - Benjamin Lewin

(6) Molecular Biology of the Gene - James D. Watson

(7) Review papers

MBTCR 7171T: Advanced Cell Biology

Theory: [CIA: 20 Marks; End-Sem: 80 Marks]

Module A: Cell Compartmentalization & Protein Trafficking (40 Marks) (3 Classes per Week)

UNIT I: Protein localization based on fluorescence-based techniques.

UNIT II: Translocation of Secretory Proteins across the ER Membrane, Insertion of Membrane Proteins into the ER Membrane, Protein Glycosylation in the ER and Golgi Complex, protein transport in bacteria.

UNIT III: Golgi and Post-Golgi Protein Sorting and Proteolytic Processing, Molecular Mechanisms of Vesicular Traffic, molecular mechanisms. Lysosomes and endocytic pathways.

UNIT IV: Membrane-less organelles (nucleolus, stress granules and P granules: formation and function)

Module B: Cell Signaling (40 Marks)

(3 Classes per Week)

Unit V – General Principles and Mechanisms

Signals and Receptors – Receptors with associated protein kinase activity (RTK), receptors with associated serine-threonine kinase activity; G-protein-coupled receptors (GPCR); TNF receptor family; Cell adhesion receptors and mechano-transducers (Integrins); nuclear receptors (Steroid Hormone Receptors); Gases as signal molecules (NO)

Unit VI – Protein Regulation in Signal Transduction

Post-translational modification and the regulation of protein activity; Regulation of protein-protein interaction – interacting domains; Regulation of protein location; Regulation of protein production or protein degradation

Unit VII – Second Messengers

Cyclic nucleotides (cAMP, cGMP); Lipid derived second messengers (PIP₃ and DAG); Ions (Ca²⁺)

Unit VIII – Signaling Networks – “Bow Tie” or “Hour-Glass” Network

Common signaling pathways –MAP-kinase pathways, PI3K-PKB/Akt Pathway, Calcium Signaling, TGFβ Signaling, JAK/STAT Pathway; EGFR activated signaling network;

Unit IX – Signaling Processes

Signaling by Sensory Receptors – vision; olfaction; gustation;

Signaling involved in Glucose Homeostasis - Insulin and Glucagon Signaling; Insulin Resistance

Immunoreceptor Signaling.

Unit X – Laboratory techniques frequently used in cell signaling study

Teacher involved: Dr. Chandana Barat (Module A), Dr. Uma Siddhanta (Module B)

Texts & Reading/Reference Lists:

1. Molecular Biology of the Cell - Alberts, Johnson, Lewis, Raff, Roberts & Walter (4thed)
2. Leininger Principles of Biochemistry - Nelson & Cox (5th Ed)
3. Signal Transduction – Principles, Pathways & Processes – Cantley, Hunter, Sever & Thorner
4. Molecular Cell Biology Lodish and Darnell et. al (5th edition)
5. Molecular and Cell Biol. (Lodish 6th Ed.)
6. Relevant scientific literature.

MBTCR 7181T: Microbial Biotechnology and Bioethics

Theory: [CIA: 20 Marks; End-Sem: 80 Marks]

Module A: (35 Marks)

(2 Classes per Week)

UNIT I: Enzyme Biotechnology: Enzyme immobilization - advantages; technology for immobilized enzymes (or whole cells); large scale applications of immobilized glucose isomerase and penicillin acylase

UNIT II: Applications of microbes in industries: Bioremediation; bioleaching; biofilm and quorum sensing; Type three secretion systems (TTSS); biosurfactant; biofertilizers and PGPRs; bioinsecticides, biofuel and biodiesel; biosensors; biotransformation; Probiotics; microbe-mediated jute processing; core genome pool, flexible genome pool; concept of pangenome and metagenome

UNIT III: Recombinant microorganisms for commercial products: Metabolic engineering for cloning and overexpression of heterologous genes; limitations in metabolic engineering; synthesis of commercial products like ascorbic acid, indigo, amino acids, antibiotics and biopolymers (xanthan gum, bioplastics)

Module B: (45 Marks)

(4 Classes per Week)

UNIT IV: Industrial production processes:

- a. Amino-acid (L-Lysine)
- b. Chemotherapeutic agent (Penicillin)
- c. Condiment (Soy sauce)
- d. Enzyme used in Molecular Biology (Taq DNA polymerase)
- e. Food (Bread, Cheese)
- f. Food additive (Nucleotides, Vitamin B₁₂)
- g. Microbial biomass production (Baker's yeast, Mushrooms)
- h. Organic acid (Citric acid)
- i. Recombinant therapeutic protein (Human growth hormone, Human interferon)

UNIT V: Advanced biotechnological applications:

- a. Bacteriophages as therapeutic agents
- b. Botox
- c. Gaseous fuel - biohydrogen
- d. Marine biotechnology
- e. Microbial electricity – bacterial batteries
- f. Microbial flavors and fragrances
- g. Therapeutics from gut bacteria

UNIT VI: Bioethics:

- a. Patenting of Microorganisms in Biotechnology
- b. Clinical Research and Drug Trials (FDA guidelines and Indian perspective)
- c. Drugs and Cosmetics Act (Schedule Y)
- d. The Drugs and Magic Remedies Act

Teachers involved: Dr. Aryadeep Roy Choudhury (Module A), Dr. Souvik Roy (Module B)

Texts & Reading/Reference Lists:

1. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.
3. Das HK. (2005). Text Book of Biotechnology. 2nd edition. Wiley Dreamtech India (P) Ltd.
4. Dubey RC. (2010 Reprint Edition). A Text Book of Biotechnology. S. Chand & Company Ltd.
5. Ignacimuthu S. Bioethics.

6. Madigan MT, Martinko JM and Parker J. (2003). Brock Biology of Microorganisms. 10th edition. Pearson / Benjamin Cummings.
7. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.
8. Salle AJ. (1974). Fundamental Principles of Bacteriology. 7th edition, 2005 27th Reprint. Tata McGraw-Hill.
9. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.
10. Waites MJ, Morgan NL, Rockey JS, Higton G. (2001). Industrial Microbiology - An Introduction. 2002 Indian Reprint Edition. Blackwell Publishing.
11. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.
12. Relevant Review papers.

**End-semester marks are shown with the theory modules.*

-----X-----