
Semester-IV

Course Code: BC408T
Core Course VIII: Molecular Biology

The objective of this course is to expose the students to Biological Macromolecules and various processes involved with these macromolecules

THEORY (Credit :4)

Lectures: 60

Unit 1: Nucleic acids : Carriers of genetic information (4 lectures)

Historical perspective; DNA as the carrier of genetic information (Griffith's, Hershey & Chase, Avery, McLeod & McCarty

Unit 2. The Structures of DNA and RNA / Genetic Material (10 lectures)

DNA Structure: Miescher to Watson and Crick- historic perspective, DNA structure, Salient features of double helix, Types of DNA (DNA, RNA), Types of genetic material, denaturation and renaturation,; Organization of DNA- Prokaryotes, Viruses, Eukaryotes.RNA Structure Organelle DNA -- mitochondria and chloroplast DNA.

Unit 2:The replication of DNA (10 lectures)

Chemistry of DNA synthesis (Kornberg's discovery); General principles – bidirectional, semi-conservative and semi discontinuous replication, RNA priming; Various models of DNA replication, including rolling circle, θ (theta) mode of replication, replication of linear ds-DNA.

Unit 3: Central dogma and genetic code (2 lectures)

Key experiments establishing-The Central Dogma (Adaptor hypothesis and discovery of mRNA template), Genetic code; experimental proof of triplet codon (deciphering & salient features**)**

Unit 4: Transcription (18 lectures)

Transcription in prokaryotes and eukaryotes. Principles of transcriptional regulation; Prokaryotes: lac operon in *E.coli.* Eukaryotes: transcription factors, Gene silencing.

Unit 5: Processing and modification of RNA (8 lectures)

Split genes-concept of introns and exons, removal of introns, spliceosome machinery, splicing pathways, group I and group II intron splicing, eukaryotic mRNA processing(5' cap, 3' polyA tail); Ribozymes; RNA editing; mRNA transport.

Unit 6: Translation (8 lectures)

Ribosome structure and assembly, mRNA; Charging of tRNA, aminoacyl tRNA synthetases; Various steps in protein synthesis, proteins involved in initiation, elongation and termination of polypeptides; Fidelity of translation; Inhibitors of protein synthesis; Post-translational modifications of proteins.

Course Code: BC408P
Core Course VIII - Practical: Molecular Biology

1. Preparation of LB medium and raising *E.Coli.*
2. Isolation of genomic DNA
3. DNA estimation by diphenylamine reagent/UV Spectrophotometry.
4. Study of DNA replication mechanisms through photographs (Rolling circle, Theta replication and semi-discontinuous replication).
5. Study of structures of prokaryotic RNA polymerase and eukaryotic RNA polymerase II through photographs.
6. Photographs establishing nucleic acid as genetic material (Messelson and Stahl's, Avery et al, Griffith's, Hershey & Chase's and Fraenkel & Conrat's experiments)
7. Study of the following through photographs: Assembly of Spliceosome machinery; Splicing mechanism in group I & group II introns; Ribozyme and Alternative splicing.

Suggested Readings

1. Watson J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. (2007). Molecular Biology of the Gene, Pearson Benjamin Cummings, CSHL Press, New York, U.S.A. 6th edition.
2. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons Inc., U.S.A. 5th edition.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. Benjamin Cummings. U.S.A. 9th edition.
4. Russell, P. J. (2010). i-Genetics- A Molecular Approach. Benjamin Cummings, U.S.A. 3rd edition.
5. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition.

Course Code: BC409T
Core Course IX: Plant Ecology and Phytogeography

The objective of this course is to expose the students to interaction of plant with its surroundings and also the geographic distribution of different plants

(Credits: Theory-4, Practical-2)

THEORY
Lectures: 60

Unit 1: Introduction **(4 lectures)**

Basic concepts; Levels of organization. Inter-relationships between the living world and the environment, the components and dynamism, homeostasis.

(15 lectures)

Unit 2: Soil : Importance, Origin, Formation, Composition, Physical, Chemical and Biological components, Soil profile, Role of climate in soil development; **Water:** Importance, States of water in the environment, Atmospheric moisture, Precipitation types (rain, fog, snow, hail, dew); Hydrological Cycle, Water in soil, Water table. **Light, temperature, wind and fire** Variations, adaptations of plants to their variation.

Unit 3: Biotic interactions: **(5 lectures)**

Trophic organization, basic source of energy, autotrophy, heterotrophy; symbiosis, commensalism, parasitism;

Unit 4: Population ecology: **(6 lectures)**

Characteristics and Dynamics .Ecological Speciation

Unit 5: Plant communities **(6 lectures)**

Concept of ecological amplitude; habitat and niche; Characters: analytical and synthetic; Ecotone and edge effect; Dynamics: succession – processes, types; climax concepts.

0Unit 6: Ecosystems: Structure and Function **(12 lectures)**

Ecological pyramids. Principles and models of energy flow; Production and productivity; Ecological Biogeochemical cycles; Cycling of Carbon, Nitrogen and Phosphorus.

Unit 7: Phytogeography

(12 lectures)

Principles; static and dynamic phytogeography, Continental drift; Theory of tolerance; Endemism; Brief description of major terrestrial biomes (one each from tropical, temperate & tundra); Phytogeographical regions of India; Local Vegetation.

Course Code: BC409P
Core Course IX - Practical: Plant Ecology and Phytogeography

1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter.
2. Determination of pH of various soil and water samples (pH meter, universal indicator/Lovibond comparator and pH paper)
3. Analysis for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency from two soil samples by rapid field tests.
4. Determination of organic matter of different soil samples by Walkley & Black rapid titration method.
5. Comparison of bulk density, porosity and rate of infiltration of water in soils of three habitats.
6. Determination of dissolved oxygen of water samples from polluted and unpolluted sources.
7. (a). Study of morphological adaptations of hydrophytes and xerophytes (four each).
   (b). Study of biotic interactions of the following: Stem parasite (*Cuscuta*), Root parasite (*Orobanche*) Epiphytes, Predation (Insectivorous plants).
8. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus, by species area curve method (species to be listed).
9. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law.
10. Quantitative analysis of herbaceous vegetation for density and abundance in the college campus.
11. Field visit to familiarise students with ecology of different sites.

Suggested Readings

1. Odum, E.P. (2005). Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.
2. Singh, J.S., Singh, S.P., Gupta, S. (2006). Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi, India.
3. Sharma, P.D. (2010). Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.
4. Wilkinson, D.M. (2007). Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A.
5. Kormondy, E.J. (1996). Concepts of ecology. PHI Learning Pvt. Ltd., Delhi, India. 4th edition.

Course Code: BC410T
Core Course X: Plant Systematics

The objective of this course is to expose the students to identification, classification and nomenclature of higher plants

(Credits: Theory-4, Practical-2)

THEORY
Lectures: 60

Unit 1: Significance of Plant systematics (8 lectures)

Introduction to systematics; Kingdom concept, Plant identification, Classification, Nomenclature. Evidences from palynology, cytology, phytochemistry and molecular data. Field inventory; Functions of Herbarium; Important herbaria and botanical gardens of the world and India; Virtual herbarium; E-flora; Documentation: Flora, Monographs, Journals; Keys:Single access and Multi-access.

Unit 2: Taxonomic hierarchy (6 lectures)

Concept of taxa (family, genus, species); Categories and taxonomic hierarchy; Species concept (taxonomic, biological, evolutionary).

Unit 3: Morphology and Botanical nomenclature (10 lectures)

Angiosperm morphology, Principles and rules (ICN= International Code of Nomenclature of Algae, fungi & Plants); Ranks and names; Typification, author citation, valid publication, rejection of names, principle of priority and its limitations; Names of hybrids.

Unit 4: Systems of classification (10 lectures)

History of Plant Taxonomy: Linnaeus, Adanson, de Candolle, Bessey, Hutchinson, Takhtajan and Cronquist; Classification systems of Bentham and Hooker (upto series) and Engler and Prantl (upto series); Brief reference of Angiosperm Phylogeny Group classification.

Unit 5: Biometrics, numerical taxonomy and cladistics (6 lectures)

Characters; Variations; OTUs, character weighting and coding; Cluster analysis; Phenograms, cladograms (definitions and differences).

Unit 6: Phylogeny of Angiosperms (10 lectures)

Terms and concepts (primitive and advanced, homology and analogy, parallelism and convergence, monophyly, Paraphyly, polyphyly and clades). Origin and evolution of life (mechanism and therories), Origin and evolution of angiosperms; Co-evolution of angiosperms and animals; Methods of illustrating evolutionary relationship (phylogenetic tree, cladogram).

Unit 7: Major families of Angiosperms (10 lectures)

Study of morphological characters of some major families of Angiosperms: Magnoliaceae, Brassicaceae, Malvaceae, Fabaceae, Cucurbitaceae, Apiaceae, Asteraceae, Lamiaceae, Euphorbiaceae, Orchidaceae, Zingiberaceae, Arecaceae, Poaceae

Course Code: BC410P
Core Course X - Practical: Plant Systematics

Practical

1. Study of vegetative and floral characters of the following families (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification):

   Locally available plants of the following families-

   Magnoliaceae, Brassicaceae, Apiaceae, Asteraceae, Solanaceae, Lamiaceae, Euphorbiaceae, Zingiberaceae, Orchidaceae, Poaceae

2. Field visit (local) – Subject to grant of funds from the university.
3. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book).

Suggested Readings

1. Singh, (2012). *Plant Systematics:* Theory and Practice Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.
2. Jeffrey, C. (1982). An Introduction to *Plant Taxonomy.* Cambridge University Press, Cambridge.
3. Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. (2002). Plant Systematics-A Phylogenetic Approach. Sinauer Associates Inc., U.S.A. 2nd edition.
4. Maheshwari, J.K. (1963). *Flora* of Delhi. CSIR, New Delhi.
5. Radford, A.E. (1986). Fundamentals of *Plant Systematics*. Harper and Row, New York.