

5TH SEMESTER

DISCIPLINE SPECIFIC ELECTIVES (DSEs)

OPTION - I

BOT516DA: BOTANY - CELL AND MOLECULAR BIOLOGY

(Credits: Theory-4, Practicals-2)

Unit 1: Cell as a unit of Life, Cell wall and Plasma membranes (16 Hours)

The cell theory; prokaryotic and eukaryotic cells; properties of cell; eukaryotic cell components. Bio-membranes; structure and function, fluid mosaic concept, fluidity of bio-membranes; membrane proteins and their functions; carbohydrates in the plasma membrane; Faces of the membranes. Cell wall-structure and functions.

Unit 2: Cell Organelles (20 hours)

Non-membranous organelles: Structure and functions of ribosomes, centrioles and basal bodies

Single membrane bound organelles: endoplasmic reticulum, golgi bodies and lysosomes, peroxisomes and glyoxisomes.

Double membrane bound organelles: Mitochondria; structure and functions, semi-autonomous nature; endosymbiont hypothesis; mitochondrial DNA.

Chloroplast; structure and functions; semiautonomous nature, chloroplast DNA.

Nucleus: Nuclear Envelope- structure of interphase nucleus; chromatin material, euchromatin and heterochromatin, nucleolus.

Unit 3: Cell Cycle & Genetic Material (12hours)

Overview of Cell cycle, mitosis and meiosis.

DNA- Watson and Crick's model, Griffith's and Avery's transformation experiments.

Hershey-Chase bacteriophage experiment,

DNA- structure, types, replication (Prokaryotes and eukaryotes).

Unit 4: Gene Expression & Gene Regulation (12 hours)

Types of RNA (mRNA, tRNA, rRNA), RNA polymerase- various types; Transcription and translation in prokaryotes, genetic code.

Gene regulation in Prokaryotes: Lac operon and Tryptophan operon

Practical

1. To study prokaryotic cells (bacteria), viruses, eukaryotic cells with the help of light and electron micrographs.
2. Study of the photomicrographs of cell organelles
3. To study the structure of plant cell through temporary mounts.
4. Study of mitosis and meiosis (temporary mounts and permanent slides).
5. Study the effect of temperature, organic solvent on semi permeable membrane.
6. Study of plasmolysis and deplasmolysis in onion peelings.
7. Study the structure of nuclear pore complex by photograph.
8. Study of special chromosomes (polytene & lampbrush) either by slides or photographs.
9. Preparation of the karyotype and ideogram from given photograph of somatic metaphase chromosome.

Suggested Readings

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.
5. Bruce Alberts, James Watson, Dennis Bray, J. Lewis. Molecular Biology of Cell. Garland Science publishers.
6. Bruce Alberts & Lewis. Essential Cell Biology. Garland Science.
7. Watson J.D. Molecular Biology of the Gene. 7th Edition. Melno Park Calif, Benjamin/Cummings
8. Lodishet *al.* Molecular Cell Biology. W.H.Freeman and Co.
9. David E. Sadava. Cell Biology: Organelle Structure and Function.Jones and Bartlett Pub.
10. David Freifelder. Molecular Biology.

5TH SEMESTER
DISCIPLINE SPECIFIC ELECTIVES (DSE)
OPTION - II

BOT516DB: BOTANY - ANALYTICAL TECHNIQUES IN PLANT SCIENCES

(Credits: Theory-4, Practicals-2)

Unit 1: Microscopy

10 Lectures

- Principle and types of microscopy
- Light Microscopy: Structure of a bright field compound microscope
- Introduction, Principle, working and application of fluorescence microscope.
- Scanning And transmission electron microscope: Principle and working; Sample preparation for Scanning Electron Microscope(SEM)

Unit 2: Centrifugation, Spectrophotometry and Histological Techniques.

18 lectures

- Centrifugation and types of centrifugation
- Ultra- centrifugation: Differential and Density Gradient centrifugation, Sucrose density gradient centrifugation and CsCl₂ Gradient centrifugation.
- Spectrophotometry: Principle working and applications in biological research; Atomic absorption spectrophotometry: Principle and applications
- Histological Techniques: Sample Preparations: - Fixation, Processing, dehydration, clearing, and Embedding, Sectioning, Staining: Preparation of different types of stains.

Unit 3: Chromatography and Electrophoresis

18 lectures

- Principle and types of chromatography
- Paper Chromatography: Solvent and mobile phase
- Thin Layer Chromatography (TLC): Applications, mobile and stationary phase.
- Column chromatography: Stationary phase, mobile phase, types of columns
- Gas Liquid Chromatography: Principle and applications, Preparation of sample, column types and detectors.
- High Performance Liquid Chromatography (HPLC); Principle and applications, Basic instrumentation.
- Electrophoresis: Principle and Basic instrumentation, Agarose gel electrophoresis (AGE); Polyacrylamide gel electrophoresis(PAGE); Sodium dodecyl sulphate (SDS- PAGE)

Unit 4: Biostatistics

14 lectures

Statistics: Introduction and application in biological research, Data sampling, Sampling techniques, Representation of data: Tabular and Graphical, Arithmetic mean, mode and median, Standard deviation and standard error, Chi square test

Practicals

1. Study of Blotting Techniques: Southern, Northern and western Blotting, DNA fingerprinting, DNA sequencing, PCR through photographs.
2. To separate photosynthetic pigments by Paper chromatography
3. To separate sugar by thin layer chromatography
4. To separate chloroplast pigments by column chromatography.
5. Demonstration of Gel electrophoresis apparatus
6. Study of different microscopic techniques using photographs/micrographs (Freeze fracture, freeze etching, negative staining, positive staining, fluorescence and FISH).
7. Preparation of different types of stains.
8. Preparation of permanent slides (double staining)
9. Study of various instruments (SEM, Fluorescence microscope, AAS, Centrifuges, Electrophoresis apparatus) through photographs.
10. Two visits to laboratories having facility of instruments like Scanning electron microscope, Atomic Absorption spectrophotometer, Fluorescence microscope, Ultracentrifuges etc.

5TH SEMESTER
DISCIPLINE SPECIFIC ELECTIVES (DSEs)
OPTION - III

BOT516DC: BOTANY - PLANT BIOCHEMISTRY

(Credits: Theory-4, Practicals-2)

Unit-I: Micro-biomolecules

Metabolism and its types; types and significance of chemical bonds; structure and properties of water. pH and buffers. Brief account of isomerism and polymerization in biomolecules.

Nomenclature, classification and biological significance of monosaccharides; biologically important disaccharides.

Amino acids: structure, biologically important properties and significance of amino acids.

Fatty acids: types, biologically important properties and significance of fatty acids, alcohols, sterols and steroids.

Nucleosides and nucleotides- structure, biologically important properties and significance of nucleosides, nucleotides and dinucleotides.

Unit-II: Macro-biomolecules

Structure, types, properties and biological significance of- polysaccharides; conjugate carbohydrates; proteins; conjugate proteins; fats, oils and waxes; RNA and DNA.

Unit-III

Enzymes- nature, properties, classification, mechanism of action and regulation. Phytohormones – types, structure, properties, physiological roles and applications. Coenzymes- types and biological roles. **Unit-IV**

Carbohydrate metabolism- CO₂ fixation-C₃, C₄ and CAM pathways, photorespiratory pathway.

Glycolysis, Pentose Phosphate Pathway, TCA cycle

Photosynthesis - Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms;

Nitrogen metabolism - Biological nitrogen fixation, nitrite and nitrate reduction, nitrogen assimilation, Nitrate and ammonium assimilation; amino acid biosynthesis.

Plant hormones – Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action.

Practical:

1. Qualitative tests for carbohydrates, reducing sugars, non-reducing sugars, lipids and proteins.
2. Study of plant cell structure with the help of epidermal peel mount of Onion.
3. Demonstration of the phenomenon of protoplasmic streaming in *Hydrilla* leaf.
4. Study the phenomenon of plasmolysis and deplasmolysis.
5. Study the effect of organic solvent and temperature on membrane permeability.
6. Chemical separation of photosynthetic pigments.
7. To study the effect of light intensity on the rate of photosynthesis.
8. Effect of carbon dioxide on the rate of photosynthesis.
9. To study the activity of lipases in germinating oilseeds and demonstrate mobilization of lipids during germination.
10. Demonstration of fluorescence by isolated chlorophyll pigments.
11. Demonstration of absorption spectrum of photosynthetic pigments.

Suggested Readings

1. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons. U.S.A. 4th edition.
2. Taiz, L., Zeiger, E., MØller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
3. Harborne, J.B. (1973). Phytochemical Methods. John Wiley & Sons. New York.
4. Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning
5. Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone
6. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman
7. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company
8. Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company.
9. Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition.
10. Hardin, J., Becker, G., Skliensmith, L.J. (2012). Becker's World of the Cell, Pearson Education Inc. U.S.A. 8th edition.
11. Cooper, G.M. and Hausman, R.E. (2009) The Cell: A Molecular Approach. 5thW.H.Freeman
12. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company
13. Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company.
14. Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition.
15. Hardin, J., Becker, G., Skliensmith, L.J. (2012). Becker's World of the Cell, Pearson Education Inc. U.S.A. 8th edition.
16. Cooper, G.M. and Hausman, R.E. (2009) The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
16. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009) The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco

5TH SEMESTER

DISCIPLINE SPECIFIC ELECTIVES (DSEs)

OPTION - IV

BOT516DD: BOTANY - FUNDAMENTALS OF HORTICULTURE

(Credits: Theory-4, Practicals-2)

Unit: I

15 lectures

- Scope and importance of horticulture with special reference of J & K, classification of horticulture crops, important temperature fruit crops grown in Kashmir.
- Area, production and productivity of rosaceous fruits in J & K with special reference to Apple, Peach, Almond and Apricot.
- Orchard layout and its types, square, rectangle, quincunx, hexagons, fencing of orchard.
- Planting techniques, traditional and high density planting, precautions during plantation of fruit crops.

Unit: II

15 lectures

- Propagation of fruit crops- concept of scion and rootstock, stock-scion relationship and its significance, Rootstock types- seedling and clonal rootstocks, merits and demerits.
- Techniques of generating clonal rootstocks (cutting, layering, stooling), Grafting techniques – scion and bud grafting, merits and demerits.
- Soil fertility and factors affecting fertility in horticultural crops, essential micro and macro elements and their deficiency symptoms in fruit crops.
- Role of microbes in maintaining soil fertility in horticultural crops

Unit: III

15 lectures

- Pollination mechanisms in major fruit crops, concept of self-incompatibility.
- Concept and role of pollinators, importance of bee keeping in enhancing crop production.
- Fruit characteristics with special reference to Apple, Almond, Cherry, Pear, Walnut, Important fruit quality traits in apple and cherry affecting marketability.
- Fruit fall – early, mid and late fruit fall vis-à-vis rosaceous fruits, causes and concerns.

Unit: IV

15lectures

- Major diseases, disease symptoms and management practices in apple, cherry, pear and apricot.
- Integrated pest/disease management (IPM) – biological and cultural practices.
- Factors affecting fruit set and fruit production (light and temperature), role of chilling in flowering and fruit set, chilling units for various fruits crops.
- Role of plant growth regulators in fruit production and ripening, impact of synthetic substances in fruit ripening

Practicals (Credits = 2)

- Study of the morphological symptoms of mineral deficiency in horticultural crops.
- Collection of soil sample from an orchard and its nutrient evaluations.
- Estimation of soil moisture content, soil pH and Soil fertility.
- Practical demonstration on drip and sprinkle irrigation.
- Field visit to study various methods of asexual propagation of a fruit plant.
- Study of characteristics of fruit with special reference to apple, pear, walnut, cherry.
- Identification of different varieties of apple based on fruit quality traits.
- Field study of bearing habit of fruit crops
- Filed visit on understanding of pruning and thinning in fruit crops
- Study of grafting techniques – scion grafting and bud grafting – practical demonstration on Apple/ Cherry plant.

- Practical demonstration of disease symptoms of apple scab, alternaria, powdery mildew and red mite, causative agent and control measures.

Suggested Readings

1. Adams, C.R. and M. P. Early. 2004. Principles of horticulture. Butterworth – Heinemann, Oxford University Press.
2. Bansil. P.C. 2008. Horticulture in India. CBS Publishers and Distributors, New Delhi.
3. Kumar, N.1997. Introduction to Horticulture, Rajalakshmi Publication, Nagercoil.
4. Chadha, K.L. 2001, Handbook of Horticulture, ICAR, New Delhi.
5. Chandra, R. and M. Mishra. 2003. Micropropagation of horticultural crops. International Book Distributing Co., Lucknow.
6. Chattopadhyaya, P.K.2001. A text book on Pomology (Fundamentals of fruit growing) Kalyani Publication, New Delhi.
7. Christopher, E.P. 2001. Introductory Horticulture, Biotech Books, New Delhi.
8. Edmond, J.B. T.L.Senn, F.S. Andrews and P.G.Halfacre, 1975. Fundamentals of Horticulture, Tata MC. Graw Hill Publishing Co.New Delhi.
9. George Acquah, 2002, Horticulture-principles and practices. Prentice-Hall of India pvt. Ltd., New Delhi.
10. VijaikumarUmRao. 2008. Horticulture terms – Definitions and Terminology. IBD publishers, Dehradun.
11. Genin, A. 1994. Application of Botany in Horticulture. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
12. Hartmann, H.T., D.E. Kester, F.T. Davies and R.L. Greeneve. 2006 Plant Propagation. Principles and Practices. Prentice Hall of India Private Ltd., New Delhi.
13. Bose T.K.S.K. Mitra, M.K. Sadhu, B. Mitra., 2001 Propagation of tropical and subtropical horticultural crops, Naya Prakash 206, Bidhan Sarani, Calcutta, Six. India.
14. Prasad, S. and U. Kumar, 2005. Principle of Horticulture. 3rd edition, Agrobios, India.
15. Manibhushan K. Rao. 1991. Text Book of horticulture. Macmillan India Ltd., 2/10, Ansari Road, Daryaganj, New Delhi 110 002
16. Nanda, K.K and V.K. Kochhar., 1995. Vegetative propagation of plants. Kalyani publishers, New Delhi. 7. Sadhu. M.K. 1989. Plant Propagation. Wiley Eastern Ltd., 4835 / 24, Ansari Road, Daryaganj, New Delhi 110 002.