COURSES OFFERED BY DEPARTMENT OF BOTANY

Category-I

Botany (H) Courses for Undergraduate Programme of study with Botany as a Single Core Discipline

DISCIPLINE SPECIFIC CORE COURSE – 1: Plant Diversity and Evolution

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Plant Diversity and Evolution **BOT-DSC-1**	**4**	**2**	**0**	**2**	10+2 from any recognized Board with Biology/Biotechnology	**Nil**

Learning Objective:

- To make students aware about the diversity of plants and microbes present on the planet and their relationships with each other in light of evolution.

Learning outcomes

By studying this course students will gain basic knowledge on:

- the diversity and general characteristics of plants and microbes.
- various groups of plants and their evolutionary relationships.
- basic principles and concepts of evolution that contribute to plant diversity.

SYLLABUS OF BOT-DSC-1

Unit1: Origin of life **Weeks: 1.5**

Principles and concepts of evolution, Tree of Life, and classification (upto six kingdoms)

Unit2: Bacteria **Week: 01**

General characteristic features, cell structure, asexual reproduction and modes of gene ransfer (conjugation, transformation and transduction), brief introduction to Archaebacteria.

Unit3: Viruses **Week: 01**

General characteristic features, replication, RNA virus (structure of TMV), DNA virus (structure of T-phage), Lytic and Lysogenic life cycle (Lambda phage).

Unit4: Algae **Weeks: 1.5**

General characteristic features, cell structure, range of thallus, methods of reproduction and evolutionary classification (only upto groups). Brief account of *Spirogyra*, *Sargassum*.

Unit5: Fungi **Weeks: 02**

General characteristic features, reproduction and broad classification. Myxomycetes and their similarities with fungi, plants and animals, Brief account of *Rhizopus*, *Agaricus*. Introduction to lichens.

Unit6: Bryophytes **Weeks: 02**

General characteristic features and reproduction, adaptation to land habit, broad classification, evolutionary trends in Bryophytes. Brief account of *Marchantia*, and *Funaria*.

Unit7: Pteridophytes **Weeks: 02**

General characteristic features and reproduction, broad classification, evolutionary trends in Pteridophytes, affinities with Bryophytes. Brief account of *Adiantum*, *Selaginella*.

Unit8: Gymnosperms **Weeks: 02**

General characteristic features and reproduction, broad classification, evolutionary trends in Gymnosperm, affinities with Pteridophytes. Brief account of *Gnetum*, *Ephedra*.

Unit9: Angiosperms **Weeks: 02**

General characteristic features and reproduction, Concept of natural, artificial and phylogenetic system of classification. Affinities with Gymnosperms.

Practical component:

1. To study structure of TMV and Bacteriophage (electron micrographs/models). **(Week: 01)**
2. To study morphology of *Volvox*, *Oedogonium*, *Chara*, *Fucus* and *Polysiphonia* (Temporary preparation/specimens/slides). **(Weeks: 02)**
3. To study *Rhizopus*, *Penicillium*, *Alternaria* (Temporary preparations), symptoms of rust of wheat, white rust of crucifer (specimen). **(Weeks: 02)**
4. To study *Marchantia* (morphology, WM of rhizoids and scales), *Anthoceros* (morphology), *Sphagnum* (morphology, WM of leaf), *Funaria* (morphology WM of rhizoid and leaf). **(Weeks: 02)**
5. To study *Selaginella* (morphology, WM of strobilus and spores), *Equisetum* (morphology, WM of spores), *Pteris* (morphology, tease mount of sporangia and spores). **(Weeks: 02)**
6. To study *Cycas* (morphology, leaf, leaflet anatomy, coralloid root, bulbils, megasporophyll and microsporophyll); *Pinus* (morphology of dwarf shoot, needle anatomy, male and female cones, WM pollen grains). **(Weeks: 02)**
7. To study variation in leaf venations in dicots and monocots (at least two specimens each). **(Weeks: 02)**
8. To study the types of inflorescences in angiosperms (through specimens). **(Week: 01)**
9. To study the types of fruits in angiosperms (through specimens). **(Week: 01)**

Essential/recommended readings:

- Campbell, N.A., Reece,J.B. (2008) Biology, 8th edition, Pearson Benjamin Cummings, San Francisco.
- Evert, R. F., Eichhorn,S.E. (2012).Raven Biology of Plants, 8th edition, New York, NY: W.H.Freeman and Company.
- Bhatnagar, S.P., Moitra, A. (1996).Gymnosperms. New Delhi, Delhi, New Age International (P) Ltd. Publishers.
- Kumar, H.D. (1999). Introductory Phycology, 2nd edition .Delhi, Delhi, Affiliated East-

West. Press Pvt. Ltd.

- Pelczar, M. J. (2001). Microbiology, 5th edition. NewDelhi, Delhi:TataMcGraw-HillCo.
- Puri,P. (1985). Bryophytes. New Delhi, Delhi, Atma Ram and Sons.
- Sethi, I.K. and Walia, S.K. (2018). Textbook of Fungi and Their Allies. (2nd Edition), Medtech Publishers, Delhi.
- Tortora,G.J., Funke, B.R., Case, C.L. (2007). Microbiology. San Francisco, U.S.A, Pearson Benjamin Cummings.
- Vashishta, P.C., Sinha, A.K., Kumar, A. (2010). Pteridophyta. New Delhi, Delhi, S.Chand & Co Ltd.
- Singh, G. (2019) Plant Systematics-An Integrated Approach. 4th edition. CRC Press, Taylor and Francis Group.
- Blackmore, S., Crane, P. (2019) How Plants Work–Form, Diversity, Survival, Princeton University Press; Illustrated edition.
- Ingrouille, M., Eddie, B. (2006) Plants: Evolution and Diversity. Cambridge University Press.

Suggestive readings:

- Parihar, N.S. (1991). An Introduction to Embryophyta. Vol.II. Pteridophytes. Prayagraj: U.P.: Central Book Depot.
- Singh,V., Pandey,P.C., Jain,D.K. (2001).A Text Book of Botany. Meerut, UP: Rastogi and Co.
- Webster, J., Weber, R. (2007). Introduction to Fungi. Cambridge, Cambridge University Press.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE – 2: Cell Biology: Organelles and Biomolecules

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Cell Biology: Organelles and Biomolecules **BOT-DSC-2**	**4**	**2**	**0**	**2**	10+2 from any recognized Board with Biology/Biotechnology	**Nil**

Learning Objectives:

- To study the Cell as a structural and functional unit of life.
- To study the various types of biomolecules (proteins, carbohydrates, lipids and nucleic acids) and their roles in cell structure and function.
- To study the structures of different organelles and their role in fundamental metabolic processes of a cell.

Learning outcomes

By studying this course, students will gain basic knowledge on:

- The relationships between the properties of biomolecules, their cellular activities and biological functions.
- Physico-chemical composition of organelles and their functional organization.

SYLLABUS OF BOT-DSC-2

Unit 1: Biomolecules **Weeks: 05**

Types of chemical bonds and their biological significance. Structure and biological roles of carbohydrates, lipids, proteins and nucleic acids. ATP: structure and its role as an energy currency molecule.

Unit 2: The Cell **Week: 01**

Cell as a unit of structure and function; Characteristics of prokaryotic and eukaryotic cells; Origin of eukaryotic cell (Endosymbiotic theory).

Unit 3: Cell Wall and Plasma Membrane **Weeks: 1.5**

Chemistry, structure and function of Plant Cell Wall. Singer and Nicolson's fluid mosaic model of cell membrane.

Unit 4: Cell Organelles: Structure and function of the following Organelles

Weeks: 5.5

Nucleus: Structure and function (nuclear envelope, nuclear pore complex, nuclear lamina); types of chromatin; nucleolus.

Chloroplast and Mitochondria: Structural organization; Function; Semi- autonomous nature of mitochondria and chloroplast.

Endomembrane system: Endoplasmic Reticulum – Structure and function of RER and SER, protein folding, processing in ER, export of proteins and lipids; Golgi Apparatus - Organization, protein glycosylation, protein sorting and export from Golgi Apparatus. Introduction to post-translational modifications.

Peroxisome and Lysosomes: Structure and function.

Cytoskeleton: Role and structure of microtubules, microfilaments, intermediary filament and motor proteins.

Unit 5: Cell division **Weeks: 02**

Eukaryotic cell cycle, mitosis and meiosis; regulation of cell cycle.

Practicals:

1. Study of cell and its organelles with the help of electron micrographs and otherdigital resources. **(Weeks: 02)**
2. Study of plant cell structure with the help of epidermal peel mount of

Allium/*Rhoeo*/*Crinum*. **(Week: 01)**

3. Microchemical tests for carbohydrates (reducing, non-reducing sugars and starch), lipids and proteins. **(Weeks: 02)**
4. Separation of chloroplast pigments by paper chromatography/ Thin Layer Chromatography. **(Weeks: 02)**
5. Separation of amino acids by paper chromatography. **(Weeks: 02)**
6. Study the effect of organic solvent and temperature on membrane permeability. **(Weeks: 02)**
7. Demonstration of the phenomenon of protoplasmic streaming in *Hydrilla* leaf. **(Weeks: 01)**
8. Demonstration of the phenomenon of plasmolysis and deplasmolysis. **(Week: 01)**
9. Demonstration of separation of biomolecules by dialysis. **(Week: 02)**

Essential/recommended Readings:

- Hardin, J. and Lodolce, J.P. (2022). Becker's World of The cell, 10th edition, Pearson
- Berg, J.M., Tymoczko, J.L., Stryer, L. (2011). *Biochemistry.* New York, NY: W. H. Freeman and Company.
- Campbell, N. A. (2020). Biology: A Global Approach, 12th Edition, Pearson
- Campbell, P.N., Smith, A.D. (2011). *Biochemistry Illustrated*, 4th edition.London, UK: Churchill Livingstone.

Suggested readings:

- Cooper, G.M., Hausman, R.E. (2019). The Cell: A Molecular Approach, 7thedition. Sinauer/OUP.
- Iwasa, J, Marshall , W. (2020). Karps's Cell Biology, 9th edition, New Jersey,U.S.A.: John Wiley & Sons.
- Majumdar, R., Sisodia, R. (2019). Laboratory Manual of Cell Biology, withreference to Plant Cells. New Delhi, Delhi: Prestige Publication.
- Nelson, D.L., Cox, M.M. (2021). Lehninger Principles of Biochemistry, 8thedition. New

York, NY: W.H. Freeman and Company.

- Raven, F.H., Evert, R.F., Eichhorn, S.E. (1992). Biology of Plants. New York,NY: W.H.Freeman and Company.
- Tymoczko, J.L., Berg, J.M., Stryer, L. (2012). Biochemistry: A short course, 2ndedition. New York, NY: W.H. Freeman and Company.

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DISCIPLINE SPECIFIC CORE COURSE – 3: Basic Laboratory and Field Skills in Plant Biology

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Basic Laboratory and Field Skills in Plant Biology **BOT-DSC-3**	**4**	**2**	**0**	**2**	10+2 from any recognized Board with Biology/ Biotechnology	**Nil**

Learning Objectives

The course will help students to:

- Learn fundamental skills important for performing laboratory and field experiments

Learning outcomes

This course will be able to demonstrate basic knowledge and understanding of:

- Good laboratory practices, management of laboratory waste, understanding hazards and risks to ensure a safe laboratory environment.
- Basics of measurements, units and common mathematical calculations, sampling and data collection.
- Operation and maintenance of basic laboratory instruments
- Presentation, analysis of data and interpretation of results.

SYLLABUS OF BOT-DSC-3

Unit 1: Lab safety and good lab practices **Weeks: 02**

General laboratory safety, good laboratory practices, biosafety measures (first-aid practices to be followed in case of burn, acid spills and injury), safety symbols, lab safety equipments (fire extinguisher, fume hood, safety glasses), classes of laboratory chemicals, maintenance and handling of chemicals (Labels, Quality - LR/ AR/ Molecular biology grade/ HPLC grade/Tissue culture grade; Expiry date; Precautions for use), Disinfectants, Biocontainment, Disposal of hazardous chemicals, radioactive and biological waste, Laboratory waste management.

Unit 2: Use and maintenance of Laboratory equipment **Weeks: 02**

Weighing balance (Top loading and Analytical), pH meter (calibration and use), magnetic stirrer, pipettes and micropipettes, autoclave, laminar airflow, BOD incubator, incubator shaker, micrometer, haemocytometer, spectrophotometer, Agarose gel electrophoresis unit,SDS PAGE unit, centrifuge, distillation unit, conductivity meter, Lux meter.

Unit 3: Microscopy, sample and slide preparation **Weeks: 2.5**

Microscopes (Dissecting, Compound and Electron microscopes), Fixation and Preservation (for light and electron microscopy); staining, mounting; basic introduction to other types of microscopes (Confocal, Fluorescence)

Unit 4: Measurements and calculations **Week: 01**

Units of measurements and conversion from one unit to another, measurement of volumes of liquids, Weighing, calculations: scientific notations, powers, logarithm and fractions.

Unit 5: Solutions and Buffers **Week: 01**

Molarity, Molality, Normality, percent solution, stock solution, standard solution, dilution, dilution series, pH, acids and bases, buffers - phosphate, Tris- acetate, Tris-Cl and Citrate buffer.

Unit 6: Basic culturing techniques **Weeks: 1.5**

Basic culture media (LB, YEB, MS)- liquid and solid, Culture techniques: plating

(streak, spread & pour), replica plating, serial dilution.

Unit 7: Data collection, statistical analysis and interpretation **Weeks: 02**

Fundamentals of data collection, data types - primary and secondary, methods of data collection, sample, sampling methods - merits and demerits, technical and biological replicates, classification - tabulation and presentation of data, Descriptive statistics - Mean, Mode, Median, Variance, Standard Deviation, Standard error, Coefficient of Variation, difference between sample mean and population mean.

Unit 8: Basic computer skills for biology **Weeks: 02**

MS-Word, PowerPoint, Excel, introduction to biological databases.

Unit 9: Field Skills **Week: 01**

Identification, collection, cataloguing and preservation of plant specimens, Herbarium and Museum.

Practical component:

1. Preparation of solutions- molar, molal, normal, percentage, stock, standard andserial dilution **(Week: 01)**
2. Determining pH of solutions (pH paper, Universal indicator, pH meter) andpreparation of buffers (Phosphate, Tris-Cl, Electrophoresis buffers - TBE/TAE) **(Week: 01)**
3. Working of instruments -light microscope, autoclave, laminar air flow, spectrophotometer, centrifuge, gel electrophoresis unit (Agarose & Poly acrylamide). **(Week: 01)**
4. Temporary peel mount slide preparation and staining (safranin and acetocarmine). **(Week: 01)**
5. Calculate cell size using micrometer. **(Week: 01)**
6. Calculate number of cells (pollen/spores) using haemocytometer. **(Week: 01)**
7. Preparation of LB medium, growth and maintenance of bacterial cultures (liquid -serial dilution method; and semi-solid cultures - streak, spread and pour plates)

(Weeks: 02)

8. Isolation of genomic DNA from *E. coli* and plant leaf material, Agarose gel electrophoresis **(Weeks: 02)**
9. Calculation of mean, mode, median, standard deviation using data set (collectedfrom experiments 5 and 6). **(Week: 01)**
10. Using software to draw tables, graphs and calculating descriptive statistics(Microsoft Excel) **(Week: 02)**
11. Laboratory safety equipment (Fire extinguisher, Fume hood, safety glasses) **(Week: 01)**
12. Mounting of a properly dried and processed plant specimen with herbarium label. **(Week: 01)**

Essential/recommended Readings:

- Evert, R. F., Eichhorn, S. E., Perry, J.B. (2012). Laboratory Topics in Botany. W.H. Freeman and Company.
- Mesh, M.S., Kebede-Westhead, E. (2012). Essential Laboratory Skills for Biosciences. John Wiley & Sons, Ltd.
- Mu, P., Plummer, D. T. (2001). Introduction to practical biochemistry. Tata McGraw-Hill Education.
- Mann, S. P. (2016). Introductory Statistics, 9th edition. Hoboken, NJ, John Wiley and Sons Inc.
- Danniel, W.W. (1987). Biostatistics. New York, NY: John Wiley Sons.
- Jones, A.M., Reed, R., Weyers, J. (2016). Practical Skills in Biology, 6th Edition, Pearson
- Bisen, P.S. (2014). Laboratory Protocols in Applied Life Sciences, 1st edition. CRC Press.

Suggested readings:

- Zar, Z. H. (2010). Biostatistical Analysis, 5th edition, Pearson Prentice Hall, New Jersey, USA.

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