Introduction

Content: The B.Sc. – Botany programme includes a wide diversity of courses covering all aspects of Plant Sciences. In addition to unique combinations of basic, advanced and applied courses (as Core, ability enhancement courses, Skill enhancement courses, Generic elective courses and Discipline-Specific Elective papers), the programme also has a strong interdisciplinary component. Emphasis is on experiential learning through hands-on laboratory exercises, field trips and assignments. Current thrust areas of teaching provide students with substantial exposure and skills in plant biology. The disciplines studied include plant structure, growth and development, molecular biology, physiology, biochemistry, pathology, ecology, genetics, systematics, evolution, bioinformatics, biostatistics and transgenic technology on a variety of taxa ranging from algae, fungi and other microbes, bryophytes and vascular plants (ferns, gymnosperms and angiosperms including crop plants) at the cellular, organismal, community and ecosystem levels.

Learning Outcome based approach to Curriculum Planning

>> Aims of Bachelor's degree programme in (CBCS) B.SC.(HONS.) BOTANY

Content: Understanding of plant classification systematics, evolution, ecology, developmental biology, physiology, biochemistry, plant interactions with microbes and insects, morphology, anatomy, reproduction, genetics and molecular biology of various life-forms. Understanding of various analytical techniques of plant sciences, use of plants as industrial resources or as human livelihood support system and is well versed with the use of transgenic technologies for basic and applied research in plants. Understanding of various life forms of plants, morphology, anatomy, reproduction, genetics, microbiology, molecular biology, recombinant DNA technology, transgenic technology. and use of bioinformatics tools and databases and in the application of statistics to biological data

Learning Outcome based approach to Curriculum Planning

>> Nature and extent of the B.Sc/B.A./B.Com Programme

Content: B.Sc Botany Programme is base on the basic knowledge on various fields of plant biology through the teaching, interactions and practical classes. Students wold gain wide knowledge as follow:

1. Diversity of plants and microbes their habitat, morphology, and reproduction.
2. Genetics and molecular biology of plants
3. Fungi and disease causing microbes and fungi
4. Economic value of plant and their use in Biotechnology

Graduate Attributes in Subject
  >> Disciplinary knowledge

Content: The B.Sc. - Botany programme is formed to gain knowledge and technical skills to study plants in a holistic manner. Students would get training in various disciplines of plant sciences using a combination of core and elective papers with significant inter-disciplinary components. Students would be exposed to basic and advanced knowledge that are currently used in the study of plant life forms, adaptation, evolution, classification, ultrastructure processes in the plant system and interactions with other organisms and with the ecosystem use of plants in biotechnology and economic value of plants. and social and environmental significance of plants.

Graduate Attributes in Subject
  >> Scientific reasoning

Content: In addition to academic acquaintance and training in the various field of plant sciences, students would also get training in application of the subject, critical thinking, reasoning and analytical skills, effective communication, laboratory safety, sensitivity to environment and sustainable living.

Graduate Attributes in Subject
  >> Critical thinking

Content: The course enhance the skill of thinking about the application of the biology
Disciplinary knowledge

Content: The programme also has a strong interdisciplinary component. Emphasis is on experiential learning through hands-on laboratory exercises, field trips and assignments. Current thrust areas of teaching provide students with substantial exposure and skills in plant biology.

Graduate Attributes in Subject

>> Critical thinking

Content: Learning of the basic concepts, principles and processes in plant biology and have the ability of explanation of principles and usage of the acquired knowledge in applied botany.

Graduate Attributes in Subject

>> Problem solving

Content: The B.Sc. - Botany programme is formed to gain knowledge and technical skills to study plants in a holistic manner. Students would get training in various disciplines of plant sciences using a combination of core and elective papers with significant inter-disciplinary components.

Graduate Attributes in Subject

>> Analytical reasoning

Content: The student would develop a skill to analyse the knowledge of the subject and think in a multi-directional way to solve the problem and to gain benefit in a sustainable manner. They would be able to think about the use of plants as industrial resources or as human livelihood support system and is well versed with the use of transgenic technologies for basic and applied research in plants.
Graduate Attributes in Subject

>> Reflective thinking

Content: Students would gain knowledge and technical skills to study plants in a holistic manner. Students would get training in various disciplines of plant sciences using a combination of core and elective papers with significant inter-disciplinary components.

Graduate Attributes in Subject

>> Multicultural competence

Content: Understanding of various analytical techniques of plant sciences, use of plants as industrial resources or as human livelihood support system and is well versed with the use of transgenic technologies for basic and applied research in plants.

Graduate Attributes in Subject

>> Lifelong learning

Content: The subject of botany the applied theoretically and practically applied in day today life. The successful students will be able to learn the basic concepts, principles and processes in plant biology. They have the ability of explanation of concepts, principles and usage of the acquired knowledge in biotechnological, pharmaceutical, medical, ecological and agricultural applications. Use basic biology techniques to explore molecular biology of plants.

Graduate Attributes in Subject

>> Self-directed learning

Content: The programme also has a strong interdisciplinary component. Emphasis is on experiential learning through hands-on laboratory exercises, field trips and assignments. Current thrust areas of teaching provide students with substantial exposure and skills in plant biology.
Graduate Attributes in Subject
   >> Communication Skills

Content: The student will get a confidence after getting the knowledge and skill after this course and they will be able to communicate their views, present their work and impress the audience.

Graduate Attributes in Subject
   >> Research-related skills

Content: This course provide wide interdisciplinary knowledge and stimulate the students to think beyond the course knowledge, apply this knowledge in for solving the environmental problems and think for efficient use of resources through the designing the experiments and innovations.

Graduate Attributes in Subject
   >> Cooperation/Team work

Content: The students would learn the team work, division of the work and the corporate life of the academics.

Graduate Attributes in Subject
   >> Information/digital literacy

Content: The students would learn the use of the new technologies in the biology, fast transfer of the information.

Graduate Attributes in Subject
   >> Moral and ethical awareness/reasoning
Content: Besides the theoretical knowledge, the student gain the acquaintance of the moral and ethical duties and the awareness towards the conservation of nature and natural resources.

Graduate Attributes in Subject

>> Leadership readiness/qualities

Content: The vast and deep knowledge of the subject, analytical and scientific reasoning, effective communication and problem solving task develop special qualities in a person to attract and influence the audience, which would be gained after the completion of this course.

Qualification Description

Content: • Basics of structure, versatility function, value and the role of plants sustainable development
• Concept and significance of sustainable development and use of the plant resources
• Students will also be able to learn the various ecological processes and interaction between animals and plants.

Programme Learning Outcome in course

Content: Understanding of plant classification systematics, evolution, ecology, developmental biology, physiology, biochemistry, plant interactions with microbes and insects, morphology, anatomy, reproduction, genetics and molecular biology of various life-forms.
Understanding of various analytical techniques of plant sciences, use of plants as industrial resources or as human livelihood support system and is well versed with the use of transgenic technologies for basic and applied research in plants.
Understanding of various life forms of plants, morphology, anatomy, reproduction, genetics, microbiology, molecular biology, recombinant DNA technology, transgenic technology, and use of bioinformatics tools and databases and in the application of statistics to biological data.
Teaching-Learning Process

Content: Visual media should be made available. It is suggested that Botany Department, University of Delhi may be entrusted with preparation of good visual aids that would help students get a feel of the subject and they find the subject interesting. Even the college teachers can form a group and work out these possibilities of visual aids that would enhance teaching learning process. Field trips and Institutional visits may also be added.

Assessment Methods

Content: Instead of making drawings compulsory part of practical record books, we may ponder over making students involve in highlighting the salient features of the genera/groups through digital media such as ppt and animations.

<table>
<thead>
<tr>
<th>Semester</th>
<th>Core Course (14)</th>
<th>Ability Enhancement Compulsory Course (AEC) (2)</th>
<th>Skill Enhancement Course (SEC) (2)</th>
<th>Discipline Specific Elective: SEC-I (Any one)</th>
<th>Generic Elective: (GE) (4)</th>
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<tbody>
<tr>
<td>I</td>
<td>1. Microbiology and Phycology</td>
<td>English/MIL Communication/Environmental Science</td>
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<td>GE-1 (Any one)</td>
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<td></td>
<td>2. Biomolecules and Cell Biology</td>
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<td></td>
<td>1. Biodiversity (Microbes, Fungi, Algae, and Archeogoniates)</td>
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<tr>
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<td></td>
<td>2. Plant Anatomy and Embryology</td>
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<tr>
<td>II</td>
<td>3. Mycology and Phytopathology</td>
<td>English/MIL Communication/Environmental Science</td>
<td></td>
<td></td>
<td>GE-II</td>
</tr>
<tr>
<td>III</td>
<td>5. Anatomy of Angiosperms</td>
<td>SEC-I (Any one)</td>
<td></td>
<td></td>
<td>GE-III (Any one)</td>
</tr>
</tbody>
</table>
**Anatomy of Angiosperms (BHCC5)**  
**Core Course - (CC) Credit: 6**

**Course Objective (2-3)**
To acquaint the students with internal basic structure and cellular composition of the plant body. To correlate structure with important functions of different plant parts. Study of various tissue systems and their development and functions in plants.

**Course Learning Outcomes**
Knowledge of various cells and tissues, meristem, epidermal and vascular tissue system in plants. Various aspects of growth, development of the tissues and differentiation of various plant organs. Knowledge of basic structure and organization of plant parts in angiosperms. Correlation of structure with morphology and functions.
Unit 1

Tissues

Classification of tissues; Simple and complex tissues (no phylogeny); Pits and plasmodesmata; Wall ingrowths and transfer cells; Ergastic substances.

Unit 2

Stem and leaf

Organization of shoot apex (Apical cell theory, Histogen theory, Tunica Corpus theory, continuing meristematic residue, cyto-histological zonation); Types of vascular bundles; Structure of dicot and monocot stem; Shoot Chimeras; Structure of dicot and monocot leaf, Kranz anatomy; Development of Leaf.

Unit 3

Root

Organization of root apex (Apical cell theory, Histogen theory, Korper-Kappe theory); Quiescent centre; Root cap; Structure of dicot and monocot root; Endodermis, exodermis and origin of lateral root.

Unit 4

Vascular Cambium

Structure (Axially and radially oriented elements); function and seasonal activity of cambium; Secondary growth in root and stem, Anomalies in secondary growth in stem: Included phloem and Phloem wedges.

Unit 5

Wood

Types of rays and axial parenchyma; Cyclic aspects and reaction wood; Sapwood and heartwood; Ring and diffuse porous wood; Early and late wood, tyloses; Dendrochronology.
Unit 6

**Periderm**

Development and composition of periderm; rhytidome and lenticels.

Unit 7: Adaptive and Protective Systems

Epidermal tissue system; cuticle; epicuticular waxes; trichomes (uni-and multicellular, glandular and non-glandular, two examples of each); stomata (classification); Adcrustation and incrustation; Anatomical adaptations of xerophytes and hydrophytes.

Unit 8: Secretory System

Hydathodes, cavities, lithocysts and laticifers.

Unit 9: Scope of Plant Anatomy

Applications in systematics, forensics and pharmacognosy.

Practical

Study of anatomical details through permanent slides/temporary stain mounts/macarations/museum specimens with the help of suitable examples.

1. Apical meristem of root, shoot and vascular cambium.
2. Distribution and types of parenchyma, collenchyma and sclerenchyma.
3. Xylem: Tracheary elements-tracheids, vessel elements; thickenings; perforation plates; xylem fibres.
4. Wood: ring porous; diffuse porous; tyloses; heartwood and sapwood.
5. Phloem: Sieve tubes-sieve plates; companion cells; phloem fibres.
8. Stem: monocot, dicot - primary and secondary growth; phloem wedges in *Bignonia*, included phloem in *Leptadenia/Salvadora*; periderm; lenticels.
9. Leaf: isobilateral, dorsiventral, C4 leaves (Kranz anatomy).
10. Adaptive Anatomy: xerophytes, hydrophytes.

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**References**


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**Additional Resources:**


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**Teaching Learning Process**

Chalk and blackboard teaching methodology

Powerpoint presentations

Study of anatomical details through permanent slides/temporary stain mounts/ macerations/ museum specimens with the help of suitable examples
Assessment Methods

Assignments/ Projects
Class tests
Student presentations
Continuous evaluation

Making drawings as a part of practical record books. we may ponder over making students involve in highlighting the salient features of the genera/ groups through digital media such as ppt and animations.

Keywords

Tissues, Stem, Leaf, Root, Vascular cambium, Wood, Periderm, Anatomical adaptations, Secondary anomalies. Plant tissue systems, meristems, trichomes,

Archegoniatae
(BHCC4)
Core Course - (CC) Credit:6

Course Objective(2-3)

This course aims at making a familiarity with special groups of plants joined together by a common feature of sexual reproduction involving Archeogonia.

Creating an understanding by observation and table study of representative members of phylogenetically important groups should be able to make students learn the process of evolution in a broad sense.
Study of morphology, anatomy, reproduction and developmental changes therein through typological study should create a knowledge base in understanding plant diversity, economic values, taxonomy of lower group of plants.

Course Learning Outcomes

The students will be made aware of the group of plants that have given rise to land habit and the flowering plants. Through field study they will be able to see these plants grow in nature and become familiar with the biodiversity. To my knowledge students should create their small digital reports where they can capture the zoomed in and zoomed out pictures as well as videos in case they are able to find some rare structure or phenomenon related to these plants.

Unit 1

The entire team feels that we need to update our concepts of the adaptations that lead to land habit. This should also include the evolution that occurred after land habit get established. There is also need to teach undergrads, APG system of classification for each of the three groups.

Unit 2

Classification: Recent phylogenetic classification to be followed. Morphology, anatomy and reproduction of Riccia, Marchantia, Pellia, Porella, Anthoceros, Sphagnum and Funaria (Developmental details not to be done). Comparative and evolutionary trends in liverworts, hornworts and mosses.

Progressive sterilization of the sporophyte.

Ecological and economic importance with special reference to Sphagnum. Besides economic importance new research in field of bryophytes could be done such as whole genome of Marchantia polymorpha has been sequenced to elucidate evolution.

Unit 3

Classification: Recent phylogenetic classification to be followed

Unit 4
Classification: Recent phylogenetic classification to be followed. Concept of double fertilization to be introduced taking example of *Ephedra* and *Gnetum gnemone*. While teaching *Cycas*, a brief mention of *Ginkgo* may also be made (only similarity between *Cycas* and *Ginkgo* such as motile sperms).

Comparison of Cycadales with ferns on one hand and *Gnetum* with angiosperms should be made.

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**Unit 5**

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**Practical**

Following to be added

1. *Riccia*: VS Thallus showing sporophyte

3. *Anthoceros*: LS sporophyte

12. *Pinus*: TS root (primary and secondary)

13. *Gnetum*: TS Stem showing 1, 2 and 3 rings. LS Male and Female inflorescence.

14. Botanical excursion (mandatory) should be carried out for imparting field knowledge to the students. The university/UGC should revise the amount of financial support for the excursion. The Students should be asked to submit a detailed report on the plants studied along with digital images.

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**References**

5. Vander-Poorteri 2009 Introduction to Bryophytes. COP.
7. Christenhauz and Reveal 2011 for gymnosperms
8. Crandall- Stotler et al 2008. for liverworts and hornworts
Teaching Learning Process

Visual media should be made available. It is suggested that Botany Department, University of Delhi may be entrusted with preparation of good visual aids that would help students get a feel of the subject and they find the subject interesting. Even the college teachers can form a group and work out these possibilities of visual aids that would enhance teaching learning process.

Assessment Methods

Instead of making drawings compulsory part of practical record books, we may ponder over making students involve in highlighting the salient features of the genera/ groups through digital media such as ppt and animations.

Keywords

Phylogenetic system of classification
Comparison of various groups
Evolutionary trends

Biomolecules and Cell Biology
(BHCC2)
Core Course - (CC) Credit:6
Course Objective

Biomolecules and Cell biology study will help the students to gain knowledge on the activities in which the giant molecules and minuscule structures that inhabit the cellular world of life are engaged. This will provide inside into the organization of cell, its features and regulation at different levels. Through the study of biomolecules (i.e protein, carbohydrate, lipid and nucleic acid) and cell organelles, they will be able to understand the various metabolic processes such as respiration, photosynthesis etc. which are important for life.

Course Learning Outcomes

This course will be able to demonstrate foundational knowledge in understanding of:

- The relationship between the properties of macromolecules, their cellular activities and biological responses
- Understanding of Cell metabolism, chemical composition, physiochemical and functional organization of organelle
- Contemporary approaches in modern cell and molecular biology.

Unit 1

Biomolecules

Types and significance of chemical bonds; Structure and properties of water; pH and buffers.

**Carbohydrates**: Nomenclature and classification; Role of monosaccharides (glucose, fructose, sugar alcohols – mannitol and sorbitol); Disaccharides (sucrose, maltose, lactose), Oligosaccharides and polysaccharides (structural-cellulose, hemicelluloses, pectin, chitin, mucilage; storage – starch, inulin). **Lipids**: Definition and major classes of storage and structural lipids. Storage lipids: Fatty acids structure and functions, Structural lipid: Phosphoglycerides; Building blocks, General structure, functions and properties. Lipid functions: cell signals, cofactors, prostaglandins, Introduction of lipid micelles, monolayers, bilayers.

**Proteins**: Structure of amino acids; Peptide bonds; Levels of protein structure-primary, secondary, tertiary and quaternary; Isoelectric point; Protein denaturation and biological roles of proteins

**Nucleic acids**: Structure of nitrogenous bases; Structure and function of nucleic acids
Unit 2

**Bioenergetics** (4 lectures)

Laws of thermodynamics, concept of free energy, endergonic and exergonic reactions, coupled reactions, redox reactions. ATP: structure, its role as a energy currency molecule.

Unit 3

**Enzymes** (6 lectures)

Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group; mechanism of action (activation energy, lock and key hypothesis, induced-fit theory), enzyme inhibition and factors affecting enzyme activity (in brief).

Unit 4

**The cell** (2 lectures)

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

Unit 5

**Cell wall and plasma membrane** (4 lectures)

Chemistry, structure and function of Plant Cell Wall. Overview of membrane function; fluid mosaic model; Chemical composition of membranes; Membrane transport – Passive, active and facilitated transport, endocytosis and exocytosis.

Unit 6

**Cell organelles** (22 lectures)

*Nucleus*: Structure-nuclear envelope, nuclear pore complex, nuclear lamina, molecular organization of chromatin; nucleolus.
Cytoskeleton: role and structure of microtubules, microfilaments and intermediary filament.

Chloroplast, mitochondria and peroxisomes: Structural organization; Function; Semiautonomous 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; Lysosomes

Unit 7: Cell division (4 lectures)

Eukaryotic cell cycle, mitosis and meiosis. Regulation of cell cycle

________________________________________________________________________

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/Rhoeo/Crinum.
3. Demonstration of the phenomenon of protoplasmic streaming in Hydrilla leaf.
4. Separate chloroplast pigments by paper chromatography.
5. Demonstrate the activity of any two enzymes (Urease, Amylase, Catalase).
6. Study of cell and its organelles with the help of electron micrographs.
7. Study the phenomenon of plasmolysis and deplasmolysis.
8. Study the effect of organic solvent and temperature on membrane permeability.
9. Study different stages of mitosis.

________________________________________________________________________

References


Additional Resources:


Teaching Learning Process

Visual media would be helpful. Botany Department, University of Delhi

may be entrusted with preparation of good visual aids that would help students get a feel of the subject and they find the subject interesting. College teachers can form a group and work out these possibilities of visual aids that would enhance teaching learning process.

Assessment Methods

Making drawings ma be made a compulsory part of practical record books, We may ponder over
making students involve in highlighting the salient features of the genera/ groups through digital media such as ppt and animations.

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**Keywords**

Proteins, lipids, carbohydrates, nucleic acids, enzymes, plasma membrane, cytoskeleton, chloroplast, meiosis, mitosis, cell division

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**Ecology**

(BHCC9)

Core Course - (CC) Credit:6

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**Course Objective (2-3)**

To introduce the students with environmental factors affecting the plants, the basic principles of ecology and phytogeography. To make them understand complex community patterns and processes, and ecosystem functioning.

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**Course Learning Outcomes**

It acquaint the students with complex interrelationship between organisms and environment; make them understand methods to studying vegetation, community patterns and processes, ecosystem functions, and principles of phytogeography. This knowledge is critical in evolving strategies for sustainable natural resource management and biodiversity conservation.

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**Unit 1**

**Introduction** (4 lectures)
Brief History, Basic concepts, Levels of organization, Inter-relationships between the living world and the environment, the components and dynamism, homeostasis (with reference to Ecosystem).

Unit 2

Soil (8 lectures)

Importance; Origin; Formation; Composition: Physical, Chemical and Biological components; Soil profile; Role of climate in soil development.

Unit 3

Water (3 lectures)

Importance; States of water in the environment; Atmospheric moisture; Precipitation types (rain, fog, snow, hail, dew); Hydrological Cycle; Water in soil; Water table.

Unit 4

Light, Temperature, Wind and Fire (6 lectures)

Variations; adaptations of plants to their variation.

Unit 5

Biotic interactions (2 lectures)

Definition; types of biotic interactions

Population ecology (4 lectures)

Distribution and characteristics of populations; population growth; population dynamics; Ecological Speciation (Ecads, ecotypes, ecospecies, etc)

Plant communities (9 lectures)
Concept of ecological amplitude; Habitat (types) and Ecological niche (types); Community characters (analytical and synthetic); Ecotone and edge effect; Methods to studying vegetation; Dynamics of communities; Succession: processes, types (Lithosere, Hydrosere); climax concepts.

Unit 6

**Ecosystems** (5 lectures)

Structure; Types; Processes; Trophic organisation; Food chains and Food webs; Ecological pyramids.

Unit 7: Functional aspects of ecosystem (9 lectures)

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

Unit 8: Phytogeography (10 lectures)

Principles; Continental drift; Theory of tolerance; Endemism; Brief description of major terrestrial biomes (one each from tropical, temperate & tundra); Phytogeographical division of India; Vegetation of Delhi.

Practicals

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/Lovi bond 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.

References


Teaching Learning Process

The Class room teaching are integrated with practical classes, and field visit to impart a sound understanding of the course. The theory topics are covered in lectures with the help of blackboard teaching and PowerPoint presentations. When the entire syllabus is completed, a few lectures are devoted to discuss the previous years’ question papers.

Every practical session begins with detailed instructions, followed by students conducting the experiment/s in the laboratory/college campus. When all the students have collected the data, the observations are discussed. Any deviation from the expected trend in results is explained. The students are encouraged to graphically represent the data and record the experiment during class hours. The students are asked to submit their record notebooks to the teacher/s for checking.

College teachers can also form a group and prepare e-contents for theory as well as for practicals.

Field visit is also be organised to familiarise the students with local plant species, and to understand community pattern and processes.

Assessment Methods

Theory: The students are continuously evaluated based on a assignments/presentation and class test. After marking, the answer scripts of the test are returned to the students.

In fact, presentations by students improves their reasoning and communication skills. The presentations of students are evaluated by the teacher based on the content, effectiveness of the presentation, whether any new information has been added, and lastly on the answers given by students to the questions posed by the teacher. An assignment can be given in place of the presentation.

The Internal Assessment has a break-up as 10 marks for the test, 10 marks for the presentation/assignment and 5 marks for the attendance, and comprises 25 % of the total marks. Practical: For
continuous evaluation, 10 marks are allotted for test, 10 marks for record /field report, and 5 marks for attendance. The Internal Assessment for practicals comprises 50% of the total marks.

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Keywords

Environmental factors, Soil profile, Biotic interactions, Ecological niche, Succession, Ecosystem functions, Homeostasis, Endemism, Phytogeography

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**Economic Botany**

**(BHCC6)**

Core Course - (CC) Credit:6

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**Course Objective**

(2-3)

To make the students familiar with economic importance of diverse plants that offer resources to human life. It emphasize the plants used as food for man, fodder for cattle, feed for poultry, plants having medicinal value and also plant source of huge economic value etc

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**Course Learning Outcomes**

After studying Economic Botany, students would have first hand information of plants used as food, the various kinds of nutrients available in the plants. The dietary requirements of proteins, fats, amino-acids, vitamins etc that can be met by plants. The students will learn to perform the micro-chemical tests to demonstrate various components. The students will learn about the use of fibre plants, beverages, fruits and vegetables that are integral to day to day life of plants. Students will learn to explore the regional diversity in food crops and other plants and their ethno-botanical importance as well.

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**Unit 1**

**Origin of Cultivated Plants**

(4 lectures)
Concept of Centres of Origin, their importance with reference to Vavilov’s work. Examples of major plant introductions; Crop domestication and loss of genetic diversity (Only conventional plant breeding methods); Importance of germplasm diversity.

<table>
<thead>
<tr>
<th>Unit 2</th>
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<tbody>
<tr>
<td><strong>Cereals</strong></td>
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<tr>
<td>Wheat and Rice (origin, evolution, morphology, post-harvest processing &amp; uses); Green revolution; Brief account of millets and pseudocereals.</td>
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<th>Unit 3</th>
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<tr>
<td><strong>Legumes</strong></td>
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<td>General accounts (including chief pulses grown in India); Importance to man and ecosystem.</td>
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| Unit 4 | (3 lectures) |
|---|
| **Fruits**  Mango and Citrus (Origin, morphology, anatomy and uses) |

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<thead>
<tr>
<th>Unit 5</th>
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<tbody>
<tr>
<td><strong>Sugars and Starches</strong></td>
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<tr>
<td>Morphology, ratooning, evolution (nobilization) and processing of sugarcane, products and by-products of sugarcane industry; Potato – morphology, tuber anatomy, propagation (conventional and TPS) and uses.</td>
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<th>Unit 6</th>
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<tr>
<td><strong>Unit 6: Spices</strong></td>
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<tr>
<td>Listing of important spices, their family and part used, economic importance with special reference to fennel, saffron, clove and black pepper</td>
</tr>
</tbody>
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| Unit 7: Beverages | (4 lectures) |
Tea, Coffee (morphology, processing & uses)

**Unit 8: Oils and fats**

(8 lectures)

General description, classification, extraction, their uses and health implications; groundnut, coconut, linseed, mustard (Botanical name, family & uses).

**Unit 9: Essential Oils**

(4 lectures)

General account, extraction methods, comparison with fatty oils & their uses.

**Unit 10: Natural Rubber**

(3 lectures)

Para-rubber: tapping, processing and uses.

**Unit 11: Drug-yielding plants**

(5 lectures)

Therapeutic and habit-forming drugs with special reference to *Cinchona*, *Digitalis*, *Papaver* and *Cannabis*.

**Unit 12: Tobacco**

(Morphology, processing, uses and health hazards).

(3 lectures)

**Unit 13: Fibers**

(6 lectures)

Classification based on the origin of fibers; Cotton (origin of tetraploid cotton, morphology, extraction and uses) and Jute (morphology, extraction and uses).

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**Practical**

1. **Cereals**: Wheat (habit sketch, L.S/T.S. grain, starch grains, micro-chemical tests), Rice (habit sketch, study of paddy and grain, starch grains, micro-chemical tests). Millets and Pseudocereals (specimens / photographs and grains)

2. **Legumes**: Soybean, Groundnut, (habit, fruit, seed structure, micro-chemical tests).

3. **Fruits**: Mango (habit sketch, L.S. fruit, micro-chemical tests in ripe fruit); Citrus (habit sketch, T.S. hesperidium, W.M. vesicle, micro-chemical tests including test for vitamin C)

4. **Sugars and starches**: Sugarcane (habit sketch; cane juice- micro-chemical tests); Potato (habit sketch, tuber morphology, T.S. tuber to show localization of starch grains, W.M. starch grains, micro-chemical tests).

5. **Spices**: Black pepper, Fennel and Clove (habit and sections L.S./T.S.).
6. **Beverages:** Tea (plant specimen, tea leaves), Coffee (plant specimen, beans).

7. **Oils and fats:** Coconut– T.S. nut, Mustard– plant specimen, seeds

8. **Essential oil-yielding plants:** Habit sketch of *Rosa*, *Vetiveria*, *Santalum* and *Eucalyptus* (specimens/photographs).

9. **Rubber:** specimen, photograph/model of tapping, samples of rubber products.

10. **Drug-yielding plants:** Specimens of *Cinchona*, *Digitalis*, *Papaver* and *Cannabis* (male & female plant).

11. **Tobacco:** specimen and products of Tobacco.

12. **Fiber-yielding plants:** Cotton (specimen, whole mount of seed to show lint and fuzz; whole mount of fiber and test for cellulose), Jute (specimen, transverse section of stem, test for cellulose and lignin on transverse section of stem and fiber).

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**References**

**Suggested Readings**


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**Teaching Learning Process**

The theory topics are covered in lectures with the help of blackboard teaching and PowerPoint presentations. When the entire syllabus is completed, a few lectures are devoted to discuss the previous years’ question papers.

Specimens along with their products are maintained to explain the students. Every practical session begins with detailed instructions, followed by students conducting the experiment/s.
When all the students have cut the section/perform micro-chemical tests of the material, the observations (temporary preparation/micro-chemical tests) has to be recorded and discussed. Any deviation from the expected trend in results is explained. Making drawings from specimens/temporary preparations as practical record book. The students are encouraged to graphically represent the data and record the experiment during class hours. The students are asked to submit their record notebooks to the teacher/s for checking.

College teachers can also form a group and prepare e-contents for theory as well as for practicals.

Assessment Methods

**Theory:** The students are continuously evaluated based on assignments/presentation and class test. After marking, the answer scripts of the test are returned to the students.

In fact, presentations by students improves their reasoning and communication skills. The presentations of students are evaluated by the teacher based on the content, effectiveness of the presentation, whether any new information has been added, and lastly on the answers given by students to the questions posed by the teacher. An assignment can be given in place of the presentation.

The Internal Assessment has a break-up as 10 marks for the test, 10 marks for the presentation/assignment and 5 marks for the attendance, and comprises 25% of the total marks.

**Practicals:** For continuous evaluation, 10 marks are allotted for test, 10 marks for record, and 5 marks for attendance. The Internal Assessment for practicals comprises 50% of the total marks.

Keywords

Cultivated plants, Green revolution, Cereals, Legumes, Starches & Sugars, Spices, Oils & Fats, Drug yielding plants, Natural rubber, Fibres
Course Objective (2-3)

To have knowledge of Mendelian and non-Mendelian inheritance, Chromosome biology and structure and function of genes.

To have understanding of structure and functions of DNA and RNA, models of DNA replication, prokaryotic and eukaryotic genome-structure, Central dogma and genetic code, transcription and gene silencing. Acquaintance of RNA processing and translation, protein synthesis and gene functions. Such knowledge is applied in the field of biotechnology

Course Learning Outcomes

To generate interest among the students in Genetics and make them aware about the importance and opportunities in higher education and research, the first unit should be Introductory dealing with how this area has revolutionised all aspects of our life from its growth from Mendel to Genetic Engineering. The first unit may include brief introduction of: Definition, Application of this field in Food production, Medicines, Industries, Bioinformatics, Genomics, Proteomics, Transcriptomics, System Biology to Personalised medicines.

Unit 1

Mendelian genetics and its extension (16 L)

Mendelism: History; Principles of inheritance; Chromosome theory of inheritance; sex determination (briefly with reference to Humans and Drosophlla); Probability and Pedigree analysis; Incomplete dominance and co- dominance; Multiple allelism; lethal alleles; Epistasis; Pleiotropy; Penetrance and expressivity; Polygenic inheritance; numericals. Basics of epigenetics, DNA Methylation and epigenetic code.
Extra-chromosomal Inheritance (6L)

Chloroplast Inheritance: Variegation in Four O’ clock plant; Mitochondrial inheritance in yeast; Maternal effect- shell coiling in snails; Infective heredity- Kappa particles in Paramecium.

Unit 3

Linkage, crossing over and chromosome mapping (12L)

Linkage and crossing over- Cytological basis of crossing over (eg. Maize); Recombination frequency: two factor and three factor crosses; interference and coincidence; Numericals based on gene mapping; Sex linkage (Drosophilla). QTL mapping and its significance

Unit 4

Variation in Chromosome number and structure (8L)

Deletion; Duplication; Inversion; Translocation; Position effect; Euploidy and aneuploidy.

Unit 5

Gene mutations (7L)

Mutation types; Molecular basis of mutation; Mutagens- Physical and chemical mutagens (Base analogs, deaminating, alkylating and intercalating agents); Detection of mutation ( CLB method); role of Transposon in mutation; DNA repair mechanisms (light dependent repair, excision repair, mismatch repair and SOS repair), Transposable genetic elements and its significance; Bacteria-IS elements, The Tn3 family Eukaryotes L Yeast TY elements, Maize transposones, Drosophila transposones; transposones in human genome; Alu, Retro-transposones (LINEs and SINEs)

Unit 6

Fine structure of gene (5L)

Classical vs molecular concepts of gene; Cis – Trans complementation test for functional allelism; Structure of phage T4, rII locus.
Unit 7: Population and evolutionary genetics (6L)

Allele frequencies, genotype frequencies, Hardy-Weinberg law, role of natural selection, mutation, genetic drift, genetic variation and speciation (modes of speciation and genetics of speciation)

Practical

1. To study male meiosis in Allium cepa (two stages to be shown)

2. To understand the genetic interaction involved using the seed mixture given. Genetic ratio to be calculated using Chi square analysis.

3. To do problems based on Hardy-Weinberg’s law.

4. Pedigree analysis

5. To study/list human dominant and recessive traits and to observe the listed physical traits among the students present in the class. Data thus generated may be used for calculating allelic and genotypic frequencies using Hardy-Weinberg’s principle.

6. To study the syndromes (Downs, Klinefelter/ Turner/ Patau/ Edwards)

7. To study colour blindness/ hemophilia (Ishihara cards may be used to study colour blindness)

8. Chromosomal aberrations: Complex translocation ring, quadrivalents, lagging chromosomes, dicentric/ inversion bridge

9. Xeroderma Pigmentosum/ Sickel cell anemia Industrial and Environmental Microbiology

References


Teaching Learning Process

Visual media should be made available. It is suggested that Department of Genetics, University of Delhi may be entrusted with preparation of good visual aids that would help students get a feel of the subject and they find the subject interesting. Even the college teachers can form a group and work out these possibilities of visual aids that would enhance teaching learning process.

Assessment Methods

Making drawings as part of practical record books, we may ponder over making students involve in highlighting the salient features of the genera/ groups through digital media such as ppt and animations.

Keywords

Inheritance theory, linkage, crossing over, chromosome mapping, cytology, Gene, Gene mutation, Population genetics
Course Objective (2-3)

To gain knowledge of diversity, life forms, life cycles, morphology and importance of microorganisms (Bacteria and algae).

Course Learning Outcomes

Students would have understanding of the classification, characteristics features, cell structure and growth and reproduction in viruses, bacteria, and various groups of marine and fresh water algae and their ecological and economic importance.

Unit 1

Introduction to microbial world.

Unit 2

Viruses (7 lectures)

Discovery, physiochemical and biological characteristics; classification (Baltimore). General structure with special reference to viroids and prions. General account of replication, DNA virus (T-phage), lytic and lysogenic cycle; RNA virus (TMV). Viral diseases

Unit 3

Bacteria (8 lectures)

Discovery, general characteristics, types-archaebacteria, eubacteria, wall-less forms. (mycoplasma and spheroplasts). Cell structure, nutritional types,. Reproduction-vegetative, asexual and recombination (conjugation, transformation and transduction). Bacterial diseases
Unit 4

Applied Microbiology (4 lectures)

Economic importance of viruses with reference to vaccine production, role in research, medicine and diagnostics, and as causal organisms of plant diseases. Economic importance of bacteria with reference to their role in agriculture and industry (fermentation and medicine).

Unit 5

Algae (7 lectures)

General characteristics; Ecology and distribution; range of thallus organization; Cell structure and components; cell wall, pigment system, reserve food (of only groups represented in the syllabus), flagella; Methods of reproduction, classification; Criteria, system of Fritsch, and evolutionary classification of Lee (only up to groups); significant contributions of important phycologists (F.E. Fritsch, G.M. Smith, R.N. Singh, T.V. Desikachary, H.D. Kumar, M.O.P. Iyengar).

Unit 6

Cyanophyta (6 lectures)

Ecology and occurrence, range of thallus organization, cell structure, heterocyst, reproduction. Economic importance; role in biotechnology. Morphology and life-cycle of Nostoc.

Unit 7: Chlorophyta (5 lectures)


Unit 8: Charophyta (2 lectures)

General characteristics; occurrence, morphology, cell structure and life-cycle of Chara; evolutionary significance.

Unit 9: Xanthophyta (3 lectures)

General characteristics; range of thallus organization; Occurrence, morphology and life-cycle of Vaucheria.
Unit 9: Phaeophyta (6 lectures)

Characteristics, occurrence, range of thallus organization, cell structure and reproduction. Morphology and life-cycles of *Ectocarpus* and *Fucus*. Unit 10: Rhodophyta (6 lectures)

General characteristics, occurrence, range of thallus organization, cell structure and reproduction. Morphology and life-cycle of Polysiphonia.

Unit 11: Applied Phycology (4 lectures)

Role of algae in the environment, agriculture, biotechnology and industry.

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Practical

Microbiology


2. Types of Bacteria to be observed from temporary/permanent slides/photographs. Electron micrographs of bacteria, binary fission, endospore, conjugation, root Nodule.

3. Gram staining.

Phycology

4. Study of vegetative and reproductive structures of *Nostoc, Chlamydomonas, Volvox, Oedogonium, Coleochaete, Chara, Vaucheria, Ectocarpus, Fucus* and *Polysiphonia, Prochlororon* through electron micrographs, temporary preparations and permanent slides

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References


Additional Resources:


Teaching Learning Process

Visual media would be used for teaching. Botany Department, University of Delhi may be entrusted with preparation of good visual aids that would help students get a feel of the subject and they find the subject interesting. College teachers can form a group and work out these possibilities of visual aids that would enhance teaching learning process.

Assessment Methods

Making drawings from the temporary preparations as practical record books. We may ponder over making students involve in highlighting the salient features of the genera/groups through digital media such as ppt and animations.

Keywords

Bacteria, Viruses, Algae, Cyanobacteria, algal reproduction, viroids, bacterial reproduction
Molecular Biology
(BHCC8)
Core Course - (CC) Credit:6

Course Objective(2-3)
To gain the knowledge of structure and functions of DNA and RNA

Course Learning Outcomes
Understanding of nucleic acid, organization of DNA in prokaryotes and Eukaryotes, DNA replication mechanism, genetic code and transcription process. Processing and modification of RNA and translation process, function and regulation of expression. Application in biotechnology

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, Fraenkel-Conrat’s experiment

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, Types of genetic material, denaturation and renaturation, cot curves; Organization of DNA- Prokaryotes, Viruses, Eukaryotes. RNA Structure_Organelle DNA -- mitochondria and chloroplast DNA. The Nucleosome_Chromatin structure- Euchromatin, Heterochromatin- Constitutive and Facultative heterochromatin.

Unit 3
The replication of DNA (10 lectures) Chemistry of DNA synthesis (Kornberg’s discovery); General principles – bidirectional, semiconservative and semi discontinuous replication, RNA
priming; Various models of DNA replication, including rolling circle, (theta) mode of replication, replication of linear ds-DNA, replication of the 5’end of linear chromosome; Enzymes involved in DNA replication.

Unit 4

Central dogma and genetic code (2 lectures) Key experiments establishing-The Central Dogma (Adaptor hypothesis and discovery of mRNA template), Genetic code (deciphering & salient features)

Unit 5

Mechanism of Transcription (10 lectures) Transcription in prokaryotes; Transcription in eukaryotes

Unit 6

Processing and modification of RNA (8 lectures) Split genes-concept of introns and exons, removal of introns, spliceosome machinery, splicing pathways, group I & group II intron splicing, alternative splicing eukaryotic mRNA processing (5’ cap, 3’ polyA tail); Ribozymes, exon shuffling; RNA editing and mRNA transport.

Unit 7: Translation (Prokaryotes and eukaryotes) (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.

Unit 8: Regulation of transcription in prokaryotes and eukaryotes (8 lectures)

Principles of transcriptional regulation; Prokaryotes: Regulation of lactose metabolism and tryptophan synthesis in E.coli. Eukaryotes: transcription factors, heat shock proteins, steroids and peptide hormones; Gene silencing.

Practical

1. Preparation of LB medium and raising E.Coli.

2. Isolation of genomic DNA from E.Coli.
3. DNA isolation from cauliflower head.

4. DNA estimation by diphenylamine reagent/UV Spectrophotometry.

5. Study of DNA replication mechanisms through photographs (Rolling circle, Theta replication and semi-discontinuous replication).

6. Study of structures of prokaryotic RNA polymerase and eukaryotic RNA polymerase II through photographs.

7. Photographs establishing nucleic acid as genetic material (Messelson and Stahl’s, Avery et al, Griffith’s, Hershey & Chase’s and Fraenkel & Conrat’s experiments)

8. Study of the following through photographs: Assembly of Spliceosome machinery; Splicing mechanism in group I & group II introns; Ribozyme and Alternative splicing.

References


Teaching Learning Process

Theory: The theory topics are covered in lectures with the help of PowerPoint presentations and the chalkboard. Students are encouraged to ask questions. The reading list has been suitably upgraded.
When the entire syllabus is completed, a few lectures are devoted to discuss the previous years’ question papers, thus preparing the students for the examination.

**Practicals:** Every practical session begins with detailed instructions, followed by students conducting the experiment/s. When all the students have collected the data, the observations are discussed. Any deviation from the expected trend in results is explained. The students are encouraged to graphically represent the data and record the experiment during class hours.

The students are asked to submit their record notebooks to the teacher/s for checking.

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**Assessment Methods**

**Theory:** The students are continuously evaluated based on a class test and the presentation given by each student. The answer scripts of the test are returned to the students and the test paper is discussed at length. Students who are absent for the test are allowed to appear for the test at a later date; the question paper is suitably modified for such students.

Each student in a class is given a different topic to prepare a PowerPoint presentation. All the remaining students listen to the presentation of each student, and peer students are also encouraged to ask questions. Presentations by students improves their reasoning and communication skills. The presentations of students are evaluated by the teacher based on the content, effectiveness of the presentation, whether any new information has been added, and lastly on the answers given by students to the questions posed by the teacher.

An assignment can be given in place of the presentation.

The Internal Assessment has a break-up as 10 marks for the test, 10 marks for the presentation/assignment and 5 marks for the attendance, and comprises 25% of the total marks.

**Practicals:** For continuous evaluation two tests are conducted; one on the table work experiments for 10 marks, and the other on setups for 10 marks. The total marks obtained is scaled down to 10. Ten marks are allotted for record notebooks, and 5 marks for attendance. The Internal Assessment for practicals comprises 50% of the total marks.

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**Keywords**

Nucleic acids, DNA, RNA, Genetic material, Nucleosome, DNA replication, Central dogma, genetic code, transcription, Splicing pathways, RNA editing, Ribosome, polypeptides
Course Objective(2-3)

1. To introduce students with various fungal groups and lichens, their ecology, classification, characteristics, reproduction and economic importance
2. To introduce students with the phytopathology, its concepts and principles
3. To acquaint with various plant diseases, causal organisms and their control

Course Learning Outcomes

Upon completion of this course, the students will be able to:

1. Understand the world of fungi, lichens and pathogens of plants
2. Appreciate the characteristics of the fungi and lichens
3. Understand the ecological and economic significance of lichen
4. Understand the application of mycology in various fields of economic and ecological significance
5. Understand the economic and pathological importance of fungi, bacteria and viruses
6. Identify common plant diseases and their control measures

Unit 1

Introduction to true fungi (6 lectures)

Definition, General characteristics; Affinities with plants and animals; Thallus organization; Cell wall composition; Heterokaryosis and parascxuality; Nutrition; Classification.
Unit 2
General account of Chytridiomycetes (1 lecture)

Unit 3
Zygomycota (4 lectures)
General characteristics; Ecology; Thallus organization; Life cycle with reference to *Rhizopus*.

Unit 4
Ascomycota (10 lectures)
General characteristics; Ecology; Life cycle, life cycle and classification with reference to *Saccharomyces, Penicillium, Alternaria* and *Neurospora* and *Peziza*.

Unit 5
Basidiomycota (8 lectures)
General characteristics; Ecology; Life cycle and Classification with reference to black stem rust on wheat *Puccinia* (Physiological Specialization), *Ustilago* (loose and covered smut, symptoms only), *Agaricus*; Bioluminescence, Fairy Rings and Mushroom Cultivation.

Unit 6
Mixomycota (Allied Fungi) (3 lectures)
General characterises; Status of Slime molds, Classification; Occurrence; Types of plasmodia; Types of fruiting bodies.

Unit 7: Oomycota (4 lectures)
General characteristic; Ecology; Life cycle and classification with reference to *Phytophthora, Albugo*.

Unit 8: Symbiotic associations (4 lectures)
Lichen – Occurrence; General characteristics; Growth forms and range of thallus organization; Economic importance of lichens. ; Mycorrhiza-Ectomycorrhiza, Endomycorrhiza and their significance.

Unit 9: Applied Mycology (10 Lectures)

Role of fungi in biotechnology, Application of fungi in food industry (Flavour & texture, Fermentation, Baking, Organic acids, Enzymes, Mycoproteins); Secondary metabolites; Mycotoxins; Biological control (Mycofungicides, Mycoherbicides, Mycoinsecticides, Myconematicides); Medical mycology.

Unit 10: Phytopathology (10 lectures)

Terms and concepts; General symptoms; Geographical distribution of diseases; Host-Pathogen relationships; disease cycle and environmental relation; Methods of control of plant diseases, and role of quarantine. Bacterial diseases – Citrus canker and angular leaf spot disease of Cotton. Viral diseases – Tobacco Mosaic viruses, vein clearing.

Practical

1. Introduction to the world of fungi (Unicellular, coenocytic/septate mycelium, asocarps & basidiocarps).

2. Rhizopus: study of asexual stage from temporary mounts and sexual structures through permanent slides.

3. Aspergillus and Penicillium: study of asexual stage from temporary mounts. Study of Sexual stage from permanent slides/photographs.

4. Peziza: sectioning through ascocarp.

5. Alternaria: Specimens/photographs and temporary mounts.

6. Puccinia: Herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves; sections/mounts of spores on wheat and permanent slides of both the hosts.

7. Agaricus: Specimens of button stage and full grown mushroom; sectioning of gills of Agaricus, fairy rings and bioluminescent mushrooms to be shown.

8. Study of phaneroplasmodium from actual specimens and/or photograph. Study of Stemonitis sporangia.

9. Albugo: Study of symptoms of plants infected with Albugo; asexual phase study through section/temporary mounts and sexual structures through permanent slides.
10. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose) on different substrates. Study of thallus and reproductive structures (soredia and apothecium) through permanent slides. Mycorrhizae: ectomycorrhiza and endomycorrhiza (Photographs)


References


Additional Resources:


Teaching Learning Process

1. The acquired knowledge in the classroom will be integrated with practical classes to impart a sound understanding of the course

2. Field visits to enhance the understanding about the ecology of fungi and lichens

3. More emphasis on physical specimens of fungi and lichens to better comprehend the morphology and other characteristics

4. Plants materials infested with diseases will be utilized for practical classes/ field visits may be planned
5. Students will be motivated to become self-directed learners by being able to monitor and adjust their approach to learning the course.

Assessment Methods

1. Continuous evaluation of the progress of students
2. Field based projects/reports  3. Interactive sessions/presentations
4. Semester end evaluation

Making of drawings as part of practical record books. We may ponder over making students involve in highlighting the salient features of the genera/groups through digital media such as ppt and animations.

Keywords

Fungi, Ascomycota, Puccinia, Agaricus, slime molds, symbiotic association, economic importance, Fungal disease, Bacterial disease, TMV

Course Objective (2-3)

1) The objective of the course is to give students new knowledge and widening of the knowledge acquired in other course by handling of classical and modern plant biotechnology processes, including tissue culture for healthy plants, plants with improved characteristics.

2) This course explores the use of biotechnology to both generate genetic variation in plants and to understand how factors at the cellular level contribute to the expression of genotypes and hence to phenotypic variation.
3) Understanding of biotechnological processes such as recombinant DNA technology and its applicative value in pharmaceuticals (vaccines, antibodies, antibiotics etc.), food industry (transgenic crops with improved qualities (nutraceuticals, industrial enzymes etc.), agriculture (biotic and abiotic stress tolerant plants, disease and pest resistant plants, improved horticultural varieties etc.), ecology (plants role in bioremediation). This knowledge is central to our ability to modify plant responses and properties for global food security and commercial gains in biotechnology and agriculture.

4) In the laboratory classes, students will perform some of the techniques currently used to generate information and detect genetic variation.

Course Learning Outcomes

The successful students will be able to:

Learn the basic concepts, principles and processes in plant biotechnology.

Have the ability of explanation of concepts, principles and usage of the acquired knowledge in biotechnological, pharmaceutical, medical, ecological and agricultural applications.

Use basic biotechnological techniques to explore molecular biology of plants

Explain how biotechnology is used to for plant improvement and discuss the biosefty concern and ethical issue of that use.

Unit 1

Plant Tissue Culture (12 lectures)

Historical perspective, Composition of media; Nutrient and hormone requirements (role of vitamins and hormones); Plasticity and Totipotency; Organogenesis; Embryogenesis (somatic and zygotic);

Unit 2

Protoplast isolation, culture and fusion; Tissue culture applications (micropropagation, androgenesis, virus elimination, secondary metabolite production, haploids, triploids and cybrids; Cryopreservation; Germplasm Conservation).
Unit 3

Recombinant DNA technology (32 lectures)

Restriction Endonucleases (History, Types I-IV, biological role and application); Restriction Mapping (Linear and Circular); Cloning Vectors: Prokaryotic (PUC 18 and pUJC19, pBR322, Ti plasmid, BAC); Lambda phage, MI 3 phagemid, Cosmid, Shuttle vector; Eukaryotic Vectors (YAC and briefly PAC).

Unit 4

Gene Cloning (Recombinant DNA, Bacterial Transformation and selection of recombinant clones, PCR and RT-PCR mediated gene cloning); Gene Construct; construction of genomic and cDNA libraries, screening DNA libraries to obtain gene of interest by genetic selection; complementation, colony hybridization; Probes-oligonucleotide, heterologous, PCR; Methods of gene transfer- Agrobacterium-mediated, Direct gene transfer by Electroporation, Microinjection, Microprojectile bombardment: Selection of transgenics— selectable marker and reporter genes (Luciferase, GUS, GFP).DNA fingerprinting by RAPD and RFLP;

Unit 5

Applications of Biotechnology (16 lectures)

Engineering plants to overcome abiotic (drought and salt stress) and biotic stress Pest resistant (Bt-cotton) and herbicide resistant plants (RoundUp Ready soybean); Transgenic crops with improved quality traits (FlavrSavr tomato, Golden rice); Improved horticultural varieties (Moondust carnations); Role of transgenics in bioremediation (Superbug)

Unit 6

Molecular farming (Plants as bioreactors) for edible vaccines, antibodies, polymers, biodegradable plastics (PHA), biomass utilization and industrial enzymes) (- amylase, phytase, lignocelluloses degrading enzymes); Biosafety concerns.

Practical

1. (a) Preparation of MS medium.

(b) Demonstration of in vitro sterilization and inoculation methods using leaf and nodal explants of tobacco, Datura, Brassica etc.
2. Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis & artificial seeds through photographs.

3. Isolation of protoplasts.

4. Construction of restriction map of circular and linear DNA from the data provided.

5. Study of methods of gene transfer through photographs: Agrobacterium-mediated, direct gene transfer by electroporation, microinjection, microprojectile bombardment.

6. Study of steps of genetic engineering for production of Bt cotton, Golden rice, FlavrSavr tomato through photographs.

7. Isolation of plasmid DNA.

8. Restriction digestion and gel electrophoresis of plasmid DNA (demonstration/photograph).

9. Calculate the percentage similarity between different cultivars of a species using RAPD profile. Construct a dendrogram and interpret results.

References


2. Glick, B.R., Pasternak, J.J. Molecular Biotechnology Ill unoplse and Applications ofl•ecombinant DNA. ASM Press, Washington.36


Teaching Learning Process

2) Problem oriented learning

3) Individual seminar
4) Presentation and interpretation to other students

5) Discussion of published research articles on the selected topics

6) Practical will introduce the students to a range of tools and techniques of biotechnology

Assessment Methods

Assessment must encourage and reinforce learning.

Assessment must enable robust and fair judgments about student performance.

Assessment practices must be fair and equitable to students and give them the opportunity to demonstrate what they have learned.

Assessment must maintain academic standards.

Assessment will be by written class test, assignment, project work, viva for internal assessment and written theory and practical examination for university evaluation.

Keywords

Tissue culture, micropropagation, organogenesis, totipotency, cryopreservation, recombinant DNA technology, Gene cloning, gene transfer, electroporation microinjection, DNA library, transgenic crops, Humulin, biosafety, edible vaccines,

Plant Metabolism
(BHCC13)
Core Course - (CC) Credit:6

Course Objective(2-3)

A comprehensive study of different pathways including their biochemistry and to some extent the molecular details.

Current understanding of regulation and integration of metabolic processes in plants with reference to crop productivity.
Significance of metabolic pathways for metabolic engineering in producing transgenics.

To gain the knowledge of physiological and biochemical processes in the plant system

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**Course Learning Outcomes**

Concept and significance of metabolic redundancy in plants.

Students will also be able to learn the similarity and differences in metabolic pathways in animals and plants.

To have understanding of water and nutrient uptake and movement in plants, role of mineral elements, translocation of sugars, Role of various plant growth regulators, phytochrome cytochromes and phototropins, and flowering stimulus.

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**Unit 1**

Concept in Metabolism (4 lectures)

Introduction, anabolic and catabolic pathways, Principles of thermodynamics, coupled reactions

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**Unit 2**

Enzymes (10 lectures)

Historical Background, structure, nomenclature and classification of enzymes, Mechanism of action (activation energy, lock and key, induced fit model), Michaelis Menten equation, enzyme inhibition (competitive, non-competitive and uncompetitive), factors affecting enzyme activity, role of regulatory enzymes, allosteric regulation and covalent modulation, isozymes and alloenzymes

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**Unit 3**

Carbon assimilation (14 lectures)

Historical background, concept of light-action and absorption spectra, photosynthetic pigments, role of photosynthetic pigments (chlorophyll and accessory pigments (no structural details), antenna molecules and reaction centres, photochemical reactions, photosynthetic electron transport, photophosphorylation, PSI, PSII, Q cycle, CO2 reduction, photorespiration, C4 pathways, Crassulacean acid metabolism, factors affecting CO2 reduction
Unit 4

Carbohydrate metabolism (2 lectures)

Metabolite pool and exchange of metabolites, synthesis and catabolism of sucrose and starch (no structural details)

Unit 5

Carbon Oxidation (10 lectures)

Historical Background of Glycolysis and Krebs cycle, Glycolysis, fate of pyruvate- aerobic and anaerobic respiration and fermentation, regulation of glycolysis, oxidative pentose phosphate pathway, oxidative decarboxylation of pyruvate, regulation of Krebs cycle, mitochondrial electron transport, oxidative phosphorylation, cyanide-resistant respiration, factors affecting respiration.

Unit 6

ATP synthesis (4 lectures)

Mechanism of ATP synthesis, substrate level phosphorylation, chemiosmotic mechanism (oxidative and photophosphorylation), ATP synthase, Boyer’s conformational model, Racker’s experiment, Jagendorf’s experiment, role of uncouplers, P/O ratio

Unit 7: Lipid Metabolism (8 lectures)

Synthesis and breakdown of triglycerides, -oxidation, glyoxylate cycle, gluconeogenesis and its role in mobilization of lipids during seed germination, -oxidation.

Unit 8: Nitrogen Metabolism (8 lectures)

Nitrate assimilation, biological nitrogen fixation (examples of legumes and non-legumes), Physiology and biochemistry of nitrogen fixation, Ammonia assimilation (GS-GOGAT), reductive amination and transamination.

Practical

1. To study the activity of urease enzyme and effect of substrate concentration and temperature on enzyme activity.

2. To study the activity of catalase enzyme and effect of heavy metal and pH on enzyme activity.
3. To study the activity of peroxidase and tryosinase and effect of inhibitor (phenylthiourea of tryosinase and sodium azide of peroxidase) on any one of the enzymes.

4. Chemical separation of photosynthetic pigments.

5. Experimental demonstration of Hill’s reaction.

6. To demonstrate and verify Blackman’s law of limiting factors.

7. To compare the rate of respiration in different parts of a plant (at least 3 parts).

8. To study activity of Nitrate reductase in leaves of two plant sources.

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.

12. Demonstration of respiratory quotient (RQ).

References


Teaching Learning Process

The experiments included in the paper are performed individually or in group and are followed by group discussions and interjections.

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The students are asked to submit their record notebooks to the teacher/s for checking.

Assessment Methods

Students are continuously assessed during practical class.

Submission of class records is mandatory. This exercise develops scientific skill as well as methods of recording and presenting scientific data.

Keywords

Bioenergetics, Coupled reactions, allosteric regulation, photochemical reaction, Glyoxylate cycle, Electron transport chain, ATP synthase, triglycerides, nitrogenase, Anabolism, catabolism, carbon assimilation, carbon oxidation, Lipid metabolism, nitrogen metabolism, signal transduction
Course Objective(2-3)

The course aims at making students realize how plants function, namely the importance of water, minerals, hormones, and light in plant growth and development; understand transport mechanisms and translocation in the phloem, and appreciate the commercial applications of plant physiology.

Course Learning Outcomes

The students are able to correlate morphology, anatomy, cell structure and biochemistry with plant functioning. The link between theory and practical syllabus is established, and the employability of youth would be enhanced. The youth can also begin small-scale enterprises.

Unit 1

Plant water relationship (10 lectures)


Unit 2

Mineral nutrition (8 lectures)

Essential and beneficial elements, macro- and micronutrients, methods of study and use of nutrient solutions (ash analysis, hydroponics, aeroponics), criteria for essentiality, mineral deficiency symptoms, roles of essential elements, chelating agents (including phytosiderophores).

Unit 3

Nutrient uptake (8 lectures)
Soil as a nutrient reservoir, transport of ions across cell membrane--passive absorption: simple (Fick’s law) and facilitated diffusion (carrier and channel proteins), active absorption, proton ATPase pump, electrochemical gradient, ion flux, uniport, co-transport (symport, antiport), role of mycorrhizae (in brief).

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**Unit 4**

Translocation in the phloem (6 lectures)

Experimental evidence in support of phloem as the site of sugar translocation, composition of phloem sap, aphid stylet technique, Pressure-Flow Model, phloem loading and unloading, source-sink relationship.

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**Unit 5**

Plant growth regulators (16 lectures)

Discovery, chemical nature (basic structure, precursor), bioassay, physiological roles and commercial applications of Auxins, Gibberellins, Cytokinins, Abscisic Acid, Ethylene; brief introduction: mechanism of action of auxins; Brassinosteroids and Jasmonic acid (brief introduction).

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**Unit 6**

Physiology of flowering (6 lectures)

Photoperiodism, concept of florigen, CO-FT Model for long-distance transport of flowering stimulus, ABC model of flowering (in brief), vernalization, seed dormancy (causes and methods to overcome dormancy).

**Unit 7:** Phytochrome (6 lectures)

Discovery, chemical nature, role of phytochrome in photomorphogenesis, low energy responses (LER) and high irradiance responses (HIR), mode of action.

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**Practical**

1. Determination of osmotic potential of plant cell sap by plasmolytic method.

2. Determination of water potential of given tissue (potato tuber) by weight method.

3. Determination of water potential of given tissue (potato tuber) by falling drop method.

5. Calculation of stomatal index and stomatal frequency from the two surfaces of leaves of a mesophyte and a xerophyte.

6. To calculate the area of an open stoma and percentage of leaf area open through stomata in a mesophyte and a xerophyte (any one surface).

7. To study the phenomenon of seed germination (effect of light and darkness).

8. To study the induction of amylase activity in germinating barley grains.

Demonstration experiments

1. To demonstrate suction due to transpiration.

2. Fruit ripening.

3. Rooting from cuttings.

4. Bolting experiment.

5. To demonstrate the delay of senescence by cytokinins

References


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Keywords

Movement of water, ascent of sap, transpiration, stomatal movements, mineral nutrients, active and passive transport, translocation, plant growth regulators, photoperiodism, photomorphogenesis

Plant Systematics
(BHCC10)
Core Course - (CC) Credit:6

Course Objective(2-3)
To gain the knowledge on the taxonomy, phylogeny of plants

Course Learning Outcomes
Understanding of systematics its importance in bioresource utilization and biodiversity management. Nomenclature pattern, Phylogeny, Classification systems of the plants.

Unit 1
Plant identification, Classification, Nomenclature, Biosystematics (2 lectures)

Unit 2
Identification (6 lectures)
Field inventory; Herbarium Techniques; Functions of Herbarium; Important herbaria and botanical gardens of the world and India; Virtual Herbarium; E-flora: Flora, Monographs, Journals; Keys: Single Access and Multi-access.

Unit 3
Systematics—an interdisciplinary science (6 lectures)

Evidence from palynology, cytology, phytochemistry [Alkaloids, Phenolics, Glucosides, terpenes and Semantides (in brief)] and molecular data (cp.DNA, mt-DNA, nuclear DNA, PCR amplification, sequence data analysis)

Unit 4

Taxonomic hierarchy (6 lectures)

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

Unit 5

Botanical nomenclature (10 lectures)

Principles and rules (ICN); Ranks and names; Typification, author citation, valid publication, rejection of names, principle of priority and its limitations; Names of hybrids and cultivated plants.

Unit 6

Systems of classification (10 lectures)

Major contributions of Theophrastus, Bauhin, Tournefort, Linnaeus, Adanson, de Candolle, Bessey, Hutchinson, Takhtajan and Cronquist; Classification systems of Benthan and Hooker (up to series) and Engler and Prantl (up to series); Brief references of Angiosperm Phylogeny Group (APG IV) classification.

Unit 7: Biometrics and numerical taxonomy (8 lectures)

Characters; Variations; OTUs, character weighing and coding; cluster analysis; Phenograms

Unit 8: Phylogeny of Angiosperms (12 lectures)

Terms and concepts (primitive and advanced, homology and analogy, parallelism and convergence, monophyly, Paraphyly, polyphyly and clades). Origin and evolution of angiosperms; Cladistics; methods of illustrating evolutionary relationships (phylogenetic tree, cladogram)
Practical

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

Ranunculaceae- *Ranunculus, Delphinium*

Brassicaceae- *Brassica, Alyssum/ Iberis*

Myrtaceae- *Eucalyptus, Callistemon*

Umbelliferae- *Coriandrum/ Anethum / Foeniculum*

Asteraceae- *Sonchus/ Launaea, Veronia/ Ageratum, Elipta/ Tridax*

Solanaceae- *Solanum nigrum/ Withania*

Lamiaceae- *Salvia/Ocimum*

Euphorbiaceae- *Euphorbia hirta/ E.milli, Jatropha*

Liliaceae- *Asphodelus/ Lilium/ Allium*

Poaceae- *Triticum/ Hordeum/ Avena*

Malvaceae- *Abutilon/ Hibiscus/ sida*

Caryophyllaceae- *Stellaria/ Dianthus*

Apocyanaceae- *Vinca rosea*

Asclepidiaceae- *Calotropis procera*

Moraceae- *Morus alba*

Chenopodiaceae- *Chenopodium alba*

Cannaceae- *Canna indica*

Ten families should be selected out of the given list of seventeen families representing the following

Class/ Subclass as mentioned below:

Polypetalae- Any 3 families
Gamopetalae- Any 3 families

Monochlamydeae- Any 2 families

Monocotyledons- Any 2 families

1. Field visit (local)- Subject to grant funds from the University

1. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book).

References


Additional Resources:


Teaching Learning Process

Field visits to the forested areas and on the spot Plant identification feature would be very helpful. Visual media should be made available. It is suggested that Botany Department, University of Delhi may be entrusted with preparation of good visual aids that would help students get a feel of the subject and they find the subject interesting. Even the college teachers can form a group and work out these possibilities of visual aids that would enhance teaching learning process.

Assessment Methods

Making drawings from the live specimens should compulsory part of practical record books. We may ponder over making students involve in highlighting the salient features of the genera/groups through digital media such as ppt and animations.
Keywords

Plant Taxonomy, plant classification, Flora, plant nomenclature, phylogeny, cladogram

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Reproductive Biology of Angiosperms
(BHCC11)
Core Course - (CC) Credit:6

Course Objective (2-3)

To have knowledge of the flowering and fruiting, reproduction process, role of pollinators, ovule and seed development.

Course Learning Outcomes

Student would have an understanding of

1. Induction of flowering and molecular and genetic aspects of flower development.
2. Pollen development, dispersal and pollination
3. Ovule development and fertilization,
4. Endosperm development and its importance
5. alternation pathways of reproduction

Student would be able to apply this knowledge for conservation of pollinators and fruit development

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Unit 1

Introduction (2 lectures)


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Unit 2
Anther (4 lectures)

Anther wall: Structure and functions, microsporogenesis, callose deposition and its significance.

Unit 3

Pollen biology (8 lectures)

Micro-gametogenesis; Pollen wall structure, MGU (male germ unit) structure, NPC system (no details but table to be included); Palynology and scope (a brief account); Pollen wall proteins; Pollen viability, storage and germination; Unique features: Pseudomonads, polyads, massulae, pollinia.

Unit 4

Ovule (8 lectures)

Structure; Types; Special structures–endothelium, obturator, aril, caruncle and hypostase; Female gametophyte– megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis (details of Polygonum type); Organization and ultrastructure of mature embryo sac; Female germ

Unit 5

Pollination and fertilization (6 lectures)

Pollination types and significance; adaptations; structure of stigma and style; path of pollen tube in pistil; structure of pollen tube; double fertilization.

Unit 6

Self incompatibility (8 lectures)

Basic concepts (interspecific, intraspecific, homomorphic, heteromorphic, GSI and SSI); Methods to overcome self- incompatibility: mixed pollination, bud pollination, stub pollination; Intraovarian and in vitro pollination; Modification of stigma surface, parasexual hybridization; Cybrids( in brief with examples) , in vitro fertilization.

Unit 7: Endosperm (4 lectures)

Types ( 2 examples each), development, structure and functions.
Unit 8: Embryo (6 lectures)

Six types of Embryogeny (no details); General pattern of development of dicot and monocot embryo; Suspensor: structure and functions; Embryo-endosperm relationship; Nutrition of embryo; Unusual features; Embryo development in Paeonia.

Unit 9: Seed (4 lectures)

Structure, importance and dispersal mechanisms (Adaptations – Autochory, Anemochory, Hydrochory, Zoochory with 2 examples each).

Units 10: Polyembryony and apomixes (6 lectures)

Introduction; Classification (given by Bhojwani and Bhatnagar); Causes and applications.

Unit 11: Germline transformation (4 lectures)

Pollen grain and ovules through pollen tube pathway method

Practical

1. Anther: Wall and its ontogeny; Tapetum (amoeboid and glandular); MMC, spore tetrads, uninucleate, bicelled and dehisced anther stages through slides/micrographs, male germ unit (MGU) through photographs and schematic representation.

2. Pollen grains: Fresh pollen showing ornamentation and aperture, psuedomonads, polyads, pollinia (slides/photographs,fresh material), ultrastructure of pollen wall(micrograph); Pollen viability: Tetrazolium test. germination: Calculation of percentage germination in differen media using hanging drop method.

3. Ovule: Types-anatropous, orthotropous, amphitropous/campylotropous, cirrinotropous, unitegmic, bitegmic; Tenuinucellate and crassinucellate; Special structures: Endothelium, obturator, hypostase, caruncle and aril (permanent slides/specimens/photographs).

4. Female gametophyte through permanent slides/photographs: Types, ultrastructure of mature egg apparatus.

5. Intra-ovarian pollination; Test tube pollination through photographs.

6. Endosperm: Dissections of developing seeds for endosperm with free-nuclear haustoria.

7. Embryogenesis: Study of development of dicot embryo through permanent slides; dissection of developing seeds for embryos at various developmental stages; Study of suspensor through electron micrographs.
8. Seed dispersal mechanisms (adaptations through photographs / specimens)

9. Fluorescent Microscopes can be purchased for the colleges.

(a) Study of pollen cytology to see 2-celled and 3-celled pollen grains.
(b) To perform pollen culture or anther culture.
(c) To isolate protoplast from pollen grains.
(d) To study pollen-pistil interactions (fluorescent microscopes).

References


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Keywords

flowering development, anther, plooen biology, ovule, gametogenesis, Pollination, fertilization, self -incompatibility, endosperm, seed, apomixix, polyembryony

Analytical Techniques in Plant Sciences
(BHDS1)

Discipline Specific Elective - (DSE) Credit:6

Course Objective(2-3)

To gain the knowledge on various techniques and instruments used for the study of plant biology.
Course Learning Outcomes

Understanding of principles and use of light, confocal transmission and electron microscopy, centrifugation, spectrophotometry, chromatography, x-ray diffraction technique and chromatography techniques

Unit 1

Imaging and related techniques (15 lectures)

Principles of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy; Use of fluorochromes: (a) Flow cytometry (FACS); (b) Applications of fluorescence microscopy: Chromosome banding, FISH, chromosome painting; Transmission and Scanning electron microscopy – sample preparation for electron microscopy, cryofixation, negative staining, shadow casting, freeze fracture, freeze etching.

Unit 2

Cell fractionation (8 lectures)

Centrifugation: Differential and density gradient centrifugation, sucrose density gradient, CaCl2 gradient, analytical centrifugation, ultracentrifugation, marker enzymes.

Unit 3

Radioisotopes (4 lectures)

Use in biological research, auto-radiography, pulse chase experiment.

Unit 4

Spectrophotometry (4 lectures)

Principle and its application in biological research.

Unit 5

Chromatography (8 lectures)
Principle; Paper chromatography; Column chromatography, TLC, GLC, HPLC, Ion-exchange chromatography; Molecular sieve chromatography; Affinity chromatography.

Unit 6

Characterization of proteins and nucleic acids (6 lectures)

Mass spectrometry; X-ray diffraction; X-ray crystallography; Characterization of proteins and nucleic acids; Electrophoresis: AGE, PAGE, SDS-PAGE

Practical

1. Study of Blotting techniques: Southern, Northern and Western, DNA fingerprinting, DNA sequencing, PCR through photographs.

2. Demonstration of ELISA.

3. To separate nitrogenous bases by paper chromatography.

4. To separate sugars by thin layer chromatography.

5. Isolation of chloroplasts by differential centrifugation.

6. To separate chloroplast pigments by column chromatography.

7. To estimate protein concentration through Lowry’s methods.

8. To separate proteins using PAGE.

9. To separation DNA (marker) using AGE.

10. Study of different microscopic techniques using photographs/micrographs (freeze fracture, freeze etching, negative staining, positive staining, fluorescence and FISH).

11. Preparation of permanent slides (double staining).

References


2. Ruzin, S.E. (1999). Plant Microtechnique and Microscopy, Oxford University
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**Keywords**

Microscopy, Flow cytometry, Chromosome banding, FISH, SCM, Centrifugation, radioisotopes, spectrophotometry, chromatography, electrophoresis, PAGE, mass spectrometry

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**Bioinformatics**

**(BHDS4)**

**Discipline Specific Elective - (DSE) Credit:6**

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**Course Objective(2-3)**

A computer-based approach is now central to biological research. Bioinformatics operates at the intersection of biology and informatics and has a strong mathematical component. Training students in various aspects of Bioinformatics is the objective of this course.

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**Course Learning Outcomes**

With a working knowledge of the practical and theoretical concepts of bioinformatics, you will be well qualified to progress onto advanced graduate study. The portfolio of skills developed on the programme is also suited to academic research or work within the bioinformatics industry as well as range of commercial settings.

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**Unit 1**

**Introduction to Bioinformatics (10 lectures)**

Unit 2

Biological databases (5 lectures)

Introduction to biological databases - primary, secondary and composite databases, NCBI, nucleic acid databases (GenBank, EMBL, DDBJ, NDB), protein databases (PIR, Swiss-Prot, TrEMBL, PDB), metabolic pathway database (KEGG, EcoCyc, and MetaCyc), small molecule databases (PubChem, Drug Bank, ZINC, CSD). Structure viewers (Ras Mol, J mol).

Unit 3

Data Generation and Data Retrieval (5 lectures)

Generation of data (Gene sequencing, Protein sequencing, Mass spectrometry, Microarray), Sequence submission tools (BankIt, Sequin, Webin); Sequence file format (flat file, FASTA, GCG, EMBL, Clustal, Phylip, Swiss-Prot); Sequence annotation; Data retrieval systems (SRS, Entrez)

Unit 4

Basic concepts of Sequence alignment (10 lectures)

Similarity, identity and homology. Alignment – local and global alignment, pairwise and multiple sequence alignments, alignment algorithms. Methods of Alignment (Dot matrix, Dynamic Programming, BLAST and FASTA); Scoring Matrices/ Amino acid substitution matrices (PAM and BLOSUM), and CLUSTALW.

Unit 5

Phylogenetic analysis (10 lectures)

Construction of phylogenetic tree, dendrograms, methods of construction of phylogenetic trees - maximum parsimony, maximum likelihood and distance methods.

Unit 6

Applications of Bioinformatics (20 lectures)

Functional genomics (genome-wide and high throughput approaches to gene and protein function), Protein structure prediction and analysis- Levels of protein structure, gene prediction methods and tools. Structural Bioinformatics in Drug Discovery, Quantitative structure-activity
relationship (QSAR) techniques in Drug Design, Microbial genome applications, Crop improvement.

**Practical**

1. Sequence retrieval (protein and gene) from NCBI.
2. Structure download (protein and DNA) from PDB.
3. Molecular file formats - FASTA, GenBank, Genpept, GCG, CLUSTAL, Swiss-Prot, FIR.
4. Molecular viewer by visualization software.
5. Translate a nucleotide sequence and select the correct reading frame of the polypeptide from the output sequences.
6. Predict the structure of protein from its amino acid sequence.
7. BLAST suite of tools for pairwise alignment.
8. Sequence homology and Gene annotation.
10. Generating phylogenetic tree using PHYLIP.
11. Gene prediction using GENSCAN and GLIMMER.

**References**


**Additional Resources:**


Teaching Learning Process

Multimedia tutorials and hands on training over biological data using world wide web services.

Interactive classroom teaching of mathematical modelings and Computer programs.

Assessment Methods

Theoretical tests with the help of assignments, project works, presentations, and through practical examinations.

Keywords

Biological Databases, Sequence Alignment, Phylogenetics Analysis, Protein Structure prediction and analysis.

Biostatistics (BHDS2)

Discipline Specific Elective - (DSE) Credit:6

Course Objective(2-3)

To have knowledge of analysis of scientific data

Course Learning Outcomes

Understanding of interpreting the scientific data that is generated during scientific experiments. It is the responsibility of biostatisticians and other experts to consider the variables in subjects to understand them, and to make sense of different sources of variation. In essence, the goal of biostatistics is to disentangle the data received and make valid inferences that can be used to solve problems in public health. Biostatistics uses the application of statistical methods to
conduct research in the areas of biology, public health, and medicine. Many times, experts in biostatistics collaborate with other scientists and researchers.

Unit 1

Biostatistics - definition - statistical methods - basic principles. Variables - measurements, functions, limitations and uses of statistics. (8 lectures)

Unit 2

Collection of data primary and secondary - types and methods of data collection procedures - merits and demerits. Classification - tabulation and presentation of data – sampling methods. (12 lectures)

Unit 3

Measures of central tendency - mean, median, mode, merits & demerits of harmonic and geometric mean - . Measures of dispersion - range, standard deviation, mean deviation, standard error, skewness and kurtosis, quartile deviation – merits and demerits; Co- efficient of variations. (13 lectures)

Unit 4

Correlation - types and methods of correlation, regression, simple regression equation, fitting prediction, similarities and dissimilarities of correlation and regression.

(10 lectures)

Unit 5

Statistical inference - hypothesis - simple hypothesis - student ‘t’ test - chi square test, Ftest.

(10 lectures)

Unit 6

Basic concept of probability, Introduction to binomial, poisson and Normal distribution; Uses of advance softwares (MS-excel, SPSS, Sigmaplot and R) in modern biostatistics. (6 Lectures)
Practical
1) Classification - tabulation and presentation of data
2) Calculation of mean, mode, median, standard deviation, quartile deviation, standard error and coefficient of variance
3) Calculation of correlation coefficient values by Karl Pearson’s and Spearman Rank methods
4) Statistical inference - hypothesis – student ‘t’ test - chi square test
5) Addition and multiple rules of probability
6) One way analysis of variance
7) Uses of software in biostatistics

References
5. The Principles of scientific research, Freedman, P. New York, Pergamon Press.

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**Keywords**

Biological database, Sequence database, ,NCBI, Sequence alignment, molecular Phylogeny QSAR, crop improvement ,
Course Objective(2-3)

i) To introduce students with the industrial microbiology: concepts, principles, scope and application
ii) To introduce students with the environmental microbiology: concepts, principles, scope and application

Course Learning Outcomes

Upon successful completion of the course, students are expected to be able to:

• Understand how microbiology is applied in manufacturing of industrial products
• Know about design of bioreactors, factors affecting growth and production
• Understand the rationale in medium formulation & design for microbial fermentation, sterilization of medium and air
• Comprehend the different types of fermentation processes
• Comprehend the techniques and the underlying principles in upstream and down-stream processing
• Learn the occurrence, abundance and distribution of microorganism in the environment and their role in the environment and also learn different methods for their detection
• Understand various biogeochemical cycles – Carbon and Nitrogen, and microbes involved
• Understand the basic principles of environment microbiology and application of the same in solving environmental problems – waste water treatment and bioremediation
• Comprehend the various methods to determine the quality of water

Unit 1

Scope of microbes in industry and environment (4 lectures)
Unit 2

**Bioreactors/Fermenters and fermentation processes (12 lectures)**

Solid-state and liquid-state (stationary and submerged) fermentations; Batch and continuous Fermentations; Components of a typical bioreactor, Types of bioreactors: laboratory, pilotscale and production fermenters; Constantly stirred tank fermenter, tower fermenter, fixed bed and fluidized bed bioreactors and air-lift fermenter.

Unit 3

**Microbial production of industrial products (14 lectures)**

Microorganisms involved, microorganisms generally regarded as safe (GRAS), media, fermentation conditions, downstream processing and uses; Filtration, centrifugation, cell disruption, solvent extraction, precipitation and ultrafiltration, lyophilization, spray drying; production of industrially important products: enzyme (amylase); organic acid (citric acid); alcohol (ethanol); antibiotic (penicillin)

Unit 4

**Microbial enzymes of industrial interest and enzyme immobilization (8 lectures)**

Overview of enzymes used for industrial applications, Methods of immobilization, advantages and applications of immobilization, large scale applications of immobilized enzymes: glucose isomerase and penicillin acylase.

Unit 5

**Microbes and quality of environment. (6 lectures)**

Distribution of microbes in air, soil and water; isolation of microorganisms from soil, air and water.

Unit 6

**Microbial flora of water. (10 lectures)**
Water pollution: various sources and control measures; role of microbes in sewage and domestic waste water treatment systems. Microorganisms as indicators of water quality: coliforms and fecal coliforms.

Practical

1. Principles and functioning of instruments in microbiology laboratory (autoclave, laminar air flow, incubators, types of fermenters)

2. Preparation of different culture media (Nutrient medium/ Luria Bertani medium/Potato dextrose medium/Czapek Dox medium)

3. Hydrolysis of casein / starch by microorganisms

4. Alcohol production by yeast using sugar/ jaggery

5. Serial dilution method for isolation of microorganisms from water and soil and study of aeromicroflora.

6. Determination of BOD, COD, TDS and TOC of water samples

7. Determination of coliforms in water samples using eosin methylene blue (EMB) medium

8. A visit to any educational institute/ industry to see an industrial fermenter, and other downstream processing operations and a report to be submitted.

References


3. Principles of Fermentation Technology by Peter F Stanbury, Allan Whitaker, Stephen J Hall

4. Industrial Microbiology by AH Patel

5. Textbook of Environmental Microbiology by PK Mohapatra

Additional Resources:

1. Industrial Microbiology by LE Cassida
2. Microbial Ecology by Atlas and Bartha
3. Environmental Microbiology by PD Sharma

Teaching Learning Process

i) The acquired knowledge in the classroom will be integrated with practical classes to impart a sound understanding of the course

ii) More emphasis on hands on practical sessions

iii) Visits to various research institutes/industries to understand the application of microbes for commercial productions.

iv) Visits to industries/ research institutions working towards mitigation of various environmental issues through microbial application.

v) Students will be motivated to become self-directed learners by being able to monitor and adjust their approach towards learning of the course.

Assessment Methods

i. Continuous evaluation of the progress of students

ii. Field based projects/reports

iii. Interactive sessions/ presentations

iv. Semester end evaluation
Keywords

Industrial microbiology, environmental microbiology, microbes, bioreactors, fermenters, fermentation, upstream processing, downstream processing, microbial enzymes, enzyme immobilization, aeromicroflora, water pollution, coliform, biological fixation, bioremediation

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**Plant Breeding**
(BHDS8)
**Discipline Specific Elective - (DSE) Credit:6**

**Course Objective (2-3)**

To gain the knowledge on plant reproduction, breeding system, heterosis, superior characters of commercially important plants and crop improvement

**Course Learning Outcomes**

Student would be able to understand the bringing of improvement characters through artificial pollination. The would know the methods the inheritance of characters in the progeny

**Unit 1**

**Plant Breeding (10 lectures)**


**Unit 2**

**Methods of crop improvement (20 lectures)**

Introduction: Centres of origin and domestication of crop plants, plant genetic resources; Acclimatization; Selection methods: For self pollinated, cross pollinated and vegetatively propagated plants; Hybridization: For self, cross and vegetatively propagated plants – Procedure, advantages and limitations.
Unit 3

Quantitative inheritance (10 lectures)

Concept, mechanism, examples of inheritance of Kernel colour in wheat, Skin colour in human beings. Monogenic vs polygenic Inheritance.

Unit 4

Inbreeding depression and heterosis (10 lectures)

History, genetic basis of inbreeding depression and heterosis; Applications.

Unit 5

Crop improvement and breeding (10 lectures)

Role of mutations; Polyploidy; Distant hybridization and role of biotechnology in crop improvement.

Unit 6

Practical

1. Study of flowers with respect to stamens and gynoecium
2. Study of pollen -ornamentation, viability, counting
3. Study of pollinators
4. study of quantitative and qualitative characters of seeds of crops and fruits
5. Emasculation and bagging experiments.

References


Additional Resources:

Teaching Learning Process

The theory topics are covered in lectures with the help of PowerPoint presentations and the chalkboard. Students are encouraged to ask questions. The reading list has been suitably upgraded.

When the entire syllabus is completed, a few lectures are devoted to discuss the previous years’ question papers, thus preparing the students for the examination.

Assessment Methods

The students are continuously evaluated based on a class test and the presentation given by each student. The answer scripts of the test are returned to the students and the test paper is discussed at length. Students who are absent for the test are allowed to appear for the test at a later date; the question paper is suitably modified for such students.

Each student in a class is given a different topic to prepare a PowerPoint presentation. All the remaining students listen to the presentation of each student, and peer students are also encouraged to ask questions. Presentations by students improves their reasoning and communication skills. The presentations of students are evaluated by the teacher based on the content, effectiveness of the presentation, whether any new information has been added, and lastly on the answers given by students to the questions posed by the teacher.

An assignment can be given in place of the presentation.

The Internal Assessment has a break-up as 10 marks for the test, 10 marks for the presentation/assignment and 5 marks for the attendance, and comprises 25% of the total marks.

Keywords

breeding system, reproduction, pollination, domestication of plants, genetic resources, hybridization, inheritance, inbreeding depression, crop improvement
Biofertilizers
(BHSE3)
Skill-Enhancement Elective Course - (SEC) Credit:4

Course Objective(2-3)

To gain the knowledge on the following aspects
1. Eco-friendly fertilizers like Rhizobium, Azospirilium Azotobactor, cyanobacteria and mycorrhizae, their identification, growth multiplication
2. Organic farming and recycling of the organic waste

Course Learning Outcomes

The student would have a deep understanding of ecofriendly fertilizers. They will be able to understand the growth and multiplication conditions of useful microbes such as Rhizobium, cyanobacteria, mycorrhizae, Azotobactor etc, their role in mineral cycling and nutrition to plants. The can also think of the methods of decomposition of biodegradable waste and convert into the compost

Unit 1

General account about the microbes used as biofertilizer – Rhizobium – isolation, identification, mass multiplication, carrier based inoculants, Actinorrhizal symbiosis. (4 lectures)

Unit 2

Azospirillum: isolation and mass multiplication – carrier based inoculant, associative effect of different microorganisms. Azotobacter: classification, characteristics – crop response to Azotobacter inoculum, maintenance and mass multiplication. (8 lectures)

Unit 3

Cyanobacteria (blue green algae), Azolla and Anabaena azollae association, nitrogen fixation, factors affecting growth, blue green algae and Azolla in rice cultivation. (4 lectures)

Unit 4

Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield – colonization of VAM – isolation
and inoculum production of VAM, and its influence on growth and yield of crop plants. (8 lectures)

Unit 5

Organic farming – Green manuring and organic fertilizers, Recycling of biodegradable municipal, agricultural and Industrial wastes – biocompost making methods, types and method of vermicomposting – field Application. (6 lectures)

Unit 6

Practical

Isolation of *Anabaena* from *Azolla* leaf

Study of Rhizobium from root nodules of leguminous plants by Gram staining method

Test for pH, No2, SO4, Cl and organic matter of different composts

Observation of mycorrhizae from roots

isolation of arbuscular mycorrhizal spores from rhizospheric soil

Spots

Specimen /photographs of earthworm, azolla, arbuscules . vesicles

Biocontrol photographs -pheromons trap,Trichoderma,. Pseudomonas,. Neem etc,. Identification and application

Photographs of biocompost methods,

Projects on any topic mentioned in the syllabus, with Rhizobium technology, , AMF technology, Organicfarming, vermicomposting, , biocompost , *Azolla* culture

References


Teaching Learning Process

Theory: The theory topics are covered in lectures with the help of PowerPoint presentations and the chalkboard. Students are encouraged to ask questions. The reading list has been suitably upgraded.

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Practicals: Every practical session begins with detailed instructions, followed by students conducting the experiment/s. When all the students have collected the data, the observations are discussed. Any deviation from the expected trend in results is explained. The students are encouraged to graphically represent the data and record the experiment during class hours.

The students are asked to submit their record notebooks to the teacher/s for checking.

Assessment Methods

Theory: The students are continuously evaluated based on a class test and the presentation given by each student. The answer scripts of the test are returned to the students and the test paper is discussed at length. Students who are absent for the test are allowed to appear for the test at a later date; the question paper is suitably modified for such students.

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An assignment can be given in place of the presentation.

The Internal Assessment has a break-up as 10 marks for the test, 10 marks for the presentation/assignment and 5 marks for the attendance, and comprises 25% of the total marks.

Practicals: For continuous evaluation two tests are conducted; one on the table work experiments for 10 marks, and the other on setups for 10 marks. The total marks obtained is scaled down to 10. Ten marks are allotted for record notebooks, and 5 marks for attendance. The Internal Assessment for practicals comprises 50% of the total marks.

Keywords

Rhizobium, Azotobacter, inoculum, cyanobacteria, nitrogen fixation, Azolla, VAM, mycorrhizae

Ethnobotany
(BHSE1)
Skill-Enhancement Elective Course - (SEC) Credit:4

Course Objective(2-3)

To have the knowledge of the plants used by the local communities, tribals, ethenic groups, their nutritive and medicinal value.

Course Learning Outcomes

Students would have an understanding of the treasure, value and usefulness of the the natural products and their efficient use by the local communities as food and medicine and their conservation practices.

Unit 1

Ethnobotany (6Lectures)
Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science. The relevance of ethnobotany in the present context; Major and minor ethnic groups or Tribals of India, and their life styles. Plants used by the tribals: a) Food plants b) Intoxicants and beverages c) Resins and oils and miscellaneous uses.

Unit 2

Methodology of Ethnobotanical studies (6 lectures)

a) Field work b) Herbarium c) Ancient Literature d) Archaeological findings e) temples and sacred places.

Unit 3

Role of ethnobotany in modern Medicine (10 lectures) Medicoethnobotanical sources in India; Significance of the following plants in ethnobotanical practices (along with their habitat and morphology) a) Azadiractha indica b) Ocimum sanctum c) Vitex negundo d) Gloriosa superba e) Tribulus terrestris f) Pongamia pinnata g) Cassia auriculata h) Indigofera tinctoria.

Unit 4

Role of ethnobotany in modern medicine with special example of Rauvolfia sepentina, Trichopus zeylanicus, Artemisia, Withania. Role of ethnic groups in conservation of plant genetic resources. Endangered taxa and forest management (participatory forest management).

Unit 5

Ethnobotany and legal aspects (8 lectures) Ethnobotany as a tool to protect interests of ethnic groups. Sharing of wealth concept with few examples from India. Biopiracy,

Unit 6

Intellectual Property Rights and Traditional Knowledge.

Practical

Collection, identification and preparation of herbarium of three ethnobotanically important plants with appropriate references.
Preparation of crude extract of ethnobotanically important plants with appropriate references (any method to be used)
Project work-documentation, literature survey, and collection of information on ethnobotanically useful plants from traditional healers

References


3) Lone et al., Palaeoethnobotany


Teaching Learning Process

To engage students and transform them into active learners the students are updated with latest books and review articles.

The experiments included in the paper are performed individually or in group and are followed by group discussions and interjections

Assessment Methods
The students are assessed on the basis of oral presentations and regular class tests.

Students are continuously assessed during practical class.

Submission of class records is mandatory. This exercise develops scientific skill as well as methods of recording and presenting scientific data.

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Keywords

Tribals, minor forest products, intoxicants, beverages, Resins, Field work, Herbarium, sacred groves, ethnobotanical practices, Azadiractha indica, Ocimum sanctum, Vitex negundo. Gloriosa superba, Indigofera tinctoria, ethnomedicines, conservation, Traditional Knowledge.

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**Floriculture (BHSE5)**

Skill-Enhancement Elective Course - (SEC) Credit: 4

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Course Objective (2-3)

To have knowledge of gardening and cultivation of ornamental plants and knowledge of landscaping, soil condition.

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Course Learning Outcomes

Students would be able to identify the ornamental plants. They will have an understanding of cultivation methods, landscaping, and making the flower arrangement.

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Unit 1

Introduction: History of gardening; Importance and scope of floriculture and landscape gardening. (2 Lectures)

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Unit 2
Nursery Management and Routine Garden Operations: Sexual and vegetative methods of propagation; Soil sterilization; Seed sowing; Pricking; Planting and transplanting; Shading; Stopping or pinching; Defoliation; Wintering; Mulching; Topiary; Role of plant growth regulators. (8 lectures)

Unit 3

Ornamental Plants: Flowering annuals; Herbaceous perennials; Divine vines; Shade and ornamental trees; Ornamental bulbous and foliage plants; Cacti and succulents; Palms and Cycads; Ferns and Selaginellas; Cultivation of plants in pots; Indoor gardening; Bonsai. (4 lectures)

Unit 4

Principles of Garden Designs: English, Italian, French, Persian, Mughal and Japanese gardens; Features of a garden (Garden wall, Fencing, Steps, Hedge, Edging, Lawn, Flower beds, Shrubbery, Borders, Water garden. Some Famous gardens of India. (4 lectures)

Unit 5

Landscaping Places of Public Importance: Landscaping highways and Educational institutions. (4 lectures)

Unit 6

Commercial Floriculture: Factors affecting flower production; Production and packaging of cut flowers; Flower arrangements; Methods to prolong vase life; Cultivation of Important cut flowers (Carnation, Aster, Chrysanthemum, Dahlia, Gerbera, Gladiolous, Marigold, Rose, Lilium, Orchids). (6 lectures)

Unit 7: Diseases and Pests of Ornamental Plants. (2 lectures)

Practical

Study of flower with reference to stamens and gynoecium

Study of Soil sterilization process

Seed sowing and transplantation methods

Garden designing and hedge preparation methods
patterns of flower arrangement in vase

study of disease and pastes of ornamental plants

References


Teaching Learning Process

The topics are covered in lectures with the help of PowerPoint presentations and the chalkboard. Students are encouraged to ask questions. The reading list has been suitably upgraded. When the entire syllabus is completed, a few lectures are devoted to discuss the previous years’ question papers, thus preparing the students for the examination.

Assessment Methods

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Keywords

Propagation methods, Gardening, transplantation, saplings, Ornamental, cacti, succulents, hedge, fencing lawns, grass, orchids
Course Objective (2-3)

To have knowledge of roles regulations, laws and processes of patents, copyright trade marks and concepts of traditional knowledge and protection of plant varieties.

Course Learning Outcomes

Students would have deep understanding of patents copyrights, their importance. Thy can think about the importance of traditional knowledge, bio-prospecting, biopiracy. They would gain the knowledge of farmers rights and the importance on indigenous plant varieties, concept of novelty and biotechnological inventions.

Unit 1

Introduction to intellectual property right (IPR) (2 lectures)

Concept and kinds. Economic importance. IPR in India and world: Genesis and scope, some important examples. IPR and WTO (TRIPS, WIPO).

Unit 2


Unit 3

Copyrights (3 Lectures) Introduction, Works protected under copyright law, Rights, Transfer of Copyright, Infringement

Unit 4

Trademarks (3 Lectures) Objectives, Types, Rights, Protection of goodwill, Infringement, Passing off, Defences, Domain name
Unit 5

Geographical Indications (3 Lectures) Objectives, Justification, International Position, Multilateral Treaties, National Level, Indian Position

Unit 6

Protection of Traditional Knowledge (4 Lectures)

Objective, Concept of Traditional Knowledge, Holders, Issues concerning, Bio-Prospecting and Bio-Piracy, Alternative ways, Protectability, need for a Sui-Generis regime, Traditional Knowledge on the International Arena, at WTO, at National level, Traditional Knowledge Digital Library.

Unit 7: Industrial Designs (2 Lectures) Objectives, Rights, Assignments, Infringements, Defences of Design Infringement


Unit 10: Biotechnology and Intellectual Property Rights. (4 Lectures) Patenting Biotech Inventions

Practical

Patent search

Trademark search

copyright infringement (Plagiorism check by Urkund and other available software,

Geographical Indicators (i) food- Malabar pepper, Basmati rice, Darjeeling Tea, and Requefort cheese, handlooms, (Kota Doria, Banarasi Sari, Muga Silk, Kanchipuram). II- Industry (Mysore agarbatti, Feni Goa, Champagne, (France). IV. Natural resources- (Makrana marbles

Two example of each category
Biopiracy – neem, turmeric

Industrial designs- Jewellery design, chair design, car design, Bottle design, Aircraft design,

IPR e diary

References


Additional Resources:


Teaching Learning Process

Theory: The theory topics are covered in lectures with the help of PowerPoint presentations and the chalkboard. Students are encouraged to ask questions. The reading list has been suitably upgraded.

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Practicals: Every practical session begins with detailed instructions, followed by students conducting the experiment/s. When all the students have collected the data, the observations are discussed. Any deviation from the expected trend in results is explained. The students are encouraged to graphically represent the data and record the experiment during class hours.

Assessment Methods

Theory: The students are continuously evaluated based on a class test and the presentation given by each student. The answer scripts of the test are returned to the students and the test paper is discussed at length. Students who are absent for the test are allowed to appear for the test at a later date; the question paper is suitably modified for such students.
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**Practicals:** For continuous evaluation two tests are conducted; one on the table work experiments for 10 marks, and the other on setups for 10 marks. The total marks obtained is scaled down to 10. Ten marks are allotted for record notebooks, and 5 marks for attendance. The Internal Assessment for practicals comprises 50% of the total marks.

**Keywords**

Patents, IPR, Copyrights, trademarks, geographical indicators, traditional knowledge, industrial design, plant varieties, novelty, biotechnology

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**Medicinal Botany**  
(BHSE4)  
**Skill-Enhancement Elective Course - (SEC)** Credit:4

**Course Objective (2-3)**

To introduce students to complementary and alternative medicine and provide them an opportunity

To explore uses of plants as medicine ranging from traditional indigenous approach for treating ailments to modern pharmaceuticals

· To inculcate awareness about the rich diversity of medicinal plants in India.
Course Learning Outcomes

Knowledge Skills

An appreciation of the contribution of medicinal plants to traditional and modern medicine and the importance of holistic mode of treatment of the Indian traditional systems of medicine.

To develop an understanding of the constraints in promotion and marketing of medicinal plants.

Professional and Practical Skills

Transforming the knowledge into skills for promotion of traditional medicine.

Developing entrepreneurship skills to establish value addition products, botanical extracts and isolation of bioactive compounds.

Unit 1

Scope and importance of medicinal plants in the traditional systems of medicine and modern medicine. Importance of preventive and holistic healing in the Indian traditional systems of medicine. Ayurveda: History, origin, fundamental doctrine and concepts of Panchamahabhutas, Saptadhatus and Tridoshas in relation to health and disease.

Unit 2

Therapeutic and pharmaceutical uses of important plants used in the Ayurveda system of medicine. Concept of Rasayanadrugs. Siddha:

Origin, concepts, therapeutic and pharmaceutical uses of important plants used in Siddha system of medicine. Unani: History, concept of Umoor-e-Tabiya (Fundamentals of Physique), therapeutic and pharmaceutical uses of plants used in Unani system of medicine

Unit 3

Nutraceuticals and polyherbal formulations. Plants used for the treatment of hepatic disorders, cardiac diseases, infertility, diabetes, blood pressure, cancer and skin diseases. Role of AYUSH, NMPB and AIIA in the promotion of medicinal plants.

Unit 4

Unit 5


Unit 6


Practical

1. Identification and medicinal value of locally available medicinal plants in the field.

2. Study of organoleptic, macroscopic and microscopic parameters of any two plant drugs. Sections and powder microscopic evaluation.

3. Isolation of bioactive compounds in the lab and phytochemical analysis of the crude extract of various parts of medicinal plants.

4. Study of ingredients and medicinal uses of common polyherbal formulations used in the traditional systems of medicine.

5. Project Report based on visit to Pharmaceutical Industries and/or Institutes.

6. E-presentations : Traditional Systems of Medicine, Contribution of medicinal plants to alternative and modern medicine, Conservation strategies of medicinal plants, Nutraceuticals, Rasayana drugs, Medicinal plants and non-communicable diseases, Cultivation, marketing and utilisation of medicinal plants.

7. Laboratory Records

References

Teaching Learning Process

To encourage innovation, to link theoretical knowledge with practical training and application of knowledge to find practical solutions to the challenges encountered in the field of traditional medicine.

- To hold regular and structured workshops, seminars, field trips, collaboration with Research institutions, Industry and other Government Organizations, in order to facilitate peer learning and skill enhancement.

- To complement classroom teaching with discussions, presentations, quizzes, interpretation of results, short projects, writing project reports and field exposure.

Assessment Methods

Continuous Evaluation

(Project/ E-presentation :10 marks, Lab Records :

Attendance in Practicals

Practical Examination :

Keywords
Nursery and Gardening  
(BHSE7)  
Skill-Enhancement Elective Course - (SEC) Credit:4

Course Objective(2-3)
To gain knowledge of gardening, cultivation, multiplication, raising of seedlings of ornamental plants

Course Learning Outcomes
Students would have an understanding of

How nursery of the plants is prepared?
How rooting is promoted in the stem cuttings?
How seeds are stored and the what are the soil conditions for seed sowing and seedling growth?
How landscaping is designed?

Unit 1

Unit 1: Nursery: definition, objectives and scope and building up of infrastructure for nursery, planning and seasonal activities - Planting - direct seeding and transplants.(4 Lectures)

Unit 2

Seed: Structure and types - Seed dormancy; causes and methods of breaking dormancy - Seed storage: Seed banks, factors affecting seed viability, genetic erosion - Seed production technology - seed testing and certification. (6 Lectures)

Unit 3

Vegetative propagation: air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings - Hardening of plants - greenhouse - mist chamber, shed root, shade house and glass house. (6 Lectures)

Unit 4

Gardening: definition, objectives and scope - different types of gardening - landscape and home gardening - parks and its components - plant materials and design - computer applications in landscaping - Gardening operations: soil laying, manuring, watering, management of pests and diseases and harvesting. (8 Lectures)

Unit 5

Sowing/raising of seeds and seedlings - Transplanting of seedlings - Study of cultivation of different vegetables: cabbage, brinjal, lady’s finger, onion, garlic, tomatoes, and carrots - Storage and marketing procedures. (6 Lectures)

Unit 6

Practical

Breaking of seed dormancy

Seed viability tests

Preparation of stem cutting, air layering

soil layering and manuring

compost preparation

Diseases and pests of plants

References


**Additional Resources:**


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**Teaching Learning Process**

Teaching session begins with detailed instructions, followed by students conducting the experiment/s. When all the students have collected the data, the observations are discussed. Any deviation from the expected trend in results is explained. The students are encouraged to graphically represent the data and record the experiment during class hours. Field visits and institutional visits will also be included.

The students are asked to submit their record notebooks to the teacher/s for checking.

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**Assessment Methods**

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**Keywords**
Transplantation seed dormancy, seed viability, vegetative propagation, layering, cutting, rooting medium, hardening, landscaping

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**Biodiversity (Microbes, Fungi, Algae and Archegoniates)**

(BHGE1)

Generic Elective - (GE) Credit: 6

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**Course Objective (2-3)**

Biodiversity generally refers to the variety and variability of life on earth. Earth is a ‘green’ planet due to the presence of plants. Plants are relevant to humans as they provide us with food, shelter, clothing, energy, health, aesthetic beauty, environment and even economy. This paper is relevant to ALL students.

1. Introduction to Biodiversity ranging from Microbes (Viruses and Bacteria), to Fungi, to various plant groups (Algae and Archegoniates-Bryophytes, Pteridophytes and Gymnosperms).
2. Information on the Ecological and Economic Importance of Microbes, Fungi and various plant groups to enable students understand and appreciate relevance of Microbes and Plants to environment and human well-being.
3. Insight into the line of Plant Evolution on Earth and the consequent Biodiversity is instrumental in creating Awareness on the threats to biodiversity and sensitize young minds towards the Biodiversity Conservation for sustainable development.

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**Course Learning Outcomes**

1. Combination of Theoretical and Practical components will provide comprehensive information and insight into the fascinating world of Microbes and Plants.

2. Hands on Training will help students learn use of microscope, mounting, section-cutting and staining techniques for the study of plant materials.

3. Making Drawings in Practical Records will enhance understanding morphological and structural details and related functional aspects in diverse plant groups.
4. Use of Illustrations, Photographs, Charts, Permanent Slides, Museum and Herbarium Specimens along with ICT Methods will provide an interesting insight into the beautiful world of microbes and plants.

5. Scope of Biodiversity includes Medicinal field, Industry, Agriculture, Research and Study, Job Opportunities and Environmental Conservation. This paper is both informative and interesting and will enable students to learn about Biodiversity not only as a plant or nature lover, but also for higher academic pursuits, particularly in the field of Biological Sciences, Environment and Biodiversity Conservation.

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**Unit 1**

**MICROBES (14 Lectures)**

a) **Viruses** – Discovery; General Structure- RNA virus (TMV) and DNA virus (T-phage); Replication-Lytic and Lysogenic Cycle; Economic Importance.

b) **Bacteria** – Discovery; General Characteristics and Cell Structure; Reproduction-Vegetative, Asexual and Genetic Recombination (Conjugation, Transformation and Transduction); Economic Importance.

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**Unit 2**

**FUNGI (8 Lectures)**

General Characteristics; Outline Classification (Webster); Economic Importance; Thallus Organization and Reproduction in *Rhizopus, Penicillium, Alternaria* and *Puccinia*.

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**Unit 3**

**ALGAE (8 Lectures)**

General Characteristics; Outline Classification (Fritsch); Economic Importance; Thallus Organization and Reproduction in *Nostoc, Chlamydomonas, Vaucheria* and *Ectocarpus*.

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**Unit 4**

**ARCHEGONIATES (30 Lectures)**

a) **Bryophytes (10 Lectures)**
General Characteristics; Outline Classification; Ecological and Economic Importance; Morphology, Structure and Reproduction in *Marchantia, Anthoceros* and *Funaria*.

b) **Pteridophytes (10 Lectures)**

General Characteristics; Outline Classification; Economic Importance; Morphology, Structure and Reproduction in *Selaginella, Equisetum* and *Pteris*.

c) **Gymnosperms (10 Lectures)**

General Characteristics; Outline Classification; Economic Importance; Morphology, Structure and Reproduction in *Cycas* and *Pinus*.

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**Practical**

**MICROBES**

a) **Viruses**- Structure of TMV and T-Phage (EMs/ Models/ Photographs); Lytic and Lysogenic Cycle (Line Drawings/ Photographs).

b) **Bacteria**- Types and Structure (Permanent Slides/ Photographs); EM Bacterium; Binary Fission and Conjugation (Photographs).

**Fungi**

*Rhizopus, Penicillium* and *Alternaria* - Asexual Stage from Temporary/ Tease Mounts, *Puccinia* - Black Stem Rust of Wheat and Infected Barberry Leaves (Herbarium Specimens/ Photographs), Tease Mounts of Spores on Wheat, Section of infected portion of Wheat and Barberry (Permanent Slides).

**Algae**


**Archegoniates**

a) **Bryophytes**

*Marchantia* - Morphology of Thallus, W.M. Rhizoids, V.S. Thallus through Gemma Cup, W.M. Gemma (all Temporary Slides), L.S. Sporophyte (Permanent slide).
**Anthoceros**- Morphology of Thallus, W.M. Rhizoids, L.S./T.S. Capsule, W.M. Spores, W.M. Pseudoelaters, (all Temporary Slides), L.S. Sporophyte (Permanent slide).

**Funaria**- Morphology of Gametophyte bearing Sporophyte, W.M. Rhizoids, W.M. Leaf, W.M. Operculum, W.M. Peristome, W.M. Spores (all Temporary Slides), L.S. Capsule (Permanent Slide).

b) **Pteridophytes**

**Selaginella**- Morphology, T.S. Stem, W.M. Strobilus, W.M. Microsporophyll and Megasporophyll (all Temporary Slides), L.S. Strobilus (Permanent Slide).

**Equisetum**- Morphology, T.S. Stem (Internode), L.S./T.S. Strobilus, W.M. Sporangioaphore, W.M. Spores (Wet and Dry) (all Temporary Slides).

**Pteris**- Morphology, V.S. Sporophyll, W.M. Sporangium, W.M. Spores (all Temporary Slides), W.M. Prothallus with Sex Organs (Permanent Slide).

c) **Gymnosperms**

**Cycas**- Morphology (Coralloid Roots, Leaf, Microsporophyll, Megasporophyll), T.S. Coralloid Root (Permanent Slide), V.S. Leaflet, V.S. Microsporophyll, W.M. Spores (all Temporary Slides), L.S. Ovule (Permanent Slide).

**Pinus**- Morphology (Long and Dwarf Shoots, Male and Female Cones), W.M. Dwarf Shoot, T.S. Needle, L.S/T.S. Male Cone, W.M. Microsporophyll, W.M. Microspores (all Temporary Slides), L.S Female Cone (Permanent Slide).

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**References**


Teaching Learning Process

THEORY:

1. The theory topics are covered in lectures with the help of both conventional (chalk board) and modern (ICT) methods, including use of Charts.
2. Emphasis is on interactive class room environment so as to encourage students ask questions/ doubts/ queries for clarification/explanation and discussion.
3. Students are encouraged to refer to reference books in library to inculcate reading habit for better grasp and understanding on the subject.
4. Emphasis is given to illustrations- neat, well-labelled outline and cellular diagrams/ flowcharts for improving creative skills and to substantiate the text content.
5. On completion of theory syllabus, previous years’ question papers are discussed so as to apprise students about the general format of semester exam question papers.
6. Assignment (10), Test (10) and Theory Attendance (5) are components of Internal Assessment Scheme for compilation of Internal Assessment Score of each student out of 25 marks.

PRACTICAL:

1. Every practical session begins with instructions, followed by students doing table work for detailed microscopic plant study.
2. Plant study is done using fixed plant materials, museum and herbarium specimens, photographs and permanent slides.
3. The students are instructed about maintaining practical records, which includes comments and diagrams.
4. Students are asked to submit practical records regularly, on a continuous basis, for checking.
5. On completion of practical syllabus, Practical Exam Guidelines are discussed to apprise students about the formant of Practical exam.
6. As part of Continuous Evaluation guidelines, total score for each student is calculated out of 25 marks, taking into consideration Practical Records (10), Practical Test/Assessment (10) and Practical Attendance (5).

Assessment Methods

THEORY:

1. Emphasis is given for an interactive classroom environment, with at least few minutes for question-answer session.
2. Assignment topics are given to students for submission of hand written assignments.
3. Test is taken, with both objective and descriptive questions, from a defined portion of syllabus.
4. Assignment (10), Test (10) and Theory Attendance (5) are components of Internal Assessment Scheme for compilation of Internal Assessment Score of each student out of 25 marks.

PRACTICAL:

1. Students are monitored in the practical class w.r.t their performance in table work for detailed plant study.
2. Students are asked to submit practical records regularly, on a continuous basis, for checking.
3. Emphasis is given on neat, labelled diagrams and proper, concise comments in practical records, with properly maintained Index page regularly signed by the teacher.
4. Practical Test/Assessment is taken to evaluate students performance as per guidelines framed for Continuous Evaluation under C.B.C.S.
5. As part of Continuous Evaluation guidelines, total score for each student is calculated out of 25 marks, taking into consideration Practical Records (10), Practical Test/Assessment (10) and Practical Attendance (5).

Keywords
Course Objective (2-3)

To gain the knowledge on the economically important of plants, their life cycle, processing, plant part used, application of biotechnology for the production of plant resources and production of new varieties.

Course Learning Outcomes

Understanding of morphology, and processing and economic value of plant sources of cereals, legumes, spices, oil, rubber, timber and medicines.

Unit 1

Origin of Cultivated Plants (4 lectures)

Concept of centres of origin, their importance with reference to Vavilov’s work.

Unit 2

Cereals (4 lectures): Wheat - Origin, morphology, uses

Unit 3

Legumes (6 lectures): General account with special reference to Gram and soybean

Unit 4
Spices (6 lectures) General account with special reference to clove and black pepper (Botanical name, family, part used, morphology and uses)

Unit 5

Beverages (4 lectures) Tea (morphology, processing, uses)

Unit 6

Oils and Fats (4 lectures) General description with special reference to groundnut

Unit 7: Fibre Yielding Plants (4 lectures) General description with special reference to Cotton (Botanical name, family, part used, morphology and uses)

Unit 8: Introduction to Plant Biotechnology (1 lecture)

Unit 9: Tissue Culture Technology (9 lectures)

Introduction; nutrient media; aseptic and culture conditions; developmental pathways: direct and indirect organogenesis and embryogenesis; single cell and protoplast culture.

Unit 10: Recombinant Technology (18 lectures)

Molecular techniques: Blotting techniques (Southern, Northern and Western); PCR; Molecular DNA markers (RAPD, RFLP, SNPs) and DNA fingerprinting in plants.

Genetic Engineering Techniques: Gene cloning vectors (pUC 18, pBR322, BAC, YAC, Ti plasmid); construction of genomic and C-DNA libraries; screening for gene of interest by DNA probe hybridisation, complementation; Insertion of genes into plant tissues (Agrobacterium mediated, electroporation, micro-projectile bombardment); selection of recombinants by selectable marker and reporter genes (GUS, luciferase, GFP). Applications: Bt cotton, Roundup ready soybean, Golden rice, Flavr-Savr tomato, edible vaccines, industrial enzyme production, Bioreactors

Applications: Micropropagation, androgenesis, gynogenesis, embryo and endosperm culture, secondary metabolite production, germplasm conservation.

Practical

Study of economically important plants: Wheat, Gram, Soybean, Black pepper, Clove Tea, Cotton, Groundnut through specimens, sections and microchemical tests

2. Familiarization with basic equipments in tissue culture.
3. Study through photographs: Anther culture, somatic embryogenesis, endosperm and embryo culture; micropropagation.

4. Study of molecular techniques: PCR, Blotting techniques, AGE and PAGE.

References


Additional Resources:


Teaching Learning Process

**Theory:** The theory topics are covered in lectures with the help of PowerPoint presentations and the chalkboard. Students are encouraged to ask questions. The reading list has been suitably upgraded.

When the entire syllabus is completed, a few lectures are devoted to discuss the previous years’ question papers, thus preparing the students for the examination.

**Practicals:** Every practical session begins with detailed instructions, followed by students conducting the experiment/s. When all the students have collected the data, the observations are discussed. Any deviation from the expected trend in results is explained. The students are encouraged to graphically represent the data and record the experiment during class hours.

The students are asked to submit their record notebooks to the teacher/s for checking.

Assessment Methods
**Theory:** The students are continuously evaluated based on a class test and the presentation given by each student. The answer scripts of the test are returned to the students and the test paper is discussed at length. Students who are absent for the test are allowed to appear for the test at a later date; the question paper is suitably modified for such students.

Each student in a class is given a different topic to prepare a PowerPoint presentation. All the remaining students listen to the presentation of each student, and peer students are also encouraged to ask questions. Presentations by students improves their reasoning and communication skills. The presentations of students are evaluated by the teacher based on the content, effectiveness of the presentation, whether any new information has been added, and lastly on the answers given by students to the questions posed by the teacher.

The Internal Assessment has a break-up as 10 marks for the test, 10 marks for the presentation/assignment and 5 marks for the attendance, and comprises 25 % of the total marks.

**Practicals:** For continuous evaluation two tests are conducted; one on the table work experiments for 10 marks, and the other on setups for 10 marks. The total marks obtained is scaled down to 10. Ten marks are allotted for record notebooks, and 5 marks for attendance. The Internal Assessment for practicals comprises 50 % of the total marks.

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**Keywords**

Vavilove, Cultivated plants, Wheat, Gram, soyabean, spices, Tea, cotton, groundnut, tissue culture, recombinant DNA technology, Molecular markers, RAPD, PCR, ELISA.

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**Environmental Biotechnology**
*(BHGE6)*

**Generic Elective - (GE) Credit:6**

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**Course Objective(2-3)**

To gain the knowledge of of environmental problems of pollution and their management and policies

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**Course Learning Outcomes**

Students will have an insight on the causes and consequences of environmental pollution, pollutants,
They can think about the prevent of degradation of environment and management of pollutants.

Unit 1

Environment - basic concepts and issues, global environmental problems - ozone depletion, UV-B, greenhouse effect and acid rain due to anthropogenic activities, their impact and biotechnological approaches for management. (4 lectures)

Unit 2

An overview of atmosphere, hydrosphere, lithosphere and anthrosphere - environmental problems. Environmental pollution - types of pollution, sources of pollution, measurement of pollution, methods of measurement of pollution, fate of pollutants in the environment, Bioconcentration, bio/geomagnification. (6 lectures)

Unit 3

Microbiology of waste water treatment, aerobic process - activated sludge, oxidation ponds, trickling filter, towers, rotating discs, rotating drums, oxidation ditch. Anaerobic process - anaerobic digestion, anaerobic filters, up-flow anaerobic sludge blanket reactors. Treatment schemes for waste waters of dairy, distillery, tannery, sugar and antibiotic industries. (8 lectures)

Unit 4

Xenobiotic compounds - organic (chlorinated hydrocarbons, substituted simple aromatic compounds, polyaromatic hydrocarbons, pesticides, surfactants) and inorganic (metals, radionuclides, phosphates, nitrates). Bioremediation of xenobiotics in environment - ecological consideration, decay behavior and degradative plasmids, molecular techniques in bioremediation. (10 lectures)

Unit 5

Role of immobilized cells/enzymes in treatment of toxic compounds. Biopesticides, bioreactors, bioleaching, biomining, biosensors, biotechniques for air pollution abatement and odour control. (6 lectures)

Unit 6
Sustainable Development: Economics and Environment: Economic growth, Gross National Productivity and the quality of life, Tragedy of Commons, Economics of Pollution control, Cost-benefit and cost effectiveness analysis, WTO and Environment, Corporate Social Responsibility, Environmental awareness and Education; Environmental Ethics. (8 lectures)


Unit 9: Public Participation for Environmental Protection: Environmental movement and people’s participation with special references to Gandhamardan, Chilika and Narmada Bachao Andolan, Chipko and Silent valley Movement; Women and Environmental Protection, Role of NGO in bringing environmental awareness and education in the society. (6 lectures)

Practical

1. To determine the pH and total hardness of water samples collected from different places (polluted and non-polluted sites).

2. To determine the salinity of water samples (polluted and non-polluted sites).

3. To determine the dissolved oxygen of two water samples.

4. To determine alkalinity of water samples.

5. To determine pH and rapid field test of soil samples (Calcium, Magnesium, Nitrate and Chloride).

6. Set-ups- through photograph

I. Microbial assessment of air (open air plate) and water. ii. Interaction of plant seeds with diesel for potential use in remediation of diesel fuel from contaminated soil. iii. Growth response of Bacteria on Petroleum Fuel. iv. Isolation and characterization of Bacteria from crude petroleum oil contaminated soil.

References
Teaching Learning Process

To engage students and transform them into active learners the students are updated with latest books and review articles.

The experiments included in the paper are performed individually or in group and are followed by group discussions and interjections.

Assessment Methods

The students are assessed on the basis of oral presentations and regular class tests.

Students are continuously assessed during practical class.

Submission of class records is mandatory. This exercise develops scientific skill as well as methods of recording and presenting scientific data.

Keywords

Green house effect, anthropogenic activity, pollutants, bioconcentration, geomagnification, Aerobic process, activated sludge, oxidation ponds, oxidation ditch, anaerobic digestion,
Course Objective(2-3)

The Objective of this paper is to provide basic knowledge of plant internal architecture and cellular composition and reproduction. This help them to understand how different plant tissue structure evolve and modify their functions with respect to their environment.

Course Learning Outcomes

Knowledge regarding anatomy equipped the students to identify different types of tissues and make them able to correlate their physiology in a better away. This will also help them to understand how different plant tissue evolve and modify their structure and functions with respect to their environment. Knowledge regarding embryology make them understand how reproduction play significant role in defining population structure, natural diversity and sustainability of ecosystem in a better way.

Unit 1

Meristematic and permanent tissues (8 lectures)

Simple (parenchyma, collenchyma, sclerenchyma) and complex tissues (xylem, phloem), Root and shoot apical meristems (describe theories in brief with special reference to Tunica Corpus and Korper-Kappe theory)

Unit 2

Organs (4 lectures)

Structure of dicot and monocot root stem and leaf.
Unit 3

Secondary Growth (8 lectures)

Vascular cambium: structure and function, seasonal activity. Secondary growth in root and stem, Wood (heartwood and sapwood)

Unit 4

Adaptive and protective systems (8 lectures)

Epidermis (trichomes and hair), cuticle, stomata: structure and type (Metcalf and Chalk Classification); General account of adaptations in xerophytes and hydrophytes (Examples may be cited from *Nerium, Opuntia, Hydrilla and Nymphaea*).

Unit 5

Introduction to Reproduction (5 lectures)

Modes of reproduction in plants: vegetative options - natural and artificial; introduction and Significance of sexual reproduction.

Unit 6

Structural organization of flower (10 lectures)

Organization of flower, Structure; Anther and Pollen (No developmental stage); Ovules: Structure and types; Embryo sac: Types special reference to Polygonum type.

Unit 7: Pollination and fertilization (10 lectures)

Pollination mechanisms and adaptations; Double fertilization and triple fusion; Seed: Structure (Dicot and Monocot, No developmental stages) appendages and dispersal mechanisms.

Unit 8: Embryo and endosperm (10 lectures)

Endosperm types (one example of each type), structure and functions; Dicot and Monocot embryo; Embryo endosperm relationship (General account).
Practical

1. Study of meristems through permanent slides and photographs.

2. Tissues (parenchyma, collenchyma and sclerenchyma); Macerated xylary elements, Phloem (Permanent slides, photographs)


5. Leaf: Dicot and Monocot (only Permanent slides).

6. Adaptive anatomy: Xerophyte (Nerium leaf); Hydrophyte (Hydrilla stem).

7. Structure of anther (young and mature).

8. Types of ovules: anatropous, orthotropous, circinotropous, amphitropous/ campylotropous.


11. Pollination types and seed dispersal mechanisms (including appendages, aril, caruncle) Photographs/specimens).

12. Dissection of embryo/endosperm from developing seeds.

13. Calculation of percentage of germinated pollen in a given medium.

References


Additional Resources:

Teaching Learning Process

Theory: The theory topics are covered in lectures with the help of PowerPoint presentations and the chalkboard. Students are encouraged to ask questions. The reading list has been suitably upgraded. When the entire syllabus is completed, a few lectures are devoted to discuss the previous years’ question papers, thus preparing the students for the examination.

Practicals: Every practical session begins with detailed instructions, followed by students conducting the experiment/s. When all the students have collected the data, the observations are discussed. Any deviation from the expected trend in results is explained. The students are encouraged to graphically represent the data and record the experiment during class hours. The students are asked to submit their record notebooks to the teacher/s for checking.

Assessment Methods

Theory: The students are continuously evaluated based on a class test and the presentation given by each student. The answer scripts of the test are returned to the students and the test paper is discussed at length. Students who are absent for the test are allowed to appear for the test at a later date; the question paper is suitably modified for such students. Each student in a class is given a different topic to prepare a PowerPoint presentation. All the remaining students listen to the presentation of each student, and peer students are also encouraged to ask questions. Presentations by students improves their reasoning and communication skills. The presentations of students are evaluated by the teacher based on the content, effectiveness of the presentation, whether any new information has been added, and lastly on the answers given by students to the questions posed by the teacher. An assignment can be given in place of the presentation.

The Internal Assessment has a break-up as 10 marks for the test, 10 marks for the presentation/assignment and 5 marks for the attendance, and comprises 25 % of the total marks.

Practicals: For continuous evaluation two tests are conducted; one on the table work experiments for 10 marks, and the other on setups for 10 marks. The total marks obtained is scaled down to 10. Ten marks are allotted for record notebooks, and 5 marks for attendance. The Internal Assessment for practicals comprises 50 % of the total marks.

Keywords
meristem, secondary growth, Vascular cambium, anther, embryo sac, pollination, double fertilisation, endosperm, reproductive biology.

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**Plant Diversity and Human welfare**  
*(BHGE4)*  
**Generic Elective - (GE) Credit:6**

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**Course Objective(2-3)**

To gain the knowledge of

1. Biodiversity and its importance.
2. Agricultural diversity
3. biodiversity loss and biodiversity management

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**Course Learning Outcomes**

The students would be able to judge the value of biodiversity and its role in stabilizing the climate and economy. They would know the causes and consequences of loss of biodiversity and planning of conservation strategies.

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**Unit 1**

Plant diversity and its scope- Genetic diversity, Species diversity, Plant diversity at the ecosystem level, Agrobiodiversity and cultivated plant taxa, wild taxa. Values and uses of Biodiversity: Ethical and aesthetic values, Precautionary principle, Methodologies for valuation, Uses of plants, Uses of microbes. (8 lectures)

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**Unit 2**

**Loss of Biodiversity:** Loss of genetic diversity, Loss of species diversity, Loss of ecosystem diversity, Loss of agrobiodiversity, Projected scenario for biodiversity loss, **Management of Plant Biodiversity:** Organizations associated with biodiversity management-Methodology for execution-IUCN, UNEP, UNESCO, WWF, NBPR; Biodiversity legislation and conservations, Biodiversity information management and communication. (8 lectures)

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**Unit 3**
Conservation of Biodiversity: Conservation of genetic diversity, species diversity and ecosystem diversity, In situ and ex situ conservation, Social approaches to conservation, Biodiversity awareness programmes, Sustainable development. (8 lectures)

Unit 4

Role of plants in relation to Human Welfare: a) Importance of forestry their utilization and commercial aspects b) Avenue trees, c) Ornamental plants of India. d) Alcoholic beverages through ages. Fruits and nuts: Important fruit crops their commercial importance. Wood and its uses. (6 lectures)

Unit 5

Unit 6

Practical

Mapping of species diversity and Herbarium preparation

Mapping of crop diversity and Herbarium preparation

Visits of plant conservatories

study of wood features

Herbarium study of

a. Avenue trees,

b) Ornamental plants

c Fruits and nuts: Important fruit crops

importance. Wood and its uses. (6 lectures)

References

Teaching Learning Process

Every practical session begins with detailed instructions, followed by students conducting the experiment/s. When all the students have collected the data, the observations are discussed. Any deviation from the expected trend in results is explained. The students are encouraged to graphically represent the data and record the experiment during class hours. The students are asked to submit their record notebooks to the teacher/s for checking. Field visits will also be arranged.

Assessment Methods

The students are continuously evaluated based on a class test and the presentation given by each student. The answer scripts of the test are returned to the students and the test paper is discussed at length. Students who are absent for the test are allowed to appear for the test at a later date; the question paper is suitably modified for such students.

Each student in a class is given a different topic to prepare a PowerPoint presentation. All the remaining students listen to the presentation of each student, and peer students are also encouraged to ask questions. Presentations by students improves their reasoning and communication skills. The presentations of students are evaluated by the teacher based on the content, effectiveness of the presentation, whether any new information has been added, and lastly on the answers given by students to the questions posed by the teacher.

Keywords

Genetic diversity, species diversity, crop diversity, biodiversity loss, crop diversity, value of diversity, IUCN, UNEP, UNESCO, WWF, NBGPR; Biodiversity legislation, conservation, forestry, fruits, timber.

Plant Ecology and Taxonomy
(BHGE3)
Generic Elective - (GE) Credit:6

Course Objective(2-3)
Objectives: To make students understand ecology and basic ecological concepts, inter-relation between the living world and environment. Also to make them aware about identification, nomenclature and classification.

Course Learning Outcomes

After successful completion of the course the student shall have adequate knowledge about the basic principals of environment and taxonomy.

Unit 1

Introduction (1 lecture)

Inter-relation between the living world and environment

Unit 2

Ecological factors (11 lectures)


Unit 3

Plant communities (6 lectures)

Characters; Ecotone and edge effect; Succession; Processes and types (autogenic, allogenic, autotrophic, heterotrophic, primary and secondary)

Unit 4

Ecosystem (8 lectures)

Structure; energy flow trophic organisation; Food chains and food webs, Ecological pyramids production and productivity; Biogeochemical cycling; Cycling of carbon, nitrogen and Phosphorous

Unit 5
Phytogeography (4 lectures)

Principle biogeographical zones; Endemism (definition and types)

Unit 6

Introduction to plant taxonomy (1 lecture)
Identification, Classification, Nomenclature.

Unit 7 Identification (5 lectures)
Functions of Herbarium, important herbaria and botanical gardens of the world and India; Documentation: Flora, Keys: single access and multi-access

Unit 8 Taxonomic evidences from palynology, cytology, phytochemistry and molecular data. (6 lectures)

Unit 9 Taxonomic hierarchy (2 lectures)
Ranks, categories and taxonomic groups

Unit 10 Botanical nomenclature (6 lectures)
Principles and rules (ICN); ranks and names; binominal system, typification, author citation, valid publication, rejection of names, principle of priority and its limitations.

Unit 11 Classification (6 lectures)
Types of classification-artificial, natural and phylogenetic. Bentham and Hooker (upto series), Engler and Prantl (up to series).
Unit 12 Biometrics, numerical taxonomy and cladistics (4 lectures)

Characters; variations; OTUs, character weighting and coding; cluster analysis; phenograms, cladograms (definitions and differences).

Practical

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, and analysis of two soil samples for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency by rapid field test.

3 (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)

4. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus by species area curve method. (species to be listed)

5. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer’s frequency distribution law

6. 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):Brassicaceae - Brassica, Alyssum / Iberis; Asteraceae - Sonchus/Launaea, Vernonia/Ageratum, Eclipta/Tridax; Solanaceae - Solanum nigrum, Withania; Lamiaceae - Salvia, Ocimum; Liliaceae - Asphodelus / Lilium / Allium.

7. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted on the herbarium sheet with appropriate label.)

References


Teaching Learning Process

**Theory:** The theory topics are covered in lectures with the help of PowerPoint presentations and talk and chalk method. Students are encouraged to ask questions. The reading list has been suitably upgraded. A few lectures are devoted to discuss the previous years’ question papers, thus preparing the students for the examination.

**Practicals:** Every practical session begins with detailed instructions, followed by students conducting the experiment/s. When all the students have collected the data, the observations are discussed. Any deviation from the expected trend in results is explained. The students are encouraged to graphically represent the data and record the experiment during class hours.

The students are asked to submit their record notebooks to the teacher/s for checking and evaluation.

Assessment Methods

**Theory:** The students are continuously evaluated based on a written assignment, class test and/or presentation given by each student. The answer scripts of the test are returned to the students and the test paper is discussed at length. Students who are absent for the test are allowed to appear for the test at a later date; the question paper is suitably modified for such students.

Each student in a class is given a different topic to prepare a Assignment/PowerPoint presentation. All the remaining students listen to the presentation of each student, and peer students are also encouraged to ask questions. Presentations by students improve their reasoning and communication skills. The presentations of students are evaluated by the teacher based on the content, effectiveness of the presentation, whether any new information has been added, and lastly on the answers given by students to the questions posed by the teacher.

The Internal Assessment has a break-up as 10 marks for the test, 10 marks for the presentation/assignment and 5 marks for the attendance, and comprises 25% of the total marks.

**Practicals:** For continuous evaluation two tests are conducted; one on the table work experiments for 10 marks, and the other on setups for 10 marks. The total marks obtained is scaled down to 10. Ten marks are allotted for record notebooks, and 5 marks for attendance. The Internal Assessment for Practicals comprises 50% of the total marks.
Keywords
Environment, Soil, Water, Plant communities, Succession, Ecosystem, Phytogeography, Endemism, Plant taxonomy, Taxonomic hierarchy, Botanical Nomenclature, Classification, Biometrics

Plant Physiology and Metabolism (BHGE5)
Generic Elective - (GE) Credit: 6

Course Objective (2-3)

The course aims at making students realize how plants function, namely the importance of water, minerals, hormones, and light in plant growth and development; understand transport mechanisms and translocation in the phloem, and appreciate the commercial applications of plant physiology.

Course Learning Outcomes

The students are able to correlate morphology, anatomy, cell structure and biochemistry with plant functioning. The link between theory and practical syllabus is established, and the employability of youth would be enhanced. The youth can also begin small-scale enterprises.

Unit 1

Plant-water relations (8 Lectures)

Importance of water, water potential and its components, pathway of water movement, ascent of sap, transpiration and its significance, factors affecting transpiration, root pressure and guttation, stomatal movements – only ion theory.

Unit 2

Mineral nutrition (8 Lectures)
Essential elements, macro- and micronutrients, criteria of essentiality of elements, methods of studying mineral requirement (Hydroponics, Aeroponics), role of essential elements, transport of ions across membrane, active and passive transport, carriers, channels and pumps.

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**Unit 3**

**Translocation in phloem**

(6 lectures)

Composition of phloem sap, girdling experiments, Pressure Flow Model, phloem loading and unloading.

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**Unit 4**

**Photosynthesis**

(10 Lectures)

Historical contribution of Julius von Sachs, Blackman, Emerson, Engelmann, Hill, Arnon; photosynthetic pigments (chlorophyll a and b, xanthophyll, carotene); photosystem I and II, reaction centre, antenna molecules; electron transport and mechanism of ATP synthesis, C3 pathway; C4 and CAM plants (in brief, no pathways); photorespiration.

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**Unit 5**

**Respiration**

(6 Lectures)

Glycolysis, anaerobic respiration, TCA cycle, oxidative phosphorylation, glyoxylate cycle, RQ.

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**Unit 6**

**Enzymes**

(4 Lectures)

Structure and properties, Km (no derivation), mechanism of enzyme catalysis and enzyme inhibition.

**Unit 7: Nitrogen metabolism**

(6 Lectures)

Biological nitrogen fixation - nodulation in detail, nitrate and ammonia assimilation, dinitrogenase, NR, NiR, transamination.

**Unit 8: Plant growth regulators**

(6 Lectures)

Discovery, physiological roles of auxins, gibberellins, cytokinins and ethylene.
Unit 9: Plant response to light and temperature (6 Lectures)

Photoperiodism - discovery (SDP, LDP, day neutral plants); phytochrome (discovery and structure), red and far-red light response on photomorphogenesis (general account), florigen (brief account).

*NO STRUCTURES AND FORMULAE TO BE ASKED IN THE EXAM

Practical

1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. To study the effect of the environmental factor light on transpiration by excised twig.
3. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
4. To Study Hill's reaction.
5. To study the activity of catalase and study the effect of pH and enzyme concentration.
6. To study the effect of light intensity on O2 evolution in photosynthesis.
7. Comparison of the rate of respiration in any two parts of a plant.

Demonstration experiments

1. Bolting.
2. Effect of auxins on rooting.
3. Suction due to transpiration.
4. Hydroponics (using a photograph).
5. To demonstrate the delay of senescence by cytokinins.
6. To study the phenomenon of seed germination (effect of light and darkness)

References
Teaching Learning Process

**Theory:** The theory topics are covered in lectures with the help of PowerPoint presentations and the chalkboard. Students are encouraged to ask questions. The reading list has been suitably upgraded.

When the entire syllabus is completed, a few lectures are devoted to discuss the previous years’ question papers, thus preparing the students for the examination.

**Practicals:** Every practical session begins with detailed instructions, followed by students conducting the experiment/s. When all the students have collected the data, the observations are discussed. Any deviation from the expected trend in results is explained. The students are encouraged to graphically represent the data and record the experiment during class hours.

**Assessment Methods**
Theory: The students are continuously evaluated based on a class test and the presentation given by each student. The answer scripts of the test are returned to the students and the test paper is discussed at length. Students who are absent for the test are allowed to appear for the test at a later date; the question paper is suitably modified for such students.

Each student in a class is given a different topic to prepare a PowerPoint presentation. All the remaining students listen to the presentation of each student, and peer students are also encouraged to ask questions. Presentations by students improves their reasoning and communication skills. The presentations of students are evaluated by the teacher based on the content, effectiveness of the presentation, whether any new information has been added, and lastly on the answers given by students to the questions posed by the teacher.

The Internal Assessment has a break-up as 10 marks for the test, 10 marks for the presentation/assignment and 5 marks for the attendance, and comprises 25% of the total marks.

Practicals: For continuous evaluation two tests are conducted; one on the table work experiments for 10 marks, and the other on setups for 10 marks. The total marks obtained is scaled down to 10. Ten marks are allotted for record notebooks, and 5 marks for attendance. The Internal Assessment for practicals comprises 50% of the total marks.

Keywords

Movement of water, ascent of sap, transpiration, stomatal movements, mineral nutrients, active and passive transport, translocation, plant growth regulators, photoperiodism, photomorphogenesis