Outlines of tests, syllabi and courses of reading for M.Sc. (Hons. School) in Botany (Semester System) I-IV examinations of 2016-17.

M.Sc. (Hons. School) I Semester Botany

**THEORY (500 marks)**

<table>
<thead>
<tr>
<th>Paper I</th>
<th>:</th>
<th>Bryology</th>
<th>75 (60A+15CA) + 25 (20A+5CA)</th>
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</thead>
<tbody>
<tr>
<td>Paper II</td>
<td>:</td>
<td>Pteridology</td>
<td>75 (60A+15CA) + 25 (20A+5CA)</td>
</tr>
<tr>
<td>Paper III</td>
<td>:</td>
<td>Gymnosperms</td>
<td>75 (60A+15CA) + 25 (20A+5CA)</td>
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<tr>
<td>Paper-IV</td>
<td>:</td>
<td>Plant Resource Utilization</td>
<td>75 (60A+15CA) + 25 (20A+5CA)</td>
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<tr>
<td>Paper-V</td>
<td>:</td>
<td>Angiosperms: Phylogeny &amp; Embryology</td>
<td>75 (60A+15CA) + 25 (20A+5CA)</td>
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M.Sc. (Hons. School) II Semester Botany

**THEORY (500 marks)**

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<tr>
<th>Paper I</th>
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<th>Phycology</th>
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<tbody>
<tr>
<td>Paper II</td>
<td>:</td>
<td>Plant Anatomy</td>
<td>75 (60A+15CA) + 25 (20A+5CA)</td>
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<tr>
<td>Paper III</td>
<td>:</td>
<td>Taxonomy of Angiosperms</td>
<td>75 (60A+15CA) + 25 (20A+5CA)</td>
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<tr>
<td>Paper-IV</td>
<td>:</td>
<td>Cytogenetics &amp; Plant Breeding</td>
<td>75 (60A+15CA) + 25 (20A+5CA)</td>
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<td>Paper-V</td>
<td>:</td>
<td>Environmental Botany</td>
<td>75 (60A+15CA) + 25 (20A+5CA)</td>
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M.Sc. (Hons. School) III Semester Botany

**THEORY (500 marks)**

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<tr>
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<tr>
<td>Paper II</td>
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<td>Plant Physiology</td>
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<tr>
<td>Paper III</td>
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<td>Plant Biochemistry</td>
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<tr>
<td>Paper-IV</td>
<td>:</td>
<td>Molecular Biology</td>
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<tr>
<td>Paper-V</td>
<td>:</td>
<td>Ecosystem Ecology and Forestry</td>
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M.Sc. (Hons. School) IV Semester Botany

**THEORY (500 marks)**

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<td>Paper II</td>
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<td>Biostatistics &amp; Research methodology</td>
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<tr>
<td>Paper III</td>
<td>:</td>
<td>Plant Biotechnology &amp; Genetic Engineering</td>
<td>75 (60A+15CA) + 25 (20A+5CA)</td>
</tr>
<tr>
<td>Paper-IV</td>
<td>:</td>
<td>Comprehensive Test &amp; Field Botany</td>
<td>50+50</td>
</tr>
<tr>
<td>Paper-V</td>
<td>:</td>
<td>Project &amp; Seminar</td>
<td>50+50</td>
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M.Sc. (Hons. School) I Semester Botany

Paper– I : Bryology

Objectives: To expose the students to the key fundamentals and queries in the recent advances in bryophytes with an objective to mould them to be excellent teachers/scientists in the subject of Bryology. To enable the students to solve various short-answer questions which they are likely to face at various competitive examinations like NET, GATE, All India Civil Service Examinations etc.

Teaching Methodology:
1. Enquiry approach is adopted while delivering the lectures which makes the students equal partners in teaching-learning process and also inspires them for discussions and questioning.
2. To make teaching-learning process interesting and inspiring, the lectures are accompanied by teaching aids such as overhead projections, slide projections, computerized illustrations etc. alongwith demonstrations of living materials in the lab. and in the field are used while teaching bryophytes.

Instructions for the Paper-setter
Question paper will have four units. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

UNIT-I
1. Modern system of classification with salient features of different taxonomic categories upto the orders level.

UNIT-II
3. Evolution of thallose condition in bryophytes.
4. Ontogeny of Antheridia and Archegonia in major taxonomic groups of bryophytes : Exogenous and Endogenous sex organs, development by an apical cell.
5. Ontogeny of sporophytes in bryophytes : Filamentous, quadrant, Octant and Bipolar embryo, Fate of amphithecium and endothecium, Archesporium and its products. Spore-elater division.

UNIT-III
8. Drought tolerance, Desiccation and Rehydration; Mechanism of Damage.

UNIT-IV
Practicals

1. Morphology and Internal Organization of the following:

2. To compare the structure and behaviour of endohydrhic and ectohydric mosses.

3. To study regeneration potential of dried moss leaves and stem fragments.

Essential Reading


Further Reading


Semester-I

Paper– II : Pteridology

Theory : 75 (60 A+ 15CA)

Practical: 25 (20 A+ 5CA)

Objective: To familiarize students with the diversity of Pteridophytes (both ferns and fern allies), their evolutionary history and origin, economic importance, classification, detailed study on the representative ferns of major families with reference to their morphology, anatomy and reproduction. Practicals and exposure of students to fern flora in the surrounding areas and botanical garden further add to their knowledge.

Teaching Methodology: Teaching is done in any way (following both traditional and modern methods) so as to sensitize and inspire students on the subject.

Instructions for the Paper-setter

Question paper will have *four* units. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

UNIT-I

1. Origin and evolution of Pteridophytes
2. Economic importance of Pteridophytes
3. Diversity and distribution of Pteridophytes in India.
UNIT-II

5. Comparative morphology of the sporophyte, stelar system, sporangial characteristics and reproduction of the living ferns belonging to major fern families especially Marattiaceae, Ophioglossaceae, Osmundaceae, Dryopteridaceae, Pteridaceae, Marsileaceae, Salviniaeaceae, Azollaceae, Aspleniaceae, Polypodiaceae etc.

UNIT-III

7. Structure, types and development of fern prothalli
8. Antheridium-inducing substances in ferns

UNIT-IV

9. Natural and induced apogamy and apospory in pteridophytes, heterospory and its significance.
10. Utility of ferns for phytoremediation, ferns as hyperaccumulators of arsenic, mechanism of uptake, transfer and tolerance.

Practicals

1. Study of the morphology, anatomy and reproductive structures of the representatives of the fern families mentioned in the theory part.
2. Taxonomical characters of ferns for generic identification and characterization of families.

Essential Reading


Further Reading

7. Mehra, P.N. and Gupta, A. Gametophytes of Himalayan Ferns, Publisher: Mehra, P.N., Bot Department, P.U., Chandigarh, 1986.

Semester-I

Paper– III : Gymnosperms

Objective: The course will involve detailed study about the vegetative and reproductive morphology of various gymnosperms specimens and their economic importance.

Teaching Methodology: It will involve class room lectures, power point presentations, charts, models, practicals and field visits etc.

Instructions for the Paper-setter

Question paper will have four units. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer type covering the whole
syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

UNIT-I
2. General characteristic features of Gymnosperms and their affinities with pteridophytes and angiosperms.
3. Distribution of Gymnosperms with special reference to Indian members and emphasis on their distribution in the Himalayas.

UNIT-II
4. Vegetative morphology and reproductive organs only (excluding developmental stages) of Indian representatives of: Living Coniferopsida: Pinaceae, Taxodiaceae, Cupressaceae, Podocarpaceae, Cephalotaxaceae, Araucariaceae.
5. Range and form of structure in the leaves of Coniferales.

UNIT-III
6. Vegetative morphology and reproductive organs only (excluding developmental stages) of Indian representatives of:
   (a) Gnetopsida: Ephedraceae, Gnetaceae, and Welwitschiaceae.
   (b) Ginkgopsida: Ginkgoaceae.

UNIT-IV
7. Economic importance of Gymnosperms.
8. Cytological studies in Gymnosperms.
9. Comparative analysis of various gymnosperm taxa on the basis of their distribution, morphology and reproductive structures.

Practicals
1. Wood Anatomy in Cedrus, Ginkgo, Ephedra and Gnetum
2. Leaf Anatomy in Cedrus, Abies, Picea, Podocarpus Cryptomeria, Cephalotaxus.
3. Male cones (external morphology) & microsporophylls in Cedrus, Abies, Cephalotaxus, Podocarpus, Cryptomeria, Cupressus, Thuja and Juniperus.

Essential Reading

Further Reading
Semester-I

Paper –IV : Plant Resource Utilization

Objective: To acquaint the students about the origin and uses of cereals, psychoactive drugs and medicinal plants and their resource utilization.

Teaching Methodology: It will involve class room lectures, power point presentations, charts, models, practicals and field visits etc.

Instructions for the paper setter

Question paper will have four units. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

UNIT-I

1. General Account, centre of origin and uses of (a) Minor cereals – Millets, barley, oat (b) Oil crops – Mustard, groundnut, coconut and linseed (c) Legumes – chickpea, red gram, soyabean, lentil, pea, fodder legume.
2. Psychoactive drugs and Narcotics: Source, botany, active principle and commercial significance.

UNIT-II

3. Medicinal Plants: History and classification of drugs; source, part used, active principle and uses of important drugs of B.P. & I.P.
4. Aromatic Plants: Source, botany and uses.

UNIT-III

5. Innovations for meeting world food demands.
6. Plants used as avenue trees for shade, pollution control and aesthetics.
7. Insecticides: Source and uses of plant based insecticides.

UNIT-IV

8. World centres of primary diversity of domesticated plants: The Indo-Burmese centre; plant introductions and secondary centres.

Practicals

The Practical Course is divided into two units; (1) Laboratory Work; and (2) Field Survey and Scientific Visits.

Laboratory Work:

1. Food Crops: Wheat, rice, maize, chickpea (Bengal gram), potato, tapioca, sweet potato, sugarcane. morphology, anatomy, microchemical tests for stored food materials.
2. Forage/fodder Crops: Study of any five important crops of the locality (for example fodder sorghum, bajra, berseem, clove, guar, bean, gram, Ficus sp.).
3. Vegetables Oils: Mustard, groundnut, soyabean, coconut, sunflower, castor, morphology, microscopic structure of the oil-yielding tissues, tests for oil and iodine number.

Field Survey :

1. Prepare a list of 10 most important sources of firewood and timber in your locality. Give their local names, scientific names and families to which they belong. Mention their properties.
2. The students should be taken to a recognized botanical garden or a museum (such as those at the Forest Research Institute, Dehra Dun; National Botanical Research Institute, Lucknow) and to a CSIR Laboratory doing research on plants and their utilization and an ICAR Research Institute or a field station dealing with crops.

**Essential Reading**


**Further Reading**


**Semester-I**

**Paper–V : Angiosperms : Phylogeny and Embryology**

**Theory : 75 (60A+15CA)**

**Practical: 25 (20A+ 5CA)**

**Objective:** To acquaint the students about the origin and evolution of angiosperms, developmental stages of gametophyte and embryo development.

**Teaching Methodology:** It will involve class room lectures, power point presentations, charts, models, practicals and field visits etc.

**Instructions for the paper setter**

Question paper will have four sections. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

**UNIT-I**

1. **The Origin of Angiosperms:** The first traces of angiosperms, probable ancestors and diversification, origin of monocots, relationship of monocots and dicots.
2. **General Evolutionary Trends in Angiosperms:** Habits and habitats, leaf structure, inflorescence and flowers.

**UNIT-II**

3. **Development of Male and Female Gametophytes:** Ultrastructural details and relationships.
4. **Fertilization:** Zygote and embryo development; Suspensor, Structural organization and functional aspects.

**UNIT-III**

5. **Apomixis :** Types and evolutionary significance.
6. **Sexual Incompatibility:** Significance, types, Self- incompatibility: genetic basis, barriers to fertilization, biological significance.

**UNIT-IV**

7. **Polyembryony:** Classification, causes, experimental induction, and practical applications.
8. **Experimental Embryology**: Seed, embryo, and proembryo culture; regulation of gene activity during embryogenesis; Somatic embryogenesis, its cytological and physiological basis; Pollen embryogenesis, pathways, competence and cytogenetics. Applied aspects of embryogenesis in vitro, embryo rescue in inviable crosses; Clonal multiplication, preservation of germplasm.

**Practicals**

1. Study of phenetic variability and character analysis of representative members of various angiospermic families represented in the local flora and study of their phylogenetic relationships.
2. Study of stigma, style and pollen types; Histological aspects of stigma; pollen germination and path of pollen tubes; pollen-stigma incompatibility and controlled pollination; and experiments related to experimental embryology (somatic embryogenesis, methods of testing pollen viability, hanging drop method of pollen germination).
3. Some basic techniques for study of pollen structure and viability.

**Essential Reading**


**Further Reading**


**M.Sc. (Hons. School) Botany Semester –II**

**Paper - I - Phycology**

**Theory**: 75 (60A+15CA)

**Practical**: 25 (20 A+ 5CA)

**Objective**: To acquaint the students about the morphology, biology and importance of algal organisms.

**Teaching Methodology**: It will involve class room lectures, practicals and field visits etc.

**Instructions for the paper setter**

Question paper will have **four** units. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

**UNIT-I**

1. Criteria for algal classification (pigments, reserve food, flagella, chloroplast endoplasmic reticular membrane etc.); Comparative account of important systems of classification (Fritsch and Lee); Salient features of major divisions (Cyanophyta, Chlorophyta, Xanthophyta, Bacillariophyta; Phaeophyta, Dinophyta, Cryptophyta and Rhodophyta).

**UNIT-II**

2. Diversity in algal habitats (terrestrial, freshwater and marine).
3. Thallus organization in algae including evolutionary trends.

UNIT-III

5. Current concepts and relationships of prochlorophycean algae.

UNIT-IV

6. Rhythms and bioluminiscence in dinoflagellates.
7. Economic Importance of algae (algal biofertilizers, algal blooms, algae as food and feed, uses in industries etc.).

Practicals
1. Collections and culture (media preparation, sterilization, inoculation and incubation).
2. Range of thallus and sex organs in major algal groups.
3. Heterocysts and their frequency in some cyanophycean genera.

Essential Reading

Further Reading

Semester –II

**Paper–II : Plant Anatomy**

**Objective:** To acquaint the students about the detailed structure of xylem, phloem, leaf and seed coat anatomy.

**Teaching Methodology:** It will involve class room lectures, power point presentations, charts, models, practicals and field visits etc.

**Instructions for the paper setter**

Question paper will have four units. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

UNIT-I


UNIT-II

UNIT-III

3. The Leaf: Variation in structure, Kranz anatomy, Leaf abscission, Transfer Cells.

UNIT-IV


Practicals
1. T.S., L.S. and R.L.S. of selected hard and soft woods. Maceration of some gymnospermous and Dicotyledonous woods and studying the constituents of xylem and phloem tissues.
2. T.S. of various types of leaves (isobilateral, bifacial, hydrophytic, xerophytic, C₃ and C₄ leaves).
3. Abnormal activity of cambium in selected and available taxa.
4. Study of ergastic substances.
5. Fixation and maceration techniques, staining techniques of plant tissues.
6. Microtomes and microtomy.

Essential Reading

Further Reading


Semester –II

Paper–III: Taxonomy of Angiosperms

Theory : 75 (60A + 15CA)
Practical: 25 (20A+ 5CA)

Objective: To acquaint the students about the basic concepts in plant taxonomy, various systems of classification, ranks and nomenclature of taxa.

Teaching Methodology: It will involve class room lectures, power point presentations, charts, models, practicals and field visits etc.

Instructions for the paper setter
Question paper will have four units. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

UNIT- I
1. Significance, aims and procedures of plant taxonomy; Alpha- and Omega- taxonomy; Biosystematics.
2. Herbarial practices and Herbaria.
3. Botanical gardens and their importance.

UNIT- II
5. Diagnostic keys.
UNIT- III
6. Ranks of taxa and Nomenclature of taxa according to their ranks.

UNIT- IV
8. Taxonomy as a synthetic discipline.
9. **Numerical Taxonomy:** Definition and aims; applications of numerical taxonomy; merits and demerits of using numerical methods.

Practicals
1. Study of phenetic variability and character analysis of representative members of various angiospermic families represented in the local flora and study of their phylogenetic relationships.
2. Plant collection, identification, and preservation.
3. Study of local flora.
4. Derivation of families of local flowering plants using diagnostic keys.

**Essential Reading**

**Further Reading**

**Semester –II**

**Paper-IV: Cytogenetics and Plant Breeding**

**Theory : 75 (60 A+15CA)**

**Practical: 25 (20 A+ 5CA)**

**Objective:** Course objective is to study about genomes, functioning of genes and chromosomes and their characterisation and various methods of plant breeding.

**Teaching Methodology:** Traditional and power point presentations.

**Instructions for the paper setter**

Question paper will have **four** units. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

**UNIT- I**

1. **Genomes:** Organization in prokaryotes and eukaryotes, law of DNA constancy and C value paradox. Organization of plastid and mitochondrial genomes.
2. **Chromatin and chromosomal organization**: Chromosome structure and DNA packaging, euchromatin and heterochromatin, karyotype analysis and banding patterns. Special chromosome types: polytene, lampbrush, B and sex chromosomes.

3. **Fine structure of gene**: Coding and noncoding sequences, unique and repetitive DNA; pseudogenes, gene families.

**UNIT – II**

4. **Cell cycle**: Phases, cell cycle checkpoints, genetic regulation of the cell cycle.

5. **DNA enzymes**: Enzymes involved in replication, polymerase, topoisomerase, methylase, nuclease and restriction endonucleases; replication origin and replication fork, fidelity of replication.

6. **DNA damage and repair**: Causes of DNA damage; Photoreactivation, excision, mismatch, post replication and error prone repair systems.

**UNIT – III**

7. **Genetic recombination**: Crossing over and chiasma formation; molecular basis of genetic recombination.

8. **Sex determination**: Mechanism of sex determination, sex chromatin and dosage compensation, Sex linked inheritance and common genetic disorders.

9. **Gene mapping methods**: Genetic and physical maps of chromosome, mapping with molecular markers and somatic cell hybrids.

**UNIT – IV**

10. **Principles of plant breeding**: Principles and objectives, methods of breeding self and cross pollinated crops; heterosis and hybrid vigour; utility of hybrids in genetics and plant breeding.

11. **Male sterility**: Concept, classification, genetic control, inheritance pattern and breeding utility.

**Practicals**

1. Preparation and study of prefixatives, fixatives and stains.
2. Staining and study of polytene chromosomes.
3. Characteristics and behavior of B chromosomes.
4. Preparation and study of karyotype.
5. Mitosis and meiosis in higher plants.
6. Study of aberrant meiosis in *Rhoeo, Tradescantia* and *Chrysanthemum*.
7. Calculation of mitotic index and chiasma frequency.

**Suggested Reading**


**Further Reading**


**Semester – II**

**Paper–V: Environmental Botany**

**Theory : 75 (60 A+15CA)**

**Practical: 25 (20 A+ 5CA)**

**Objective:** After going through the content of this course, the students are expected to understand and appreciate the current ecological and environmental problems confronted by man at local, regional, national and global level for the present and the future, especially pollutions of different
types, conservation for posterity apart from issues of climate change and biodiversity. It also aims at appreciating the efforts of different governments of the world to combat the problems individually as well as collectively.

**Teaching Methodology:** Teaching is done in any way (following both traditional and modern methods) so as to sensitize and inspire students on the subject.

**Instructions for the paper-setter**

Question paper will have four units. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

**UNIT-I**

1. **Management and Conservation of Natural Resources**: Aims, Objectives and Principles of conservation, conservation policies, Conservation strategies required at national and international level, Types of resources, Conservation of plant genetic diversity, Sustainable development and ecological economics.
2. **Environmental Issues**: Environmental pollution and impact on plants; Problem of Solid wastes, Primary methods of waste disposal – Landfills, incineration, source reduction, recycling, vermicomposting. An introduction to Environment Impact assessment

**UNIT-II**

3. **Global Environmental Changes**: Global warming, climate change, Reasons, possible effects and measures to combat the problem.
4. **Ozone Depletion**: Phenomenon, reasons, possible ecological effects and measures to check the depletion of ozone
5. **Protection of Environment**: International concern and efforts for environmental protection, global plan, Stockholm Summit, priority issues; Earth Summits

**UNIT-III**

6. **Biodiversity**: Concept, Status, Measuring of biodiversity, Monitoring and documentation, Significance in terms of economic, spiritual, scientific, educational, ecological and genetic values, Major drivers of Biodiversity change, Biodiversity management approaches, Indian case studies especially - Project Tiger.
7. **Biosphere Reserves and Biodiversity hotspots**: The concept, major functions and current status in India and world
8. **Risk categories of plants**: Major risk categories, IUCN Red List of threatened species.

**UNIT-IV**

9. **Weed Ecology & Management**: The impact, use and ecological role of weeds in agroecosystems, weed characteristics related to success, Major-weeds of the world; Ecological approach to weed management, **Allelopathy**: concept, mechanisms and exploitation in weed management. **Plant Invasion**: Definition, factors (both Intrinsic and extrinsic) affecting invasion, Status and impact of plant invasion on native flora.
10. **Methods in field biology**: Methods of estimating population density of plants, ranging patterns, through direct, indirect and remote observations, sampling methods in the study of behavior, habitat characterization: ground and remote sensing methods.

**Practicals**

1. An introduction to various methods of sampling vegetation
2. Determination of density, dominance and cover area and Importance values Index
3. Determination of various ecological indices
4. Vegetation analysis – Direct gradient analysis and Ordination and indirect methods
5. Methods to study species association
   Jaccard’s and Sorenson Similarity indices
6. Demonstration of impact of pollutants on plants through field studies and laboratory experiments
7. Demonstration of allelopathy under laboratory and field conditions
8. An assignment on the floral diversity of weeds and other common herbs of the Panjab University Campus.

**Essential Reading**


**Further Reading**


**M.Sc. (Hons. School) III Semester**

**Paper –I : Mycology**

**Theory : 75 (60A+15CA)**

**Practical: 25 (20A+ 5CA)**

**Objective:** To acquaint the students about the morphology, biology, systematics and importance of fungal organisms.

**Teaching Methodology:** It will involve class room lectures, power point presentations, charts, models, practicals and field visits etc.

**Instructions for the paper setter**

Question paper will have four units. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

**UNIT-I**

1. Kingdom Fungi: Introduction to Fungi and their significance to humans.
2. Characteristics of fungi and fungal systematics.
3. Recent trends in classification of fungi.

**UNIT-II**

A general account, structure and reproduction of the following:

4. Phylum Chytridiomycota and Zygomyctota.
5. Phylum Ascomycota: Introduction to Ascomycetes

**UNIT-III**

A general account, structure and reproduction of the following:
10. Phylum Basidiomycota: Agaricales and Gasteromycetes
11. Phylum Basidiomycota: Aphyllophorales (Polypores, Chantarelles, Tooth fungi, Coral fungi and Corticiodis)

UNIT-IV
A general account, structure and reproduction of the following:
15. Phylum Hyphocytziomycota: General characteristics and classification.
16. Phylum Labyrinthulomycota: Net slime moulds
17. Phylum Plasmodiophoromycota: Endoparasitic slime moulds.
18. Phylum Dictyosteliomycota: Dictyostelid cellular slime moulds

Practicals
Morphological study of the following genera:

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<thead>
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<th>Peronospora</th>
<th>Chaetomium</th>
<th>Drechslera</th>
<th>Puccinia</th>
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<tbody>
<tr>
<td>Albugo</td>
<td>Morchella</td>
<td>Phoma</td>
<td>Ustilago</td>
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<td>Mucor</td>
<td>Melamspora</td>
<td>Penicillium</td>
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Essential Reading

Further Reading

Semester-III

**Paper –II : Plant Physiology**

**Theory : 75 (60 A+15CA)**
**Practical: 25 (20 A+ 5CA)**

**Objective:** The course would deal with advances in plant physiology especially involving molecular concepts. Beginning with overview of the cell and its organelles, the course would cover the advances in membranes (structure and function), photosynthesis, respiration, nitrogen metabolism,
plant hormones, reproductive physiology and conclude with responses of the plants to abiotic stresses. The course has been designed keeping in view the UGC-NET syllabus.

**Teaching Methodology:** The teaching methodology would provide comprehensive information on board along with demonstration through models, slides and practicals.

**Instructions for the paper setter**

Question paper will have **four** units. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

**UNIT-I**

1. **Membranes:** Recent concepts of structure and composition of membrane with various classes of pumps and their significance.
2. **Plant Respiration:** Detailed mechanism; Glycolysis and TCA cycle, Mitochondria as biological oxidators; Chemiosmotic regeneration of ATP; CN− resistant respiration and metabolic inhibitors regulating the respiration.

**UNIT-II**

3. **Photosynthesis:** Energy pathway in photosynthesis; Chloroplast as an energy transducing organelle, Composition and characterization of photosystem-I and -II; Electron flow through cyclic, non-cyclic and pseudo-cyclic photophosphorylations, Pathways of CO₂ fixation; (C₃, C₄ and CAM) and regulation of photorespiration; RUBISCO as an example of model enzyme for semi-autonomy at the molecular level.
4. **Nitrogen fixation by free and symbiotic organisms:** An overview - mechanism of biological nitrogen fixation; Nodule formation and Nod factors; Interrelationship between photosynthesis and nitrogen metabolism; Mechanism of nitrate uptake and reduction, ammonium assimilation; Sulfur and phosphorus uptake; transport and assimilation.

**UNIT-III**

5. **Plant Hormones:** A critical discussion on hormones, their molecular mechanism of action and role in modulating metabolism, tropisms and reproduction at tissue cell and at genetic level.
6. **Reproductive Physiology:** Phytochrome/Hormones in reproduction.

**UNIT-IV**

7. **Stress physiology:** Introduction to various abiotic stresses, effects at physiological, biochemical and molecular levels.
8. **Secondary Metabolites:** Terpenes, Phenols, Nitrogenous substance; roles.

**Practicals**

1. Determination of water potential by various methods.
3. Spectroscopic determination of chlorophyll a, chlorophyll b, and total chlorophyll, carotenoids and anthocyanins under varied environmental conditions.
4. Determination of chlorophylla and chlorophyll, b ratio in C₃ and C₄ plants.
5. Seed germination as affected by environmental factors.
7. Preparation of biovisual aids with respect to plant metabolic or molecular process(es).

**Essential Reading**

Objective: To acquaint the students about the basic concepts of plant biochemistry including composition, structure and functions of bio-molecules.

Teaching Methodology: The teaching methodology would involve elaborative description of the various topics on board along with demonstration through models and practicals.

Instructions for the paper setter

Question paper will have four units. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

UNIT-I
2. Lipids: Classification, Structure and functions; Biosynthesis of Fatty Acids.

UNIT-II
3. Amino acids and Proteins: Structure types, properties and Metabolism of Amino acids; Primary, Secondary, Tertiary and Quaternary structure of proteins; stability of protein structure; Classification of proteins based on composition, solubility function; Reverse turns and Ramachandran plot.

UNIT-III
5. Enzymes: Nomenclature and Classification; Enzyme Kinetics; Mode and Mechanism of Enzyme Action, Enzyme Regulation, Activators, Inhibitors and Isoenzymes: Allosteric enzymes.
6. Vitamins: Structure, and functions of Thiamine, Riboflavin, Nicotinic Acid, Pantothenic Acid, Pyridoxine, Biotin, Folic Acid, Vitamin B12, Ascorbic Acid, Vitamin A, D, E and K.

UNIT-IV
7. Compounds of Energy Transfer and Redox Reactions: Compounds of Energy Transfer: Adenosine Triphosphate, Uridine Triphosphate. Cytidine Triphosphate, Guanosine Triphosphate

Practical
1. Detection of reducing, non reducing and total sugars.
2. Quantitative estimation of total carbohydrates by anthrone reagent.
3. Qualitative tests of protein like Biuret test, Ninhydrin test.
4. Quantitative estimation of amino acid and phenols by using Spectrophotometer.

**Essential Reading**


**Suggested Readings**


**Semester-III**

**Paper-IV: Molecular Biology**

**Theory :** 75 (60 A+ 15CA)

**Practical:** 25 (20 A+ 5CA)

**Objective:** Objective of this course is to expose students to current knowledge of plant molecular biology and the experimental basis of that knowledge.

**Teaching Methodology:** Traditional and power point presentations.

**Instructions for the paper setter**

Question paper will have *four* units. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

**UNIT – I**

1. **Analysis of macromolecules:** Isolation and purification of RNA, DNA and proteins and their analysis by gel electrophoresis.
2. **RNA synthesis and processing:** Structure and functions of different types of RNA, formation of initiation complexes; Transcription factors, activators and repressors, RNA polymerases. RNA processing (capping, splicing polyadenylation); RNA editing and RNA transport.

**UNIT – II**

3. **Control of gene expression:** Regulation of gene expression in, prokaryotes and eukaryotes; role of chromatin in regulating gene expression and gene silencing.
4. **Gene expression analysis:** DNA micro-assays for gene expression analysis, types, target preparation; Probe synthesis and hybridization, data analysis.

**UNIT- III**
5. **Gene libraries**: Construction of genomic and cDNA libraries in plasmid, phage, cosmid, BAC and YAC vectors.

6. **DNA sequencing**: Principle, dideoxy chain termination and chemical methods. Strategies for genome sequencing; automated sequencing.

7. **Polymerase chain reaction**: Principle and procedure; types, applications of PCR in basic and applied research.

**UNIT – IV**

8. **Blotting techniques**: Concept of nucleic acid hybridization; Southern, Northern and Western blotting.

9. **Molecular markers**: Types and characteristic features, RFLP, RAPD, AFLP and SNP techniques. Applications of molecular markers in germplasm assessment and conservation.

**Practicals**

1. Extraction and estimation of DNA from plant material.
2. Extraction and estimation of RNA from plant material.
3. Genomic DNA isolation.
4. DNA analysis by gel electrophoresis.
5. Protein isolation and their separation by polyacrylamide gel electrophoresis.
6. To prepare a restriction digest by using different restriction enzymes.
7. DNA amplification by polymerase chain reaction.

**Essential Reading**


**Further Reading**


**Semester-III**

**Paper –V : Ecosystem Ecology and Forestry**

**Theory : 75 (60 A+15CA)**

**Practical: 25 (20 A+ 5CA)**

**Objective**: This syllabus is designed with the view to sensitize and familiarize the students of M.Sc with the basic concepts of ecology and forestry. The major goals for designing this course include: to make students learn various ecological theories, their applications and implementation and to provide them a platform for further studies and competitive exams.

**Teaching Methodology**: Teaching is done in any way (following both traditional and modern methods) so as to sensitize and inspire students on the subject.

**Instructions for the paper setter**

Question paper will have *four* units. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

**UNIT- I**
1. **Basic concepts of Ecology**: Physical conditions of Environment, resources. Concept of habitat and niche: Types of niche (Fundamental and Realized), Resource partitioning and character displacement.

2. **Ecosystem**: Structure and function, energy flow and mineral cycling (CNP), primary production and decomposition, structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, estuarine).

3. **Ecological succession**: Types, mechanisms, changes involved in succession, concept of climax.

**UNIT- II**

4. **Population ecology**: Characteristics of populations, population growth curves, population regulation, life history strategies \((r \text{ and } K)\) selection, Metapopulations- demes and dispersal, interdemic extinctions, age structured populations

5. **Community ecology** Nature of communities, community structure and attributes, levels of species diversity and its measurement, edges and ecotones.

6. **Species interactions**: Various types of positive and negative interactions - Competition, herbivory, carnivory, pollination, Mutualism, symbiosis, proto-cooperation.

**UNIT- III**

7. **Conservation at the population and species level**: Problems of small populations, effective population size, minimum viable population, loss of genetic variability, demographic variations, approaches to establishing new populations

8. **Conservation biology**: Approaches to conservation, Ex-situ conservation strategies (Zoos, botanical gardens, aquaria, seed/germplasm banks).

9. **Establishment protected areas**: Establishment and classification of protected areas, existing protected areas, creating new protected areas.

**UNIT- IV**

10. **Designing and management of protected areas**: Issues of reserve design, protected area networks, landscape ecology and park design. Various management tools, identifying and managing various threats to protected areas. Indian case studies on conservation (Project Tiger, Biosphere reserves).

11. **Forest Types**: Climate of India, different climatic regions of India. Central characters and distribution of the different forest types of India.

12. **Forest Ecosystem Services**: What are ecosystem services, Classification of various forest ecosystem services and their management.

**Practicals /Assignments**

1. To determine various sampling techniques to study plant communities
2. To determine various ecological indices in the open grassland areas
3. To determine degree of association between two species by Chi-square method
4. To determine index of similarity between vegetation of two communities
5. To calculate and understand alpha, beta and gamma diversity
6. To study the ecological attributes some important invasive exotic plants found in Chandigarh
7. To demonstrate and write a small project on allelopathy (a type of plant-plant interaction)
8. To measure tree height and diameter at the breast height of important tree species in the Panjab University Campus
9. To identify and enlist various ecosystem services
10. An assignment on the Trees, herbs and shrubs of Panjab University campus
Essential Reading


Further Reading


M.Sc. (Hons. School) IV Semester

Paper –I : Plant Pathology

Objective: To acquaint the students about the history of plant pathology and detailed study about various diseases and their defense mechanisms.

Teaching Methodology: It will involve class room lectures, power point presentations, charts, models, practicals and field visits etc.

Instructions for the paper setter

Question paper will have four units. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

UNIT-I

1. Introduction, History of Plant Pathology.
2. Pathogenesis: Introduction, prepenetration, penetration and development inside host tissue.

UNIT-II

5. Defence mechanism.

UNIT-III

7. Dispersal of Plant Pathogens: Direct and indirect transmission.
9. Disease Control: Cultural and chemical control, breeding for disease resistance.

Practicals
1. V. S. of White Rust of Crucifer.
2. T. S. of Linseed Rust.
3. Rust on Wheat and Barberry.
5. Downy mildew of Grapes.
7. Red rot of Sugarcane.
8. Tikka disease of Groundnut.
9. Late blight of Potato.
10. Early blight of Potato.
11. Diseases caused by fungi imperfecti.
12. Study of Viral diseases.
15. Wart disease of Potato.
17. Citrus canker.
18. Tundu disease of Wheat.

Essential Reading

Further Reading

Semester-IV

Paper-II : Biostatistics & Research Methodology

Objective: This course is designed to make students learn and understand the applications of various statistical methods in plant sciences and the research methodology as to how to design experiments, write research papers and familiarize them with Science citation index, impact factor etc. and importance of ethics in research. This course content of this paper is prepared on the patterns of relevant topics of the life sciences paper of UGC-CSIR with the aim of imparting comprehensive knowledge to the students.

Teaching Methodology: Teaching is done in any way (following both traditional and modern methods) so as to sensitize and inspire students on the subject.

Instructions for the paper setter
Question paper will have four units. Examiner will set a total of nine questions comprising four questions from each unit, and one compulsory question of short answer type covering the whole syllabus. Students will attempt at least one question from each unit apart from the compulsory question. All questions may carry equal marks, unless specified.

**SECTION (A): Biostatistics**

UNIT-I

1. Introduction, objectives and applications of statistical methods in plant sciences; Collection, compilation and presentation of data;
2. Central tendency: mean (arithmetic, geometric and harmonic) median and mode. Standard deviation and standard error;
3. Probability distributions (Normal, Binomial and Poisson), Tests of hypothesis and statistical significance;
4. Test for comparing means of one or two samples.

UNIT-II

5. Analysis of variance (one way) multiple comparisons – Duncan’s Multiple range test,
6. Dunnett’s test, Tukey test;
8. Tests of association, goodness of fit using chi-square test

**SECTION (B): Research Methodology**

UNIT-III

1. Basic principles and significance of research design;
2. Experimental set-up;
3. Randomized Block Designs (RBD), completely randomized designs,
4. Research articles research papers, popular research articles and reviews,

UNIT-IV

5. How to write a research paper, reference styles, process of reviewing;
6. Important journals in plant sciences,
7. An introduction to science citation index and impact factor of a journal;
8. Copyright act, academic frauds, plagiarism.

**Practicals**

Data collection, calculation of mean, median and mode, standard deviation and error, t-value, F-value and r value, One way analysis of variance and introduction to post hoc tests with the help of statistical softwares, Calculation of chi square value. Listing of important journals of botany, introduction to online submission of research papers and calculation of impact factor of a journal.

**Essential Reading**


**Further Reading**

Objective: Objective of this course is to expose students to current knowledge of plant molecular biology, genetic engineering and their experimental basis.

Teaching Methodology: It will involve classroom lectures, power point presentations, charts, models, practicals and field visits etc.

Instructions for the paper setter

Question paper will have four units. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

UNIT-I
3. Plant regeneration: Definition, pre-conditions, role of plant material, effect of culture media and culture conditions, and biotechnological utilization of regeneration potential.

UNIT-II
5. Somatic Embryogenesis; factors affecting somatic embryogenesis and its utility.

UNIT-III
7. Somaclonal variations and their applications.
8. Haploid Production: Definition, androgenesis, Gynogenesis, culture techniques and induction factors, biotechnological utilization of haploid production.

UNIT-IV
10. Genetic Engineering: Transgenic Plants, recombinant DNA technology, cloning vehicles, gene engineering through cutting and joining DNA molecules, restriction endonucleases, ligases, applications of genetic engineering.

Practicals
1. Laboratory organization and techniques for tissue culture.
2. Different nutrient Media; their preparation and sterilization.
3. Selection of different explants, surface sterilization and inoculations to initiate cultures.
4. To study different regeneration pathways in explants, under controlled conditions.
5. To study effect of different growth regulators in in vitro cultures.
6. Anther and pollen culture techniques to establish haploid cultures.
7. Technique of single cell cultures and suspension culture.
8. Technique of production of haploids.
10. Technique of encapsulation of shoot meristem/somatic embryos in calcium alginate beads.

**Essential Reading**


**Further Reading**


**Semester-IV**

**Paper-IV: Comprehensive Test & Field Botany (Marks: 50+50)**

**Objective:** The basic objective of this course is to acquaint the students with natural flora and fauna in various regions through field trips.

**Teaching Methodology:** It will involve organizing botanical excursions and visits to various herbaria and botanical gardens of the country.

The students will have to go for field study trip to the place of the choice of the course instructor/Academic Committee and prepare a field report. The team of accompanying teachers will evaluate the level of academic interest, team-spirit, cooperativeness, discipline and other non-scholastic attributes, apart from the Field Report submitted by the students. The Teacher-in-charge of the Course / Academic Committee will also arrange a comprehensive test based on the Field Botany.

**Semester-IV**

**Paper-V:(A) Project Work & (B) Seminar Marks : (A) 50 & (B) 50)**

**Objective:** The paper will involve seminar presentations by the students on topics pertaining to their course study and submission of project report based on field trips.

**Teaching Methodology:** It will involve power point presentations followed viva-voce examinations

- The topic of Project work shall be of the choice of the students in consultation with the Academic Committee.
- Topics of current interest and related to the theory papers shall be selected by the student and approved by the Academic Committee.
- Each student has to present her/his seminar on the assigned topic.
- The schedule of the seminar shall be decided and finalized by the Chairman.
- Attendance in the seminar is compulsory.
- There is no internal assessment as such.
- Credit to be given for attendance and participation in discussion by the board of examiners.
- End written examination will be conducted from within the topics of the seminar.