(w.e.f. 2018-2019)

SEMESTER SYLLABUS STRUCTURE
M.Sc. (BOTANY)
## M.Sc. (BOTANY) PREVIOUS YEAR

### FIRST SEMESTER

<table>
<thead>
<tr>
<th>PAPER</th>
<th>DESCRIPTION</th>
<th>INTERNAL</th>
<th>EXTERNAL</th>
<th>MARKS</th>
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<tbody>
<tr>
<td>PAPER I (BOT 101)</td>
<td>MICROBIOLOGY, PLANT VIROLOGY &amp; BACTERIOLOGY</td>
<td>25</td>
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<tr>
<td>PAPER II (BOT 102)</td>
<td>MYCOLOGY</td>
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<td>PAPER III (BOT 103)</td>
<td>PHYCOLOGY AND LICHENS</td>
<td>25</td>
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<td>PAPER IV (BOT 104)</td>
<td>BRYOPHYTES</td>
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<td>PAPER I (BOT 201)</td>
<td>PTERIDOPHYTA</td>
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<td>PAPER II (BOT 202)</td>
<td>GYMNOSPERMS &amp; PALAEOBOTANY</td>
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<td>PAPER III (BOT 203)</td>
<td>ANGIOSPERM: TAXONOMY, MORPHOLOGY &amp; ECONOMIC BOTANY</td>
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### M.SC. (BOTANY) FINAL YEAR

### THIRD SEMESTER

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<td>PLANT PHYSIOLOGY</td>
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<td>GENETICS AND CYTOGENETICS</td>
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<td>PLANT BREEDING &amp; BIOSTATISTICS</td>
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<td>ANATOMY, EMBRYOLOGY AND MORPHOGENESIS</td>
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<td>MOLECULAR BIOLOGY AND BIOLOGICAL TECHNIQUES</td>
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<td>PAPER IV (BOT 404)</td>
<td>SPECIAL PAPERS (ANY ONE OF THESE): ENVIRONMENTAL BOTANY, ADVANCED PLANT PHYSIOLOGY, PLANT PATHOLOGY</td>
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**Note:** There will be 9 questions in each paper and candidate has to attempt only 5 questions. **Q.1** will carry short answers and will be **compulsory** based on units I - IV. **Two** questions will be set from **each unit**, out of which one question has to be attempted. Candidate must obtain minimum pass marks in Theory and Practical Examinations separately.
M.Sc. (Botany) Practical
Marks Distribution
(w.e.f. 2018-2019)

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SEMESTER-I: Paper I

BOT 101: MICROBIOLOGY, PLANT VIROLOGY＆BACTERIOLOGY

UNIT I
1. Plant virus classification, structure, transmission, detection
   a. Nomenclature and classification of plant viruses.
   b. Range of plant virus particle and its genomic organization.
   c. Nature of plant viruses.
   d. Morphological, anatomical, and biochemical changes in virus infected plants.
   e. Transmission of plant viruses and their relationship with vectors.
   g. Virus detection by serological and nucleic acid hybridization methods.

UNIT II
2. Plant virus replication, sub-viral pathogens, and techniques
   a. Infection and replication of plant viruses.
   b. Modern methods of plant virus disease control.
   c. Structure, replication and pathogenicity of viroids
   d. Structure and replication of virus infecting bacteria.
   e. MLO structure and multiplication.

UNIT III
3. Bacteria- History, classification, structure and genetics
   a. History of microbiology.
   b. Classification of Bacteria and Archaebacteria based on Bergey’s Manual of Systematic Bacteriology.
   c. Bacterial cell structure, function of cell components.
   d. Bacterial genome structure, replication, expression and recombination, and plasmids.

UNIT IV
4. Bacterial metabolism, microbiological applications
   a. Bacterial nutrition and metabolism, including Nitrogen fixation.
   b. Antibiotics and their mode of action.
   c. Decomposition of organic matter in soil, cycling of essential elements in nature, and Biofertilizers.
   d. Microorganisms in food processing-Cheese, butter, milk, bread.
   e. Microorganisms in relation to biotechnology: Production of alcohol, beverages, organic acid, vitamins and enzymes.
   f. Water borne pathogenic microbes, role of microorganism in sewage disposal.

Internal Assessment  
25
1. Short test/ Quiz  
   10
2. Long Test  
   15
SEMESTER-I: Paper II

BOT 102: MYCOLOGY

UNIT I:
1. General Account of Fungi
   a. Status of fungi.
   b. Detailed fungal Classification of Alexopoulos and Mims.
   c. Mode of nutrition of fungi and their physical and chemical requirement for growth and reproduction.
   d. Reproduction, hormonal mechanism of sexual reproduction.
   e. Heterokaryosis, parasexuality, heterothallism.

UNIT II:
1. Methods of isolation and culturing of fungi.
2. Fossil fungi.
3. Mycorrhizae.
4. Fungi as a biocontrol agent.
5. Economic importance of fungi-
   i. Utilization of fungi by man as food, in food processing, in production of organic acid, vitamins and enzymes.
   ii. Harmful activities: Deterioration of material by fungi, fungi as an agent of plant and human diseases.

UNIT III:
2. Characteristic features, systematic position, thallus organization, reproduction, phylogeny and interrelationships of the principal classes of fungi with special reference to following genera:
   A. Myxomycota:
      i. Myxomycetes- Stemonitis.
      ii. Plasmodiophormycetes- Plasmodiophora.
   B. Eumycota: 
      a. Mastigomycotina:
         i. Chytridiomycetes- Synchytrium, Allomyces.
         ii. Oomycetes- Saprolegnia, Phytophthora, Pythium, Peronospora, Sclerospora.
   b. Zygomycotina:
      i. Zygomycetes: Pilobolus, Entomophthora
   C. Ascomycotina: 
      i. Ascomycetes: Taphrina, Penicillium, Protomyces, Phyllactinia
   D. Basidiomycotina:
      i. Basidiomycetes: Puccinia, Uromyces, Melampsora, Ustilago, Cyathus.
   E. Deuteromycotina:
      i. Deuteromycetes: Fusarium, Colletotrichum, Alternaria, Cercospora.

Internal Assessment 25
1. Short test/ Quiz 10
2. Long Test 15
SEMESTER-I: Paper III

BOT 103: PHYCOLOGY AND LICHENS

UNIT I:
Phycology:
1. General account of Algae
   a. Study of important systems of classifications, criteria used in algal classifications including recent trends up to order.
   b. Range of thallus structure and organization.
   c. Algal Pigment.
   d. Nature of reserved food products.
   e. Reproductive diversity, life history patterns and alternation of generations.
   f. Economic and environmental aspects of algae.
   g. Isolation and culture techniques of algal groups.

UNIT II:
2. Characteristics features, systematic position, thallus organization, reproduction, phylogeny and interrelationships of the principal classes of algae with special reference to-

UNIT III:
   c. Xanthophyceae: Botrydium.
   d. Bacillariophyceae: Navicula, Melosira.
   e. Phaeophyceae: Ectocarpus, Dictyota, Laminaria, Fucus.

UNIT IV:
Lichens:
1. A general account of lichens and its symbionts, thallus structure, reproduction, physiology,
2. Classification and distribution.
3. Chemistry of lichens, Isolation of symbionts and synthesis of thallus.
4. Economic importance of lichens.

Internal Assessment 25
1. Short test/ Quiz 10
2. Long Test 15

M.M. 25+75=100
SEMESTER-I: Paper IV

BOT 104: BRYOPHYTES

UNIT I:
1. General account of Bryophytes
   a. General characteristics and life cycle of Bryophytes
   b. Broad outline classification of Bryophytes.
   c. Ecology and Physiology of Bryophytes
   d. Reproductive biology of Bryophytes.
   e. Geographical distribution of Bryophytes with special reference to India.
   f. Bryophytes as indicators of mineral enrichment and environmental pollution.
   g. Economic importance of bryophytes.
   h. Peristome structure and its significance in the classification of mosses.
   i. Evolution of sporophyte in bryophyte.

UNIT II:
2. Characteristic features, classification, gametophytic and sporophytic organization (morphology, anatomy and their distribution in India) of the principle classes of bryophytes with special reference to following genera:
   a. MUSCI:
      i. *Sphagnum*
      ii. *Polytrichum*
      iii. *Takakia*

UNIT III:
   b. ANTHOCEROTAЕ:
      i. *Anthoceros*
      ii. *Notothylas*
      iii. *Dendroceros*

UNIT IV:
   c. HEPATICAE:
      i. *Calobryum*
      ii. *Porella*
      iii. *Plagiochasma*

Internal Assessment 25
1. Short test/ Quiz 10
2. Long Test 15
M. Sc. Semester-I Practical (BP 105)

Paper I- Microbiology, Plant Virology and Bacteriology
1. Preparation of Nutrient media and sterilization technique
2. Gram’s staining and Antibiotic susceptibility test of bacteria
3. Inoculation techniques for growth of bacterial population
4. Isolation of microorganisms from different natural sources- soil, water and sewage
5. Bacteriological examination of water, milk and milk product
6. Identification of symbiotic bacteroids of *Rhizobium*
7. Symptomatology of virus

Paper II- Mycology
1. Study of following genera of fungi-
   *Stemonitis, Synchitrium, Saprolegnia, Phytophthora, Pythium, Peronospora,*
   *Sclerospora, Pilobolus, Taphrina, Penicillium, Protomyces,*
   *Phyllactinia, Puccinia, Melampsora, Ustilago,*
   *Lycoperdon, Geaster, Cyathus, Fusarium, Colletotrichum, Alternaria, Cercospora,*
2. Isolation and culture of fungi
3. Herbarium (Plant/ plant parts with fungal disease)

Paper III- Phycology and Lichen
1. Study of following genera
   **Chlorophyceae**- *Pandorina, Eudorina, Chlorella, Hydrodictyon, Scenedesmus,*
   *Enteromorpha, Ulva, Sphaeroplea, Cladophora, Stigeoclonium, Pithphora, Fritschiella,*
   *Zygonema, Bulbocheate, Mougeotia*
   **Cyanophyceae**- *Microcystis, Lyngbya, Gleotrichia, Stigonema*
   **Xanthophyceae**- *Botrydium*
   **Bacillariophyceae**- *Navicula*
   **Phaeophyceae**- *Ectocarpus, Dictyota, Laminaria*
   **Rhodophyceae**- *Batrachospermum, Gelidium, Polysiphonia*
2. External morphology and preparation of slides of Lichens

Paper IV- Bryophytes
1. Study and Identification of following genera with suitable preparation
   *Sphagnum, Polytrichum,*
   *Anthoceros, Notothylas,*
   *Porella, Plagiochasma,*
M. Sc. Semester-I

Book References

Paper I- Microbiology, Plant Virology and Bacteriology

Paper II- Mycology

Paper III- Phycology and Lichen

Paper IV- Bryophytes
SEMESTER-II: Paper I

BOT 201: PTERIDOPHYTA

UNIT I:

1. General account of Pteridophytes
   a. Classification of Pteridophytes.
   b. Ecology of Pteridophytes.
   c. Distribution of ferns.
   d. Origin and evolution of Pteridophytes.
   e. Telome theory and evolution of stellar system
   f. Heterospory and seed habit.
   g. Apogamy and Apospory.
   h. Physiology of germination of spores and development of fern prothallus.

UNIT II:

2. Classification, distribution, morphology, life history and phylogeny of the following classes with special reference to following genera:
   b. Psilotopsida – *Psilotum*.
   c. Lycopsida –
      i. Selaginellae – *Selaginella*.
      ii. Lepidodendrales – *Lepidodendron*.
      iii. Isoetales – *Isoetes*.
   d. Equisetopsida:
      i. Sphenophyllales – *Sphenophyllum*.
      ii. Calamitales – *Calamites*.

UNIT III:

e. Primofilices:
   i. Zygopteridales - *Botryopteris*.
   ii. Cladoxylales – *Cladoxylon*.
   f. Filicopsida
      • Eusporangiateae: Ophioglossales – *Ophioglossum*.
      • Protoleptosporangiatae: Osmundales – *Osmunda*.

UNIT IV:

• Leptosporangiatae:
  i. Schizaeales – *Lygodium*.
  ii. Pteridales - *Pteris, Adiantum*.
  iii. Dicksoniales –*Pteridium*.
  iv. Hymenophyllales – *Hymenophyllum*.
  v. Gleicheniales – *Gleichenia*.
  vi. Cytatheales – *Cytacea*.
  vii. Marsileales – *Marsilea*.
  viii. Salviniales –*Azolla*

Internal Assessment 25
1. Short test/Quiz 10
2. Long Test 15
SEMESTER-II: Paper II

BOT 202: GYMNOSPERMS AND PALAEOBOTANY

UNIT I:
1. General account of Gymnosperm
   a. General characteristics of Gymnosperms.
   b. Classification of Gymnosperms
   c. Distribution of Gymnosperms with special reference to India.
   d. Economic importance of Gymnosperms
   e. Origin and evolutionary tendencies in Gymnosperm.

UNIT I:
2. A study of their morphology, structure, life history, interrelationship and phylogeny of the following classes with special reference to the following genera:
   a. Cycadopsida
      i. Pteridospermales: Glossopteris.
      ii. Cycadales: Zamia.
      iii. Cycadeoideales (Bennettitales): Williamsonia, Cycadeoidea (Bennittites).
   b. Coniferopsida
      i. Cordaitales: Cordaites.
      ii. Ginkgoales: Ginkgo.
      iii. Coniferales: Araucaria, Cupressus, Thuja.
      iv. Taxales: Taxus.
   c. Gnetopsida
      i. Ephedrales: Ephedra
      ii. Gnetales: Gnetum
      iii. Welwitschiales: Welwitschia

Palaeobotany
1. Types of Fossils, their methods of preservation and methods of study.
4. Theory of continental drift.

Internal Assessment

1. Short test/ Quiz  10
2. Long Test  15

M.M. 25+75=100
SEMESTER-II: Paper-III

BOT 203: ANGIOSPERMS: TAXONOMY, MORPHOLOGY AND ECONOMIC BOTANY

UNIT I:
Taxonomy: A general account
1. History of plant taxonomy.
2. Systems of Classification: History, outlines, basis, merits and demerits of following classifications-
   a. Benthom and Hooker
   b. Hutchinson
   c. Takhtajan
   d. Comquist
3. ICBN (History, Principles and Application.)

UNIT II:
4. Field and herbarium techniques.
5. Herbaria and Botanical Gardens of India and World.
6. Organisation and activities of BSI.
7. Taxonomy as a synthetic discipline, Modern trends of taxonomy:
   Morphology, Cytology, Nucleic Acid Hybridization, Chemotaxonomy, numerical taxonomy and serotaxonomy.

UNIT III:
General knowledge of the distinguishing features of the following families with special reference to best flora:

UNIT IV:
Economic botany:
1. Scope of economic botany, study of economically important plants and plant products.
3. Textile plants and products: A general account.
4. Fumitories and masticatories: A general account.
5. Narcotics and Insecticide as plant products.

Morphology:
1. Phylogeny and interrelationship of Angiosperm.
2. Morphology of flower with special reference to the morphology of carpel and inferior ovary.

Internal Assessment 25
1. Short test/ Quiz 10
2. Long Test 15
SEMESTER II: Paper –IV

BOT 204: ECOLOGY, BIODIVERSITY AND PLANT-SOIL RELATIONSHIP

UNIT I:
2. Autecological studies, gene ecology with emphasis on Indian work
4. Life-forms and biological spectrum.
5. Plant community dynamics and development: succession and climax.
6. Study of plant communities (Analytical and Synthetic characters)
8. Ecological niche.

UNIT II:
9. Study of different types of ecosystem.
10. Ecological energetic.
12. Production ecology, measurement of primary productivity.
13. Ecological adaptation of plants in different ecosystems.
14. Environmental pollution and its consequences

UNIT III:
15. Biodiversity and its conservation:
   a. Introduction to Biodiversity.
   b. Levels of Biodiversity: Genetic species community and Ecosystem.
   c. Mega diversity Zones and Hot spots.
   d. Threats to Biodiversity: Causes of Biodiversity loss species extension.
   e. Red Data Book. IUCN threat categories.

UNIT IV:
16. Plant-soil relationship
   a. Soil properties in relation to plant growth: Physical texture, density, porosity, permeability.
   b. Soil water, energy concept of soil, water, soil water quantities and their measurement.
   c. Soil: its origin and development.
   d. Process of soil formation and soil profile.
   e. Soil erosion: its causes and effects on environment.
   f. Methods of soil conservation.

**Internal Assessment**

1. Short test/ Quiz 10
2. Long Test 15
M. Sc. Semester II Practical

Paper I- Pteridophytes
1. Monographic study of the sporophyte body of the following
   Selaginella, Lepidodendron, Isoetes, Sphenophyllum, Calamites, Botryopteris,
   Cladoxylon, Ophioglossum, Osmunda, Lygodium, Pteris, Adiantum, Pteridium,
   Hymenophyllum, Gleichenia, Cytathea, Marsilea, Azolla

Paper II- Gymnosperms and Palaeobotany
1. A study of representative types
   Zamia, Ginkgo, Araucaria, Cupressus, Thuja, Taxus, Ephedra, Gnetum
2. Study of fossils and fossils slides

Paper III- Angiosperms, Taxonomy, Morphology and Economic Botany
1. Description of local plant in semi technical language
2. Identification of Angiospermic plants of known family up to the level of genus and
   species with the help of flora

Note: - Compulsory excursion- Students have to collect and submit at least 100 plants
   properly pressed, mounted and arranged according to Bentham and Hooker’s
   classification on Herbarium sheets.
3. Study of all economically important plants and their products included in syllabus

Paper IV- Ecology and Plant soil Relationship
1. Autecology observations on selected plant species
2. Study of the vegetation by
   i. Transect method
   ii. Quadrante method
   iii. Point method
3. Study of the environmental factors
   i. Climatic factors and their measurement
   ii. Edaphic factors, mineral composition of soil, pH, soil profile, moisture content,
      nitrate, calcium, carbonate
   iii. Water Analysis
4. Measurement of Biomass
5. Ecological anatomy of hydrophytes, halophytes and xerophytes
M. Sc. Semester-II
Book References

Paper I- Pteridophytes

Paper II- Gymnosperms and Palaeobotany

Paper III- Angiosperms, Taxonomy, Morphology and Economic Botany

Paper IV- Ecology and Plant Soil Relationship
BOT 301: PLANT PHYSIOLOGY

UNIT I:

1. Water metabolism:

2. Photosynthesis:
   a. General aspects and historical background.
   c. Mechanism of electron transport- structure and functions of components of Photosystem I and II, Photophosphorylation.
   d. Proton transport and ATP synthesis in chloroplast- ATP synthetase.
   e. Carbon assimilation: Calvin cycle and its regulation, Photorespiration (C 2 Cycle) and C4 cycle and their regulation.
   f. CAM pathway, Factors affecting Photosynthesis

UNIT II:

3. Respiration:
   a. Aerobic and anaerobic respiration.
   c. Pentose phosphate Pathway, Glyoxylate cycle.

4. Lipid Metabolism: Synthesis of fatty acids and degradation.

UNIT III:

5. Mineral Nutrition:
   a. Essential and Beneficial elements.
   b. Role and deficiency effects of essential nutrient elements.

6. Stress Physiology:
   a. Plant responses to abiotic stress.
   b. Stress Proteins (HSP, LEA).
   c. Water deficit and drought, heat, chilling and freezing, salinity, light and anoxia stress.

UNIT IV:

7. Growth regulators:
   Auxin, Cytokinins, Gibberellins, Ethylene, Brassinosteroids, Polyamines and hormones mediated cell signalling.

8. Flowering:
   a. Floral evocation, florigen concept, circadian rhythms, photoperiodism and its regulation.
   b. Vernalization, phytochrome and its functions.
   c. Abscession, dormancy (bud and seed), seed germination and senescence.

Internal Assessment

1. Short test/ Quiz 10
2. Long Test 15
SEMESTER-III: Paper II

BOT 302: GENETICS AND CYTOGENETICS

UNIT I:
1. Inheritance Genetics
   b. Cytoplasmic inheritance: Cytoplasmic inheritance involving chloroplast (*Mirabilis jalapa, Zea mays*) and Mitochondria (petite yeasts and cytoplasmic male sterility in higher plants), mitochondrial and chloroplast genomes, interaction between nuclear and cytoplasmic genes (Rubisco and Cytochrome oxidase)
   c. Quantitative Inheritance: Qualitative and Quantitative traits, Continuous variation, Inheritance of quantitative traits, (corolla length in *Nicotiana*, cob length in *Zea mays*), multiple factors hypothesis and heritability.

UNIT II:
2. Cytogenetics and induced variation

UNIT III:
   c. Recombination and Linkage: - Concept of Linkage, types and applications, Concept and Types of Recombination, Molecular mechanism of recombination, Site specific recombination, estimation of recombination percentages and map distances, Gene mapping in Fungi using ordered and unordered tetrads of Neurospora. Three point test crosses and estimation of linkage distances in plants. Gene maps and physical maps.

UNIT IV:
   d. Sex Determination: Important theories of sex determination, sex determination in plants.
   e. Mutation—Spontaneous and induced mutation, physical and chemical mutagens, molecular basis of mutations.
   f. DNA damage and repair mechanism- Types of DNA damage, enzymes involved in repair of DNA, excision repair, recombination repair and mismatch repair systems.
   g. IS element, transposable elements in prokaryotes and eukaryotes, mechanism of transposition, retroelement, application of transposons.

Internal Assessment
25
1. Short test/ Quiz 10
2. Long Test 15
SEMESTER-III: Paper-III

BOT 303: PLANT BREEDING AND BIOSTATISTICS

Plant Breeding:

Unit-I
1. Plant Genetic resources: Genetic diversity in plants, Penetrance and Expressivity, Pleiotropy, Centres of origin, Importance of genetic diversity in crop improvement and its erosion.
2. Collection and evaluation of germplasm.
3. Competition in natural populations, Inter genotype competition, Environmental variation.
5. Incompatibility and Male sterility: Genetic, physiological and biochemical basis of incompatibility, Utility of self incompatibility, Evolution of incompatibility mechanism; Genetic and Cytoplasmic male sterility

Unit-II
8. Testing of combining ability, prediction of performance of hybrids- single cross hybrid, three way cross hybrid, double cross hybrid, Multiple crosses –composite cross breeding.
10. Heterosis, Theories of heterosis, Environmental heterosis, Inbreeding depression.
11. Methods of direct gene transfer.

Unit-III
15. Breeding methods of important crop plants e.g. wheat, rice.

Biostatistics:

Unit-IV
1. Importance and scope of Biostatistics.
2. Sample and sampling,
3. Collection and representation of date-tabulation, graphical, diagrammatic
4. Measures of Central tendency
5. Measures of dispersion: range, mean deviation, Standard deviation, Variance, Deviation
6. Tests of significance: Significance and difference in means, Standard error of mean, Standard error of SD, Students ‘t’ test , Chi-square test.
7. Analysis of variance (ANOVA).

Internal Assessment 25
1. Short test/ Quiz 10
2. Long Test 15

M.M. 25+75=100
SEMESTER-III: Paper- IV

BOT 304: CELL BIOLOGY AND BIOCHEMISTRY

CELL BIOLOGY

Unit-I

Unit-II
4. Active and Passive uptake of ions- facilitated diffusion, primary and secondary active transport, ion carriers, channel proteins and pumps (Na+/K+ and Ca 2+pumps).
6. Cell cycle & Apoptosis: Biochemical and genetic mechanism–
   a. Mitosis, spindle formation mechanism, cytokinesis, cell plate formation,
   b. Programmed Cell Death (PCD).
   c. Meiosis and its significance

Unit-III
BIOCHEMISTRY
1. Amino acids, Peptides and Proteins:
   a. Chemical and enzymatic hydrolysis of protein to peptides, amino acid sequencing.
   b. Secondary structure of proteins, forces responsible for holding of secondary structure.
      L-helix, M-sheet, super secondary structure,
   c. Tertiary structure of protein-folding and domain structure, Quaternary structure.
   d. Biosynthesis of amino acid.
   e. Denaturation, degradation and renaturation of protein.
2. Carbohydrate:
   a. Conformation of monosaccharides, structure and functions of important derivatives of monosaccharides.
   b. Disaccharides and polysaccharides. Structural polysaccharides-Cellulose and chitin. Storage polysaccharides-starch and glycogen.
   c. Carbohydrate metabolism: Glycogenesis, gluconeogenesis.

Unit-IV
3. Nucleic Acid:
   a. Biosynthesis of nucleotides.
   b. Denaturation, degradation and renaturation of nucleic acids.
4. Enzymes:
   a. General aspects, nomenclature and classification.
   b. Mode of action, Active sites, reversible and irreversible enzyme inhibition.
   c. Enzyme kinetics and Michaelis- Menton equation.
   d. Factors affecting enzymatic reactions.
   e. Structure and function of co-enzymes.
5. Chromatography

Internal Assessment

25
1. Short test/ Quiz 10
2. Long Test 15
M. Sc IIIrd SEMESTER PRACTICAL

Paper I- Plant Physiology
1. To determine the Osmotic pressure of vacuolar sap of *Rheo discolor* or *Tradescantia* leaves by Plasmolytic method (50% plasmolysis)
2. To determine the diffusion pressure deficit (water potential) of potato tuber tissue by weighing method
3. To determine the structure, size and frequency of stomata in mesophytic and xerophytic leaves
4. To determine the rate of transpiration of plant i. Weight ii. Potometer method
5. To determine the rate of transpiration by Cobalt Chloride paper method and to calculate transpiration index (TI), Transpiration efficiency (TE) of various leaves
6. To measure the rate of photosynthesis in aquatic plants by Willmotts bubble counting method
7. To study the effect of i. CO$_2$; ii. Light quality and intensity; iii. Injury; iv. Temperature on the rate of photosynthesis in leaves of an aquatic / terrestrial plant
8. To extract the major plant pigments from leaves by different solubility method

Paper II- Genetics and Cytogenetics
1. Chromosomal Technique- Pretreatment, fixation, staining techniques- Acetocarmine- Fuelgen, Banding Technique- G Banding
2. Karyotypic studies- Preparation of mitotic metaphase plates and to draw Camera Lucida drawing of chromosome and study of chromosome morphology Calculation of arm ratios, chromosome formula and symmetry of karyotype, preparation of idiograms and drawing photograph
3. Study of genetic crosses based on Mendel’s Laws, modification to Mendel and Interaction of genes

Paper III- Plant Breeding and Biostatistics
1. Emasculation Techniques
2. Statistic analysis of seed samples and applying suitable statistical test for interpretation as desired
3. Numerical problem and design

Paper IV- Cell Biology and Biochemistry

Cell Biology
1. Preparation of squash for the study of mitosis
2. Preparation of smear for the study of meiosis
3. Meiotic studies- Permanent Slide Studies of various stages of meiosis, study of diakinensis and metaphase bivalent,
4. Model studies for cell organelles

Biochemistry
1. To separate the major plant pigments (i) Paper chromatography and (ii) Thin Layer Chromatography to calculate Rf values of the pigment
2. To extract the free amino acid from germinating seed of mung bean/ black gram and to separate them by two dimensional paper chromatography
3. To determine the Rf values of a given mixture of amino acids using Circular Paper chromatography
4. To measure the activity of enzyme catalase and to study the effect of – (i) Substrate concentration and (ii) pH on enzyme activity
5. To extract proteins from germinating seeds of moong bean/ black gram and to estimate them by the Biuret test
6. To extract and test the presence of Reducing sugar by Benedict’s test
7. Effect of (a) enzyme concentration (b) substrate concentration on the activity of Urease
M. Sc. SEMESTER-III
Book References

Paper I- Plant Physiology

Paper II- Genetics and Cytogenetics

Paper III- Plant Breeding and Biostatistics

Paper IV- Cell Biology and Biochemistry
SEMESTER IV: PAPER –I

BOT 401: ANATOMY, EMBRYOLOGY AND MORPHOGENESIS

Unit-I

ANATOMY
1. Shoot development: Organization of shoot apical meristem (SAM), Leaf (Marginal meristem).
2. The cambium, its derivative tissues, differentiation of secondary phloem and xylem.
3. Structure of woods in relation to its weight, strength, durability and taxonomic significance.

Unit-II
6. Abscission layers.

EMBRYOLOGY
1. Structure of microsporangium, microsporogenesis and development of male gametophyte.
2. Structure of ovule, megasporogenesis and development of female gametophyte.
3. Pollen-Pistil interaction.
4. Fertilization and its control.

Unit-III
5. Endosperm: Development, types, haustoria, ruminate endosperm, xenia, metaxenia.
6. Embryogenesis in dicot and monocot.
7. Apomixis, causes and significance.
8. Parthenocarpy.

Unit-IV

MORPHOGENESIS
2. Correlation: Physiological and genetical correlations.
4. Morphogenesis in Acetabularia.

Internal Assessment 25
1. Short test/Quiz 10
2. Long Test 15
BOT 402: BIOTECHNOLOGY

Unit-I

TISSUE CULTURE
2. Culture media and laboratory requirements.
4. Endosperm and nucellus culture.

Unit-II
5. Somaclonal variation---applications and reasons for generation.
7. Production and uses of haploids.
8. Applications of plant tissue culture.

Unit-III

BIOTECHNOLOGY
1. Genetic Engineering: Cloning vectors (plasmid and bacteriophage vectors, cosmids, BAC and YACs) and Enzymes (restriction endonucleases, polymerases, reverse transcriptase, alkaline phosphatase, polynucleotide kinase, Ligases, terminal transferases).
2. DNA cloning, preparation of plasmid DNA, Restriction and electrophoresis, ligation.
4. Principles and methods of Genetic Engineering, Gene libraries and cDNA libraries, Polymerase chain reaction, DNA fingerprinting.

Unit-IV
5. DNA Sequencing, Southern blotting, RAPD, RFLP, Restriction mapping.
6. Biotechnology and Human welfare
a. Applications of genetically engineered bacteria in crop production and protection, biodegradation of xenobiotics and toxic wastes, production of chemicals, biofuels and medicines.
b. Biopesticides and integrated pest management, Biofertilizers, Organic farming.
c. Microbes for improving soil fertility.

Internal Assessment 25
1. Short test/ Quiz 10
2. Long Test 15
SEMESTER -IV: PAPER –III

BOT 403: MOLECULAR BIOLOGY AND BIOLOGICAL TECHNIQUES

Unit-I
1. Genome-Basic concept and organization.
4. Dissociation and reassociation kinetics of DNA, Cot curves, Cot ½ values and its significance.
5. Unique, moderately repetitive and highly repetitive DNA, conformation of nucleic acids. (A, B, Z DNA, t-RNA, m-RNA).

Unit-II
6. DNA amplification, molecular genetic maps, genome projects.
7. Allele concept, multiple alleles, isoalleles, pseudoalleles.
8. Genetic Code
10. DNA Replication: - Mechanism of prokaryotic and eukaryotic DNA replication, replication apparatus, Origins of replication, priming and DNA polymerases.
11. Transcription: RNA polymerases and their role, Transcription apparatus, Transcription in prokaryotes and eukaryotes, Initiation, elongation and termination, RNA processing, reverse transcription, Ribonucleoproteins.

Unit-III
12. Regulation of Transcription in prokaryotes and eukaryotes: Operon concept (Lac, Tryptophan, cAMP ) positive and negative regulation of prokaryotic genes, eukaryotic transcription factors, transcriptional and translational control.
13. Translation in prokaryotes and eukaryotes.

BIOLOGICAL TECHNIQUES
1. Theory of fixation and important fixatives, storage of fixed material.
2. Different types of stains, their preparation and uses: Safranin, fast green, hematoxylin, iodine, cotton blue, crystal violet, ruthenium red, Janus green, Gram’s stains, Acetocarmine.
3. Microtomy: Dehydration, clearing and embedding of material, section cutting, dewaxing.

Unit-IV
4. Uses of Basic Instruments: pH meter, oven, incubator, autoclave.
5. Microscopy: Compound (Bright and Dark field), Phase contrast, Fluorescence, Ultra violet and Infra Red, Scanning and Transmission Electron Microscopy.
7. Methods of quantitative analysis-
   a. Spectrophotometry, MS, NMR, ESR, ORD/CD spectrometers.
   b. Radioisotopic methods: Geiger Muller & Liquid Scintillation Counters, Autoradiography.
   c. DNA Chip technology and Microarrays.
   d. Mass Spectrometry for genome and proteome analysis.
   e. Biosensors.
   f. Elementary knowledge of IPR and Patenting.

Internal Assessment

25
1. Short test/ Quiz 10 2. Long Test 15
SEMESTER -IV: SPECIAL PAPERS (IV)

Paper – IVA

BOT 404A: ENVIRONMENTAL BOTANY

M.M. 75+25=100

Unit – I
1. Introduction: Relation of man with environment, National and International effects on environmental problems, applied aspects of environmental botany.
2. Ecosystem: Classification, general idea of different ecosystems.

Unit – II
5. General idea about pollution, Pollutants.
7. Air pollution: Air pollutants, PAN, Ozone, Ozone layer and Ozone hole, Green house effects; Consequences of climate change (global warming, Sea level rise).
8. Radioactive pollution: General ideas about hazardous impacts of radiations and radioactive fallouts.
9. Noise Pollution: General idea about various levels of noise pollution and human response.

Unit – III
10. Environmental management: Control of environmental pollution:
a. Water management of aquatic ecosystem.
c. Air methods for monitoring air pollutants air quality management and air pollution control device, role of plants in air pollution abatement.
d. Soil conservation: Solid waste and their disposal, waste collection, reclamation and cycling processes.
e. Radioactive waste treatment.
f. Noise abatement.

Unit – IV
12. Renewable energy sources.
14. Environmental education in India, international summits and treaties related to environment.
15. Control of environmental pollution through law.
16. Phytogeography: Distribution patterns, barriers and Age area hypothesis, vegetation & floristic regions of India.

Internal Assessment 25
1. Short test/ Quiz 10
2. Long Test 15
SEMESTER -IV
Paper –IVB
BOT404B: ADVANCED PLANT PHYSIOLOGY MM. 75+25=100

Unit-I

Plant Metabolism
1. Photosynthesis and chemosynthesis:
   a. Quantaosomes, biosynthesis of chlorophylls, heme compounds, role and biosynthesis of accessory pigments, photo oxidation.
   b. Biochemical pathways of conversion of solar energy into chemical energy and its utilization in CO2 reduction cycle.
   c. Efficient and inefficient plants, bacterial photosynthesis and its utility in nature.
3. Plant Energetics : As controlled by photosynthesis, respiration and photorespiration
4. Respiration: Biological oxidation of carbohydrates and interconversions of the products, terminal oxidation, electron transport, role of cytochromes and other heme compounds.

Unit-II:
5. Nitrogen metabolism:
6. Phosphorus metabolism: Metabolism of phosphorylated compounds and their role.
8. Vitamins : Water and fat-soluble vitamins, biochemical function of thiamine, riboflavin, nicotinic acid, pantothenic acid, pyridoxin, biotin, folic acid, vitamin B12, ascorbic acid, vitamin A and vitamin D.

Unit-III
9. Secondary metabolites :
   b. Tannins : Distribution synthesis and function.
   d. Hallucinogens: Distribution, chemistry and function.
   e. Alkaloids : Pyrrole, pyrrolidine, pyridine, polyacetyl isoquinoline, tropane and indole alkaloids- their distribution, synthesis and function.
   f. Saponins and sapogenins : Sterols, steroids, steroidal alkaloids - their distribution, synthesis and function.

Growth
10. Plant growth regulators: Natural and synthetic, biochemistry and physiological effects of auxins, gibberellins, cytokinins, brassinosteroids, jasmonic acid; salicylic acid, polyamines, morphactins and cyanogenic compounds.

Unit-IV
13. Circadian rhythms in plants: Nature of oscillator, rhythmic outputs, entrainments (inputs) and adaptive significance.
14. Flower Initiation and Floral Expression

Internal Assessment 25
1. Short test/ Quiz 10
2. Long Test 15
SEMESTER –IV  
Paper –IVC

BOT 404C: PLANT PATHOLOGY  
MM. 75+25=100

Unit-I: Principles of Phytopathology
1. Historical development and present status of Phytopathology.
2. Classification of plant diseases
4. Concept of disease, Koch’s postulates.
5. Mode of infection and development of pathogen in plants.
6. Role of enzymes and toxins in pathogenesis.

Unit-II
8. Defence mechanism in host, effect of infection on host physiology.
11. Mycotoxins and storage diseases.
12. Integrated pest management.

Unit-III:
13. Epidemiology, symptoms, etiology, perennation and control of following diseases:
14. Diseases caused by Fungal Pathogens:
   Fruit and stem rot of papaya, Red rot of sugarcane, Damping off of seedling of crop plants, Downy mildew of bajra, crucifer and pea, Powdery mildew of barley and cucurbits, Rust of linseed, Cover and loose smut of barley, Wilt of Arhar, Leaf spot of crucifer, rice and turmeric, Blast of rice, Late blight of potato, Stem gall of coriander, Peach leaf curl, Tikka disease of groundnut.

Unit-IV
15. Diseases caused by nematodes: Ear cockle of wheat, Root knot of vegetables.
18. Disease caused by plant viruses:
   Mosaic of apple, papaya, tobacco and potato; Leaf curl of tobacco, chilly and tomato; Tungro of paddy; Yellow vein of mosaic; Bunchy top of banana.

Internal Assessment  
25
1. Short test/ Quiz  
10
2. Long Test  
15
M. Sc. IV SEMESTER PRACTICAL

Paper I- Anatomy, Embryology and Morphogenesis
1. Study of the plants and its parts (root, stem and leaves) by sectioning and staining
2. Prepare of smear for the study of gametophyte
3. Micro- dissection techniques for embryo and embryo sac
4. Elementary techniques for pollen germination
5. Study for various stages in reproduction from permanent slides, pre and post fertilization
   in embryo sac

Paper II- Biotechnology
1. Preparation of MS (Murashige and Skoog) basal medium for tissue culture
2. Preparation of medium for regeneration of Bryophyllum
3. To prepare medium for Anther culture Datura innoxia using IAA, MS medium

Paper III- Molecular Biology and Biological Techniques
1. Study of permanent slides of chromosomes and special chromosomes (Lampbrush, Polyten and B-
   chromosome)
2. Study of banding pattern of DNA by electrophoresis
3. Karyotypic studies- Preparation of mitotic metaphase plates and to draw Camera Lucida drawing of
   chromosome and study of chromosome morphology Calculation of arm ratios, chromosome formula and
   symmetry of karyotype, preparation of idiograms and drawing photograph.
4. Preparation of various stains- Safranin, Fast green, Hematoxylin and Carmine
5. Study of fixation of botanical materials
6. Method for preparation of permanent slides- section cutting by the use of Microtome
7. To study the use of ocular and stage micrometers for the measurement of pollen grains and stomata
8. To extract and to detect nucleic acid from cauliflower or any floral tissue: (i) DNA by
    Diphenylamine test, (ii) RNA by Orcinol test
9. Isolation and purification of DNA from various sample using Agarose gel electrophoresis
10. Use of spectrophotometer in biochemical estimations- chloroplastic pigments, proteins, carbohydrates etc.
12. Demonstration of instruments: Gel Electrophoresis, Microtome, pH meter, oven, incubator, autoclave and centrifuge.

Paper IV- Special Papers
IV A-Environmental Botany
1. Physico chemical analysis of polluted water- colour, acidity, alkalinity, taste, turbidity, total solids, total dissolved solids, conductivity, hardness, pH, Biological oxygen demand, Dissolved oxygen, Chemical oxygen demand
2. Biological examinations of polluted water- microscopic and culturing method (Density count)
3. Physico chemical analysis of polluted soil, pH, Electric conductivity, soluble cations and anions, heavy metals (base deficiency)
4. To analyze distribution pattern of selected species in an ecosystem
5. To measure the photosynthetic rate (A) and the specific leaf area of five tree species and observe relation between them.
IV B-Advanced Plant Physiology
1. To extract the pigment from green leaf and to estimate quantitatively the percentage of Chl a, Chl b and total chlorophyll and the carotenoids spectrophotometrically.
2. Estimate the percentage of total free amino acids in any plant material spectrophotometrically by using Ninhydrin.
3. To estimate the amount of Total Nitrogen in dry leaves by Micro-Kjeldahl method.
4. To estimate total protein of fresh moong, bean seedlings by biuret reagent.
5. To estimate the percentage of soluble protein of fresh moong, bean seedling by Lowry’s Method.
6. To estimate the percentage of reducing sugar in any plant material by Somogy-Nelson’s Method.
7. To estimate the percentage of total soluble sugar in plant tissue using anthrone reagent.
8. To estimate ascorbic acid in plant tissue.
9. To measure the ascorbic acid in germinating barley and moong seeds and to study the effect of: (i) substrate concentration, (ii) pH, (iii) Temperature, and (iv) any Heavy metal on amylase activity.
10. To study the effect of any stress (temperature, water) on germination in barley seed.
11. To estimate the percentage of fatty acid in castor, bean, mustard by Sexhlet’s extraction method.
12. To test the presence of fatty acid in castor seed.
13. To measure the activity of the enzyme nitrate reductase (NR) in the leaves of Vigna mungo and to study the effect of: (1) substrate concentration, and (2) pH, on enzyme activity.
14. To study the effect of various Plant Growth Regulators (IAA, GA₃, Kinetin Brassins and polyamines) on germination of bean seeds.
15. To study the effect of GA₃ on flower initiation and expression in any plant.
16. To study the phenomenon of Apical Dominance in Coleus and Tulsi.
17. To study the phenomenon of Phototropism in plants.
18. To study the phenomenon of Geotropism in plants.

IV C-Plant Pathology
1. A study of symptomology, histopathology, and identification of pathogen of various fungal diseases: Fruit and stem rot of Papaya, Red rot of sugarcane, Damping off of seedling of crop plants, Downy mildew of bajra, crucifer and pea, Powdery mildew of barley and cucurbits, Rust of linseed Cover and loose smut of barley, Wilt of Arhar, Leaf spot of crucifer, rice and turmeric, Blast of rice, Late blight of potato, Peach leaf curl, Ergot of bajra, Tikka disease of ground nut.
2. A study of symptomology in bacterial (Citrus canker, Blight of rice, Tundu disease of wheat, Soft rot of carrot/onion), viral (Mosaic of apple, papaya, tobacco and potato, Leaf curl of tobacco, chilly and tomato, Tungru of paddy, Yellow vein mosaic and Bunchy top of banana) and M.L.O. (Sesame phyllody, Little leaf of brinjal, and Grassy shoot of sugarcane) disease.
3. Preparation of culture media and sterilization.
4. Isolation of fungi and bacteria from diseases plant.
5. Inoculation experiment with fungal and bacterial plant pathogens.
7. Transmission experiments (mechanical and insect transmission) of plant virus.
8. Use of fungicides and plant protection appliances.
**M. Sc. SEMESTER-IV**  
**Book References**  

**Paper I- Anatomy, Embryology and Morphogenesis**

**Paper II- Biotechnology and Tissue Culture**

**Paper III- MOLECULAR BIOLOGY AND BIOLOGICAL TECHNIQUES**
**Paper IV- Special Papers**

**IV A-Environmental Botany**

**Paper IV B- Advanced Plant Physiology**

**IV C-Plant Pathology**