M.Sc : BOTANY

New Curriculum According To U.G.C.
(with minor revision and rearranged paper sequence)
M.Sc. Examination
Annual System

An Out- Line
First Year :

Course- I (Paper-I) - Biology & diversity of lower plants (cryptogams) - I (Algae & Bryophyta, Morphogenesis).

Course- II (Paper-II) - Biology & diversity of lower plants-II (Fungi & Mircobiology).

Course- III (Paper-III) - Biology & diversity of vascular plants (Pteridophyta/Gymnosperm/ Palaeobotany)

Course- IV (Paper-IV) - Plant Physiology, Biochemistry and Fundamental Process.

Course- V (Paper-V) - Plant Ecology, Soil Science & Phyto-geography.

Second Year :

Course- I (Paper-I) - Techniques in Biology & Genetic Engineering.

Course- II (Paper-II) - Diversity and taxonomy of seed plants-Angiosperms (Taxonomy, Anatomy, Embryology.)

Course- III (Paper-III) - Cell Biology/Genetics/Plant Breeding/Statistics.

Course- IV (Paper-IV) - Plant Resource utilization and Applied Botany.

Course- V (Paper-V) (Anyone Optional) - Elective- Specialization paper
i) Advanced Plant Physiology.
ii) Molecular Plant Pathology
iii) Environment and Plant Response
UNIT I ALGAE

Algae in diversified habitat.

Principles, criteria (pigments, flagellation, food reserve and eye spots) and systems of classification.

Cyanophyceae: Cyanophyta: cell structure, heterocyst and akinete development, chromatic adaptation, thallus organization and reproduction, and Salient features of Gloeocapsa, Microcystis, Anabaena, Gloeotrichia, Nostoc, Rivularia, Scytonema.

A brief account of thallus organization, structure and reproduction in Chlorophyta, Phaeophyta and Rhodophyta; alternation of generation in Phaeophyta and post-fertilization development and site of meiosis in Rhodophyta.

A brief account of Proto Chlorophyta, Chlorophyta, Xanthophyta, Bacillariophyta,

Phaeophyta: Ectocarpales (Ectocarpus); Laminariales (Laminaria); Dictyotales (Dictyota, Padina); Fucales (Fucus and Sargassum)

Rhodophyta: Bangioideae (Porphyra); Florideae (Batrachospermum, Polysiphonia)

Economic importance of algae
(Algae as food, biofertilizers and source of phycocolloids.)

UNIT II BRYOPHYTA

Classification of Bryophytes

Comparative account of gametophyte structure

Sporophytic structure and evolution; Peristome structure and its significance in the classification of Mosses

Morphology, structure reproduction, life history, distribution and phylogeny of bryophytes based on following:-
(A) Hepaticopsida (i) Sphaerocarpaceae (Sphaerocarpus), (ii) Marchantiales
   (Riccia, Marchantia, Cyathodium, Plagiocerasma, Lunularia, Astrella), (iii) Monoleales
   (Monoclea)

(B) Anthocerotopsida: Anthocerotales [Anthocerous and Notothyas].

(C) Bryopsida: Sphagnales (Sphagnum), Andreales (Andreacea), Bryales (Funaria), Buxbaumiales (Buxbaumia).

UNIT III: Morphogenesis

1. Meristem (Apical meristem of root, stem and leaf.)
2. Polarity (As expressed in external structure. Its manifestation and developmental pattern.)
3. Symmetry (Radial, bilateral, dorsiventral, development of symmetry and form.)
4. Totipotency
5. Somatical variation and its applications.

PRACTICAL: Practicals related to this paper will be based on plant types prescribed in each section (i.e. algae and bryophyta).
UNIT-I FUNGI

1. General characteristics, nutrition (saprophytic, symbiotic, biotrophic), reproduction, and recent trends of classification of fungi.

2. Heterothallism, Heterokaryosis, Parasexuality, Physiological specialization.

3. Systematic study of structure and reproduction, life cycle, phylogeny and affinities of main groups of fungi with special reference to following.

(i) **Myxomycetes** (Trichiales, Stemonitales, Physarales).

(ii) **Plasmodiophoromycetes** - (Plasmodiophorales).

(iii) **Oomycetes**: Saprolegniales (**Saprolegnia, Achlya**), Peronosporales (**Phytophthora, Peronospora**).

(iv) **Chytridiomycetes**: Chytridiales, Blastocladiales, Monoblepharidales.

(v) **Zygomycetes**: Mucorales (**Pilobolus**), Entomophthorales.

(vi) **Ascomycetes**: Protomycetales (**Protomyces**), Endomycetales (**Saccharomyces**), Taphrinales (**Taphrina**), Eurotiales (**Aspergillus, Penicillium**), Erysipheales (**Erysiphe, Phyllactenia**), Sphaeriales (**Xylaria**), Clavicipitales, Laboulbeniales, Pleosporales, Pezizales (**Morchella**).

(vii) **Basidiomycetes**: Tremillales, Ustilaginales (**Ustilago, Urocystis**), Uredinales (**Puccinia, Melampsora, Uromyces, Ravenel**).

(viii) **Deuteromycetes**: Sphaeropsidales, Melanconiales (**Colletotrichum**), Moniliales (**Helminthosporium, Alternaria, Cercospora, Fusarium**).

(ix) Economic importance of fungi.

(4) Lichens: A general account with particular reference to mode of life, thallus structure, reproduction, classification and economic importance.

UNIT-II Microbiology

Introduction: A brief idea of microbial diversity; present status and future challenges; a general account of Archaea and Eubacteria.

Nutritional types of microorganisms, *Rhizobium*-legume symbiosis and mycorrhiza.
Anoxygenic photosynthesis with special reference to light reaction in purple bacteria; methanogenesis.
Genetics of bacteria: Genetic recombination- an overview; mechanisms of transformation, conjugation, and transduction in bacteria.
Viruses: Characteristics and ultrastructure, isolation and purification of viruses, transmission, and multiplication.

Lytic cycle in T even phages and its regulation; lysogeny and its regulation in lambda phage; a brief account of viroids and prions.

Phytoplasma:- General characteristics and role in causing plant diseases.

PRACTICAL EXERCISE:
1. Practicals related to this paper will be based on plant types of each section.
2. Symptomatology of important fungal, bacterial and viral diseases of plants.
3. Identification of fungal cultures of possible/available fungal types.
5. Study of foliose and other types of lichen thalli.
M.Sc. (PREVIOUS) BOTANY
PAPER-III
(BIOLOGY & DIVERSITY OF VASCULAR PLANTS)
(Pteridophyta, Gymnosperm, Palaeobotany)

UNIT-I PERIDOPHYTA:
Classification of pteridophytes.

Morphology, anatomy and reproduction, phylogenetic relationships with emphasis on
detailed study of following:
(i) Psilopsida- (Psilophytales, Psilotales)
(ii) Lycopsida- (Lycopodiales, Selaginiales, Lepidodendrales, Isoetales, Pleuromiiales).
(iii) Sphenopsida- (Equisetales, Hyeniales, Sphenophyllales, and Calamitales).
(iv) Pteropsida- (A general account): Eusporangiate ferns, leptosporangiate ferns.

Brief account of the range of structure and reproduction in Ferns.

Telome concept, apogamy and apospory, heterosporous seed habit

Evolution of stele in pteridophytes.

Economic importance of Pteridophytes.

UNIT-II GYMNOSPERMS & PALAEOBOTANY
Classification, distribution, morphology, life history of gymnosperms.

Brief Account of the families of Pteridosperms (Lyginopteridaceae, Medullosaceae,
Caytoniaceae, and Glassopteridaceae).

Comparative study of Cycadales, Bennettitales, Ginkgoales, Coniferales (Pinaceae,
Cupressaceae, Araucariaceae, Podocarpaceae, Cephalotaxaceae, Taxodiaceae), Taxales
and Gnetales (Gnetaceae, Ephedraceae and Welwitschiaceae) etc.

Distribution of conifers in India and their economic importance.

Principles of palaeobotany, fossil forms and fossilization, techniques to study fossils,
geological time scale.

PRACTICAL EXCERCISES:
1. Comparative and monographic study of the anatomy of vegetative and
reproductive parts of Cycas, Ginkgo, Cedrus, Abies, Picea, Cupressus, Araucaria,
Cryptomaria, Taxodium, Podocarpus Agathis, Taxus, Ephedra and Gnetum.
2. Study of fossil forms with the help of permanent slides.
3. Monographic Study of Pteridophyte based on theory papers.
UNIT-I PLANT PHYSIOLOGY

Water relationship to plants: (Water potential and component potentials, its role in hydrodynamics, Absorption and translocation of water).

Mineral relationship to plants: (Macro and Micronutrient elements, Active transport across membrane, Carrier Proteins).

Photosynthesis - Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO₂ fixation-C₃, C₄ and CAM pathways.

Respiration and photorespiration - glycolysis, Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photorespiratory pathway.

Nitrogen metabolism – Nitrogen cycle, nitrate and ammonium assimilation, amino acid biosynthesis.

Metabolism of lipids, amino acids, nucleotides.

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

Sensory photobiology - Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks.

Solute transport and photoassimilate translocation - uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates.

Secondary metabolites - Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles.

Stress physiology - Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses.
UNIT-II BIOCHEMISTRY & FUNDAMENTAL PROCESSES

Bioenergetics, thermodynamics, coupled reaction, group transfer, biological energy transducers.

Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes

Conformation of proteins (Ramachandran plot, secondary structure, domains, motif and folds).

Conformation of nucleic acids (helix (A, B, Z), t-RNA, micro-RNA).

DNA replication, repair and recombination (Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication).

RNA synthesis and processing (transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing, and polyadenylation, structure and function of different types of RNA).

Protein synthesis and processing (Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors, Post-translational modification of proteins).

Control of gene expression at transcription and translation level (regulating the expression of phages, viruses, prokaryotic and eukaryotic genes, role of chromatin in gene expression and gene silencing).

PRACTICAL EXERCISES:
1. Effect of time, enzyme concentration, substrate concentration on enzyme activity (diastase, catalase, nitrate reductase).
2. To show substrate inducibility of enzyme nitrate reductase.
3. Extraction of chloroplast pigments and separation of chlorophylls and carotenoids by paper chromatography.
4. Extraction and isolation of seed protein and test by biurete reagent.
7. To study frequency of stomata and transpiration (potometer method).
8. To determine real rate of photosynthesis by continuous air stream method.
9. To determine rate of respiration in germinating seeds by continuous air stream method.
10. To isolate and estimate reducing sugar from plant material (onion bulb) by using Fehling's reagent.
UNIT-I ECOLOGICAL PRINCIPLES

The Environment: Physical environment; biotic environment; biotic and abiotic interactions.

Habitat and Niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.

Population Ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); concept of metapopulation - demes and dispersal, interdemic extinctions, age structured populations.

Species Interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.

Community Ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones.

Ecological Succession: Types; mechanisms; changes involved in succession; concept of climax.

Ecosystem Ecology: Ecosystem structure; ecosystem function; energy flow and mineral cycling (C, N, P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, estuarine).

Biogeography: Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.

Ecological Stability: Concept, ecological perturbations, and ecology of plant invasion.

Ecological Management: Concept, sustainable development, and plant indicators.


UNIT-II (SOIL SCIENCE & PHYTOGEOGRAPHY)

Soil types, Soil profile, Soil formation (Gleization, Podzolization and Laterization), Soil texture, soil humus.
Soil moisture constants.

Soil erosion and conservation.

Phytogeography-Distribution pattern, barriers, endemism and Age-Area hypothesis.

**PRACTICAL EXERCISES:**

1. To find out minimum size and number of quadrat required for reliable estimate of grassland vegetation.
2. Study of quantitative characteristics of grassland vegetation by quadrat and point frame method.
   (i) Frequency and relative frequency.
   (ii) Density and relative density.
   (iii) Dominance and relative dominance.
   (iv) Importance value Index (IVI)
3. Comparison of leaf area index of two types of vegetation.
4. To find out association between important grassland species using chi-square-test.
5. Estimation of standing biomass of a local vegetation by any standard method.
6. To determine net phytoplankton productivity by light and dark bottle method.
7. To determine soil moisture content, water holding capacity of soil collected from different location.
8. To determine percent organic carbon in soil sample of cropland and grassland, titrimetrically.
9. To determine dissolved oxygen in water samples by Wrinkler’s method.

[Signatures]
M.Sc. (Previous) Botany Practical

Scheme of Practical Examination: There will be two practical examinations of 125 marks each. Part-A will include the experiments related in to theory papers I, II and III and Part - B will be based on theory paper IV and V.

**Part - A**

**Time : 5 hours**

Q.1 Identification and study of four specimens from mixture – A (Algae) **Max Marks : 125**

Q.2 Identification and study of structure with suitable sketches of specimen 'B' and 'C' (Fungi) **20**

Q.3 Identification, and study of structure, (vegetative and reproductive parts) of specimen D & E (Bryophytes). **15**

Q.4 Monographic study of specimen 'F' (Pteridophyte or Gymnosperm). **15**

Q.5 Identify and comment upon spots 1-10 **20**

Q.6 Viva-Voce **15**

Q.7 Class records and collection. **20**

**Part - B**

**Time : 5 hours**

Q.1 To perform a Plant Ecology experiment **Max. Marks : 125**

Q.2 To perform one soil science experiment **20**

Q.3 One Plant Physiology experiment. **20**

Q.4 One Plant Biochemistry experiment. **20**

Q.5 Comment upon spots (1-5) **15**

Q.6 Viva voce **10**

Q.7 Class record & tour report **20**

Signatures
M.SC. (FINAL) BOTANY

Paper – I: Microtechnique, Biotechnology, Genetic Engineering:

Max: 100

Unit – I (Microtechnique):

1. Techniques of collection, fixation, embedding, dehydration, microtomy and staining of plant materials.
2. Techniques for preparation of herbarium and museum specimens and their maintenance.
4. Histo chemical and cyto Chemical techniques for localization of protein, carbohydrate, fat, nucleic acid and ascorbic acid.
5. Literature review and preparation of reference cards.

Unit – II: (Biotechnology & Genetic Engineering):

2. Plant cell and Tissue Culture: General account, and scope.
3. Somatic hybridization: Protoplast isolation, culture, achievements and limitations of technique.
4. Recombinant DNA technology: Gene cloning, principle and scope, construction of genomic/cDNA library.
5. Genetic Engineering in plants: Aims, strategies for development of transgenics, chloroplast transformation and its utility, genetic engineering of industrial microbes and fermentation
technology.

6. **Biofertilizers**: Source, use and application in soil fertility.

**Suggested Practical Exercise:**

1. Preparation of blocks for microtomy, sectioning of block and preparation of permanent slides.
2. Use of Camera Lucida for drawing sketches of microscopic slides.
3. Demonstration of tissue and organ culture.
4. Isolation of Rhizobium from root nodules.
5. Demonstration of Hydroponic cultivation of economically important plant, principle and scope of technique.
7. Effect of temperature and osmoticum on protoplast culture.
8. Cocultivation of plant material (e.g. leaf discs) with agrobacterium and study of GUS activity his to chemically.

**Paper – II: Diversity and Taxonomy of Seed Plants: Angiosperm**

*(Taxonomy, Anatomy, Embryology)*

**Section – I:**

*(Taxonomy & Phylogeny)*

1. Phylogeny of angiosperm, evolution and differentiation of species.
2. Species concept, taxonomic units, species, genus, family, order, delimitation of taxa and attribution of rank.
4. **Taxonomic Tools**: Herbarium, Flora, Role of histology cytology, phytochemistry in taxonomic studies.
5. **System of Angiosperm Classification**: Phenetic and phylogenetic systems. Merits and Demerits of major systems of classification (e.g. Bentham and Hooker, Engler and Prantl, Bessy and Hutchinson.)
6. Recent trends in Plant taxonomy.
7. General knowledge of distinguishing features of important families with special reference to local flora.
1. Cell Biology: Organism and Cell

2. Cell and Tissue:

3. Anatomy and Physiology

4. Genetics

5. Cytogenetics

6. Biochemistry

7. Biotechnology

8. Microbiology

9. Virology

10. Immunology

11. Biostatistics

12. Environmental Biology

13. Biological Anthropology

14. Microbial Ecology

15. Plant Pathology

16. Parasitology

17. Aquaculture

18. Forensic Science

19. Conserved Biology

20. Wildlife Management

21. Aquatic Zoology

22. Parasitological Imaging

23. Marine Biology

24. Tropical Ecology

25. Biotechnology and Terrestrial Biodiversity

26. Biotechnology and Aquatic Biodiversity

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Time: 6 Hours

Practical 1 (General)

By students at the time of examination.

Note: The time allotted for two practical examinations is 3 hours each.

Syllabus of Practical Examination:

1. Preparation of genotypes from dihybrid cross and pollination grains.
2. Demonstration of plant propagation through tissue culture technique.
3. Study of cell division and growth.
4. Influence of auxins on growth and development of different crops including cereals, oilseeds, and vegetables.
5. Demonstration of plant breeding in different crop plants including cereals, neem, and sugarcane.
6. Use of chemical mutagens for crop plants and study of mutation.
7. Study of ecological and biological cross in important crop plants-wheat.
8. Major contributions of Indian plant breeders in green revolution.
9. Improvement plant breeding in different crop plants using traditional techniques.
10. Recent tools and techniques of plant breeding for crop plants: wheat, rice, maize, sugarcane, potatoes, and tomato.

Suggested Practical Exercises and Farm Prospects:

11. Evaluation of hardness of water: pH and SO4
12. Measurement of moisture content by hygrometer.
13. Demonstration of Montezuma technique.
15. Emission of dissolved oxygen in water.
16. Major achievements of plant breeding in India with reference to pollinating crops.
17. Techniques of plant breeding in self-pollinating and cross pollinated crops.
18. Concept of plant selection and improvement in crop improvement.
19. General basis of plant breeding in sexually reproducing crops.
20. Principles and concepts: scope of plant breeding in India.

Section - B: Plant Breeding

and Development of Transgenic Plants

1. Microbial transformation and genetic engineering in crop improvement
2. Cytology of important crop plants
3. Modern concept of gene and gene expression
4. DNA manipulation and chromosomal manipulation biological significance of nuclear and chromosomal manipulation, biotechnology
5. Modern concept of molecular regulation and concept of genetic engineering
6. Concept of gene and gene expression
7. Environmental and environmental influences
8. Chromosomal manipulation: molecular regulation
9. Sexual and asexual reproduction
10. Concept of gene and gene expression
11. Modern concept of molecular regulation

M. Sc. Botany
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<th>E: Environmental and Plant Breeding (Special)</th>
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<td>4.</td>
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**Total = 200**

1. Environmental and plant breeding (Special)
2. Environmental and plant breeding (Special)
3. Environmental and plant breeding (Special)
4. Environmental and plant breeding (Special)