

SEMESTER STRUCTURE M.Sc. (BOTANY) PREVIOUS YEAR

FIRST SEMESTER			
PAPER	DESCRIPTION	MARKS	Credit
PAPER I(BOT 101)	MICROBIOLOGY, PLANT VIROLOGY & BACTERIOLOGY	100	4
PAPER II(BOT 102)	MYCOLOGY	100	4
PAPER III(BOT 103)	PHYCOLOGY AND LICHENS	100	4
PAPER IV(BOT 104)	BRYOPHYTES	100	4
PRACTICAL(BP 105)	(BASED ON PAPER 101-104)	100	4
MINOR (BOT 106)**	WATER RESOURCE MANAGEMENT	100	4
	Research Project*		4
	Total		

SECOND SEMESTER			
PAPER	DESCRIPTION	MARKS	Credit
PAPER I(BOT 201)	PTERIDOPHYTA	100	4
PAPER II(BOT 202)	GYMNOSPERMS AND PALAEOBOTANY	100	4
PAPER III(BOT 203)	ANGIOSPERMS: TAXONOMY, MORPHOLOGY AND ECONOMIC BOTANY	100	4
PAPER IV(BOT 204)	ANATOMY, EMBRYOLOGY AND MORPHOGENESIS	100	4
PRACTICAL(BP 205)	(BASED ON PAPER 201-204)	100	4
	Research Project*	100	4
	Total		

M.SC. (BOTANY) FINAL YEAR

THIRD SEMESTER			
PAPER	DESCRIPTION	MARKS	Credit
PAPER I(BOT 301)	PLANT PHYSIOLOGY	100	4
PAPER II(BOT 302)	GENETICS ,PLANT BREEDING AND BIOSTATISTICS	100	4
PAPER III(BOT 303)	ECOLOGY, PLANT-SOIL RELATIONSHIP	100	4
PAPER IV(BOT 304)	PLANT BIOCHEMISTRY	100	4
PRACTICAL(BP 305)	(BASED ON PAPER 301-304)	100	4
	Research Project*		4
	Total		
FOURTH SEMESTER			
PAPER	DESCRIPTION	MARKS	Credit
PAPER I(BOT 401)	CELL BIOLOGY	100	4
PAPER II (BOT) 402	PLANT BIOTECHNOLOGY	100	4
PAPER III(BOT 403)	PLANT MOLECULAR BIOLOGY	100	4
PAPER IV(BOT 404)	SPECIAL PAPERS (ANY ONE OF THESE) : ENVIRONMENTAL BOTANY ADVANCED PLANT PHYSIOLOGY PLANT PATHOLOGY	100	4
IV-A(BOT 404A) IV-B(BOT 404B) IV-C(BOT 404C)			
PRACTICAL:(BP 405)	BASED ON PAPER I , II ,III (PAPER 401-403)	50	4
(BP 406)	BASED ON PAPER IV (SPECIAL PAPER:404)	50	
	Research Project*	100	4
	Total		

*Research Projects include industrial training/ internship/ survey work etc.

*It will be evaluated at the end of each year out of 8 (4+4) credits.

**It will be opted by students of other faculties.

M.Sc. (Botany) Practical Marks Distribution (w.e.f. 2022- 2023)

M.Sc I st Semester	100 Marks
Paper I	15
Paper II	15
Paper III	15
Paper IV	15
Class Record and collections	15
Spot (5) 5×3	15
Viva	10
 M.Sc II nd Semester	 100 Marks
Paper I	15
Paper II	15
Paper III	15
Paper IV	15
Class Record and collections	15
Spot (5) 5×3	15
Viva	10
 M.Sc III rd Semester	 100 Marks
Paper I	15
Paper II	15
Paper III	15
Paper IV	15
Class Record and collections	15
Spot (5) 5×3	15
Viva	10
 M.Sc IV th Semester	 100 Marks
Paper I to III	50
Paper I	08
Paper II	08
Paper III	08
Class Record and collections	08
Spot (5) 5×2	10
Viva	08
 Special Paper (Paper IV)	 50
Paper IV	20
Class Record and collections	10
Spot (5) 5×2	10
Viva	10

BOT 101: MICROBIOLOGY, PLANT VIROLOGY & BACTERIOLOGY

UNIT I

Plant virus classification, structure, transmission, detection

- Nomenclature and classification of plant viruses.
- Range of plant virus particle and its genomic organization.
- Nature of plant viruses.
- Morphological, anatomical, and biochemical changes in virus infected plants.
- Transmission of plant viruses and their relationship with vectors.
- Purification and electron microscopy of viruses.
- Virus detection by serological and nucleic acid hybridization methods.

UNIT II

Plant virus replication, sub-viral pathogens, and techniques

- Infection and replication of plant viruses.
- Modern methods of plant virus disease control.
- Structure, replication and pathogenicity of viroids
- Structure and replication of viruses infecting bacteria.
- MLO structure and multiplication.

UNIT III

Bacteria- History, classification, structure and genetics

- History of microbiology.
- Classification of Bacteria and Archaeobacteria based on Bergey's Manual of Systematic Bacteriology.
- Bacterial cell structure, function of cell components.
- Bacterial genome structure, replication, expression and recombination, and plasmids.

UNIT IV

Bacterial metabolism, microbiological applications

- Bacterial nutrition and metabolism, including Nitrogen fixation.
- Antibiotics and their mode of action.
- Decomposition of organic matter in soil, cycling of essential elements in nature, biofertilisers.
- Microorganisms in food processing-Cheese, butter, milk, bread.
- Microorganisms in relation to biotechnology: Production of alcohol, beverages, organic acid, vitamins and enzymes.
- Water borne pathogenic microbes, role of microorganism in sewage disposal.

● PRACTICAL: BASED ON THEORY PAPER

BOT 102: MYCOLOGY

UNIT I:

- Status of fungi.
- Principle of important system of classification of fungi up to the rank of classes.
- Detailed fungal Classification of Alexopoulos and Mims.
- Thallus organization, phylogeny and cell structure.
- Mode of nutrition of fungi and their physical and chemical requirement for growth and reproduction.
- Reproduction, hormonal mechanism of sexual reproduction.

UNIT II

- Heterosis, parasexuality, heterothallism.
- Methods of isolation and culturing of fungi.
- Fossil fungi.
- Mycorrhizae.
- Fungi as a biocontrol agent.
- Economic importance of fungi-
- Utilization of fungi by man as food, in food processing, in production of organic acid, vitamins and enzymes.
- Harmful activities: Deterioration of material by fungi, fungi as an agent of plant and human diseases.

UNIT III:

Characteristic features, systematic position, thallus organization, reproduction, phylogeny and interrelationships of the principal classes of fungi with special reference to following genera:

- Myxomycota:
 - Myxomycetes- *Stemonitis*.
 - Plasmodiophormycetes- *Plasmodiophora*.
- Eumycota:
 - Mastigomycotina:
 - Chytridiomycetes- *Synchytrium*, *Allomyces*.
 - Oomycetes- *Saprolegnia*, *Achlya*, *Phytophthora*, *Pythium*, *Peronospora*, *Sclerospora*.
 - Zygomycotina:
 - Zygomycetes: *Pilobolus*, *Entomophthora*, *Choanophora*.

UNIT IV:

- Ascomycotina:
 - Ascomycetes: *Yeasts*, *Taphrina*, *Penicillium*, *Protomyces*, *Erysiphe*, *Phyllactinia*, *Uncinula*, *Xylaria*, *Claviceps*, *Morchella*.
- Basidiomycotina:
 - Basidiomycetes: *Puccinia*, *Uromyces*, *Melampsora*, *Ustilago*, *Lycoperdon*, *Geaster*, *Cyathus*.
- Deuteromycotina:
 - Deuteromycetes: *Fusarium*, *Colletotrichum*, *Helminthosporium*, *Alternaria*, *Cercospora*, *Rhizoctonia*.

● PRACTICAL: BASED ON THEORY PAPER

BOT 103: PHYCOLOGY AND LICHENS

Unit -I

- Study of important systems of classifications, criteria used in algal classifications including recent trends up to order.
- Range of thallus structure and organization.
- Algal Pigment.
- Nature of reserved food products.
- Reproductive diversity, life history patterns and alternation of generations.
- Economic and environmental aspects of algae.

Unit -II

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

- Cyanophyceae: *Microcystis*, *Oscillatoria*, *Lyngbya*, *Gloeotrichia*, *Stigonema*.
- Chlorophyceae: *Pandorina*, *Eudorina*, *Chlorella*, *Hydrodictyon*, *Scenedesmus*, *Microspora*, *Enteromorpha*, *Ulva*, *Sphaeroplea*, *Cladophora*, *Stigeoclonium*, *Frittschiella*, *Zygnema*, *Draparnaldiopsis*, *Odeogonium*, *Bulbochaete*, *Mougeotia*, *Caulerpa*, *Valonia*, *Chara*, *Nitella*.
- Xanthophyceae: *Botrydium*.
- Bacillariophyceae: *Navicula*, *Melosira*.

Unit-III

- Phaeophyceae : *Ectocarpus*, *Dictyota*, *Laminaria*, *Fucus*.
- Rhodophyceae : *Batrachospermum*, *Gelidium*, *Gracilaria*, *Polysiphonia*.

Unit-IV

Lichens:

- A general account of lichens and its symbionts, thallus structure, reproduction, physiology, classification and distribution.
- Chemistry of lichens, Isolation of symbionts and synthesis of thallus.
- Economic importance of lichens.

Culture Techniques:

- Isolation and culture of algal groups.

● PRACTICAL: BASED ON THEORY PAPER

BOT 104: BRYOPHYTES

Unit-I

- General characteristics, life cycle and broad outline classification of bryophytes.
- Ecology, Physiology and Reproductive biology of Bryophytes.
- Geographical distribution of bryophytes with special reference to India.
- Bryophytes as indicators of mineral enrichment and environmental pollution.
- Economic importance of bryophytes.
- Peristome structure and its significance in the classification of mosses.
- Evolution of sporophyte in bryophyte.

Unit-II

Characteristic features, classification, range of gametophytic and sporophytic organization (morphology, anatomy and their distribution in India) of the principle classes of bryophytes with special reference to following genera:

- MUSCI: *Sphagnum*,
Polytrichum.

Unit- III

HEPATICAE: *Takakia*,
Calobryum,
Porella,
Plagiochasma.

Unit: IV

- ANTHOCEROTAE: *Anthoceros*,
Notothylas,
Dendroceros.
- Origin, evolution, fossil history, phylogeny of principal classes: Hepaticae, Anthocerotae and Musci.

● PRACTICALS: BASED ON THEORY PAPER

BOT-105 M. Sc. Ist Semester Practical

Paper I- Microbiology, Plant Virology and Bacteriology

1. Preparation of Nutrient media (NAM, LB, PDA) 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 Rhizobia
7. Symptomatology, mechanical and vector transmission of virus
8. Measurement of microbial activity in soil by respiration method

Paper II- Mycology

1. Study of following genera of fungi-
Stemonitis, Sclerotium, Saprolegnia, Achlya, Phytophthora, Pythium, Peronospora, Sclerospora, Pilobolus, Yeast, Taphrina, Penicillium, Protomyces, Erysiphae, Phyllactinia, Uncinula, Xylaria, Claviceps, Morchella, Puccinia, Melampsora, Ustilago, Lycoperdon, Geaster, Cyathus, Fusarium, Colletotrichum, Heminthosporium, Alternaria, Cercospora, Rhizoctania
2. Isolation and culture of fungi

Paper III- Phycology and Lichen

1. Study of following genera
Chlorophyceae- *Pandorina, Eudorina, Chlorella, Hydrodictyon, Scenedesmus, Enteromorpha, Ulva, Sphaeroplea, Cladophora, Stigeoclonium, Pithophora, Frittschiella, Zygonema, Draparnaldiopsis, Oedogonium, 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 Lichen

Paper IV- Bryophytes

1. Study and Identification of following genera with suitable preparation
Sphagnum, Polytrichum, Takakia, Calobryum, Porella, Plagiochasma, Anthoceros, Notothylas, Dendroceros

SEMESTER -I: Minor Paper

M.M. 100

BOT 106: WATER RESOURCE MANAGEMENT

UNIT-I :

General Characteristics of water, Distribution of water, Water in lakes, rivers and oceans, Factors affecting surface water quality.

UNIT-II :

Hydrologic cycles, concept of watershed and drainage basin, Plant-water soil relationship, Characteristics and distribution of wetlands, Ramsar sites.

UNIT-III :

Water Pollution, Concept of Eutrophication, Indicators of Eutrophication, Phytoplankton and productivity of freshwater ecosystem.

UNIT-IV :

Concept of Integrated water shed management, Waste water treatment, Ground water recharging, Drinking water processing.

BOT 201: PTERIDOPHYTA

Unit-I

- Classification of pteridophytes.
- Ecology of pteridophytes.
- Distribution of ferns.
- Origin and evolution of pteridophytes.
- Telome theory and evolution of stellar system
- Heterospory and seed habit.
- Apogamy and Apospory.
- Physiology of germination of spores and development of fern prothallus.

Unit-II

Classification, distribution, morphology, life history and phylogeny of the following classes with special reference to following genera:

- Rhyniopsida - *Rhynia*, *Horneophyton*.
- Psilotopsida – *Psilotum*.
- Lycopsidea –
 - Selaginellaes – *Selaginella*.
 - Lepidodendrales – *Lepidodendron*.
 - Isoetales – *Isoetes*.
- Equisetopsida:
 - Sphenophyllales – *Sphenophyllum*.
 - Calamitales – *Calamites*.

Unit-III

- Primofilices:
 - Zygopteridales -*Botryopteris*.
 - Cladolylales – *Cladoxylon*.
- Filicopsida
 - Eusporangiatae:
 - Ophioglossales – *Ophioglossum*.
 - Protileptosporangiatae:
 - Osmundales – *Osmunda*.

Unit-IV

- Leptosporangiatae:
 - Schizaeales – *Lygodium*.
 - Pteridales - *Pteris*, *Adiantum*.
 - Dicksoniales –*Pteridium*.
 - Hymenophyllales – *Hymenophyllum*.
 - Gleicheniales – *Gleichenia*.
 - Cyatheales – *Cyathea*.
 - Marsileales – *Marsilea*.
 - Salviniales –*Azolla*

● PRACTICALS : BASED ON THEORY PAPER

BOT 202: GYMNOSPERMS AND PALAEOBOTANY

Unit-I

- General characteristics of Gymnosperms.
- Classification of Gymnosperms
- Distribution of Gymnosperms with special reference to India.
- Economic importance of Gymnosperms
- Origin and evolutionary tendencies in Gymnosperm.

Unit-II

A study of their morphology, structure, life history, interrelationship and phylogeny of the following classes with special reference to the following genera:

- Cycadopsida
 - Pteridospermales: *Glossopteris*.
 - Cycadales: *Zamia*.
 - Cycadeoideales (Bennettitales): *Williamsonia*, *Cycadeoidea* (Bennittites).
 - Pentoxylales: with special reference to *Pentoxylon*.

Unit-III

- Coniferopsida
 - Cordaitales: *Cordaites*.
 - Ginkgoales: *Ginkgo*.
 - Coniferales: *Araucaria*, *Cryptomeria*, *Cupressus*, *Thuja*.
 - Taxales : *Taxus*.

Unit-IV

- Gnetopsida
 - Ephedrales : *Ephedra*
 - Gnetales : *Gnetum*
 - Welwitschiales: *Welwitschia*

Palaeobotany

- Types of Fossils, their methods of preservation and methods of study.
- Applied Palaeobotany: Carbon dating, palaeobotany of coal and petroleum, palynology.
- Study of Indian Fossil Flora: Gondwana Flora, The Rajmahal Flora, Deccan Intertrappean Flora.
- Theory of continental drift.

• PRACTICALS: BASED ON THEORY PAPER

SEMESTER-II: Paper-III

M.M. 100

BOT 203: ANGIOSPERMS: TAXONOMY, MORPHOLOGY AND ECONOMIC BOTANY

Unit-I:

Taxonomy: A general account

- History of plant taxonomy.
- Systems of Classification: History, outlines, basis, merits and demerits of following classifications-
 - Benthom and Hooker
 - Hutchinson
 - Takhtajan
 - Cornquist
- ICBN (History, Principles and Application.)

Unit-II:

- Field and herbarium techniques.
- Herbaria and Botanical Gardens of India and World.
- Organisation and activities of BSI.

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:

- *Dicots*: Ranunculaceae, Caryophyllaceae, Capparaceae, Tiliaceae, Fabaceae, Mimosaceae, Caesalpiniaceae, Rosaceae, Apiaceae, Amaranathaceae, , Asclepiadaceae, Rubiaceae, Asteraceae, Acanthaceae, Verbenaceae, Lamiaceae, Scrophulariaceae, Polygonaceae, Euphorbiaceae, Moraceae.
- *Monocots*: Cyperaceae, Poaceae, Lilaceae, Orchidaceae, Arecaceae, Commelinaceae, Zingiberaceae.

Unit-IV:

Economic botany:

- Scope of economic botany, study of economically important plants and plant products.
- Forest Products: a) Wood Timber and Lumber. b) Resins, gum, tanning, material and cork. c) Rubber and other latex products.
- Textile plants and products: A general account.
- Fumitories and masticatories: A general account.
- Narcotics and Insecticide as plant products.

Morphology:

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

- PRACTICALS: BASED ON THEORY PAPER

SEMESTER-II: Paper-IV

M.M. 100

BOT 204: ANATOMY, EMBRYOLOGY AND MORPHOGENESIS

Unit-I

- Shoot development: Organization of shoot apical meristem (SAM), Leaf (Marginal meristem).
- The cambium, its derivative tissues, differentiation of secondary phloem and xylem.
- Structure of woods in relation to its weight, strength, durability and taxonomic significance.
- Anomalous secondary growth in roots and stems.
- Cork cambium and its derivatives.

Unit-II

- Abscission layers.
- Origin of lateral and adventitious roots, root-stem transition.
- Anatomy in relation to taxonomy.
- Structure of microsporangium, microsporogenesis and development of male gametophyte.
- Structure of ovule, megasporogenesis and development of female gametophyte.
- Pollen-Pistil interaction.
- Fertilization and its control.

Unit-III

- Endosperm: Development, types, haustoria, ruminant endosperm, xenia, metaxenia.
- Embryogenesis in dicot and monocot.
- Apomixis, causes and significance.
- Parthenocarpy.
- Polyembryony and its induction.
- Embryology in relation to taxonomy.

Unit-IV

- Polarity: Polarity in isolated cells, plasmodia & coenocytes. Expression of polarity in external and internal structure of plants. Role of polarity in developmental pattern.
- Correlation: Physiological and genetical correlations.
- Symmetry: Inorganic and organic symmetries. Radial, bilateral and dorsiventral symmetries in plant body. Development of symmetry.
- Morphogenesis in *Acetabularia*.

● PRACTICALS: BASED ON THEORY PAPER

BOT-205 M. Sc. IInd Semester 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*, *Cyathea*, *Marsilea*, *Azolla*

Paper II- Gymnosperms and Palaeobotany

1. A study of representative types
Zamia, *Ginkgo*, *Araucaria*, *Cryptomeria*, *Thuja*, *Taxus*, *Ephedra*, *Gnetum*, *Cupressus*
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 up to the level of family
3. Identification of Angiospermic plants of known family up to the level of genus and species with the help of flora

Note: - Students have to collect and submit at least 100 plants properly pressed and mounted on Herbarium sheets by excursion

Paper IV- 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
6. Preparation of permanent slides

M.SC. (BOTANY) FINAL YEAR

SEMESTER-III: Paper- I BOT 301: PLANT PHYSIOLOGY

M.M. 100

Unit-I

Water metabolism:

- Cell osmotic quantities: Osmosis, osmotic potential, water potential.
- Mechanism of water uptake and translocation: water absorption by roots, root pressure and turgor pressure. Phloem loading and unloading.

Transpiration and its regulation: Stomatal opening and closing.

Photosynthesis:

- General aspects and historical background.
- Action spectra, organization of photosynthesis apparatus, pigments and light harvesting complexes, photolysis of water.
- Mechanism of electron transport- structure and functions of components of Photosystem I and II.
- Photophosphorylation.
- Proton transport and ATP synthesis in chloroplast- ATP synthetase.
- Carbon assimilation: Calvin cycle and its regulation.

Unit-II

- Photorespiration (C₂ Cycle) and C₄ cycle and their regulation.
- CAM pathway,
- Factors affecting Photosynthesis

Respiration:

- Aerobic and anaerobic respiration.
- Glycolysis, Krebs's Cycle and their regulation. Substrate level Phosphorylation. Alternate Glycolytic reaction (Gluconeogenesis), Pentose phosphate Pathway, Glyoxylate cycle.
- Electron Transport System and ATP synthesis.

Unit-III

Mineral Nutrition:

- Essential and Beneficial elements.
- Role and deficiency effects of essential nutrient elements.

Stress Physiology:

- Plant responses to abiotic stress.
- Stress Proteins (HSP, LEA).
- Water deficit and drought, heat, chilling and freezing, salinity, light and anoxia stress.

Unit-IV

Growth regulators:

- Auxin, Cytokinin, Gibberellin, Ethylene.

Flowering:

- Floral evocation, florigen concept, circadian rhythms, photoperiodism and its regulation.
- Vernalization, phytochrome and its functions.
- Abscission, dormancy (bud and seed), seed germination and senescence.

PRACTICALS: BASED ON THEORY PAPER

SEMESTER-III: Paper II
BOT 302: GENETICS, PLANT BREEDING
AND BIOSTATISTICS

M.M. 100

Unit-I

Inheritance Genetics

- Principles of Mendelian inheritance and Interaction of genes: Complementary, epistasis, inhibitory, Duplicate, Polymeric, Lethal genes.
- Cytoplasmic inheritance involving chloroplast (*Mirabilis jalapa*, *Zea mays*),
- Population genetics: Gene and genotype frequencies, Hardy-Weinberg law,
- Structural changes in chromosomes: Origin, meiosis and breeding behaviour of duplication, deficiency, inversion and translocation heterozygotes. Cytological consequences of crossing over in Inversion and translocation heterozygotes Genetics of structural heterozygotes, complex translocation heterozygotes,

Unit-II

- Numerical Changes in chromosomes: aneuploidy and euploidy, cytology and genetics, their role in crop improvement.
- Recombination and Linkage: - Gene mapping in Fungi *Neurospora*.
- Sex Determination in plants, mutation, DNA damage and repair mechanism, transposable elements in prokaryotes and eukaryotes and its mechanism.

Unit-III

- Introduction to plant breeding; Domestication; plant introduction and acclimatization, kinds of germplasm, Methods of selection and hybridization; Techniques of selfing and crossing.
- Cytoplasmic male sterility; Heterosis and hybrid seed production; Mutant breeding; Polyploidy in plant breeding; Breeding for nutritional quality.

Unit IV

- Relevance of biostatistics to biological interpretation, elementary idea of probability, combination and permutations, continuous and discontinuous variables;
- Measures of central tendency: Mean, Median and Mode; Measures of dispersion: Standard deviation, Standard error, Mean deviation.
- Test of significance: Chi- square test, t- test; Analysis of variance; Correlation and regression.

- PRACTICALS: BASED ON THEORY PAPER

SEMESTER-III: Paper III

M.M. 100

BOT 303: ECOLOGY, PLANT-SOIL RELATIONSHIP

UNIT I

- Plant Ecology and its scope.
- Autecological studies, gene ecology with emphasis on Indian work
- Plant communities: characteristics and its classification.
- Life-forms and biological spectrum.
- Plant community dynamics and development: succession and climax.
- Study of plant communities (Analytical and Synthetic characters)
- Population ecology.
- Ecological niche.

Unit II

- Study of different types of ecosystem.
- Ecological energetic.
- Biogeochemical cycles of nutrients in ecosystem.
- Production ecology, measurement of primary productivity.
- Ecological adaptation of plants in different ecosystems.

Unit III

Biodiversity and its conservation:

- Introduction to Biodiversity.
- Levels of Biodiversity: Genetic species community and Ecosystem.
- Mega diversity Zones and Hot spots.
- Threats to Biodiversity: Causes of Biodiversity loss species extension.
- Red Data Book. IUCN threat categories.
- Strategies for Biodiversity conservation: Principles of Biodiversity conservation in-situ and ex-situ conservation strategies.

Unit – IV

- Environmental pollution and its consequences.
- Soil properties in relation to plant growth: Physical texture, density, porosity, permeability.
- Soil water, energy concept of soil, water, soil water quantities and their measurement.
- Soil: its origin and development.
- Process of soil formation and soil profile.
- Soil erosion: its causes and effects on environment.
- Methods of soil conservation.

● PRACTICALS: BASED ON THEORY PAPER

SEMESTER-III: Paper- IV
BOT 304: PLANT BIOCHEMISTRY

M.M. 100

Unit-I

Amino acids, Peptides and Proteins:

- Chemical and enzymatic hydrolysis of protein to peptides, amino acid sequencing.
- Secondary structure of proteins, forces responsible for holding of secondary structure. α -helix, β -sheet, super secondary structure,.
- Tertiary structure of protein-folding and domain structure.
- Quaternary structure.
- Biosynthesis of amino acid.
- Denaturation, degradation and renaturation of protein.

Unit-II

Carbohydrate:

- Conformation of monosaccharides, structure and functions of important derivatives of monosaccharides.
- Disaccharides and polysaccharides. Structural polysaccharides-Cellulose and chitin. Storage polysaccharides-starch and glycogen.
- Carbohydrate metabolism: Glycogenesis, gluconeogenesis.
- Lipid Metabolism: Synthesis of fatty acids and degradation.

Unit- III

Nucleic Acid:

- Biosynthesis of nucleotides.
- Denaturation, degradation and renaturation of nucleic acids.

Enzymes:

- General aspects, nomenclature and classification.
- Mode of action, Active sites, reversible and irreversible enzyme inhibition.
- Enzyme kinetics and Michaelis- Menton equation.
- Factors affecting enzymatic reactions.
- Structure and function of co-enzymes.

Unit- IV

Uses of Basic Instruments:

- pH meter, oven, incubator, autoclave.
- Microscopy: Compound (Bright and Dark field), Phase contrast, Fluorescence, Ultra violet and Infra Red, Scanning and Transmission Electron Microscopy.

Biochemical Methods: Chromatography, Electrophoresis, Centrifugation, X- ray diffraction.

Methods of quantitative analysis-

- Spectrophotometry
- Radioisotopic methods: Geiger Muller & Liquid Scintillation Counters, Autoradiography.
- DNA Chip technology and Microarrays. Biosensors

- PRACTICALS: BASED ON THEORY PAPER

BOT-305 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. CO₂
 - ii. Light quality and intensityOn the rate of photosynthesis in leaves of an aquatic / terrestrial plant
8. To extract the major plant pigments from leaves by different solubility method
9. To study the effect of
 - i. Injury
 - ii. Temperature
 - iii. LightOn the rate of photosynthesis in leaves of land plant

Paper II- Genetics, Plant breeding and Biostatistics

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. Emasculation Techniques
4. Statistic analysis of seed samples and applying suitable statistical test for interpretation as desired
5. Numerical problem and design

Paper III- Ecology and Plant soil Relationship

1. Autecology observations on selected plant species
2. Study of the vegetation by
 - i. Transect method
 - ii. Quadret 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. Ecological anatomy of hydrophytes, halophytes and xerophytes
5. To measure the photosynthetic rate (A) and the specific leaf area of five tree species and

observe relation between them

Paper IV- Plant Biochemistry

1. To separate the major plant pigments (i) Paper chromatography and 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 Paper chromatography
4. To determine the Rf values of a some given reducing sugar using Paper chromatography
5. To measure the activity of enzyme catalase and to study the effect of – (i) Substrate concentration and (ii) pH on enzyme activity
6. To extract proteins from germinating seeds of moong bean/ black gram and to estimate them by the Biuret test
7. To extract and test the presence of Reducing sugar by Benedict's test
8. Effect of enzyme concentration on the activity of Urease
9. Effect of substrate concentration on urease activity

SEMESTER IV: Paper –I

M.M. 100

BOT 401: Cell Biology

Unit-I

- Techniques in cell Biology, Light Microscopy, Phase Contrast, Confocal Microscope, TEM and SEM

Unit-II

- Cell structure and function: Structural organization of cell, organization of microtubules and microfilaments, plasmodesmata.
- Cell organelles (micro bodies, Golgi apparatus, Lysosomes, endoplasmic reticulum, vacuole, ribosomes, nucleus, chloroplast, mitochondria).

Unit-III

- Cell wall, Plasma membrane and their structural models and functions.
- 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).
- Membrane transport proteins- Plasma membrane H^+ -ATPase, vacuolar H^+ -ATPase and H^+ pyrophosphatases.

Unit- IV

- Cell Division, Cell Cycle, Mitosis and Meiosis, Control of cell division
 - Cell cycle check points, Apoptosis and Programmed Cell Death (PCD) in plants.
 - Cell Signaling
- PRACTICALS: BASED ON THEORY PAPER

BOT 402: PLANT BIOTECHNOLOGY

Unit-I

Plant cell and tissue culture techniques:

- Plant Cell and Tissue culture: Introduction, history, scope, concept of cellular differentiation, totipotency.
- Culture media and laboratory requirements.
- Micropropagation-Organogenesis and embryogenesis.
- Endosperm and nucellus culture.
- Somaclonal variation---applications and reasons for generation.

Unit-II

- Somatic hybridization –protoplast culture, regeneration and somatic hybridization, cybrids.
- Production and uses of haploids.
- Applications of plant tissue culture.

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).
- DNA cloning, preparation of plasmid DNA, Restriction and electrophoresis, ligation.

Unit-III

- Methods of direct and indirect gene transfer in plants, *Agrobacterium*, Ti and Ri plasmids, application of genetic engineering, transgenic plants for pest and disease resistance, abiotic stress tolerance, production of useful products.
- Principles and methods of Genetic Engineering, Gene libraries and cDNA libraries, Polymerase chain reaction, DNA fingerprinting, DNA Synthesis.

Unit-IV

- DNA Sequencing, Southern blotting, RAPD, RFLP, Restriction mapping.

Biotechnology and Human welfare:

- Applications of genetically engineered bacteria in crop production and protection, biodegradation of xenobiotics and toxic wastes, production of chemicals, fuels and medicines.
- Biopesticides and integrated pest management, Biofertilizers, Organic farming.
- Restoration of degraded land –Development of stress tolerant plants, microbes for improving soil fertility.

● PRACTICALS: BASED ON THEORY PAPER

BOT 403: PLANT MOLECULAR BIOLOGY

Unit-I

- Genome-Basic concept and organization.
- Chromosome structure, nucleosome, solenoid and packaging of DNA, molecular organization of centromere and telomere, nucleolus and ribosomal RNA genes, euchromatin and heterochromatin, karyotype analysis, banding patterns.
- Specialized chromosomes—Polytene chromosomes, lampbrush chromosomes, B chromosomes.
- Nuclear DNA content, C-value paradox.
- Structure and Properties of Nucleic acids: Structure, Chemical, Physical and thermal properties of nucleic acids.
- Dissociation and reassociation kinetics of DNA, Cot curves, Cot $\frac{1}{2}$ values and its significance.
- Unique, moderately repetitive and highly repetitive DNA, conformation of nucleic acids. (A, B, Z DNA, t-RNA, m- RNA).

Unit- II

- DNA amplification, molecular genetic maps, genome projects.
- Allele concept, multiple alleles, isoalleles, pseudoalleles.
- Genetic Code
- Gene Structure: Organization and Structure of prokaryotic and eukaryotic genes; structure and role of promoters, exons, introns, terminators and enhancers.
- DNA Replication: - Mechanism of prokaryotic and eukaryotic DNA replication, replication apparatus, Origins of replication, priming and DNA polymerases.
- Transcription: RNA polymerases and their role, Transcription apparatus, Transcription in prokaryotes and eukaryotes, Initiation, elongation and termination, RNA processing, reverse transcription, Ribonucleoproteins.

Unit-III

- 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.
- Translation in prokaryotes and eukaryotes.

Unit-IV

- Theory of fixation and important fixatives, storage of fixed material.
- 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.
- Microtomy: Dehydration, clearing and embedding of material, section cutting, dewaxing.

- PRACTICALS: BASED ON THEORY PAPER

SEMESTER -IV: SPECIAL PAPERS

Paper – IVA

M.M. 100

BOT 404A: ENVIRONMENTAL BOTANY

Unit –I

- Introduction: Relation of man with environment, National and International effects on environmental problems, applied aspects of environmental Botany.
- Ecosystem: Classification, general idea of different ecosystems.
- Environment: concept of environment, environmental segments, Biosphere.
- Biodegradable substances: Classification of pesticides, A brief history of use of synthetic pesticides, ecological effects of pesticide pollution, Bio-accumulation and biomagnifications of pesticide.

Unit – II

- General idea about pollution, Pollutants.
- Water pollution: Physico-chemical and biological characteristics of polluted and drinking water.
- Air pollution :Air pollutants, PAN, Ozone, Ozone layer and Ozone hole ,Green house effects ; Consequences of climate change (global warming, Sea level rise).
- Radioactive pollution: General ideas about hazardous impacts of radiations and radioactive fallouts.
- Noise Pollution: General idea about various levels of noise pollution and human response.

Unit – III

Environmental management: Control of environmental pollution:

- Water management of aquatic ecosystem.
- Purification of water sewage treatment.
- Air methods for monitoring air pollutants air quality management and air pollution control device, role of plants in air pollution abatement.
- Soil conservation: Solid waste and their disposal, waste collection, reclamation and recycling processes.
- Radioactive waste treatment.
- Noise abatement.

Unit – IV

- Conservation: (Forest, Forestation, deforestation and social forestry).
 - Renewable energy sources.
 - Non – conventional energy sources.
 - Environmental education in India , international summits and treaties related to environment.
 - Control of environmental pollution through law.
- Phytogeography:
Distribution patterns, barriers and Age area hypothesis , vegetation & floristic regions of India.

• PRACTICALS: BASED ON THEORY PAPER

SEMESTER -IV

Paper –IVB

BOT404B: ADVANCED PLANT PHYSIOLOGY

M.M. 100

Unit-I: Plant Metabolism

- Photosynthesis and chemosynthesis:
 - Quantasomes, biosynthesis of chlorophylls, heme compounds, role and biosynthesis of accessory pigments, photo oxidation.
 - Biochemical pathways of conversion of solar energy into chemical energy and its utilization in CO₂ reduction cycle.
 - Efficient and inefficient plants, bacterial photosynthesis and its utility in nature.
- Organic acid metabolism: Succulents, CAM pathway and its significance.
- Plant Energetics : As controlled by photosynthesis, respiration and photorespiration
- Respiration: Biological oxidation of carbohydrates and interconversions of the products, terminal oxidation, electron transport, role of cytochromes and other heme compounds.

Unit-II: Nitrogen metabolism: Synthesis and activation of amino acids, transcription and translation of genetic code, the template.

- Chemical regulation and biosynthesis of proteins and enzymes.
- Biochemistry of biological nitrogen fixation and its significance.
- Phosphorus metabolism: Metabolism of phosphorylated compounds and their role.
- Lipid metabolism: Classification of fat and fatty Acids, biosynthesis and breakdown of fats and lipids, its significance. Unsaturated fatty acids.
- 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

- Secondary metabolites :
 - Coumarins and lignins : Structure and synthesis.
 - Tannins : Distribution synthesis and function.
 - Flavonoids and water-soluble pigments: Synthesis and function.
 - Hallucinogens: Distribution, chemistry and function.
 - Alkaloids : Pyrrole, pyrrolidine, pyridine, polyacetyl isoquinoline, tropane and indole alkaloids - their distribution, synthesis and function.
 - Saponins and sapogenins : Sterols, steroids, steroidal alkaloids - their distribution, synthesis and function.
- 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

- Stress physiology : Plant responses to biotic and abiotic stresses, mechanism of biotic and abiotic stress resistance, plant defence mechanisms against water stress, salinity stress, metal toxicity, freezing and heat stress and oxidative stress.
- Photobiology: Photoreceptors, Phytochrome : history, discovery, physiological properties, interaction between hormones, and phytochrome, role of different phytochromes in plant development and flowering, mechanism of phytochrome signal transduction. Cryptochromes and phototropins.
- Circadian rhythms in plants: Nature of oscillator, rhythmic outputs, entrainments (inputs) and adaptive significance.
- Flower Initiation and Floral Expression
- PRACTICALS: BASED ON THEORY PAPER

SEMESTER –IV
Paper –IVC

M.M. 100

BOT 404C: PLANT PATHOLOGY

Unit-I: Principles of Phytopathology

- Historical development and present status of phytopathology.
- Classification of plant diseases
- General symptoms of plant diseases caused by fungi, bacteria and virus.
- Concept of disease, Koch's postulates.
- Mode of infection and development of pathogen in plants.
- Role of enzymes and toxins in pathogenesis.

Unit-II

- Defence mechanism in host, effect of infection on host physiology.
- Dissemination of phytopathogens, plant disease forecasting and management.
- Principle methods of plant disease control: Regulatory, cultural and biological, physical, chemical methods, resistant varieties.
- Mycotoxins and storage diseases.
- Integrated pest management.

Unit-III:

- Epidemiology, symptoms, etiology, perennation and control of following diseases:
- 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

- Diseases caused by nematodes:
 - Ear cockle of wheat.
 - Root knot of vegetables.
- Abiotic/Non pathogenic diseases:
 - Black tip of mango.
 - Black heart of potato.
- Disease caused by plant bacteria:
 - Citrus canker.
 - Blight of rice.
 - Tundu disease of wheat.
 - Soft rot of carrot/onion.
- 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.
- Disease caused by plant MLO:
 - Sesame phyllody
 - Little leaf of brinjal.
 - Grassy shoot of sugarcane.
- PRACTICALS: BASED ON THEORY PAPER

BOT 405 M. Sc. IVth Semester Practical

Paper I- Cell Biology

1. Preparation of squash for the study of mitosis
2. Preparation of squash for the study of meiosis
3. Meiotic studies- Studies of various stages of meiosis, study of diakinesis and or metaphase bivalent, drawing diagrams and calculations of chiasma frequency and terminalisation coefficient

Paper II- Plant 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- Plant Molecular Biology

1. Preparation of various stains- Safranin, Fast green, Haematoxylin and carmine
2. Study of fixation of botanical materials
3. Method for preparation of permanent slides- section cutting by the use of Microtome
4. To study the use of ocular and stage micrometers for the measurement of pollen grains and stomata
5. To extract and to detect nucleic acid from cauliflower or any floral tissue: (i) DNA by Diphenylamine test, (ii) RNA by Orcinol test
6. Isolation and purification of DNA from various sample using Agarose gel electrophoresis
7. Estimation of protein by Bradford reagent
8. Use of spectrophotometer in biochemical estimations- chloroplastic pigments, proteins, carbohydrates etc.
9. Demonstration of instruments: Gel Electrophoresis, Microtome , pH meter, oven, incubator, autoclave and centrifuge

BOT 406-Paper IV- Special Papers

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 analyse 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

OR

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 activity of amylase in germinating barley and moong seeds and to study the effect of : (1) substrate concentration, (2) pH, (3) Temperature, and (4) 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 Soxhlet'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, Brassinolide 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

OR

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, Tungro 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
6. Measurement of fungal spores
7. Transmission experiments (mechanical and insect transmission) of plant virus
8. Use of fungicides and plant protection appliances
9. Field collection of 50 diseased plant specimens (fungal, viral and bacterial)