

New Curriculum According To U.G.C.

(with minor revision and rearranged paper sequence)

M.Sc. Examination

BOTANY

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/ Bacteria/virus/lichens/Microbioloty).
- Course-III (Paper-III) - Biology & diversity of vascular plants (Pteridophyta/Gymnosperm/Palabotany)
- Course-IV (Paper-IV) - Plant Physiology and Biochemistry.
- Couse-V (Paper-V) - Plant Ecology and Soil Science & Phytogeography.

Second Year :

- Couse-I (Paper-I) - Microtechnique, Biotechnology & Genetic Engineering.
- Course-II (Paper-II) - Diversity and taxonomy of seed plants-Angiosperms (Toxonomy, Anatomy, Emelriology.)
- Course-III (Paper-III) - Cell Biology/Genetics/Plant Breeding/ Statistics.
- Course-IV (Paper-IV) - Plant Resource utilization & Conservation and Applied Botany.
- Course-V (Paper-V) - Elective-Specialization paper (Anyone Optional)
- i) Advanced Plant Physiology.
 - ii) Molecular Plant Pathology or Palaeo botany.
 - iii) Environment and Plant Response or
 - iv) Crop Genetics and Plant Breeding.

Details of New Curriculum according to UGC, revised in Present set up.

Note :

1. Total Curriculum divided in five courses/or five papers in first and second year each, in U.G.C. model. Present set up of university curriculum already has included five papers each year according to U.G.C. recommendation.
2. Only minor alterations have been made particularly in sequence of paper in M.Sc. (Previous) and M.Sc. (Final) in the U.G.C. model to accommodate content of courses in present setup of syllabus.
3. Some recommended practical exercises on few courses are new in U.G.C. model and our universities/Colleges have not specific facilities for it. Only such exercises are not included in present setup, otherwise most of recommendations adapted as such.

Paper - I : Biology & Diversity of Lower Plants :

Cryptogams (Algae & Bryophyta)

M.M. 100

Section - A : Algae :

1. Algae in diversified habitat.
2. Systematic study of thallus organization, structure, reproduction, pigmentation, criteria for classification of algae (pigments, reserve food, flagella) and classification.
3. Salient features of Protochlorophyta, chlorophyta, charophyta, xanthophyta, Bassillariophyta, Phaeophyta, Rhodophyta.
4. Phylogeny and inter-relationship of principal group based on the following.
 - i) *Chlorophyta* : Volvocales (*Pandorina*, *Eudorina*, *Volvox*), Chlorococcales (*Chlorococcus*, *Hydrodictyon*), Ulotricales (*Ulothrix*, *Microspora*, *ulva*), Cladophorales (*Pithophora*), Chaetophorales (*Chaetophora*, *Fritschella*, *Draparnaldia*, *Draparnaldiopsis*, *Coleochaete*), Oedogoniales (*Oedogonium*) Conjugales (*Spirogyra*) Sclerogoniales (*Yougheria*, *Acetabularia*), Charales (*Chara*).
 - ii) *Xanthophyta* : A general account.
 - iii) *Bassillariophyta* : A general account.
 - iv) *Phaeophyta* : Ectocarpales (*Ectocarpus*); Laminariales

(*Laminaria*); Dictyotales (*Dictyota*, *Padina*); Fucales (*Fucus* and *Sargassum*).

- v) *Cyanophyta* : Ultrastructure, salient features of *Gleocapsa*, *Microcystis*, *Anabena*, *gleotrichia*, *Nostoc*, *Rivularia*, *Scytonema*.

5. Economic Importance of Algae.

Section - B : Bryophyta :

1. Morphology, structure, reproduction, life history, distribution phylogeny of bryophytes based on following :-

A) *Hepaticopsida* :

- (i) *Sphaerocarpaceae* (*Sphaerocarpus*, *Geothallus*)
- (ii) *Marchantiales* (*Riccia*, *Cyathodium*, *Plagiochasma*, *Lunularia*, *Astrella*, *Marchantia*);
- (iii) *Monocleales* (*Monoclea*)
- (iv) *Jungermanniales* (*Pellia*, *Porella*, *Fossombronia*)
- (v) *Calobryales* (*Calobryum*);
- (vi) *Takakiales* (*Takakia*).

B) *Anthocerotopsida* : Anthocerotales (*Anthoceros*, *Notothylus*)

C) *Bryopsida* : Sphagnales (*Sphagnum*), Andreales (*Andreaea*) Bryales (*Furnaria*, *Pogonatum*), Buxbaumiales (*Buxbaumia*)

Section - C : Morphogenesis

(A general Introduction to 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.)

Practical : Practical related to this paper will be based on plant types prescribed in each section (i.e. algae and bryophyta).

Paper - II : Biology and Diversity of Lower Plants - II (Fungi, Bacteria, Virus, Lichens, Microbiology)

M.M. 100

Section - A : Fungi :

1. General characteristics, nutrition (saprophytic, symbiotic,

- biotrophic) Reproduction in Fungi.
- Heterothalism, Heterokaryosis, Parasexuality, Physiological specialization.

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

- Myxomycetes* : (Trichiales, Stemonitales, Physarales).
 - Plasmodiophoromycetes* : (Plasmodiophacales).
 - Oomycetes* : Saprologniales (*Saprolognia*, *Achyra*)
Pernosporales (*Pythium*, *Phytophthora*, *Albugo*, *Peronospora*).
 - Chitridiomycetes* : Chitridiales, Blastocladiates, Monoblepharidales.
 - Zygomycetes* : Mucorales (*Pilobolus*), Entomophthorales.
 - Ascomycetes* : Protomycetales, (*Protomycetes*), Endomycetales (*Sachromyces*), Taphrinales (*Taphrina*), Urotiales (*Aspergillus*, *Penicillium*), Erysiphales (*Erysiphe*, *Phyllactenia*, *Phyllachora*, *Chaetomium*), Sphaeriales (*Xylaria*), Clavicipitales, Laboulbeniales, Pleosporales *Pezizales* (*Peziza*, *Morchella*).
 - Basidiomycetes* : Tramitiales, Ustilaginales (*Ustilago*, *Urocystis*) Uredinales (*Puccinia*, *Melampsora* *Uromyces*, *Revenelia*).
 - Deuteromycetes* : Sphaeropsidales, Melanconiales (*Collariotricum*), Moniliales (*Helmintosporium*, *Alternaria*, *Cercospora*, *Fusarium*).
- Record trends of classification of fungi.

Section - B : Bacteria, Virus, Lichens :

- Bacteria** : A general account of structure, nutrition, cytology, classification and economic importance and reproduction in bacteria.
- Viruses** : Characteristics and ultrastructure, Isolation and purification of viruses, transmission, and multiplication.
- Phytoplasma** : General characteristics and role in causing plant diseases.
- Lichens** : A general account with particular reference to mode of life, structure, reproduction, classification and economic

importance.

Section - C : Microbiology :

- Archaeobacteria (Archaea) and Eubacteria.
- Cyanobacteria - salient features, biological importance.

Practical Exercise :

- Practical related to this paper will be based on plant types of each section.
- Symptomatology of important fungal, bacterial and viral diseases of plants.
- Identification of fungal cultures of possible/available fungal types.
- Gram staining of bacteria.
- Study of foliose and other types of lichen thallus.

Paper - III : Biology and Diversity of Vascular Plants (Pteridophyta, Gymnosperm, Palaeobotany)

M.M. 100

Section - A : Pteridophyta :

- Morphology, anatomy and reproduction, phylogenetic relationships with emphasis on detailed study of following :
 - Psilopsida* : (Psilophyales, Psilotales)
Lycopsidea : (Lycopodiales, Sellagenales, Lepidodendrales, Isoetales, Pleuromitales).
 - Sphenopsida* : (Equisetales, Hymeniales, Sphenophyllales, and Calamitales)
 - Pteropsida* : (A general account)
 - Filicinae* : A general account
 - Eusporangiate Ferns* : (Ophioglossales, Marattiatales)
 - Leptosporangiate ferns* : Filicales.
- General Account of fossil Pteridophyta
- Evolution of Stele in pteridophytes.
- Heterospory and origin of seed habit.
- Economic importance of Pteridophytes.

Section - B : Gymnosperm and Palaeobotany

- Classification, distribution, morphology, Life history of gymnosperm.

2. Brief Account of the families of Pteridosperms (Lyginopteridaceae, Medullosaceae, Caytoniaceae, and Glossopteridaceae).
3. Structure and reproduction in Cycadales, Bennettiales, welwitschiales, Coniferales, Ephedrales, Ginkgoales, Gnetales etc.
4. Systematic study of Coniferales (Voltziaceae, Pinaceae, Aurocariaceae, Cupressaceae, Podocarpaceae, Cephalotaxaceae, Taxaceae, etc.)
5. Distribution of conifers in India & their economic importance.
6. Principles of palaeobotany, Fossilization, Geological timescale and fossil forms.

Practical Exercises :

1. Comparative and monographic study of the anatomy of vegetative and reproductive parts of *Cycas*, *Ginkgo*, *Cedrus*, *Abies*, *Picea*, *Cupressus*, *Arucaria*, *Cryptomeria*, *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.

Paper : IV : Plant Physiology and Bio Chemistry

M.M. 100

Section : A : Plant Physiology :

1. **Water relation to plants :** (Water potential and component potentials, its role in hydrodynamics, Absorption and translocation of water).
2. **Mineral relation to plant :** (Macro and Micronutrient elements, Active transport across membrane, Carrier Proteins).
3. **Photo Chemistry & Photosynthesis :** (Historical evolution of Photosynthetic study, Photosynthetic apparatus (Chloroplast) Photosynthetic pigments, Photo synthetic mechanism - Light reaction (Cyclic & Noncyclic photophosphorylation, pigment excitation and energy transfer), Dark reaction (C3 - Calvin cycle, C4 - H-Sk Pathway, Crassulacean Acid Metabolism (CAM).
4. **Respiration :** Overview of plant respiration (Aerobic and Anaerobic), fermentation, Glycolysis, Krebs cycle, Oxidative Phosphorylation, Pentose - shunt Pathway.
5. **Lipid Metabolism :** Characteristics, classification, biosynthesis and oxidation.

6. **Protein Metabolism :** Chemical nature, structural conformations (primary, secondary, Tertiary and quaternary), Biosynthesis (Amino acid synthesis, activation, Transcription and Translation), Regulation of Protein synthesis.
7. **Phytohormones :** Chemical nature, physiological effects and mechanism of action of auxins, gibberellins, cytokinins.
8. Photoperiodism and Vernalization.

Section - B : Biochemistry :

1. Principle of biochemical techniques (chromatography, colorimetry and spectrophotometry).
2. **Bioenergetics :** Principles of thermodynamics, free energy, chemical potential, redox reactions, structure and function of ATP.
3. **Fundamentals of Enzymology :** General aspects, enzyme and co-enzyme, Isoenzymes, Mechanism of enzyme catalysis, Michaelis-Menten Equation and its significance.
4. Structure of DNA and RNA and their function (gene expression).

Practical Exercise :

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 biuret reagent.
5. Determination of osmotic potential ($\psi^2\pi$) of cell sap using epidermal peelings - plasmolytic method.
6. Determination of osmotic potential of storage tissue - plasmolytic method.
7. To study frequency of stomata and transpiration per stomata (potometer method).
8. To compare rate of transpiration from two surfaces of leaf.
9. To determine real rate of photosynthesis by continuous air stream method.
10. To determine rate of respiration in germinating seeds by continuous air stream method.
11. To isolate and estimate reducing sugar from plant material (onion

bulb) titrimetrically using fehling's reagent.

Paper – V : Plant Ecology, Soil Science & Phytogeography :

(4 questions from Section A and B each);

Students have to answer 5 questions

M.M. 100

Section – A :

Plant Ecology :

1. Climate and Vegetation pattern of the world (General account)
2. Scope of ecological study.
3. **Vegetation Organization** : Concept of community, structure, Analysis (qualitative, Quantitative and synthetic characters, Continuum. Concept, interspecific, association, concept of ecological niche).
4. **Ecosystem Organization** : Structure and function, primary production, energy dynamics (trophic organization and energy flow), Global biogeochemical cycles of C, N, P, and S. A general idea of major terrestrial and aquatic ecosystems.
5. **Environmental Pollution** : Air, water, soil and radiation pollution, their impact on plants and ecosystem. Climatic change (Green house gases CO₂, CH₄, N₂O, CFS, - sources, trends and role).
6. **Ecological stability** : Concept, ecological perturbations ecology of plant invasion.
7. **Ecological Management** : Concept, sustainable development and sustainability – Indicators.

Section – B :

Soil Science & Phytogeography :

1. Soil types, soil profile, soil formation (gleization, Podzolization and Laterization), Soil texture, soil humus.
2. Soil moisture constants.
3. Soil erosion and conservation.
4. Phytogeography : Distribution pattern, barriers, endemism and age – area hypothesis.
5. Vegetation and floristic regions of India.

Practical Exercises :

1. To find out minimum size and number of quadrats 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 constant, water holding capacity of soil collected from different locations.
8. To determine percent organic carbon in soil sample of cropland and grassland, titrimetrically.
9. To determine dissolved oxygen in water samples by winkler's method.
10. Rapid test of pH, carbonate, N, P, K, and base deficiency.

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

Max Marks : 125

- Q.1 Identification and study of four specimens from mixture – A (Algae)

20

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

15

- Q.3 Identification, and study of structure, (vegetative and reproductive parts) of specimen D & E. (Bryo phytes).

15

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

20

- 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** **Max. Marks : 125**

Q.1 To perform a Plant Ecology experiment 20

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

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.
3. Microtomy and use of Camera Lucida.
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) :

1. **Basic Concepts** : Principles and scope.
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.
6. Study of E. coli culture : Growth characteristics using planting and turbidimetric method.
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) :**M.M. 100****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.
3. Morphology of flower (with special reference to carpel and inferior ovary).
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 Prantle, Bessy and Hutchinson.)
6. Recent trends in Plant taxonomy.
7. General knowledge of distinguishing features of important families with special reference to local flora.

a)

Dicotyledons: Ranunculaceae, Annonaceae, Papaveraceae, Brassicaceae, Capparidaceae, Caryophyllaceae, Maliaceae, Linaceae, Rutaceae, Meliaceae, Violaceae, Anacardiaceae, Fabaceae, Rosaceae, Myrtaceae, Apiaceae, Rubiaceae, Asteraceae, Cucurbitaceae, Primulaceae, Boraginaceae, Convolvulaceae, Solanaceae, Scrofulariaceae, Bignoniaceae, Acenthaceae, Verbinaceae, Lamiaceae, Asclpiadaceae, Polygonaceae, Nyctaginaceae, Loranthaceae, Euphorbiaceae.

b)

Monocotyledon: Orchidaceae, Liliaceae, Musaceae, Palmae, Alismaceae, Cyperaceae, Graminae (Poaceae), etc.

8. Botanical Survey of India, Important Herbaria and Botanical gardens.

Section – II

(Anatomy & Embryology) :

1. Primary Meristem : Organization of shoot and root apex.
2. Structure of wood in relation to its weight, strength, durability and its taxonomic significance.
3. Anomalous secondary growth.
4. Cork cambium and its products.
5. Anatomy in relation to taxonomy/floral anatomy.
6. Development of male and female gametophyte.
7. Fertilization, development of embryo in dicot and monocot, Endosperm.
8. Apomixis, Polyembryony, Parthenocarp.
9. Seed development and fruit growth.
10. Embryology in relation to taxonomy.

Suggested Practicals:

1. Describing of plant specimen from representative locally available families.
2. Identification of taxa upto family using flora and identification of genus and species with, the help of available keys.
3. Collection of plants and preparation of herbarium, through field trips within and local area around campus.
4. Preparation of smears for study of male gametophyte.
5. Study of embryological permanent slides.

6. Embryo dissection.

7. Study of angiospermic plant materials with particular reference to anatomical features of special interest.

Paper – III (Cell Biology, Genetics, Plant Breeding, Statistics)

M.M. 100

Unit – I : (Cell Biology) :

1. Cell : Dynamic characteristic, structural organization of plant cell types, cell cycle.
2. Study of structural organization of plasma membrane and organelles, (Mitochondria, Nucleus, ribosome).
3. Tools and techniques for study of cell structure.
4. Structure of genetic material (DNA)
5. Cell division, crossing over, Synaptonemal complex spindle dynamics.

Unit – II (Genetics) :

1. Chromosome structure, molecular organization of centromere and telomere, euchromatin, heterochromatin, Karyotype analysis, types of chromosome (Polytene, lampbrush, β Chromosome, Sex chromosome)
2. Structural and numerical alteration in chromosome.
3. Mendelism and non-mendelian inheritance.
4. Interaction of genes.
5. Sex determination and sex-linkage.
6. Cytoplasmic inheritance – a general account.
7. Gene concept, Genetic code, Gene expression, Genetic mapping.
8. Genetics of prokaryote and Eukaryote organelles.
9. Mutation (Spontaneous, and Induced mutation, physical and chemical mutagens, molecular basis of gene mutation, DNA-damage and repair mechanism.)

Unit – III (Plant Breeding & Elementary Statistics) :

1. Principle and scope of plant breeding.
2. Inbreeding and heterosis.
3. Breeding in self pollinated and cross pollinated plants.
4. Concept of statistics and Biometry.

5. Measurement of central tendencies (mean, mode, median, standard deviation, standard error.)
6. Significance test (chi square test & t-test)
7. Diagrammatic representation of statistical data.

Practical Exercises :

1. To study cell structure using onion leaf peels.
2. Study of protoplasmic streaming movement (cyclosis) in *Hydrilla* and staminal hairs of *Tradescantia* flower.
3. Demonstration of prokaryotic and eucaryotic cell structure with the help of electron micrographs.
4. Examination of mitosis and meiosis using appropriate plant material (onion root – tip, flower bud of sweet pea and flos.)
5. Cytological examination of special types of chromosome.
6. Emasculation of flower bud and demonstration of hybridization technique.
7. Statistical exercise based on theory paper.

Paper : IV : Plant Resource Utilization & Applied Botany :

M.M. 100

Unit - I : Plant Resource Utilization :

1. *Plant diversity and sustainable development* : Basic concepts and status in India.
2. *Cultivation and uses of economically important plants* (with special reference to origin, evolution, cultivation and uses).
 - i) Food, Forage and fodder crops (Cereals, legumes & nuts and general account of fodder crops).
 - ii) Fibre yielding crops (Textile fibre plants and their products, its uses and cultivation in India).
 - iii) *Medicinal Plants and Aromatic Plants* : (Important related plants of medicinal importance and aromatic plants as source of essential oil - A general account).
 - iv) *Vegetable Crops* : A general Account.
 - v) *Oil Yielding Crops* : A general Account.
 - vi) *Important fire wood and timber yielding plants* : A general Account.
 - vii) *Non-Wood Forest products (NWFPs)* : (Bamboo, rattans,

raw material of paper industry, gums, tannins, dyes resins, rubber and latex-products : A General Account).

- viii) *Sugars and sugar yielding plants* : A general Account.
- ix) *Funigatories and masticatories* : A general Account.

Unit - II : Applied Botany :

1. *Green revolution* : Benefits and adverse conditions, innovation for meeting world food demands.
2. *Strategies for conservation* : In situ conservation (a general account of sanctuaries, national parks, biosphere reserve wetlands, mangroves for conservation of wild bio diversity) *Ex-situ conservation* : (Principle and practices), A general account of the activities of B.S.I., National Bureau of Plant Genetic resource (NBPGR), Indian Council of Agricultural research (ICAR) for conservation of plants and nonformal conservation efforts.
3. Seed certification and its application in agricultural production.
4. Application of plant breeding in agronomic practices.
5. Induction of parthenocarpy in production of seedless fruits.

Suggested Practical exercise :

1. *Laboratory work* : Study of food crops (wheat, rice, maize, potato, sugar-cane with reference to its characteristics and nature of reserve food material), Forage/Fodder crops (sorghum, bajra, barseem, guarbean) Plant fibres (Textile, fibres, coir, silk cotton or kopak). Medicinal / Aromatic Plants (Select few medicinal plants - e.g., *Papaver somniferum*, *Atropa belladonna*, *Adhatoda vasica*, *Rauwolfia serpentina*, *Withania somnifera*, *Andrographis paniculata*, *Aloe barbadense*, *Mentha arvensis*, *Vitiveria zizanioides*, *Cymbopogon* spp - study with herbarium materials or visible specimens). Vegetable oils (Mustard, groundnut, coconut, sunflower, study morphological and oil characteristics).
2. *Field Survey and Scientific visits* : (Study, survey of firewood, timber yielding plants in local forests, and visit to Institutes to see their role in conservation of biodiversity (e.g. B.S.I., CSIR, NBPGR, FRI etc.)

Special Paper - V (Elective)

B. Molecular Plant Pathology

M.M. : 100

Section A (Principles of Plant Pathology) :

1. History of plant pathology.

2. Elementary idea of infection, susceptibility, resistance, host parasite relationship, host reactions, symptomatology physiological specialization and interpretation of each aspect at molecular level.
3. Dissemination of Pathogens and disease Occurrence.
4. Plant Protection : Principle and concept of disease control, disease control prophylaxis, eradication, chemotherapy, immunization, plant quarantine, biological control of plant diseases.
5. Identification of plant diseases - Koch's postulate.

Section - B (Crop Diseases of U.P.) :

1. Study of following diseases of principle crops of U.P.
 - i) *Rust* : (Wheat rust, and rust of gram, pea, linseed) & study of wheat rust problem in India.
 - ii) *Smut* : (Smut disease of wheat, barley, sugarcane and maize).
 - iii) *Bunt* : (of rice and wheat).
 - iv) *Blight* : (Disease of potats, cucurbits, wheat, tomato, colacacia and rice.)
 - v) *Wilt* : disease of sugarcane, linseed, pigeon-pea.
 - vi) *Leaf Spot* : of rice, ground-nut and turmeric.
 - vii) *Mildews* : of pea, cucurbits, maize and wheat.
 - viii) *Rots* : of papaya, turmeric, wheat and ginger.
 - ix) *Cankers* : of citrus, wart of potato, white rust of crusifer and stemgall of Coriander.
 - x) Viral diseases of potato, tomato, papaya, bhindi, sugar-cane and chilli.
 - xi) Diseases caused by mycoplasma.
 - xii) Elementary idea of physiological diseases and those caused by phanerogam - parasites.
2. Rapid method for diagnosis of plant diseases caused by (Viruses, Bacteria and Fungi with reference to 'ELISA' & PCR).

Practical Exercise :

1. Collection and identification of plant diseases in local area.
2. solation, cultivation and maintenance of plant diseases.
3. Morphological and histopathological study the diseases of crops

available in local area.

4. Preparation of dried herbarium and museum specimen of plant diseases.

Note : Students will have to collect minimum 20 different pathological specimens and submit then at time of examination in form of pressed herbarium.

Sepecial Paper - V (Elective)

C : Environment and Plant Response

M.M. : 100

Section - A : Soil and water Environment :

1. **Soil Environment** : Soil composition, organic matter input and decomposition, soil nutrient storage and accumulation in plants, agrochemical residues and their pollutive effect.
2. **Water Environment** : hydrological cycle, primary production and productivity of different aquatic weeds, Distribution, adaptation and dynamics of fresh water and wet-land plant communities, water pollution due to sewage, agrochemicals, industrial wastes and urban solid wastes.

Section - B : Environment Planning and Strategies :

1. Air environment and its ecological perspective with reference to rural, urban and industrial areas.
2. Effect of air pollutants e.g. SO₂, Fluoride, photo-chemical, suspended particulates on vegetation of local area.
3. Indexing of sensitivity and resistance to pollutants, of plants.
4. Nuclear power - energy and its environmental effect.
5. Environmental planning strategies, criteria for environmental standard, monitoring techniques, control of air pollution through plants and microbes. Control of pollution of water bodies.

Suggested Practical Exercise :

1. Estimation of soil organic matter by standard method.
2. quantitative evaluation of major soil nutrients (N,P,R.)
3. Estimation of fertilizer residue in soil.
4. Measurement of primary productivity of aquatic system by standard method.
5. Measurement of pH, soil conductivity, and level of water pollution, of different water samples.
6. Determination of BOD and COD of polluted and non-polluted water

samples.

7. Estimation of dissolved oxygen in water.
8. Sampling and assessment of particulate and gaseous pollutants (e.g., SO₂, Ozone, NO_x and dust)
9. Demonstration of monitoring techniques.
10. Measurement of smoke density by Ringleman charts.
11. Evaluation of hardness of water.

Special Paper - 5

D : Crop Genetics and Plant Breeding :

M.M. : 100

Section - A : Crop Genetics :

1. *Heridity and continuity of Life* : Reproduction cycle in plants.
2. *Mendelism* : (Laws of inheritance), Interaction of genes, leathality, Quantitative inheritance, chromosomal basis of inheritance.
3. Sex-determination, autosomes, chromosomal theory of sex-determination.
4. Chloroplastidic genome (molecular organization) and concept of extranuclear inheritance.
5. *Mutation and Mutagens* : Role of mutation in origin and evolution of species, spontaneous and induced mutations, numerical mutatin and chromosomal mutation, biological significance of mutation.
6. Modern concept of gene and gene expression.
7. Cytology of important crops plants.
8. role of biotechnology and genetic engineering in crop improvement and development of transgenic plants.

Section - B : Plant Breeding :

1. Principles and concepts : Scope of plant breeding in India.
2. Genetic basis of breeding in sexually reproducing crops.
3. Germ plasm preservation and gene-library.
4. Concept of pure line selection and hotrosis in crop improvement, inbreeding dippression, male-sterility and incompatibility, their role in plant breeding.
5. Techniques of plant breeding in self pollinating and cross pollinating crops.
6. Major achievements of plant breeding in India with reference to

wheat, rice, maize, sugarcane, potato, cotton, pea, groundnut, castor, and sunflower.

7. Recent tools and techniques of plant breeding for crop improvement (plant tissue hybridization, somatic hybridization, mutation and polyploidy).

8. Major contributin of Indian plant breeders in green revolution and future prospects.

Suggested Practical exercises :

1. Study floral morphology and biology of important crop plants-wheat, rice, maize, sugarcane, linseed, brassica, and cotton.
2. to perform emasculation in different crop plants including cereals, oil-crops, solanaceous-vegetable crops.
3. Study of cell division/cell cycle.
4. Use of chemical mutagens for crop plants and study of mutagenesis.
5. Demoustration of plant propogation through tissue culture technique.
6. Preparation of karyotypes from dividing root tip cell and pollen grains.

Scheme of Practical Examination :

Note : There shall be two practical examinations in M.Sc. (Final) Botany. Practical-I will be 'general' based on theory papers (I-iv), carrying 200 marks, and practical-II will be based on special (elective) paper of 50 marks only. There will be one long tour and atleast two local excursions and a detailed tour report will be submitted by students at the time of examination.

Practical - I (General)

Time : 6 Hours

M.M. : 200

1. Preparation of slide of anatomical material 'A' and identification & study of features of anatomical interest (Anotomy) 20
2. Describing flowering plant specimens 'B' and 'C' in semitechnical language, identification upto family and gems, assigning systemic position (Txonomy) 20
3. Dissection of Embryo from provided seed and study of features of embryological importance. 15
4. To perform one experiment based on paper - I 15
5. One statistical Exercise 10
6. One plant breeding exercise (e.g. Emasculation, bagging, tagging, labelling etc.) 10

7. Cytology (demonstration of stages of mitosis/meiosis) experiment 10
 8. Comment upon spots (1-15) including 7 spots of economic importance (paper-IV) 30
 9. viva-voce 20
 10. Class records 20
 11. erbarium and tour report (10 + 10) 20
- Total = 200

Practical - II (Special)

A : Advanced Plant Physiology (Special)

Time : 4 hrs.

M.M. : 50

1. to perform one physiology experiment 20
2. to perform one enzymology experiment 14
3. Viva-voce 10
4. Class records 06

OR

B. Plant pathology (Special)

Time : 4 hrs.

M.M. : 50

1. Identification, histopathology and host-pathogen relationship of specimen - 'A' 10
2. Identification of pathogen and assessment of its effect on host in specimen 'B' and 'C' 08
3. Demonstration of pathological technique 06
4. Comment upon spots (1-5) 10
5. Viva-voce 10
6. Class record and Herbarium 06

OR

D : Crop Genetics and Plant Breeding (Special)

Time : 4hrs.

M.M. : 50

1. To study mutatin on muosis 15
2. To perform plant breeding experiment 15
3. Viva-voce 10
4. Records 10

OR C : Environment and Plant Response (Special)

Time : 4hrs.

M.M. : 50

1. Two experiments concerning water and air studies 16
2. One experiment concerning soil studies 08
3. Comment upon spots (1-5) 10
4. Viva-voce 10
5. Class records 06