**M.Sc. in Botany**

There shall be two academic years in one complete session of M.Sc. Each academic year will have TWO Semesters. Each Semester will have four Theory Papers of 100 marks each and two practical Papers of 100 mark each. In fourth Semester, instead of two practical Papers, there will be one Practical and one Dissertation of 100 marks each.

Each Theory paper will have 80 marks for examination and 20 marks for internal assessment. The pass marks will be 45 in each paper. The total marks for M.Sc. (all four semesters included) should be 2400.

**M.Sc. BOTANY PART I**

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<tr>
<th>SEMESTER I</th>
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<td>Microbiology</td>
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<th>PAPER II (Theory)</th>
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<td>Gymnosperms</td>
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PAPER VI
Practical
Full Marks 100

SEMESTER II
PAPER VII (Theory)
Cell biology and Genetics
Full Marks 100 (80+20)

PAPER VIII (Theory)
Molecular Biology
Full Marks 100 (80+20)

PAPER IX (Theory)
Taxonomy
Full Marks 100 (80+20)

PAPER X (Theory)
Ecology

PAPER XI
Practical
Full Marks 100

PAPER XII
Practical
Full Marks 100

TOTAL = 1200
M.Sc. BOTANY PART II

SEMESTER III  
PAPER XIII (Theory)  
Embryology and Anatomy  
Full Marks 100 (80+20)  
PAPER XIV (Theory)  
Genetic Engineering, Biotechnology and Plant Tissue Culture  
Full Marks 100 (80+20)  
PAPER XV (Theory)  
Plant Physiology and Metabolism  
Full Marks 100 (80+20)  
PAPER XVI  
Plant Biochemistry  
PAPER XVII  
Practical  
Full Marks 100  
PAPER XVIII  
Practical  
Full Marks 100

SEMESTER IV  
PAPER XIX (Theory)  
Environmental Biology  
Full Marks 100 (80+20)
M.Sc. PART I

SEMESTER I

PAPER I

MICROBIOLOGY

1. Salient features of Archaebacteria, Eubacteria and Cyanobacteria 06
2. Structure of bacterial cell 06
3. Nutrition, reproduction and Economic Importance of Bacteria 04
4. Bacterial recombination: conjugation, transduction and transformation 10
5. Structure and multiplication of Bacteriophage and TMV 08
6. Structure and multiplication of viruses of bacteria 06
7. Modes of transmission of viruses in plants 04
8. Economic importance of viruses 02
9. A general account of Mycoplasma and study of plant diseases:
   Grassy shoot of sugarcane, Sesamum phylloidi, Little leaf of Brinjal 04

Total lectures 50

**PAPER II**

**FUNGI AND ALGAE**

**GROUP – A**

1. Outline classification of fungi as proposed by Alexopoulos and Mims, 1979 03
2. Heterothallism, heterokaryosis, parasexuality 06
3. General account of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina 06
4. Symptoms, causal organisms and control measures of the following types of Fungal diseases: (a) Blights, (b) Mildews, (c) Smuts, (d) Rusts
   (e) Wilts, (f) Rots 06
5. Mycorrhizae and Lichens: general account and its importance 02
6. Economic Importance of Fungi 02

**GROUP – B**

1. Algae in diversified habitats (terrestrial, freshwater, marine) 04
2. Outline classification of algae as proposed by (a) Fritsch (1935), (b) Smith (1950) 03
3. Range of thallus structure and reproduction in (a) Cyanophyta (b) Chlorophyta
   (C) Charophyta, (d) Bacillariophyta, (e) Phaeophyta, (f) Rhodophyta 12
4. Evolutionary trends in Algae

5. Economic Importance of Algae: Algal Blooms, Biofertilizers, as food and feed

In industry

Total lectures 52

PAPER III

BRYOPHYTES AND PTERIDOPHYTES

GROUP – A

1. General features, origin and classification of Bryophytes
2. Salient Features of the following orders:
   (a) Sphaerocarpales
   (b) Marchantiales
   (c) Jungermanniales
   (d) Anthocerotales
   (e) Sphagnales
   (f) Funariales
   (g) Polytrichales
3. Evolutionary trends in Bryophytes and origin of land plants

GROUP – B

1. Classification of Pteridophytes
2. Salient features of the following orders:
   (a) Psilophytales
   (b) Psilotales
   (c) Lepidodendrales
   (d) Isoetales
   (e) Sphenophyllales
   (f) Ophiolglossales
   (g) Osmundales
   (h) Filicales
3. Origin and evolution of sphenophytes in Pteridophytes - Telome concept
4. Heterospory and seed habit

Total lectures 57

PAPER IV
GYMNOSPERMS

1. Gymnosperms: an introduction 02
2. Classification of Gymnosperms and their distribution in India as proposed by Pant 04
3. Salient features of Cycadales, Ginkgoales, Coniferales, Ephedrales, Welwitschiales, Gnetales 18
4. Fossils: Mode of preservation, geological time-table, Indian fossils 05
5. Salient features of Pteridospermales: Lyginopteridaceae, Medullosaceae, Caytoniaceae, Glossopteridaceae 12
6. Salient features of Cycadeoidales and Cordaitales 10

Total lectures 51

PAPER V

PRACTICAL

PAPER VI

PRACTICAL

SEMESTER II

PAPER VII

CELL BIOLOGY AND GENETICS

GROUP – A (CELL BIOLOGY)

1. Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes. 12
2. Structure of nucleus and nuclear wall 04
3. Other cellular organelles: structure and functions of microbodies, Golgi apparatus, lysosomes, endoplasmic reticulum. 04
4. Cell cycle: Mechanism and control of cell division 08
5. Chromatin organization: Chromosome structure, types (ring chromosomes, iso, pseudoiso types) and packaging of DNA, molecular organization of centromere and telomere, nucleolus and ribosomal RNA genes, Euchromatin and heterochromatin, karyotype analysis, banding patterns, specialized types of chromosome, Polytene, Lampbrush, B chromosome and sex chromosome pairing. 20
GROUP – B (GENETICS)

1. Mutations: spontaneous and induced mutation, physical and chemical mutagens, molecular basis of gene mutation, transposable elements in prokaryotes and eukaryotes, mutation induced by transposons, site-directed mutagenesis, DNA damage and repair mechanisms, inherited human diseases and defects in DNA repair, initiations of cancer at cellular level, proto-oncogenes and oncogenes.

2. Polyploidy: auto and allopolyploidy, cytonogetics of aneuploids and structural heterozygotes: effects of aneuploidy on phenotype in plants, transmission of monosomic and trisomic and their use in chromosome mapping of diploid and polyploid species, breeding behaviour and genetics of structural heterozygotes, translocation tester sets, Robertsonian translocation, B-A translocations. Origin, occurrence, production of autopolyploids, chromosome and chromatin segregation, allopolyploids, genome constitution and characterization of Trisomics and Monosomics.


Total lectures 84

PAPER VIII

MOLECULAR BIOLOGY

1. DNA replication, repair and recombination (Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms, homologous and site-specific recombination).

2. 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, RNA transport).

3. Protein synthesis and processing (Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoaacylation of tRNA, tRNAs-identity, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors, Post-translational modification of proteins).
4. **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).

5. **Cell signaling** Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two-component systems, light signaling in plants, bacterial chemotaxis and quorum sensing.

6. **Techniques in cell biology**: Immunotechniques, in situ hybridization to locate transcripts in cell types, FISH, GISH, Confocal microscopy.

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**PAPER IX**

**TAXONOMY**

**GROUP – A**

1. Taxonomy: definition, purpose and scope  
2. Literature on taxonomy  
3. Origin of angiosperms  
4. Classification of angiosperms : Benthem and Hooker system, Engler and Prantl System, Hutchinson system and Takhtajan system of classification and its Comparison  
5. Plant nomenclature : need and scope, history of nomenclature, ICBN- principles, rules and recommendations  
6. Taxonomic evidences: anatomy in relation to taxonomy, palynology in relation to taxonomy, Embryology in relation to taxonomy and cytology in relation to taxonomy  
7. Modern trends in plant taxonomy  
8. Study of plants of different families available in Jharkhand: Ranunculaceae, Brassicaceae, Capparidaceae, Meliaceae, Leguminosae, Apiaceae, Rubiaceae, Asclepiadaceae, Catharanthaceae, Convolvulaceae, Solanaceae, Scrophulariaceae, Acanthaceae, Lamiaceae, Verbenaceae, Poaceae, Cyperaceae

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**PAPER X**

**ECOLOGY**

1. Climate, soil and vegetation pattern of the world: Life zones: major biomes and major vegetation and soil types of the world.
2. Vegetation organization: Concepts of community and continuum; analysis of communities; community coefficients; inter specific associations, concepts of Ecological niche 10
3. Vegetation development: mechanism of ecological succession; changes in ecosystem properties during succession 06
4. Ecosystem organization; structure and functions; primary productions (methods of measurement, global pattern, controlling factors); global bio-geo-chemical cycles of C, N, P, S; mineral cycles (pathways, processes, budgets) in terrestrial and aquatic Ecosystems 10
5. Biological diversity: concept and levels; role of biodiversity in ecosystem functions and stability; IUCN categories of threat 07
6. Phytogeography 06

Total lectures 47

PAPER XI

PRACTICAL

PAPER XII

PRACTICAL

M.Sc. PART II

SEMESTER III

PAPER XIII

EMBRYOLOGY AND ANATOMY

GROUP – A

1. Microspore and Microsporogenesis; Megaspore and Megasporogenesis 04
2. Development of male and female gametophyte 06
3. Germination of pollen grains, path of pollen tube and its entry Into embryo sac, double fertilization and pollen-pistil interaction 04
4. Endosperm and its types, morphological nature of endosperm 02
5. Embryogenesis, development of monocot and dicot embryo 04
6. Apomixis and polyembryony 04
7. Morphogenesis and organogenesis in plants: Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development.

GROUP – B

1. Cambium: normal and anomalous secondary growth 06
2. Ecological Anatomy 06
3. Periderm 02
4. Mechanical tissue and their distribution 04

Total lectures 46

PAPER XIV

GENETIC ENGINEERING AND BIOTECHNOLOGY AND PLANT TISSUE CULTURE

GROUP – A

1. Biotechnology: basic concepts, principles and scope 04
2. Recombinant DNA-technology: gene cloning, principle and techniques 08
3. DNA-fingerprinting, Polymerase chain reaction 08
4. Genetic engineering of plants: aims, strategies for development
   Of Transgenic plants with suitable examples 08
5. Agrobacterium- the natural genetic engineer, T-DNA and transposon
   Mediated gene tagging 06

GROUP – B

1. Plant tissue culture: history, techniques, embryogenesis,
   Micro propagation and its application 12
2. Anther, Embryo, Endosperm culture and their significance 10

Total lectures 56

PAPER XV

PLANT PHYSIOLOGY AND METABOLISM
1. Absorption of water: mechanism of active and passive absorption; factors affecting water absorption 05
2. Ascent of sap: mechanism 02
3. Transpiration: stomatal structure and movement; guttation; factors Affecting the rate of transpiration 05
4. Absorption of minerals: anatomy of root, soil profile and soil water, mechanism of absorption: active and passive; factors affecting absorption, Mineral nutrition of plants, deficiency symptoms and diseases, macro and micro nutrients, chelating agents 10
5. Translocation of solutes: substances translocated in phloem, direction and speed of translocation, mechanism of phloem transport, transport of ions; factors affecting translocation 06
6. Stress physiology – Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses. 05
7. Plant growth regulators (Phytohormones): structure, biosynthesis, physiological responses and mechanism of action of Auxins, Gibberellins, Cytokinins, Ethylene Abscissic acid 10
8. Sensory photobiology - Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks. 06

Total lectures 49

PAPER XVI

BIOCHEMISTRY

1. Structures & function of primary metabolites: Carbohydrates, proteins, fats. 06
2. Structures and function of secondary metabolites : Terpenoids, phenols & alkaloids. 02
3. Photosynthesis : Pigment system, Photophosphorylation, Calvin cycle, Hatch & Slack pathway , CAM pathway, photorespiration, factors affecting rate of photosynthesis. 08
4. Respiration : Glycolysis, Fermentation, Kreb’s cycle, Electron Transport System, Hexose monophosphate shunt, theories of phosphorylation, factors affecting rate of respiration. 08
5. Enzymes : nature properties & classification, enzyme energetic , mode & mechanism of action, factors affecting enzyme activities. 06
7. Fats : nature & classification; biosynthesis, degradation of fats : beta-oxidation & alpha-oxidation, glyoxylate cycle. 06
8. Bioenergetics . 02

Total lectures 42
PAPER XVII
PRACTICAL

PAPER XVIII
PRACTICAL

SEMESTER IV
PAPER XIX
ENVIRONMENTAL BIOLOGY

1. Environment and pollution: general concept and impact on human beings 04
2. Air, water and soil pollution: kinds, sources; quality parameters: effect on plants and ecosystems and control measures 14
3. Climate change: Greenhouse gases (CO2, CH4, N2O, CFCs; sources, trends and role) Ozone layer and ozone hole 10
4. Ecosystem stability: Concept (resistance and resilience); ecological perturbations (Natural and anthropogenic) and their impact on plants and ecosystems, Ecosystem restoration 08
5. Ecological management: concepts; sustainable developments; sustainability indicators 06
6. Energy resources: conventional and non-conventional 06

Total lectures 48

PAPER XX

PLANT RESOURCE UTILIZATION, BIOSTATISTICS AND BIODIVERSITY CONSERVATION

GROUP – A

1. Origin, evolution, botany, cultivation and uses of; (a) food crops, (b) fiber, forage and Fodder crops, (c) medicinal and aromatic plants, (d) vegetables and oil yielding crops 08
2. Plants yielding timber, tannins, dyes, resins and fruits 05
3. Plants used as revenue trees for shade, pollution control and aesthetics 02
GROUP – B

1. Presentation of biological data in tables, graphs, histograms and pie chart 04
2. Concept of statistical analysis in biology 04
3. Preliminary ideas about mean, mode, median, standard deviation
   Probability, correlation, trends 04

GROUP – C

1. Principles of conservation 06
2. Strategies for conservation: in situ conservation; international efforts and Indian initiatives;
   Protected areas in India- sanctuaries, national parks, biosphere reserves, wet lands,
   Mangroves and coral reefs for conservation of wild biodiversity 12
3. Strategies for conservation: ex situ conservation; principles and practices; botanical gardens,
   Field gene banks, seed banks; in vitro repositories, cryo banks; general account of the
   activities of Botanical Survey of India(BSI), National Bureau of Plant Genetic
   Resources(NBPGR), Indian Council of Agricultural research (ICAR), Council of Scientific
   and industrial research (CSIR), and the department of biotechnology (DBT) for
   conservation 10
4. Plant biodiversity: concept, status in India, utilization and concerns 05

Total lectures 60

PAPER XXI

SPECIAL PAPER I

PLANT PATHOLOGY – I

1. History and modern approaches to plant pathology 02
2. General symptoms of plant diseases caused by fungi 04
3. Mode of attack:
   (a) Enzymes: role of enzymes in pathogenesis 08
   (b) Toxins: types and their role in pathogenesis
4. Physiology of diseased plants with special reference to:
   (a) Osmo-regulation
   (b) Respiration
(c) Photosynthesis
(d) Nitrogen and phenol metabolism

5. Mechanism of defense:
   (a) Structural defense mechanism
   (b) Biochemical defense mechanism

6. Control measures of plant diseases:
   (a) Cultural practices
   (b) Biological
   (c) Chemical control (fungicide)
   (d) Plant quarantine

Total lectures 50

PAPER XXII

SPECIAL PAPER II

PLANT PATHOLOGY – II

1. Important plant diseases caused by the fungi (symptoms, etiology and control):
   (a) Downy mildew of maize
   (b) Powdery mildew of pea
   (c) Loose smut of wheat
   (d) Covered smut of barley
   (e) Whip-smut of sugarcane
   (f) Linseed rust
   (g) Tikka disease of groundnut
   (h) Wilt of arhar
   (i) Blast of rice
   (j) False smut of rice
   (k) Red rot of sugarcane
   (l) Early blight of potato

2. Important diseases of Bacteria:
3. Important viral diseases:
4. Important diseases caused by Nematodes: