

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

SEMESTER I

PAPER I (Theory)

Microbiology

Full marks 100 (80+20)

PAPER II (Theory)

Fungi and Algae

Full Marks 100 (80+20)

PAPER III (Theory)

Bryophytes and Pteridophytes

Full Marks 100 (80+20)

PAPER IV (Theory)

Gymnosperms

Full Marks 100 (80+20)

PAPER V

Practical

Full Marks 100

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)

PAPER XX (Theory)

Plant Resource utilization, Biostatistics and Biodiversity

Conservation

Full Marks 100 (80+20)

PAPER XXI (Theory)

Special Paper I

PAPER XXII (Theory)

Special Paper II

PAPER XXIII

Practical

Full Marks 100

PAPER XXIV

Project

Full marks 100

TOTAL MARKS=1200

Total Marks for M.Sc. part I and II = 2400

M.Sc. PART I

SEMESTER I

PAPER I

MICROBIOLOGY

- | | |
|--|----|
| 1. Salient features of Archaeobacteria, 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	04
5. Economic Importance of Algae: Algal Blooms, Biofertilizers, as food and feed In industry	04

Total lectures 52

PAPER III

BRYOPHYTES AND PTERIDOPHYTES

GROUP – A

1. General features, origin and classification of Bryophytes	02
2. Salient Features of the following orders:	
(a) Sphaerocarpaceae	02
(b) Marchantiales	02
(c) Jungermanniales	02
(d) Anthocerotales	04
(e) Sphagnales	02
(f) Funariales	04
(g) Polytrichales	04
3. Evolutionary trends in Bryophytes and origin of land plants	02

GROUP – B

1. Classification of Pteridophytes	02
2. Salient features of the following orders:	
(a) Psilophytales	03
(b) Psilotales	03
(c) Lepidodendrales	03
(d) Isoetales	03
(e) Sphenophyllales	03
(f) Ophioglossales	03
(g) Osmundales	03
(h) Filicales	03
3. Origin and evolution of sporophytes in Pteridophytes- Telome concept	03
4. Heterospory and seed habit	04

Total lectures 57

PAPER IV

GYMNOSPERMS

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|--|----|
| 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. 12
2. Polyploidy: auto and allopolyploidy, Cytonoetics 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. 20
3. Chromosomal Aberration: Structural and Numerical alterations in chromosomes, meiotic behavior of duplication, deficiency, inversion and translocation heterozygotes. 04

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). 10
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). 10
3. **Protein synthesis and processing** (Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors, Post- translational modification of proteins). 10

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). 10
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. 05
6. **Techniques in cell biology:** Immunotechniques, in situ hybridization to locate transcripts in cell types, FISH, GISH, Confocal microscopy. 05

PAPER IX

TAXONOMY

GROUP – A

1. Taxonomy: definition, purpose and scope 06
2. Literature on taxonomy 06
3. Origin of angiosperms 04
4. Classification of angiosperms : Bentham and Hooker system, Engler and Prantl System, Hutchinson system and Takhtajan system of classification and its Comparison 10
5. Plant nomenclature : need and scope, history of nomenclature, ICBN- principles, rules and recommendations 08
6. Taxonomic evidences: anatomy in relation to taxonomy, palynology in relation to taxonomy, Embryology in relation to taxonomy and cytology in relation to taxonomy 08
7. Modern trends in plant taxonomy 06
8. Study of plants of different families available in Jharkhand: Ranunculaceae, Brassicaceae, Capparidaceae, Meliaceae, Leguminoceae, Apiaceae, Rubiaceae, Asclepiadaceae, Catharanthaceae, Convolvulaceae, Solanaceae, Scrophulariaceae, Acanthaceae, Lamiaceae, Verbenaceae, Poaceae, Cyperaceae 20

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. 08

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|--|----|
| 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. 04

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, Krebs' 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
6. Nitrogen metabolism: amino acid metabolism, protein synthesis in pro & eukaryotes, genetic code polypeptide chain, nitrogen fixation in free living and symbiotic bacteria.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 (CO ₂ , CH ₄ , N ₂ O, 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
(b) Toxins: types and their role in pathogenesis | 08 |
| 4. Physiology of diseased plants with special reference to:
(a) Osmo-regulation
(b) Respiration | |

(c) Photosynthesis	
(d) Nitrogen and phenol metabolism	14
5. Mechanism of defense:	
(a) Structural defense mechanism	
(b) Biochemical defense mechanism	08
6. Control measures of plant diseases:	
(a) Cultural practices	
(b) Biological	
(c) Chemical control (fungicide)	
(d) Plant quarantine	14

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	24
2. Important diseases of Bacteria:	
3. Important viral diseases:	
4. Important diseases caused by Nematodes:	

PAPER XXIII

PRACTICAL

PAPER XXIV

PROJECT