Web Site Address: https://jmi.ac.in

Two Year M.Sc. Botany Program
Department of Biotechnology
Faculty of Life Sciences
Jamia Millia Islamia, New Delhi-110025

M.Sc. Botany Course Structure and Credit Distribution as per NEP Guidelines

1ST YEAR

Semester I					
Paper Code	**Papers (2 Credits Theory and 2 Credits Practical for DSC & DSE Courses)**	**Total Credits**	**Internal Assessments (Theory/Practical)**	**Final Exams**	**Total Marks (Theory+ Practical)**
MBOT-401	Plant Diversity **(DSC-1)**	4	20/25	30/25	100
MBOT-402	Plant Physiology and Metabolism **(DSC-2)**	4	20/25	30/25	100
MBOT-403	Plant Pathology and Crop Protection **(DSC-3)**	4	20/25	30/25	100
MBOT-404	*Elective I **(DSE-1) (VAC)**	4	20/25	30/25	100
MBOT-405	**Elective II **(DSE-2)**	4	20/25	30/25	100
MBOT-406	Ecological Study / Biodiversity Assessment in the Adjoining Area **(SEC)**	4	50	50	100
Total		**24**			**600**

***DSE-1 (Elective) Choose ANY ONE**

(i) Climate Change Biology (ii) Medicinal Plants and Pharmacognosy

****DSE-2 (Elective) Choose ANY ONE**

(i) Recombinant DNA Technology (ii) Molecular Biology

Note: Students can choose both DSE OR Any One DSE and One GE (General Elective) offered by other Department

DSC-Discipline Specific Course; DSE-Discipline Specific Elective; SEC-Skill Enhanced Course

Semester II					
Paper Code	**Papers (2 Credits Theory and 2 Credits Practical for DSC & DSE Courses)**	**Total Credits**	**Internal Assessments (Theory/Practical)**	**Final Exams**	**Total Marks (Theory+ Practical)**
MBOT-407	Genetics, Genomics and Plant Breeding **(DSC-4)**	4	20/25	30/25	100
MBOT-408	Plant Anatomy and Developmental Biology **(DSC-5)**	4	20/25	30/25	100
MBOT-409	Cell Biology **(DSC-6)**	4	20/25	30/25	100
MBOT-410	Advanced Mycology and Fungal Biotechnology	4	20/25	30/25	100
MBOT-411	*Elective I **(DSE-3)**	4	20/25	30/25	100
MBOT-412	**Elective II **(DSE-4)**	4	20/25	30/25	100
MBOT-413	Research Methodology **(SEC)**	2	25	25	50
MBOT-414	Seminar/Technical Writing **(VAC)**	2	25	25	50
Total		**28**			**700**

***DSE-3 (Elective) Choose ANY ONE**

(i) Seed Science and Technology (ii) Reproductive Biology of Flowering Plants

****DSE-4 (Elective) Choose ANY ONE**

(i) Nanobiotechnology & Bioprospecting (ii) Intellectual Property Rights and Entrepreneurship

Note: Students can choose both DSE OR Any One DSE and One GE (General Elective) offered by other Department

DSC-Discipline Specific Course; DSE-Discipline Specific Elective; SEC-Skill Enhanced Course; VAC-Value Added Course;

Semester III					
Paper code	**Papers (2 Credits Theory and 2 Credits Practical for DSC & DSE Courses)**	**Total Credits**	**Internal Assessments (Theory/Practical)**	**Final Exams**	**Total Marks (Theory+ Practical)**
MBOT-501	Plant Biotechnology & Tissue Culture **(DSC-7)**	4	20/25	30/25	100
MBOT-502	Ecology and Environmental Biology **(DSC-8)**	4	20/25	30/25	100
MBOT-503	Angiosperm, Economic Botany & Plant Systematics **(DSC-9)**	4	20/25	30/25	100
MBOT-504	Molecular Aspects of Host-Pathogen Interaction **(DSC-10)**	4	20/25	30/25	100
MBOT-505	*Elective I **(DSE-5)**	4	20/25	30/25	100
MBOT-506	**Elective II**(DSE-6)**	4	20/25	30/25	100
MBOT-507	Bioinformatics and Biostatistics **(SEC)**	2	25	25	50
MBOT-508	Critical analysis of classical papers / Internship for 4 weeks **(VAC)**	2			50
Total		**28**			**700**

***DSE-5 (Elective) Choose ANY ONE**

(i) Industrial Microbiology (ii) Synthetic Biology

****DSE-6 (Elective) Choose ANY ONE**

(i) Plant Biochemistry (ii) Applied Botany and Environmental Management

Note: Students can choose both DSE OR Any One DSE and One GE (General Elective) offered by other Department

DSC-Discipline Specific Course; DSE-Discipline Specific Elective; SEC-Skill Enhanced Course; VAC-Value Added Course;

Semester IV					
Paper code	**Paper**	**Credits**	**Internal Assessments**	**Final Exams**	**Total Marks**
MBOT-509	Dissertation	14		350	350
	Thesis defense	3		75	75
	Thesis Evaluation	3		75	75
MBOT-510	SWAYAM	2	As per the SWAYAM	As per the SWAYAM/JMI	50
Total		**22**			**550**

NOTE: SWAYAM Paper will be notified as per the availability of paper on NPTEL. Code of SWAYAM paper will be same for the same semester.

M.Sc. Botany- 2 Year (4 Semester) Course Structure
As Per NEP 2020 Guidelines

- **Total Duration: 2 Years**
- **Total Semesters: 4**
- **Total Credits: 92**
- **Programme Type: Core + Elective papers+ Practicals + Internship+ Research**
- **Total Seats: 30**
- **Eligibility for Admission: B.Sc/B.Sc. (Hons.) Botany/Agriculture sciences/ Biosciences/ Biotechnology/Microbiology/ Genetics/ Biochemistry/ B.tech (Biotechnology)/B.Sc Multidisciplinary in Biological Sciences OR in any area of Life Sciences with not less than 50% marks in aggregate**

Semester Wise Summary

- **Semester I- (Core + Skill Enhancement)**
- **Credits: 24**

- **Semester II- (Advanced Core + Skill Enhancement+ Technical Writing)**
- **Credits: 28**

- **Semester III- (Advanced + Specialized + Skill + Internship)**
- **Credits: 28**

- **Semester IV- (Research + Applied Specialization)**
- **Credits: 22**

Key Features Included In The Course Structure

- Multidisciplinary approach
- Skill development courses (SEC)
- Value added papers (VAC)
- Research based learning
- Internship/Industrial training
- Project/Dissertation
- Indian knowledge system
- Environmental and Agriculture consciousness

M.Sc. Botany (Semester I)
Plant Diversity

Course Code: MBOT-401 **Credit: 4**
Total Hours 60 (Theory 30/Practical 30)

Unit I – Algae
Introduction to algal diversity; Classification systems including modern trends (molecular and chemotaxonomy); Life cycles and alteration of generations of types: Chlamydomonas, *Volvox, Spirogyra, Sargassum, Nostoc;* Economic, Ecological and Biotechnological importance of algae.

Unit II – Fungi
General characteristics and nutrition classification (Ainsworth & Bisby, Modern phylogenetic systems) of Fungi, Reproduction, Life cycles and heteroecism of types: *Rhizopus, Aspergillus, Puccinia and Agaricus*; Economic importance

Unit III – Bryophytes and Pteridophytes
General characteristic feature and classification of Bryophytes, Gametophyte & Sporophyte structure, Evolution of sporophytes and study of types: *Riccia, Marchantia, Funaria and Sphagnum;* Ecological role & importance; General Characteristics and classification of Pteridophytes; Stelar evolution, Heterospory and seed habit, Evolution of telome theory, study of types: *Lycopodium, Selaginella, Equisetum, Pteris*; Economic and ecological importance

Unit III – Gymnosperm
General Characteristics and classification of Gymnosperm, Morphology and anatomy of vegetative and reproductive parts, Pollination and fertilization, Study of types: *Cycas; Pinus; Gnetum, Ephedra;* Economic importance and phylogenetic relationships

Practicals: (*Based on the theoretical content of the syllabus)*
-Study of vegetative and reproductive structures through slides
-Identification of specimens
-Life cycle diagrams
--Field visit, collection of specimens, preparation of slides
-Study of stellar pattern (slides)
-Identification of cones and reproductive structures

Course Learning Outcomes (CLOs): *Students will be able to develop a comprehensive understanding of plant diversity, mainly lower group of organisms across major groups, classification, economic importance and different types with their life cycle.*

Suggested Readings:
Douglas E. Soltis et al.- Molecular Systematics of Plants
Ashok M. Bendre & Ashok Kumar- Algae, Fungi, Lichens, Bryophyta, Pteridophyta and Gymnosperms
Constantine J. Alexopoulos-Introductory Mycology
O.P. Sharma- Bryophyta
Kenneth R. Sporne- Morphology of Pteridophytes
Kenneth R. Sporne- Gymnosperms

M.Sc. Botany (Semester I)
Plant Physiology and Metabolism

Course Code: MBOT-402 **Credit: 4**
Total Hours 60 (Theory 30/Practical 30)

Unit I: Plant Water Relations & Mineral Nutrition
Water potential and its components, Absorption and transport of water (apoplast and symplast pathways), Transpiration and stomatal movement, Essential mineral nutrition: uptake, transport and deficiency

symptoms.

Unit II: Photosynthesis & Carbon Metabolism
Photosynthetic pigments and light harvesting complexes, Light reactions: PSI & PSII, photophosphorylation, Carbon fixation pathways: C3, C4, CAM, Photorespiration and its significance, Sucrose and starch metabolism, Chloroplast organelles, Photobiology: action of phytochromes, cryptochromes and phototropins, stomatal movement, photomorphogenesis

Unit III: Respiration & Nitrogen Metabolism
Glycolysis, TCA cycle and electron transport chain, ATP synthesis and respiratory regulation, Nitrogen fixation (biological), nitrate assimilation, Amino acid biosynthesis, Mitochondria organelles

Unit IV: Plant Growth Regulators & Stress Metabolism
Plant hormones: auxins, gibberellins, cytokinins, ABA, ethylene, Signal transduction mechanisms, Abiotic stress (drought, salinity, temperature, metal), Oxidative stress and antioxidant defense system, Secondary metabolites (alkaloids, phenolics, terpenoids).

Practicals: (*Based on the theoretical content of the syllabus)*

-Determination of osmotic potential by plasmolytic method
-Measurement of transpiration rate
- Estimation of chlorophyll and reducing sugars
-Separation of photosynthetic pigments by paper/TLC chromatography
-Estimation of protein, nitrate reductase, catalase & peroxidase activity
-Effect of stress on growth parameters
-Data skills with basic statistics

Course Learning Outcomes (CLOs): *Students will be able to understand the mechanisms of plant physiological processes, key metabolic pathways and their regulation, biochemical and physiological experiments, response of plant under varying stress conditions and data analysis.*

Suggested Readings:
Taiz, Zeiger, Moller & Murphy-Plant Physiology and Development
Hopkins and Huner- Introduction to Plant Physiology
Salisbury and Ross- Plant Physiology
Buchanan, Gruissem and Jones-Biochemistry & Molecular Biology of Plants

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M.Sc. Botany (Semester I)
Plant Pathology and Crop Protection

Course Code: MBOT-403 **Credit: 4**
Total Hours 60 (Theory 30/Practical 30)

Unit I: Fundamentals of Plant Pathology
Scope and Definition, History, development and concepts of plant diseases, Classification of plant diseases (biotic and abiotic) , Symptoms and diagnosis, Disease triangle and disease cycle.

Unit II: Plant Pathogens and Host Pathogen Interaction
Infection process: penetration, colonization, spread; Role of enzymes, toxins and growth regulators; Host defense mechanisms, structural & biochemical; Concepts of resistance (vertical & horizontal)

Unit III: Epidemiology and Disease Forecasting
Factors responsible for disease development. Epidemiology of plant diseases; Disease forecasting principles and models; Role of climate and environment in disease spread.

Unit IV: Diseases of major crops and Crop Protection Strategies
Cereals: wheat rust, rice blast; Vegetables: leaf spot, wilt disease; Fruits: bacterial canker, anthracnose; Brief

study of viral, bacterial, fungal and nematode disease, Oilseeds and cash crops diseases; Principles of plant disease management: Exclusion, eradication, protection; Chemical control (fungicides, bactericides), Biological control (bioagents like Trichoderma, Pseudomonas); Integrated disease management (IDM), Organic and sustainable crop protection

Practicals: (*Based on the theoretical content of the syllabus)*

- Study of symptoms and signs of plant diseases and identification of fungal, bacterial and viral diseases
- Preparation of slides
- Staining and microscopic observation
- Pure culture technique
- Study of fungicides and biocontrol agents
- Isolation of plant pathogens (serial dilution method)
- Spore count by haemocytometer
- Seed pathology tests (seed health testing)
- Survey and collection of diseased samples

Course Learning Outcomes (CLOs): *Students will be able to identify plant diseases based on symptoms and pathogens, mechanism of infection, host-pathogen interaction, integrated and eco-friendly crop protection strategies and modern tools for evaluation*

Suggested Readings:

Agrios, G.N.-Plant Pathology
Mehrotra, R.S.- Plant Pathology
Rangaswami & Mahadevan- Disease of Crop Plants in India
Bilgrami & Dube- Modern Plant Pathology

M.Sc. Botany (Semester I)
Medicinal Plants and Pharmacognosy (DSE 1)

Course Code: MBOT-404 **Credit: 4**
Total Hours 60 (Theory 30/Practical 30)

Unit I: Introduction to Medicinal Plants

Definition, scope and importance, History and traditional systems: Ayurveda, Unani, Siddha, Classification of medicinal plants. Conservation strategies (in situ & ex situ), cultivation and sustainable harvesting.

Unit II: Phytochemistry

Primary vs secondary metabolites, Study of major groups: Alkaloids, Glycosides, Terpenoids, Flavonoids, Tannins and phenolics, Biosynthetic pathway (basic overview), Role of phytochemicals in plant defense and medicine.

Unit III: Pharmacognosy Fundamentals

Definition and scope of pharmacognosy, Sources of crude drugs (plant origin), Morphological and anatomical evaluation, Barcoding, Adulteration and substitution, Drug standardization techniques.

Unit IV: Herbal Drug Technology

Extraction methods: maceration, Percolation, Soxhlet extraction, Isolation and purification basics, Quality control of herbal drugs, WHO guidelines for herbal medicines, Introduction to nutraceuticals and herbal formulations.

Practicals: (*Based on the theoretical content of the syllabus)*

- Identification and morphology of selected medicinal plants
- Morphological and microscopic studies of crude drugs (powder analysis), determination of ash value, moisture content, extractive values
- Preparation of selected plant extracts

- Qualitative tests for flavonoids, alkaloids, tannins etc.
- TLC
-Visit to herbal industry/ documentation of local medicinal plants

Course Learning Outcomes (CLOs): *Students will be able to identify major medicinal plants, uses, phytochemical constituents, pharmacognostic techniques, analysis of secondary metabolites, standardization of herbal drugs.*

Suggested Readings:
Trease & Evans- Pharmacognosy
Kokate, Purohit & Gokhale- Pharmacognosy
Harborne- Phytochemical Methods
WHO guidelines on Herbal Medicines

M.Sc. Botany (Semester I)
Molecular Biology (DSE 2)

Course Code: MBOT-405 **Credit: 4**
Total Hours 60 (Theory 30/Practical 30)

Unit I: Structure and Organization of Genetic Material
DNA structure, RNA types and structure, Genome organization in prokaryotes vs eukaryotes, Plant nuclear, chloroplast and mitochondrial genomes, chromatin structure: nucleosome model.

Unit II: DNA Replication and Repair
Mechanism of DNA replication (prokaryotes & eukaryotes), Enzymes involved: DNA polymerases, helicases, ligase, Replication models and regulation, DNA replication models, DNA damaging agents, DNA repair mechanisms (nucleotide excision repair, base excision repair, mismatch repair, recombination repair, double strand break repair, transcriptional coupled repair)

Unit III: Recombinant DNA Technology & Genomics
Tools of recombinant DNA technology, Restriction enzymes, Vectors (plasmids, cosmids), Gene cloning and transformation, PCR and its types, DNA sequencing methods, Introduction to genomics, transcriptomics, proteomics, Application in plant biotechnology, Molecular markers (SNP, microsatellites), Next Generation Sequence technologies

Unit IV: Protein synthesis and Post-Translational Processing
Translation mechanism in prokaryotes and eukaryotes, ribosomes-composition and assembly; universal genetic codes, degeneracy of codons, Wobble hypothesis; Iso-accepting tRNA; mechanism of initiation, elongation and termination, post translational modifications: phosphorylation, glycosylation. methylation, protein folding, protein degradation pathways.

Practicals: (*Based on the theoretical content of the syllabus)*
-Methods of isolating DNA (genomic and plasmid) and RNA,
-DNA and RNA purity check
-DNA and RNA analysis by electrophoresis, agarose and polyacrylamide gels
-PCR amplification of plant DNA
- SDS-PAGE
-DNA fingerprinting techniques
- Primer design (bioinformatics approach)
- Sequence analysis using databases (NCBI tools)

Course Learning Outcomes (CLOs): *Students will be able to understand molecular mechanisms governing cellular processes in plants, gene structure, expression and regulation, protein synthesis mechanisms and post translational processing, skills in molecular biology techniques.*

Suggested Readings:

Bruce Alberts et al. – Molecular Biology of Cell
James D. Watson- Molecular Biology of the Gene
T.A. Brown- Genomes 3
J. Sambrook, D.W. Russel- Molecular cloning: A laboratory manual
Primrose & Twyman- Principles of Gene manipulation
Buchanan et al.- Biochemistry and Molecular Biology of Plants
P.K. Gupta- Molecular Biology and Genetic Engineering
Russel L. Jones et al. -The Molecular Life of Plants