BUNDELKHAND UNIVERSITY, JHANSI

ORDINANCES FOR M.Sc. BOTANY

1 A. **Course** : M.Sc. Botany
Eligibility : B.Sc. with Botany; 50% marks

Note: Eligibility for SC/ST students to appear in the Entrance Examination will be 45% marks.

1 B. **Intake** : 90 seats for M.Sc. course in Botany.

Note: Reservation: as per state government /university rules.

2. **Duration** : Minimum 2 years (4 Semesters)

3. **Criteria of admission** **:** Admission of eligible candidates will be strictly on the basis of entrance test/merit list.

Note: 15% marks have obtained in entrance test will be awarded as addition marks to all candidates who passed the B.Sc. Examination with more than 50% marks from any institution affiliated to Bundelkhand University.

4. **Medium of Instruction and Examination** : English

5. **Fee** : Rs. 19000.00 per annum.

(i). Tution and other fee : As prescribed by the university from time to time.

(ii). Refund of fee :

(a). Request for refund of fee should be made to the Vice-Chancellor, Bundelkhand University within 3 weeks of deposition of fee. On approval such candidate will be entitled for refund of 50% of prescribed fee.

(b). Request for refund of fee shall not be entertained under any circumstances if made after three weeks from the date of deposition of admission fee by the candidate.

6. Examination Schedule:

July 15	:	Start of Teaching for Semester I and III classes.
October 31	:	Teaching ends.
November 15	:	Start of Semester Exam for Semester I and III.
December 1	:	End of Examination.
December 15	:	Start of Teaching for Semester II and IV.
March 30	:	Teaching ends.
April 15	:	Start of Exam for Semester II and IV.
April 30	:	End of Exam.

It is suggested that Practical Examinations be conducted before the theory Examinations.

(i). Attendance:

Minimum attendance required to become eligible to appear in the examination for each paper shall be 75% of the class lectures (for each of Theory and Practical). In case a student is short of attendance due to illness, participation in sports, extra curricular activities etc. the following rules shall apply.

(a). Shortage of attendance of up to 10% shall be conducted by HOD on specific recommendations of the course instructor.

(b). A shortage of attendance of up to 25% can be condoned by the Vice-Chancellor on specific recommendations of the HOD.

(ii). Process of Evaluation:

Minimum-passing marks of Theory Semester Exam and Sessionals combined will be 40% for each paper.

(a). Theory Papers:

Semester Examination shall be conducted by the university as mentioned in the academic calendar of the Department. The question papers will be set by examiners appointed by Vice-Chancellor based on recommendations of Board of Studies. At least 50% of question papers should be set by examiners from other universities running the curriculum suggested by Curriculum Development Committee (CDC). University Grants Commission, New Delhi. The pattern of question papers will be decided by the university. The weightage of Theory Semester Exam will be 70% for each paper.

(b). Sessional Examination :

The paper instructor shall conduct Sessional Examination for each Theory paper within 50 – 60 days of the start of the Semester. The questions should be so set to test the understanding of the subject by the student as well as problems from Tutorials. The weightage of Sessional Examination will be 20% and that of Student Seminar/Assignments will be 10%. Sessionals are to be conducted by the concerned

instructors teaching that paper. The Sessional marks should be submitted to Departmental Head.

(c). Practical Examination:

Practical Examinations shall be conducted by examiners appointed by Vice-Chancellor on recommendations of Course Committee of Department/Board of Studies. The practical examination will be conducted at the end of each semester. Minimum passing marks in practical paper will be 40%.

(d). Educational Tours:

Educational tours for students of some Department should be conducted by the concerned Departments between Semesters II and III as a compulsory part of Curriculum and should be funded by the University.

(e). M.Sc. Research Project/Dissertation:

Each student of M.Sc. (Final) Semester IV will have to undertake Dissertation under the guidance of his supervisor for a period of 4 – 5 months. The supervisor will normally be a faculty member of the Department. The student will have the option of undertaking Dissertation in the Department itself or in other institutions on prior approval.

(f). Submission of Dissertation:

The student will be allowed to submit his thesis once his supervisor is satisfied with the progress and completion of research work. The Dissertation work should comprise of original research. The student will have to submit his thesis in four copies for evaluation. The thesis should include a certificate of original work carried out by the student duly signed by the candidate, his supervisor and Department Head.

(g). Evaluation of Dissertation/Thesis:

The student will have to defend his research work carried out in Dissertation in front of Examiners [comprising of his Supervisor Internal Examiner and an External Examiner appointed by Vice-Chancellor/Dean (Academic)] and an audience. The Examiners will do the assessment of the project work jointly. If the examiners decided that the performance of the student is unsatisfactory, the student will have to conduct additional work suggested by examiners and rewrite the Dissertation/Thesis and resubmit.

(h). Qualifying Marks and Promotion:

The minimum passing marks shall be 40% in each paper. The division shall be awarded on the basis of percentage of total marks secured in the aggregate of all years by a candidate, as per details given below:

(i).	First division with distinction :	75% and above
(ii).	First division:	60% or more than but less than 75%
(iii).	Second division:	50% or more than but less than 60%
(iv).	Third division:	40% or more than but less than 50%

A candidate having back paper/s can be provisionally promoted to the next Semester if he fulfills the following condition:

If he has obtained 40% marks in the aggregate of all papers but has failed to secure 40% marks in each theory paper, sessional, practical, industrial visit and project work.

(i). Declaration of results and award of degree:

After completion of the evaluation process, result will be declared by the university. Candidates declared successful will get the provisional certificate from the Registrar/Vice-Chancellor of the University immediately after the declaration of the result. Formal Degree will be conferred at the time of convocation to be held annually.

(j). Back Paper and Improvement:

In case, a candidate is unable to clear maximum of two theory papers in a semester examination, he will be promoted to next year on the condition that he has to clear back paper/s, which shall be conducted along with the scheduled exam of back paper for University students. In case a student fails to appear in Theory or Practical examination, he will be given a chance to appear in the back paper examination. But a prior request has to be made by the student and the permission for the same should be granted by Director of the concerned Institute or Dean (Academic). Such candidate will be given a maximum of two attempts to clear these back papers. Further the student has to pay additional fee to appear in the back paper examination as fixed by the university.

A student may be allowed one chance to improve his/her division for a maximum of two papers in subsequent examination of concerned papers. The improvement of percentage will be allowed in both Previous and Final years. For improvement of percentage in Semester examinations, a candidate can take examination of only one paper in each semester. The improvement of percentage will be done only at the end of the academic year.

(k). Ex-Student:

In case a student fails in the examination as per relevant provision, he/she may be allowed to re-appear in the subsequent examination as an ex-student, without attending classes. He/She shall be required to appear and clear all papers, exam etc. as per provision of the syllabus in that year.

In such case the marks obtained by the student in Dissertation and Practical exams obtained earlier would be carried over.

(l). Scrutiny:

Scrutiny facility will be given to the student in two papers on payment of prescribed fee as decided by the University from time to time.

(m). Amendment:

Any ordinance, fee structure and eligibility is subjected amendment from time to time as may be decided by appropriate body of the University.

DEPARTMENT OF BOTANY
M.Sc. BOTANY (SEMESTER PATTERN)

I Semester

Paper No.	Paper Name	Paper code	Theory Marks	Sessional Marks	Seminar/ Assignment Marks	Total M.
I	Cell Biology of Plants	BOY-111	70	20	10	100
II	Molecular Biology of Plants	BOY-112	70	20	10	100
III	Biology & Diversity of Viruses, Bacteria & Fungi	BOY-113	70	20	10	100
IV	Biology & Diversity of Algae, Bryophytes & Pteridophytes	BOY-114	70	20	10	100
	Practical					100
	Total					**500**

II Semester

Paper No.	Paper Name	Paper code	Theory Marks	Sessional Marks	Seminar/ Assignment Marks	Total M.
V	Genetics & Cytogenetics	BOY-115	70	20	10	100
VI	Biology & Diversity of Gymnosperms	BOY-116	70	20	10	100
VII	Taxonomy of Angiosperms	BOY-117	70	20	10	100
VIII	Plant Physiology	BOY-118	70	20	10	100
	Practical					100
	Total					**500**

III Semester

Paper No.	Paper Name	Paper code	Theory Marks	Sessional Marks	Seminar/ Assignment Marks	Total M.
IX	Plant Development and reproduction	BOY-119	70	20	10	100
X	Plant Ecology –I	BOY-120	70	20	10	100
XI	Plant Ecology – II	BOY-121	70	20	10	100
XII	Plant Resource Utilization	BOY-122	70	20	10	100
	Practical					100
	Total					**500**

IV Semester

Paper No.	Paper Name	Paper code	Theory Marks	Sessional Marks	Seminar/ Assignment Marks	Total M.
XIII	Plant Resource Conservation	BOY-123	70	20	10	100
XIV	Biotechnology – I Or (Plant Cell, Tissue & Organ culture)	BOY-124	70	20	10	100
XV	Biotechnology & Genetics Engineering – II Or (Genetic Engineering of Plants & Microbes)	BOY-125	70	20	10	100
XVI	Project Work/Dissertation/ **Elective paper:** *Stress Physiology* *Plant Protection* *Crop Genetics & Plant Breeding* *Ethnobotany* *Forest Biology* Practical	BOY-126 (SP) (PP) (CB) (ET) (FB)	70	20	10	100 100
	Practical					100
	Total					**600**

M.Sc. (I Semester)

Course I (BOY-111): *Cell Biology of Plants.*

The dynamic cell: Structural organization of the plant cell; specialized plant cell types; Chemical foundation; biochemical energetics.

Cell wall: Structure and functions; biogenesis; growth.

Plasma membrane: Structure, models, and functions; sites for ATPases, ion carriers, Channels and pumps; receptors.

Plasmodesmata: Structure; role in movement of molecules and macromolecules comparison with gap junctions.
Structure, function and biogenesis of different plant cell organelles e.g. Chloroplast, Mitochondria, Plant vacuoles, Nucleus and Nucleolus, Ribosomes, Microbodies, Golgi apparatus, Lysosomes, Endoplasmic reticulum, Microtubules and Microfilaments.

Techniques in cell biology: Immunotechniques; in situ hybridization to locate transcripts in cell types; FISH; GISH; confocal microscopy.

Chromatin organization: chromosome structure and packaging of DNA , molecular organization of Centromere and telomere; nucleolus and ribosomal RNA genes; euchromatin and heterochromatin; Karyotpye analysis; Banding pattern; Karyotype evolution; Specialized type of chromosome; Polytene chromosome; Lampursh chromosome, B. chromosome; Molecular basis of chromosomes pairing .

M.Sc. (I Semester)

Course II (BOY-112): *Molecular Biology of Plants.*

Cell cycle and apoptosis: Control mechanism; role of cyclins and cyclin dependent kinases retinoblastoma and E2F proteins; cytokinesis and cell plate formation; mechanisms of programmed cell death (PCD)

Cell shape and motility: The cytoskeleton; organization and role of microtubules and Microfilaments; motor movement; implications in flagellar and other movements.
Genome Organization of Chloroplast: RNA editing, Nucleo-chloroplastic interaction.

Mitochondria: Genome Organization.
DNA Structure, A, B and Z forms, replication, damage and repair mechanisms of DNA, Transcription: Plant promoters and transcription factors, Splicing mRNA transport, rRNA biosynthesis, Translation mechanism, Inition, elongation and terminal, Structure and role of tRNA.

Protein sorting: Targeting of proteins to organelles.

M.Sc. (I Semester)

Course III (BOY-113): *Biology and Diversity of Viruses, Bacteria and Fungi.*

Archaebacteria and eubacteria: General account; ultrastructure, nutrition and reproduction biology and economic importance; Cyanobacteria – salient features and biological importance.

Viruses: Characteristics and ultrastructure of virions; isolation and purification of viruses; chemical nature, replication, transmission of viruses; economic importance.

Mycoplasma: General characteristics and role in causing plant diseases.

Mycology: General character of fungi; substrate relationship in fungi; cell ultrastructure; unicellular and multicellular organization; cell wall composition; nutrition (saprobic, biotrophic, symbiotic); reproduction (vegetative, asexual, sexual); heterothallism; heterokaryosis, parasexuality; recent trends in classification.

Phylogeny of fungi; General account of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina, Deteromycotina; fungi industry, medicin and as food; fungal diseases in plants and human; Mycorrhizae; fungi as biocontrol agents.

M.Sc. (I Semester)

Course IV (BOY-114): *Biology and Diversity of Algae, Bryophytes and Pteridophytes.*

Phycology: Algae in diversified habitats (terrestrial, freshwater, marine); thallus organization; cell ultrastructure; reproduction (vegetative, asexual, sexual); criteria for classification of algae pigments, reserve food flagella; classification, salient feature of Protochlorophyta, Chlorophyta, Charophyta, Xanthophyta, Bacillariophyta, Phaeophyta and Rhodophyta; algal blooms, algal biofertilizers; algae as food, feed and uses in industry.

Bryophyta: Morphology, structure, reproduction and life history; distribution; classification; General account of Marchantiales, Junger – maniales, Anthoceratales, Sphagnales, Funariales and Polytrichales; economic and ecological importance.

Pteridophyta: Morphology, anatomy and reproduction; classification; evolution of stele, heterospory and origin of seed habit; general account of fossil pteriodophyta; introduction to Psilopsida, Lycopsida, Sphenopsida and Pteropsida.

M.Sc. (II Semester)

Course V (BOY-115): *Genetics and Cytogenetics.*

Genetic recombination and genetic mapping: Recombination; independent assortment and crossing over; molecular mechanism of recombination; role of RecA and RecBCD enzymes site-specific recombination, chromosome mapping, linkage groups.

Mutation: Spontaneous and induced mutations; physical and chemical mutagens; molecular basis of gene mutations; transposable elements in prokaryotes and eukaryotes; mutations induced by transposons; site – directed mutagenesis; DNA damage and repair mechanism inherited human diseases and defects in DNA repair; initiation of cancer at cellular level protooncogenes and oncogenes.

CYTOGENETICS

Cytogenetics of aneuploids and structural heterozygotes: Effect of aneuploidy on phenotype in plants; transmission of monosomics and trisomics and their use in chromosome mapping of diploid and polyploid species; breeding behaviour and genetics of structural heterozygotes;

Molecular cytogenetics: Nuclear DNA content; C -value paradox; cot curve and its significance; restriction mapping – concept and techniques; in situ hybridization – concept and techniques; physical mapping of genes on chromosomes, computer assisted chromosome analysis; flow cytometry and confocal microscopy in karyotype analysis.

Alien gene transfer through chromosome manipulations: Transfer of whole genome, examples from *wheat, Arachis* and *Brassica*; transfer of individual chromosomes and chromosome segment; methods for detecting alien chromatin; production characterization and utility of alien addition and substitution lines; genetic basis of inbreeding and heterosis; exploitation of hybrid vigour.

M.Sc. (II Semester)

Course VI (BOY-116): *Biology and diversity of gymnosperm.*

Introduction: Gymnosperms, the vessel- less and fruitless seed plants varying in the structure of their sperms, pollen grains, pollen germination and the complexity of their female gametophyte; evolution of gymnosperms.

Classification of Gymnosperms and their Distribution in India.

Brief account of the families of Pteridospermales (Lyginopteridaceae, Medellosaceae, Caytoniaceae and Glossopteridaceae).

General Account of Cycadeoidales and Cordaitales

Structure and reproduction in Cycadales, Ginkgoales, Coniferales, Ephedrales, Welwitschiales and Gnetales.

M.Sc. (II Semester)

Course VII (BOY-117): *Taxonomy of Angiosperms.*

Origin of intrapopulation variation: Population and the environment; ecads and ecotypes; evolution and differentiation of species- various models

The Species Concept: Taxonomic hierarchy, species, genus, family and other categories; principles used in assessing relationship, delimitation of taxa and attribution of rank**.** Salient features of the International Code of Botanical nomenclature.

Taxonomic Evidence: Morphology, anatomy, palynology, embryology, cytology, phytochemistry; genome analysis and nucleic acid hybridization.

Taxonomic Tools: Herbarium; floras; histological, cytological, photochemical, serological, biochemical and molecular techniques; computers and GIS.

Systems of Angiosperm Classification: Phenetic versus phylogenetic systems; cladistics in taxonomy; relative merits and demerits of major systems of classification; relevance of taxonomy to conservation, sustainable utilization of bio-resources and ecosystem research. Majors families of angiosperms of your locality.

Concept of phytogeography: Endemism, hotspots and hottest hotspots; plant expiorations, invasions and introductions; local plant diversity and its socio-economic importance.

Taxonomy description of some important families:

Dicot: Rananculaceae, Bressicaceae, Malvaceae, Rutaceae, Fabaceae, Apocynaceae, Asclepiadeaceae, Acanthaceae, Solanaceae, Euphorbiace, Lamiaceae, Chenopodiaceae, Asteraceae and Papaveraceae.

Monocot: Cyperaceae, Graminaeae and Liliaceae.

M.Sc. (II Semester)

Course VIII (BOY-118): *Plant Physiology*.

Energy flow: Principles of thermodynamics, free energy and chemical potential, redox reactions, structure and functions of ATP.

Membrane transport and translocation of water and solutes: Plant water relations, mechanism of water transport through xylem, root-microbe interactions in facilitating nutrient uptake, comparison of xylem and phloem transport, phloem loading and unloading.

Photochemistry and photosynthesis: General concepts and historical background, evolution of photosynthetic apparatus, photosynthetic pigments and light harvesting complexes, photooxidation of water, mechanisms of electron and proton transport, carbon assimilation – the Calvin cycle, photorespiration and its significance, the C4 cycle, the CAM pathway.

Sensory photobiology: History of discovery of phytochromes and cryptochromes, and their photochemical and biochemical properties, photophysiology of light – induced responses, cellular localization, molecular mechanism of action of photomorphogenic receptors, signaling and gene expression.

Plant growth regulators and elicitors: Physiological effects and mechanism of action of auxins, gibberellins, cytokinins, ethylene, abscisic acid, brassinosteroids, polyamines,

The flowering process: Photoperiodism and its significance, endogenous clock and its regulation, floral induction and development- genetic and molecular analysis, role of vernalization.

Stress physiology: Plant responses to biotic and abiotic stress, moisture stress. salinity stress, metal toxicity, freezing and heat stress,

Fundamentals of enzymology: General aspects, mechanism of action of enzymes. kinetics of enzymatic catalysis, Michaelis- Menten equation and its significance.

Lipid metabolism: structure and function if lipids, fatty acid biosynthesis, synthesis of membrane lipids, structural lipids and storage lipids, and their catabolism.

Nitrogen fixation, nitrogen and sulphur metabolism: Overview, biological nitrogen fixation, mechanism of nitrate uptake and

M.Sc. (III Semester)

Course IX (BOY-119): *Plant development and reproduction.*

Introduction: Unique features of plant development; differences between animal and plant development.

Seed germination and seedling growth: Metabolism of nucleic acids, proteins and mobilization of food reserves; tropisms; hormonal control of seedling growth; gene expression; use of mutants in understanding seedling development.

Shoot development: Organization of the shoot apical meristem (SAM); cytological and molecular analysis of SAM; control of cell division and cell to cell communication, control of tissue differentiation, especially xylem and phloem; secretary ducts and laticifers; wood development in relation to environmental factors.

Leaf growth and differentiation: Determination; phyllotaxy; control of leaf form differentiation of epidermis (with special reference to stomata and trichomes) and mesophyll.

Root development: Organization of root apical meristem (RAM) cell, fates and lineages vascular tissue differentiation; lateral roots; root hairs; root-microbe interactions.

Latent life- dormancy: Importance and types of dormancy; seed dormancy; overcoming seed dormancy; bud dormancy.

Reproduction: Vegetative options and sexual reproduction; flower development, genetics of floral organ differentiation; homeotic mutants in Arabidopsis and Antirrhinum, sex determination.

Pollination, pollen-pistil interaction and fertilization: Floral characteristics, pollination mechanisms and vectors; breeding systems; commercial considerations; structure of the pistil pollen- stigma interactions, sporophytic and gametophytic self-incompatibility (cytological, biochemical and molecular aspects); double fertilization; in vitro fertilization.

Seed development and fruit growth: Endosperm development during early, maturation and desiccation stages; embryogenesis, ultrastructure and nuclear cytology; cell lineages during late embryo development; storage proteins of endosperms and embryo; polyembryony; apomixes; embryo culture; dynamics of fruit growth; biochemistry and molecular biology of fruit maturation.

M.Sc. (III Semester)

Course X (BOY-120): *Plant Ecology –I.*

Climate, soil and vegetation patterns of the world: Life zones; major biomes and major vegetation and soil types of the world.

Vegetation organization: Concepts of community and continuum; analysis of communities (analytical and synthetic characters); community coefficients; interspecific association, ordination; concept of ecological niche.

Vegetation development: Temporal changes (cyclic and non-cyclic); mechanism of ecological succession (relay floristics and floristic composition; facilitation, tolerance and inhibition models); changes in ecosystems properties during succession.

Ecosystem organization: Structure and functions; primary production (methods of measurement, global pattern, controlling factors); energy dynamics (trophic organization, energy flow pathways, ecological efficiencies); litter fall and decomposition (mechanism, substrate quality and climatic factors); global biogeochemical cycles of C, N, P and S; minerals cycles (pathways, processes, budgets) in terrestrial and aquatic ecosystems.

M.Sc. (III Semester)

Course XI (BOY-121): *Plant Ecology-II*.

Biological diversity: Concept and levels; role of biodiversity in ecosystems functions and stability; speciation and extinction; IUCN categories of threat; distribution and global patterns. Terrestrial biodiversity hot spots; inventory.

Air, water and soil pollution: Kinds; sources; quality parameters; effects on plants and ecosystems.

Climate change: Green house gases (CO_2, CH_4, N_2O, CFCs: sources, trends and role); ozone layer and ozone hole; consequences of climate change (CO_2 fertilization, global warming, sea level rise, UV radiation)

Ecosystem stability: Concept (resistance and resilience); ecological perturbations (natural and anthropogenic) and their impact on plants and ecosystems; ecology of plant invasion environmental impact assessment; ecosystem restoration.

Ecological management: Concepts; sustainable development; sustainability indicators.

M.Sc. (III Semester)

Course XII (BOY-122): *Plant Resource Utilization*.

Plant Biodiversity: Concept, status in India, utilization and concerns.

Sustainable development: Basic concepts.

Origins of Agriculture.

World centers of primary diversity of domesticated plants: The Indo-Burmese center; plant introductions and secondary centers.

Origin, evolution, botany, cultivation and uses of (1). Food, forage and fodder crops, (2). Fibre crops (3). Medicinal and aromatic plants, and (4). Vegetable oil-yielding crops.

Important fire- wood and timber yielding plants and non-wood forest products (NWFPs) such as bamboos, rattans, raw materials for paper-making, gums, tannins, dyes, resins and fruits.

Green revolution: Benefits and adverse consequences.

Innovations for meeting world food demands.

Plants used as avenue trees for shade, pollution control and aesthetics.

M.Sc. (IV Semester)

Course XIII (123): *Plant Resource Conservation.*

Principles of conservation; extinctions; environmental status of plants based on International Union for Conservation of Nature.

Strategies for conservation –in situ conservation: International efforts and Indian initiatives; protected areas in India –sanctuaries, national parks, biosphere reserves, wetlands, mangroves and coral reefs for conservation of wild biodiversity.

Strategies for conservation ex- situ conservation: Principles and practices; botanical gardens, field gene banks, seed banks, in vitro repositories, cryobanks; 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 & Industrial Research (CSIR), and the Department of Biotechnology (DBT) for conservation, non-formal conservation efforts.

M.Sc. (IV Semester)

Course XIV (BOY-124): *Biotechnology-I.*

Biotechnology: Basic concepts, principles and scope. Plant cell and tissue culture: General introduction, history, scope, concept of cellular differentiation, totipotency.

Organogenesis and adventive embryogenesis: Fundamental aspects of morphogenesis: somatic embryogenesis and androgenesis, mechanisms, techniques and utility.

Somatic hybridization: Protoplast isolation, fusion and culture, hybrid selection and regeneration, possibilities, achievements and limitations of protoplast research.

Applications of plant tissue culture: Clonal propagation, artificial seed, production of hybrids and somaclones, production of secondary metabolites/natural products, cryopresrvation and germplasm storage.

M.Sc. (IV Semester)

Course XV (BOY-125): *Biotechnology and Genetic engineering-II.*

Recombinant DNA technology: Gene cloning principles and technique, construction of genomic/cDNA libraries, choice of vectors, DNA synthesis and sequencing, polymerase chain reaction, DNA fingerprinting.

Genetic engineering of plants: Aims, strategies for development of transgenics (with suitable examples), *Agrobacterium* – the natural genetic engineer, T – DNA and transposon mediated gene tagging, chloroplast transformation and its utility, intellectual property rights, possible ecological risks and ethical concerns.

Microbial genetic manipulation: Bacterial transformation, selection of recombinants and transformants, genetic improvement of industrial microbes and nitrogen fixers, fermentation technology.

Genomics and proteomics: Genetic and physical mapping of genes, molecular markers for introgression of useful traits, artificial chromosomes, high throughput sequencing, genome projects, bioinformatics, functional genomics, microarrays, protein profiling and its significance.

M.Sc. (IV Semester)

Course XIX (BOY-126 ST): Elective Paper: *Stress Physiology*.

1- Chemical and Water potential gradients, determination of Water potential of plants and tissues by Chardakov's, pressure chamber and psychromatic methods. Diffusion and Osmosis: absorption and Conduction of water. Transpiration, its measurements and role in water stress. Mechanisms of stomatal opening and closing.

2- Plant responses to biotic and abiotic stress, mechanism of biotic and abiotic stress tolerance, HR and SAR, Water deficit and drought resistance, salinity stress, freezing, chilling and heat stress, oxidative stress. Nitrogen fixation and drought.

3- Screening methods for water stress and salt stress tolerant varieties.

4- Ultra-structural consequences of drought.

M.Sc. (IV Semester)

Course XIX (BOY-126 PP): Elective Paper: *Plant Protection.*

Unit I: Definition of Pest, Pest problems and Crop damage caused by Pests, Plant Pathogens as Pests-identifying characters of fungal, bacterial, viral, mycoplasma and nematode as Pest; Pest surveillance.

Unit II: Symptoms caused by different Plant Pathogens Mechanism of Pathogenesis including general idea about role of enzymes and toxins host defense mechanism; Plant disease epidemiology.

Unit III: Important Fungal diseases of crop plants caused by Plant Pathogens (Wheat, Rice, Sugarcane, Jowar, Maize, Pulses, Cotton, Potato, Ginger) with special reference to causal organism, etiology and disease cycle.

Unit IV: Plant protection with chemical Pesticides, general idea about fungicides (Inorganic, Organic, Systemic), insecticides, bactericides, nematicides, herbicides, theirtradenames, formulations etc; soil and Seri treatments.

Unit V: Cultural methods of Pest management-field sanitation, use of clear planting material, crop rotation etc; Physical method of Pestcontrol; Biological Pesticides (microbial insecticides, microbial herbicides, mycopesticides etc); Legislative measures of plant protection; Integrated Pest and disease management.

M.Sc. (IV Semester)

Course XIX (BOY-126 CB): Elective Paper: *Crop Genetics and Plant Breeding.*

UNIT I-Genetic principles: Origin &development of crop genetics, Mendelian principles of inheritance, Interaction of Genes, Multiple allelism, Lethality Atavism, Pleotropy, Qualitative and Quantitative Inheritance, Extra chromosomal inheritance, Evolution of crop plants such as wheat Rice Cotton ,Sugarcane, Gram & Mustard.

Apomixis, Incompatibility and male sterility systems & their uses in plant breeding.

Role of plant breeding in Agriculture: History &Objectives of plant breeding, early plant breeders and their accomplishments.

UNIT II-Plant Breeding Methods: Basic schemes, Pure lines and Inbred lines, Breeding methods for improvement of self pollinated plants, cross pollinated plants and asexually propagated plants. Back crossing; Single seed decent method, Development of synthetics &composites. Role of Mutation & polyploidy in plant Breeding.

UNIT III-Breeding for Biotic & Abiotic Stresses: Mechanism for disease and insect resistance. Breeding for quality traits and for resistance to heat, frost &drought, Release, Seed Production and Distribution of cultivars, Hybrid seed production Identification and release of varieties, Seed Certification, Organization for crop improvement in India.

UNIT IV-Statistical Methods and Field Plot Techniques: Data collection and interpretation Source of Variation Design, of experiments, Correlation &Regression; Measure of control tendencies, Test of significance (t&Chi square, Mean, Mode, Median, Standard deviation standard error, Coefficieient of variability, Inbreeding depression & heterosis)

M.Sc. (IV Semester)

Course XIX (BOY-126 ET): Elective Paper: *Ethnobotany.*

1. **Ethnobotany:** Its scope, interdisciplinary approach.

2. **Ethnic groups of India:** Major and minor tribes with special reference to Bundelkhand region, life styles of ethnic tribes, conservation practices of biodiversity.

3. World centers of ethnobotany with special reference to India.

4. Role of ethnobotany in national priority, health care and development of cottage industries in India.

5. History and principles of Ayurveda, Unani and Siddha systems of medicines.

6. **Plant used in medicines with special reference to the following:** *Adhatoda vasica, Azadirachta indica, Asparagus racemosus, Tinospora cordifolia* and *Terminalia arjuna*.

7. **Herbaceous plant used in medicines with special reference to the following:** *Argemone mexicana, Boerhaavia diffusa, Calotropis procera, Eclipta alba, Evolvulus alsinoides, Withania somnifera, Rauwolfea serpentine* and *Datura alba.*

8. **A general study of economically important plants:** Important sources of sugars, fats and oils, spices, fruits and nuts, vegetables and forage crops.

9. Plants for scarcity, emergency and supplementary foods.

10. Intellectual property rights (patents).

M.Sc. (IV Semester)

Course XIX (BOY-126 FB): Elective Paper: *Forest Biology.*

Introductory Forestry & Resources: Forest types in India – forest classification & distribution, role of forestry-productive, ameliorative recreational development etc. non timber forest productive NTFPS, definition and scope, gums, resin, oleoresin, seeds, nuts, rubber, canes, bamboo, medicinal plants, charcoal, lac, katha, bidi leaves, wood seasoning, preservation, pup paper and rayon, farm forestry, social forestry & joint forest management.

Forest ecology & environment: Ecosystem, forest community concepts, vegetation concepts, ecological succession & climax, primary productivity nutrient cycling & water relation, environmental factors of site & classification of sites.

General Siliviculture: Definition scope and objective of siliviculture, natural and artificial regeneration of forests, nursery and planting techniques, maintenance, management, siliviculture of some of the economically important species in India such as *Acacia catechue, Albizialebbek, Anogeissus pendula, Azdirachta indica, Butea monospermua, Dalbergia sissoo, Tectona grandis, Cedrus deodara, Pinus roxburghi, Casurina equistefolia.*

Forest soil and conservation: Classification factors affecting soil formation physical, chemical and biological properties, soil erosion-definition, course of soil erosion, type wind and water erosion, type-wind and water erosion, conservation and management of eroded soil/areas and C cycles, VAM water shaded management.

Forest protection and range management: Insect pest and disease, general forest production against fire and grazing, range management-nomadic and migratory grazing rotational and controlled grazing, different methods of control against grazing and browsing animals, human impacts, sifting cultivation and control.