

M.SC. - (BOTANY)

Mode	Dual Mode University System
Duration	2 Years
Pattern of Examination	Annual
Eligibility	Graduation in relevant subject

SCHEME OF EXAMINATION

Subject Code	Title
1st Year	
MSCB-101	CELL AND MOLECULAR BIOLOGY OF PLANTS
MSCB-102	BIOLOGY AND DIVERSITY OF LOWER PLANTS: CRYPTOGAMS
MSCB-103	PLANT PHYSIOLOGY AND METABOLISM
MSCB-104	CYTOLOGY, GENETICS AND CYTOGENETICS
MSCB-105	TAXONOMY AND DIVERSITY OF SEED PLANTS
MSCB -106	CYTOGENETICS AND PLANT BREEDING
MSCB -107	PRATICAL
2nd Year	
MSCB-201	PLANT DEVELOPMENT
MSCB-202	BIOTECHNOLOGY AND GENETIC ENGINEERING OF PLANTS AND MICROBES
MSCB-203	PLANT ECOLOGY
MSCB-204	PLANT RESOURCE UTILIZATION AND CONSERVATION
MSCB-205	BIOSTATISTICS AND COMPUTER APPLICATION
MSCB -206	PLANT REPRODUCTION
MSCB -207	PRATICAL

MSCB -101: CELL AND MOLECULAR 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 of ATPases, ion carriers, channels and pumps; receptors.

PLASMODESMATA: Structure; role in movement of molecules and macromolecules; comparison with gap junctions

CHLOROPLAST: Structure; genome organization; gene expression; RNA editing; nucleochloroplastic interactions.

MITOCHONDRIA: Structure; genome organization; biogenesis.

PLANT VACUOLE: Tonoplast membrane; ATPases; transporters; as storage organelle.

NUCLEUS: Structure; nuclear pores; nucleosome organization; DNA structure; A, B & Z forms; replication, damage and repair; transcription; plant promoters and transcription factors; splicing; mRNA transport; nucleolus; rRNA biosynthesis.

RIBOSOMES: Structure; site of protein synthesis; mechanism of translation; initiation, elongation and termination; structure and role of tRNA.

OTHER CELLULAR ORGANELLES: Structure and functions of microbodies, golgi apparatus, lysosomes, endoplasmic reticulum.

CELL SHAPE AND MOTILITY: The cytoskeleton; organization and role of microtubules and microfilaments; motor movements; implications in flagellar and other movements.

CELL CYCLE AND APOPTOSIS: Control mechanisms; role of cyclins and cyclin-dependent kinases; retinoblastoma and E2F proteins; cytokinesis and cell plate formation; mechanism of programmed cell death.

PROTEIN SORTING: Targeting of proteins to organelles.

TECHNIQUES IN CELL BIOLOGY: Immunotechniques; in situ hybridization to locate transcripts in cell types; FISH, GISH; confocal microscopy.

MSCB -102: BIOLOGY AND DIVERSITY OF LOWER PLANTS: CRYPTOGAMS

MICROBIOLOGY:

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.

PHYTOPLASMA: General characteristics and role in causing plant diseases.

PHYCOLOGY: Algae in diversified habitats (terrestrial, freshwater, marine); thallus organization; cell ultrastructure; unicellular and multicellular organization; cell wall composition; nutrition (saprobic, biotrophic, symbiotic); thallus organization; cell ultrastructure; reproduction (vegetative, asexual, sexual); criteria for classification of algae: pigments, reserve food, flagella; classification, salient features of Protochlorophyta, Chlorophyta, Charophyta, Xanthophyta, Bacillariophyta, Phaeophyta and Rhodophyta; algal blooms, algal biofertilizers, algae as food, feed and uses in industry.

MYCOLOGY:

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

Phylogeny of Fungi; general account of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina, Deuteromycotina; fungi in Industry, medicine and as food; fungal diseases in plants and humans; Mycorrhizae; fungi as biocontrol agents.

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 stele; heterospory and origin of seed habit; general account of fossil pteridophyta; introduction to Psilopsida, Lycopsidea, Sphenopsida and Pteropsida.

MSCB -103: PLANT PHYSIOLOGY AND METABOLISM

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

FUNDAMENTALS OF ENZYMOLOGY: General aspects, allosteric mechanism, regulatory and active sites, isozymes, kinetics of enzymatic catalysis, Michaelis-Menten equation and its significance.

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, passive and active solute transport, membrane transport proteins.

SIGNAL TRANSDUCTION: Overview, receptors and G-proteins, phospholipid signaling, role of cyclic nucleotides, calcium-calmodulin cascade, diversity in protein kinases and phosphatases, specific signal mechanisms, e.g. two component sensor regulator system in bacteria and plants, sucrose sensing mechanism.

PHOTOCHEMISTRY & 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, biosynthesis of starch and sucrose, physiological and ecological considerations.

RESPIRATION & LIPID METABOLISM: Overview of plant respiration, glycolysis, the TCA cycle, electron transport and ATP synthesis, pentose phosphate pathway, glyoxylate cycle, alternative oxidase system, structure and function of 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, nodule formation and nod factors, mechanism of nitrate uptake and reduction, ammonium assimilation, sulfate uptake, transport and assimilation.

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 & ELICITORS: Physiological effects & mechanism of action of auxins, gibberellins, cytokinins, ethylene, abscisic acid, brassinosteroids, polyamines, jasmonic acid & salicylic acid, hormone receptors, signal transduction and gene expression.

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, mechanisms of biotic and abiotic stress tolerance, HR & SAR, water deficit and drought resistance, salinity stress, metal toxicity, freezing and heat stress, oxidative stress.

MSCB -104:CYTOLOGY, GENETICS AND CYTOGENETICS

CYTOLOGY:

CHROMATIN ORGANIZATION: Chromosome structure and packaging of DNA, molecular organization of centromere and telomere; nucleolus and ribosomal RNA genes; euchromatin and heterochromatin; karyotype analysis; banding patterns; karyotype evolution; specialized types of chromosomes; polytene, lampbrush, B-chromosomes and sex chromosomes; molecular basis of chromosome pairing.

STRUCTURAL AND NUMERICAL ALTERATIONS IN CHROMOSOMES:

Origin, meiosis and breeding behavior of duplication, deficiency, inversion and translocation heterozygotes; origin, occurrence, production, and meiosis of haploids, aneuploids and euploids; origin and production of autopolyploids; chromosome and chromatid segregation; allopolyploids, types, genome constitution and analysis; evolution of major crop plants; induction and characterization of trisomics and monosomics.

GENETICS:

GENETICS OF PROKARYOTES AND EUKARYOTIC ORGANELLES:

Mapping the bacteriophage genome; phage phenotypes; genetic recombination in phage; genetic transformation, conjugation and transduction in bacteria; genetics of mitochondria and chloroplasts; cytoplasmic male sterility.

GENE STRUCTURE AND EXPRESSION: Genetic fine structure; cis-trans test; fine structure analysis of eukaryotes; introns and their significance; RNA splicing; regulation of gene expression in prokaryotes and eukaryotes.

GENETIC RECOMBINATION AND GENE MAPPING: Recombination; independent assortment and crossing over; molecular mechanism of recombination; role of RecA & RecBCD enzymes; site-specific recombination; chromosome mapping, linkage groups, genetic markers, construction of molecular maps, correlation of genetic and physical maps;

somatic cell genetics- an alternative approach to gene mapping.

MUTATIONS: 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 mechanisms; 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 polyploidy species; breeding behavior and genetics of structural heterozygotes; complex translocation heterozygotes; translocation tester sets; Robertsonian translocations; B-A translocations

MOLECULAR CYTOGENETICS: Nuclear DNA content; C-value paradox; cot curve and its significance; restriction mapping- concept and techniques; multigene families and their evolution; in situ hybridization- concept and techniques; physical mapping of genes on chromosomes; computer assisted chromosome analysis chromosome microdissection and microcloning; 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 segments; 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.

MSCB -105: TAXONOMY AND DIVERSITY OF SEED PLANTS

GYMNOSPERMS:

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 GYMNASPERMS AND THEIR DISTRIBUTION IN INDIA: BRIEF ACCOUNT OF THE FAMILIES OF PTERIDOSPERMALES:

Lyginopteridaceae, Medullosaceae, Caytoniaceae and Glossopteridaceae.

GENERAL ACCOUNT OF CYCADEOIDALES AND CORDAITALES:

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

TAXONOMY OF ANGIOSPERMS:

ORIGIN OF INTRAPOPULATION VARIATION: Population and 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 ICBN.

TAXONOMIC EVIDENCE: Herbarium; floras; histological, cytological, phytochemical, 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.

CONCEPTS OF PHYTOGEOGRAPHY: Endemism, hotspots and hottest hotspots; plant explorations; invasions and introductions; local plant diversity and its socio-economic importance.

MSCB -106: CYTOGENETICS AND PLANT BREEDING

Cytogenetics of aneuploids and structural heterozygote : Effect of aneuploidy on phenotype in plants; transmission of monosomics and trisomics and their use in chromosomemapping of diploid and polyploids, translocation tester; Robertsonian translocation, B-B translocation.

Molecular cytogenetics : Nuclear DNA content; C-Value paradox; cot curve and its significance; computer assisted chromosome analysis; chromosome microdissection and microcloning.

Alien gene transfer, chromosome manipulation : transfer of whole genome, example from wheat, Arachis and Brassica; transfer of individual chromosomes and chromosome segments; method of detecting alien chromatin; production characterization and utility of alien addition and substitution lines;

Perspectives of Plant Breeding, methods of reproduction in crop plants and breeding methods in crops : Aims and achievements of plant breeding; Breeding methods for self pollinated crops, pure line breeding and mass selection, pedigree method; Selection in cross pollinated crops. recurrent selection, clonal selection; hybrid and synthetic varieties; Heterosis and inbreeding depression.

Polyploidy, mutation and biotechnology in crop improvement, seed production practice : Autopolyploidy, Allopolyploidy and aneuploidy, seed production practices; Mutation breeding : Procedure, achievements and pitfalls of mutation breeding; Haploid Production : Embryo culture, somatic cell hybridization, genetic engineering; Seed production practices : Improved varieties, role of seed certification, National Seed Corporation, seed labeling and seed testing.

MSCB -107: PRATICAL

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MSCB -201:PLANT DEVELOPMENT

Introduction :Unique features of plant development, differentiation, specialization and morphogenesis.

Seed germination and seedling growth :Metabolism of nucleic acids, mobilizationof food reserves, hormonal control of seeding growth; use of mutants in understanding seedling growth.

Shoot development :Organization of the shoot apical meristem; cytological and molecular analysis of SAM; maintenance of SAM; Primary and secondary anomalous growth, control of tissue differentiation in phloem and xylem; Nodal Anatomy; Root stem Transition.

Leaf growth and differentiation :Determination of phyllotaxy; control of leaf form; differentiation of epidermis (stomata and trichome) and mesophyll.

Root Development :Organization of Root Apical Meristem; cell fates and lineages; vascular tissue differentiation; role of auxim in development; leteral roots, root hairs, root-microbe interactions, root nodules.

MSCB -202: BIOTECHNOLOGY AND GENETIC ENGINEERING OF PLANTS AND MICROBES

BIOTECHNOLOGY: Basic concepts, principles & scope.

PLANT CELL & TISSUE CULTURE: General introduction, history scope, concept of cellular differentiation, totipotency.

ORGANOGENESIS & ADVENTIVE EMBRYOGENESIS: fundamental aspects of morphogenesis: somatic embryogenesis & androgenesis, mechanisms, techniques & utility.

SOMATIC HYBRIDIZATION: Protoplast isolation, fusion & culture, hybrid selection & regeneration, possibilities, achievements & limitations of protoplast research.

APPLICATIONS OF PLANT TISSUE CULTURE: Clonal propagation, artificial seed, production of hybrids & somatocloning, production of secondary metabolites/ natural products, cryopreservation & germplasm storage.

RECOMBINANT DNA TECHNOLOGY: gene cloning principles & techniques, construction of genomic/cDNA libraries, choice of vectors, DNA synthesis & 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 & transposon mediated gene tagging, chloroplast transformation & its utility, intellectual property rights, possible ecological risks & ethical concerns.

MICROBIAL GENETIC MANIPULATION: Bacterial transformation, selection of recombinants & transformants, genetic improvement of industrial microbes & nitrogen fixers, fermentation technology.

GENOMICS & PROTEOMICS: genetic & physical mapping of genes, molecular markers for introgression of useful traits, artificial chromosomes, high throughput sequencing, genome projects, bioinformatics, functional genomics, microarrays, protein profiling & its significance.

MSCB -203: PLANT ECOLOGY

Climate, soil and vegetation patterns of the world: Major biomes soil types, pedogenesis; physical and chemical characters of soil. Inter and intra specific associations; concept of ecological niche,

Vegetation Development: Temporal changes (Cyclic and non-cyclic); mechanism of ecological succession; genecology study, synecology; changes in ecosystem properties during succession.

Ecosystem Organization: Structure and function; primary production (methods of Measurement). Energy dynamics, trophic organization, energy flow pathways, ecological efficiencies.

Air, Water and Soil Pollution: Kinds; source; quality parameters; effects on plants and ecosystems.

Climate Change: Greenhouse gases (CO₂, CH₄, N₂O, CFCs; source, trends and role); ozone layer and ozone hole; consequences of climate changes (CO₂ fertilization, global warming, Sea level rise). World summits on climate change.

Ecosystem Development: Environmental impact assessment; ecosystem invasion restoration.

Ecological management : Concepts; sustainability indicators.

Environmental Education: problems, Target groups for environmental education, Means of motivation, Non formal and formal environmental education.

MSCB -204: PLANT RESOURCE UTILIZATION AND CONSERVATION

PLANT BIODIVERSITY: Concept, status in India, utilization & concerns.

SUSTAINABLE DEVELOPMENT: basic concepts

ORIGINS OF AGRICULTURE WORLD CENTRES OF PRIMARY DIVERSITY

OF DOMESTICATED PLANTS: the Indo-Burmese centre; plant introductions & secondary centres.

ORIGIN, EVOLUTION, BOTANY, CULTIVATION & USES OF:

- Food, forage & fodder crops
- Fibre crops
- Medicinal & aromatic plants
- Vegetable yielding crops

IMPORTANT FIRE-WOOD & TIMBER-YIELDING PLANTS & NON-WOOD FOREST PRODUCTS

(NWFPs)

Such as bamboos, rattans, raw materials for paper making, gums tannins, dyes, resins & fruits.

GREEN REVOLUTION: Benefits & adverse consequences.

INNOVATIONS FOR MEETING WORLD FOOD DEMANDS

PLANTS USED AS AVENUE TREES for shade, pollution control & aesthetics.

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 initiatives; protected areas in India- sanctuaries, national parks, biosphere reserves, wetlands, mangroves & coral reefs for conservation of wild biodiversity.

STRATEGIES FOR CONSERVATION: ex situ conservation: principles & 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), & Department of Biotechnology (DBT) for conservation, non formal conservation efforts.

MSCB -205: BIOSTATISTICS AND COMPUTER APPLICATION

Biostatistics and biometry : Concepts, Continuous variables, Brief description of data and its graphical representation.

Statistical Methods : Measures of central tendency and dispersion, mean, median and mode; range, standard deviation, variance. Elementary probability addition and multiplication laws.

Simple linear regression and correlation: Idea of two types of errors and level of significances, test of significance (F & t-test); chi square test.

Computer and its application: Introduction of digital computers; organization; low and high level language; binary number system. Flow charts and programming techniques, data structure and database concepts; internet and its application.

Introduction to MS-Office software, word processing, Spreadsheets, Power Point presentations Introduction of Corel draw.

MSCB -206: PLANT REPRODUCTION

Reproduction : Sexual reproduction and vegetative propagation; Flower development, initiation of floral meristem, genetics of floral organ differentiation, homeotic mutants in *Arabidopsis* and *Antirrhinum*.

Male gametophyte : Structure of anthers and pollen, microsporogenesis, tapetum; pollen development; sperm dimorphism; pollen germination, pollen tube growth; pollen storage; pollen allergies, pollen embryos.

Female gametophyte : Development; megasporogenesis; organization of embryosac.

Pollination, Pollen-pistil interaction and fertilization: Pollination mechanism and vectors; breeding system; structure of 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; embryogenesis; storage proteins of endosperms and embryo; polyembryony; embryo culture; dynamics of fruit growth; biochemistry of fruit maturation.

Dormancy : Importance and types of seed and bud dormancy and causes and removal of dormancy.

Senescence and programmed cell death: Basis concepts, types of cell death, PCD in the cell cycle of plants, senescence and its regulation; influence of hormones and environmental factors on senescence.

MSCB -207: PRATICAL

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