



MSC in Botany

1st Semester

PAPERS CODE	PAPERS NAME	INTERNAL	EXTERNAL	TOTAL
MSB 101	Cell & Molecular Biology of Plants	40	60	100
MSB 102	Cytology Genetics & Cytogenetics	40	60	100
MSB 103	Biology & diversity of lower plants	40	60	100
MSB 104	Botany Practical	60	40	100
Total		180	220	400

2nd Semester

PAPERS CODE	PAPERS NAME	INTERNAL	EXTERNAL	TOTAL
MSB 201	Taxonomy & diversity of seed plants	40	60	100
MSB 202	Plant physiology & Metabolism	40	60	100
MSB 203	Microbiology and plant Pathology	40	60	100
MSB 204	Botany Practical	60	40	100
Total		180	220	400

3rd Semester

PAPERS CODE	PAPERS NAME	INTERNAL	EXTERNAL	TOTAL
MSB 301	Plant Morphology, Development Anatomy and Reproductive Biology	40	60	100
MSB 302	Plant Ecology	40	60	100
MSB 303	Advance plant pathology I	40	60	100
MSB 304	Botany Practical	40	60	100
Total		180	220	400

4th Semester

PAPERS CODE	PAPERS NAME	INTERNAL	EXTERNAL	TOTAL
MSB 401	Plant Resource utilization & Conservation	40	60	100
MSB 402	Biotechnology & Genetic Engineering of plants & Microbes	40	60	100
MSB 403	Advance plant pathology II	40	60	100

MSB 404	Botany Practical	60	40	100
Total		180	220	400

M.Sc. I year (Botany) Syllabus

1MSBO01 : Cell & Molecular Biology of Plants

Introduction to modern tools and techniques of cell biology: advances in light and electron microscopy, techniques supplementing microscopy (cytochemistry, microprobe analysis, x-ray diffraction, etc.), Cell fractionation and visualization/characterization of various cell fractions. The Dynamics of cell, shape and motility: Structural organization of the plant cell, biochemical energetics. cytoskeleton, microtubules and microfilaments, motor and flagellar movements. Cell wall, plasma membrane and plasmadesmata: Structure and functions, biogenesis, growth models and functions, sites for ATPases, ion carriers, channels and pumps, receptors. Role in movement of molecules and macromolecules, comparison with gap junctions.

Chloroplast and mitochondria: Structure,, Organization and function of mitochondrial and chloroplast genomes, diversity and evolution of organelle genomes, chloroplast protein targeting to different compartments, mitochondrial DNA and male sterility, transfer of genes between nucleus and organelles.

Plant vacuole: Structure and function Other Cellular organelles: Structure and functions of micro-bodies, Golgi apparatus, ribosomes, lysosomes, endoplasmic reticulum. Nucleus: Structure, nuclear pores, nucleosome organization, nucleolous, 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. Cell cycle and apoptosis: Control mechanisms, role of cyclins and cyclin- dependent kinases, retinoblastoma and E2F proteins, cytokinesis and cell plate formation, mechanisms of programmed cell death.

Cell signaling: Hormones and their receptors, Cell surface receptors, signaling through G protein coupled receptors, signal transduction pathways, mechanism and cellular response to environmental signaling. Cellular communication: Regulation of hematopoiesis, General principles of cell communication, Cell adhesion and role of different adhesion molecules, Gap junctions, Extracellular matrix integrins, Neurotransmission and its regulation.

1MSBO02: Cytology Genetics& Cytogenetics

UNIT I

A. Mendelian principles in haploid organisms (Chlamydomonas and Neurospora), Tetrad analysis B. Dominance relationships (Incomplete dominance, Codominance, Overdominance) C. Allelic variations and gene function (Lethal genes, Conditional lethals) D. Gene concept: Concept of allelism (Factors, alleles, multiple alleles, pseudoalleles), Cistrans test, Benzers work on rII locus in T4 phage, Fine structure of gene (cistron, recon and muton)

UNIT II

A. Types of mutations (Spontaneous, Induced, Base substitutions and frameshifts - Transitions, Transversions, gain in function, loss in function, Neutral mutations), B. Molecular mechanism of mutations (Base analogs, alkylating agents); Detection of mutations : Dominant lethal test, Sex-linked recessive

lethal test, II-III translocations, Ames test, P-mediated mutagenesis C. Cytogenetic effects of ionizing and nonionizing radiations D. Linkage and construction of genetic maps: Cytogenetic and linkage maps, Two and three point cross in *Drosophila*, RFLP mapping

UNIT III

A. Molecular mechanism of cell division: Amitosis, Endomitosis and Mitosis, Ultra structure and organization of centrosome, centromere, Kinetochore, Microtubules and their dynamic instability, Microtubule Associated proteins, Anaphasic movements, Cytokinesis B. Molecular organization of eukaryotic chromosomes, Telomeres, C. Karyotyping and its importance D. Molecular mechanism of sex determination in *Drosophila* and man,

UNIT IV

A. Heterochromatin - Cytological features and localization, Facultative and constitutive heterochromatin, B. Structural organization and significance of polytene, lampbrush and supernumerary chromosomes C. Structural and numerical variations of chromosomes, Chromosomal rearrangements and their cytogenetic consequences with examples from plants, *Drosophila* and Man, Practical applications of chromosome rearrangements - Balancers and attached X- chromosome in *Drosophila*

1MSBO03 Biology & diversity of lower plants :cryptogams

Unit -I

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, modern classification. Salient features of Protochlorophyta, Chlorophyta, Charophyta, Xanthophyta, Bacillariophyta.

Phaeophyta and Rhodophyta, with special reference to *Microcystis*, *Hydrodictyon*, *Drapernaldiopsis*, *Cosmarium*, algal blooms, algal biofertilizers: algae as food, feed and use in industry.

Unit-II

Mycology : General character of fungi, substrate relationship in fungi, cell ultrastructure, unicellular and multicellular organization, cell wall composition, nutrition (saprotrophic, biotrophic, symbiotic), heterothallism, heterokaryosis, parasexuality, recent trends in classification, phylogeny of fungi.

Unit-III

General account of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina, Deuteromycotina, with special reference to *Pilobolus*, *Chaetomium*, *Morchella*, *Melampsora*, *Polyporus*, *Drechslera* & *Phoma*, fungi in industry medicine and as food, Mycorrhizae, fungi as biocontrol agents.

Unit-IV

Bryophyta : Morphology, structure, reproduction and life history, distribution, classification, general account of Sphaerocarpaceae. Sphaerocarpaceae- *Sphaerocarpos* Jungermanniales-Porella, Anthocerosales-Notothyllas, Sphagnales-Sphagnum, Polytrichales-Pogonatum. Economic and ecological importance.

Unit-V

Pteridophyta : Morphology, anatomy and reproduction, classification; evolution of stele; heterospory and origin of seed habit; general account of fossil pteridophyta; introduction to Psilopsida, Lycopsida, Sphenopsida and Pteropsida; with special reference to *Lycopodium*, *Gleichenia*, *Pteris*, *Isoetes* & *Ophioglossum*.

Suggested Readings:

Alexopoulos, C.J., Mims. C.W. and Blackwell, M. 1996. Introductory Mycology, John Wiley & Sons Ind. Cliffron, A. 1958. Introduction to the Bacteria. McGraw-Hill Book Co., New York. Kumar, H.D; 1988. Introductory to Plant Viruses. Chand & Co. Ltd., Delhi

1MSBO04 Taxonomy & diversity of seed plants

Unit-I

Introduction : Gymnosperms, the vesselless 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.

Economic Importance of Gymnosperms. Brief account of the families of Pteridospermales (Lyginopteridaceae, Meudullosaceae, Caytoniaceae and Glossopteridaceae) General Account of Cycadeoidales and Cordaitales. Structure and reproduction in Cycadales, Ginkgoales (Ginkgo), Coniferales, Welwitschiales (Welwitschia) and Gnetales (Gnetum)

Unit-II

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.

Unit-III

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

Unit-IV

Concepts of phytogeography: Endemism, hotspots and hottest hotspots, plant explorations, invasions and introductions, local plant diversity and its socio-economic importance. Sustainable utilization of bioresources. Unit-V Phylogeny of Angiosperms : Ancestors of Angiosperms, time and place of origin of Angiosperms, Habit of Angiosperm, Primitive living Angiosperms, Interrelationship among the major groups of Angiosperms.

Suggested Readings:

1. Bhatnagar, S.P. and Moitra, A. 1996. Gymnosperms. New Age International Pvt. Ltd., New Delhi. 2. Cole, A.J. 1969. Numerical Taxonomy, Academic Press, London. 3. Devis, P.H. and Heywood, V.H. 1973, Principles of Angiosperms Taxonomy, Robert E. Kreiger Publ Co., New York. 4. Grant, V. 1971. Plant Speciation. Columbia University Press, New York

1MSBO05: PLANT PHYSIOLOGY &

METABOLISM

Unit -I

Water relation of plants : Unique physico chemical properties of water, chemical potential, water potential, apparent free space, bulk movement of water, Soil Plant Atmosphere Continuum (SPAC), stomatal regulation of transpiration, signal transduction in guard cell. Membrane

Transport : Passive-non-mediated transport and Ernst equation, Passive-mediated transport, ATP-driven active transport, Uniport, Symport, Antiport, Ion channels. Amino acids, Proteins and Enzymes : Nod factor, root nodulation and nitrogen fixation, structure of amino acids, stereoisomers, Amphoteric properties, synthesis of amino acids by reductive amination, GS-GOGAT system and transamination.

Unit-II

Structure of proteins : Primary, secondary, tertiary, quaternary domain structure, reverse turn and

Ramchandran Plot. Protein ability : electrostatic forces, hydrogen bonding, disulfide bonding hydrophobic interaction. Enzymes : Structure and properties, substrate specificity, classification and mechanism of enzyme action. Carbohydrates : Classification, structure and function of monosaccharides, polysaccharides and glycoproteins including starch, cellulose and pectins.

Unit-III

Photosynthesis : Photosynthetic pigments, absorption and transformation of radiant energy, photooxidation, four complexes of thylakoid membranes :photosystem I, cytochrome b-f complex photosystem II and coupling factors, photolysis of water and C4 evolution, non-cyclic and cyclic transportation of electrons, water cycle, proton gradient and photophosphorylation, Calvin cycle regulation of RUBISCO activity, control of Calvin cycles. C4 pathway and its adaptive significance, CAM pathway, differences between C3 and C4 plants. Glycolate pathway and photorespiration chlororespiration and CO2 concentrating mechanism in micro-organism.

Unit-IV

Respiration : Anaerobic and aerobic respiration, amphibolic nature of TCA cycle, pentose phosphate pathway, glyoxylate pathway, oxidative phosphorylation, gluconeogenesis, high energy compounds : their synthesis and utilization. Fat metabolism : Synthesis of long chain fatty acids, lipid biosynthesis, and oxidation. Secondary metabolites : Biosynthesis and function of secondary metabolites with special reference to tannins, alkaloids and steroids

Unit-V

Plant growth regulators : Auxins-chemical nature, bioassay physiological effects and mode of action. Gibberellins : chemical nature, bioassay, physiological effect and mode of action. Cytokinins-chemical nature, bioassay, physiological effects and mode of action. Abscisic acid :

chemical nature, bioassay, physiological effect and mode of action. Physiology of flowering : Photoperiodism and vernalization

Suggested Reading : 1 Bachanan, B.B. Gruissim, W. a2nd lones, R.L. 2000, Biochemistry and Molecular Biology of Plants. American Society Plant physiologists, Maryland, USA. 2. Dennis, D.T. Turpin, D.H. Lefebvre, D.D. and Layzell, D. (Eds) 1997. Plant Metabolism (second edition). Longman sex, England. 3. Galston, A.W. 1989. Life Processes in Plants. Scientific American, Springer-Verlag. New York, USA. 4. Hooykaas, P.J.J., Hall M.A. and Libbenga, K.R. (eds) 1999. Biochemistry and Molecular Biology of Plant Hormones, Elsevier, Amsterdam, The Netherlands. 5. Hopkins, W.G. 1995. Introduction to Plant Physiology. John Wiley & Sons, Inc., New York, USA.

1MSBO06: Microbiology & Plant pathology

Unit-I

Important landmarks in the history of microbiology arch-aebacteria and eubacteria : General account, ultrastructure, nutrition and reproduction, biology and economic importance, cyanobacteria-salient features and biological importance. Viruses : Classification, characteristics and ultrastructure of isolation and purification of viruses, chemical nature, replication, transmission of viruses, cyanophages, economic importance. Phytoplasma : General characteristics and role in causing plant diseases

Unit-II

Scope and application of microbes in agriculture, industry, pollution and biological control of pests. General account of immunity, allergy, properties of antigens antibodies. Antibody structure and function, affinity and anti body specificity. Monoclonal antibodies and their uses, antibody 14 engineering, serology, types of vaccines. Preliminary account of Biofilms, biochips, biosensors and biosurfactants.

Unit-III

History and scope of plant pathology : General account of diseases caused by plant pathogens. Pathogen attack and defense mechanisms Physical, physiological, biochemical and molecular aspects. Plant disease management : Chemical, biological, IPM systems, development of transgenics, biopesticides, plant disease clinics.

Unit-IV

Symptomology, identification and management of following plant diseases. Fungal diseases : Wheat (Rust, Smut, Bunt), Bajra (Greenear, ergot and smut), crucifer (Rust). Paddy (Paddy blast), Cotton (Wilt), Grapes (Downy mildew and powdery mildew).

Unit-V

Preliminary account of application of Biotechnology in plant pathology. Bacterial disease : Wheat (Tundu), Soft rot of vegetables. Viral disease : Tobacco mosaic, Bhindi yellow mosaic. Phytoplasma disease : Little leaf of brinjal. Nematode disease : Root-knot of vegetables. Suggested Reading 1. Alexopoulos, C.J., Minis, C.W. and Blackwell, M. 1996 Introductory Mycology. John Wiley &

Sons Inc. 2. Agrios, G.N. 1997. Plant Pathology. Academic Press, London. 3. Albajes, R., Cullino, M.L., Van Lenteren, J.C. and Elad, 2000 Integrated Pest and Disease Management in Greenhot Crops. Kluwer Academic Publishers

M.Sc. II year (Botany) Syllabus

2MSBO01: PLANT MORPHOLOGY, DEVELOPMENTAL ANATOMY AND REPRODUCTIVE BIOLOGY

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 during seed germination and seedling growth, 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, Primary and Secondary tissue differentiation, control of tissue differentiation, especially xylem and phloem, secretory 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, Leaf traces and leaf gaps, Petiolar anatomy.

Root development: Organization of root apical meristem (RAM), cell fates and lineages, vascular tissue differentiation, lateral roots, root hairs, root-microbe interactions. Seed coat development: Ontogeny of seed coat, mature structure, Spermoderm pattern.

2MSBO02: PLANT ECOLOGY

Introduction to ecology, evolutionary ecology, ecological models; Characteristics of population, population size and exponential growth, limits of population growth, population dynamics, life history pattern,

fertility rate and age structure, population growth. Competition and coexistence, intra-specific interactions, interspecific interactions, scramble and contest competition model, mutualism and commensalism, prey-predator interactions.

Vegetation organization: Concepts of community and continuum, community coefficients, interspecific associations, ordination, Species Diversity and Pattern Diversity in Community, Concept of Habitat and Ecological Niche.

Vegetation development: Temporal changes (cyclic and non-cyclic), mechanism of ecological succession (relay floristic and initial floristic composition, facilitation, tolerance and inhibition models). Changes in Ecosystem Properties during Succession, Concept of Climax Nature of ecosystem, production, food webs, energy flow through ecosystem.

Biogeochemical Cycles (global) of C, N, P and S, resilience of ecosystem, ecosystem management. The biosphere, biomes and impact of climate on biomes. Biodiversity – assessment, conservation and management, biodiversity act of India and related international conventions. Sustainable development, natural resource management in changing environment. Molecular ecology, genetic analysis of single and multiple population, molecular approach to behavioural ecology, conservation genetics.

2 MSBO03: PLANT RESOURCE UTILIZATION & CONSERVATION

Plant Biodiversity : Concept, status in India, utilization and concerns Sustainable development : Basic Concepts. Origins of agriculture. World centres of primary diversity of domesticated plants : The Indo-Burmese centre, plant introductions and secondary centres. Origin, evolution, botany, cultivation and uses of (i) Food, forage and fodder crops, (ii) fibre crops, (iii) medicinal and aromatic plants and (iv) 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. 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 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 and Industrial Research (CSIR), and the Department of Biotechnology (DBT) for conservation, non formal conservation efforts.

2 MSBO04: BIOTECHNOLOGY & GENETIC ENGINEERING

Plant Tissue culture: Principles, Concept, History, General methodology, culture media ingredients, preparation, methods of sterilization and disinfestations, aseptic techniques and preparation of explants, histological and photographic techniques for plant tissue culture. Micropropagation in plants, Shoot morphogenesis and organogenesis, callus and suspension cultures, microspore culture and its importance. Somatic embryogenesis: Principles, concepts and applications. Protoplast technology: Isolation methods, purification, viability tests, culture, plating efficiency, Somatic cell hybridization, selection of protoplast

fusion hybrids, Applications. Somaclonal Variation. Plant tissue culture and Secondary metabolite production. Overview of Plant Tissue Culture Applications.

Recombinant DNA Technology: tools and techniques, construction of genomic/cDNA libraries, polymerase chain reaction, DNA fingerprinting Vectors for plant transformation: Basic features of vectors (Promoters and terminators, selectable markers, reporter genes, origin of replication, Co-integrative and binary vectors), Optimization, clean gene technology.

Techniques for plant transformation: Agrobacterium mediated gene transfer, process of T-DNA transfer and integration, practical applications of Agrobacterium-mediated gene transfer, Direct gene transfer methods. The genetic manipulation of Herbicide tolerance, pest tolerance, plant disease resistance. Reducing the effects of viral disease, Strategies for engineering stress tolerance, Improvement of crop yield and quality, Molecular farming of carbohydrate & lipids (Starch, polyfructans, bioplastics), proteins (custom made antibodies, edible vaccines, oleosin system).

Metabolic Engineering and industrial Products: control mechanisms and manipulation of phenylpropanoid pathway, alkaloids, industrial enzymes, biodegradable plastics, polyhydroxybutyrate, therapeutic proteins, Antibiotics, ethanol, Polyketides, Vitamins, Biopolymers, Biological Pigments, Amino acids, solvents.

Science and society: Public acceptance of genetically modified crops (Public concerns, current status of transgenic crops, concerns about GM crops, regulation of GM crops and products), Introduction to Intellectual property, Biosafety guidelines, Environmental release of GMO's, Risk analysis, Risk Assessment, Risk management.

2MSBO05: ADVANCED PLANT PATHOLOGY-I

Plant Pathology : History & Scope. Nature, Origin. & Evolution of parasitism. Biotic and abiotic pathogens, Pathogen factors in disease development. Penetration, infection and pathogenesis. Physiological specialisation in phytopathogenic microbes.

Host factors in disease development. Inoculum Potential, Phenomena of resistance and susceptibility. Protective and defence mechanisms in plants, Phytoalexins. Breeding for disease resistance plants. Environmental factors in disease development. Epiphytotics and plant disease forecasting. Principles of plant protection. Physical, chemical and biological control of plant diseases, IPM, Application of biotechnology and information technology in pest management.

Molecular Plant Pathology : Molecular diagnosis, identification of genes and specific molecules in disease development molecular manipulation of resistance. Non-parasitic diseases and control measures. Classification and anatomy of galls: Some insect induced plant galls of Rajasthan, mechanism and physiology of insect galls.

2MSBO06: ADVANCED PLANT PATHOLOGY-

II

Fungal diseases : Symptomatology, disease identification and control of flag smut wheat, covered smut of barley, blast of paddy, smut Jowar, Red rot of sugarcane, flax rust, early blight of potato. Bacteria : Classification and nomenclature of bacterial plant pathogens. Methods of identification of bacterial pathogens (morphology, physiology, serology and pathogenicity).

Bacterial diseases : Brown rot of potato, blight of rice, soft rot of vegetables, Crown gall disease, angular leaf spot of cotton. Virus, viroid and phytoplasma disease : Symptomatology and transmission of viral diseases; Potato virus X & Y, Tomato ring mosaic, bunchy top of banana; viroids and important viroid diseases. Phytoplasma General account; Sesame phyllody, Spike disease of sandal. Nematology : Brief history, classification and identification of plant pathogenic nematodes. Morphology and anatomy of

nematodes. Methods used in Nematology. Control of plant parasitic nematodes. Nematode Disease : Molya disease of wheat & barley/ear cockle of wheat, root-knot disease.

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