

XL	Life Sciences
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XL2: Botany**Section XL2.1: Plant Systematics**

Botanical nomenclature; History of plant taxonomy; Diversity and classification of plants; APG system of plant classification; Major families such as Apiaceae, Apocynaceae, Asteraceae, Lamiaceae, Myrtaceae, Solanaceae, Verbenaceae, Poaceae and Orchidaceae; Phylogenetics and cladistics; Molecular taxonomy and DNA barcoding; Centers for plant taxonomy and herbaria in India.

Section XL2.2: Plant Anatomy

Anatomy of root, stem and leaves, floral organs, embryo and young seedlings; Primary and secondary meristems; Stellar organization; Vascular system and their ontogeny; Xylem and phloem structure; Secondary growth in plants and wood anatomy; Plant cell structure and differences from animal cells.

Section XL2.3: Plant development; Cell and Tissue Morphogenesis

Life cycle of an angiosperm; Development of male and female gametophyte; Cell fate determination and tissue patterning; Spacing mechanisms in trichomes and stomata; Embryogenesis, organization and function of shoot and root apical meristems; Transition to flowering: photoperiodism and vernalization; ABC model of floral organ patterning, pollen germination, double fertilization, seed development; Xylem and phloem cell differentiation, photomorphogenesis; Phytochrome, cryptochrome, phototropin; Role of auxin, cytokinin, gibberellins, and brassinosteroids on plant development.

Section XL2.4: Plant Physiology and Biochemistry

Plant water relations, mechanisms of uptake and transport of water, ions, solutes from soil to plants, apoplastic and symplastic transport mechanisms; Mechanism of stomatal movements, nitrogen metabolism, photosynthesis; C₃, C₄ and CAM cycles, photorespiration, respiration: glycolysis, TCA cycle and electron transport chain; Plant responses and mechanisms of abiotic stresses including drought, salinity, freezing and heat stress, metal toxicity; Role of abscisic acid in abiotic stresses; Structure and function of biomolecules (proteins, carbohydrates, lipids, nucleic acid), enzyme kinetics; Structure and biosynthesis of major plant secondary metabolites (alkaloids, terpenes, phenylpropanoids, flavonoids); Biosynthesis, mechanism of action and physiological effects of auxin, cytokinin, gibberellic acids, brassinosteroid, ethylene, strigolactone, abscisic acid, salicylic and jasmonic acid; Plant peptide hormones; Concept of hormone-receptor-repressor; Senescence and programmed cell death.

Section XL2.5: Genetics and Genomics

Cell cycle and cell division; Principles of Mendelian inheritance, linkage, recombination, genetic mapping; Extra chromosomal inheritance; Introduction to epigenetics; Gene silencing- transgene silencing, post transcriptional gene silencing, miRNA and siRNA; Evolution and organization of eukaryotic genome structure, gene expression, gene mutation and repair, chromosomal aberrations (numerical: euploidy and aneuploidy and structural: deletion, duplication, inversion, translocation), transposons; Model organisms for functional genetics and genomics; Introduction to transcriptomics, proteomics and metabolomics; Large data analysis, bioinformatics, statistical analysis.

Section XL2.6: Plant Breeding, Genetic Modification, Genome Editing

Principles, methods – selection, hybridization, heterosis; Male sterility; Genetic maps and molecular markers; Embryo rescue; haploid and doubled haploids; Plant tissue culture: micropropagation, embryo culture and in vitro

regeneration, somatic embryogenesis, artificial seed, cryopreservation, somaclonal variation, somatic cell hybridization, marker-assisted selection, gene transfer methods viz. direct and vector-mediated, generation of transgenic plants; Introduction to genome editing: CRISPR/Cas9, Cre-Lox system to generate chimeras; Plastid transformation; chemical mutagenesis.

Section XL2.7:	Economic and Applied Botany
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A general account of economically and medicinally important plants - cereals, pulses, plants yielding fibers, timber, sugar, beverages, oils, rubber, pigments, dyes, gums, drugs and narcotics; Economic importance of algae, fungi, lichen and bacteria; Major Indian cash crops; Effect of industrialization on agricultural botany such as plastic on fiber economy; Genetically modified crops and its regulation eg. Bt cotton, Bt brinjal, golden rice etc.; Chemical biology of phytochemicals; Postharvest processing of tea and essential oil-bearing plants.

Section XL2.8:	Plant Pathology
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Nature and classification of plant diseases; Diseases of important crops caused by fungi, bacteria, nematodes and viruses, and their control measures (chemical and biological) mechanism(s) of pathogenesis, resistance: basal, systemic, induced systemic resistance, gene for gene concept; Molecular detection of pathogens; Plant-microbe interactions: symbionts and mycorrhiza, pathogens and pests; Signaling pathways in plant defence response; Salicylic acid (SA) and jasmonic acid (JA) in plant-pathogen and plant-herbivore interaction, necrosis; Calcium signalling in plants; Host-parasitic plant interaction (such as Cuscuta).

Section XL2.9:	Ecology and Environment
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Ecosystems – types, dynamics, degradation, biogeochemical cycles, ecological succession; Food webs and energy flow through ecosystem; Vegetation types of the world, Indian vegetation types and biogeographical zones, climate and flora endemism; Pollution and global climate change, speciation and extinction, biodiversity and conservation strategies, ecological hotspots, afforestation, habitat restoration; Plant interactions with other organisms; epiphytes, parasites and endophytes.