

**SARDAR PATEL UNIVERSITY
VALLABH VIDYANAGAR**



**Programme: MSC (CBCS)
Syllabus with effective from: 2018-19**

**BOTANY
Semester III**

PS03CBOT21: PLANT DEVELOPMENT & REPRODUCTION

Unit 1:

Introduction to growth and development of higher plants:

The major groups of plants; The structure of higher plants – The cell, meristems; simple tissue; complex tissues and tissue systems – Protective systems, Absorbing systems, Supporting systems, Photosynthetic systems, Storage systems, Transporting systems; Secretory and Excretory systems, Aerating systems; Movement systems of positional perception, Intra-organismal communication systems.

Concepts of plant growth and development from an organismal perspective.

Unit 2:

Seed to seedling: Seed germination, seedling growth.

Seedling to adult plant – Primary vegetative body of the plant: Growth and Differentiation of the shoot, leaf and root; Secondary body of the plant: The vascular cambium, secondary xylem, secondary phloem, periderm.

Unit 3:

Reproduction : Floral evocation and development of the floral meristem, formation of floral organs, Microsporogenesis and formation of the male gametophyte, Megasprogenesis and formation of the embryo sac, Pollen-pistill interaction and fertilization.

Unit 4:

Seed and Fruit formation: Endosperm development and embryogenesis, Fruit growth and ripening, Dormancy of seeds and buds.

Alternative Development strategies: Embryonic development of somatic cells and pollen grains, Abnormal Growth.

Reference Books :

- Carlquist, S. Comparative Wood Anatomy, Springer – Verlag, Berlin.
- Cutter, D. F., Applied Plant Anatomy, Logman, London.
- Cutter, E. G. Plant Anatomy : Experiment and Interpretation : Part 2 – Organs. Edward Arnold, London.
- Cutter, E. G., Plant Anatomy : Part – 1 Cells and Tissues, 2nd Edition, Edward Arnold, London.
- Eames, A. J. and Mac Daniels, L. H. An Introduction to Plant Anatomy, 2nd Edition, McGraw – Hill, New York.
- Fahn, A., Plant Anatomy, 4th Edition, Butterworth, Heinemann Ltd.
- Fosket, D. E., Plant Growth and Development : A Molecular Approach. Academic press, San Diego.
- Kozolowski, T. T., Growth and Development of Trees. Vols. I and II. Academic Press, New York.
- Lyndon, R. F., Plant Development: The cellular basis. Unwin Hyman, London.
- Maheswari, P. An Introduction to the Embryology of Angiosperms. McGraw-Hill Book Co., New York.
- Mauseth, J. D. Plant Anatomy, The Benjamin/Cummings Publishing Co. California.
- Metcalfe, C. R. and Chalk. L. Anatomy of the Dicotyledons. 2nd Edition Vol – III, Clarendon Press, Oxford.
- Metcalfe, C. R. and Chalk. L. Anatomy of the Dicotyledons, Vols.I and II, Clarendon Press, Oxford.
- Murphy, T. M. and Thompson, W. F. Molecular Plant Development, Prentice Hall, New Jersey.
- Peter, W., Jeske, H., Jurgens, G. ,Kloppstech, K. and Link, G. Molecular Plant Development: from gene to plant. OxfordUniversity Press, Oxford, NY.
- Raghavan, V. An Introduction to the Embryology of Angiosperms. McGraw Hill Book Co., NY.
- Raghavan, V. Developmental Biology of Flowering Plants. Springer – Verlag, NY.
- Romberger, J. A., Hejnowicz, Z. and Hill, J. F. Plant Structure : Function and Development : A Treatise on Anatomy and Vegetative Development, with special reference to woody plants, Springer – Verlag, NY
- Zimmerman, M. H. and Brown, C. L. Trees – Structure and Function, Springer-Verlag, Berlin.

PS03CBOT22: PLANT PHYSIOLOGY

Unit 1:

Introduction - The scope of Plant Physiology

Plant and water relations - Water potential, Absorption of water by land plants, Transpiration

Mineral Nutrition and Translocation in plants

General functions of Essential elements, Nutrient roles and deficiency symptoms; Toxicity of micronutrients; Criteria of essentiality, chemical analysis, detection of mineral elements, Mineral salt absorption and transport.

Ascent of sap, Mechanism of ascent of sap, phloem transport

Unit 2:

Photosynthesis - Light and pigments; Light dependent reactions of Photosynthesis; Carbon metabolism – The Photosynthetic Carbon Reduction (PCR) cycle; Activation and regulation of the PCR cycle, The C₄ syndrome, Crustacean Acid Metabolism (CAM), Regulation of C₄ photosynthesis and CAM; Translocation and distribution of photoassimilates, Photorespiration, Factors affecting the rate of photosynthesis .

Respiration - Organization of mitochondrial electron transport system in plants, cyanide resistant pathway and alternative oxidase, its role in regulation of mitochondrial electron transport. Transport of metabolites across mitochondrial membrane. Regulation of pentose phosphate pathway and its significance. Gluconeogenesis. Anaerobic respiration.

Unit 3:

Physiology of flowering & Vernalization

Photomorphogenesis: Phytochrome, Phytochrome in dark grown seedling, Physiological effects of Phytochrome, Phytochrome in green plants, Phytochrome under natural conditions, mechanism of Phytochrome action. Temperature and Plant Development: Temperature in the Plant environment, Influence of temperature on growth and plant distribution and development. Photoperiodism and Rhythmic Phenomena: Photoperiodism; the Biological Clock, Genetic approaches to photoperiodism, and rhythms; Photoperiodism in nature.

Plant growth regulators and elicitors: Physiological effects and mechanism of action of auxins, gibberellins, Cytokinins, ethylene, abscisic acid, brassinosteroids, Polyamines, Salicylic acid hormone receptors, signal transduction and gene expression.

Unit 4:

Physiology of fruit ripening, senescence and abscission.

Seed Germination and Dormancy

Physiology of plants under stress: Water stress, Temperature stress, Salt stress, Insects and diseases

Plant movements

References:

- Hopkins, W. G., Introduction to Plant Physiology. 3rd Edition. John Wiley & Sons, New York.
- Salisbury, F. B. and Ross, C. W., Plant Physiology, 4th Edition. Wadsworth Publishing Company, California.
- Marschner, H., Water relations of plants. Academic Press, New York.
- Briggs, W. R. (ed.) Plant hormones. Klywer Academic Publishers, Dordrecht.
- Kendrick, R. E. and Kroenber, G. H. M., Photomorphogenesis in plants, 2nd Edition, Kluwer Academic Publishers, Dordrecht.
- Thomas, B. and Vince-Prue, D. Photoperiodism in plants, 2nd Edition. Academic Press, San Diego.
- Thimann, K. V. Senescence in plants, CRC Press, Florida.
- Bewley, J. D. and Black, M. Seeds: Physiology of development and germination. Plenum, New York.
- Levitt, J. Responses of plants to environmental stresses. Academic Press, New York.
- Witham et. al. Experiments in Plant Physiology. Van NostrandRenhold Company, New York.
- Meidner, H. Class experiments in Physiology. George Allen & Unwin Publishers Ltd., London
- Kalra, Y. P. (ed.). Hand book of reference methods for plant analysis. CRC Press, USA.

PS03CBOT23: ENVIRONMENTAL & ECOLOGICAL PRINCIPLES

Unit 1:

Environment and Ecology: Concept of Biosphere, its components, development and functioning, Ecological considerations; population growth; Limiting factors and their operation; Ecological balances and survival thresholds; Need for preservation of environmental quality.

Ecosystems and their functioning: Structural and functional attributes of Ecosystem; Biogeochemical cycles; Natural succession; Dynamic equilibrium and factors contributing to it; Major Ecosystems on Earth; Habitat and Niche; Diversity and stability in the ecosystem.

Unit 2:

Impact of human activities on Environment: Over exploitation of natural resources including biological resources; indiscriminate agriculture; big dams; mining; urbanization and industrialization.

Environmental Pollution and Treatment: Atmospheric pollution; water pollution; land degradation; Pollution and Environmental Health.

Fossil fuels and the Environment: Conservation of Non Renewable Energy Resources and Alternative energy resources and Environment.

Unit 3:

Environmental Impact Assessment and Management : Concept of Environmental inventory and impact assessment, key steps in EA process with reference to big dams/ chemical industries/ power plants/mining; methods for forecasting, assessing and preparing environmental impact statement, reviewing and evaluating EIA report; Environmental Audit: Programme planning, on-site audit, post-audit activities, Restoration of ecosystem.

Environmental Laws: Air quality and emission standards; Air pollution legislation and regulations; Functions of the central Board and the state Boards; Environmental law in independent India.

Unit 4:

Environmental Education: Meaning, scope and principles of environmental education; Role of environmental education in bringing awareness among the public in problem solving and management; formal and informal environmental education; Role of various kinds of mass media in environmental education.

Biological diversity: Concepts and levels of biodiversity, role of biodiversity in ecosystem functions and stability, speciation and extinction, local categories of threats, terrestrial biodiversity hot-spots.

Reference Books :

- Trivedi, P. R. and Singh, U. K. Global environmental Education
- Botkin, D. B. and Keller, E. A. Environmental Science: Earth as a living Planet
- Kaufman, D. G. and Fraz, C. M. Biosphere 2000: Protecting our Global Environment
- Chary, EP Fundamentals of Ecology
- The State of India's Environment: The second citizen's Report Centre for Science and Environment
- B. C. Rana. Biomonitoring
- Botkin, E. B. *et al.* Changing the Global Environment: Perspectives on Human Involvement
- Saxena, A. B. Environmental Education
- Khoshoo, T. N. Environmental priorities in India and sustainable development
- Mansfield: Effect of Air pollution on plants
- Masson, C. J. Biology of pollution

PS03CBOT24: Laboratory I (Practicals based on PS01CBOT21 and PS01CBOT22)

PS03CBOT25: Laboratory II (Practicals based on PS01CBOT23 and PS01EBOT2X)

PS03EBOT21: SYSTEMATIC BOTANY

Unit 1:

Taxonomy – Aims, principles and functions. Levels of taxonomy: Alpha taxonomy, omega taxonomy, numerical taxonomy, chemotaxonomy, structural, biochemical and molecular systematics.

Species concept: – Classical, modern, typological, non-dimensional, multidimensional.
Plant Nomenclature: ICBN – principles, rules, recommendations, articles, typification, principle of priority, effective and valid publications, citation of authority, transference, rejection of names, synonyms and homonyms.

Unit 2:

Systems of classifications – principles, outlines, merits and demerits of important systems of Plant classifications.

Floristic diversity of India, hot-spots, endemic and genetic diversity of plants, floristic works in Gujarat.

Unit 3:

Class Magnoliopsida

Salient features, morphological diversity inter-relationships of the following

Sub-class : Magnolidae – Magnoliaceae, Piperaceae,

Sub-class : Hamamelidae – Casuarinaceae, Urticaceae.

Sub-class : Caryophyllidae – Caryophyllaceae, Polygonaceae.

Sub-class : Dilleniidae – Tiliaceae, Sapotaceae.

Sub-class : Rosidae – Myrtaceae, Geraniaceae.

Sub-class : Asteridae – Scrophulariaceae, Gentianaceae.

Unit 4:

Class Liliopsida

Salient features, morphological diversity inter-relationships of the following

Sub-class : Alismatidae – Hydrocharitaceae.

Sub-class : Arecidae – Araceae.

Sub-class : Commelinidae – Commelinaceae.

Sub-class : Zingiberidae – Zingiberaceae.

Sub-class: Liliidae – Orchidaceae.

References:

- Ahmedullah M. and M. P. Nair. 1987. Endemic Plants of Indian Region.
- Cronquist A. 1981. An Integrated System of Classification of Flowering Plants.
- Davis P. H. and V. M. Heywood. 1963. Principles of Angiosperm Taxonomy.
- Lawrence G. H. M. 1951. Taxonomy of Vascular Plants.
- Naik V. N. 1984. Taxonomy of Angiosperms.
- Nayar M. P. 1996. Hotspots of Endemic Plants of India, Nepal and Bhutan.

- Rao R. R. 1994. Biodiversity of India.
- Stace C. A. 1980. Plant Taxonomy and Biosystematics.
- Rendle A.R. A classification of flowering plants vol I &vol II Cambridge University press.
- Sokal, S.R and Sneath P.H, Principles of Numerical Taxonomy. N.H Fremen& Co.
- Sivarajan, V.V. Introduction to Principles of Plant Taxonomy. Oxford & IBH Pvt.ltd.
- Stace Clive, A. Plant Taxonomy and Biosystematics. Edward Arnold.

PS03EBOT22: Omics and Computational Biology

Unit I Genomics and methods in genomics

Introduction to the proteome and the genome, codon bias, gene expression, Genome size-C value paradox, DNA sequencing: Maxam- Gilbert, Sanger, Pyrosequencing, automated DNA sequencing. Other features of nucleic acid sequencing. Analysis and Annotation-ORF

Exon-intron boundaries, DNA Microarray technology: The generation of cDNA expression libraries, their robotic arraying, Complex hybridization on DNA chips.

Transcriptomics: Comparative transcriptomics, Differential gene expression; Genotyping/SNP detection; Detection technology; Computational analysis of microarray data.

Unit II Proteomics and methods in proteomics

Relationship between protein structure and function, Identification and analysis of proteins by 2D analysis; Spot visualization and picking; Tryptic digestion of protein and peptide fingerprinting; Common ionization methods for peptide/protein analysis; Introduction to Mass spectrometers; MALDI-TOF and LCMS analyses

Protein-protein interactions: Solid phase ELISA, pull-down assay (using GST-tagged protein), far western analysis, surface plasmon resonance technique, Yeast two hybrid system, Phage display; Protein interaction maps.

Protein arrays-definition, applications- diagnostics, expression profiling. Uses of automated technologies to generate protein arrays and chips.

Unit III Introduction to computational biology basics and biological databases

Computers in biology, Overview of biological databases, nucleic acid & protein databases, primary, secondary, functional, composite, structural classification database, Sequence formats & storage **Pairwise and multiple sequence alignments:** Local alignment, Global alignment, Scoring matrices - PAM, BLOSUM, Gaps and penalties, Dot plots. Dynamic programming approach: Needleman and Wunsch Algorithm, Smith and Waterman Algorithm, Hidden Markov Model: Viterbi Algorithm. Heuristic approach: BLAST, FASTA. Building Profiles, Profile based functional identification.

Unit IV Genome analysis

Polymorphisms in DNA sequence, Introduction to Next Generation Sequencing technologies, Whole Genome Assembly and challenges, Sequencing and analysis of large genomes, Gene prediction, Functional annotation, Comparative genomics, Probabilistic functional gene networks, Human genome project. **Structure visualization:** Retrieving and drawing structures, Macromolecule viewing platforms, Structure validation and correction, Structure optimization, Analysis of ligand-protein interactions; Tools such as PyMol or VMD.

References:

- Discovering Genomics, Proteomics and Bioinformatics, A.M, Campbell, C,S,H, Press,
- (2003).
- Essential of Genomics and Bioinformatics C,W, Sensen, Wiley (2003).
- Hand book of Comparative Genomics: Principle and Methodology by Cecilia Saccone,
- GrazianoPesole, Wiley-LISS publication (2003).
- Proteomics: From protein sequencing to function by S.R. Pennington and M.J. Dunn, Private Ltd (2001).
- Introduction to Proteomics by Daniel C, Liebler, Humana Press.
- Mount, D. W. (2001). Bioinformatics: Sequence and Genome Analysis. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.
- Bourne, P. E., & Gu, J. (2009). Structural Bioinformatics. Hoboken, NJ: Wiley-Liss.
- Lesk, A. M. (2004). Introduction to Protein Science: Architecture, Function, and Genomics. Oxford: Oxford University Press.
- Campbell, M &Heyer, L. J. (2006), Discovering Genomics, Proteomics and Bioinformatics, Pearson Education.

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