# MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

## M. Sc. BOTANY SEMESTER –II

**Core course 5 : *M2BOT01-CT05***

**Paper I: *Genetics and Evolution***

**Unit-I Credit hours: 12**

**Mendelism**: Concept of gene, Mendel and his laws. Applications of laws and probability tests, Chi-square test and its application in the analysis of genetic data. Pattern of inheritance in haploid and diploid organisms.

**Extension of Mendelism**: alleles, allelic variation and genetic factor dominant relationship, basis of dominant and recessive inheritance, Multiple alleles and allelic series, pseudoallele, complementation tests, lethal alleles, penetrance and expressivity. Inheritance of genes, Pleiotropy.

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**Unit-II Credit hours: 12**

**Chromosomal basis of inheritance:** Sex determination; Sex linked, sex influenced and sex limited traits; genetic marker, Linkage and crossing over, Linkage analysis and linkage map.

**Extra chromosomal inheritance:** Maternal inheritance, Extra-nuclear inheritance in Neurospora, Chlamydomonas, Paramecium, Yeast, Drosophila and Man, Mitochondrial genomes, Chloroplast genomes, Cytoplasmic male sterility.

**Unit-III Credit hours: 12**

**Somatic cell genetics:** Cell-cell hybridization, cell hybrids, mapping of genes by cell hybridization methods, Mapping by in-situ hybridization.

**Genetic recombination**: Recombination and genetic mapping, Homologous and non-homologous recombination, site-specific recombination. Molecular markers and mapping. Physical mapping of genes, artificial chromosomes,

**Unit-IV Credit hours: 12**

**Pedigree:** Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders. Quantitative genetics: Polygenic inheritance, heritability and its measurements

**Mutations:** Spontaneous and induced mutations, physical and chemical mutagens. molecular basis of gene mutations, transposable elements in eukaryotes and prokaryotes.

**Unit-V Credit hours: 12**

**Plant breeding;** Introduction and objectives. Methods of crop improvement, advantages and limitations; Hybridization, mass selection, pure line selection; inbreeding depression, heterosis. Green revolution.

**Evolution:** Emergence of evolutionary thoughts: Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; spontaneity of mutations; the evolutionary synthesis. Origin of cells and unicellular evolution: Origin of basic biological molecules; abiotic synthesis of organic monomers and polymers; concept of Oparin and Haldane; experiment of Miller; the first cell: origin and evolution in prokaryotes and eukaryotes.

**Practicals:**

1. Emasculation, crossing and bagging in crop plants.
2. Problem of genetics.
3. Karyotype determination in onion.
4. Barr body analysis.
5. Genetic exercises and test of goodness of fit using Chi-square

**Reference books:**

1. Khush G. S. Cytogenetics of aneuploides. Academic Press New York USA.
2. Burnham C. R. Discussions in Cytogenetics. Burgess Publishing Co. Minnesota.
3. Hartl D. L. and Jones E. W. Genetics: Principles and Analysis Jones and Barew Publishers Massachusetts USA.
4. Karp G. 2015. Cell and Molecular Biology : Concepts and Experiments, John Wiley and Sons Inc USA.
5. Fikui K. and Nakayama S. Plant chromosomes; Laboratory Methods CRC Press Boca Ration Florida.
6. Gupta P. K. Cytogenetics. Rastogi Publication Meerut.
7. Prasad G. Introduction to Cytogenetics. Kalyani Publishers, New Delhi.
8. Sinha U. and Sinha S. Cytogenetics, Plant Breeding and Evolution. Vikas Publishing house Pvt. Ltd. New Delhi
9. Sumner A.T. Chromosome and organization. Blackwell publishing
11. Swanson C. P., Merz T. and Young J. Cytogenetics. Prentice Hill of India Private Ltd. New Delhi.

# MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

## M. Sc. BOTANY SEMESTER –II

**Core course 6:** ***M2BOT02-CT06***

***Paper II: Fundamentals of Molecular Biology***

**Unit-I Credit hours: 12**

**Cell Cycle and DNA:** Cell cycle regulation, role of cyclins and cyclin-dependent kinases. DNA structure and types (A-, B-, Z-, DNA). DNA replication, enzymes of DNA replication, DNA repair mechanisms.

**Unit-II Credit hours: 12**

**RNA:** RNA synthesis and processing: Transcription factors and machinery, RNA polymerases, transcription initiation, elongation and termination, RNA processing: RNA editing, capping, polyadenylation, splicing, RNA transport, structure and function of different types of RNA, Reverse transcriptase.

**Unit-III Credit hours: 12**

**Protein:** Protein synthesis and processing: Genetic code, Ribosome, Translation: formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, translational proof-reading, translational inhibitors, post-translational modification of proteins.

**Unit-IV Credit hours: 12**

**Gene regulation:** Regulation of gene expression in pro- and eukaryotes, the control sequences (operator, promoter, terminator, attenuator, enhancer), Operon model - lac, trp, operon, attenuation, role of chromatin in regulating gene expression and gene silencing.

**Unit-V Credit hours: 12**

**Genomics and Proteomics:** Introduction to Structural, functional genomics and its application to health and agriculture, including gene therapy. Brief account of Proteomics.

**Cancer:** Molecular genetics of Cancer: oncogenes, tumor suppressor genes, metastasis, therapeutic interventions of uncontrolled cell growth, apoptosis.

**Practicals:**

1. Isolation of genomic DNA and its visualization on Agarose gel.
2. Quantification of DNA.
3. Cot-curve preparation for given DNA sample.
4. Demonstration of function of thermal cycler and thermal program
5. Demonstration of preparation of reaction mixture for amplification of gene of interest from isolated genomic DNA
6. Horizontal gel electrophoresis for separation of amplified PCR products for marker studies
7. Demonstration of primer designing for amplification of gene of interest
8. Perform BLAST for given nucleotide sequence
9. Sequence retrieval from databases.

**Reference Books:**


1. J.D. Watson, T.A. Baker, S.P. Bell etc., Molecular Biology of the Gene, Pearson Education, India.
2. J.W. Dale and Mv Schantz, From Genes to Genomes, John Wiley & Sons.
3. B.D. Singh, Biotechnology, Kalyani Publishers.
4. An Introduction to Molecular Biotechnology by M. Wink, Wiley-VCH.
5. Introduction to Molecular Biology, Genomics & Proteomics for Biomedical Engineers by M.R. Neuman, CRC Press.

# MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

## M. Sc. BOTANY SEMESTER –II

### Core course 7*: M2BOT03-CT07*

### Paper III: *Structural and Reproductive Plant Biology*

**Unit-I Credit hours: 12**

**Meristems:** Introduction, organization of meristems, shoot development– organization of the shoot apical meristems (SAM), wood development in relation to environmental factors. Organization of root apical meristem (RAM), lateral roots; root hairs. Floral meristems and floral development in *Arabidopsis*.
**Tissue and tissue systems;** Parenchyma, Collenchyma, Sclerenchyma, Xylem, Phloem, Secretory structures and periderm

**Unit –II Credit hours: 12**

**Plant anatomy:** Primary and secondary structure of root and stem of angiosperms. Anomalous secondary growth in stem and roots of angiosperms. Leaf anatomy. Leaf development and phyllotaxy.
**Flower**: Evolution of flower, genetics of floral organ differentiation; foliar stamens; open carpels; primitive living angiosperms.

**Unit –III Credit hours: 12**

**Male gametophyte:** Structure of anthers, microsporogenesis, role of tapetum, pollen germination, pollen tube growth and guidance, pollen embryos.
**Female gametophyte**: Ovule development and types, placentation types and its evolution. Megasporogenesis

**Unit –IV Credit hours: 12**

**Embryo sacs:** organization of the embryo sac, types of embryo sacs.
**Pollination and Fertilization:** pollen-pistil interaction; pollination mechanisms and vectors; sporophytic and gametophytic self-incompatibility. Double fertilization, *in vitro* fertilization.

**Unit –V Credit hours: 12**

**Endosperm**: Types, ultrastructure, endosperm haustoria, their extension, persistence and function.
**Embryo**-Polarisation of Zygote, embryogenic types, organogenesis of mono and dicot embryos. Structure and function of suspensor. Polyembryony (types and significance). Apomixis. Seed development and fruit growth.

**Practicals:**

1. Training in paraffin wax method for preparation of serial sections from fixation to mounting of permanent slides
2. Staining of slides using single and double stains
3. Demonstration of slides showing embryological peculiarities (male and female gametophytes, endosperm, embryo)
4. Anatomical study of the following materials:

   Stem: *Boerhaavia, Achyranthes, Bignonia, Chenopodium, Leptadaenia, Nyctanthes, Salvadora, Dracaena, Triticum, Mirabilis, Aristolochia, Amaranthus, Chenopodium.*

   Root: *Tinospora, Ficus.*

   Floral anatomy: Buds of *Opuntia, Rosa, Calotropis, Hibiscus* and *Nerium*.
   Nodal Anatomy: *Calotropis, Nerium*

**Reference books:**

Bhojwani, S.S. and Bhatnagar, S.P. Embryology of Angiosperms (4th Revised and enlarged edition), 2000.

Burgess, J. 1985. An Introduction to Plant Cell Development, Cambridge University Press, Oxford.

Fahn, A. 1982. Plant Anatomy (3 rd Ed.), Pergamon Press, Oxford.

Johri, B.M., Ambegaokar, K.B. and Srivastava, P.S. Comparative Embryology of Angiosperms, Vol. I & II, SpringerVerlag.

Lyndon, R.F. 1990. Plant Development – The Cellular basis, Unnin Hyman, London.

Maheshwari, P. An Introduction to Embryology of Angiosperms, 1950.

Raghavan, V. 1999. Developmental Biology of Flowering Plants, SpringerVerlag, NewYork.

Shivanna, K.R. and Johri, B.M. The Angiosperm Pollen structure and Function, Wiley Eastern Ltd., Publications, 1989.

# MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

## M. Sc. BOTANY SEMESTER –II

### Core course 8: *M2BOT04-CT08*

### Paper IV: *Plant Growth and Development*

**Unit-I Credit hours: 12**

**Water relations:** Chemical and Water potential. Absorption of water. Ascent of Sap, Transpiration, Factors affecting the rate of transpiration, Physiology of stomatal movement and regulation of transpiration. Guttation. Membrane transport: transport proteins, passive and active mechanisms.

**Unit-II Credit hours: 12**

**Plant nutrition:** Nutrient requirement of plants. Essential nutrients: macro and micronutrients, Chelating agents, Nutrient deficiency (Symptoms and disorders).
**Seed:** Seed development, germination and dormancy, bud dormancy, Ageing, Senescence and death.

**Unit –III Credit hours: 12**

**Plant growth and Regulation:** Over view, Historical account, Measurement of growth and growth kinetics. Plant growth regulators: Biosynthesis, chemical nature, physiological effects and mode of action of auxins, gibberellins, cytokinins, ethylene, abscisic acid, brassinosteroids, jasmonic acid and salicylic acid.

**Unit –IV Credit hours: 12**

**Photomorphogenesis:** Over view, Historical account, Photoreceptors: structure, function, properties (Phytochrome and cryptochrome), molecular mechanism of action and role in photomorphogenesis. Photoperiodism: significance, Florigen, floral induction and development, Vernalization.

**Unit –V Credit hours: 12**

**Signal transduction:** Basic concept and principles, Receptors and Second messengers (types, function), Signal transduction and gene expression, Signaling involving calcium, inositol phospholipids and G proteins, Two component sensor regulator system. Plant movements and taxis; Types, role of signal transduction.

**Practicals:**

1. Study of effect of radiation on seed germination.
2. Determination of gibberellic acid by half seed (cereal) method.
3. Seed viability test.
4. Estimation of total auxins, cytokinins and Gibberellins in plant material.
5. Effect of IAA on rooting.
6. Hormonal effects on senescence.

**Reference Books:**


1. Introductory Plant Physiology, 2nd Edition G. Ray Noggle (Emeritus),George J. Fritz. Prentice Hall of India. 2002.
2. Plant Physiology; Sebanek J. Sebanek. Elsevier Science & Technology. 1992.
3. Plants Under Stress: Biochemistry, Physiology and Ecology and Their Application to Plant Improvement; Hamlyn G. Jones, T. J. Flowers, M. B. Jones. Cambridge University Press. 2008.
4. Biochemistry & Molecular Biology of Plants; Eds: Bob Buchanan, Wilhelm Gruissem, Russell Jones (Editor) Wiley; 1st. edition. 2002.
5. Physiology and Biochemistry of Metal Toxicity and Tolerance in Plants. M. N. V. Prasad, Kazimierz Strzalka, M. N. V. Prasad. Springer. 2002.
6. Plant Hormones: Physiology, Biochemistry and Molecular Biology: P. J. Davies Peter J. Davies. Kluwer Academic Publishers. 1995.
7. The Physiology of Flowering Plants; Opik, Helgi. Cambridge University Press.
8. Text book of Plant Physiology. V. Verma. Ane Books. New Delhi. 2007.
9. Plant Physiology; R.M. Devlin & Witham. Reinhold publications. 1969.