

GENETICS

Unit 1 : Transmission Genetics

Mendelism, Extensions of Mendelism (Allelic variations and gene function, Multiple alleles and allelic series, Lethal alleles, Penetrance and expressivity, Interaction of genes, Pleiotropy), Evolution of concept of gene (alleles, multiple alleles, pseudoalleles, One mutant gene-One metabolic block, One gene – One enzyme concept, One gene – One polypeptide concept, Complementation test), Linkage and crossing over, Sex-linked inheritance, Non-Mendelian inheritance, Behavioural genetics.

Unit 2: Chromosome Genetics

Microscopy, Chromosomal theory of Inheritance, Cytoskeleton, Chromosomal structural rearrangements, Numerical variations in chromosomes, Special chromosomes (Polytene, Lampbrush), Cell Division, Chromosomal basis of sex determination, Effects of radiations on chromosomes.

Unit 3: Gene structure and function

Central dogma of Molecular Biology, Nucleic acids structure, replication of DNA (Regulation of initiation, Fidelity), Damage, repair, and recombination of DNA (models and protein machinery), Transcription (post transcriptional processing of RNA), translation, Gene regulation in Prokaryotes and Eukaryotes (Transcriptional, Post transcriptional, Chromatin remodeling).

Unit 4: Molecular Cytogenetics

Molecular basis of mutations, Chemical mutagens, Molecular organization of eukaryotic chromosomes, Heterochromatin, Molecular basis of sex determination and dosage compensation (*Drosophila*, *C.elegans* and Man), Somatic cell genetics and imprinting. Molecular dynamics of cell division

Unit 5: Population genetics and Evolution

History of evolutionary thought, Lamarckism, Darwinism, Evidences for evolution, Neo-Darwinism, Inheritance of quantitative traits, Inbreeding and Heterosis, Isolation mechanisms, Speciation, Molecular population genetics, Molecular Phylogenetics and Human phylogeny.

Unit 6: Genetic Engineering

Historical account, Tools of Gene cloning (cloning vectors, hosts, DNA modifying enzymes), Methods of gene isolation, Screening and characterization of clones, DNA sequencing methods, PCR (Mechanism, types and applications), DNA Engineering techniques (Gel electrophoresis of nucleic acids and proteins, Microarray technology, RNAi, Blotting of macromolecules, Promoter characterization, DNA fingerprinting, Gene transfer techniques, *In vitro* translation).

Unit 7 : Genes and Development

Introduction, Morphogenetic determinants, Gastrulation, Axis formation, Homeotic selector genes, Signaling and pathways in morphogenesis, limb development, Axonal pathfinding, Metamorphosis, Regeneration, environment and animal development, Developmental mechanisms of evolutionary change.

Unit 8: Molecular Human Genetics

History of human genetics, Genetic mapping of mendelian traits (Two-point mapping, Multipoint mapping, Homozygosity mapping) and complex traits (Allele sharing methods, Allelic association, Linkage disequilibrium mapping, Transmission disequilibrium test), Reproductive genetics (Hermaphroditism, Gonadal dysgenesis, Genetics of infertility, Technology in reproductive assistance), Genetic basis of syndromes and disorders (Cystic fibrosis, Tay-Sachs syndrome, Phenylketonuria, Maple syrup urine disease, Mucopolysaccharidosis, Marfan syndrome, Prader-Willi, Neurofibromatosis, Charcot-Marie-Tooth syndrome, Duchenne Muscular Dystrophy, Sickle cell anemia, Colour blindness, Diabetes mellitus, Dyslexia, CHD), prenatal and pre-implantation diagnosis, Genetic counseling, Ethical considerations.

Unit 9: Advanced Cell Biology

Molecular architecture of eukaryotic cell, Ultra structure and functions of Cell organelles, Eukaryotic cell cycle and its regulation, Biology of Neoplasm, Cell-cell interaction, Cell signaling, Apoptosis, Aging, Stem cells and their applications, Immunobiology and Clinical immunology.

Unit 10: Genome Genetics

Scope of genome genetics, Organization of prokaryotic and eukaryotic genomes, Mapping of genomes by genetics(RFLPs, SSLPs, SNPs) and physical techniques (Restriction mapping, FISH, Sequence tagged site mapping, Radiation hybrids), understanding of genome sequence, Comparative, structural, and functional genomics and pattern of genome evolution.
