508. Genetic

PRINCIPLES OF INHERITANCE: Laws of segregation and independent assortment – pedigrees – extensions to Mendelian genetics, codominance, incomplete dominance, lethals and sub-lethals, pleiotropy, penetrance and expressivity, phenocopy, multiple allelism, epistatic interactions– sex-linked inheritance (X and Y linked inheritance), sex-limited and sex-influenced characters, sex determination in Drosophila, birds, man, bonellia–quantitative inheritance- Linkage and crossing over, two point and three point test crosses, tetrad analysis in Neurospora - Extra chromosomal inheritance.

CELL BIOLOGY & CYTOGENETICS: Structure and organization of chromosomes, polytene and lamp brush chromosomes, euchromatin and heterochromatin, chromatin organization, centromere and telomere - chromosomal abnormalities, structural, numerical and their genetic implications.- cell division, mitosis and meiosis, cell cycle, check points and CDK's; abnormalities in cell cycle, structure and functions of cell organelles, cytoskeleton, cell-cell junctions, cell-matrix junctions, apoptosis, necrosis.

BIOCHEMISTRY: Nomenclature, classification and properties of enzyme, Factors affecting the rate of the reaction, Michaelis-Menton equation and kinetics, Structure and functions of carbohydrates, aminoacids, lipids and nucleic acids- Metabolism, Glycolytic Pathway, TCA Cycle Oxidative Phosphorylation, Photophosphorylation, Electron Transport Chain, Glyoxylate Cycle, Pentose Phosphate Pathway, Gluconeogenesis, Photosynthesis-C_3 and C_4 and CAM Pathways, β - Oxidation of fatty acids.

BIOSTATISTICS: Concepts of Probability, Probability distributions (binomial, poisson and normal distributions), hypothesis testing, z- test, t-test, chi-square test, F-test, correlation and regression analysis, ANOVA.

POPULATION GENETICS: Hardy-Weinberg principle, establishment of law for autosomal biallelic loci, multiple allelic loci and X-linked loci. Factors affecting HWE- mutation, selection, migration, genetic drift, effective population size, genetic load, inbreeding and assortative mating- heritability- Neutral theory, molecular clock, phylogenetic tree construction methods.

MOLECULAR GENETICS: DNA and RNA as genetic material-Watson and Crick model of DNA double helix, forms of DNA, DNA replication–homologous and Non-homologous recombination - DNA damage and repair- Transposable elements- prokaryotic and eukaryotic genes and genome organization, gene families- transcription in prokaryotes and eukaryotes, gene regulation at transcription level- translation in prokaryotes and eukaryotes, gene regulation at translational and post translational level, Epigenetic regulation of gene expression.

RECOMBINANT DNA TECHNOLOGY: Properties and applications of DNA modifying enzymes, restriction enzymes - cloning vectors- hosts used in genetic engineering –cloning strategies, -construction of genomic and cDNA libraries, selection and screening, blotting and hybridization techniques –DNA sequencing –PCR technology, types of PCR. Gene knock-in & knock-out technologies – applications of r-DNA technology in medical, agricultural and industrial biotechnology.

BIOINFORMATICS: Bioinformatics data and databases - sequence alignment; pair wise alignment algorithms, database searching algorithms (Blast/Fasta) – bioinformatics for genome sequencing, genome variation studies, proteomic research and transcript profiling; metabolic reconstruction – medical application of bioinformatics.

IMMUNOGENETICS: Types of immunity -cells and organs of the immune system – antigens, antibodies organization and structure of immunoglobulin, types and expression of immunoglobulin light and heavy chain genes-antibody diversity, monoclonal antibodies, – MHC haplotypes, MHC Class-I & class II molecules structure and functions, Types of grafts, human leukocyte antigen(HLA)typing, hypersensitivity -cell-mediated immune response, Cytokines, Autoimmunity, Immuno-deficiency disorders.

MICROBIAL GENETICS: Bacterial genetics (plasmids, conjugation, transduction, transformation) – Phage virus reproduction (lytic & lysogenic cycle)- Virus genetics (mutations, recombination, reassortment, complementation, phenotypic mixing)– Fungal genetics (mating systems, outcrossing, non-outcrossing, parasexual cycle)– Protozoan genetics (genetic exchange in *Trypanosoma brucei*)– genetic and molecular basis of pathogenesis: (*Vibriocholera*, *HIV*)- Emerging & re-emerging infectious diseases - recombinant vaccine strategies- Plant-fungal interactions and Plant-bacterial interactions – genetic improvement of strains for biotechnology- microbial biofuel production–microbial bioremediation.

PLANT GENETICS AND MOLECULAR BREEDING: Plant breeding methods, self-pollinated and cross-pollinated crops – hybrid development - breeding abiotic and biotic stress tolerance, nutritional quality- molecular markers, MAS and GS.

PLANT BIOTECHNOLOGY: plant tissue culture methods, organogenesis and somatic embryogenesis, micropropagation, somaclonal variation, protoplast fusion, anther and pollen culture, synthetic seeds - plant cell biotechnology, mass cultivation of plant cell and organ culture- modes of bioreactor operations, different types of bioreactors - transgenic plants, vectors, selectable markers, iRNA silencing, biotic and abiotic stress tolerance, nutrition, chloroplast transformation, molecular farming.

PLANT GENOMICS: Nuclear and organellar genomes - epigenome – Genomics, transcriptomics, metabolomics and proteomics - genome editing and genome engineering applications.

HUMAN GENETICS, GENOMICS & MEDICAL GENETICS: Patterns of inheritance (Autosomal dominant, autosomal recessive, X-linked and mitochondrial inheritance), sex influenced and limited traits, Nuclear and mitochondrial genome organization; Human Genome Project, molecular pathology and genetic diseases, molecular mechanism for X-chromosome inactivation, genomic imprinting, uniparental disomy and mosaicism, loss of function, gain of function, Pathogenic potential of repeated sequences, molecular mechanisms of cancer, linkage analysis and mapping- Identification of human genome variations via whole genome, proteome, exome, transcriptome and epigenome analyses, analysis of gene variants– screening genetic disorders, prenatal, neonatal, preclinical- genetic counselling.

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