

Department of Genetics and Genomics

I semester

	Paper	No.of credits	Hrs per week	Max.marks : 100		Exam time(hrs)
				Internal	External	
1	Paper-1	4	4	25	75	3
2	Paper-2	4	4	25	75	3
3	Paper-3	4	4	25	75	3
4	Paper-4	4	4	25	75	3
5	Practical-1	4	8	100		3
6	Practical-2	4	8	100		3

II semester

	Paper	No.of credits	Hrs per week	Max.marks : 100		Exam time(hrs)
				Internal	External	
1	Paper-1	4	4	25	75	3
2	Paper-2	4	4	25	75	3
3	Paper-3	4	4	25	75	3
4	Paper-4	4	4	25	75	3
5	Practical-1	4	8	100		3
6	Practical-2	4	8	100		3
7	Non core-1	4	4	25+75		3

III semester

	Paper	No.of credits	Hrs per week	Max.marks : 100		Exam time(hrs)
				Internal	External	
1	Paper-1	4	4	25	75	3
2	Paper-2	4	4	25	75	3
3	Paper-3	4	4	25	75	3
4	Paper-4	4	4	25	75	3
5	Practical-1	4	8	100		3
6	Practical-2	4	8	100		3
7	Non core-2	4	4	25+75		3

IV semester

	Paper	No.of credits	Hrs per week	Internal	External	Exam time(hrs)
1	Paper-1	4	4	25	75	3
2	Paper-2	4	4	25	75	3
3	Paper-3	4	4	25	75	3
4	Project	12		300		

Credits:

Total for core papers 96

Total for noncore papers 8

Grand total 104

(2600 Marks)

Department of Genetics and Genomics
Semester-I
GG01: PRINCIPLES OF GENETICS

UNIT-I

History and Milestones in genetics, importance and applications of genetics; Model organisms in genetics- *Pisumsativum*, *Saccharomyces cerevisiae*, *Drosophila melanogaster*, *C. elegance*, *Arabidapsis thaliana*; Terminology of genetics; Outlines of cell structure, Chromosome structure- Bacterial chromosome, eukaryotic chromosome (primary constriction, secondary constriction, satellites, telomeres, euchromatin, heterocromatin); chromosome number, sex chromosomes, special type of chromosomes-salivary gland chromosome, lampbrush chromosomes, accessory chromosomes; Cell division-Mitosis and meosis and their significance; Spermatogenesis and Oogenesis.

UNIT-II

Mendel's principles of inheritance-Principles of dominance, segregation and independent assortment, punnet square method and forked-line method; The rediscovery of mendelian principles; Extensions of Mendel's principles-incomplete dominance, codominance, multiple alleles, allelic series, testing gene mutations for allelism; Genetic interactions, Epistasis-recessive epistasis, dominant epistasis, duplicate dominant genes, duplicate recessive genes, duplicate genes with cumulative effect, dominant-and-recessive interaction; non epistatic interactions and pleotropism; The classical genetics of organelles-Leaf variation in plant and antibiotic resistance in clamydomonas;

UNIT-III

Methods to know genotype of an organism-Test cross, back cross, tri-hybrid cross and polyhybrid cross; Inheritable characters in human beings; Influence and effect of environmental factors on gene expression. Heterosis- Occurrence and causes of heterosis, effect of heterosis, role of heterosis in increasing production.

Cytological techniques-analysis of mitotic chromosomes, the human karyotypes, Cytogenetic variations : Overview of cytogenetic variation; Polyploidy- sterile polyploids, fertile polyploids, tissue-specific polyploidy and polyteny; Aneuploidy-Trisomy, monosomy, deletion and duplications of chromosome segments; Rearrangement of chromosome structure-inversion, translocations, compound chromosomes and robertsonian translocations; Mutations : Origin and frequency of spontaneous mutations, Induced mutations-physical and chemical mutagenes, screening and selection of mutations, molecular basis of spontaneous and induced mutations. Transposable element, detection of transposition in bacteria

UNIT-IV

Sex determination, sex linked genes, sex limited traits, sex influenced traits, Linkage-linkage through experiments, complete and incomplete linkage, strength of linkage, factors affecting strength of linkage, measurement of linkage strength, importance of linkage; Recombination and crossing over; Chromosome mapping-crossing over as measure of genetic distance, Morgan's cross and strut's event map; recombination mapping with two point test cross, determination of gene order by three point test cross; Mapping of genes by tetrad analysis; Interference and the coefficient of coincidence; Linkage analysis in humans (pedigree analysis).

Recommended books:

1. Principles of genetics, by Snustad . Simmons.4th Ed.2006.
2. The science of genetics by Atherly, Girton and McDonald.1999.
3. Genetics *A molecular approach* by Peter J.Russell.2nd Ed.2006.
4. Genetics fundamentals and applications by Srivastava and Debmalya barch.1st Ed.2008.
5. Genetics by Winter, Hickey and Fletcher.2nd Ed.2003.
6. Genetics Analysis of genes and genomes by Jones and Bartlett.6th Ed.2005.
7. Genetics, Schaum's outlines.4th Ed. TATA McGraw-hill edition.2002.
8. Principles of genetics by Robert H. Tamarin. 4th Ed. TATA McGraw-hill edition.2002.

Department of Genetics and Genomics
Semester-I
GG 02: BIOMOLECULES

UNIT – I

Major Constituents of Cells Introduction of biomolecules: Classification of carbohydrates: outline, structure and properties of mono(glucose, galactose, fructose) Oligo (lactose, maltose, sucrose) and Polysaccharides and their identification and analysis. Structure, occurrence and biological significance of polysaccharides: (starch, cellulose, glycogen); Mucopolysaccharides.

UNIT – II

Amino acids: Classification, structure and physico chemical properties. Peptide bond, peptides of non protein origin (glutathione, tyrosedine, gramicidin, valinomycin), Acid – base properties of peptides, chemical properties and chemical synthesis of peptides.

Proteins – classification, physico – chemical properties and biological functions of proteins Structural organization 1°, 2°, 3° & 4° and supra molecular level of organization. Ramachandran plot. Sequencing of amino acids in peptides. Structural & functional relationship of proteins, denaturation, renaturation (hemoglobin, RNase) and evolution of proteins.

UNIT – III

Lipids and Porphyrins: Structure, properties and classification of lipids, fatty acids, waxes, phospholipids, cerebrosides and gangliosides, lipoproteins, prostaglandins, leukotrienes, thromboxanes, steroids and bile acids. Structure of Porphyrins, Structure and function of Heme, Cytochromes and Chlorophyll.

Nucleic acids: Purine and Pyrimidine Bases, Nucleosides, Nucleotides, Formation of phosphodiester bond and its stability, Structure of DNA-Watson and Crick model, different forms of DNA, types of DNA, Structure of t-RNA, Denaturation and Renaturation of DNA, melting curves.

UNIT – IV

Enzymes: Classification and nomenclature of enzymes: The Six main classes of enzymes. kinetics of enzyme catalyzed reaction: Michaelis –Menten equation, determination of V_{max}, K_m and their significance. Line weaver-Burk plot. Factors affecting enzyme Activity (concentration, pH, temperature). Enzyme inhibition- reversible and irreversible inhibition, competitive and non competitive inhibitors, Allosteric inhibition. Catalytic mechanism of lysozyme, chymotrypsin and ribonuclease.

Reference:

1. LEHNINGER (2000) Principles of Biochemistry, 3rd edition, NELSON & COX (Worth) Publ.
2. CONN, STUMPF, Outlines of Biochemistry (5th edition) BRUENING & DOI.
3. David E. Metzler and Carol M. Metzler (2001). Biochemistry-The chemical reactions of living cells- Vol 1 & 2. (2nd edition). Harcourt/Academic press, New York.
4. Donald Voet and Judith G. Voet (1995). Biochemistry – Second Edition. John Wiley and Sons, Inc.
5. Geoffrey, L and Zubay (1998). Biochemistry. (Fourth Edition) Wm. C. Brown Publishers.
6. Jeremy M. Berg. John L. Tymoczko and Lubert Stryer (2002). Biochemistry. (5th edition). W. H. Freeman and company, New York.
7. Lubert Stryer. (1995). Biochemistry. (4th edition). W.H. Freeman and company, New York.
8. Christopher K. Mathews and Van Holde, K.E. (1996). Biochemistry. (2nd edition). The Benjamin/Cummings publishing company Inc.
9. MARTIN, MAYER & RODWELL Harper's Review of Biochemistry.
10. Reginald, H., Garret & Charles M. Grishm. (1998). Biochemistry (Second Edition) Saunders College Publishing.
11. SMITH, HILL, LEHMAN, Principles of Biochemistry: General aspects LEFKOWITZ, HANDLER & WHITE.
12. Thomas M. Devlin. (2002). Textbook of Biochemistry with clinical correlations. (5th edition). A John Wiley and sons, Inc., publication, New York.
13. Trudy McKee and James R. McKee. (1999). Biochemistry-An Introduction. (2nd edition). WCB McGraw- Hill, U.S.A
14. U. Satyanarayana U. Chakrapani (2005) Biochemistry, 3rd Edition, Books and allied Publications.
15. Zubay, G. (1998). Biochemistry WCB. McGraw-Hill, Iowa.

Department of Genetics and Genomics
Semester-I
GG 03: CELL BIOLOGY

UNIT-I

Structural organization of prokaryotic and eukaryotic cells, Ultrastructure and functions of nucleus, mitochondria, plastids, endoplasmic reticulum, Golgi complex, lysosomes, microbodies, ribosomes. Cytoskeleton – microtubules and microfilaments.

UNIT-II

Plant and animal cells – variation in structure and function, Types of tissues – Epithelial tissues, basement membrane, extracellular matrix – Collagen, Elastin, fibrillin, Chromatin organization, telomere, centromere, cell receptors, endocytosis and exocytosis. Biomembranes - composition of Membranes (plasma and organelle membranes). Membrane lipids, proteins and carbohydrates. Molecular structure of membranes, Membrane fluidity, fluid mosaic model of biological membranes.

UNIT- III

Membrane transport: Active transport, Active transport of Na⁺ K⁺(sodium potassium ATPase) Ca²⁺ (Ca²⁺ - ATPase). Basic concepts of cell signaling and transduction, different signaling molecules, second messengers, calcium, calmodulin, inositol phosphate, cAMP, cGMP, NO. Signal cascades, inhibition of cell signaling pathways.

UNIT-IV

The cell cycle (eukaryotic cell cycle): Phases of cell cycle, Control of the cell cycle-Role of protein kinases, checkpoints, kinase inhibitors and cellular responses; M-Phase: Prophase-Formation of the mitotic chromosome and spindle, dissolution of the nuclear envelope and partitioning of cytoplasmic organelles; Prometaphase; Metaphase-metaphase plate, microtubule flux; Anaphase- role of proteolysis in progression through mitosis, events of anaphase, spindle assembly checkpoints; Telophase, forces required for mitotic movement, cytokinesis; Meiosis and fertilization-stages and process of meiosis, regulation of Oocyte meiosis, fertilization, quorum sensing.

Recommended books

1. Cell Biology by Karp 2010, 6th Ed. John Wiley & Sons (Asia) Pte Ltd
2. The Cell a molecular approach by G M Cooper & E Hausman 2007, 4th Ed.
3. Molecular Cell Biology by Lodish et al., 2008, 6th Ed. W.H Freeman and Company.
4. Essential Cell Biology by Alberts et al., 2004, 2nd Ed. Garland Science, Taylor & Francis group

Department of Genetics and Genomics
Semester-I
GG04: ANALYTICAL BIOTECHNIQUES

Unit I

pH, Buffers & Centrifugation Techniques

Biological relevance of pH, pH meter, glass electrode, reference electrodes, ion selective electrodes, and oxygen electrode. Measurement of pH, pKa of functional group in biopolymers such as proteins and nucleic acids. Importance of buffers in biological systems, Solutions - Molarity, Molality, Normality.

Microscopy: basic principles of light microscopy, phase contrast microscopy, electron microscopy and fluorescence microscopy. Sedimentation methods: Basic principles of centrifugation, analytical ultra centrifugation/Gradient centrifugation.

Unit II

Separation Techniques & Molecular biological Techniques: Theoretical principles, methodology and biochemical applications of separation methods: counter current distribution, paper, Thin layer, Reverse phase, Adsorption, ion exchange, and gas chromatography, affinity chromatography, gel filtration, HPLC, electrophoresis: paper, agar, immune electrophoresis, high voltage electrophoresis, iso- electrophoresis, iso- tachophoresis, Northern blot, southern blot, western blot analyses. Autoradiography, *in situ* hybridization.

Unit III

Radioactive Tracer & Immunological Techniques

Radioactivity: half – life, decay constant, average life, units of radioactivity, Radioactivity measuring techniques, and correction factors. GM counter, liquid scintillation counter, γ , counter Radio active disposal. Biological effects of radiation, isotope dilution techniques and its application in biochemical investigations. Radioisotopes in biochemistry and medicine. ELISA, Chemiluminescence, RIA.

Unit IV

Spectroscopy: electromagnetic radiations, Beer – Lamberts law principles and applications of colorimetry, spectrophotometry. Concept and biological application of UV, fluorimetry, flame photometry, AAS, AES, Infrared, ESR, NMR spectroscopy, polarimetry, CD&ORD. Principles and applications of X – ray Diffraction.

Recommended Books:

1. Principles and Techniques of Practical Biochemistry, Ed. Williams and Wilson.
2. Techniques in Molecular Biology Ed. Walker & Gastra, Croom Helm.
3. Principles of Instrumental Analysis, 2nd Ed. Holt-Sanders.
4. An Introduction to Spectroscopy for Biochemistry, Ed. Brown Sn., Academic Press.
5. Analytical Biochemistry, Holmes and Hazel Peck, Longman.
6. An Introduction to Practical Biochemistry. David t. Plummer, Tata Mac grew – Hill.
7. Biophysical Chemistry, Ed. Shall & Wyman, Academic Press Vol II & I.
8. A text book of quantitative inorganic analysis including elementary instrumental analysis, Vogel ELBS.
9. Biochemical Calculations Seigel, IH, 2nd Ed. John Wiley & Sons Inc.
10. Analytical Biochemistry by David Friefelder.

**Department of Genetics and Genomics
Semester-I**

PRACTICALS I: PRICIPLES OF GENETICS AND BIOMOLECULES

1. Problems in Genetics
2. Qualitative tests for identification of carbohydrates
3. Qualitative tests for identification of amino acids
4. Qualitative tests for identification of nucleic acids
5. Quantitative tests for protein (Lowry and Bradford methods)
6. Quantitative tests for glucose (DNS method)
7. Quantitative tests for Glycine
8. Quantitative tests for Bilirubin
9. Quantitative tests for Cholesterol
10. Determination of activity of peroxidase from leaves
 - a. Purification and study of acid phosphatase from potato tubers : Extraction of enzyme; effect of substrate concentration, temperature; pH on enzyme activity

**Department of Genetics and Genomics
Semester-I**

PRACTICALS II: CELL BIOLOGY AND ANALYTICAL TECHNIQUES

1. Mitosis
2. Meiosis
3. Micrometry for cell size determination
4. Isolation of chloroplasts by sucrose density gradient centrifugation(Demonstration)
5. Measurement of pH
6. Verification of Beer's Law and determination of λ max for colored solutions.
7. Paper chromatography for separation of amino acids
8. Thin layer chromatography (TLC) for separation of lipids and amino acids
9. Dialysis
10. SDS-PAGE for separation of protein
11. Submarine Agarose gel electrophoresis for DNA separation
12. Ion-exchange column chromatography(Demonstration)
13. Gel permeation column chromatography(Demonstration)
14. Separation and determination of concentration of green/yellow pigments by spectrophotometry
15. Mitosis
16. Meiosis

Department of Genetics and Genomics
Semester-II
GG05: Microbial Genetics

UNIT-I

General properties, growth and culture of bacteria; **Essentials of microbial genetics** : Genetic nomenclature, Mutants and mutations- Types of mutants, isolation and characterizations of mutants, revertants, reversion, uses of mutations; Genetic analysis of mutants-Genetic recombination, genetic mapping, linkage and multifactor crosses, multiple exchanges and the recombination frequency for distant markers, deletion mapping, complementation and intragenic complementation, isogenic strain for genetic analysis.

UNIT-II

Transformation-Transformation in the history of molecular biology, competence in gram-positive and negative bacteria, uptake of DNA in transformation, evidence for single stranded DNA uptake, Integration of transforming DNA;

Transduction- Generalized transduction, specialized transduction, Phage conversion.

Conjugation- Essential features and mechanism of DNA transfer during conjugation, Formation of Hfr strains, Chromosome mobilization, Use of Hfr strains in genetic cross, Transfer of chromosomal genes to F plasmid.

UNIT-III

General properties, nucleic acid based classification (Baltimore classification), replication of DNA viruses- SV40, CaMV, Bacteriophage T4, λ and M13, Adenovirus, Parvovirus; RNA viruses- Diversity of RNA virus genomes, regulatory elements for RNA virus genome synthesis, generation and amplification of defective-interfering virus (DI) RNA; Poliovirus and potyvirus; Retroviruses- HIV, Human hepatitis B virus.

UNIT-IV

Genetics of viruses: Phage mutants, recombination in phages, fine-structure mapping of T4 rII locus; Eukaryotic viruses-recombination and reassortment, cross and multiplicity reaction, phenotypic mixing, ploidy, satellites, viroids and prions; Transduction of genes by retroviruses; Virus evolution and the emergence of new viruses.

Recommended books

1. Microbials genetics by Stanley R.Maloy, John E.Cronan and David Frieflder (1994), second ed.,Jones and Bartlett publishers.
2. Molecular genetics of bacterial by Larry syder and Wendy champnes (2007), 3rd ed., ASM press.
3. Modern virology by N.J.Dimmock, A.J.Easton and K.N.Leppard (2007), sixth ed.,Blackwell publishing.
4. Principles of Virology,molecular biology,pathogenesis and control by S.J.Flint, L.W.Enquist, R.M.Skalka (2000)ASM press.
5. Principles of Molecular Virology by A.Cann (1997), 2nd ed., Academic Press

Department of Genetics and Genomics
Semester-II
GG06: MOLECULAR BIOLOGY

UNIT-I

Genetic material : Functions of the genetic material; Evidence for DNA is the genetic material; Evidence for RNA is the genetic material.

Nucleic acids : Types , chemistry; polymorphism of DNA and RNA; Chargaff's ratios; Chemical, physical and spectroscopic properties of nucleic acids; Denaturation and renaturation kinetics of nucleic acids; Hydrolysis of nucleic acids-Exonucleases, endonucleases and ribozymes; DNA topology-linking, writhing, twisting number, positive and negative supercoiling, significance of supercoiling *in vivo*, topoisomerases types and mechanism; Unusual DNA secondary structures.

UNIT-II

Genome organization : Bacterial genome, plasmids, Eukaryotic chromosome-Histone proteins, non-histone chromosomal proteins, nucleosome, linkers, chromatin fibers, centromeres, telomeres and alternative chromatin structures. **DNA replication**: Concepts and strategies/models for replication. Relation between cell cycle and DNA replication. Molecular mechanisms of DNA replication in prokaryotes and eukaryotes. Replication models- mtDNA and phage θ X174. Inhibitors of DNA replication. DNA damage and repair.

UNIT-III

Recombination: Homologous recombination, site-specific recombination and transposition.

Gene expression (Transcription and translation): Overview of gene expression. **Transcription (RNA biosynthesis)**: Types of RNA and their role; RNA polymerases involved in transcription of prokaryotes and eukaryotes. Mechanism in pro and eukaryotic cells-promoter recognition, initiation, elongation and termination of RNA synthesis. Maturation and processing of different RNA transcripts-capping, methylation, polyadenylation, splicing, RNA editing and modification of nucleosides in tRNAs. Inhibitors of transcription.

UNIT-IV

Translation (protein biosynthesis) : Genetic code and its elucidation, structure and composition of prokaryotic and eukaryotic ribosome's; Structural features of rRNA, mRNA and tRNAs in relation to function, mechanisms of protein biosynthesis in prokaryotic and eukaryotes; post-translational modification of proteins and their sorting and targeting and degradation; regulation of translation; inhibitors of protein biosyntheses.

Regulation of gene expression: Principles of gene regulation, terminology and operon concepts, enzyme induction and repression; positive and negative regulation in *E.coli* –lac, and regulation by attenuation-trp operons.

Recommended books:

- 1) Fundamental Molecular Biology.2007, by Lizabeth A.Allison. Blackwell publishing.
- 2) Molecular Biology of the gene by Watson et al.,5th Edition,2004,Addison Wesley Longman.
- 3) The foundations of Biochemistry by Lehninger,4th Edition
- 4) Principles of Genetics by Snustad,Simmons, 4th Edition,2006
- 5) Instant notes in Molecular Biology by P.C.Turner et al.Viva Books Pvt.Ltd.
- 6) Advanced Molecular Biology by A Concise reference.1998, by R.M.Twyman. Viva Book Pvt.Ltd.
- 7) Molecular Biology by David Fdreifelder,1995 Narosa Publ.House.
- 8) Molecular Cell Biology by Lodish et al., 2003, Scientific American books, W.H.Freeman and Company.
- 9) Genes VI by Lewin,1997,Oxford University Press.

Department of Genetics and Genomics
Semester-II
GGO7: GENETIC ENGINEERING

Unit – I

Introduction to Genetic engineering; **Tools for genetic engineering:** Enzymes - Restriction endonucleases, polymerases, reverse transcriptase, ligase, kinases, nucleotidyl transferases, alkaline phosphatase; Oligonucleotides- primers, linkers and adaptors; Vectors for cloning- types, plasmid and phage vectors, cosmids, phagemids, BAC, YAC and other advanced vectors.

Unit – II

PCR for gene amplification and detection: PCR principles, factors affecting PCR, different types of PCR (RT-PCR, IC-RT-PCR, nested PCR, Multiplex PCR and real time PCR) and their applications, **Probes:** Oligonucleotide, DNA and RNA probes, methods for radioactive and non radioactive labeling; **Strategies for molecular cloning:** Choice of vector for cloning, preparation of DNA molecules for cloning, ligation, transformation into bacterial cells, screening and identification of positive clones.

Unit-III

Libraries: Construction and screening of cDNA and genomic DNA libraries; **DNA sequencing-** Chemical method of Maxam and Gilbert, Sanger's dideoxy chain termination and automated sequencing; **Protein sequencing-** Protein sequencing by Edman degradation method. **Site-directed mutagenesis:** Oligonucleotide directed mutagenesis, site-directed mutagenesis by means of the PCR and importance of site-directed mutagenesis;

Unit – IV

Gene expression: Construction of vectors for expression- choice of promoter, ribosome binding sites, transcription terminator, fusion protein tags, purification tags, protease cleavage sites and reporter genes; Over expression of heterologous protein in bacterial, yeast, insect and mammalian systems; purification and detection and analysis of recombinant protein. Applications of genetic engineering.

Recommended books:

- 1) Principles of Gene Manipulation and genomics: An Introduction to genetic engineering. 2007, by Primrose and Twyman
- 2) Fundamental Molecular Biology.2007, by Lizabeth A.Allison. Blackwell publishing.
- 3) Molecular Biology of the gene by Watson et al.,5th Edition,2004,Addison Wesley Longman.
- 4) The foundations of Biochemistry by Lehninger,4th Edition
- 5) Principles of Genetics by Snustad,Simmons, 4th Edition,2006
- 6) Instant notes in Molecular Biology by P.C.Turner et al.Viva Books Pvt.Ltd.
- 7) Advanced Molecular Biology by A Concise reference.1998, by R.M.Twyman. Viva Book Pvt.Ltd.
- 8) Molecular Biology by David Fdreifelder,1995 Narosa Publ.House.
- 9) Molecular Cell Biology by Lodish et al., 2003, Scientific American books, W.H.Freeman and Company.
- 10) Genes VI by Lewin,1997,Oxford University Press.

Department of Genetics and Genomics
Semester-II
GG08: ENERGY METABOLISM

Unit I

Bioenergetics: Thermodynamic principles – Chemical equilibria; free energy, enthalpy (H), entropy (S). Free energy change in biological transformations in living systems; High energy compounds. Phosphoryl group transfer and calculation of phosphorylation potential. oxidation-reduction reactions. Electron transfer reactions in mitochondria. ATP synthesis and regulation of ATP producing pathways. Regulation of oxidative phosphorylation. Utilization of oxygen by oxygenases, Superoxide dismutase and catalase.

Unit II

Broad outlines of metabolism. Metabolism of carbohydrates: Glycolysis: Preparative and payoff phases of Glycolysis, Regulation of glycolysis, Fermentation: the anaerobic fate of pyruvate, Metabolism of hexoses other than glucose: fructose, galactose and mannose, Citric acid cycle: pyruvate dehydrogenase complex, metabolic sources of acetyl CoA, Reactions and regulation of citric acid cycle, Amphibolic nature of citric acid cycle.

Unit III

Uronic acid pathway, metabolism of amino sugars, glycogen metabolism: glycogen synthesis and break down, Regulation of glycogen synthesis and breakdown. Other pathways of carbohydrate metabolism: Gluconeogenesis and maintenance of blood glucose levels, glyoxylate cycle. Pentose phosphate pathway of glucose oxidation, Disorders of carbohydrate metabolism – Glycogen, galactose, Fructose.

Unit IV

Overview of amino acid catabolism, Biosynthesis and degradation of fatty acids (Saturated and unsaturated), energy yield and regulation, Biosynthesis of triacyl glycerols, and membrane phospholipids. Biosynthesis and degradation of cholesterol and its regulation. Metabolism of lipoproteins and Ketone bodies.

Recommended Books:

1. Principles of Biochemistry, White. A, Handler, P and Smith.
2. Biochemistry, Lehninger A.L.
3. Biochemistry, David E. Metzler.
4. Biochemistry, Lubert Stryer.
5. Review of physiological chemistry, Harold A. Harper.
6. Text of Biochemistry, West and Todd.
7. Outlines of Biochemistry, Conn and Stummf.
8. Metabolic pathways – Greenberg.
9. Biochemistry, 2 nd Edition, G. Zubay.

Department of Genetics and Genomics

Semester-II

PRACTICAL PAPER-I: MICROBIAL GENETICS AND MOLECULAR BIOLOGY

1. Bacterial growth curve
2. Isolation of mutants by gradient plate technique
3. Isolation of mutants by replica plate technique
4. UV survival curve
5. Isolation of mutations in bacteria by physical agents
6. Isolation of mutations in bacteria by chemical agents
7. Bacterial conjugation
8. Bacterial transformation
9. Setting of molecular biology laboratory Creating of ribonuclease free environment in the laboratory.
10. Determination of DNA and RNA by UV-spectrophotometry and DPA methods
11. Isolation of total DNA from *E.coli* cells.
12. Plant leaf tissue
13. Isolation of total RNA from plant leaf tissue
14. Isolation of plasmid DNA from *E.coli* cells.
15. Agarose gel electrophoresis analysis of nucleic acids
16. Quantification of nucleic acids by U.V.spectrophotometer

Department of Genetics and Genomics

Semester-II

PRACTICAL PAPER-II: GENETIC ENGINEERING AND ENERGY METABOLISM

1. Preparation of *E.coli* competent cells for transformation
2. Transformation of Plasmid DNA into competent cells
3. Screening and confirmation of recombinant clone
4. Restriction digestion of plasmid DNA
5. Ligation of inset with Plasmid DNA
6. Polymerase chain reaction (PCR)
7. Over-expression of recombinant proteins in *E. coli* system
8. Purification and confirmation of recombinant proteins
9. Southern blotting (Capillary and diffusion methods)
10. Determination of type of nucleic acid by nucleases
11. Restriction fragment length polymorphism (RFLP)
12. Solving the black board problems related to genetic engineering
13. Isolation and estimation of glycogen/starch
14. Over-expression of recombinant proteins in *E. coli* system
15. Purification and confirmation of recombinant proteins
16. Assay and enzyme kinetics of lactate dehydrogenase (isoenzyme) from serum.

Department of Genetics and Genomics
Semester-II
Non Core 1: Basics in Genetics

UNIT I

An over view on biological organization (eg.human); Introduction, role and functions of different cell components- carbohydrates, lipids, proteins, and nucleic acids generalized structure of DNA and RNA, types and role of RNA molecules; DNA as genetic material; Introduction to enzymes and hormones.

UNIT II

Structure and functions of cells: Bacterial cell – cell wall, membrane, cytoplasm, arrangement of DNA; Plant and animal cells- variation, cell membrane, cell wall, endoplasmic reticulum, golgi complex, mitochondria, plastids, nucleus.

UNIT III

Chromosome- generalized classification, structure and organization of eukaryotic chromosome; chromosome number, euchromatin, heterochromatin, telomere, centromere, homologous and non-homologous chromosomes; Cell cycle and its importance, Mitosis – prophase, metaphase, anaphase, telophase, and cytokinesis; Meiosis-generalized mechanism; diploid (body cells), haploid (sperm and egg) and stem cells.

UNIT IV

Mile stones in genetics, Inheritance and its importance, terminology: genotype, phenotype, self-fertilization, cross-fertilization, true-breeding strain, P,F1 and F2 generations, monohybrid crosses, reciprocal crosses, allele, Mendelian experiments of inheritance-, principles of dominance, segregation and independent assortment; a generalized over view of non-mendelian inheritance.

Recommended books

1. Principles of Genetics 2006; Snustad Simmons
2. Introduction to Genomics 2012; Arthur M.Lesk
3. iGenetics 2006; Peter J.Russell

Department of Genetics and Genomics
Semester-III
GG09: Structural Genomics

UNIT I

Introduction to Genomics: Definitions, Classification based on system attributes, relationships to other scientific disciplines and types of organisms studied, Historical Perspective of Genomics, Genome sizes, Organization of genome of viruses, prokaryotes, eukaryotes, telomers, tandemly repeated sequences, DNA transposons, retro transposans, organelle DNA.

Mapping in prokaryotes: Transformation method, Transduction method, Conjugation method.

UNIT II

Genetic linkage mapping: DNA markers:-RFLP, AFLP, RAPD, SSRs, SNPs, CAPS, SCAR markers; Construction of the genetic linkage maps:- human, plants, Map based cloning- Mutant Mapping, LOD score, MAPMAKER.

Quantitative genetics: Two locus control, Three locus control, Study of polygenic traits, Effect of environment on QTLs, heritability and description of continuous variation of wheat kernel color and human skin color, Cloning QTLs.

Physical mapping: Cytogenetic maps of chromosomal banding, STS, FISH, restriction maps, radiation hybrid mapping (RH), clone contig maps.

UNIT III

Whole genome sequencing: DNA sequencing strategies, clone-by-clone approach, whole genome shotgun sequencing, assembly and finishing genome sequencing, Human genome project.

Sequence databases: Nucleotide sequence databases, protein sequence databases, protein structural databases, literature databases; Genomic databases- UCSC, NCBI Map viewer, ENSEMBL; data files and formats.

UNIT IV

Predictive methods using DNA sequences: Gene prediction methods and programs, promoter characterization and prediction, strategies and considerations.

Sequence comparison : Sequence alignment- pair wise sequence alignment, multiple sequence alignment and their importance.

Phylogenetic analysis: Background terminology and basics, tree construction and importance, common software

Protein structure prediction: How protein structures are determined, Secondary structure prediction; Visualizing proteins; Three dimensional structure of protein-Homology modeling, threading or Ab initio method, protein structure evaluation and protein structure comparison

Reference books:

1. Genetics-A molecular approach by peter J.Russel (2006), 2nd ed.
2. Genomes3 by T.A.Brown (2007)
3. Principles of Gene manipulation & Genomics by S.B.Primrose&R.M.Twyman, 7thed, (2007)
4. Microbial functional genomics by Jizhgahov, Dorothea K.Thompson Ying xu, James M.Tiedje
5. Bioinformatics-Apractical guide to the analysis of Genes and proteins, by Andreas D.Baxevanis, B.F.Francis Ouellette, 3rd.
6. Bioinformatics-Tools and applications by David Edwards, Jason strajich and David Hansen (2009)

Department of Genetics and Genomics
Semester-III
GG10: Advanced Biotechnology

Unit I

Definition, scope and importance of Biotechnology

Plant tissue culture-Basic structure and growth of plant, terms used in tissue culture, plasticity and totipotency; Culture types-Callus, Cell-suspension cultures, Protoplasts, Root cultures, Shoot tip and meristem culture, Embryo culture, Microspore culture; Plant regeneration-somatic embryogenesis and organogenesis. **Animal tissue culture**-History and development of animal tissue culture, conditions and media for animal cell culture, cultured cell biology and its characterization, primary cell culture, cell lines, subculture, stem cell cultures, scale up of animal cell subculture: scale up in suspension and monolayer. Applications of plant and animal cell cultures

Unit II

Gene transfer methods: Physical methods-Electroporation, microinjection and particle bombardment; chemical methods-Liposomes, receptor mediated gene transfer; Biological methods- Viral vectors, bacteria (Ti plasmid of *Agrobacterium tumefaciens*). **Transgenic plants:** resistant plants for insects-increasing production of the *B.turingensis* prototoxin; viruses-Non-pathogenic and pathogenic derived resistance and herbicides. **Transgenic animals:** production of transgenic mice and its applications in medicine, cloning livestock by nuclear transfer (sheep-Dolly), transgenic bird and fish

Unit III

Vaccines: Designing vaccines for active immunization, classification of common vaccines for humans, production of subunit (recombinant protein antigens), DNA and recombinant vector vaccines. **Monoclonal antibodies:** production and applications; **Gene therapy-** Ex vivo and In vivo gene therapy methods; Determining eukaryotic gene function by gene elimination, in vitro mutagenesis, knockout mice, RNA interference.

Unit IV

Nanobiotechnology: Introduction to nanoparticles and their uses, nanoparticles for labeling, delivery of drugs and DNA or RNA; Visualization- principles of scanning tunneling microscope (STM), and Atomic force microscope (AFM), virus detection via AFM ; Applications- nanoparticles in cancer therapy, assembly of nanocrystals by microorganisms, nanotubes, antibacterial nano carpets, detection of viruses by nanowires, ion channel nanosensors, nano engineering of DNA, DNA mechanical nanodevices, controlled denaturation of DNA by gold nano particles, controlled change of protein shape by DNA, biomolecular motors. **Bioethics in Biotechnology:** Novel bioethical issues in modern technology, possible dangers to individuals, society or nature.

Reference books:

- 1) Biotechnology-applying the genetic revolution by David P.Clark& Nanette J.Pazdernik, (2009)Accademic press Elsevier
- 2) Principles of Gene Manipulation and genomics: An Introduction to genetic engineering . 2007, by Primrose and Twyman
- 3) Fundamental Molecular Biology.2007, by LizabethA.Allison. Blackwell publishing.
- 4) Principles of Genetics by Snustad,Simmons, 4th Edition,2006
- 5)iGeneticsA *molecular approach* by Peter J.Russell.2nd Ed.2006.
- 6) Culture of Animal Cells: A Manual of Basic Technique and Specialized by R. Ian Freshney (2005)
- 7) Plant tussue culture: Theory and practice a revised edition by S.S.Bhojwani, M.K.Razdan (1996) Elsevier
- 8) Plant tissue culture:techniques and experiments by Roberta H.Smith (2000)9) Introduction to plant tissue culture by M.K.Razdan (2003)

Department of Genetics and Genomics
Semester-III
GG11: Immunology and Immunogenetics

Unit I

Basic concepts in Immunology

Types of immunity - innate and acquired. Cells of the immune system - B cells, T cells, NK cells, phagocytes, inflammatory cells, antigen presenting cells, organs of immune system - primary, secondary and tertiary lymphoid organs. Immunohematology: blood groups, blood transfusion and Rh- incompatibility.

Unit II

Antigens and Antibodies

Antigens - nature, types, factors influencing antigenicity, haptens, adjuvants and superantigens. Antibodies - structure, types, classes and functions. Antigen – antibody interactions: Flocculation, Precipitation, immunodiffusion, Agglutination, Phagocytosis, Opsonization, complement fixation, Neutralization

Unit III

Immune Response

Humeral and cell mediated immune response. Recognition of antigen: MHC - Types, Antigen processing and presentation, activation and differentiation of B cells and T cells. Effector mechanisms: Cytokines, CTL, NK cell mechanism of cytolysis and ADCC. Complement activation pathways: Classical, alternate and lectin pathway. Hypersensitivity, Regulation of immune response.

Unit IV

Immunogenetics

Organization and rearrangement of BCR and TCR genes. Inherited and acquired immunodeficiency diseases: Recessive gene defects, X- xlinkedlymphoproliferativesyndrom, SCID, Type 1 diabetes mellitus, mutiple sclerosis, Inflammatory bowl disease, Rheumatoid arthritis, Chronic lymphocytic leukemia, haemophilia, sickle cell anaemia, erythroblastosisfetalis, AIDS.

Reference books:

1. Essentials of Immunology - Ian Roitt - Blackwell Scinentific Publications
2. Fundamentals of immunology - William C. Boyed (Wiley Toppan).
3. Introduction to Immunology - John W. Kinball.
4. Fundamentals of Immunology - Otto S. View and others.
5. Immunology - D.M. Wier.
5. Immunology - Jains Kubay, (2001) Second Edition, W H Frecman& Com. New York.
7. Cellular and Molecular Immunology 3rd ed. Abul K. Abbas Andrew K. Lichtman Jordan S. Pober
8. Immunebiology: The immune system in health and disease. Charles A Janeway and others.

Department of Genetics and Genomics
Semester-III
GG12: Biostats and Computers

UNIT-I

Population, sample, variables, classification and Tabulation of data, Diagrams & graphs, frequency distribution, skewness, kurtosis, central tendency, Average, mean, median, mode, Dispersion, Measures of dispersion, Standard deviation, coefficient of Poisson, Normal distribution, standard error.

UNIT-II

Hypothesis testing, Null hypothesis, Type-I & Type-II errors, level of significance, Decision about Null hypothesis (H₀), Students 't' test-applications, chi-square test, Application Analysis of Variance (ANOVA)- F test- Applications Correlation, Types-Applications, Regression-Applications.

UNIT – III

A). Introduction to windows 2000: Desktop files and folders; simple operations like creation, deletion, moving, copying files or folders using window explorer. Searching files and folders and other simple operations. **Word processing:** creating, saving and opening documents. Typing, navigating, selecting, editing and sorting, checking spelling and grammar formatting – changing appearance of page – importing graphics, working with tables, documents printing.

B). Excel Basics: Touring the Excel Program Window, Touring the Workbook Window, Entering and editing Data in cells, Excel Formulas and Functions, Entering a formula in to a Worksheet Cell, Using the Chart wizard, Understanding Data Series and Data Categories, Picking a chart type, Adding and editing Titles, Legends and Data labels.

UNIT – IV

A). Basics of power point: Creating a power point presentation, Entering and formatting the text on slides, Creating a table slide, Ways of viewing and working on slides, Inserting, deleting, rearranging and copying slides.

B). Internet Basics: Introduction, Evolution of Internet, Basic Internet Terms, Getting Connected to Internet, Internet Applications. Electronic Mail: An Introduction, How E-Mail Works, Searching the Web (Search Engines), Language of Internet, Internet and Viruses.

Reference books:

1. The Complete Reference Office 2000: Stephen L.Nelson: TATA McGRAW-HILL EDITION 2002.ISBN 0-07-463768-1.
2. Introduction to computer science: ITL Education Solutions Ltd.ISBN 978-81-317-0436-3
3. Peter Norton's Introduction to computers: II edition Tata MC Graw Hill Publication

Department of Genetics and Genomics
Semester-III
Practical I: Structural Genomics and Advanced Biotechnology

1. Nucleotide and amino acid sequence based practical's using online public databases and offline bioinformatics software tools
2. Mega 5
3. Bio edit
4. Primer designing
5. Compute based protein structure prediction experiments
6. DNA sequence based Phylogenetic tree construction and analysis
7. Protein sequence based Phylogenetic tree construction and analysis
8. Mapmaker
9. RFLP
10. QTL Cartographer
11. Preparation of media and sterilization of glassware for animal cell culture
12. Primary culture Preparation of Chick embryo cells for
13. Preparation of Sheep kidney cells for primary culture
14. Trypsinization of the cells
15. Counting and checking the viability of the cells
16. Subculture of the primary cells
17. Viability checking of embrocated chick egg
18. Inoculation of virus into embrocated chick egg
19. Preparation of media and sterilization of glassware for plant tissue culture
20. Anthere culture
21. Shoot tip culture
22. Leaf culture

Department of Genetics and Genomics
Semester-III
Practical paper II Immunology & immune genetics and Biostats& computers

1. Separation of serum and plasma from whole blood.
2. Separation of immunoglobulins
3. Trypan blue exclusion test of Lymphocyte viability
4. Isolation of peripheral blood lymphocytes by Ficoll- Hypaque gradient.
5. Different routes of immunization (Rat/Rabbit)
6. Production and purification of polyclonal antibodies from immunized Rabbit.
7. Dissection and identification of thymus, spleen and lymph nodes.
8. Cell counting by Hemocytometer (WBC and RBC).
9. Differential count for Laucocytes.
10. Quantitative precipitation test:
 - A) Redial immunodiffusion.
 - B) Ouchterloney double diffusion.
11. Immunoelectrophoresis
12. VDRL test for syphilis, Widal test for typhoid
13. Determination of A,B,O and Rh grouping & Rh typing by Agglutination.
14. HBs Ag test
15. HCG test
16. Enzyme Linked Immunosorbent Assay (ELISA) / Tridot test.
17. Frequency tables and ban diagrams
18. Normal distribution Z-test
19. Calculation of standard deviation,
20. χ^2 test calculation
21. Student t-test for measuring significance between sample and population test
22. Correlation between two parameters
23. Prepare a resume in MS-word
24. Prepare a visiting card in MS-word
25. Create a chart for students marks in excel
26. Prepare a presentation using MS-power point

Department of Genetics and Genomics
Semester-III
Non Core 2: Inherited diseases in Humans

UNIT I

Reasons for genetic disorders, syndromes: Chromosome mutations - Chromosome rearrangement-duplication, deletions, inversion and translocation; aneuploidy and polyploidy; Gene mutations- Base substitution, base insertion and base deletion, transposable elements in humans (SINEs and LINEs).

UNIT II

Genetic basis of syndromes and disorders: Introduction, Monogenic disorders- Cystic fibrosis, Huntington's disease, Hemophilia, Neurofibromatosis, sickle cell disease and thalassemias; chromosome disorders- cri-du-chat syndrome, Down syndrome; Inborn errors of metabolism- Albinism, Alkaptonuria, cystinuria and pentosuria; DNA repair defects- Xerodermpigmentosum; and multifactorial disorders – diabetes, coronary artery disease and congenital malformation.

UNIT III

Cancer genetics: Definition, types, relationship of the cell cycle to cancer, cancer and programmed cell death, genetic basis for cancer, oncogenes, tumor suppressor genes, role of environmental factors in cancer and genetic pathways to cancer. An overview of epigenetic modifications for cancer

UNIT IV

Diagnosis, Genetic counseling and treatment: Prenatal diagnosis- Ultrasonography and fetal echocardiography, Maternal serum screening, Amniocentesis and chorionic villus sampling; Genetic testing for common mutations - protein truncation test, Single stranded conformation polymorphism test and full resequencing of the gene. Genetic counseling- introduction, psychotherapeutic counseling, genetic susceptibility and treatment of genetic diseases.

Reference books:

1. Principles of Genetics 2007: Gardner, Simmons, Snustad; Wiley India Edition
2. Human Genetics 2010: Gardner and Davies;
3. Elements of Medical Genetics, Emery's.

Department of Genetics and Genomics
Semester-IV
GG13: Functional Genomics

Unit I

Functional genomics: Concepts and applications, Forward genetics and Reverse genetics approaches, Loss of function, Gain of function.

Mutagenesis as Functional Genomics Tool: T-DNA insertional mutagenesis, Transposon-based mutagenesis (*Ac/Ds* and *En/Spm*), Activation tagging, Enhancer trapping, GAL4 mediated over expression, Floxing, Viral mediated transfection.

Genome wide mutation screening: TILLING (Targeted Induced Local Lesion IN Genome) - principle and experimental approach, ECO-TILLING; **DEALING** (Detecting Adducts Local Lesion IN Genome) - principle, experimental approach; Site directed Mutagenesis.

Unit II

DNA Microarray Technology: Introduction, Types of Microarrays and Advantages, Experimental design- Concepts, principles, Probe design, target preparation, Hybridization and Detection, Specificity, sensitivity, reproducibility, and Data Analysis; **RNA silencing:** Antisense RNA technology, RNAi and Si RNA; **SAGE for transcript profiling-** principle, methodology, problems associated with SAGE, modifications (Micro-SAGE, Long-SAGE, Super-SAGE) and applications, SADE; Molecular analysis of gene expression (RT-PCR).

Unit III

Functional proteomics: Gene functions through protein interactions: Identification of Protein–Ligand Interactions. **Yeast Two-Hybrid Selection System:** Analysis of genome-wide protein–protein interactions in organisms, Use of M13, T7 Phage to Detect Protein–Ligand Interactions, Combining yeast two-hybrid and phage display data, Detecting Interactions with Protein Fragment Complementation Assays.

Mass Spectrometry for Protein–Protein Interaction Mapping: Overview, Identification of substrates for *E. coli* GroEL; **Functional protein microarrays:** process overview, principle, limitations; peptidomics; Microarray for protein-carbohydrate interaction (phage display technology).

Unit IV

Genomics of Pathogens: Chipping Away at HIV Pathogenesis: Genechip technology; Ribozymes as Gene Therapeutic Agents for HIV/AIDS; Genomics of the *Mycobacterium tuberculosis* complex: strain-to–strain variability with *M.tuberculosis* spp., genomic analysis of *M.bovis* BCG vaccines;

Patho Genomics-applications and new diagnostics: Molecular Microbiological Diagnostic Methods in the Diagnosis of Infectious Diseases; Alternative approaches in antibacterial drug discovery: Targeting the resistance mechanism, extremely narrow-spectrum drugs, phage therapies. Reverse vaccinology: MenB vaccine approach by reverse vaccinology.

References:

1. Protein Microarrays, edited by Mark schena, Jones and Bartlet pblisher, 2005.
2. Microbial Functional Genomics, Jizhong Zhou, Dorothea K. Thompson, Ying Xu, James M. Tiedje, A John Wiley & Sons, Inc., Publication, 2004.
3. Microarrays for an Integratiul J. But. Kho and Atte, Published in India by Ane Books, 2003.
4. Gene Cloning and DNA analysis An Introduction, Sixth Edition, T. A. Brown, Wiley-Blackwell publications, A John Wiley & Sons, Inc., Publication, 2010.
5. Pathogen Genomics: Impact on Human Health, edited by Karen Joy Shaw, PhD, 2002
6. Genome Analysis of Pathogenic Microbes Edited by J Hacker and Ulrich Dobrindt 2006
7. Encyclopedia of genetics, genomics, proteomics and bioinformatics by Lynn B.Jorde et al.,

Department of Genetics and Genomics
Semester-IV
GG14: EPIGENOMICS

UNIT-I

Introduction, DNA methylation-De Novo methylation, Maintenance methylation and DNA methylation and transcriptional silencing; DNA methylation in prokaryotes and eukaryotes; Histone modifications and Histone code- Acetylation, Methylation, Phosphorylation, Ubiquitinylation and ADP-Ribosylation and Sumoylation; Non-coding RNA (ncRNA)-MicroRNA biogenesis and function, Small interfering RNA biogenesis and function and Epigenetic regulation by ncRNA.

UNIT-II

Epigenetic regulation of gene and genome expression- Heterochromatin spreading and position effect variegation, Transvection, Paramutation, Imprinting and X-chromosome inactivation; Epigenomics in Cancer- Epigenetic features of a normal cell, DNA Hypomethylation in tumours, inactivation of tumor suppressor genes, Histone modifications of cancer cells, Epigenetic factors and miRNA epigenetics in cancer management, epigenetic therapy of cancer;

UNIT III

Epigenetics and its genetic syndromes : Introduction, Chromatin remodeling- X-Linked Thalassemia Mental Retardation syndrome, CHARGE syndrome, Cockayne syndrome (CSB), ICF syndrome, Rett syndrome, CLS syndrome and FSHD.

Epigenetics and Immunity: Introduction, Epigenetics in immune differentiation and the immune response, Epigenetics in Autoimmunity, Epigenetic changes in other Autoimmune disorders

UNIT IV

Analysis of gene-specific DNA methylation : Introduction, principles of DNA methylation analysis, characteristics of individual techniques-Southern blot hybridization, Bisulfite sequencing, Combined Bisulfite restriction analysis (COBRA), Methylation-specific PCR (MSP), Real-Time MSP, pyrosequencing and MethyLight.

Methods for Assessing genome-wide DNA methylation : Introduction, Restriction Landmark genomic scanning (RLGS), Methylation sensitive restriction finger printing (MSRF), Methylated CpG island amplification coupled microarray (MCAM)

Reference Books:

1. Epigenomics by Anne C.Ferguson Smith (2009)
2. Epigenetics and diseases by Susan M.Gasser, En Li (2011)
3. Epigenetics in Biology and Medicine by Nanel Esteller (2009)
4. Handbook of Epigenetics-The new molecular and medical genetics by Trygve Tollefsbol (2011)
5. Epigenetics in Cancer-The new England journal of medicine by Manel Esteller (2008)
6. Advanced Molecular Biology by Twyman (1999)

Department of Genetics and Genomics
Semester-IV
GG15: INTERGRATED GENETIC ANALYSIS

UNIT-I

Developmental Genetics : Development through cell determination-cloning experiments on plants and animals; Genetic control of development in Drosophila- Development of fruit fly, egg-polarity genes, determination of the dorsal-ventral axis, determination of the anterior-posterior axis; Segmentation of genes, Homeotic genes in Drosophila, home box genes in other organisms; Connecting concepts : Gene control the development of flowers in plants- flower anatomy, genetic control of flower development; Programmed cell death-Apoptosis, regulation of apoptosis, apoptosis in development, apoptosis in disease.

UNIT-II

Quantitative genetics : Quantitative characteristics-variability, relation between genotype and phenotype, types of quantitative characteristics, phenotypic inheritance, determining gene number for a polygenic characteristic ; Heritability- phenotypic variance, Types of heritability, calculating heritability, limitations of heritability; Locating genes that affect quantitative characteristics- Mapping QTL, Genome wide association studies.

UNIT-III

Population genetics : Fundamental concepts, genetic structure of populations- Genotype frequencies, Allele frequencies; The Hardy-Weinberg Law- Assumption, prediction, deviation and extensions; Genetic variation- in space and time, in natural populations; Forces that changes gene frequencies in population- Mutation, genetic drift, migration; Hardy-Weinberg and natural selection.

UNIT-IV

Evolutionary genetics : Organism evolve through genetic change, Natural populations, Genetic variation- Molecular variation, protein variation, DNA sequence variation; New species through evolution of reproductive isolation- the biological species concept, reproductive isolating mechanisms, modes of speciation, genetic differentiation associated with speciation; Evolutionary history by homologous characteristics- The alignment of homologous sequences, construction of phylogenetic trees; Molecular evolution : Genome evolution- early RNA world, the first DNA genome, peptide nucleic acid; Acquisition of new genes by duplication and from other species; Noncoding DNA and genome evolution- transposable elements and genome evolution, the origin of introns; evolutionary history of human genome.

Reference books:

1. *Genetics A conceptual approach* by Benjamin A. Pierce (2010)
2. *Genetics Analysis and principles* by Robert J. Brooker (2009)
3. *Genomes 3* by T.A. Brown (2007)
4. *iGenetics A molecular approach*, second ed. By Peter J. Russell (2006)