UNIT I

2. DNA Replication: General features of Chromosomal Replication; DNA Replication Machinery in Prokaryotes and its comparison with Eukaryotes
3. Enzymology of DNA Replication: DNA Polymerases; Primases; Ligases; Helicases; Topoisomerases; Gyrases and Single Stranded Binding Proteins
4. Regulation of DNA Replication

UNIT II

1. Transcription in Prokaryotes: Initiation, elongation and termination
2. Structure and functions of prokaryotic promoter
3. Control of transcriptional initiation in prokaryotes: Structure and functions of RNA Polymerase; Sigma factors – Types and functions
4. Control of transcriptional termination in prokaryotes: Intrinsic termination and Rho factor dependent termination; attenuation and antitermination

UNIT III

1. Regulation of Gene Expression in Prokaryotes: Operon concept, induction and repression, Structure and regulation of lactose, arabinose and tryptophan operons
2. Initiation of Transcription in Eukaryotes: RNA Polymerases – Types and properties; Promoter – Types, structure and properties
3. Transcription factors – Types and properties; Enhancers – Structure and properties; Response Elements
4. Post-transcriptional Modification Eukaryotes – 5’ and 3’ modification of mRNA

UNIT IV

1. Post-transcriptional Processing of pre mRNA, pre rRNA and pre tRNA transcripts
2. Genetic Code: Evidence and properties; Wobble hypothesis; Translational adaptors and amino acyl tRNA synthetases
3. Translation: Successive stages of protein synthesis in prokaryotes and its comparison with eukaryotes
4. Post-translational Modification: Types and Significance

UNIT V

1. Regulation of Gene Expression in Eukaryotes: cis-acting DNA Elements; Chromatin organization and regulation of gene expression; Regulation at the level of processing of transcripts
2. Regulation of Gene Expression in Eukaryotes: RNA Editing; Gene Alteration; DNA methylation and gene regulation; Regulation of gene expression by hormones; Regulation of gene expression at translational level
3. Transposable elements in Prokaryotes and Eukaryotes: Types and significance
4. Oncogenes and Tumor Suppressor Genes: Properties and significance
Practical Exercises

1. Isolation of genomic DNA and restriction digestion
2. Size fractionation of restricted DNA fragments by Agarose Gel Electrophoresis
3. Quantitation of DNA
4. Determination of Amax of purified DNA fragments
5. Determination of Tm of nucleic acid
6. Isolation of RNA
7. Fractionation of poly (A)+ RNA
8. In vitro transcription
9. In vitro translation
10. Metabolic labeling of proteins and immunoprecipitation
11. Protein-DNA interaction

Reference Books

1. Genes VIII, by Benjamin Lewin
2. Molecular Biology, by Turner et al
3. Cell and Molecular Biology: Concepts and Experiments, by Gerald Karp
4. Transcriptional Regulation in Eukaryotes, by Carey and Smale
5. Translational control of gene Expression, by Sonenberg et al
6. Chromatin and Gene Regulation, by Turner
7. An Introduction to Genetic Analysis, by Griffiths et al
8. Genome, by Brown
9. Concepts of Genetics, by Klug and Cummings
10. Proteins, by Creighton
11. Molecular Cell Biology, by Lodhish et al
12. Biochemistry and Molecular Biology of Plants, by Buchanan
13. Plant Biochemistry and Molecular Biology, by Lea and Leegood
14. Plant Biochemistry, by Dey and Harborne

Note: All text books are of latest editions.
UNIT I

1. Immune response: Innate immune mechanisms and characteristics of adaptive immune response, Hematopoiesis
4. Inflammation; its mediators and the process, Cell adhesion molecules and their role in inflammation, lymphocyte homing, tissue injury and immune response leading to an inflammatory reaction, role of anaphylatoxins, granulocytes in inflammatory process

UNIT II

1. Major histocompatibility systems: Structure of MHC I and II molecules, polymorphism, distribution variation and function. Organization of MHC complex in Mouse and Humans. Association of MHC with disease
2. Recognition of antigens by T and B Cells: Antigen processing, Role of MHC molecules in antigen presentation and Costimulatory signals
3. T-cell receptor complex, T-cell accessory membrane molecules, activation of T cells, Organization and arrangement of T-receptor genes
4. B-cell receptor complex, Activation of B-cells, Immunoglobulins: Molecular structure, types and functions. Antigenic determinants on immunoglobulins

UNIT III

1. Molecular mechanism of antibody diversity: Organization of genes coding for constant and variable regions of heavy chains and light chains. Mechanisms of antibody diversity, Class switching
2. Antibody engineering, Antigen-Antibody interaction, avidity & affinity measurement
3. Monoclonal antibodies: Production, characterization and applications in diagnosis, therapy and basic research
4. Complement system, components, activation pathways, and regulation of activation pathways, Complement deficiencies, Role of complement system in immune responses

UNIT IV

1. Cytokines: Structure and functions, cytokine receptors, signal transduction mediated by cytokine receptors, cytokine regulation of immune responses, cytokine related diseases and therapeutic applications of cytokines
2. Cytotoxic T cells and their mechanism of action, NK cells and mechanism of target cell destruction. Antibody dependent cell mediated cytotoxicity, Delayed type hypersensitivity. Techniques of Cell mediated immunity
3. Immunoregulation mediated by antigens, antibodies, immune complexes, MHC and cytokines
4. Hypersensitivity: Definition, IgE mediated hypersensitivity, mechanism of mast cell degranulation, mediators of type-I reactions and consequences. Type II reactions, Immune complex mediated hypersensitivity and Delayed type hypersensitivity
UNIT V

1. Autoimmunity: Organ specific diseases, Systemic diseases, Mechanisms of autoimmunity and therapeutic approaches
2. Immunodeficiency syndromes: Primary immunodeficiencies and Secondary immunodeficiencies and their diagnosis and therapeutic approaches
3. Vaccines: Active and passive immunization, Whole organism vaccines, Macromolecules as vaccines, Recombinant-vector vaccines, DNA Vaccines, Synthetic peptide vaccines and sub-unit vaccines
4. Immunodiagnostics: Precipitation techniques, Agglutination, Fluorescence techniques, ELISA, RIA, Western blotting and Immuno-histochemical techniques

Practical Exercises

1. Blood Film preparation and identification of cells.
2. Lymphoid organs and their microscopic organization.
3. Immunization and production of polyclonal antibodies
4. Double diffusion and Immuno-electrophoresis.
5. Radial Immunodiffusion.
6. Purification of IgG from serum.
7. Separation of mononuclear cells by Ficoll-Hypaque.
8. Con-A induced proliferation of thymocytes (by MTT method).
9. Western blotting.
10. ELISA
11. Preparation of antibody-enzyme conjugates

Reference Books

1. Kubey, Immunology, R.A. Goldsby, Thomas J. Kindt, Barbara, A. Osbarne. (Freeman).
2. Immunology- A short Course, -Eli Benjamini, Richard Coico, Geoffrey Sunshine.
3. Immunology by Tizzard
5. Immunology by Roitt et al
6. Immunology by Abbas

Note: All text books are of latest editions.
UNIT I

1. Centrifugation: Basic principle, type, instrumentation and applications
2. Photometry: Basic principles of colorimetry, and UV visible spectrophotometry, instrumentation and applications
3. Infra red spectroscopy
4. Fluorimetry: Principle, instrumentation and applications

UNIT II

1. Chromatography: Principle, types, instrumentation and applications
2. Affinity chromatography, HPLC and FPLC
3. Electrophoresis: Principle, types and applications
4. Ioselectricfocussing and isotachophoresis

UNIT III

1. Atomic absorption spectroscopy: Principle, instrumentation and applications
2. Flame emission spectroscopy: Principle, instrumentation and applications
3. Polariometry: Principle, instrumentation and applications
4. ORD and CD

UNIT IV

1. ESR: Principle, instrumentation and applications
2. NMR, GC Mass: Basic principle, instrumentation and applications
3. X ray crystallography: Principle, instrumentation and applications
4. Radio immunoassay: Basic principle and applications

UNIT V

1. Microscopy: Light, phase contrast, interference, fluorescence and polarization microscopy
2. Electron microscopy: Principle and Applications
3. Radioactivity: Principle, Geiger Muller Counter, liquid scintillation counter, solid scintillation counter, gamma counter
4. Autoradiography: Principles, and applications

Practical Exercises

1. Verification of Beer's law
2. Determination of absorption maxima
3. Electrophoresis of Proteins- native and under denaturing conditions.
4. Amino acid and carbohydrate separations by paper & thin layer chromatography
5. Gas chromatography
6. Ion exchange and gel filtration chromatography
7. Separation of blood cells by density gradient centrifugation

Reference Books

1. Physical Biochemistry: Applications to Biochemistry and Molecular Biology by Freifelder
2. Biochemical Techniques: Theory and Practice by Robyt and White
3. Principles of Instrumental Analysis by Skoog and West
4. Analytical Biochemistry by Holme and Peck
5. Biological Spectroscopy by Campbell and Dwek
6. Organic Spectroscopy by Kemp
8. Principles of Instrumental Analysis by Skoog, Hollar and Nicman

Note: All text books are of latest editions.
UNIT I
1. First and second laws of thermodynamics
2. Concept of free energy
3. ATP Cycle, ATP as high energy compound, functions of ATP
4. Other high energy biological compounds

UNIT II
1. Basic Concepts of intermediary metabolism
2. Carbohydrate metabolism: Glycolysis, Kreb’s cycle, glycogenolysis, glycogenesis, pentose phosphate pathway, glyconeogenesis, glyoxalate pathway
3. Regulation of carbohydrate metabolism
4. Inborn errors of carbohydrate metabolism

UNIT III
1. Electron transport and oxidative phosphorylation
2. Biosynthesis and degradation of lipids
3. Regulation of lipid metabolism
4. Inborn errors of lipid metabolism

UNIT IV
1. Nitrogen assimilation
2. Biosynthesis of amino acids
3. Degradation of amino acids
4. Regulation of amino acid metabolism

UNIT V
1. Inborn errors of amino acid metabolism
2. Nucleic acid metabolism
3. Inborn errors of nucleic acid metabolism
4. Integration of metabolism and metabolomics

Practical Exercises
1. To observe the catabolism of carbohydrates by micro-organisms
2. To observe the production of gas by micro-organisms during fermentation
3. To demonstrate the production of pyruvate and acetaldehyde during fermentation of glucose by yeast
4. To demonstrate biological oxidation and electron transport in heart muscle tissue
5. To observe the effect of fasting on the metabolism of rats

205: Lab Course III
Consists of practical exercises listed out under 201 & 202

206: Lab Course IV
Consists of practical exercises listed out under 203 & 204