DEPARTMENT OF BIOCHEMISTRY AND BIOTECHNOLOGY
M.Sc. BIOCHEMISTRY
Choice Based Credit System (CBCS)– 2 year Programme (2018 – 2019)
Revised Scheme of Examinations and Syllabus

Subject Code	Theory & Practical	Credit			Internal Assessment Marks	End Semester Examination Marks	Total Marks
		L	P	C			
SEMESTER-I							
BIO C 101	Biomolecules	4	-	4	25	75	100
BIO C 102	Cell Biology and Genetics	4	-	4	25	75	100
BIO P 103	Practical – I	-	12	3	40	60	100
	Optional-I	4		4	25	75	100
ENG C 116	Soft Skills	4	-	4	25	75	100
Total Credits: 19							
SEMESTER-II							
BIO C 201	Enzymes	4	-	4	25	75	100
BIO C 202	Metabolism and Regulation	4	-	4	25	75	100
BIO C 203	Immunology	4	-	4	25	75	100
BIO C 204	Molecular Biology	4	-	4	25	75	100
BIO P 205	Practical II	-	10	3	40	60	100
BIO P 206	Practical – III	-	10	3	40	60	100
	Optional II	4	-	4	25	75	100
Total Credits: 26							
SEMESTER –III							
BIO C 301	Analytical Techniques	4	-	4	25	75	100
BIO C 302	Molecular Endocrinology and Signaling	4	-	4	25	75	100
BIO C 303	Physiology & Nutritiion	4	-	4	25	75	100
BIO C 304	Biotechnology	4	-	4	25	75	100
BIO P 305	Practical IV	-	12	4	40	60	100
	Optional III (Value Added Course)	4	-	4	25	75	100
Total Credits: 24							
SEMESTER IV							
BIO C 401	Clinical Biochemistry	4	-	4	25	75	100
BIO C 402	Genomics, Proteomics and Bioinformatics	4	-	4	25	75	100
BIO P 403	Practical V	-	12	4	40	60	100
	Optional IV (Value Added Course)	4	-	4	25	75	100
BIOPJ 404	Project	-	-	5	25	75	100
Total Credits:21							

Distribution of Credits
Core Courses and Project:**70 credits**
Soft Skills and Optionals:**20 credits**
Total: 90 credits

Optionals: Any 4 from the following:

1. Chemistry
2. Microbiology
3. Statistical Methods
4. Drug Design and Drug Action
5. Genetic Engineering
6. Yoga
7. Vermiculture & Sericulture
8. Structural Biology
9. Marine Biology
10. Any other course offered by other departments from time to time.

M.Sc. BIOCHEMISTRY (CBCS)

BIO C 101: BIOMOLECULES

Objective: To understand the structure and functions of biomolecules.

Unit-I Proteins I

Amino acids- structure and properties. Orders of protein structure. Primary structure- Determination of amino acid sequence of proteins. The peptide bond: The Ramachandran plot.

Secondary structures- α-helix, β-sheet and β-turns. Pauling and Corey model for fibrous proteins. Collagen triple helix.

Supersecondary structure- helix-loop-helix, hairpin β motif, Greek key motif and β-α-β motif. Structural classification of proteins.

Unit-II Proteins II

Tertiary structure- All α, all β, α/β, α+β domains. Structural motifs- protein family and superfamily.Quaternary structure– protomers, multimers– rotational and helical symmetry.

The structure of haemoglobin. Binding of oxygen to haemoglobin, Hill equation, Bohr effect, changes in conformation on O_2 binding. Role of 2,3-BPG. Models for haemoglobin allostery. Methods for characterization and purification of proteins. Criteria for purity of proteins.

Unit–III Nucleic Acids

DNA double helical structure- Watson and Crick model.A, B and Z forms of DNA. Unusual structures– palindrome, inverted repeats, cruciform and hairpins.Triple and quadruple structures. DNA supercoiling and linking number. Properties of DNA: buoyant density, viscosity, UV absorption, denaturation, the cot curve. Differences between DNA and RNA. Major classes of RNA- mRNA, rRNA, tRNA: structure and biological functions. Minor classes of RNA.

Nucleic acid-binding proteins- HTH, HLH, zinc finger motif, leucine zipper motif.

Unit–IV Glycosaminoglycans and Glycoconjugates

Glycosaminoglycans- structure, location and biological role of hyaluronic acid, chondroitin sulphate, keratin sulfate, heparin sulfate, dermatan sulfate and heparin. Sialic acid- structure and significance.Proteoglycans.

Glycoproteins and their biological importance.Principal sugars in human glycoproteins.Lectins- structure, function, applications.

Major classes of glycoproteins- O-linked, N-linked, GPI linked oligosaccharides. Blood group antigens and bacterial cell wall polysaccharides.

Unit–V Lipids

Fatty acids- saturated, unsaturated and hydroxy fatty acids.Eicosanoids-structure and biological actions of prostaglandins, prostacyclins, thromboxanes, leukotrienes and lipoxins.Phospholipids and glycosphingolipids- structure and biological functions.Steroids- plant and animal sterols.Structure, properties and functions of cholesterol.

Lipoproteins-classification and composition.Amphipathic lipids (membranes, micelles, emulsions and liposomes).

Text Books

1. Nelson and Cox. Lehninger Principles of Biochemistry. Freeman, 7th ed. 2017.
2. Voet and Voet. Fundamentals of Biochemistry. 5th ed. Wiley. 2016.
3. Murray et al. Harper's Illustrated Biochemistry 30th ed. McGraw Hill, 2015.
4. Berg, Tymoczko. Stryer Biochemistry 8th ed. Freeman 2015.

Reference Books

Blackburn et al. Nucleic acids in Chemistry and Biology.Royal SocChem 2006.

BIO C 102: CELL BIOLOGY AND GENETICS

Objective*:* To learn the organization of cells and tissues, cell division, differentiation,cell cycle, and cell death. Students will also learn the principles and applications of plant and animal tissue culture as well as the principles of genetics,

Unit – I Cell and Tissue organization

Molecular organization of prokaryotic and eukaryotic cells. Structure and functions of subcellular organelles. The cytoskeleton-microtubules, microfilaments and intermediate filaments. Types of tissues. Epithelium- organization and types. The basement membrane.Connective tissue.

Major classes of cell junctions- anchoring, tight and gap junctions. Major families of cell adhesion molecules (CAMs)-cadherins, integrins. Brief account of the extracellular matrix.

BIOO6: CLINICAL BIOCHEMISTRY

Objective: This course will enable students to understand the biochemical basis of diseases.

Unit–I

Genetic diseases: Patterns of inheritance. Chromosomal disorders: Brief account of Down syndrome. Monogenic disorders (autosomal dominant, autosomal recessive, sex-linked). Prenatal and neonatal screening for inborn errors. Treatment strategies for inborn errors. Collection of blood and urine samples for analysis: precautions and changes on keeping.

Unit–II

Structure and functions of the liver.Composition and functions of bile. Jaundice: classification, causes and biochemical findings.

Normal and abnormal constituents of urine.Pathogenesis, biochemical findings and management of nephrotic syndrome.

Unit–III

Diabetes mellitus–classification, diagnosis and management. Acute complication–diabetic ketoacidosis. Long-term complications–retinopathy, neuropathy, nephropathy and diabetic foot. Atherosclerosis: Risk factors and management.

Unit–IV

Differences between benign and malignant tumors. Growth characteristics of cancer cells, Morphological changes in tumor cells. Invasion and metastasis. Agents causing cancer–radiation, viruses, chemicals. Oncogenes and tumor suppressor genes (brief account only).

Unit–V

AIDS-Incidence and clinical diagnosis. The HIV genome, HIV life cycle. Brief account of treatment strategies.

Protein Energy Malnutrition: Marasmus and Kwasiorkor: clinical features and biochemical findings. Obesity: Causes, consequences and management (brief account only).

Books Recommended

1. Harper's Biochemistry 30th edition McGraw-Hill (2015)
2. Practical Clinical Biochemistry Varley 6th ed. CBS Publ. (2006)
3. Clinical chemistry in diagnosis and treatment Mayne ELBS. (1994)
4. Clinical Chemistry. Marshall et al.8thed., 2016 Mosby.
5. TietzTextbook of Clinical Chemistry and Molecular Diagnostics–7thed. Saunders (2014)

BIOO5: GENETIC ENGINEERING

Objective: To master the basic principles and applications of genetic engineering.

Unit–I Restriction enzymes and cloning vectors

Basic principles of rDNA technology. Type II Restriction endonucleases-nomenclature and types of cleavage types. Cloning vectors-essential features. Mechanism of cloning in plasmid (pBR322) and phage (λ phage) vectors. Cosmids. Brief introduction to high-capacity cloning vectors.

Unit–II Ligation and rDNA transfer

Ligation of rDNA molecules: cohesive end method, homopolymeric tailing, blunt-end ligation. Linkers and adaptors. Gene transfer methods: calcium phosphate coprecipitation, electroporation, lipofection, viruses, microinjection. Host organisms for cloning-bacteria, plant, yeast and mammalian cells.

Unit–III rDNA Screening and Cloning strategies

Screening of recombinants: marker inactivation (antibiotic resistance, blue-white selection). Cloning strategies: Construction of genomic and cDNA libraries. Differences between genomic and cDNA libraries. Cloning of insulin gene in *E. coli*

Unit–IV Transgenic plants and animals

Methods of gene transfer in plants-*Agrobacterium*-mediated transformation and particle gun method. Transgenic plant technology-development and applications. Methods for producing transgenic animals- retroviral, microinjection, engineered stem cell.Uses of transgenic animals.

Unit–V Techniques

DNA sequencing- Sanger method. Southern Western hybridization. DNA fingerprinting- principle and applications. PCR: basic reaction, and applications. Gene therapy- basic principles. The human genome project (elementary details). Hazards and safety aspects of genetic engineering.

Text Books

1. Nicholls DTS. An Introduction to Genetic Engineering. 3rd ed. Cambridge Univ Press. 2008.
2. Glick and Pasternak. Molecular Biotechnology. 4th ed. ASM Press 2009.

Unit – II Membrane composition and transport

Composition of membranes- the lipid bilayer, peripheral and integral proteins.The fluid mosaic model. Brief account of membrane rafts. Endocytosis and exocytosis.

Membrane transport: types. Diffusion- passive and facilitated.General classes of transport systems- uniport, symport, antiport.Active transport- primary and secondary.The P-type ATPases (Na^+K^+-ATPase), F-type ATPases (ATP synthases), ABC transporters, ionophores, aquaporins, ion channels (ligand-gated and voltage-gated).

Unit– III Cell division, cell differentiation, cell cycle, and cell death

Molecular events in mitosis and meiosis. Brief account of cell differentiation. Stem cells: types (embryonic, adult), isolation, identification, expansion, differentiation and uses, stem cell engineering, ethical issues.

The cell cycle: phases, regulation by cyclins and cyclin-dependent kinases. Checkpoints.

Cell death- types. Necrosis- causes and mechanism. Apoptosis: morphology, mitochondrial and death receptor pathways. Differences between apoptosis and necrosis.

Unit–IV Cell Culture Techniques

Cell and tissue culture- merits and demerits, aseptic techniques, substrates, culture media, freeze storing, transport, contamination. Growth and development of plant cells and tissues *in vitro*. Callus, suspension, and protoplast culture. Somatic hybridization. Applications of plant cell and tissue culture in breeding and industry.

Animal cell culture: Primary cell culture: disaggregation, separation of viable cells. Secondary culture-maintenance of cell lines. Cancer cell lines. 3D culture. Large-scale cell cultures. Commercial applications of animal tissue culture.

Unit-V Genetics

Definitions of some common terms in genetics- phenotype, genotype, heterozygous, homozygous, allele (dominant, recessive, wild-type, mutant), character, gene, gene locus, pure line, hybrid. Mendel's laws. Monohybrid cross, multiple alleles, dihybrid cross, test cross, backcross, epistasis.

Chromosome structure. Polytene and lampbrush chromosomes. Types of chromosomes on the basis of centromere position. Karyotyping.Variation in chromosome number (euploidy, aneuploidy), arrangement (translocation, inversion), number of segments (deletion, duplication). Population genetics- The Hardy-Weinberg law (basic concept).

Text Books

1. Elrod S. Schaum's Outline of Genetics. 5th ed. McGraw Hill. 2010.
2. Fletcher et al. Instant Notes in Genetics. 4th ed. Garland Science. 2012.
3. Karp. Cell & Molecular Biology 8thed 2016. Wiley.
4. Lodish et al Molecular Cell Biology 8th ed. Freeman, 2016.
5. Murray et al. Harper's Illustrated Biochemistry 30th ed. McGraw Hill, 2015.
6. Nelson and Cox. Lehninger Principles of Biochemistry. Freeman, 7th ed. 2017.
7. Martin BM. Tissue Culture Techniques- An Introduction. 2013. Springer science and Business media.

Reference Books

1. De Robertis and De Robertis. Cell and Molecular Biology. Lippincott Williams and Williams 8th (Paperback), 2017.
2. Alberts *et al*. Molecular Biology of the cell 6th ed. Garland Sci. 2014.
3. Freshney RI. Culture of animal cells: A manual of basic technique. 6th ed. Wiley - Liss, 2010.
4. Smith RH. Plant tissue culture. 3rd ed. Elsevier. 2013.
5. Abouelmagd and Ageeley. Basic Genetics. 2nd ed. Univ Publ. 2013.

BIOP 103:PRACTICAL – I

BIOMOLECULES, GENETICS AND CELL BIOLOGY

1. Estimation of glucose by anthrone method.
2. Qualitative analysis of amino acids
3. Estimation of protein by Lowry *et al* method/ Bradford method
4. Estimation of DNA by diphenylamine method.
5. Estimation of RNA by orcinol method
6. Thermal denaturation of DNA.
7. Microscopic examination of epithelial cells, plant cells.
8. Tissue culture techniques: Surface sterilisation techniques, media preparation and storage, serum inactivation.
9. Staining of cell cultures and observations under microscope.
10. *cry*^{b} mutants of *Drosophila melanogaster*.

BIOO4: IMMUNOLOGY

Objective: To acquire knowledge on immunological mechanisms and immunotechniques.

Unit–I

Types of immunity-innate and acquired.Humoral and cell mediated immunity. Central and peripheral lymphoid organs.Cells of the immune system- lymphocytes, mononuclear phagocytes-dendritic cells, granulocytes, NK cells and mast cells.Antigens- antigenicity, epitopes, haptens.Immunoglobulins- structure, classification and functions.

Unit–II

T-cell, B-cell receptors, Antigen recognition- processing and presentation to T-cells. Immunological memory.Effector mechanisms-macrophage activation. Complement activation. Organization and expression of immunoglobulin genes. Generation of antibody diversity.

Unit–III

Transplantation types. MHC antigens in transplantation. Immunodeficiency disorders - AIDS: The HIV genome and life cycle. Autoimmunity and elementary details of autoimmune disorders (systemic lupus erythematosus).

Unit–IV

Immunization practices- active and passive immunization. Vaccines-killed, and attenuated.Recombinant vaccines- DNA vaccines, synthetic peptide vaccines. Production of applications of polyclonal and monoclonal antibodies.

Unit–V

Agglutination and precipitation techniques.Immunoelectrophoresis, RIA, Immunoblotting, Avidin-biotin mediated immunoassay. Immunohistochemistry, immunofluorescence. ELISA-principle and applications.

Text Books

1. Goldsby*et al*. Kuby Immunology. WH Freeman & Co. 7thed 2013.
2. Abbas *et al*. Cellular and Molecular Immunology. 9th ed.Elsevier 2018.
3. Janeway, C. (Ed), Paul Travers. Immunobiology 9th ed. Garland Publ. 2016.
4. Coico and Sunshine. Immunology: A short course. 7th ed. Wiley, 2015.

BIOO3: BIOCHEMICAL TECHNIQUES

Objective: To learn the principle, operation, and applications of various techniques for analyzing biomolecules.

Unit–I Spectroscopic techniques

Laws of absorption and absorption spectrum.Principle, instrumentation and applications of UV-visible spectrophotometry, spectrofluorimetry and. Atomic spectroscopy.

Unit–II Radioisotope techniques

Nature and units of radioactivity. Detection and measurement of radioactivity- Geiger-Muller counter, solid and liquid scintillation counting. Autoradiography. Applications of radioisotopes in biology. Radiation hazards.

Unit–III Electrophoresis and blotting techniques

Principle, technique and applications of PAGE, SDS-PAGE, agarose gel electrophoresis and isoelectric focusing. Blotting techniques: Southern and Western.

Unit–IV Chromatography

General principles of partition and adsorption chromatography. Principle, operation and applications of thin layer, ion-exchange, molecular exclusion, and affinity chromatography. HPLC- principle, instrumentation and applications.

Unit–V Centrifugation

Basic principles. Types of centriugation: analytical and preparative. Subcellular fractionation. Ultracentrifugation.

Text Books

1. Wilson and Walker.Principles and techniques of Biochemistry and Molecular biology.7th ed. Cambridge University Press 2012.
2. Upadhyay, Upadhyay and Nath.Biophysical Chemistry principles and Techniques.Himalaya Publ. 2010.

BIO C 201: ENZYMES

Objective: At the end of the course, students will appreciate the characteristics of enzymes, enzyme kinetics, mechanism of enzyme action and regulation. The developments in enzyme engineering and potential uses of enzymes are also included.

Unit–I

Enzymes- general characteristics, classification and IUB nomenclature, methods of enzyme isolation and purification. Methods of enzyme assay. Enzyme units: IU, Katal, specific activity. Active site- investigation of active site structure. Brief account of extremozymes and non-protein enzymes (abzymes, ribozymes, DNA enzymes).

Unit–II

Enzyme kinetics. Elucidation of intermediates and rate limiting steps (flow and relaxation methods). Effect of pH, temperature, enzyme and substrate concentration. Presteady state and steady state kinetics.Michaelis-Menten plot, Lineweaver-Burk plot. Significance of K_m and V_{max}. Turnover number.

Kinetics of allosteric enzymes, positive and negative cooperativity, MWC and KNF models. Hill's equation and co-efficient. K and V series enzymes. Sequential and nonsequential bisubstrate reactions.

Unit–III

Enzyme inhibition- irrerversible and reversible, competitive, non competitive, uncompetitive, mixed inhibition (derivation not required). Clinical uses of competitive inhibition using methotrexate, methanol and insecticide poisoning.

Mechanism of enzyme action– acid base catalysis, covalent catalysis, strain, proximity and orientation effects. Mechanism of action of chymotrypsin.

Unit–IV

Coenzymes- coenzymic role of thiamine pyrophosphate FAD, NAD, pyridoxal phosphate, Coenzyme A, biotin, folic acid and cobalamine. Multienzyme complexes. Metal-dependent and metalloenzymes.

Enzyme regulation: feedback inhibition and feedforward stimulation. Enzyme repression, induction and degradation, control of enzymic activity by products and substrates. Zymogen activation. Covalent modification of enzymes- phosphorylation. Compartmentation.

Unit–V

Immobilized enzymes- methods of immobilization, applications. Enzyme Engineering with reference to T4 lysozyme. Enzyme electrode.

Industrial and Clinical Enzymology: Enzymes of industrial and clinical significance, sources and applications of amylases, protease and lipases. Therapeutic use of asparginase. Streptokinase. Enzymes and isoenzymes of diagnostic importance. LD, CK, transaminases, phosphatases and amylase. Enzyme patterns in diseases- liver disease and myocardial infarction.

Text Books

1. Palmer T. Understanding enzymes. Prentice Hall. 2004.
2. Buchholz et al Biocatalysts and Enzyme Technology. 2nd ed Wiley-Blackwell. 2012.
3. Pandey et al. Enzyme Technology. 2010, Springer.
4. Nelson, Cox. Lehninger Biochemistry. 7th ed. Freeman 2017.
5. Balasubramanian et al. Concepts in Biotechnology. Univ Press 2004.

Reference Books

Dixon and Webb. Enzymes 3rd ed. Longmans 1979.

BIO C 202: METABOLISM AND REGULATION

Objective: The objective of this course is to understand metabolic pathways, their interrelationship and the mechanisms of regulation.

Unit–I Bioenergetics and Biological Oxidation

Free energy and entropy, endergonic and exergonic reactions Phosphoryl group transfers and ATP. Enzymes involved in redox reactions. The electron transport chain- organization of respiratory chain complexes and electron flow.

Oxidative phosphorylation- electron transfer reactions in mitochondria. F_1F_0 ATPase- structure and mechanism of action.The chemiosmotic theory.Inhibitors of respiratory chain and oxidative phosphorylation- poisons, uncouplers and ionophores. Regulation of oxidative phosphorylation.Mitochondrial transport systems- ATP/ADP exchange, malate/glycerophosphate shuttle, creatine-phosphate shuttle.

Unit–II Carbohydrate metabolism

Overview of glycolysis and gluconeogenesis- Regulation.The citric acid cycle and regulation.The pentose phosphate pathway and uronic acid pathway. Metabolism of glycogen and regulation. Glycogen storage diseases.Galactosemia. Fructose intolerance and fructosuria.The glyoxylate cycle.Cori cycle.

BIOO2: BASIC BIOTECHNOLOGY

Objective: To master the basic principles and applications of biotechnology.

Unit–IBioprocess Engineering and Downstream Processing

Bioprocess engineering: Isolation and screening of industrially important microbes. Bioreactors- fermentation media. Downstream processing: solid-liquid separation, release of intracellular compartments, concentration of biological products, purification, preservation and stabilization. Industrial production of ethanol.

Unit–II Environmental and Energy Biotechnology

Wastewater treatment- physical, chemical and biological treatment processes. Effluent treatment. Bioremediation, oil spill clean up. Biodegradable plastics.Bioleaching- use of microorganisms in mining. Renewable sources of energy, biogas production.

Unit–III Enzyme and Food Technology

Immobilization of enzymes: methods, and applications. Biosensors. Use of enzymes in detergents, textiles, leather and food industry.Production of glucose syrup.Methods of food preservation. Elementary idea of canning and packing.Basic principles of food fermentation.Production of beer.

Unit–IV Recombinant DNA technology

Basic steps in cloning.Restriction endonucleases, cloning vectors e.g. pBR322. Introduction of rDNA into host cells by calcium phosphate coprecipitation, electroporation, lipofection, microinjection. Screening of recombinants by marker inactivation. Applications of rDNA technology.

Unit–V Plant, Animal, and Medical Biotechnology

Biofertilisers.Biopesticides (*Bacillus thuringiensis*). Transgenic plant technology: gene transfer by *Agrobacterium*-mediated method, development and uses of transgenic plants. Development and uses of transgenic animals. Gene therapy- basic principles. The human genome project (elementary details). Hazards and safety aspects of biotech.

Text Books

1. Smith. JE. Biotechnology. Cambridge Univ Press. 5th ed. 2012.
2. Singh B.D. Biotechnology. Expanding horizons. 2004 Kalyani Publ.
3. Nicholls DTS. Genetic Engineering. 3rd ed. Cambridge Univ Press. 2008.
4. Ratledge and Kristiansen. Basic Biotechnology 3rd ed. Cambridge Univ. Press 2006.

OPTIONALS OFFERED TO OTHER DEPARTMENTS
BIOO1: BASIC BIOCHEMISTRY

Objective: To understand the physiochemical principles in biochemistry and the basic concepts of the chemistry and metabolism of major biomolecules.

Unit–I

Classification of carbohydrates. Functions of biologically important monosaccharides, disaccharides, homopolysaccharides, and heteropolysaccharides. Carbohydrate metabolism:glycolysis, citric acid cycle, gluconeogenesis, glycogen metabolism (overview only, structures not required). Diabetes mellitus (elementary details).

Unit–II

Amino acids: classification and acid-base properties. Biologically important peptides. Proteins– classification, functions, denaturation and renaturation. Orders of protein structure: Primary, secondary (α-helix, β-pleated sheet), supersecondary, tertiary, and quaternary structures. Urea cycle, (overview only, structures not required).

Unit–III

Classification of lipids. Structure and functions of cholesterol. Lipid metabolism: β-oxidation of fatty acids, biosynthesis of fatty acids (overview only, structures not required). Coronary heart disease (elementary details).

Unit–IV

Enzymes: Classification and nomenclature. Specificity, factors affecting enzyme activity- substrate, pH and temperature.Michaelis-Menten equation and L-B plot. Coenzymes and Isoenzymes (brief account only). Allosteric enzymes. Applications of enzymes in clinical diagnosis, therapeutics and industry.

Unit–V

DNA structure- Watson and Crick model.A, B, and Z forms of DNA. DNA denaturation. Differences between DNA and RNA.Major classes of RNA- structure and biological functions.

Text books

1. Nelson and Cox. Lehninger Principles of Biochemistry. Freeman, 7th edition, 2017.
2. Murray et al. Harper's Illustrated Biochemistry 30th edition, McGraw Hill, 2015.
3. Satyanarayana U. Biochemistry. Books and Allied Publ, 5th ed., 2017.

Photosynthesis- photosynthetic apparatus, light reaction, cyclic and noncyclic photophosphorylation.Dark reaction- Calvin cycle, Hatch-Slack pathway.Photorespiration.Starch biosynthesis and degradation. Bioluminescence.

Unit–III Lipid metabolism

Oxidation of fatty acids- role of carnitine in fatty acid transport, α, β and ω-oxidation. Metabolism of ketone bodies.Biosynthesis of fatty acids– Fatty acid synthase complex– regulation of lipogenesis. Metabolism of triglycerides, phospholipids and sphingolipids. Cholesterol- biosynthesis, regulation, transport and excretion. Metabolism of lipoproteins and lipoproteinemias. Metabolism of prostaglandins– COX and LOX pathways.Lipid storage diseases and fatty liver.

Unit–IV Amino acid and Porphyrin metabolism

Biosynthesis of nonessential amino acids (overview only). Catabolism of amino acid nitrogen- transamination, deamination, ammonia formation and the urea cycle. Catabolism of carbon skeletons of amino acids. Conversion of amino acids to special products. Disorders of amino acid metabolism- phenylketonuria, alkaptonuria, albinism, and maple syrup urine disease.

Biosynthesis and degradation of porphyrins and heme. Porphyrias.

Unit–V Metabolism of purines and pyrimidines and Metabolic integration

Metabolism of purines- de novo and salvage pathways for biosynthesis. Purine catabolism. Biosynthesis and catabolism of pyrimidines. Regulation of purine and pyrimidine metabolism. Hyperuricemia and gout.Hypouricemia. Oroticaciduria.

Integration of metabolism– interconversion of major food stuffs. Metabolic profile of the liver, adipose tissue and brain. Altered metabolism in starvation.

Text Books

1. Nelson and Cox. Lehninger Principles of Biochemistry. Freeman, 7th ed. 2017.
2. Voet and Voet. Fundamentals of Biochemistry. 5th. Wiley. 2016.
3. Murray et al. Harper's Illustrated Biochemistry 30th ed. McGraw Hill, 2015.
4. Berg, Tymoczko. Stryer Biochemistry 8th ed. Freeman 2015.
5. Kuchel et al. Schaum's Outline of Biochemistry. McGraw Hill. 3rd ed. 2011.

BIO C 203: IMMUNOLOGY

Objective: To acquire comprehensive knowledge of immunology and immunochemical techniques

Unit–I

Central and peripheral lymphoid organs.Bone marrow, thymus.Lymph node, spleen and mucosal associated lymphoid tissue.Cells of the lymphoreticular system. T-Cells, B-Cells, mononuclear phagocytes, dendritic cells, granulocytes, NK cells, mast cells. Antigens definition antigenicity, antigenic determinants, haptens and epitopes. Antibodies- structure, classification, functions, Isotypes, allotypes and idiotypes.Complement system- components, nomenclature, activation of complement, classical pathway and alternate pathway. Biological functions of complement.

Unit–II

Types of immunity- innate and acquired immunity, Antigen recognition- T-cell and B-cell receptor complexes, antigen processing and presentation.Interaction of T and B-cells. Immunological memory, Effector mechanisms: phagocytosis, cell mediated cytotoxicity, antibody dependent CMC.

Vaccines-killed, attenuated organisms, toxoids, recombinant vaccines, subunit vaccines, DNA vaccines, synthetic peptide vaccines, antiidiotypic vaccines.

Unit–III

Antibody diversity- mechanisms contributing to diversity- somatic recombination, rearrangement and generation of antibody diversity.Class switching.MHC complex- gene organisation- HLA genes class I and II antigens-structure and function. Histocompatibility testing, cross matching. MHC & disease association. Transplantation-types- Graft versus host reactions. Immunosuppressive agents.

Unit–IV

Hypersensitivity - definition and classification - type I to type V (brief account only). Autoimmunity and autoimmune disease- SLE. AIDS-pathogenesis, diagnosis and treatment. Tumor immunology– immune surveillance, tumor antigens, immune response to tumors, cancer immunotherapy.

Unit–V

Immunochemical techniques- production of antibodies- polyclonal and monoclonal antibodies.Applications of Mab. Immunodiffusion techniques,Immunoprecipitation,RIA, ELISA, fluorescence immune-

Database similarity searching: BLAST, FASTA. Multiple sequence alignments: CLUSTAL. Gene discovery and prediction. Molecular phylogenetics: phylogenetic tree construction and analysis. Identification of orthologs and paralogs. Protein structure database-protein structure visualization, comparison and classification. Protein motifs and domain prediction.

Text Books

1. Lesk A. Introduction to Genomics. 4th ed. Oxford Univ Press. 2013.
2. Lesk A Introduction to Bioinformatics. 4th ed. OUP 2014.
3. Primrose. Principles of genome analysis. 3rd ed. Wiley 2002.
4. T.A. Brown. Genomes. 2007, 4thed, Garland Science.
5. Hartwell etal. Genetics: From Genes to Genomes. 5th ed. 2014.
6. Dale and von Schantz. From Genes to Genomes: Concepts and applications of DNA technology. 3rd ed. Wiley-Interscience. 2011.
7. Lovrik Introducing Proteomics. Wiley-Blackwell. 2011.
8. Twyman. Principles of Proteomics. 2nd ed. 2013
9. Liebler DC. Introduction to proteomics. Humana Press. 2nd ed. 2009.
10. Hodgman et al. Instant Notes in Bioinformatics. 2nd ed. Taylor and Francis, 2009.

Reference Books

1. Gibas and Per Jambeck. Developing bioinformatics computer skills. 2nd ed. O'Reilly Associates, 2013.
2. Baxevanis, Ouellette. Bioinformatics. A practical guide to the analysis of genes and proteins. 3rd ed. Wiley Interscience, 2004.

BIO P 403:Practical – V
Clinical Biochemistry & Bioinformatics

A. Estimation of blood constituents
   1. Blood glucose
   2. Blood urea.
   3. Serum uric acid.
   4. Serum creatinine.
   5. Serum cholesterol.
   6. Serum HDL cholesterol.
   7. Serum calcium.
   8. Serum iron.
   9. Serum inorganic phosphorus.
   10. Serum bilirubin
   11. Serum protein- Biuret method – A/G ratio.

B. 1. Sequence alignment and searching
   2. Phylogenetic analysis
   3. Protein sequence analysis

BIO C 402:GENOMICS, PROTEOMICS AND BIOINFORMATICS

Objective: To understand the principles of genome mapping, sequencing, genome analysis, and the tools and applications of proteomics and bioinformatics.

Unit–I Genome mapping and sequencing

Genome mapping-rationale. Types of gene map-genetic, cytogenetic and physical. Molecular markers for mapping-RFLPs, microsatellites and SNPs. Assembling a physical map of the genome - chromosome walking and jumping. Genome sequencing approaches: whole-genome shotgun, hierarchical shotgun. Identifying genes- sequence inspection, EST comparison, similarity searches.

Unit–II Genome projects, post-genome analysis

Genome projects: genome sequence data of model organisms- *E.coli, D.melanogaster*, and mouse. The Human Genome Project: goals, mapping strategies, markers, sequencing technologies, results of final sequence, potential benefits and risks, ELSI. Post-genome analysis- differential display, DNA microarray, ChIPs, knock-out analysis.

Unit–III Protein separation, identification and quantitation

Proteomics-introduction. Protein separation- general principles. 2D-gel electrophoresis, liquid-liquid chromatography. Protein identification by antibodies, Edman degradation, mass spectrometry-basic principle and instrumentation, ESI, MALDI-TOF, SELDI-TOF, tandem MS. Peptide mass fingerprinting (elementary details).

Unit–IV Structural & functional proteomics & applications

Structural proteomics: X-ray and NMR for protein structure analysis. Comparative and homology modeling, secondary structure prediction, fold recognition and *ab initio* prediction. SCOP. Protein sequence analysis: substitution score matrices, pairwise similarity search, pattern recognition.

Protein function determination: database search for homology, phylogenetic profile method, domain fusion. Protein-protein interactions: yeast 2-hybrid system. Protein arrays and chips (concept and applications). Applications of proteomics.

Unit–V Bioinformatics

Useful search engines. File formats. PubMed. Bioinformatics workstation, Unix. Biological databases (primary, secondary, organism-specific, miscellaneous). Data submission and retrieval. Sequence alignment: substitution scores and gap penalties.

assay, avidin-biotin mediated assay, immunohisto-chemistry, immunoelectrophoresis, immunoblotting. Complement fixation test. Flow cytometry.

Text Books

1. Goldsby *et al*. Kuby Immunology. WH Freeman & Co. 7th ed 2013.
2. Abbas *et al*. Cellular and Molecular Immunology. 9th ed. Elsevier 2018.
3. Janeway, C. (Ed), Travers. Immunobiology 9th ed. Garland Publ. 2016.
4. Coico and Sunshine. Immunology: A short course. 7th ed. Wiley-Liss, 2015.

Reference Books

Roitt et al. Roitt's Essential Immunology. 13th ed Wiley-Blackwell Sci. 2017.

BIO C 204: MOLECULAR BIOLOGY

Objective: This course is designed to educate students on chromatin structure, gene complexity and genomic information flow.

Unit–I Chromatin and Genome complexity

The central dogma of molecular biology. The *E. coli* chromosome and DNA-binding proteins. Plasmids- classification and properties. Eukaryotic chromatin: nucleosomes, 30 nm fiber and higher order chromatin structure. Concept of the gene. Definitions of the following: gene, cistron, coding region (ORF), transcription unit, untranslated region (UTR), pseudogenes, euchromatin and heterochromatin. Typical structure of protein-coding genes in prokaryotes and eukaryotes. Split genes- exons and introns. DNA sequence elements: unique sequence DNA, repetitive DNA (SINEs, LINEs, satellite, minisatellites and microsatellites).

Unit–II Replication, Repair and Recombination

Messelson and Stahl experiment. Enzymes and proteins involved in replication: helicases, SSB, topoisomerases, DNA polymerases, DNA ligase. DNA replication in bacteria and eukaryotes: initiation, elongation, termination. The end-replication problem and telomerase. Inhibitors of replication.

DNA damage by physical and chemical agents. DNA repair- photoreactivation, excision repair, mismatch repair, SOS response, double strand break repair. Molecular biology of homologous recombination. Transposons: mechanism of transposition and applications.

Unit–III Transcription and Post-transcriptional processing

Transcription in *E. coli:* RNA polymerase subunit structure, promoter sequence steps in transcription- template recognition, initiation, elongation and termination (intrinsic, rho-dependent). Transcription in eukaryotes: RNA pol I, II and III: subunit structure, transcription factors, promoters, inhibitors. Mechanism of RNA pol II transcription: preinitiation complex formation, transcription initiation (activator proteins, mediator, chromatin recruitment), elongation, termination.

Classes of introns. Post-transcriptional processing of prokaryotic and eukaryotic rRNA, and tRNA. and eukaryotic mRNA. Brief account of ribozymes, RNA editing and Reverse transcription.

Unit IV Genetic code and Translation

The genetic code: general features. Mitochondrial genetic code. Mutations: point mutations and frameshift mutations. Suppressor mutations- nonsense and missense suppression.

Mechanism of protein synthesis in bacteria and eukaryotes: amino acid activation, initiation, elongation and termination. Inhibitors of protein synthesis. Post-translational modifications. Protein targeting to subcellular organelles, secretory proteins (the signal sequence hypothesis). Protein degradation: the ubiquitin pathway. Protein folding- models, molecular chaperones.

Unit–V Regulation of Gene expression

Basic principles of gene regulation- levels of gene expression, definition of housekeeping genes, and inducible genes, upregulation, downregulation. Regulation of gene expression in prokaryotes: *lac* operon and *trp* operon. Translational control in bacteria (r-protein operons). Regulation of gene expression in eukaryotes: Transcriptional regulation by steroid hormone receptors, phosphorylation (STAT proteins), alternative splicing. Translational regulation. Antisense RNA and RNA interference. Epigenetic gene regulation: DNA methylation, histone acetylation and deacetylation.

Text Books

1. Nelson and Cox. Lehninger Principles of Biochemistry. Freeman, 7th ed. 2017.
2. Krebs JE et al. Lewin's. Genes XII. Jones & Bartlett Publ, 2017.
3. Alberts et al Molecular biology of the cell. 6th ed. Garland Sci. 2014.
4. Watson. Molecular Biology of the Gene. 7th ed. Pearson Edu, 2013.

Reference Books

1. Watson et al. Recombinant DNA: Genes and genomes - A short course. 3rd ed. Freeman 2006.
2. Twyman. Advanced Molecular Biology. BIOS Sci Publ. 2000.

Mechanisms of protooncogene activation. Functions of protooncogenes and tumor suppressor genes.Role of p53.

Unit–III Liver

Structure and function of the liver. Metabolism of bilirubin. Excretory, synthetic, detoxification and metabolic liver function tests. Plasma enzymes in liver disease. Jaundice- retention, regurgitation, neonatal. Inherited hyperbilirubinemias. Causes, consequences, biochemical findings and management of hepatitis, cirrhosis and gallstones.

Unit–IV Gastrointestinal and Renal disorders

Gastric function tests. Peptic ulcer: pathogenesis, biochemical findings and management. Pancreatic and intestinal function tests. Causes, biochemical findings and consequences of pancreatitis, cystic fibrosis and malabsorption.

Kidney function tests. Abnormal constituents of urine. Pathogenesis, biochemical findings and management of glomerulonephritis, renal failure, nephrotic syndrome and nephrolithiasis.

Unit–V Molecular Diagnosis and Molecular Therapeutics

Diagnostic kits.Prenatal & neonatal screening for genetic disorders. DNA diagnostic systems- probes. RFLP and PCR in disease diagnosis. Viral diagnostics: immunodiagnosis, molecular diagnosis. SNP-based diagnosis.Therapeutic agents from nonrecombinant and recombinant organisms. Antivirals and antiretrovirals. Drug delivery and targeting. Gene therapy: gene delivery systems, *ex vivo* and *in vivo* strategies, gene therapy for single-gene disorders, cancer and AIDS. Antisense and siRNA therapy. Nanotherapy. Stem cell therapy.

Text Books

1. Practical Clinical Biochemistry Varley 6th ed. CBS Publishers (2006)
2. Clinical chemistry in diagnosis and treatment Mayne ELBS. (1994)
3. Clinical Chemistry W.J. Marshall, S. K. Bengert, M. Lapsley7thedition Mosby 8th ed. (2016)
4. Harper's Biochemistry 30th th edition McGraw-Hill (2015).
5. Glick and Pasternak. Molecular Biotechnology. 4th ed. ASM Press 2009.
6. Borem et al Understanding Biotechnology. Pearson 2011.

Reference Books

1. Tietz Textbook of Clinical Chemistry and Molecular Diagnostics – 7thedition Saunders (2014).
2. Principles of Internal Medicine. Harrison's vol 1 & 2, 19th edition McGraw Hill (2015).

BIO P 305: PRACTICAL – IV
ANALYTICAL TECHNIQUES, PHYSIOLOGY, ENDOCRINOLOGY AND BIOTECHNOLOGY

1. UV-Absorption spectrum of proteins and nucleic acids.
2. Separation of lipids by TLC
3. Separation of plant pigments by adsorption chromatography.
4. Separation of proteins by SDS-PAGE and Western blotting.
5. HPLC - Demonstration.
6. Subcellular fractionation - isolation and analysis of nuclear and mitochondrial fractions.
7. Enumeration of RBCs, WBCs (Total & differential)
8. Estimation of bleeding time and clotting time.
9. Blood hemoglobin.
10. Hormone assay
11. Restriction enzyme digestion of DNA.
12. PCR and analysis of PCR products.
13. Real-time qPCR - Demonstration.
14. Determination of D.O. concentration of water sample.
15. Determination B.O.D. and C.O.D. of sewage sample.

BIO C 401:CLINICAL BIOCHEMISTRY

Objective: To understand the biochemical and molecular aspects of diseases.

Unit–I Molecular Basis of Diseases-I

Genetic diseases.Elementary details of chromosomal disorders (Down syndrome, Klinefelter's syndrome), monogenic disorders (autosomal dominant, autosomal recessive, sex-linked). Multifactorial diseases.

Role of tissues and hormones in blood glucose homeostasis. Diabetes mellitus: classification, metabolic abnormalities, diagnosis, acute (diabetic ketoacidosis, HONK coma) and long term (nephropathy, neuropathy, retinopathy, diabetic foot) complications, management. Hypoglycemia- classification, clinical manifestations, diagnosis and management.

Unit–II Molecular Basis of Diseases-II

Atherosclerosis: risk factors, biochemical findings and management. Cancer-Differences between benign and malignant tumours.Growth characteristics of cancer cells. Morphological and biochemical changes in tumour cells. Tumor markers- oncofetal proteins, hormones, enzymes, tumor-associated antigens. Agents causing cancer (radiation, viruses &chemicals). Multistage carcinogenesis.

BIO P 205: PRACTICAL–II
ENZYMES AND MOLECULAR BIOLOGY

1. Activity and specific activity of any one enzyme.
2. Effect of pH and temperature on enzyme activity.
3. Effect of substrate concentration on enzyme activity and determination of Km value.
4. Estimation of activity of serum enzymes: Transaminases and ALP
5. Enzyme immobilization using alginate beads.
6. Extraction of genomic DNA, electrophoresis in agarose gel, determination of molecular mass.
7. Isolation of RNA from yeast.
8. Plasmid preparation, characterization by electrophoresis.
9. Bacterial conjugation
10. Transformation.

BIO P 206: PRACTICAL– III
MICROBIOLOGY AND IMMUNOLOGY

1. Microscopic examination of bacteria, fungi, yeast.
2. Isolation of microbes from spoiled foods
3. Staining of microorganisms: Gram staining, acid fast staining.
4. Culture of microorganisms: media preparation, Serial dilution, innoculation, Culture of bacteria in culture tubes, agar plates.
5. Antibiotic sensitivity and resistance pattern of bacteria.
6. Blood grouping and Rh typing
7. Radial immunodiffusion
8. Double diffusion
9. Agglutination, rosette formation, complement fixation
10. Preparation of antisera
11. Immunoelectrophoresis (demonstration)
12. ELISA (demonstration)

BIO C 301: ANALYTICAL TECHNIQUES

Objectives: To learn the basic principles, instrumentation and applications of the analytical tools of biochemistry

Unit–I Spectroscopy

Laws of absorption. Absorption spectrum.Principle, instrumentation and applications of UV-visible spectrophotometry, spectrofluorimetry and luminometry. Atomic spectroscopy- principle and applications. Brief outline of the principles and biological applications of NMR and ESR, ORD, and CD.

Unit–II Radioisotope techniques and Microscopy

Nature and units of radioactivity. Solid and liquid scintillation counting, quenching, scintillation cocktails and sample preparation. Autoradiography. Applications of radioisotopes in biology. Radiation hazards.

Microscopy- basic principles, and components of light, bright field, phase contrast, and fluorescence microscopy. Electron microscopy- principle, preparation of specimens for TEM and SEM. Confocal microscopy.

Unit–III Electrophoresis and blotting techniques

Electrophoresis: General principles, support media. Electrophoresis of proteins- SDS-PAGE, isoelectric focusing, 2-D PAGE. Cellulose acetate electrophoresis. Electrophoresis of nucleic acids- agarose gel electrophoresis, PAGE, pulsed-field gel electrophoresis. Electrophoretic mobility shift assay. Blotting techniques: Southern, Northern and Western blotting techniques.

Unit–IV Chromatography

General principles of partition and adsorption chromatography. Principle, instrumentation and applications of thin layer and gas chromatography. Principle, procedure, and applications of ion-exchange, molecular exclusion, and affinity chromatography.HPLC-principle, instrumentation and applications.

Unit–V Centrifugation

Basic principles of sedimentation. Types of rotors. Low-speed and high-speed centrifuges. Analytical and preparative ultracentrifuge-instrumentation and applications. Subcellular fractionation by differential centrifugation. Density-gradient centrifugation- rate zonal and isopycnic.

Unit–IV

Cloning strategies: Construction of genomic and cDNA libraries. Difference between genomic and cDNA libraries. Cloning of insulin gene. Expression vectors- baculovirus and mammalian expression systems (brief outline).

Transgenic plant technology: Development of insect resistance, virus resistance, herbicide resistance and stress tolerant plants. Delayed fruit ripening.Terminator technology.Production of vaccines and antibodies in plants.Ethics of genetically engineered crops. Transgenic animal technology: Methods of producing transgenic animals (retroviral, microinjection, engineered stem cell). Application of transgenic animals.Transgenic animals as models of human disease.

Unit–V

Preparation of probes.DNA sequencing.Chemical, enzymatic and automated methods.DNA fingerprinting-principle and applications.Brief outline of RFLP and FISH. PCR: basic reaction and applications. Modified PCR techniques-RT-PCR, real-time qPCR.Basic concepts of site-directed mutagenesis, protein engineering and uses. Basic principles of gene knock-in and knock-out technology. The human genome project-goals, results, benefits and hazards.Hazards and safety aspects of genetic engineering.

Text books

1. Ratledge and Kristiansen. Basic Biotechnology 3rd ed. Cambridge Univ. Press 2006.
2. Gupta PK. Elements of Biotechnology, Rastogi Publication, 2nd ed. 2010.
3. Dale and von Schantz. From Genes to Genomes: Concepts and applications of DNA technology. 3rd ed. Wiley-Interscience. 2011.
4. Nicholls DTS. An Introduction to Genetic Engineering. 3rd ed. Cambridge Univ Press. 2008.
5. Glick and Pasternak. Molecular Biotechnology. 4th ed. ASM Press 2009.
6. Singh B.D. Biotechnology. Expanding horizons. 2004 Kalyani Publ.

References

1. Winnacker EL. From Genes to clones. 4thed VCH Publ. 2003.
2. Watson et al. Recombinant DNA 3rd ed. Freeman, 2006.
3. Primrose, Twyman and Old. Principles of gene manipulation. 8th ed. Wiley-Blackwell. 2016.

BIO C 304: BIOTECHNOLOGY

Objective: To understand the classification, growth and cultivation of microorganisms and the industrial applications.

Unit–I

Bioprocess engineering: Isolation and screening of industrially important microbes. Maintenance and improvement of strains.Bioreactors-types, design, parts and their function.Media for industrial fermentation, air and media sterilization.Antifoaming devices. Types of fermentation processes: Analysis of batch, fed-batch and continuous bioreactions, analysis of mixed microbial population, specialized bioreactors (pulsed, fluidized, photobioreactors).

Downstream processing: solid-liquid separation, release of intracellular compartments, concentration of biological products, purification, preservation and stabilization, product formulation.Monitoring.

Unit–II

Industrial production of ethanol, lactic acid, butanol, penicillin and phenylalanine.Commercial production of fructose. Wastewater treatment-physical, chemical and biological treatment processes. Effluent treatment. Bioremediation, oil spill clean up. Microbial mining.Biofertilizers-bacteria and blue green algae.Biopesticides in integrated pest management-*Bacillus* and *Pseudomonas* as biocontrol agents.

Single cell protein-microorganisms and steps in SCP production, biomass recovery, nutritional and safety evaluation, advantages. Soil microbiota.Bio-geochemical role of soil microorganisms.Microbial degradation of xenobiotics in the environment.

Unit–III

Basic steps in cloning.Restriction endonucleases, cloning vectors (pBR322, pUC), phages (λ and M13), cosmids, BACs, and YACs. Methods of ligating vector and insert DNA–cohesive end method, homopolymer tailing, blunt-end ligation, linkers and adapters.

Gene transfer methods-calcium phosphate coprecipitation, electroporation, lipofection, viral vectors, microinjection. Host organisms for cloning.Recombinant screening-marker inactivation (antibiotic resistance and blue-white selection), colony hybridization, immunological screening and *in vitro* translation.

Text Books

1. Wilson and Walker.Principles and techniques of Biochemistry and Molecular Biology.7th ed. Cambridge University Press 2012.
2. Upadhyay, Upadhyay and Nath.Biophysical Chemistry principles and Techniques.Himalaya Publ. 2010.
3. Boyer, R.Modern Experimental Biochemistry.3rd ed.AddisonWeslery Longman, 2000.

Reference Books

1. Sambrook. Molecular Cloning. Cold Spring Harbor Laboratory, 4th ed 2012.
2. Friefelder and Friefelder.Physical Biochemistry - Applications to Biochemistry and Molecular Biology.WH Freeman & Co. 1994.
3. Pavia Intro to spectroscopy 5th ed. 2015.

BIO C 302: MOLECULAR ENDOCRINOLOGY AND SIGNALING

Objective: This course emphasizes the general aspects of hormone action and physiological and biochemical effects of individual hormones. Disorders related to hormonal actions are included to understand the regulatory role of hormones.

Unit–I Hypothalamic and Pituitary hormones

Classification of hormones and mechanism of action. Hypothalamic and pituitary hormones. Hypothalamic releasing factors. Anterior pituitary hormones: biological actions, regulation and disorders of growth hormone, ACTH, gonadotropins and prolactin. Leptin.
Posterior pituitary hormones- biological actions of vasopressin. Diabetes insipidus and syndrome of inappropriate ADH secretion (SIADH) Oxytocin. Hypopituitarism.

Unit–II Thyroid and Parathyroid hormones

Thyroid hormones- synthesis, secretion, regulation, transport, metabolic fate and biological actions. Antithyroid agents. Thyroid function tests. Hyper and hypothyroidism. Hormonal regulation of calcium and phosphate metabolism. Secretion and biological actions of PTH, calcitonin and calcitriol. Hypercalcemia and hypocalcemia. Rickets and osteomalacia.

Unit–III Adrenal hormones

Adrenal cortical hormones. Synthesis, regulation, transport, metabolism and biological effects of glucocorticoids and mineralocorticoids. Hypo and hyper function- Cushing's syndrome, aldosteronism, CAH, aderenal cortical insufficiency, Addison's disease.

Adrenal medullary hormones- synthesis, secretion, metabolism, regulation and biological effects of catecholamines. Phaeochromocytoma.

Unit–IV Gonadal, Gastrointestinal and Pancreatic hormones

Gonadal hormones: Biosynthesis, regulation, transport, metabolism and biological actions of androgens. Hypogonadism and gynecomastia. Biosynthesis, regulation, transport, metabolism and biological effects of oestrogen and progesterone. The menstrual cycle. Pancreatic hormones- synthesis, regulation, biological effects and mechanism of action of glucagon, somatostatin and insulin. Insulin receptor. Brief account of gastrointestinal hormones.

Unit–V Signal transduction

Fundamental concepts and general features of cell signalling. Endocrine, paracrine, autocrine signaling and juxtacrine signalling. Types of receptors. Nuclear and cytosolic receptors. G-protein-coupled receptors. Second messengers: c-AMP, cGMP, diacylglycerol, inositol triphosphate and Ca^{2+}. Receptor tyrosine kinases- insulin signalling, ras-raf-MAP kinase and JAK-STAT pathways.

Text Books

1. Williams Text Book of Endocrinology, S. Melmed et al., 13th edition, Saunders (2015)
2. Murray et al. Harper's Illustrated Biochemistry. 30th ed. McGraw Hill, 2015.
3. Nelson and Cox. Lehninger Principles of Biochemistry. Freeman, 7th ed. 2017.
4. Clinical Chemistry in diagnosis and treatment Mayne ELBS. (1994)
5. Clinical Chemistry. W. J. Marshall, M. Lapsley, S. K. Bangert 8thedition Mosby. (2016).

BIO C 303: PHYSIOLOGY & NUTRITION

Objective: To acquire knowledge of the physiology of different systems.

Unit–I Neuromuscular system

Structure of neuron.Propagation of action potential.Neurotransmitters-examples, release and cycling of neurotransmitters. The neuromuscular junction. The acetylcholine receptor.

Structure of skeletal muscle. Muscle proteins- myosin, actin, troponin and tropomyosin and other proteins. Sequence of events in contraction and relaxation of skeletal muscle. Cardiac and smooth muscle (Brief account only).

Unit–II Digestive and Excretory System

Composition, functions and regulation of saliva, gastric, pancreatic, intestinal and bile secretions. Digestion and absorption of carbohydrates, lipids, proteins and nucleic acids.

Structure of nephron.Formation of urine- glomerular filtration, tubular reabsorption of glucose, water and electrolytes.Tubular secretion.Normal and abnormal constituents of urine.

Unit–III Blood, Lymph and CSF

Composition and functions of blood. Plasma proteins in health and disease.Red blood cells- formation and destruction. Composition and functions of WBCs. Blood coagulation-mechanism. Fibrinolysis. Anticoagulants. Transport of blood gases: oxygen and carbon dioxide. Lymph- composition and functions. CSF-composition and clinical significance.

Unit–IV Hydrogen ion and fluid electrolyte homeostasis

Hydrogen ion homeostasis: Factors regulating blood pH- buffers, respiratory and renal regulation. Causes, biochemical findings and management of metabolic and respiratory acidosis and alkalosis.

Distribution of water and electrolytes in the ECF and ICF. Water balance- role of ADH. Sodium balance- the renin-angiotensin-aldosterone system. Potassium balance. Hypo- and hypernatremia. Hypo and hyperkalemia.

Unit–V Nutrition

Elements of nutrition: BMR, Nitrogen balance, Essential amino acids and fatty acids, protein quality. Protein energy malnutrition-marasmus and kwashiorkor. Sources, requirements, biological functions and clinical significance of fat-soluble vitamins and water soluble vitamins. Sources, requirements, biological functions and clinical significance of calcium, phosphorous and trace elements.

Text Books

1. Nelson and Cox. Lehninger Principles of Biochemistry. Freeman, 7th ed. 2017.
2. Lodish et al Molecular Cell Biology 8th ed. Freeman, 2016.
3. Murray et al. Harper's Illustrated Biochemistry 30th ed. McGraw Hill, 2015.
4. Smith *et* al. Principles of Biochemistry. Mammalian Biochemistry. McGraw Hill 7th ed.1982.

Reference Books

1. Barrett et al. Ganong's Review of Medical Physiology. 25th ed. Lange 2015.
2. Graaf & Rees. Schaum's Easy Outline of Human Anatomy & Physiology.3rd ed.2009.