

NIMS UNIVERSITY, JAIPUR



SYLLABUS

**BACHELOR OF SCIENCE
(BIOCHEMISTRY)**

B.Sc. (Biochemistry)

	Distribution of Marks			
	Theory	Practical		Total
Year - I				
• Introduction to Chemistry	70	30		100
• Basic Microbiology	70	30		100
• Fundamentals of Biophysics	100	-		100
• Introductory Cell Biology & Molecular Biology	70	30		100
• Mathematics	100			100
• English	100			100
• Elementary Human Physiology	100			100
• Elements of Genetics	70	30		100
Year - II				
• Introductory Plant Biochemistry	100			100
• Organic & Inorganic Chemistry	100			100
• Clinical Biochemistry	100			100
• Nutritional Biochemistry	70	30		100
• Elementry Biochemistry	100			100
• Biosensors	100			100
• Biophysical and Biochemical Techniques	100			100
• Basic Intermediary Metabolism	100			100
Year - III				
• Membrane Biochemistry	100			100
• Industrial Biochemistry	100			100
• Basics of Immunology	100			100
• Introductory Bionanotechnology	100			100
• Environmental Biochemistry	70	30		100
• Introduction to Biostatics	100			100
• Fundamentals of Bioinformatics	100			100
• Emymology for beginners	100			100

INTRODUCTION TO CHEMISTRY

Unit –I

Chemical bond: type of bonding, general characteristics, hybridization involving s, p, d, orbital, dipole moment. Hydrogen bond: theories of hydrogen bonding valence bond, weak intermolecular and intra molecular force of attraction, V S E P R theory. Molecular orbital theory: detailed description of L C A O & concepts of united atom in M.O. Configurations of simple diatom molecules (H₂, O₂, NO).

Unit –II

Alkanes: nomenclature, mechanism of free radical halogenations activation energy. Alkenes: chemical reactivity stability of carbonium ions, Markownikoff rule. Free radical Mechanism, stability of free ion. Dienes: methods for preparation of conjugated dienes, Diels, alder reaction, electrophilic mechanism.

Unit- III

Stereochemistry of organic compounds: different types of stereoisomerism, geometrical isomerism, optical isomerism –optical activity, R& S configuration, asymmetry synthesis. Carbohydrate; classification, reaction, constitution of glucose & fructose, mutarotation, anomers, epimerization, conversion of glucose into fructose and vice versa.

Unit-IV

Thermodynamics; laws of thermodynamic, thermodynamic state of system, molar heat capacity relation between ΔH & ΔE , Joule Thomson effect, Carnot cycle, entropy, Helmholtz free energy, Gibb' energy, Nernst heat thermo.

Unit-V

Chemical equilibrium: law of mass action, Chatelier principle, law of distributions law, hydrolysis, Oswald dilution law, pH value and Hazel –Henderson equation, Electrode: standard electrode potential, chemical cells.

Practicals:

Practicals based on above topics will be conducted.

Books:

1. University General Chemistry by C.N. R. Rao, Macmillan
2. Principles of Physical Chemistry, 4th edition by S.H. Marron and C.F. Prutton
3. Essentials of Physical Chemistry by B.S. Bahel and G.D. Tuli
4. College Chemistry by Linus Pauling
5. Concise Inorganic Chemistry by J. D. Lee 5th Edition
6. Basic Inorganic Chemistry by Cotton and Wilkinson
7. Organic Chemistry, 5th Edition by Morrison Prentice Hall of India Pvt. Ltd. Boyd, New Delhi
8. Guide book to Mechanism in Organic Chemistry by Peper Sykes, 6th Edition, Orient Longman
9. Organic Chemistry by I.L. Finar, Volume-II, 5th Edition
10. An introduction to Electrochemistry by Samuel Glasstene

11. The elements of Physical Chemistry by P.W. Atkins
12. Physical Chemistry for biological sciences by Raymond Chang (University science)
13. Physical Chemistry by David Ball

BASIC MICROBIOLOGY

Unit- I

History of Microbiology. Bacterial nomenclature: classification, methods of classification, Whittaker 5 kingdom classification, Haeckel's three kingdom concept, Bergey's manual of systematic bacteriology. Characteristics & structure of microbes: Algae, Fungi, Mycoplasma, Virus, Protozoa & Helminthes.

Unit- II

Cells-prokaryotes & eukaryotes. Morphology & Structure of bacteria. Bacteria: Gram positive, Gram-ve, size, shape, arrangement of bacterial cells, cell wall, cytoplasmic membrane, flagella & pilli etc. Staining technique, Simple (monochrome & negative) and Differential (Gram & Acid fast) staining.

Unit- III

Bacterial Nutrition. Culture Media, Types of Media, Preparation of different Media. Isolation of Bacteria.

Unit- IV

Microbial Growth, growth curve, Factors affecting growth. Batch and continuous culture.

Measurement of bacterial growth. Gene transfer in bacteria: Conjugation, transformation, transduction.

Unit-V

Sterilization and disinfection. Bacteriology of water, milk and air. Food microbiology: Spoilage and Preservation.

Practicals:

Practicals based on above topics will be conducted

Books:

1. Brock TD, Madigan MT,(1993) Biology of microorganisms. Prentice Hall Int. Inc.
2. Ananthanarayanan R. and C. K. Jayaram Paniker (1997) Text of microbiology, Orient Longman.
3. Stanier RY, Ingraham JL, Wheelis, ML Painter PR (1986).General Microbiology
4. Topley & Wilson's (1995) Text book on principles of bacteriology, virology & immunology IX ed. Edward Arnold, London.
5. Michael J. Pelczar JR et al. (1993) Microbiology: Concepts and Applications, Mc Graw- Hill. Inc. (ISBN. 0- 07- 049258-1).
6. Prescott Harley Klein :(1996) Microbiology III ed. ECB Pub.

FUNDAMENTALS OF BIOPHYSICS

Unit- I

Conformation of Nucleic acids (A, B, Z, DNA), t RNA, micro RNA. Stability of protein and nucleic acid structure.

Unit- II

Stabilizing interaction (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, disulphide bond linkages). Conformation of proteins secondary, tertiary and quaternary structure; domain, motifs and folds, α helices, β pleated sheets.

Unit-III

Biophysics of membrane contraction (contraction cycle in striated muscles). Biophysics of nerve impulse conduction, saltatory conduction. Transportation across biomembranes; passive transport, facilitated transport, active transport (Na^+ , K^+ and ATPase pump).

Unit- IV

Concept of viscosity, surface tension and their importance in cell ecology.

Unit-V

Introduction to Bioenergetics:- Thermodynamic, terms and basic concepts, first law of thermodynamics, formulation of first law of thermodynamics, relation between H and E, Second law of thermodynamics. Entropy, Helmholtz free energy, Third law of thermodynamics in brief.

Books:

1. Cantor & Freeman W.H. –Biophysical Chemistry.
2. Molecular cell biology – Ladish, Berk, Matsudara, Kaiser, Krieger, Zipursky, Darnell
(W.H. Freeman and Co.)
3. Biophysics - Cotrell (Eastern Economy Edition)
4. Clinical Biophysics: Principles and Techniques- P.Narayanan (Bhalani Pub., Mumbai)
5. Biophysics – Pattabhi and Gautham (Narosa Publishing House)

INTRODUCTORY CELL BIOLOGY & MOLECULAR

Unit- I

Cell as a basic unit of living organism- Development of cell theory. Eukaryotic and prokaryotic cells, cell division and cell cycle, anomalies in cell division, ultra structure of the cytoplasm, cytoskeleton microtubules, microtubular organelles, microfilaments The (endo membrane system), nuclear envelope, endoplasmic reticulum and golgi complex. Membrane organelles, mitochondria, chloroplast, lysozyme, peroxisomes. Molecular organization of cell membrane, passive and active transport, $\text{Na}^+\text{-K}^+$ pump, Ca^{2+} -ATPase pumps, lysosomal and vacular membrane. ATP dependent protein pumps, co-transport into prokaryotic cells, endocytosis and exocytosis, entry of viruses and toxins in to cells

Unit- II

Cell-cell interaction, receptors and models of extra-cellular signaling: cytosolic, nuclear and membrane bound receptors, autocrine, paracrine and endocrine model of action. Muscles and nerve cells, cell senescence and death, cell differentiation. Signal transduction: signal amplification and different models, cyclic AMP, role of inositol phosphatase messenger. Biosynthesis of inositol phosphatase messenger, cyclic GMP and glycoproteins in signal transduction. Calcium model of signal amplification, phosphorylation of protein kinases.

Unit- III

. Cell culture: Techniques of culturing of prokaryotic and eukaryotic cells, cell lines and cell line generation. Maintenance of cell culture, characterization of cell, immunochemistry, morphological analysis techniques in cell culture, primary cultures, contamination, differentiation and three dimensional culture.

Unit- IV

DNA and inheritance. Genetic and biochemical experiments to prove nucleic acid as a genetic material. Prokaryotes and Eukaryotes. Organization of genes. Coding and non-coding sequences. Unique, moderately repetitive and highly repetitive DNA sequence. Stellite DNA DNA replication in prokaryotes. Semi conservative mode of replication. Replication eye, forks, okazaki fragments and RNA primers. Different enzymes involved in DNA replication

Unit-V

Replication in E-coli. Initiaton, elongation and termination of replication. Fidelity of replication. Circular DNA. DNA polymerases. Inhibition of DNA replication , DNA repair of damages caused by different agents. Mutation and its types such as spontaneous, induced and point mutations. Chromosomes aberrations. Vectors and DNA recombinant technology. Restriction and endonucleases. Plasmid, cosmid cloning vectors. Molecular cloning and application of recombinant DNA technology.

Practicals:

Practicals based on above topics will be conducted.

Books:

1. Cell and Molecular Biology by De Robertis, Lea and Febig.

2. Cell and Molecular Biology by Baltimore, WH and Freeman, WH
3. Cell Biology by Kimble, T. W.

INTRODUCTION TO MOLECULAR BIOLOGY

Unit- I

Macromolecular Synthesis; Chromosome structure and replication-DNA structure, replication, Replication in bacterial chromosome. RNA structure and function, Transcription, Process of mRNA, tRNA, rRNA, Reverse transcription, ribosome structure.

Unit- II

Translation, Details of protein synthesis, regulation of protein synthesis with Lac operon model, inhibition of translation, post translation, modification of the protein.

Unit- III

Plasmids: Properties (Replication, functions of ori region incompatibility). Plasmid cloning vectors- Conjugation, Transformation. Bacteriophage – Transposition and Non homologous recombination.

Unit- IV

Recombinant DNA techniques and cloning- (a) Restriction endo nuclease and recombinant DNA (b) DNA cloning with restriction endo nucleases. (c) Cloning bacterial genes (d) Polymerase chain reaction (e) Genomics and cDNA library.

Unit- V

Mutation elementary concept; Types of mutations; Point mutations (Base pair change, frame shift, deletion, addition, translocation etc.).

Practical: Based on the above topics

Books

1. Molecular Biology by Freifelder D., Jones & Barilett Pub. Inc.
2. Genes VIII by Benjamin Lewin, Oxford Univ. Press, Oxford, NY, 1994.

MATHEMATICS

Unit- I

Sets, Number system (in brief), Complex numbers: addition, subtraction, multiplication, division, De-Moiver's theorem, finding roots of polynomial equation.

Unit- II

Sequences and series: definition of convergent, divergent and oscillatory sequence. Following results without proof. (i) A monotonic increasing sequence bounded above is convergent.

(ii) Geometric sequence $\{a_n\}$ is convergent if $-1 < r < 1$. Definition of convergent, divergent, oscillatory series. Convergence of i) geometric series, ii) P-series (without proof). Tests of convergence i) comparison test, ii) D'Alembert's ratio test (limit form), iii) Cauchy's root test (limit form). Taylor's theorem, Maclaurin's theorem (without proof). Power series expansion of e^x , $\sin x$, $\cos x$, $(1+x)^n$.

Unit- III

Partial Differentiation :-Maxima and minima (up to 2 variables). Rules of partial differentiation. Higher order partial derivatives

Matrices: Definition, types of matrices, addition, multiplication of matrices, inverse of a matrix. System of linear equations, row echelon form, rank of a matrix, homogeneous and non-homogeneous systems $AX = B$, consistency, Gaussian elimination method.

Unit- IV

Differential equations :- Limits, differentiation, integration (brief). Graphs of standard functions:- X , X^2 , X^3 , $1/X$, $\log X$, e^X Unit. Homogeneous and non-homogeneous differential equations, exact d.e. (including integrating factor). Linear differential equation. Applications to growth and decay, law of cooling.

Unit-V

Vector spaces:- \mathbb{R}^n and $M_{m \times n}(\mathbb{R})$, subspace of a vector space, linear dependence of vectors, eigenvalues and eigenvectors, diagonalization

References Books:

1. Mallick, S.C. and Arora Mathematical Analysis
2. Jenny Olive – Maths :- a self study Guide – Cambridge Low prices edition
3. R.G. Bartle and D.R. Sherbert (2nd edition)-1992, John Wiley, New York
4. E.D. Rainville and P.E. Bedient (1989), Elementary, Differential equations – McMillan, New York
5. System of Linear Equations
6. Eigen values and Eigen vectors
7. Partial Differentiation and differential equations
8. Sequences and series.

ENGLISH

Unit -I

Phonetics and Vocabulary:

Transcription of Phonetics Symbols, Words stress, Synonyms and Antonyms, Word Formation- Prefix, Suffix Grammar and usage : Transformation of sentences: Direct and Indirect Narration, Active and Passive Voice, Interchange of Degrees of Comparison, Modals

Unit- II

Comprehension, Sequences of Tenses, Elements of a Clause, Compositional Skills CVs and Job Applications , Paragraph Writing

Unit III

Letters- Formal and Informal Technical letter writing: Purpose of writing, space/layout, economy of words, use of verb/ passive voice, type face (italics, bold, underline) and use of indentation.

Unit IV

Report writing: Preparation, report structure (purpose of report, scope, shape, presentation of report, introduction of report, style of report and index of report). Public communication: meetings, planning and discussion, planning procedure, timing, degree of formality, behavior, repetitive, interviews (complexity of situation, preparation of thinking, preparation of setting, opening of the interview, style of interview).

Recommended Readings.

- I. Sasikumar, V., Dutta And Rajeevan, A Course in Listening and Speaking-I Foundation Books. 2005.
- II. Sawhney, Panja and Verma eds. English at the Workplace, Macmillan 2003.
- III. Singh, R.P. Professional Communication. OUP. 2004
- IV. Judith Leigh. CVs and Job Applications OUP. 2004.
- V. Arthur Waldhorn and Arthur Zeiger, English made Simple Rupa and Company. **Unit-I**

ELEMENTARY HUMAN PHYSIOLOGY

UNIT I

Animal cell structure. Tissues – structure and functions of various types of tissues. Organs and organ system.

UNIT II

Digestive system – Anatomy of oesophagus, stomach and small and large intestine and liver. Process of digestion. Excretory system – structure of kidney, ureter, urinary bladder urethra, functions of kidney, formation of urine and its composition. Endocrine glands – Role of hypothalamus, functions of pituitary, thyroid, adrenal glands, parathyroid and gonads.

UNIT III

Male and female reproductive systems. Physiology of conception, contraception, parturition and secretion of milk. Five sense organs and details of eye, ear. Physiology of hearing.

UNIT IV

Locomotor system. Types of joints function. Muscle types, physiology of muscular action. Circulatory system. Composition of blood and lymph, blood vessels. Structure of arteries, veins and capillaries. Blood groups and process of blood coagulation.

UNIT V

Respiratory system – Anatomy of various respiratory organs. Process of respiration. Transport and exchange of oxygen and carbon dioxide in body. Central nervous system. Physiology of nerve cell, brain and spinal cord. Functions of cerebrum, cerebellum and medulla oblongata.

Books Recommended:

1. Physiology of Human Body – Guyton.
2. Fundamentals of Anatomy and Physiology – Ross and Wilson.
3. Human Physiology – Chatterjee.

ELEMENTS OF GENETICS

Unit- I

Mendelism: Brief history of genetics and Mendel work, Mendelian laws, their significance and current status, chromosomal theory of inheritance. Genetic interaction: supplementary genes, complementary genes. Duplicate genes, epistasis, inhibitory and polymorphic genes.

Unit- II

DNA is a genetic material, DNA and RNA structure and type, nucleic acid, sugars, phosphodiester bond. nucleosome structure, euchromatin, heterochromatin, satellite DNA, telomeres, centromeres. Polytene chromosome and lamp chromosome. Genetic code, triplet codon, characteristics of triplet codon.

Unit- III

Chromosomal mutation: classification of chromosomal mutations, translocation, inversion, deletion and duplication. Variation in chromosome numbers, haploidy, diploidy, polyploidy, aneuploidy, euploidy and polysomy. Linkage and crossing over. Hereditary defects: Klinefelter syndrome, Down syndrome. Applications of polyploidy

Unit- IV

Mitosis: phases and process of mitosis structure and function of spindle apparatus, anaphasic movement. Meiosis: phases and process of meiosis synapses and synaptonemal complex, formation and fate of chiasmata and significance of the crossing over. Interphase nucleus and cell cycle: S,G1,G2 and Mphase.

Unit-V

Microbial Genetics: Recombination in bacteria: Molecular mechanism of recombination.

Transformation, Transduction (Generalized and Specialized), Conjugation. Cytoplasmic inheritance.

Practicals: Based on the above topics

Books:

1. Genetics: Ahluwalia, K.B. Wiley Eastern Ltd New Delhi.
2. Genetics: Altenbery Oxford and IBH, New Delhi
3. Genetics: Gupta P.K
4. Principles of Genetics: Gardner E.J: Wiley Eastern New Delhi

Second Year

INTRODUCTORY PLANT BIOCHEMISTRY

UNIT I

Scope and importance of biochemistry in plants. Plant cell and its organelles with particular reference to structure and functions. Major metabolic pathways and their importance.

UNIT II

Photosynthesis, dark respiration and photo respiration. Regulation of photosynthesis and partitioning of assimilates. Nitrogen cycle. Symbiotic and asymbiotic nitrogen fixation. Nitrogenase and mechanism of nitrogen fixation. Industrial photosynthesis.

UNIT III

Phytochromes and its role. Ammonia and sulfate assimilation. Biosynthesis of sucrose, cellulose, starch and other polysaccharides.

UNIT IV

Plant pigments synthesis and degradation. Secondary metabolites synthesis and role. C3, C4 and CAM plants and their relation with productivity.

UNIT V

Auxins, gibberellins, cytokinins, ABA and ethylene. Mechanism of action, synthesis and catabolism. Toxic principles. Pest and disease resistance.

Books Recommended:

1. Plant Biochemistry – Dey and Harbone.
2. Plant Biochemistry and Molecular Biology – Helott.
3. Outlines of Biochemistry – Conn and Stumpf.
4. Biochemistry – Stryer.

ORGANIC CHEMISTRY

UNIT I

Importance of organic chemistry in everyday life. Methods of purification of organic compounds. Qualitative and quantification OF elemental analysis. Molecular, empirical and structural formulae.

UNIT II

Types of hybridization, atomic and molecular orbitals, shapes of organic molecules. Bond length, strength and energy, hydrogen bonding, bond moment and dipole moment.

UNIT III

Electronic displacement, electronic, hyper conjugative and resonance effects. Hemolytic and ionic reactions, nucleophiles and electrophiles in relation to biological systems. Characteristics and types of organic reactions. Additions, eliminations, substitutions and rearrangements. Aldol condensation. Markownikooof's rule.

UNIT IV

Stereo isomerism, geometrical isomerism and methods of determining the geometry. Optical isomerism. Specific and molar rotation. Chirality and chiral molecules. D and L isomers. Absolute configuration.

UNIT V

Preparation of aromatic hydrocarbons, halogen derivatives, nucleophilic substitution. Nitrobenzene, amines, diazonium salts and their reactions. Structure, synthesis and importance of naphthalene, anthracene and phenanthrene and their derivatives. Carcinogenicity.

Books Recommended:

1. Organic Chemistry – I.L. Finar.
2. Universal General Chemistry – Rao CNR.

CLINICAL BIOCHEMISTRY

UNIT I

Preparation of solutions and buffers. Specimen collection and processing (blood, urine and faeces). Anticoagulant and preservatives for blood and urine. Transport of specimens. Blood Chemistry: Spectroscopic examination of blood. Estimation of glucose, urea, uric acid, creatinine, cholesterol, bilirubin. Estimation of sodium and potassium in serum. Preparation of derivatives of hemoglobin.

UNIT II

Diseases related to carbohydrate metabolism. Blood glucose regulation, hypo and hyper glycemia. Diabetes mellitus types. Clinical features. Metabolic changes. Glycosuria, galactosemia and fructosuria. Glycogen storage diseases. Diseases related to amino acids and nucleic acids metabolism. Etiology and clinical manifestation of phenyl ketonuria, cystinuria, alkaptonuria, Fanconi's syndrome, albinism and tyrosinemia, hypo and hyperuricemia, Gout.

UNIT III

. Serum lipids in diseases with particular reference to cholesterol, lipidosis, triglyceridemia, hypo and hyper cholesterolemia. Clinical features of atherosclerosis and fatty livers. Liver function tests. Metabolism of bilirubin, jaundice types. Clinical features and test based on bile. Pigment level in blood and urine. Differentiation of three types of jaundice

UNIT IV

Gastric function tests. Collection of gastric contents. Examination of gastric residue, FTM, stimulation tests, tubeless gastric analysis. Renal functions and tests. Urea, creatinine, inulin, PAH test, concentration and dilution tests.

UNIT V

Clinical enzymology. Functional and non-functional plasma enzymes. Isoenzyme and diagnostic tests. Enzyme patterns in acute pancreatitis, liver damages, bone disorders, myocardial infarction and muscle wasting. Tumor markers produced by various tissues. Classification and clinical application.

Books Recommended:

1. Clinical Biochemistry – Hoffmann.
2. Practical Clinical Biochemistry – Harold Varley.
3. Text Book of Medical Biochemistry – Chatterjee and Shinde.
4. Biochemistry with clinical correlation – Devlin.
5. Practical Clinical Biochemistry – Harold Varley.
6. Clinical Biochemistry – William Hoffman.
7. Text book of Medical Biochemistry – Chatterjee and Rana Shinde.

NUTRITIONAL BIOCHEMISTRY

UNIT I

Introduction to food and nutrition. Basic food groups. Energy and its forms. Energy requirements for different persons. Energy yielding principles. Determination of energy value of foods by different methods. RQ of foods.

UNIT II

Nutritive value of proteins and biological value of plant and animal foods. Protein sparing action. Single cell proteins. Preventive and curative measures of protein caloric malnutrition. Different approaches for protein quality evaluation. Essential, semi-essential and non-essential amino acids for different species.

UNIT III

Nutritional and physiological roles of energy yielding principles. Fat and water soluble vitamins. Macro and micro minerals. Balanced and recommended daily allowance for different age groups of human beings. Geriatric nutrition.

UNIT IV

Nutritional diseases arising due to under and over consumption of carbohydrates, protein, fats, vitamins and minerals.

UNIT V

Food preservation. Mechanism of action of preservatives. Food irradiation. Development of foods for military and space persons. Post harvest changes in foods. Principal changes taking place after death of animals. Food adulteration.

Books Recommended:

1. Text Book of Physiology and Nutrition – M. Swaminathan.
2. Illustrated Physiology – Mackenna.
3. Nutritive Value of Indian Foods – Gopalan et al.
4. Applied Nutrition – R. Rajalakshmi.
5. Biochemistry – Voet and Voet.

ELEMENTRY BIOCHEMISTRY

UNIT I

Water as a biological solvent. Weak acids and bases. pH and physiological buffers. Importance and biochemistry in daily life.

UNIT II

Structures of important monosaccharides, disaccharides and polysaccharides. Optical isomerism and stereo isomerism. Reactions of monosaccharides. Important derivatives of carbohydrates. Homo and hetero polysaccharides. Blood group substances. Bacterial cell wall polysaccharides. Glycoproteins.

UNIT III

Lipids and classification of lipids. Classification, structure and properties of saturated and unsaturated fatty acids. Essential fatty acids and prostaglandins. Structure, importance of phospholipids. Steroids, glycolipids and sphingomyelins.

UNIT IV

Classification of proteins and amino acids. Structure and chemical properties of amino acids. Primary, secondary, tertiary and quaternary structure of proteins. Essential, semi-essential and non-essential amino acids.

UNIT V

Nucleic acids and their structure, functions and properties. Features of DNA double helix. Central dogma of molecular biology. Size of DNA in prokaryotic and eukaryotic cells. Genetic code and its features. Different types of RNA and DNA. Porphyrins and heme pigments and their physiological significance.

Books Recommended:

1. Biochemistry – Lubert Stryer.
2. Biochemistry – Power and Chatwal.
3. Biomolecules – M.P. Arora.

BIOSENSORS

UNIT I

Introduction to biosensors. The analyte, biological component, methods of immobilization and transducers. Performance factors. Application of biosensors in health care, regulation of industrial processes and environmental monitoring.

UNIT II

Use of enzymes, antibodies, nucleic acid and receptors as biosensors with suitable examples. Different techniques employed for immobilization of biological components used as biosensors.

UNIT III

Useful electro chemical processes employed as transducers in biosensors namely potentiometry, voltametry, conductimetry, light scattering, chemiluminescent and laser Doppler velocimetry.

UNIT IV

Piezoelectric crystals. Quartz crystals micro balance. Acoustic wave modes. Performance factors namely range, reproductibility, life time, response time, etc.

UNIT V

Three generations of biosensors. Experimental examples of biosensors and their commercial application. Stages in the development of a new biosensor and desirable attributes of markable biosensor.

Books Recommended:

1. Biosensors – an introduction: Brian E. Eggins.

BIOPHYSICAL AND BIOCHEMICAL TECHNIQUES

UNIT I

Measurement of solutes in solution. Preparation of solution and buffers. pH concept and its measurement in body fluids. Amino acid and proteins and other physiological buffers. Viscosity and surface tension. Electrochemical techniques. Use of pH meters and different types of electrodes. Centrifugation and knowledge of differential density gradient, isopycnic. Use of ultracentrifuge for molecular weight determination.

UNIT II

Different chromatographic techniques, principles, operational procedures and application. Paper, column, thin layer, ion exchange, affinity, gas liquid, molecular exclusion and high performance liquid chromatography, Electrophoresis and its general principles. SDS PAGE and molecular weight determination of protein. Banding pattern of protein, nucleic acids and other biomolecules. Immuno electrophoresis. Factors affecting electrophoretic separations

UNIT III

Analysis of macro and trace minerals by flame photometer and atomic absorption spectrophotometers. Sensitivity of various techniques for quantification of biomolecules. Biosensors and their applications in day to-day life.. Electromagnetic radiation. Light absorption and its transmittance. UV and visible spectroscopy. Single beam and double beam spectrophotometers – their principles, instrumentation and application

UNIT IV

. Principle, instrumentation and application of fluorimetry in analysis of vitamins, enzymes and toxins. Fluorescent probes and their uses in structural studies of proteins and nucleic acids, Handling of radioisotopes. Safety aspects and units of radioactivity. Autoradiography. Characteristics of radiation. Radioactive decay and characteristic of radionuclide. Measurement of radioactivity by proportional, liquid and solid scintillation counters. Quenching in counting. Elucidation of metabolic pathways and commonly used radioisotopes. Application of radioisotopes in biological sciences.

UNIT V

Immunological techniques. ELISA and ELOSA. Immunodiffusion assay. Monitoring of enzymes by different techniques. Microscopy and its basic principles. Light, phase, contrast, dark field and electron microscopy.

Books Recommended:

1. Practical Biochemistry – Sawhney and Singh.
2. Instrumental Methods of Analysis – Chatwal and Anand.
3. Biophysical Chemistry – Upadhyaya and Upadhyaya.
4. Practical Biochemistry – Wilson and Walker.
5. Biochemistry – Voet and Voet.
6. Practical Biochemistry – Sawhney and Singh.

BASIC INTERMEDIARY METABOLISM

UNIT I

General features of metabolism. Various techniques to study metabolism. Bioenergetics.

UNIT II

Major metabolic pathways of carbohydrate metabolism. Glycolysis, TCA cycle and hexose monophosphate pathway and their energetics. Glucogenesis, glycogenesis and glycogenolysis.

UNIT III

Electron transport chain, oxidative phosphorylation. Inhibitors and uncouplers of oxidative phosphorylation. Biosynthesis of purines and pyrimidines. Sources of atoms in purine and pyrimidines.

UNIT IV

Metabolism of fats. B-oxidation theory of fatty acids and its energetic. Synthesis and utilization of ketone bodies. Oxidation of unsaturated and odd chain fatty acids.

UNIT V

Decarboxylation, transamination and oxidative deamination of amino acids. Glycogenic and ketogenic amino acids. Urea cycle and elimination of nitrogen.

Books Recommended:

1. Biochemistry – Voet and Voet.
2. Physiological Reviews of Biochemistry – Harper.
3. Biochemistry – Lubert Stryer.

Third Year

MEMBRANE BIOCHEMISTRY

UNIT I

Plant, animal and microbial membranes. Chemical composition of biomembranes. Preparation of liposomes and micelles. Red cell membranes. Signal transduction.

UNIT II

Transport across cell membranes. Simple diffusion, facilitated diffusion. Active and passive transport. Fick's law. Carrier molecules. Kinetics of transport. Co-transport, anti-transport and uniport. $\text{Na}^+ - \text{K}^+$ pumps. Gap and tight junction.

UNIT III

Membrane receptors – types and function. Peptide and steroid hormones regulation through receptors and cascade mechanism.

UNIT IV

Structure and composition of bacterial and plant cell membranes. Synthesis and packaging of cell wall constituents. Importance and utilization of cell wall, constituents in animal system.

UNIT V

Membrane bound enzymes and their regulations. Differential behavior of cell membranes in food systems. Commercial use of biomembranes in industrial processes.

INDUSTRIAL BIOCHEMISTRY

UNIT I

Biomolecules like pectin, gluten, cellulose, etc. that revolve industrial processes. Better understanding of textile, leather, baking, brewing, enzyme and dairy industrial processes involving biochemistry.

UNIT II

Biotechnology and biochemistry in medicine. Pharmacogenomics. Drug designing, discovery and detoxification. In vitro fertilization and related techniques.

UNIT III

Application of biochemical and biotechnological tools in forensic science, information technology. Metagenomics and proteomics.

UNIT IV

Cloning by tissue culture. Improvement of cultivars by plant genetic engineering. Improving quality of biopesticides. Improvement of animal breeds. Industrial enzymes.

UNIT V

Polymerase chain reaction for amplification of DNA. Molecular basis of plant and animal diseases. Production of biomolecules of human and animal interests. Knowledge of national and international standards presently existing for various commodities.

Books Recommended:

1. Elements of Biotechnology – P.K. Gupta.
2. Introduction to Biodeterioration – Allsopp and Seal.
3. Bioinformatics – Higgins and Taylor.

BASICS OF IMMUNOLOGY

UNIT I

Immunity and its types. Innate immunity and its determinants. Acquired immunity, active and passive immunity. Commonly used toxoid vaccines, killed vaccines, live attenuated vaccines, bacterial polysaccharide vaccines.

UNIT II

Humoral and cellular immunity, Immunoglobins – structure and functions. Types of antibodies.

UNIT III

Antigens – nature, immunogens, paptens, cells involved in antibody formation, differentiation of lymphocyte, clonal selection theory, cooperation of T-cell with B-cell, recreation of antibody, genetic basis of antibody diversity.

UNIT IV

Antigen antibody interactions in vivo and in vitro. Complement fixation reaction. Monoclonal antibody preparation and application in biology.

UNIT V

Immunological disorders. Immunological tolerances and immune suppression. Hypersensitivity and allergy. Histocompatibility antigens. Auto immune diseases. Transplantation immunity.

Books Recommended:

1. Essential Immunology – Roitt.
2. Immunology – Weir.
3. Text book of Micorbiology – Ananthan aray anan and Panicker.

INTRODUCTORY BIONANOTECHNOLOGY

UNIT I

Overview of Bionanotechnology. Bionanomachines in action. Molecular recognition, cellular communication. Biotransformation. Storage and reading of information in the cell.

UNIT II

Bioenergetics, bioelectromagnetism, biomechanics, Neurotransport, Biological rhythms. Modern macro biomolecules.

UNIT III

Recombinant DNA technology, monoclonal antibodies. Molecular modeling and biomolecular structure determination.

UNIT IV

Structural principles of bionanotechnology, natural bionano machinery, hierarchical strategy, raw materials, protein folding, self assembly and self organization, molecular recognition and flexibility.

UNIT V

Functional principles of bionanotechnology, Information driven nanoassembly, energetics, chemical transformation, Regulation, Biomolecular motors, Biomolecular sensing, self replication and machine-phase bionanotechnology. Nanomedicine today, DNA computers, hybrid materials, artificial life and biosensors.

Books Recommended:

1. Biophysics – Patabhi and Gautham
2. Nanotechnology:- Concepts, application and perspective – Niemeyer and Merkin
3. Bionanotechnology :- Lesson from nature – Good Self and David

ENVIRONMENTAL BIOCHEMISTRY

UNIT I

Air pollution. Particulate matter. Compounds of carbon, sulphur, nitrogen and their interactions. Carbon nitrogen and sulphur cycles in nature. Quantitative estimation of carbon, sulphur and nitrogen.

UNIT II

Water pollution. Major pollutants in domestic, agricultural and industrial wastes. Effects of pollutants on animal and plants.

UNIT III

Pollution of water by microorganisms. Bacteriological analysis of water-sewage treatment in domestic and industrial circles.

UNIT IV

Toxic chemicals in environment and their effect on enzyme system. Biochemical effects of heavy metals. Biochemical effects of insecticides, pesticides and weedicides on human and animal health.

UNIT V

Bioremediation for environment, clean up bio mass utilization and microbial degradation of xenobiotics. Noise pollution and its control.

Books Recommended:

4. Environmental Biology – P.D. Sharma.
5. Environmental Chemistry – A.K. De.
6. Chemicals in Environment – V. Mydo and M. Satak.

INTRODUCTION TO BIOSTATISTICS

Unit-I

Introduction to statistics with scope in biosciences (examples). Statistics and statistical data: various types of data (Raw data, grouped data). Representation of data using frequency distribution diagram (Simple/Multiple/Subdivided bar diagram, Pie diagram), Graphs (Histogram, polygon, curve) Population, sample, sampling methods (SRS, Stratified sampling).

Unit-II

Descriptive statistics (a) Measure of central tendency: Mean (Definition & simple problems), Median, Quartiles (Definition, Graphical calculation). Mode (Definition, graphical calculation). Situations where one is preferred over others. (b) Measures of dispersion: Variance (Definition, simple problems). Standard deviation. Coefficient of variance. (c) Skewness (Definition, types of skewness and graphical representation, no formula, and real life example), (d) Kurtosis (Definition, types of Kurtosis, graphical representation, no formula, and real life example).

Unit-III

Probability (a) Classical definition and its limitations, axiomatic approach (laws of probability only statement and no proof) (b) Independence and conditional probability (real life examples in biology). Standard probability distribution (a) Binomial (Definition, biological example, additive property (only statement), simple examples). (b) Poisson (Definition, biological example), additive property (only statement), simple examples. (c) Normal (Definition, biological example), linear property (only statement, simple examples (using statistical tables), central limit theorem).

Unit-IV

Inferential statistics (a) Hypothesis- definition, types (one tailed, two tailed). (b) Sampling distribution and errors (c) Types of errors (Type I, II). Testing of hypothesis (two tailed only). (a) For mean (one population), Mean (2 populations- dependent and independent) (b) For variance (one population), Variance (2 populations) (c) Chi-square test), fitting of distribution. Independence of attributes. ANOVA 1) one way, 2) two way followed by t test (pair wise).

Unit-V

Correlation (Definition, types of correlation with simple biological problems). Scatter diagram. Covariance Multiple correlation (definition, formula when matrix is given). Partial correlation (definition, formula when matrix is given).

Books

1. Mallick, S.C. and Arora Mathematical Analysis
2. Jenny Olive – Maths :- a self study Guide – Cambridge Low prices edition
3. R.G. Bartle and D.R. Sherbert (2nd edition)-1992, John Wiley, New York
4. E.D. Rainville and P.E. Bedient (1989), Elementary, Differential equations – McMillan, New York
5. System of Linear Equations
6. Eigen values and Eigen vectors
7. Partial Differentiation and differential equations

FUNDAMENTALS OF BIOINFORMATICS

Unit- I

Introduction to database, Flat file data base, relational database: object oriented databases.

Unit -II

Sequence analysis and phylogeny: Internet sequence on the net- sequence DNA, RNA and protein, determination of protein structure, gene and protein expression data- protein interaction data. File formats-sequences databases- genome and organism specific database- retrieval, entrez, SRS; similarity searches- amino acid substitution matrices- FASTA, BLASTA- various types of BLAST.

Unit- III

Multiple sequence alignment, protein families- protein domain families. Building trees- evolution of macro molecular sequences-genome annotaton.

C-language: introduction, operators, expressions, variables, input, output statements, control statement, function, arrays, pointers, structures, unions, file handling and case studies. Introduction to PERL, variables, strings and numbers, lists analysis, hashes, conditional loops, pattern matching and application.

Unit- IV

Introduction to structural database- models of protein structure- structure, function and relationship, structural alignment- classification of 3D structure. CATH and SCOP- concepts in protein prediction.

Unit- IV

Micro array data and analysis: tools and resources, proteomics data analysis, Bioinformatics in drug discovery.

Books:

1. Bioinformatics 1998. Baxevanis.
2. Bioinformatics 2000. Higgins & Taylor. OUP.
3. Nucleic Acids Research. 2001. Jan. Genome Database issue.
4. Introduction to Bioinformatics- Attwood.
5. Instant Notes in Bioinformatics.

ENZYMOLGY FOR BEGINNERS

UNIT I

General features, nomenclature and classification of enzymes. Intracellular localization of enzymes. Metallo enzymes. Measurement of enzyme activity and its expression. Enzyme units.

UNIT II

Acid-base catalysis and covalent catalysis. Enzyme specificity. Role of various cofactors in enzyme catalysis. Metal ions as enzyme inhibitors and activators.

UNIT III

Extraction and purification of enzymes by using various techniques. Tests for purification and characterization.

UNIT IV

Factors affecting enzyme activity. Reversible, irreversible, competitive, non-competitive, uncompetitive and mixed types of inhibition. Michaelis-Menton equation. K_m and its significance. Line Weaver-Burk plots and its limitation.

UNIT V

Industrial and clinical applications of enzymes. Use of enzymes in food, Feed, dairy, leather, textile and drug industries. Enzyme electrodes. Solid state chemistry and enzymes.

Books Recommended:

1. Enzymes – Palmer.