DEPARTMENT OF BIOCHEMISTRY
PERIYAR UNIVERSITY
PERIYAR PALKALAI NAGAR
SALEM - 636 011

M.Sc. Biochemistry Syllabus

(Applicable to students admitted from the Academic year 2014-2015 onwards under CBCS)

Structure of M.Sc. Biochemistry Degree Course

The Department of Biochemistry aims in developing human resources in Biochemistry and to expand and transfer knowledge in particular to the rural community based in and around Salem district of Tamil Nadu, India.

Every biological phenomenon is to be explained ultimately in terms of biochemical changes at the molecular level. Hence in-depth knowledge of biochemistry at molecular level is required for biological scientist. With the strong and systematic knowledge proposed to be imparted in this program, the graduated student will be able to understand the objectivity and to apply the same effectively in the field of Biochemistry and its allied field properly.

There is a greater demand globally, for trained manpower in the areas of Biochemistry for Research and Development in multinational companies, public sectors, quality control labs, biopharmaceutical companies, food industries as well as in universities.

The course designed has component of summer training giving opportunities to students to get experience and exposure in academic and research institutes and in industries.

Aims and objectives of the course

The course aims to provide an advanced understanding of the core principles and topics of Biochemistry and their experimental basis, and to enable students to acquire a specialised knowledge and understanding of selected aspects by means of a stem/branch lecture series and a research project. The course aims to develop the key transferable skills required in scientific work which includes practical research skills, analytical and presentation skills and advanced scientific methods. The goal is to enhance one's knowledge and to benefit the student's future endeavors within all areas of the life sciences, and in their day-to-day personal lives as well.

- To provide foundation for a better understanding of biological molecules both individually and as a members of more complex structures.
- To provide training and research in the current fields of Molecular biology, genetic engineering, enzymology, down stream processing etc.
- To produce graduates qualified for careers in teaching and research in biochemistry in academic, research and industrial settings.
- To impart laboratory expertise in modern biochemical techniques, including the ability to analyse data and prepare scientific reports.

A two years M.Sc. program is formulated for developing competent biochemists for whom significant job opportunities exist in this country. The course is based on interdisciplinary nature of Biochemistry, Quantitative Biology, Genetics, Microbiology and

Biophysics. The program obliges students to read original publications and envisages significant inputs in laboratory work, communication skill, creativity, planning, execution and critical evaluation of the studies undertaken. This program gives common basic knowledge (Cell Biology, Membrane Biochemistry, Enzymology, Immunology, Molecular Biology, Genetic Engineering, Biostatistics and Bioinformatics, Neurochemistry and Clinical Biochemistry) to become a good biochemists.

It is also suggested that every student undertake one hour library work under the supervision of faculty members. It is envisaged that the research projects (dissertation) and specializations will inculcate aptitude for research and practical applications. The students will also have basic inputs on communications skills and computers knowledge (information technology) and learn the basics of scientific writing and presentation.

Self study courses

To mould student's skills and individuality, this course extends certain opportunities as self learning courses.

- Summer Project for 30 days.
- Training in multispecialty hospitals for 30 days.
- Group project on developing and marketing a product.

Eligibility for admission into this course

Eligibility for Admission: Graduates in Biochemistry, Chemistry, Microbiology and Life Sciences as principle subject or Biochemistry as subsidiary subject are eligible for admission to the course.

Duration of the course: Two year degree programme

Teaching methodologies

The classroom teaching would be through conventional lectures and use of OHP and Power point presentations. The lecture would be such that the students should participate actively in the discussion, students seminars would be conducted and scientific discussions would be arranged to improve their communicative skill.

In the laboratory, instructions will be given for the experiments followed by demonstration and finally the students have to do the experiments individually. Periodic tests will be conducted for the students. Slow learners will be given special attention.

Examinations

There shall be four semester examinations. Two in the first year and two in the second year. Candidates failing in any subject will be permitted to appear for such failed subjects at subsequent examination. The syllabus has been divided into 4 semesters. The examination for the Semester I & III will be held in November/December and that for the Semester II and IV will be in the month of April/May.

The Practical examination will be conducted at the end of each semesters. Candidates failing in any of the practical examination will be permitted to appear for such failed practical examination at subsequent practical examination.

Scheme of Examination

Theory	External : 75 Marks	
	Internal : 25 Marks	
	Three tests	10 Marks
	Seminar	5 Marks
	Assignment	5 Marks
	Attendance	5 Marks
Practical	External : 60 Marks	
	Internal : 40 Marks	
	Practical test	30 Marks
	Record	5 Marks
	Attendance	5 Marks

Pattern of question paper

Part A : Answer All 5 Questions either or type 5 x 5 = 25 marks
Part B : Answer All 5 Questions either or type 5 x 10 = 50 marks

Duration of the examination - 3 hours Maximum marks – 75

PERIYAR UNIVERSITY
SALEM – 636 011.
M.Sc. BIOCHEMISTRY
Curriculum and Scheme of Examination

(APPLICABLE TO STUDENTS ADMITTED FROM THE ACADEMIC YEAR 2014-2015 UNDER CBCS)

Semester	Subject code	Title of the Paper	Instruction hrs/week	Exam Marks			Duration of Exam (Hrs)	Credits
				CIA	EA	Total		
I	14BCHC01	Biomolecules	5	25	75	100	3	4
	14BCHC02	Analytical Techniques	5	25	75	100	3	4
	14BCHC03	Advanced Enzymology	5	25	75	100	3	4
	14BCHC04	Cell and Molecular Biology	5	25	75	100	3	4
	14BCHE01	Elective I (Major)	5	25	75	100	3	4
	14BCHP01	Core Practicals I	5	40	60	100	6	4
II	14BCHC05	Intermediary Metabolism	5	25	75	100	3	4
	14BCHC06	Plant Biochemistry	5	25	75	100	3	4
	14BCHC07	Molecular Biology	5	25	75	100	3	4
	14BCHP02	Core Practicals II	6	40	60	100	6	4
	14BCHE02	Elective II (Major)	5	25	75	100	3	4
	14BCHS01	Supportive I (Non-Major)	4	25	75	100	3	4
III	14BCHC08	Genetic Engineering	5	25	75	100	3	4
	14BCHC09	Advanced Clinical Biochemistry	5	25	75	100	3	4
	14BCHC10	Biostatistics	5	25	75	100	3	4
	14BCHP03	Core Practicals III	6	40	60	100	6	4
	14BCH3E2	Elective III (Major)	5	25	75	100	3	4
	14BCHS02	Supportive II (Non-Major)	4	25	75	100	3	4
IV	14BCHC11	Immunology	5	25	75	100	3	4
	14BCHC12	Drug Biochemistry and Clinical Toxicology	5	25	75	100	3	4
	14BCHP04	Core Practicals IV	5	40	60	100	6	4
	14BCHPR01	Project and Viva-voce	15	40	60	100	-	6

Subjects	**Total Marks**	**Total Credits**
Core paper/Practical /Project (17)	1700	70
Major Elective (3)	300	12
Non -Major Supportive (2)	200	08
Grand Total	2200	90

Elective courses

1. Molecular Endocrinology
2. Cancer Biology
3. Human Physiology
4. Microbiology
5. Nanotechnology
6. Bioprocess Technology
7. Nutritional Biochemistry
8. Genomics and Proteomics
9. Biotechnology
10. Industrial Biochemistry

Supportive courses for other Departments

1. Tools and Techniques in Bioscience
2. Medical Lab Technology
3. Clinical diagnosis in health and diseases
4. Introduction to Biochemistry

BIOMOLECULES

UNIT-I
Carbohydrates

Monosaccharides, Disaccharides and Polysaccharides: structure, occurrence, properties and biological functions. Homoglycans : structure, occurrence, properties and biological functions of glycans, chitin, fructans, mannans, arabinans, and galacturonans. Heteroglycans and complex carbohydrates : structure, occurrence, properties and biological functions of mucopolysaccharides – bacterial cell wall polysacharrides and sialic acid. Lectins – characteristics and uses, Blood group antigens, Major classes of glycoproteins: O-linked and N-linked oligosaccharides.

UNIT-II
Proteins

Proteins a biological machinery: Amino acid structure, peptide bond, peptides. Physical interactions that determine the properties of proteins – shot range repulsions, electrostatic forces, van der waals interaction, hydrogen bond and hydrophobic interactions. Primary structure and its determination. The Ramachandran plot and cross links. Secondary structure : The α-helix, 3_{10} and π-helix, β-sheets, reverse turns and super secondary structures. Tertiary structure and quaternary structure : Myoglobin and hemoglobin, Collagen. Corey model for fibrous proteins.

UNIT-III
Lipids

Classification of lipids. Saturated and unsaturated fatty acids. Derived lipids: Phospholipids, glycolipids, structure and function. Eicosanoids- structure and biological actions of prostaglandins, prosracyclins, thromboxanes, leukotrienes and lipoxins. Lipoproteins-Classification and composition. Amphipathic lipids – membranes, micelles, emulsions and liposomes..Lipid and protein composition of biomembranes.

UNIT-IV
Nucleic Acids

Bases, nucleosides and nucleotides, structure of nucleic acids. RNA : Types of RNA, secondary and tertiary structure. Structure of dsDNA : B,A,C, Z DNA, properties of dsDNA, Chemicals that react with DNA, DNA sequencing procedures- Maxam Gilbert method and Sanger's dideoxy methods. Renaturation and denaturation. DNA bending: The Wedge model and Junction model . Protein induced bending. Crucifrom DNA, Left handed DNA, Triple-stranded DNA.

UNIT-V
Vitamins and Porphyrins

Water soluble - thiamine, riboflavin, niacin, pyridoxine, folic acid, ascorbic acid-sources, structure, biochemical functions, deficiency diseases, daily requirements. Fat soluble - vitamin A, vitamin D_2, vitamin E and vitamin K - sources, structure, biochemical functions, deficiency diseases, daily requirements. Porphyrins the porphyrin ring system, chlorophyll, hemoglobin, myoglobin and cytochrome

Text Books

1. Nelson,D.L. and Cox,M.M. 2013**.** Lehninger Principles of Biochemistry, 6th Edition, W.H. Freeman & Co.
2. Berg,J.M. *et al*., 2012. Biochemistry, 7th Edition, W. H. Freeman & Co.
3. Voet,D. *et al.,* 2012. Fundamentals of Biochemistry: Life at the Molecular level, 4th Edition, John Wiley and Sons.

Reference Books

1. Zubay,G.L. 1998. Biochemistry, Wm.C. Brown Publishers.
2. Sinden,S.R. DNA structure and function, First Edition**,** Academic Press, 1994.
3. Carl Branden and John Tooze, Introduction to Protein Structure, Second Edition, Garland Publishing, 1999.
4. Garrett,R. and Grisham,C. 2010. Biochemistry, 4th Edition, Saunders College Publishing.

ANALYTICAL TECHNIQUES

UNIT-I
Electrochemical techniques and Microscopy

Principles, electrochemical cells - pH, Henderson - Hasselbalch equation, buffer capacity, pH measurement, glass electrode. Ion-selective and gas sensing electrodes, oxygen electrode - principle and application. Biosensors. Microscopy - bright field, darkfield, fluorescence and phase contrast microscope. Scanning and transmission electron microscopy.

UNIT-II
Chromatography & Radioisotope techniques

Principle, Instrumentation and applications- Paper, Thin layer, gas, Ion Exchange, gel filtration, Affinity chromatography- immunoaffinity, HPLC, RF-HPLC, HPTLC, FPLC, LC, Chromatofocusing, capillary electrochromatography

Measurement of radioactivity – solid and liquid scintillation counting, scintillation cocktails and sample preparation, Autoradiography, Fluorography, Phosphor-imaging - applications, cerenkov counting, autoradiography, applications of radioisotopes in biology, radiation hazards and safe disposal of radioactivity waste.

UNIT-III
Electrophoresis

Principle, Instrumentation and applications- General principle, migration of charged particle in an electric field, factors affecting mobility, Electrophoresis of proteins- native-PAGE, SDS-PAGE, 2D-PAGE, gradient gels, isoelectric focusing gels, detection, estimation & recovery of proteins in gels; electrophoresis of nucleic acids- agarose gel electrophoresis, pulse field electrophoresis, capillary electrophoresis; microchip electrophoresis, Cellulose acetate electrophoresis, Di electrophoresis, Zymography.

UNIT-IV
Spectroscopy

Principle, Instrumentation and applications- Atomic absorption spectroscopy and Atomic emission spectroscopy , UV-Visible, Spectrofluorimetry, Flame and Flameless Photometry, Nephlometry, Turbidometry, Luminometry, Infra Red, Electron Spin Resonance, Nuclear Magnetic Resonance, Mass Spectrophotometry, Lasers for spectroscopy-MALDI TOF.

UNIT-V
Centrifugation

Basic principles of sedimentation; types of centrifuge; types of rotor; preparative and analytical centrifugation – types and its applications, CsCl density gradient and sucrose gradient centrifugation – principle, application, sub cellular fractionation- disruption of cells, isolation of sub cellular organelles from liver and plant cells and marker enzymes, determination of relative molecular mass – sedimentation velocity and sedimentation equilibrium.

Text Books

1. Wilson,K. and Walker,J. 2005. Principles and Techniques of Practical Biochemistry, 6th Edition , Cambridge University. Press.
2. Upadhyay,A. Upadhyay,K. and Nath,N. 2009. Biophysical Chemistry: Principles and Techniques, Third Edition, Himalaya Publishing. 11th Edition
3. Sharma,B.K. 1981. Instrumental Methods of Chemical analysis, 5th Edition Goel Publications.

Reference Books

1. Friefelder,D. Physical Biochemistry - Application of Biochemistry and Molecular Biology, Second Edition, W.H.Freeman and Co., 1999.
2. Skoog, D.A. and Leary,J.J. Principles of Instrumental Analysis, Fourth Edition, Saunders College Publishing, 1992.
3. Boyer,R. Modern Experimental Biochemistry, Benjamin Cummings, Third Edition, An imprint of Pearson Education, 2001.
4. Homie,D.J. and Peck,H. Analytical Biochemistry, Third Edition, Longman group,1998.

ADVANCED ENZYMOLOGY

UNIT-I
Classification, Coenzymes and Purification

Enzyme - Classification and general properties like effect of pH, substrate and temperature on enzyme catalysed reactions.
Coenzymic action of NAD, FAD, TPP, PLP, Biotin, CoA, folic acid and lipoic acid
Purification of enzymes - Methods to isolate and purify enzymes, assays, activity units, Specific activity.
Multienzyme complex and multifunctional enzymes.

UNIT-II
Enzyme Kinetics and Enzyme inhibition

Pre-steady state and steady state kinetics, Michaelis Menten kinetics, importance of Vmax, Km, Linear transformation - Lineweaver- Burk plot, Eadie - Hoffstee plot and Hanes plot. Bisubstrate reactions : ordered, random, sequential, Ping-Pong reactions.
Enzyme inhibition – Reversible - competitive, non-competitive, uncompetitive and mixed inhibition, irreversible inhibition.

UNIT-III
Enzyme catalysis

Active site - Concept of active site, investigations of active site structure, use of substrate analogues, modification using chemical procedures, site-directed mutagenesis.
Types of catalysis - Acid base catalysis, electrostatic catalysis, covalent catalysis, metal ion catalysis, enzyme catalysis. Mechanism of reaction catalyzed by enzymes - lysozyme and chymotrypsin. Metal activated enzymes and metalloenzymes. Role of metal ions in mechanism - carbonic anhydrase, superoxide dismutase, carboxy peptidase.

UNIT-IV
Enzyme regulation

General mechanisms of enzyme regulation, Allosteric control, Symmetric and sequential modes for action of allosteric enzymes, Reversible covalent modification, proteolytic activation. Feedback inhibition, feed forward stimulation, sequential feedback, concerted feed back, cumulative feedback and enzyme multiplicity, Enzyme induction and repression.

UNIT-V
Industrial and Clinical applications of enzymes

Industrial application of carbohydrases, proteolytic enzyme, lignocellulose degrading enzyme, pectin and pectic enzyme. Applications of enzymes in food and allied industries : leather, textile, detergent, paper industries. Immobilisation of enzymes - methods and applications.

Clinical Enzymology: Enzymes as thrombolytic agents, anti-inflammatory agents, debriding agents, digestive aids, Enzyme therapy. Therapeutic enzymes. Enzyme and isoenzymes

in diagnosis – Phosphatases, transaminases, LDH, CK, amylase, cholinesterase. Enzyme electrodes, enzyme biosensors and their applications, ELISA, EMIT.

Text Books

1. Palmer,T. 1995.Understanding enzymes, 4th Edition, Prentise Hall.
2. Price,N.C. and Stevens,L. 1999. Fundamentals of Enzymology, 3rd Edition, Oxford University Press.
3. Berg,J.M. *et al*., 2012. Biochemistry, 7th Edition, W. H. Freeman & Co.

Reference Books

1. Walsh,G. 2002. Protein Biochemistry and Biotechnology, 2nd Edition, John Wiley and Sons Ltd.
1. Chapline,M.F. and Buke,C. 1990. Enzyme technology, 1st Edition, Cambridge University Press.
2. Burtis,C. and Bruns,D. 2007. Teitz Fundamentals of Clinical Chemistry, 3rd Edition, W.B. Saunders Co.
3. Nelson,D.L. and Cox,M.M. 2013**.** Lehninger Principles of Biochemistry, 6th Edition, W.H. Freeman & Co.

14BCHC04

MOLECULAR CELL BIOLOGY

UNIT-I
Cell and cell structure

Organization of dynamic cell – (prokaryotic and eukaryotic cell). Plant cell and animal cell – structure, function, distribution (size, shape, complexity with examples). Cell organelles – nucleus, mitochondria, endoplasmic reticulum, golgi apparatus, lysosomes, peroxisomes and their functions. Cell division – mitosis and meiosis.

UNIT-II
Membrane structure and transport

Overview of membrane protein - peripheral and integral, molecular model of cell membrane - fluid mosaic model and membrane fluidity
Membrane transport - Overview, passive diffusion, facilitated diffusion in erythrocytes. Carriers and ion channels. Ion concentration gradients. Uniporter catalysed transport, Transport process driven by light. Co-transport by symporters and antiporters, group translocation, osmosis and regulation of cell volume. Receptor mediated endocytosis.
Active transport systems, Ion pumps – Calcium ATPase mechanism, Gastric H^+K^+ATPase, ATPase that transports peptides and drugs.

UNIT-III
Cytoskeletal network

Microfilaments - Action – Structures, Assembly, Myosin, Microtubules - Organisation and dynamics, Kinesin and dynem,
Cilia and Flagella - Structure and functions, Intermediary fi1aments.
Striated muscle - structure, excitation - contraction.

UNIT-IV
Cell-cell and Cell-matrix adhesion

Cell junctions – Anchoring , tight and gap junctions, Adhesion molecules – selectins, cadherins, integrins, immunoglobulin superfamily.
Cell-Cell, interaction:- ECM; Collagen, hyaluronan, proteolycans, laminin, integrins and fibronectins.
Carbohydrates - cell surface carbohydrates - lectins, selectins. Blood group antigens.

UNIT V
Cell signaling and Cell cycle

Cell signaling – signaling molecules and their receptor, functions of cell surface receptor, pathways of intra cellular signal transduction, second messengers, G protein coupled receptors, receptor tyrosine kinases, Ras, MAP kinase.

Cell cycle and cancer - Cell cycle - Overview of cell cycle and its control. Genetic studies with yeasts. Cell cycle control in mammalian cells, checkpoints in cell cycle regulation.
Apoptosis (Programmed cell death) -- Pathways, regulators & effectors in apoptosis.

Mitochondria - Reduction potentials, electron transport chain - Overview, complexes, Q- cycle. Cytochrome C oxidase complex, translocation of protons and the establishment of a proton motive force. Machinery for ATP formation and Chemiosmotic mechanism. ATP synthase experiments, inhibitors of OP, Uncouplers, transport of metabolites, shuttles

Text Books

1. Alberts,B. *et al*., 2008. Molecular Biology of the Cell, 5th Edition, Garland Publishing Co.
2. Lodish *et al*. 2012. Molecular Cell Biology, 7th Edition, W.H. Freeman and Co.
3. Gardner,E.J. *et al*., 2006. Principles of Genetics, 8th Edition, John Wiley & Sons.
4. Cooper,G.M. and Hausman,R.E. 2013. The Cell: A Molecular Approach, 6th Edition, Sinauer Associates, Inc.

Reference Books

1. Kleinsmith,L.J. and Kish,V.M. 1995. Principles of Cell and Molecular Biology, Harpercollins College Div.
2. Primrose,S.B. *et al*., 2002. Principle of Gene Manipulation, 6th Edition, Wiley-Blackwell.
3. Watson,J.D. *et al*., 2013. Molecular Biology of the Gene, 7th Edition, Pearson Education.
4. Klug,W.S. and Cummings,M .R. 1999. Concept of Genetics, 6th Edition, Prentice Hall.
5. Hartwell,L. *et al*., 2010. Genetics: From Genes to Genomes, 4th Edition, McGraw-Hill Science.

14BCHP01

BIOCHEMISTRY PRACTICALS I

I Colorimetric, Spectrophotometric, titrimetry and Spectrofluorometric experiments

1. Preparation of normal, molar and percentage solution
2. Estimation of fructose in fruits.
3. Estimation of calcium in milk
4. Isolation and estimation of starch from potato.
5. Isolation and estimation of ascorbic acid from citrus fruit.
6. Estimation of riboflavin from cereals
7. Estimation of β-carotene from carrot
8. Estimation of total free amino acids in plant tissues.
9. Estimation of total sugars
10. Estimation of reducing sugars
11. Estimation of protein
12. Determination of saponification number of fat

II Enzymes studies

1. Isolation, purification and characterization of peroxidase or amylase
2. Electrophoretic separation of isoenzyme
3. Assay of AST or ALP from animal tissue and calculation of specific activity

III Cell Biology

1. Fractionation of sub-cellular organelles by differential centrifugation and purity assessment with marker enzymes

IV Separation techniques

1. Separation of amino acids by circular and ascending paper chromatography
2. Separation of lipids by TLC
3. Separation of proteins by SDS-PAGE
4. Agarose gel electrophoresis of DNA
5. Purification of proteins by gel filtration chromatography

Scheme for practical exam

Time – 6 hours Max . 60 marks

I Major	
Experiment - I	25
Experiment - II	25
II Viva	5
III Record	5

Split up marks for Experiment 1 and 2

Procedure	5
Table	4
Graph	4
Calculation	2
Result	10

INTERMEDIARY METABOLISM

UNIT-I
Bioenergetics and Biological Oxidation

Free energy and entropy. Phosphoryl group transfers and ATP. Enzymes involved in redox reactions. The electron transport chain - organization and role in electron capture. Oxidative phosphorylation - Electron transfer reactions in mitochondria. F1F0 ATPase - Structure and mechanism of action. The chemiosmotic theory. Inhibitors of respiratory chain and oxidative phosphorylation - Uncouplers and ionophores. Regulation of oxidative phosphorylation. Mitochondrial transport systems - ATP/ADP exchange, malate / glycerophosphae shuttle, creatine - phosphate shuttle.

UNIT-II
Carbohydrate Metabolism

Glycolysis and gluconeogenesis - Pathway, key enzymes and coordinate regulation. The citric acid cycle and regulation. The pentose phosphate pathway. Metabolism of glycogen and regulation. Metabolism of galactose and fructose. The glyoxylate cycle. Cori cycle. Futile cycles, anaplerotic reactions.

UNIT-III
Lipid Metabolism

Biosynthesis of fatty acids. Oxidation of fatty acids - α, β and ω. Metabolism of ketone bodies - Formation, utilization, excretion and clinical significance. Metabolism of triglycerides, phospholipids and sphingolipids. Cholesterol - Biosynthesis, regulation, transport and excretion. Metabolism of lipoproteins. Eicosanoid metabolism.

UNIT-IV
Amino Acid, Purine And Pyrimidine Metabolism

Overview of biosynthesis of nonessential amino acids. Catabolism of amino acid nitrogen - Transamination, deamination, ammonia formation and the urea cycle. Disorders of the urea cycle. Catabolism of carbon skeletons of amino acids. Conversion of amino acids to specialized products.
Metabolism of purines - De novo and salvage pathways for biosynthesis. Purine catabolism. Biosynthesis and catabolism of pyrimidines.

UNIT-V Porphyrins, Minerals and Metabolic Integration

Biosynthesis and degradation of porphyrins and heme. Minerals : sources, absorption, metabolism, biological roles and clinical significance of calcium, phosphate, iron and magnesium. Trace elements: absorption, metabolism, storage and transport of copper, iodine and selenium. Integration of metabolism.

Text Books

1. Murray *et al*., 2012. Harper's Biochemistry, 29th Edition, McGraw Hill Medical Publication.

2. Nelson,D.L. and Cox,M.M. 2013**.** Lehninger Principles of Biochemistry, 6th Edition, W.H. Freeman & Co.
3. Berg,J.M. *et al.,* 2012. Biochemistry, 7th Edition, W. H. Freeman & Co.

Reference Books

1. Voet,D. *et al.,* 2012. Fundamentals of Biochemistry: Life at the Molecular level, 4th Edition, John Wiley and Sons.
2. Zubey,G.L. 1998. Biochemistry, Wm.C. Brown Publishers.
3. Garrett,R. and Grisham,C. 2010. Biochemistry, 4th Edition, Saunders College Publishing.

PLANT BIOCHEMISTRY

UNIT-I

Plants and Cell wall - Structure and function of cell wall. Properties of Water : Diffusion, water balance in plants. Cell walls : structure, biogenesis, and expansion. Water uptake and movement – thermodynamics, diffusion, osmosis.
Plant genome organization. Plant nuclear genome organization. Biogenesis of organelles - developlment of chloroplast. Interaction between nuclear and organellar genome.

UNIT-II

Photosynthesis - Structure of organelles involved in photosynthesis in plants and bacteria. Proton gradients and electron transfer in chloroplasts of plants and in purple bacteria - differences from mitochondria. Light receptors - chlorophyll, light harvesting complexes, bacteriorhodopsin, rhodopsin as ion pump. Photosystems I and II. The Hill reaction, Photophosphorylation and reduction of CO_2, C_3, C_4 and CAM metabolism, light and dark reactions. Light activation of enzymes, regulation of photosynthesis. Photorespiration.

UNIT-III

Plant metabolism - carbohydrates, proteins, sugars, Transport in plants- Transpiration, Stomata, Mineral Nutrition - Biogeo cycles (Carbon, Nitrogen and Sulphur) Nutrient absorption and translocation, Nutrient functions in growth and development, Nutrient deficiency symptoms, toxicity problems.

UNIT-IV

Phytohormones : Auxins, cytokinins, Gibberellins, ethylene- Structure, Physiological function and metabolism, Plant movement, apical dominance. Stomatal movements and morphogenesis. Photoperiodism and vernalization – flower induction, initiation and development, action of phytohormones.

UNIT-V

Biological rhythm in plants, dormancy, seed germination, development and maturation, bud dormancy, floreign, senescence, aging. Plant defenses, environmental and genetic control. Special features of secondary plant metabolism-phytochemistry of plants.

Text Books

1. Heldt,H.W. and Piechulla,B. 2010. Plant Biochemistry, 4th Edition, Academic Press.
2. Heldt,H.W. 2004. Plant Biochemistry, 3rd Edition, Academic Press.
3. Buchannan,B. *et al*, 2002. Biochemistry and Molecular Biology of Plants, 1st Edition, Wiley.

Reference Books

1. Dey,P.M. and Harborne,J.B. 1997. Plant Biochemistry, 1st Edition, Academic Press.
2. Lea,P.J. and Leegood,R.C. 1999. Plant Biochemistry and Molecular Biology, 2nd Edition, Wiley.

MOLECULAR BIOLOGY

UNIT-I
DNA Replication

Types of replication, Meselson and Stahl experiment, replications in circular chromosomes - rolling circle model, theta model, plasmid replication, replication of mitochondrial DNA. DNA replication in prokaryotes - Initiation, elongation, termination. Enzymes and proteins involved in replication, inhibitors of replication. Eukaryotic replication, telomeres, telomerases and end replication.

UNIT-II
DNA Repair and Recombination

Mutations – types.

DNA damage – different types, DNA repair mechanism – Nucleotide excision repair, base excision repair, mismatch repair, recombination repair, double stranded break repair, SOS response.

Recombination – Homologous recombination, site specific recombination.

UNIT-III
Prokaryotic transcription and regulation

E.coli RNA polymerases, Promoter sequence in *E.coli*, Steps in transcription. Termination of transcription - Rho dependent and Rho independent termination. Regulation of transcription in prokaryotes – lac operon, arabinose and trytophan operon.

UNIT-IV
Eukaryotic transcription and regulation

Eukaryotic gene control and RNA polymerases, regulatory sequence in eukaryotes, activators and repressors of transcription, transcriptional factors, Transcription initiation by RNA polymerase I, II and III. Transcriptional regulation in eukaryotes - hormonal (steroid hormone receptors), phosphorylation (Stat proteins). Post transcriptional processing of mRNA, rRNA and tRNA. Alternative splicing, RNA editing.

UNIT-V
Genetic Code, Translation and Targeting

Genetic code - salient features of genetic code.

Components of protein synthesis – mRNA, ribosomes and tRNA. Protein synthesis in bacteria and eukaryotes – initiation, elongation, termination. Post-translational modifications in prokaryotes and eukaryotes. Inhibitors of protein synthesis. Protein targeting - signal sequence hypothesis, targeting of proteins to different compartment of mitochondria, ER, plasma membrane, lysosomes, peroxisomes and chloroplast

Text Books

1. Lodish *et al*. 2012. Molecular Cell Biology, 7th Edition, W.H. Freeman and Co.
4. Weaver,R.F. 2011. Molecular Biology, 5th Edition, WCB McGraw Hill, Higher Education.
5. Karp,G. 2009.Cell and Molecular Biology, 6th Edition, John Wiley & Sons, Inc.

Reference Books

1. Alberts,B. *et al*., 2008. Molecular Biology of the Cell, 5th Edition, Garland Publishing Co.
2. Watson,J.D. *et al*., 2013. Molecular Biology of the Gene, 7th Edition, Pearson Education.
3. Lewin,B. 2007. Genes IX, 9th Edition, Jones and Bartlett Publishers.

CORE PRACTICALS II

I Colorimetric experiments

1. Estimation of iron content in food
2. Estimation of phosphorus content in food
3. Estimation of tryptophan content in grains
4. Isolation and Estimation of DNA from spleen /liver- UV - Visible method
5. Isolation and Estimation of RNA from spleen /liver- UV - Visible method
6. Estimation of chlorophyll in leaves
7. Estimation of phenols in plant tissues
8. Estimation of peroxidase in plant tissues

II Plant tissue culture

1. Callus induction
2. Initiation of suspension cultures
3. Regeneration of shoot and root from callus culture

III Animal tissue culture

1. Preparation and sterilization of media
2. Filter sterilization of media
3. Primary cell culture – trypsinisation, passaging, staging
4. Cell lines, counting – vital staining
5. Cytotoxicity and viability assay

IV Clinical Microbiology

1. Isolation of pure culture - Serial dilution, pour plate, spread plate, streak plate
2. Colony morphology - colony counting
3. Staining techniques - Simple, differential, negative, acid fast, spore, capsule and fungal staining
4. Antibiotic sensitivity assay of different microbes
5. Estimation of bacteria - Growth curve and generation time
6. To identify the microbes - Biochemical tests

Scheme for practical exam

Time – 6 hours Max . 60 marks

I Major	
Experiment - I	25
Experiment - II	25
II Viva	5
III Record	5

Split up marks for Experiment 1 and 2

Procedure	5
Table	4
Graph	4
Calculation	2
Result	10

GENETIC ENGINEERING

UNIT-I
Restriction enzymes and cloning vectors

Basic principles of recombinant DNA technology. Restriction enzymes - nomenclature, types of restriction enzymes, Restriction mapping. Cloning vectors : Properties, essential features, mechanism of cloning in plasmid vectors PBR_{322} and PUC phage vectors – bacteriophage and M13. Cosmid vectors, Cosmid cloning. Phasmid – phagemids, High capacity cloning vectors - BACs, PACs and YACs. Human Artificial chromosomes

UNIT-II
Selection and screening

Blotting techniques - Nothern blotting, Southern blotting, Western blotting, Far-western blotting. Genomic library, cDNA library and chromosome walking and Chromosome jumping. Gene transfer method - Calcium phosphate precipitation, electroporation, lipofection, microinjection. Screening : Marker inactivation, nucleic acid probes- methods of labeling and applications. immunological screening for expressed gene. PCR - types and applications, *in situ* hybridization- types and applications, DNA finger printing technique. DNA Foot Printing

UNIT-III
Expression Systems

Prokaryotic expression system - Expression of cloned genes in *E. coli* – Introduction, maximizing cloned gene expression. Cloning in *Bacillus subtilus*. Eukaryotic expression system - yeast vectors. Cloning in yeast expression of cloned genes and over expression of proteins in yeast..Animal expression system - Mammalian cell expression system, insect cell expression system – Baculo viral vector, transfer of cloned genes into *Xenopus* oocytes.

UNIT-IV
Gene targeting in animal cells

Transformation, co-transformation, selectable markers, reporter genes. Transgenic animals - methods of production gene knock out in transgenic mice. Transgenic animals as models of human disease. Application of transgenic mice, animal bioreactors (Pharm animals). Gene therapy: *Ex vivo* gene therapy, I*n vivo* gene therapy, antigene and antisense therapy. ADA and Anticancer therapy.

UNIT-V
Protein and metabolic engineering

Site directed mutagenesis - types, selection of mutant peptides by phage and phasmid display. Protein engineering – To improve enzymes and therapeutic proteins by direct evolution and DNA shuffling. Metabolic Engineering - Over production of phenylalanine, novel routes to small molecules. Combinatorial biosynthesis, engineering metabolic control over recombinant pathways. Bioethics, Hazards and safety aspects of genetic engineering.

Text Books

1. Brown,T.A. 2010. Gene cloning and DNA analysis: An introduction, 6th Edition, Wiley-Blackwell Publishers.
2. Primrose,S.B. and Twyman,R. 2006. Principles of Gene Manipulation and Genomics, 7th Edition, Oxford University Press.
3. Glick,B.R. and Pasternak,J.J. 2003. Molecular Biotechnology - Principles and Applications of Recombinant DNA, 3rd Edition, ASM Publishers.

Reference Books

1. Strachan,T. and Read,A.P. 2003. Human Molecular Genetics, 3rd Edition, Garland Science Publishers.
2. Watson,J.D. *et al*., 2007. Recombinant DNA-Genes and Genomes: A short course, 3rd Edition, Cold Spring Harbor Laboratory Press.
3. Winnacker,E.L. 1987. From Genes to clones, 1st Edition, Wiley-Blackwell Publishers.
4. Nicholl,D.S.T. 2008. An introduction to Genetic Engineering. 3rd Edition, Cambridge University Press

14BCHC09

ADVANCED CLINICAL BIOCHEMISTRY

UNIT-I
Specimen collection and processing

Collection of blood by various methods, anticoagulants.
Collection of urine - Timed urine specimens, urine preservatives. Tests for urinary compounds. Clinical significance of urinary components with reference to sugars, proteins, ketone bodies, bilirubin and porphyrins. Stool – chemical examination and clinical significance.
CSF – composition and collection, chemical examination and infections and spinal cord infections.
Amniotic fluid : Origin, collection, composition and analysis of amniotic fluid
Automation in the clinical biochemistry: Precision, reliability, reproducibility and other factors in quality control.

UNIT-II
Inborn errors of metabolism

Disorders of carbohydrate metabolism – glycogen storage diseases, galactosemia, fructose intolerance and fructosuria. Disorders of lipid metabolism - Lipid storage diseases, fatty liver and lipoproteinemias. Disorders of amino acid metabolism – Aminoaciduria, phenylketonuria, Hartnup disease, alkaptonuria, albinism, cystinuria, cystinosis, homocystinuria and maple syrup urine disease. Disorders of purine, pyrimidine and porphyrin metabolism- Hyperuricemia, Hyporuricemia and gout, orotic aciduria, porphyrias – Erythropoietic and hepatic.

UNIT-III
Clinical enzymology

Serum enzyme activities in diseases - Principle and assay of transaminases, phosphatases, isocitrate dehydrogenase, 5’ nucleotidase, streptokinase, asparaginase, ά-hydroxybutyrate dehydrogenase, ceruloplasmin, γ-glutamyl transpeptidase, creatine kinase. lactate dehydrogenase, amylase, lipase, choline esterase.
Enzyme patterns in disease –hepatobiliary disease, myocardial infarction.

UNIT-IV
Hepatic, pancreatic and renal functional tests

Normal structure and functions of liver, diseases of the liver, hepatitis types, cirrhosis, alcoholic liver disease, hepatic tumor and biliary tract diseases, liver function tests, disorders of bilirubin metabolism. Pancreatic and gastric function tests.
Renal function tests and related disorders - Biochemical findings in glomerulonephritis, acute and chronic renal failure, nephritic syndrome, nephrolithiasis. Abnormal constituents of urine, urinary tract obstruction and analysis of urinary calculi.

UNIT-V
Diabetes, Atherosclerosis and Cancer

Blood glucose homeostasis-Role of organs and hormones.

Diabetes mellitus–classification, metabolic abnormalities, diagnosis and management, acute and long-term complications.
Atherosclerosis – risk factors, biochemical findings and management.
Cancer – Types of cancer, invasion and metastasis.
Tumour markers: AFP, CEA, hCG
Free radicals in diseases - Formation of free radicals, lipid peroxidation and consequences. Antioxidant defence mechanisms.

Text Books

1. Burtis,C. and Bruns,D. 2007. Teitz Fundamentals of Clinical Chemistry, 3rd Edition, W.B. Saunders Company.
2. Devlin,T.M. 1998. Text book of Biochemistry with Clinical Correlation, 4th Edition, John Wiley and Sons.
3. Varley,H. 1980.Practical Clinical Biochemistry, Volume I and II, 5th Edition, CBS Publishers.

Reference Books

1. Mayne,P.D. 1994. Clinical Chemistry in Diagnosis and Treatment, 6th Edition, Hodder Arnold Publication.
2. Marshall,W.J. and Bangeit, S.K. 1995. Clinical Biochemistry - Metabolic concepts and Clinical aspects, Churchill Livingstone.
3. Guyton,A.C. and Hall,J.E. 2010. Text Book of Medical Physiology, 12th Edition, Saunders.

BIOSTATISTICS

UNIT-I

Organizing a statistical survey, Planning and executing the survey. Source of data - Primary and secondary data, collection, observation, interview, enquiry forms, questionnaire schedule and check list. Classification and tabulation of data. Diagrammatic and graphic presentation of data.

UNIT-II

Measures of central tendency - arithmetic mean, median, mode, quartiles, deciles and percentiles. Measures of variation - range, quartile deviation, mean deviation, standard deviation, Coefficient of variation. Correlation analysis - Scatter diagram, Karl's Pearson's coefficient of correlation and Spearman's rank method. Regression analysis.

UNIT-III

Probability- Definition, concepts, theorems (proof of the theorems not necessary) and calculations of probability. Theoretical distributions – Binomial, Poisson and normal distribution-Simple problems.

UNIT-IV

Sampling distribution and test of significance – Concepts of sampling, Testing of hypothesis, errors in hypothesis testing, standard error and sampling distribution, sampling of variables (large samples and small samples.). Student's "t" distribution and its applications. Chi-square test and goodness of fit.

UNIT-V

Analysis of variance - one way and two way classification. Duncan's Multiple Range test. Mann Whittneys test-significance. Design of experiment-Completely randomised block design, Randomised block design.

Text Books

1. Gupta,S.P. 2011. Statistical Methods, 4th Edition, Sultan Chand & Son Publishers.
2. Zar,J.H. 2010. Biostatistical Analysis, 5th Edition, Pearson Education..

Reference Books

1. Daniel,W.W. 2008. Biostatistics - A Foundation for Analysis in Health Sciences, 9th Edition, John Wiley and Sons, Inc., 1999.

14BCHP03

CORE PRACTICALS III

Clinical Biochemistry

I Estimation of the following in urine and serum

1. Urea
2. Uric acid
3. Creatinine
4. Glucose
5. Calcium
6. Phosphorus
7. Chloride
8. Magnesium
9. Sodium and potassium – by flame photometry
10. Bilirubin – TB, DB
11. Hemoglobin
12. Total protein albumin, AG ratio

II Determination of the following enzymes in serum

1. Alkaline phosphatase
2. Aspartate amino transferase
3. Lactate dehydrogenase

III Genetic Engineering

1. Isolation of genomic DNA from liver/plant/ bacterial source
2. Isolation of plasmid DNA from bacteria
3. Restriction digestion of DNA
4 Southern Blotting techniques
5. Transformation in *E.coli*
6. PCR demonstration

Scheme for practical exam

Time : 6 hours Max : 60 marks

I Major experiment	
Experiment 1	25
Experiment 2	25
II Viva	5
III Record	5
Total	60

Split up marks for Experiment 1 and 2

Procedure	5
Table	4
Graph	4
Calculation	2
Result	10

.

IMMUNOLOGY

UNIT - I

Innate and adaptive immunity, comparative immunity.
Cells : Immune cells, structure and function. Erythropoiesis, growth factors, regulation of haematopoiesis, cells. clinical uses of stem cells, Null cells, granulocytes, adhesion molecules
Organs of the immune system; primary and secondary organs
Cell culture system : Primary lymphoid culture, cloned and hybrid lymphoid cell lines.
Lymphoid cells : Lymphoblasts, CD antigens, B cell receptors. T cell membrane molecules.
Experimental animal models : inbred strains, SCID mice, nude mice, knockout mice, hemolytic plaque assay.
.

UNIT- II

Antigens : B cell epitopes, T cell epitopes, Haptens - viral and bacterial antigens, factor-influencing immunogenecity, adjuvant technology.
Immunoglobulins : domains, allotypes, Isotypes and Idiotypes, antigenic determinants on Immunoglobulins. Immunoglobulins superfamily.
Monoclonal antibodies: Formation and selection of hybrid cells, production, clinical uses, Abzymes.
Organization of immunoglobulins gene : Variable region gene rearrangements, antibody diversity, expression of immunoglobulin genes.

UNIT III

MHC : Organization, MHC molecules and genes, cellular distribution, regulation of MHC and immune responsiveness, MHC and susceptible deficiency diseases. Antigen processing and presentation.
T-cell : Receptor complex structure, T-cell maturation, activation and differentiation. Cell death and T-cell population.
B-cell : Receptor complex structure, T-cell maturation, activation and differentiation. Complement activation : Pathways, regulation of complement system, Biological consequences of complement activation, complement deficiencies.
Antigens - Antibody interaction: In vivo - cross reactivity, In vitro: precipitants, agglutinants, RIA, ELISA- techniques and applications. FACS.

UNIT IV

Cytokines : Structure and function of IL, IFN, TNF, CSF, cytokines receptors, cytokine antagonists, cytokines related diseases.
Cell mediated immunity : CTL mediated cytotoxicity, NK cell mediated toxicity, delayed type hypersensitivity. Immunological tolerance.
Leukocyte mediated immune response: Cell adhesion molecule, Lymphocyte and neutrophils, extravasation, mediators of inflammation, inflammatory process.
Hypersensitivity reactions : Type I, II, III and IV. Hypersensitivity diseases. Immunity to infectious diseases : viral - influenza, bacteria – tuberculosis, parasite – Plasmodium falciparum, helminthes.
Autoimmunity : Autoimmune diseases in human, animal models, mechanism of induction of autoimmunity, therapy.

UNIT-V

Transplantation immunology : Types, Genetics of transplantation, Graft versus host reaction, tissue matching and immunosuppressive agents, clinical manifestation, therapy and bone-marrow transplants, organ- transplants.
Immunodeficiency diseases: B-cell, T-cell, SCID, Pathogenesis, diagnosis and treatments of AIDS.
Vaccines : Active and passive immunization, whole organism vaccines, recombinant vector vaccines, DNA vaccines, synthetic peptide vaccine, multivalent sub-unit vaccines.
Cancer immunology: Tumor antigens, immune response to tumors, tumor evasion, cancer immunotherapy.

Text Books

1. Owen,J.A. *et al.,* 2013. Kuby Immunology, 7th Edition, W.H. Freeman and Company.
2. Delves,P. *et al.,* 2011. Roitt's Essential Immunology, 12th Edition, Wiley-Blackwell Publishers.

Reference Books

1. Abbas,A.K. *et al*., 2012. Cellular and Molecular Immunology, Fourth Edition, Elsevier Saunders Company.
2. Ananthanarayan,R. 2009. Ananthanarayan and Paniker's Textbook of Microbiology 8th Edition, Universities Press Publishers
3. Virella,G. 2007. Introduction to Medical Immunology, 6th Edition, CRC Press.

DRUG BIOCHEMISTRY AND CLINICAL TOXICOLOGY

UNIT-I

General Principles : Basic principles of drug action-Pharmacokinetics : Absorption, distribution and elimination of drugs, routes of drug administration. Pharmacogenetics. Origin of Drug from plants and animals.

UNIT-II

Drug metabolism – general pathways of drug metabolism (different types of reaction in phase I and phase II with examples), metabolism and excretion of drugs. Mechanism of drug action, combined effect of drugs. Factors modifying drug action, tolerance and dependence.

UNIT-III

Pharmacodynamics - receptor concepts, theory, drug receptor interaction (DRI), Factors affecting DRI, Cholinergic and anticholinergic drugs, Adrenergic and adrenergic blockers, General anesthetics, Local anesthetics. Adverse reactions to drugs and common drug receptor interactions.

UNIT-IV

Principles of therapeutics : Chemotherapy of microbial diseases, Chemotherapy of fungal infections, Chemotherapy of parasitic infections, rational use of antibiotics. Application for New Drug Discovery (NDD) according to Indian Control Authority and USFDA guidelines. Ethical considerations in utilizing human subjects for drug discovery process. Helsinki's declaration.

UNIT-V

Toxicology: Principles of toxicology and treatment of poisoning. Heavy metals and antagonists. Non metallic environmental toxicants. Methods involved in the development of new drugs. Preclinical toxicological studies. Calculation of LD_{50} and ED_{50}. Acute, subacute and chronic toxicity studies. Irwin profile test, Pre-clinical pharmacokinetic and dynamic studies. Lipinski's rule for drug like molecule, High throughput screening (*in vitro* and *in vivo*) for pre-clinical pharmacokinetic and pharmacodynamic studies.

Text Books

1. Satoskar,R.S *et al*., 2013. Pharmacology and Pharmacotherapeutics, 23rd Edition, Popular Prakasham, Bombay.
2. Williams,D.A. et al., 2008. Foye's Principles of Medicinal Chemistry, 6th Edition, Lippincott Williams & Wilkins.
3. Ghosh,M.N. 1984. Fundamentals of Experimental Pharmacology, 2nd Edition, Scientific Book Agency, Kolkatta.

Reference Books

1. Shargel,L. *et al*., 2012. Applied Biopharmaceutics and Pharmacokinetics, 6th Edition, McGraw-Hill Medical,
2. Foreman,J.C. and Johansen,T.J. 1996. Text Book of Receptor Pharmacology, 2nd Edition, CRC Press.
3. Goodman,L.S. *et al*., Goodman and Gillman's the pharmacological basis of therapeutics, 6th Edition,, McGraw Hill, 1996.
4.Tripathi,K.D. 2013. Essentials of Medical Pharmacology, 7th Edition, Jaypee Brothers.

CORE PRACTICALS IV

I Estimation of enzymic, non-enzymic antioxidants in rat or goat liver

1. Glutathione Peroxidase
2. Reduced Glutathione
3. Vitamin C

II Estimation of Lipid peroxidation

III Determination of Lipid profile
1. Triglycerides
2. Phospholipids
3. Total Cholesterol
4. HDL cholesterol
5. LDL cholesterol

IV Immunology

1. Immuno diffusion – Single radial and double diffusion.
2. Immunoelectrophoresis
3. Rocket immunoelectrophoresis
4. Agglutination tests
5. Raising of antibodies – Single soluble and particulate antigen
6. C-Reactive Protein by ELISA method

V Serology
1. Serial dilution of ASO titre,VDRL titre
2. Determination of blood group

Scheme for practical exam

Time : 6 hours Max : 60 marks

I Major experiment

Experiment 1	25
Experiment 2	25
II Viva	5
III Record	5
Total	60

Split up marks for Experiment 1and 2

Procedure	5
Table	4
Graph	4
Calculation	2
Result	10

.

ELECTIVE COURSES

14BCHE01

MOLECULAR ENDOCRINOLOGY

UNIT-I

Introduction to Endocrinology. Histrorical aspects. Definition of a hormone. Chemical nature of mammalian hormones. Developmental biology of mammalian endocrine system. Feed back regulation . Historical and anatomical aspects of mammalian endocrine system – Hypothalamo – hypophyseal complex, Thyroid Parathyroid complex. Gastrointestinal system and pancreas. Adrenal cortex and medulla. Ovary and testis. Pineal Gland.

UNIT-II

Molecular endocrinology – basic theme. Historical highlights. Concept of receptors. Pharmacological receptors. Cyclin nucleotides. Protein kinases and phosphatases. Neurotrasmitter receptors (cholinergic and adrenergic) Structure – function relationship. Dopamine, Serotonin-Chemistry and biochemical functions.

UNIT-III

Peptide hormone action. Structure of receptors. G-protein coupled receptors, Adenylate cyclases. Selected hormones-GnRH : Pituitary trophic hormones-Insulin /glucagons, somatostatin,: gastrointestinal peptides-oxytocin/vasopressin-Chemistry and biochemical function.

UNIT-IV

Steroid/ thyroid hormone, vitamin – D and retinoic acids. Structure of receptors: functional domains DNA binding sites , nuclear transport mechanisms. Transcriptional and post transcriptional control mechanisms. Emphasis on estrogens, progesterone, androgens, glucocorticoids and peroxisome. Proliferation factor – Chemistry and biochemical functions.

UNIT-V

Diagnosis and clinical evaluation of endocrine dysfunction–Hyper and Hypo pituitary, thyroid, parathyroid, adrenal, pancreas, gonads abnormalities and molecular basis of endocrine diseases.

Text Books

1. Hadely,M. and Levine,J.E. 2006. Endocrinology, 6th Edition, Benjamin Cummings.
2. Smith,E. *et al*., 1983. Principles of Biochemistry, 7th Edition, Mc Graw Hill International Book Co.

Reference Books

1. Guyton,A.C. and Hall,J.E. 2010. Text book of Medical Physiology, 12th Edition, Saunders Publishers.

CANCER BIOLOGY

UNIT-I

Introduction: Cancer cell-morphology and growth characteristics. Types of growth-hyperplasia, dysplasia, anaplasia and neoplasia. Types and prevalence of cancer. Nomenclature of neoplasms, classification based on origin/organ.

UNIT-II

Epidemiology of cancer. Endocrinology of cancer. Agents causing cancer-radiation, viruses, chemicals. Multistep carcinogenesis: Initiation, Promotion, Progression. Paraneoplastic syndromes.

UNIT-III

Molecular mechanism of oncogenesis - proto oncogenesis, oncogene, oncoproteins, tumour suppressor genes involved in cancer. Free radicals and antioxidants in cancer. Diet and cancer. Cell cycle and cancer: Control of the cell cycle-cyclins and CDKs

UNIT-IV

Apoptosis and cancer (Intrinsic and extrinsic pathways). Mechanism of apoptosis, signaling pathways. Types and their impact on apoptosis and oncogenesis. Principles and methods of cancer diagnosis-Biochemical, genetic, cytotoxic, cell growth and viability tests.

UNIT-V

Cancer therapy: Different forms of therapy, chemotherapy, radiation therapy, gene therapy, immune therapy, surgical therapy and biologic therapy. Principles of cancer biomarkers and their applications.

Text Books

1. Franks,L.M. and Teich,N.M. 1991. An introduction to Cellular and Molecular Biology of cancer, 2nd Edition, Oxford University Press.
2. Vincent,T. *et al*., 2011. Principles and Practice of Oncology: Primer of the Molecular Biology of Cancer, 1st Edition, Lippincott Williams and Wilkins.
3. Weinberg,R.A. 2013. The Biology of Cancer, 2nd Edition, Garland Science.
4. Hesketh,R. 2013. Introduction to Cancer Biology, Cambridge University Press.

Reference Books

1. McKinnell, R.G. *et al*., 2006. The Biological Basis of Cancer, 2nd Edition, Cambridge University Press.
2. Pelengaris,S. and Khan,M. 2002. The Molecular Biology of Cancer, 2nd Edition, Wiley Blackwell.

HUMAN PHYSIOLOGY

UNIT-I
Blood and circulation

Composition and functions of blood and plasma. Blood groups. Blood coagulation - mechanism, fibrinolysis, anticoagulants. Hemoglobin - structure, abnormal types, anemia. Structure of heart, cardiac cycle, heart sounds, E.C.G vasomotor circulation, coronary circulation, blood pressure, spleen, lymph, normal composition and function of lymph - role of different lymph cells.

UNIT-II
Digestion, absorption and excretion

Digestive secretions - composition, functions and regulation of saliva, gastric, pancreatic, intestinal and bile secretions. Digestions and absorption of carbohydrates, lipids, proteins and nucleic acids. Excretory system - structure of nephron. Formation of urine - glomerular filtration, tubular reabsorption of glucose, water and electrolytes, tubular secretion.

UNIT-III
Respiration and reproduction

Structure of lungs, mechanism and regulation of respiration. Transport of blood gases - O_2 and CO_2. Acid-base balance - role of buffers, erythrocytes, respiratory system and kidneys. Acidosis and alkalosis - metabolic and respiratory. Fluid electrolyte balance - regulation of water balance and sodium balance - role of renin-angiotensin and ADH. Structure and function of reproductive organs, composition of semen, transport of sperm, ovulation, and sexual cycle, physiology of pregnancy, parturition and lactation.

UNIT-IV
Neuromuscular function

Structure and function of nerves, neurons, resting and action potential, transmission of nerve impulses, synaptic transmission, compounds affecting synaptic transmission, neuromuscular junction, composition and functions of cerebrospinal fluid, brain - chemical composition and metabolic adaptation, neurotransmitters and cAMP, biochemical aspects of learning and memory, enkephalins and endorphins. Structure of muscle cells and muscle contraction, molecular organization of muscle, proteins of contractile element - their organization and role in contraction, energy for contraction.

UNIT-V
Endocrine system

Secretion and functions of hormones of thyroid, pituitary and gonads. Role of hormones in reproduction and pregnancy. Mechanism of action of hormones.

Text Books

1. Guyton,A.C. and Hall,J.E. 1996. Human Physiology and Mechanisms of Disease, 6th Edition, Saunders.
2. Chatterjee,C.C. 1985. Human Physiology, 11th Edition. Medical Allied Agency.
3. Ganong,W.F. 2005. Review of Medical Physiology, 22nd Edition, McGraw-Hill.

Reference Books

1. Vander,A.J. *et al*., 1981. Human Physiology: Tata Mc Graw Hill Publishing Co., New Delhi.
2. Chaudhuri,S.K. 2006. Concise Medical Physiology, New central Book Agency.

MICROBIOLOGY

UNIT-I
Morphology, cytology and classification microbes

Bacterial nomenclature and classification; prokaryotic organism on overview, morphology and ultra structure of bacteria, shapes and arrangement of bacteria, morphology types; archeabacteria, gram positive and gram negative and subacteria structure and function of flagella, cilia and endospore. Structure and classification of algae and reproduction. Structure and classification of fungal cell, hypae, spores, Protozoa.
Light microscopy- bright field, dark field, phase contrast, fluorescent and polarization microscope, electron microscopy, TEM & SEM.

UNIT-II
Virology:

Nomenclature – classification and taxonomy of viruses; host, nucleic acids and structure. Bacterial viruses; ØX 174; T4; M13A, life cycle (Lysogenic and Lytic). RNA phages plant viruses; effects of viruses on plants, RNA viruses, TMV, satellite viruses, bromo mosaic virus. Animal viruses; classification and structure of animal and human viruses. RNA viruses; Herpes virus, RNA tumor virus-retro virus, DNA virus – vaccinia virus, SV40 adeno viruses. Viroids.

UNIT-III
Medical microbiology

Normal microbial flora of human body – (respiratory tract, skin, GIT, Infection – sources) mode of transmission (exogenous and endogenous).
Mechanism of bacterial pathogenesis. Medically significant bacteria Staphylococcus aureus, Streptococci, pathogenic, enterobacteriaceae, Vibrio, Corny bacterium, pseudomonas, Mycobacterium tuberculosis, Helicobacter pylori. Pathogenesis of parasitic disease, blood and tissue protozoa, nematodes, arthropods, influenza viruses, measles, chicken pox, hepatitis , dengue fever,
Mechanism of fungal pathogenesis, superficial and cutaneous mycoses, systemic mycoses, opportunistic mycoses.

UNIT-IV
Food microbiology and diary microbiology

Food as substrate for the microorganisms. General principles and types of microbes in spoilage of foods, different methods of preservation.
Microbes in food: mold, yeast, bacteria. Food borne diseases: Staphylococcus, Clostridium, E.Coli, Salmonella, mycotoxin, Protozoan. Viral food borne disease.
Microflora of milk- sources of contamination- intoxication-pasteurization-sterilization-fermented diary products-yogurt, kafir, kumiss, cheese production. Food hygiene and control-food sanitation in food manufacture.

UNIT-V
Industrial Microbiology

Industrial microbiology; an introduction to fermentation process- components parts of fermentation process. Industrially important organisms- upstream processing, media for industrial fermentation, formulation and sterilization.

Aerobiology – droplet nucleus – aerosols – transmission of microbes –assessments of air quality and diseases.
Soil Microbiology : Soil microbes, Soil Pollution – Micro flora of various soils – Biofertilizers
Geomicrobiology – Biochemical cycles of Carbon, Nitrogen, Phosphorus, Sulphur and Iron cycles. Biobleaching & Biomining – Petroleum degradation- Xenobiodegradation.

Text Books

1. Prescott, M.L., Harley, P.J. and Klein, A.D. 2004. Microbiology, 6th Edition, McGraw-Hill Science.
2. Pelczar, J.M. *et al*., 2001. Microbiology, 5th Edition, Tata-McGraw Hill Publications.
3. Ananthanarayanan R and Jayaram Paniker, C.K. 2009. Textbook of Microbiology, 8th Edition, Universities Press.

Reference Books

1. Medical Microbiology. Jawetz, Melinickand Adelberg's, Twenty Second Edition, McGraw Hill Medical Publication division, 2001.
2. Pommerville, J.C. Alcamo, I.E. . 2012. Alcamo's Fundamentals of Microbiology, Jones & Bartlett Publishers.
3. Cruegar,W. and Cruegar. A., Biotechnology : A Textbook of Industrial Microbiology Second Edition, Panima Publishing Corporation, Bangalore, 2004.

NANOTECHNOLOGY

UNIT-I

Background to Nanotechnology - Scientific revolution, Fundamental Properties - Size Effects on Structure and Morphology of Free or Supported Nanoparticles - Size and Confinement Effects - Fraction of Surface Atoms - Specific Surface Energy and Surface Stress - Effect on the Lattice Parameter - Atomic structures - Molecular and atomic size - Bohr radius - Emergence of Nanotechnology - Challenges in Nanotechnology - Carbon age - New form of carbon (from Graphene sheet to CNT).

UNIT-II
Nucleation and properties of nanopatricle

Influence of nucleation rate on the size of the crystals- macroscopic to microscopic crystals and nanocrystals - large surface to volume ratio, top-down and bottom-up approaches-self assembly Process - grain boundary volume in nanocrystals - defects in nanocrystals-surface effects on the properties. Kinetic features of new phase formation - Phase formation in chemical reactions - Self organization of metal containing nanoparticles (Fractal structures), carbon nanotubes (CNT) - Metals (Au, Ag) - Metal oxides (TiO_2, CeO_2, ZnO) - Semiconductors (Si, Ge, CdS, ZnSe) - Ceramics and Composites - Dilute magnetic semiconductor - Biological system - DNA and RNA - Lipids - Size dependent properties - Mechanical, Physical and Chemical properties.

UNIT-III
Types of Nanostructures

Definition of a Nano system - Types of Nanocrystals - One Dimensional (1D) - Two Dimensional (2D) - Three Dimensional (3D) nanostructured materials - Quantum dots - Quantum wire -Core/Shell structures. Carbon materials - Allotropes of carbon - Structure of carbon nanotubes - Types of CNTs - Electronic properties of CNTs - Band structure of Graphene - Band structure of SWNT from graphene - Electron transport properties of SWNTs - Scattering in SWNTs - Carrier mobility in SWNTs.

UNIT IV
Synthesis of Nanomaterials and properties

Synthesis of Nanostructures - precipitative, reactive, hydrothermal/solvothermal methods - suitability of such methods for scaling - potential uses. Plant based green synthesis of nanoaprticles. Synthesis of metallic, semiconducting and oxide nanoparticles - homo - and hetero-nucleation growth methods - template-based synthesis (electrochemical, electrophoretic, Melt and solution, CVD, ALD) - Gas Phase Synthesis of Nanopowders: - Vapor (or solution) -liquid - solid (VLS or SLS) growth - the Need for Gas/vapor State Processing - Main Stages of Gas Phase Synthesis - Applicability of the methods

UNIT V
Applications of Nanomaterials

Industrial applications of nanomaterials: Molecular electronics and nanoelectronics - Quantum electronic devices - CNT based transistor and Field Emission Display - Biological applications - Biochemical sensor - Membrane based water purification,.

Nanotechnology in textiles and cosmetics, nanotechnology in agriculture and food technology, nanotechnology in chemical industry, nanotechnology in biomedical and pharmaceutical industry, Toxicity - nanoparticles in the environment - Health threats - nanomaterials and biotoxicity, Nanoparticle interaction with biological membrane - Neurotoxicology

Text Books

1. Wilson, M. 2002. Nanotechnology: Basic Science and Emerging Technologies, Chapman and Hall. CRC Publishers.
2. Rao,C.N.R. *et al*., 2006. The Chemistry of Nanomaterials: Synthesis, properties and applications, John Wiley and Sons.

Reference Books

1. Cao,G. 2004. Nanostructures and Nanomaterials: Synthesis, properties and applications, Imperial College Press.
2. Klabunde, K.J. and Richards, R.M. 2009. Nanoscale Materials in Chemistry, 2nd Edition, John Wiley & Sons.
3. Kumar, C.S.S.R. *et al.*, 2004. Nanofabrication towards biomedical applications, Wiley-VCH Verlag GmbH & Co..

14BCHE06

BIOPROCESS TECHNOLOGY

UNIT-I

Introduction to fermentation processes, microbial growth kinetics – batch culture, continuous culture, fed-batch culture.
Isolation, preservation and improvement of industrially important microorganisms – enrichment culture – preservation at reduced temperature, dehydrated form etc., improvement by selection – induced, auxotrophic, resistant and revertant mutants and by recombinant DNA techniques.

UNIT-II

Media formulation – Water, energy sources, carbon sources, nitrogen sources, minerals, growth factors, nutrient recycle, buffers, role of precursors and metabolic regulators, oxygen, anti-foam and media optimization.
Sterilization – Batch and continuous sterilization process. Development of inoculums- bacteria, innocula for yeast, bacterial and mycelial processes.

UNIT- III

Design of fermenter – Basic functions, aseptic operation, body construction, aeration and agitation systems. Achievement and maintenance of aseptic conditions, valve and steam traps.
Types of fermenters – Waldhof, tower, cylindro-conical, air-lift, deep-Jet, cyclone column, packed tower and rotating disc fermenter.

UNIT-IV

Down stream processing – Removal of microbial cells and solid matter. Foam separation, precipitation, filtration, centrifugation, cell-disruption, separation of soluble products, purification, product formulation, monitoring of down stream processing.

UNIT-V

Microbial products - Production of organic acids – Source, recovery and uses of citric acid and lactic acid. Production of antibiotics - Source, production, recovery and uses of penicillin, tetracycline, amoxycillin.
Bioinsecticides - Bacteria and fungi, production of bacterial and fungal
polysaccharides, commercial production of xanthan gum.
Biomass production – Single cell protein.

Text Books

1. Stanbury.P.F. *et al*., 1998. Principles of Fermentation Technology, 2nd Edition, Elsevier Science Ltd.
2. Shuler, M.L., and Kargi, F. 2001. Bioprocess Engineering: Basic concepts, 2nd Edition, Prentice Hall.

Reference Books

1. Cruger,W. and Cruger,A. 2000. Biotechnology: A text book of Industrial Microbiology, 2nd Edition, Sinauer Associates Inc
2. Glazer, A.N. and Nikaido, H. 2007.Microbial Biotechnology, 2nd Edition, W.H.Freeman and Co.

14BCHE07

NUTRITIONAL BIOCHEMISTRY

UNIT-I

Basic concepts : Composition of human body. Energy metabolism- Energy content of foods- direct and indirect methods. BMR and SDA- methods of measurement of energy expenditure. Thermogenic effects of foods. Recommended dietary allowances, Food Pyramid.

Carbohydrates : Dietary requirements and sources of available and unavailable carbohydrates. Physico-chemical properties and physiological actions of unavailable carbohydrates (dietary fiber).

UNIT-II

Proteins : protein reserves of human body. Nitrogen balance studies and factors influencing nitrogen balance. Essential amino acids for man and concept of protein quality. Cereal proteins and their limiting amino acids. Protein requirement at different stages of development. Protein deficiency disorders.

Lipids : Major classes of dietary lipids. Properties and composition of plasma lipo-proteins. Dietary needs of lipids. Essential fatty acids and their physiological functions.

UNIT-III

Electrolytes and water balance : Electrolyte concentration of body fluids. Acids base regulation by the human body. Concepts of metabolic and respiratory acidosis and alkalosis.

Minerals : Nutritional significance of dietary calcium, phosphorus, magnesium, iron, iodine, zinc and copper**.**

Vitamins: Dietary sources, biochemical functions and specific deficiency diseases associated with fat and water – soluble vitamins. Hypervitaminosis symptoms of fat – soluble vitamins.

UNIT-IV

Nutraceuticals: significance in human health . Antioxidants : antioxidant enzymes- mode of action, non-enzymic antioxidants- mechanism of action,
Phytotherapeutics: phenolic compounds, flavonoids, lycopene, carotenoids, anthocyanins. Vitamin A,E,B and C.
Dietary metabolism and health
Over view and risks of dietary supplements.
Nutrition for infants, children, teenagers, pregnancy and lactation and ageing.

UNIT-V

Eating disorders- Obesity, anorexia nervosa and bulimia nervosa, total parenteral nutrition (TPN), sports nutrition, poverty and nutrition,

Food allergies - immune reactions.
Applied nutrition**:** Diet- nutrition, and lifestyle-related chronic non-communicable diseases (NCDS) - cardiovascular diseases, diabetes mellitus, cancer, diseases of kidney, nutrition and HIV/AIDS, food and nutrition security in developing countries.

Text Books

1. Bamji,M.S.*et al.,* 2009. Text book of Human Nutrition, 3rd Edition, Oxford and IBH Publishers.
2. Insel, P. *et al*. 2013. Discovering Nutrition, 4th Edition, Jones and Bartlett Publishers.
3. Swaminthan, M.S. 1986. 2007. Handbook of Food and Nutrition, 5th Edition. The Bangalore Printing and Publishing Company.

Reference Books

1. Srilakshmi,B. 2006. Nutrition Science, 2nd Edition, New Age International Publishers.
2. Weighley, E.S. 1997. Robinson's Basic Nutrition and Diet Therapy, 8th Edition, Macmillan Publishers.

GENOMICS AND PROTEOMICS

UNIT-I

The scope of bioinformatics. The internet. The world wide web. Useful search engines. Boolean searching. File formats. Biological databases – Sequence and structure. Data retrieval. Searching sequence databases – sequence similarity searches, amino acid substitution matrices. Data search – FASTA and BLAST, CLUSTAL and PHYLIP.

UNIT-II

The Core Aims of Genome Science. Mapping Genomes – genetic maps, physical maps, cytological maps, comparative genomics. Genome projects : genome sequence data of *E. coli*, *Arabidopsis thaliana* and mouse. Genome sequencing – Sanger sequencing, conventional genome sequencing, whole genome sequencing and shotgun sequencing. Genome Annotation – EST, STS, positional cloning. The human genome project – objectives, potential benefits and risks. Ethical, legal and social implications of the human genome project.

UNIT- III

Analysis of Gene expression – DNA microarray, SAGE, microbeads and differential display. DNA microarray and its applications in genomics. Transcriptomics and functional genomics. Molecular markers : SNP and its applications in genomics. Biochemical and structural genomics. Pharmacogenomics.

UNIT-IV

Proteomics : Introduction to proteomics, Genomics vs Proteomics. Tools of proteomics. Protein digestion techniques. Protein finger printing. 2D electrophoresis. Mass spectrometry – ESI and MALDI-TOF. X-ray crystallography. Protein micro arrays.

UNIT-V

Protein structure prediction: Comparative modeling, secondary structure prediction, fold recognition and Ab initio prediction. Application of proteomics - Mining proteomes, protein expression profiling, identifying protein-protein interaction and protein complex, mapping protein modification.

Text Books

1. David, W.M. 2003. Bioinformatics – sequence and genome analysis, CBS Publishers and Distributors.
2. Daniel, C.L. 2002. Introduction to Proteomics- Tools for the new Biology. Humana Press.

Reference Books

1. Pennington,S.R. and Dunn,M.G. 2002. Proteomics: From protein sequence to function. Viva Books.
2. Lesk, A.M. 2002. Introduction to Bioinformatics, Oxford University Press.

3. Rastogi,S.G. *et al*., 2004. Bioinformatics – Methods and applications. Prentice-Hall.

BIOTECHNOLOGY

UNIT-I
Bioprocess technology

Bioreactors: types, operation of conventional bioreactor, solid substrate fermentation, *Media for industrial fermentation, sterilization of culture media and gases.*
Batch culture, Fedbatch culture, and continuous culture
Downstream processing: solid-liquid separation, release of intracellular products, concentration, purification and formulation

UNIT-II
Industrial Biotechnology

Isolation of microorganism, microbial metabolic products- primary and secondary metabolites, genetic improvement of strains.
Metabolite production : Organic solvent – alcohol, organic acids – citric acid and lactic acid, antibiotics – penicillin and streptomycin, vitamins – riboflavin and ascorbic acid.
Single cell protein

UNIT-III
Animal Biotechnology

Animal cell culture: fundamentals and applications. Organ and tissue slice techniques.
Culture media for animal cells, cultured cells – Biology and characterization, primary culture and cell lines, cell viability and cytotoxicity, cell transformation and cell cloning

UNIT-IV
Medical Biotechnology

DNA in disease diagnosis : DNA probes, DNA in diagnosis of infectious diseases, genetic diseases, DNA fingerprinting.
Pharmaceutical products of DNA technology : Human protein replacement, therapeutic agents for human diseases.
Recombinant vaccines : subunit vaccines, DNA vaccines, attenuated recombinant vaccines, plants as edible subunit vaccines.

UNIT-V
Environmental Biotechnology

Environmental pollution : Types of pollution, pollution monitoring, biotechnological methods for management of pollution.
Biodegradation : xenobiotic compounds.
Bioremediation: Types of bioremediation, types of reactions in bioremediation, genetic engineering for efficient bioremediation, bioremediation of contaminated soil and waste land.

Text Books

1. Satyanarayana,U. 2005.. Biotechnology, 1st Edition, Books & Allied Ltd.
2. Clark,D.P.and Pazdernik,N.J. 2009. Biotechnology: Applying the genetic revolution, Elsevier.
3. Singh,B. and Gautam,S.K. 2013. Textbook of Animal Biotechnology, The Energy and Resources Institute, TERI.

Reference Books

1. Cruger,W. and Cruger,A. 2000. Biotechnology: A text book of Industrial Microbiology, 2nd Edition, Sinauer Associates Inc.
2. Stanbury,P. and Whitaker,A. 1984. Principles of Fermentation Technology, 1st Edition, Pergamon Press.

14BCHE10

INDUSTRIAL BIOCHEMISTRY

Unit-I
Bio Process Technology and Fermentation

Classification of reactors. Types of Bioreactors- Stirred Tank, Recycle reactors, discontinuous, semi continuous and continuous. Parameters for Bio process – Bio mass, Substrates, product, O_2 and CO_2, Temperature, agitation.. Downstream processing, process for product recovery, recycling of residual raw, by product recovery. Fermentation- Primary and secondary microbes, inoculums preparation, fermentation media, industrial sterilization, strain improvement, metabolic and genetic regulations during fermentations, pure and mix culture fermentations.

Unit-II
Isolation, purification of proteins and enzymes

Proteins & Enzymes – Source identification, isolation, recovery, concentration. Partial/total purification by salting in, salting out, precipitation, ion exchange, dialysis, ultra filtration, column chromatography (Gel filtration, Affinity, HPLC). Protein characterization, functional studies, evidence of purity, mass determination mass spectroscopy.

Unit-III
Proteins of industrial Importance

Therapeutic proteins–whole blood products (RBCs. Platelets, clotting factors and immunoglobulins), blood derived proteins. Vaccines and anti-toxoid Technology for measles, poliomyelitis, typhoid, Hepatitis B, AIDS, anti –tetanus.
Industrial Enzymes – production and applications of Proteases, Amylases, Lipases, Asparginase, Streptokinase. Hormones-conventional and engineered Insulin, Erythropoetin, Growth hormones. Interferons-production and application of alpha, beta, gamma Interleukin–2, TNF, CSF. Non- catalytic industrial proteins-casein, whey proteins, egg proteins, wheat germ proteins..

Unit-IV
Carbohydrates of industrial Importance

Manufacturing and refining of **c**ane sugar and by-products of sugar industry. Production of starch, maltodextrins, cyclodextrins, dextrose and other sweeteners, innulin. Manufacture of pectin and cellulose. Manufacturing of plant polysaccharides (Gum Arabic). Microbial

polysaccharides, Modified carbohydrates-modified starches, modified celluloses, agarose, sepharose.

Unit-V
Lipids of industrial importance

Vegetable Oils**:** Extraction process as for palm oil, Olive oil, coconut oil, groundnut oil and soyabean oil and animal fats, Refining processes for oils and fats.
Plant Pigments-Extraction processes and applications of chlorophylls, Carotenes, Lycopenes and Turmeric. Essential Oils-Extraction and industrial applications of essential oils (Eucalyptus, Wintergreen, Thyme, Clove, Cinnamon). Oleochemicals- Production and application of fatty acids, glycerol, sterols, squalene, lecithin, microbial lipids, surfactants and bio surfactants. Tailored and modified fats- Manufacture by lipase-catalysed inter-esterification and by trans-esterification for the production of Bio-diesel (Biofuel) from Jatropha. Production and applications of modified lipids-low fat food items, waxes, lubricants.

Text Books

1. Patel, A.H. 2005. Industrial Microbiology, 1st Edition, McMillan India Ltd,.
2. Gupta, B K Dass, 2008, Industrial Biochemistry, Swastik Publishers & Distributors
3. Walsh,G. 2002. Protein Biochemistry and Biotechnology, 2nd Edition, John Wiley and Sons Ltd.

Reference Books

1. Hui,Y.H. 2008. Food Biochemistry and Food Processing, Wiley

SUPPORTIVE COURSES

14BCHS01

TOOLS AND TECHNIQUES IN BIOSCIENCE

UNIT-I

Cell fractionation techniques: Cell lysis, homogenization, extraction, salting in, salting out, dialysis and ultra filtration.
Radioisotopes in Biology: Concept of half-life, decay constant, detection and quantitation - GM counter and solid and liquid scintillation counter. Specific activity, autoradiography and their applications. Applications of radioactivity.

UNIT-II

Centrifugation: Svedberg's constant, sedimentation velocity and sedimentation equilibrium. Differential and density gradient centrifugation, centrifugal elutriation, construction of preparative and analytical ultra centrifuge.
Microscopy: Principles and application of light phase contrast, fluorescence, scanning and transmission electron microscopy.

UNIT-III

Chromatographic techniques: Principles and applications of paper, TLC, adsorption, ion exchange, gel filtration, affinity, GLC, chromatofocusing, HPLC and FPLC.

UNIT-IV

Electrophoretic techniques: Polyacrylamide gel electrophoresis, SDS-PAGE, 2D-electrophoresis, agarose gel electrophoresis, isoelectric focusing, pulsed field electrophoresis, high voltage electrophoresis, capillary electrophoresis, isotachophoresis.

UNIT-V

Spectroscopic techniques: Principles of colorimeter, spectrophotometer, fluorimeter. Beer-Lambert's Law and its limitations. Extinction coefficient, Atomic absorption spectroscopy UV-Visible, Spectrofluorimetry, Flame Photometry, Nephlometry, Turbidometry,

Text Books

1. Wilson,K. and Walker,J. 2005. Principles and Techniques of Practical

Biochemistry, 6th Edition , Cambridge University. Press.
2. Upadhyay,A. Upadhyay,K. and Nath,N. 2009. Biophysical Chemistry: Principles and Techniques, Third Edition, Himalaya Publishing. 11th Edition

Reference Books

1. Sharma,B.K. 1981. Instrumental Methods of Chemical analysis, 5th Edition Goel Publications.
2. Homie,D.J. and Peck,H. Analytical Biochemistry, Third Edition, Longman group,1998.

14BCHS02

MEDICAL LAB TECHNOLOGY

UNIT-I
General approach to medical laboratory sciences

Safety in the laboratory. General laboratory instruments and equipments. Basic Chemistry and laboratory calculations. Specimen processing for Biochemical analyses - Blood, urine, cerebrospinal fluid, synovial fluid.

UNIT-II
Principles of Analytical techniques

Basic concepts in analytical chemistry, Colorimetry, Spectrophotometry, titrimetry, flame photometry, chromatography, electrophoresis. Immunochemistry - ELISA, RIA, CLIA, PCR techniques, flow cytometry and biochips.

UNIT-III
Clinical Chemistry

Biochemical tests - glucose, protein, albumin, urea, creatinine, uric acid, bilirubin and cholesterol. Enzymes - SGOT, SGPT, ALP, ACP, LDH, creatinine kinase, lipase, amylase, choline esterase. Hormones - Insulin, T3, T4, TSH, cortisol, FSH, progesterone and estrogen. Electrolytes and blood gases Biochemical profile test: Liver function test, renal function test, gastric function test, pancreatic function test and endocrine function test.

UNIT-IV
Automation in Clinical laboratory

Basic concepts, Automation of the analytical processes, Steps of automation in biochemical analysis, Computers in the clinical laboratory, Types of automated analysers, Commonly used analysers of biochemical laboratories.
Statistical procedures – Arithmetic mean, Median, standard deviation, coefficient of correlation, t test and ANOVA.

UNIT-V
Laboratory management

Clinical laboratory informatics - Computer systems, Laboratory information systems. Laboratory Management – Basic concepts, financial management. Quality management – Fundamentals, Total quality management of clinical laboratory.

Text Books

1. Mukherjee,K.L. 1988. Medical Laboratory Technology – A procedure manual for routine diagnostic tests, Vol I , II, III. Tata McGraw Hill Publishing Company Limited.
2. Burtis,C.A. and Ashwood,E.R. 2007. Teitz Textbook Clinical Chemistry., Third Edition, W.B.Saunders Company.
3. Varley,S. 1988. Practical Clinical Biochemistry, Gowenlock *et al*., Sixth Edition, CBS Publishers & Distributors. 1988

.

Reference Books

1. Henry,J.B. 1988. Clinical Diagnosis and Management by Laboratory Methods., 17th Edition, W.B.Saunders Company.
2. Chatterjee,M.N. and Shinde,R. Text book of Medical Biochemistry, 5th Edition, Jaypee Brothers Medical Publishers, 2002.
3. Devlin,T.M. 1998. Text book of Biochemistry with Clinical Correlation, 4th Edition, John Wiley and Sons.

14BCHS03

CLINICAL DIAGNOSIS IN HEALTH AND DISEASES

UNIT-I

Introduction: General health, syndrome and common diseases – communicable and non-communicable diseases. Samples for analysis: Blood, urine, pleural fluid, synovial fluid, cerebro spinal fluid and tissues and histology. General check up: Blood group, Hb, height and weight, waist to hip ratio, electro cardio gram, X-ray, abdomen scan and appearance of scars, urine analysis – routine analysis (protein, sugar, pigments and cells).

UNIT-II

Detection of metabolites and its importance. Tests for liver function: Enzyme assay (SGOT, SGPT, Alkaline phosphatase, GGT), Total protein, albumin /globulin ratio and their significance. Test for kidney function: Urea and creatinine estimation and their significance.

UNIT-III

Test for heart function: Blood pressure (cystolic and diastolic), lipid profile (cholesterol, triglycerides, HDL, LDL estimation) and their importance. Test for lung function: Chest X-ray, Spirometry. Test for Brain function: EEG, MRI, CT. Test for Surgery: Bleeding time, clotting time. Special test: X-ray, CT, MRI, Doppler, TMT, angioplasty.

UNIT-IV

Infection: Bacterial, viral, fungal and protozoans. Blood: Total cell count, differential count, erythrocyte sedimentation rate. Infectious diseases: Tuberculosis, Leprosy, Malaria, Hepatitis, Cholera, Dengue, HIV, Chikun gunya and H1N1. TORCH – Panel (infertility profile), Infection in pregnancy, Koch postulations – Microscopic examination of body fluids, ELISA and PCR tests.

UNIT-V

Non communicable diseases: Diabetes: Blood sugar, urine sugar, glucose tolerance test, HbA1c. Hyper tension: Lipid profile, electrolyte (sodium, potassium, chloride and biocarbonate) investigation.
Cancer markers: ELISA.

Text Books

1. Burtis,C. and Bruns,D. 2007. Teitz Fundamentals of Clinical Chemistry, 3rd Edition, W.B. Saunders Company.
2. Devlin,T.M. 1998. Text book of Biochemistry with Clinical Correlation, 4th Edition, John Wiley and Sons.
3. Varley,H. 1980.Practical Clinical Biochemistry, Volume I and II, 5th Edition, CBS Publishers.

Reference Books

1. Mayne,P.D. 1994. Clinical Chemistry in Diagnosis and Treatment, 6th Edition, Hodder Arnold Publication.
2. Marshall,W.J. and Bangeit, S.K. 1995. Clinical Biochemistry - Metabolic concepts and Clinical aspects, Churchill Livingstone.
3. Guyton,A.C. and Hall,J.E. 2010. Text Book of Medical Physiology, 12th Edition, Saunders.

14BCHS04

INTRODUCTION TO BIOCHEMISTRY

UNIT-I

Carbohydrates: Classification-monosaccharides, disaccharides, polysaccharides basic chemical structure, aldoses and ketoses, cyclic structure of monosaccharides, steroisomerism, anomers and epimers. Sugar derivatives, deoxy sugars, amino sugars, and sugar acids. General reaction and properties. Structure and biological functions of homo- and heteropolysaccharides.

UNIT-II

Lipids – Classification, structure, properties and functions of fatty acids, essential fatty acids, fats, phospholipids, sphingolipids, cerebrocides, steroids, bile acids, prostaglandins, lipoamino acids, lipoproteins, proteolipids, phosphatidopeptides, lipopolysaccharides.

UNIT-III

Proteins: Classification, structure and properties of amino acids, biologically active peptides, classification and properties of proteins, sequencing of proteins, conformation and structure of proteins-primary, secondary, tertiary and quaternary structure, coagulation and denaturation of proteins.

UNIT-IV

Nucleic acids – Nucleic acids as genetic information carriers, experimental evidence e.g., genetic transformation, Hershey-Chase experiments, action spectrum, etc. Structure and function of nucleotides. Primary, secondary and tertiary structure of nucleic acids, DNA forms and conformations, Denaturation of DNA.

UNIT-V

Vitamins: Structure, biochemical functions, deficiency diseases, daily requirements of water soluble and fat soluble vitamins and their coenzyme activity.

Text Books

1. Nelson,D.L and Cox,M.M.2013. Lehninger Principles of Biochemistry, 6th Edition, W.H. Freeman
2. Garrett,R. and Grisham,C. 2010. Biochemistry, 4th Edition, Saunders College Publishing

Reference Books

1. Berg,J.M. *et al*. 2012. Biochemistry, 7th Edition, W. H. Freeman & Company, 2012.
2. Voet,D. *et al.*, 2012. Fundamentals of Biochemistry: Life at the Molecular level, 4th Edition, John Wiley and Sons.
3. Zubey,G.L. 1998. Biochemistry, Wm.C. Brown Publishers.