

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



M.Sc. Biochemistry Syllabus
(Applicable to students admitted from the Academic
year 2017-2018 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: 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 test	: 10 Marks
Seminar	: 5 Marks
Assignment	: 5 Marks
Attendance	: 5 Marks

Practicals	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	5 x 3 = 15 marks
Part B : Answer All 5 Questions either or type	5 x 6 = 30 marks
Part C : Answer Any 3 Questions from 5	3 x 10 = 30 marks

Duration of the examination - 3 hours Maximum marks – 75

PERIYAR UNIVERSITY
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M.Sc. BIOCHEMISTRY
Curriculum and Scheme of Examination
(APPLICABLE TO STUDENTS ADMITTED FROM THE ACADEMIC YEAR
2017-2018 UNDER CBCS)

Semester	Subject code	Title of the Paper	Instruction hours/week	Exam marks			Duration of Exam	Credits
				CIA	EA	Total		
I	17BCHC01	Biomolecules	5	25	75	100	3	4
	17BCHC02	Analytical Techniques and Biostatistics	5	25	75	100	3	4
	17BCHC03	Advanced Enzymology	5	25	75	100	3	4
	17BCHC04	Cell Biology	5	25	75	100	3	4
	17BCHE01	Elective I (Major)	5	25	75	100	3	4
	17BCHP01	Practicals I	5	40	60	100	6	4
II	17BCHC05	Intermediary Metabolism	5	25	75	100	3	4
	17BCHC06	Plant Biochemistry	5	25	75	100	3	4
	17BCHC07	Molecular Biology	5	25	75	100	3	4
	17BCHP02	Practicals II	6	40	60	100	6	4
	17BCHE02	Elective II (Major)	5	25	75	100	3	4
	17BCHS01	Supportive I (Non-Major)	4	25	75	100	3	4
III	17BCHC08	Genetic Engineering	5	25	75	100	3	4
	17BCHC09	Advanced Clinical Biochemistry	5	25	75	100	3	4
	17BCHC10	Immunology	5	25	75	100	3	4
	17BCHP03	Core Practicals III	6	40	60	100	6	4
	17BCHE03	Elective III (Major)	5	25	75	100	3	4
	17BCHS02	Supportive II (Non-Major)	4	25	75	100	3	4
IV	17BCHC11	Drug Biochemistry and Clinical Toxicology	5	25	75	100	3	4
	17BCHP04	Core Practicals IV	5	40	60	100	6	4
	17BCHPR01	Project and Viva-voce	20	40	160	200	-	10

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**

Classification of Carbohydrate - structure, occurrence, properties and biological functions. Homoglycans - structure and biological functions. Heteroglycans and complex carbohydrates : Structure, and biological function. Mucopolysaccharides – bacterial cell wall polysaccharides and sialic acid. Lectins – characteristics and uses, Blood group antigens, Major classes of glycoproteins: O-linked and N- linked oligosaccharides.

UNIT-II**Proteins**

Amino acid 1 and 3 letter abbreviation, classification, biologically important peptides.

peptide bond, peptides. Physical interactions that determine the properties of proteins – short 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, β -sheets and Corey model for fibrous proteins, super secondary structures - Zinc motifs, Leucine zipper motif. Tertiary structure - Collagen and quaternary structure - Hemoglobin .

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, prostanoids, thromboxanes, leukotrienes and lipoxins. Lipoproteins- Classification and composition. Amphipathic lipids – membranes, micelles, emulsions and liposomes.

UNIT-IV**Nucleic Acids**

of nucleic acids, Structure of dsDNA – Watson and Crick model of DNA, properties of dsDNA, DNA sequencing procedures- Maxam Gilbert method and Sanger's dideoxy methods. Properties of DNA – denaturation, renaturation, Cot curves, Cruciform DNA, Triple stranded DNA. Triplex and duplex RNA , Major and Minor classes of RNA- mRNA, t RNA, rRNA, hn RNA.

UNIT-V**Vitamins and Porphyrins**

Water soluble vitamins - thiamine, riboflavin, niacin, pyridoxine, folic acid, ascorbic acid sources, structure, biochemical functions, deficiency diseases, daily requirements. Fat soluble - vitamin A, vitamin D₂, vitamin E and vitamin K - sources, structure, biochemical functions, deficiency diseases, daily requirements and hypervitaminosis. Porphyrins the porphyrin ring system.

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 AND BIOSTATISTICS

UNIT-I

Electrochemical, Microscopy and chromatographic techniques

pH, Henderson - Hasselbalch equation, biologically important buffers, pH measurement. Microscopy - Scanning and transmission electron microscopy. Principle, Instrumentation and applications- Gas chromatography, Ion Exchange, gel filtration and Affinity chromatography, HPLC.

UNIT-II

Electrophoresis and Spectroscopy

Factors affecting electrophoretic mobility, Electrophoresis of proteins- native-PAGE, SDS-PAGE, 2D-PAGE, electrophoresis of nucleic acids- agarose gel electrophoresis, pulse field electrophoresis, capillary electrophoresis. Principle, Instrumentation and applications- UV-Visible and Atomic absorption spectroscopy.

UNIT-III

Basic principles of sedimentation; types of centrifuge; preparative and analytical centrifugation – types and its applications, CsCl density gradient and sucrose gradient centrifugation. Immunochemical techniques: Agglutination reaction, Immunoblotting, FACS, Immunocapture PCR, TAS and DAS- ELISA.

UNIT-IV

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.

Measures of central tendency - arithmetic mean, median, mode, 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-V

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.

Analysis of variance - one way and two way classification. Duncan's Multiple Range test.

Text Books

1. Wilson, K. and Walker, J. 2010. Principles and Techniques of Biochemistry and Molecular Biology, 7th Edition, Cambridge University Press.

2. Upadhyay,A. Upadhyay,K. and Nath,N. 2016. Biophysical Chemistry: Principles and Techniques, 4th Edition, Himalaya Publishing. 11th Edition
3. Sharma,B.K. 2014. Instrumental Methods of Chemical analysis, Krishna Prakashan Ltd.
4. Gupta,S.P. 2011. Statistical Methods, 4th Edition, Sultan Chand & Son Publishers.
5. Zar,J.H. 2010. Biostatistical Analysis, 5th Edition, Pearson Education..

Reference Books

1. Skoog,d, Holler F and Crouch S. 2016 . Principles of Instrumental Analysis, 7th Edition, Cengage Learning custom publishing.
2. Boyer,R. 2009. Modern Experimental Biochemistry, 3rd Edition, Pearson India.
3. Daniel,W.W. 2008. Biostatistics - A Foundation for Analysis in Health Sciences, 9th Edition, John Wiley and Sons, Inc., 1999.

ADVANCED ENZYMOLOGY

UNIT-I

Classification, Coenzymes and Purification

Enzyme – Nomenclature and classification of enzymes. Coenzymic action of NAD, FAD, TPP, PLP, Biotin, CoA, folic acid and lipoic acid. Purification of enzymes - Methods to isolate and purify enzymes, activity units, Specific activity. Multienzyme complex : Mechanism of action and regulation of pyruvate dehydrogenase & fatty acid synthase complexes, Non protein enzymes – Ribozyme, Abzymes, DNA enzymes.

UNIT-II

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 and metal ion catalysis. Mechanism of reaction catalyzed by enzymes - lysozyme. Metal activated enzymes and metalloenzymes. Role of metal ions in mechanism – carbonic anhydrase

UNIT-III

Enzyme Kinetics and Enzyme inhibition

General properties of enzymes: effect of pH, substrate and temperature on enzyme catalysed reactions. Pre-steady state and steady state kinetics, Michaelis Menten kinetics, importance of V_{max} , K_m , 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-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: Enzyme and isoenzymes in diagnosis – Phosphatases, transaminases, LD, CK, amylase and cholinesterase. Enzymes as thrombolytic agents, anti-inflammatory agents, debriding agents, digestive aids, therapeutic enzymes.

Text Books

1. Palmer,T. 1995.Understanding enzymes, 4th Edition, Prentise Hall.
2. Allan Svendsen. 2016. Understanding Enzymes: Function, Design, Engineering and Analysis. Pan Stanford.
3. Price,N.C. and Stevens,L. 1999. Fundamentals of Enzymology, 3rd Edition, Oxford University Press.
4. Berg,J.M. *et al.*, 2012. Biochemistry, 7th Edition, W. H. Freeman & Co.
5. Choudhary .N.L. 2012. Fundamentals of Enzymology.ABD publisher.

Reference Books

1. Walsh,G. 2014. 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. 2014. Teitz Fundamentals of Clinical Chemistry, 7th Edition, Elsevier.
3. Nelson,D.L. and Cox,M.M. 2017. Lehninger Principles of Biochemistry, 7th Edition, W.H. Freeman & Co.

CELL BIOLOGY

UNIT-I

Cell and Cell division

Organization of prokaryotic and eukaryotic cell. Structural and functions of subcellular organelles. Cell division – mitosis and meiosis.

UNIT-II

Membrane structure and transport

Overview of membrane protein – peripheral, integral and fluid mosaic model. Membrane transport: Types, Diffusion - passive and facilitated. General classes of transport systems – Uniport, symport, antiport. Active transport – Primary and secondary, the P-type ATPase ($\text{Na}^+ \text{K}^+$ - ATPase), F-type ATPases (ATP synthases), ABC transporters, ionophores, aquaporins, ion channels (ligand-gated and voltage-gated)

UNIT-III

Cytoskeletal network

Microfilaments - Actin – Structures, Assembly, Myosin, Microtubules - Organisation and dynamics, Kinesin and dynein,
Cilia and Flagella - Structure and functions, Intermediary filaments.
Major classes of cell junctions – anchoring, tight and gap junctions. Major classes of cell adhesion molecules (CAMs) – cadherins, integrins.

UNIT-IV

Cell-cell and cell-matrix adhesion

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: Phases, cyclins, cyclin dependent kinases, check points.

UNIT V

Cell Culture Techniques

Cell and tissue culture – merits and demerits, aseptic techniques, substrates, culture media, freeze storing, transport, contamination. Growth and development of plant cells and tissues *in vitro*, callus suspension and protoplast culture. somatic hybridization. Applications of plant cell and tissue culture in breeding and industry. Animal cell culture: Primary cell culture, disaggregation, separation of viable cells. Secondary culture – maintenance of cell lines. Cancer cell lines, 3D culture. Large – scale cell cultures. Commercial application animal tissue culture.

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.

BIOCHEMISTRY PRACTICALS I

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 β -carotene from carrot
7. Estimation of total free amino acids in plant tissues
8. Estimation of reducing sugars
9. Estimation of protein
10. Estimation of iron
11. Thermal denaturation of DNA.
12. Isolation, purification and characterization of peroxidase or amylase
13. Separation of amino acids by circular and ascending paper chromatography
14. Mitosis and meiosis

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 / glycerophosphate shuttle, creatine - phosphate shuttle.

UNIT-II**Carbohydrate metabolism**

Glycolysis and gluconeogenesis - 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 - fatty acid synthase complex, regulation of lipogenesis. Oxidation of fatty acids – role of carnitine in fatty acid transport, α , β and ω oxidation. 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 20 amino acids found in proteins - Amino acids from Ser family (gly), pyruvate family (leu), aspartate family (lys), glutamate family (gln), aromatic amino acid family (trp) and histidine family (his). Catabolism of amino acid nitrogen- transamination, deamination, ammonia formation and the urea cycle. Catabolism of carbon skeletons of amino acids. Conversion of amino acids to special products.

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 and

magnesium. Trace elements: absorption, metabolism, storage and transport of iron, copper, zinc, selenium. Manganese, cobalt and fluoride. Integration of metabolism.

Text Books

1. Murray *et al.*, 2012. Harper's Biochemistry, 30th 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

Plant cell wall - Structure and function. Water uptake and movement – diffusion, osmosis, aquaporins. Plant genome organization: Plant nuclear and plastid genome organization. Biogenesis of organelles - development 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. Light receptors - chlorophyll, light harvesting complexes, bacteriorhodopsin, rhodopsin as ion pump. Photosystems I and II. The Hill reaction, Photophosphorylation and reduction of CO₂, C₃, C₄ and CAM metabolism, light and dark reactions. Light activation of enzymes, regulation of photosynthesis. Photorespiration.

UNIT-III

Mineral Nutrition - Biogeo cycles (Carbon, Nitrogen and Sulphur), Nitrate assimilation: structural features of nitrate reductase and nitrite reductase, incorporation of ammonia into organic compounds, regulation of nitrate assimilation. Sulphur assimilation in plants. Nutrient absorption and translocation, Nutrient functions in growth and development, Nutrient deficiency symptoms, toxicity problems.

UNIT-IV

Phytohormones : Auxins, cytokinins, Abscisic acid, Gibberellins, ethylene- Structure, physiological function and metabolism. Plant movement, apical dominance. Stomatal movements and morphogenesis. Photoperiodism and vernalization – flower induction, initiation and development.

UNIT-V

Biological rhythm in plants, plant defenses, environmental and genetic control, Antioxidative defence system in plants – reactive oxygen species and their generation, enzymic and non-enzymic components of antioxidative defence mechanism. Special features of secondary plant metabolism-phytochemistry of plants.

Text Books

1. Heldt, H.W. and Piechulla, B. 2016. Plant Biochemistry, 4th Edition, Academic Press.
2. Heldt, H.W. 2004. Plant Biochemistry, 3rd Edition, Academic Press.
3. Buchannan, B. *et al*, 2015. Biochemistry and Molecular Biology of Plants, 2nd revised Edition, Wiley.
4. Verma S.K. and Verma Mohit. 2007. Text book of Plant Physiology, biochemistry

and Biotechnology, 6th Edition, S. Chand.

5. Goodwin and Mercer. 2005. Introduction to Plant Biochemistry. 2nd edition, CBS.

Reference Books

1. Dey. 2013. Plant Biochemistry, 1st edition, Elsevier.

2. Dey, P.M. and Harborne, J.B. 1997. Plant Biochemistry, 1st Edition, Academic Press.

3. Lea, P.J. and Leegood, R.C. 1999. Plant Biochemistry and Molecular Biology, 2nd Edition, Wiley.

MOLECULAR BIOLOGY

UNIT-I

Chromatin and Genome

Central dogma of Molecular biology. Structure of the bacterial nucleoid - The *E.coli* chromosome and DNA-binding proteins. Plasmids- classification and properties.

The eukaryotic chromatin- nucleosomes, 30 nm fiber and chromatin loops. Organization of chromatin structure.

Genome complexity- genome size, C- value paradox, coding and non coding DNA, typical structure of protein-coding genes in prokaryotes and eukaryotes. Introns and exons and repetitive DNA (SINES, LINES, simple sequence repeats - satellite, minisatellite and microsatellite). gene duplication and pseudogenes

Organelle genomes- mitochondria and chloroplast.

UNIT- II

Replication, Repair and Recombination

DNA replication in prokaryotes and eukaryotes (helicases, SSB, topoisomerases, DNA polymerases and DNA ligase), Telomeres, telomerases and end replication. Inhibitors of replication.

DNA repair mechanisms - Nucleotide excision repair, base excision repair, mismatch repair, double-strand break repair, recombination repair and SOS response.

Recombination – Homologous recombination, site specific recombination. Transposons and mechanism of transposition (elementary details).

UNIT-III

Prokaryotic Transcription and Regulation

E.coli RNA polymerase, Promoter sequence in *E.coli*, Initiation, elongation and termination. Rho dependent and Rho independent termination. Inhibitors of transcription. Post-transcriptional processing of rRNA and tRNA. Regulation of transcription in prokaryotes – lac operon and tryptophan operon.

UNIT- IV

Eukaryotic Transcription and Regulation

RNA polymerases - structure, RNA pol I, II and III, transcriptional factors, Transcription initiation by RNA polymerase I, II and III. Transcriptional regulation in eukaryotes - steroid hormone receptors and phosphorylation. Post transcriptional processing of mRNA, rRNA and tRNA. Alternative splicing, RNA editing, Antisense RNA, Micro RNAs and RNA interference.

UNIT- V

Genetic Code, Translation and Targeting

Genetic code - salient features. Mitochondrial genetic code.

Mutations– point mutations and frame shift mutations. Suppressor mutations – nonsense and missense suppression.

Mechanism of protein synthesis in bacteria and eukaryotes- amino acid activation, initiation, elongation and termination. Inhibitors of protein synthesis. Co and post-translational modifications.

Protein targeting to membranes, nucleus, mitochondria, lysosomes, signal sequence hypothesis, Protein degradation- the ubiquitin pathway. Protein folding- (elementary details).

Text Books

1. Lodish *et al.* 2012. Molecular Cell Biology, 7th Edition, W.H. Freeman and Co.
2. Weaver,R.F. 2011. Molecular Biology, 5th Edition, WCB McGraw Hill, Higher Education.
3. 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

1. Isolation and estimation of DNA
2. Isolation and estimation of RNA
3. Estimation of phosphorus
4. Estimation of chlorophyll in leaves
5. Estimation of phenols in plant tissues
6. Estimation of peroxidase in plant tissues
6. Plant tissue culture (Demo)
Callus induction. Initiation of suspension cultures, Regeneration of shoot and root from callus culture
7. Animal tissue culture (Demo)
Preparation and sterilization of media, Filter sterilization of media, Primary cell culture – trypsinisation, passaging, staging, Cell lines, counting – vital staining, Cytotoxicity and viability assay
8. Isolation of pure culture - Serial dilution, pour plate, spread plate, streak plate
9. Staining techniques - Simple, differential
10. Separation of lipids by TLC
11. Separation of proteins by SDS-PAGE
12. Agarose gel electrophoresis of DNA

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 endonucleases, cloning vectors, and ligation

Basic steps in gene cloning. Type II Restriction endonucleases- nomenclature and types of cleavage. Cloning vectors: plasmids (pBR322 and pUC), phage vectors (λ), cosmids, phagemids, BACs and YACs. Methods of ligation of insert and vector DNA molecules: cohesive end method, homopolymeric tailing, blunt-end ligation, linkers and adapters.

UNIT-II

Gene transfer methods - cloning & screening strategies

Gene transfer methods: calcium phosphate coprecipitation, electroporation, lipofection, viruses, microinjection. Choice of host organisms for cloning. Construction of genomic and cDNA libraries . Cloning strategies- genomic cloning, cDNA cloning. Differences between genomic and cDNA libraries. Screening of recombinants: marker inactivation (antibiotic resistance, blue-white selection), colony hybridization, immunoscreening, screening for protein activity.

UNIT-III

Expression systems

Factors affecting expression of cloned genes. Expression of eukaryotic genes in bacteria- expression vector, promoters, industrial protein production. Fusion proteins, strategies to enhance protein stability, secretion and metabolic load. Expression in eukaryotic cells: Expression in yeast- yeast vectors, GAL system. Baculovirus and Mammalian expression systems (brief account). Tagged proteins and secretion signals. Reporter genes- types and uses.

UNIT-IV

Gene Manipulation Techniques

Extraction and purification of nucleic acids. Probes: radioactive and nonradioactive. Blotting techniques: Southern, northern, and western. Principle and applications of DNA fingerprinting, DNA footprinting in situ hybridization, PCR, RT-PCR, real-time qPCR. DNA Sequencing: Automated sequencing. Next-generation sequencing. Site-directed mutagenesis (SDM): cassette and oligonucleotide-directed mutagenesis. PCR-based methods. Protein engineering by directed evolution and DNA shuffling. Hazards and safety aspects of genetic engineering.

UNIT-V

Gene targeting & Metabolite Engineering

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). Antisense RNA technique, Herbicide resistance. Methods

of gene transfer in plants-*Agrobacterium*-mediated transformation and particle gun method. Transgenic plant technology-development and applications.

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. 2009. Molecular Biotechnology - Principles and Applications of Recombinant DNA, 4th 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

ADVANCED CLINICAL BIOCHEMISTRY

UNIT-I

Specimen collection and processing

Collection of blood by various methods, anticoagulants. Collection of urine - Timed urine specimens, urine preservatives. 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, Hypouricemia 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, α -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, liver function tests, disorders of bilirubin metabolism. Pancreatic and gastric function tests – peptic ulcer

Renal function tests - Biochemical findings in glomerulonephritis, acute and chronic renal failure, nephritic syndrome, nephrolithiasis. Normal and abnormal constituents of urine.

UNIT-V

Diabetes and Atherosclerosis

Blood glucose homeostasis-Role of tissues and hormones. Diabetes mellitus–classification, metabolic abnormalities, diagnosis and management, acute and long-

term complications. Atherosclerosis – risk factors, biochemical findings and management.

Text Books

1. Burtis,C. and Bruns,D. 20. Teitz Fundamentals of Clinical Chemistry, 7th Edition, W.B. Saunders Company.
2. Devlin,T.M. 2010. Text book of Biochemistry with Clinical Correlation, 7th 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. 2015. Text Book of Medical Physiology, 13th Edition, Saunders

PRACTICALS III

1. Estimation of blood glucose
2. Estimation of blood Urea
3. Estimation of serum uric acid
4. Estimation of serum creatinine
5. Estimation of serum calcium
6. Estimation of serum phosphorus
7. Estimation of serum Bilirubin – TB, DB
8. Estimation of serum protein, albumin, AG ratio
9. Assay of Alkaline phosphatase
10. Assay of Aspartate amino transferase
11. Isolation of genomic DNA from liver/plant/ bacterial source
12. Isolation of plasmid DNA from bacteria
13. Restriction digestion of DNA
14. Transformation in *E.coli*
15. 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 immunogenicity, 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 LD₅₀ and ED₅₀. 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

1. Estimation of Glutathione peroxidase
2. Estimation of reduced Glutathione
3. Estimation of Vitamin C
4. Estimation of Lipid peroxidation
5. Estimation of triglycerides
6. Estimation phospholipids
7. Estimation total cholesterol
8. Estimation of HDL and LDL cholesterol
9. Immuno diffusion – Single radial and double diffusion
10. Immunoelectrophoresis
11. Rocket immunoelectrophoresis
12. Agglutination tests
13. Serial dilution of ASO titre, VDRL titre

Scheme for practical exam

Max : 60
marks

Time : 6 hours

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

ELECTIVE COURSES

MOLECULAR ENDOCRINOLOGY

UNIT-I

Historical and anatomy aspects of mammalian endocrine system . Classification of hormones and mechanism of action. Hypothalamic and pituitary hormones. Hypothalamic releasing factors. Anterior pituitary hormones: biological actions, regulation and disorders of growth hormone, ACTH, gonadotropins and prolactin. Leptin.

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

Unit-II

Thyroid and Parathyroid hormones

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

Unit-III

Adrenal hormones

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

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

Unit-IV

Gastrointestinal , Pancreatic and Gonadal hormones

Gonadal hormones: Biosynthesis, regulation, transport, metabolism and biological actions of androgens. Hypogonadism and gynecomastia. Biosynthesis, regulation,

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

Unit–V

Signal transduction and Neuro transmitter

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

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.
2. S. Melmed et al., 2015. Williams Text Book of Endocrinology, 13th Edition, Saunders

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 - O₂ and CO₂. 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; archeobacteria, gram positive and gram negative and subbacteria structure and function of flagella, cilia and endospore. Structure and classification of algae and reproduction. Structure and classification of fungal cell, hyphae, 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, Corynebacterium, 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 dairy 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 dairy products-yogurt, kaffir, kumiss, cheese production. Food hygiene and control-food sanitation in food manufacture.

UNIT-V

Industrial Microbiology

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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, Melnickand 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 nanoparticle

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 (TiO₂, CeO₂, 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 nanoparticles. 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..

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, inocula 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.

3. 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.

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 lipoproteins. 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.

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, O₂ and CO₂, 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, Asparaginase, 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 cane sugar and by-products of sugar industry. Production of starch, maltodextrins, cyclodextrins, dextrose and other sweeteners, inulin. 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

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, isotachopheresis.

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, Nephelometry, 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

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

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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.

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 Chemistry, 3rd Edition W.B.Saunders Company.
2. Devlin,T.M. 1998. Text book of Biochemistry with Clinical Correlation, 4th Edition.
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.

INTRODUCTION TO BIOCHEMISTRY

UNIT-I

Carbohydrates: Classification-monosaccharides, disaccharides, polysaccharides basic chemical structure, aldoses and ketoses, cyclic structure of monosaccharides, stereoisomerism, 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.

