

APPENDIX
UNIVERSITY OF MADRAS
B.Sc.Degree Course in Biochemistry
Choice Based Credit System
(With effect from the academic year 2015-2016)

Revised Regulations

1. Eligibility for admission

Candidate for admission to the first year of B.Sc. Degree Course in Bio-Chemistry shall be required to have passed the Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry.

6. Scheme of examinations :

I SEMESTER

Course Components/Title of the paper	Credits	MARKS		
		CIA	EXT	TOTAL
Part –I - Language Paper -I	3	25	75	100
Part –II - English Paper -I	3	25	75	100
Part-III Core Paper-I: Nutritional Biochemistry	5	25	75	100
Allied Paper- I	3	25	75	100
Part-IV Basic Tamil/Adv. Tamil/ Non Major Elective -I: Health and Nutrition	2	25	75	100
Soft Skills -I	3	50	50	100

II SEMESTER

Course Components/Title of the paper	Credits	MARKS		
		CIA	EXT	TOTAL
Part –I – Language Paper -II	3	25	75	100
Part –II - English Paper –II	3	25	75	100
Part-III Core Paper -II: Cell Biology	5	25	75	100
Core Paper – III: Core Practical –I	4	40	60	100
Allied paper- II	3	25	75	100
Allied Practical –I &II	4	40	60	100
Part-IV Basic Tamil/Adv. Tamil/ Non Major Elective -II: Human diseases and Preventive Aspects	2	25	75	100
Part-IV Soft Skills -II	3	50	50	100

III SEMESTER

Course Components/Title of the paper	Credits	MARKS		
		CIA	EXT	TOTAL
Part –I – Language Paper -III	3	25	75	100
Part –II – English Paper -III	3	25	75	100
Part-III Core paper-IV: Chemistry of Biomolecules I	5	25	75	100
Allied paper- III	3	25	75	100
Part-IV Environmental Studies	2	Exam in IVSemester		
Soft Skills –III	3	50	50	100

SEMESTER – IV

Course Components/Title of the paper	Credits	MARKS		
		CIA	EXT	TOTAL
Part –I - Language Paper -IV	3	25	75	100
Part –II - English Paper -IV	3	25	75	100
Part-III Core paper-V: Chemistry of Biomolecules- II	5	25	75	100
Core Paper VI : Core Practical II	4	40	60	100
Allied paper- IV	3	25	75	100
Allied Practical –III & IV	4	40	60	100
Part-IV Environmental Studies	2	25	75	100
Soft Skills-IV	3	50	50	100

V SEMESTER

Course Components/Title of the paper	Credits	MARKS		
		CIA	EXT	TOTAL
Part-III Core Paper-VII: Enzymes	5	25	75	100
Core Paper -VIII: Metabolism	5	25	75	100
Core Paper-IX: Analytical Biochemistry	5	25	75	100
Core Elective Paper -I: Physiology	5	25	75	100
Part-IV Value Education	2			

VI SEMESTER

Course Components/Title of the paper	Credits	MARKS		
		CIA	EXT	TOTAL
Part-III	5	25	75	100
Core Paper-X: Clinical Biochemistry				
Core Paper -XI: Molecular Biology	4	25	75	100
Core Paper XII – Core Practical III	4	40	60	100
Core Paper XIII – Core Practical IV	4	40	60	100
Core Elective Paper II : Immunology	5	25	75	100
Core Elective Paper III: Biotechnology	5	25	75	100
Part-V	1			
Extension Activity				

(Core paper: 60 Credits; Core Elective paper: 15 Credits; Non-major elective: 4 Credits
Part –I: 12 Credits; Part –II: 12 Credits; Allied paper: 20 Credits; Soft Skills: 12 Credits;
EVS: 2 Credits; Value Education: 2 Credits; Extension Activity: 1 Credit)

Course content: The syllabus consists of theory and practical papers. The students are expected to present seminars on special topics.

B.Sc. DEGREE COURSE IN BIOCHEMISTRY
SYLLABUS
SEMESTER-I
CORE PAPER-I - NUTRITIONAL BIOCHEMISTRY

UNIT-I

Concepts of food and nutrition. Basic food groups- energy yielding, body building and functional foods. Units of energy. Calorific and nutritive value of foods. Measurement of calories by bomb calorimeter. Basal metabolic rate (BMR) - definition, determination of BMR and factors affecting BMR. Respiratory quotient (RQ) of nutrients and factors affecting the RQ. SDA- definition and determination.

UNIT-II

Physiological role and nutritional significance of carbohydrates, lipids and proteins. Evaluation of proteins by nitrogen balance method - Biological value of proteins - Digestibility Coefficient, Biological Value, Protein Energy Ratio and Net Protein Utilization. Protein energy malnutrition- Kwashiorkor and Marasmus. Clinical manifestations and management. Obesity (elementary details)

UNIT-III

Balanced diet, example of a low and high cost balanced diet – for infants, children, adolescents, adults and elderly people. Role of dietary fiber. Vitamins- definition and types of vitamins. Sources, requirement, biological functions, deficiency symptoms of thiamine, riboflavin, niacin, pyridoxine, pantothenic acid, folic acid, biotin, cyanocobalamine, vitamins C,A,D,E and K. Hypervitaminosis.

UNIT-IV

Minerals- sources, requirement, physiological functions, deficiency and toxicity of calcium, sodium, potassium, iron, magnesium, chromium, cobalt, copper, manganese, molybdenum, selenium, iodine and zinc.

UNIT-V

Human rights – introduction- definition, scope and need for study of human rights and relations. Categories- civil and political rights, economic relations and social relations. Institutions : International and National- United Nations Human Rights Commission, State Human Rights Commission. International Convention on civil and political rights. International convention on economic and social rights. National Human Rights Act- National Commission for minorities, SC/ST and Women, Students activity- assignment, case study, term paper.

Books Recommended:

1. Garrow, JS , James WPT and Ralph A (2000) . Human nutrition and dietetics (10th ed)
Churchill Livingstone
2. Andreas M. Papas (1998). Antioxidant Status, Diet, Nutrition, and Health (1st ed) CRC Press
3. M.Swaminathan (1995) Principles of Nutrition and Dietetics. Bappco
4. Margaret Mc Williams (2012) . Food Fundamentals (10th ed) Prentice Hall
5. Tom Brody (1998). Nutritional Biochemistry (2nd ed) , Academic Press, USA
6. Aravind Kumar (ed) (1999). Human rights and social movements, Anmol publishers.
7. Piarey Lal Mehta, Neena Verma, P I Mehta (1999) Human Rights Under the Indian Constitution. Deep & Deep Publications Pvt. Ltd.

NON – MAJOR ELECTIVE PAPER- I - HEALTH AND NUTRITION

UNIT – I

Health – definition, Factors affecting human health. Importance of health care of children, adults and elderly people. Balanced diet and calorific value.

UNIT – II

Vitamins-definition, classification, sources, properties , functions and deficiency symptoms. Recommended daily allowances.

UNIT – III

Sources and functions of dietary fats, role of fats and lipids in health. Calorific value.

UNIT – IV

Minerals- Role of minerals on human health, sources, biological functions, deficiency disorders with special reference to Calcium, Phosphorus, Potassium, Copper, Iron, Zinc and Selenium. Minerals in biological systems and their importance –Iron, Calcium, Phosphorus, Iodine, Copper, Zinc.

UNIT - V

Role of proteins and carbohydrates in health. Functions of protein and carbohydrate and their calorific value. Dietary sources and deficiency disorders – Kwashiorkor and Marasmus – supplementation programmes in India and their implications.

Books recommended

1. S.Davidson and J.R.Passmore (1986) Human Nutrition and Dietetics, (8th ed), Churchill Livingstone
2. J. S. Garrow, W. Philip T. James, A. Ralph (2000), Human Nutrition and Dietetics (10th ed), Churchill Livingstone
3. M.Swaminathan (1995) Principles of Nutrition and Dietetics, Bappco
4. Margaret Mc Williams (2012) . Food Fundamentals (10th ed) ,Prentice Hall
5. M.Swaminathan (1995) Principles of Nutrition and Dietetics. Bappco

II SEMESTER
CORE PAPER – II - CELL BIOLOGY

UNIT-I

Cell theory, cell as basic unit of life. Classification of Viruses, Bacteria and Fungi. Structure and organization of prokaryotic and eukaryotic cells. Comparison between plant and animal cells, General structure of cytoskeleton - structure, composition and functions of microfilaments , microtubules and intranuclear filaments.

UNIT-II

Subcellular organelles: The ultrastructure of cell wall, plasma membrane, nucleus, mitochondria, rough and smooth endoplasmic reticulum, Golgi apparatus, lysosome, peroxisome , chloroplast and glyoxisome and their function.

UNIT-III

Biomembrane – structure, organization and basic functions, fluid mosaic model, Transport across cell membrane – uniport, symport and antiport. Passive and active transport and water channel.

UNIT- IV

Organization of cells into tissue. Types of tissue. Cell – cell adhesion, cell matrix adhesion. Extracellular matrix– components and their biological role.

UNIT-V

Organisation of prokaryotic and eukaryotic genome, chromosomes, types, structure and function. Cell division, mitosis, meiosis, their significance. Cell cycle – phases of cell cycle.

Books recommended:

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments (6th ed). John Wiley & Sons. Inc.
2. Bruce Alberts and Dennis Bray (2013),Essential Cell Biology,(4th ed),Garland Science.
3. De Robertis, E.D.P. and De Robertis, E.M.F. (2010). Cell and Molecular Biology.(8th ed). Lippincott Williams and Wilkins, Philadelphia.
4. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. (5th ed). Sunderland, Mass. Sinauer Associates, Inc.
5. Wayne M. Baker (2008) the World of the Cell. (7th ed). Pearson Benjamin Cummings Publishing, San Francisco. Cell Biology
6. P.S.Verma and V.K.Agarwal. (2004) Cell Biology, Genetics, Molecular Biology, Evolution and Ecology (14th ed), S.Chand and Company Ltd

CORE PAPER – III - CORE PRACTICAL – I

I. Titrimetric procedures

1. Estimation of glycine by Sorenson's formal titration.
2. Estimation of calcium from milk.
3. Estimation of iron.
4. Estimation of oxalate.
5. Estimation of Vitamin C (Ascorbic acid)

II. Group experiments

1. Stages of cell division.
2. Identification of plant, animal and bacterial cell.

III. Biochemical Preparation

1. Preparation of starch from potatoes.
2. Preparation of casein and lactalbumin from milk.
3. Preparation of albumin from eggs.
4. Preparation of haemoglobin from blood.
5. Preparation of cellulose from plant material.

NON –MAJOR ELECTIVE PAPER –II
HUMAN DISEASES AND PREVENTIVE ASPECTS

UNIT-I

Diseases –definition –Examples for bacterial, viral and fungal diseases. Endemic and epidemic diseases –causes and symptoms. Major diseases of young children with special reference to diarrhea, primary complex, whooping cough, Kwashiorkor and Marasmus and their preventive aspects.

UNIT-II

Cancer- differences between benign and malignant tumors. Growth characteristics of cancer cells. Agents causing cancer- physical, chemical, biological. Prevalence of cancer in South India. Cancer therapy- surgery, radiation and chemotherapy. Cancer prevention.

UNIT-III

Diabetes mellitus –causes and types. Type I and type II diabetes mellitus. Role of antidiabetic drugs. Dietary prevention of diabetes mellitus. Examples for antidiabetic medicinal plants. Kidney stones –causes –influence of diet.

UNIT-IV

Cardiovascular disease –causes and symptoms. Role of dietary lipids. HDL and LDL as risk factors. Dietary prevention of CHD. Hypolipidemic medicinal plants and their products. Liver diseases –jaundice, hepatitis –causes and symptoms. Dietary prevention of disease progression.

Books recommended

1. M.N.Chatterjee and Rana Shinde (2007).Textbook of Medical Biochemistry (7th ed)
2. Ambika Shanmugam (2012) Fundamentals of Biochemistry for Medical Students (7th ed), Lippincott Williams & Wilkins
3. Tietz Fundamentals of Clinical Chemistry and Molecular Diagnostics (2014) (7th ed), Saunders
4. A.Catherine Ross (2012) Modern nutrition in health and diseases (11th ed) . Lippincott Williams and Wilkins
5. Michael.G.Wohl, Robert.S.Goodhart, Maurice E.Shils (1999).Modern nutrition in health and disease (9th ed) , Lippincott Williams and Wilkins

III SEMESTER

CORE PAPER – IV - CHEMISTRY OF BIOMOLECULES I

UNIT-I

Carbohydrates - classification and biological significance, physical properties, stereo isomerism, optical isomerism and mutarotation. Configuration of aldo and keto trioses, tetroses, pentoses and hexoses. Reactions of monosaccharides due to the presence of hydroxyl, aldehyde and ketone groups. Structure and properties of reducing disaccharides (lactose & maltose), non-reducing disaccharide (sucrose). Identification of ketose, pentose, reducing and non - reducing sugars.

UNIT-II

Occurrence, structure and functions of polysaccharides- starch, glycogen and cellulose.(structural elucidation is not needed). Structure and biological significance of mucopolysaccharides - hyaluronic acid, chondroitin sulphate and heparin. Composition and functions of inulin, agar, pectin, chitin, dextran, gum arabic and alginic acid. (structures are not necessary).Structure of bacterial cell wall polysaccharides (peptidoglycan and teichoic acid), blood group polysaccharides and glycoproteins.

UNIT-III

Aminoacids - biological role. General structure of amino acids. 3- and 1-letter abbreviations. Classification of amino acids based on nature of R group (polar, non polar, acidic, basic, neutral). Modified amino acids in protein, non protein amino acids. Physical properties of amino acids, isoelectric point, titration curve (alanine, lysine, glutamic acid), optical activity. Chemical reactions due to carboxyl group, amino group and side chains. Colour reactions of amino acids.

UNIT-IV

Composition and biological importance of peptides. Examples of peptide hormones. Solid state peptide synthesis. Structure of oligopeptides like glutathione, vasopressin and oxytocin, Peptidases – exo and endo peptidases. Classification of proteins based on composition, solubility, and functions. Properties of proteins- salting in and salting out, denaturation and renaturation, UV absorption. Estimation of protein by Biuret, Folin's phenol and UV methods.

UNIT-V

Definition and biological significance of hydrogen bond, hydrophobic interactions and van der waals forces. Levels of organization of protein structure – primary structure – composition, Outline of protein sequencing, Secondary structure – α helix (egg albumin), β -pleated sheath (keratin), triple helix (collagen). Tertiary structure – forces involved in maintenance of tertiary structure like hydrogen bond, hydrophobic interactions, van der waals force, disulphide linkage and ionic bonds with reference to myoglobin. Quaternary structure with reference to haemoglobin.

Books Recommended:

1. David L.Nelson and Michael M.Cox (2012) Lehninger Principles of Biochemistry (6th ed) W.H. Freeman.
2. Voet.D & Voet. J.G (2010) Biochemistry , (4th ed), John Wiley & Sons, Inc.
3. Metzler D.E (2003). The chemical reactions of living cells (2nd ed), Academic Press.
4. Zubay G.L (1999) Biochemistry , (4th ed), Mc Graw-Hill.
5. Lubert Stryer (2010) Biochemistry,(7th ed), W.H.Freeman
6. Satyanarayan,U (2014) Biochemistry (4th ed), Arunabha Sen Books & Allied (P) Ltd, Kolkata.

IV - SEMESTER

CORE PAPER – V - CHEMISTRY OF BIOMOLECULES II

UNIT-I

Lipids- Chemical nature, biological functions and classification of lipids. Fatty acids – definition, classification – saturated, unsaturated, hydroxy and cyclic fatty acids, nomenclature, structure and properties of fatty acids. Simple and mixed triglycerides – structure and general properties, Isolation of fats (Folch method) and identification. Characterization of fats – iodine value, saponification value, acid number, acetyl number, Polensky number, Reichert-Meissl number.

UNIT-II

Sterols – structure of cyclopentanoperhydrophenanthrene nucleus. Animal sterol : cholesterol - properties and functions. Plant sterol : stigmasterol – Functions, Ergosterol : Functions. Lipoproteins : general structure , classification : chylomicrons, VLDL, LDL, IDL, HDL – composition and biological roles. Classification, structure, properties and biological functions of phospholipids and sphingolipids.

UNIT-III

Structure of purine and pyrimidine bases, nucleosides and nucleotides and their biological importance. Types of DNA : A, B, C, Z DNA, structure and biological significance, superhelicity. Isolation, purification, identification and estimation of DNA. Properties of DNA – hypochromic and hyperchromic effect, melting temperature, viscosity. Denaturation and annealing.

UNIT-IV

Isolation, purification, identification and estimation of RNA. Salient features of prokaryotic and eukaryotic RNA. RNA as a genetic material. Types of RNA: mRNA, tRNA, rRNA, hnRNA, snRNA- location and role. Secondary and tertiary structure of tRNA. Action of nucleases of pancreas, spleen and venom on RNA.

UNIT-V

Heterocyclic rings of biological importance - pyridine, pyrrole, quinoline, pteridine, thiazole, imidazole, indole with examples. General structure of carotenoids, terpenes and heme. Identification and biological significance of terpenoids, carotenoids, alkaloids, flavanoids .Bile salt, bile pigments – structure and functions. Salient features and properties of penicillin, streptomycin, tetracycline.

Books Recommended:

- 1.David L.Nelson and Michael M.Cox (2012) Lehninger Principles of Biochemistry (6th ed) W.H. Freeman.
- 2.Voet.D and Voet. J.G (2010) Biochemistry , (4th ed), John Wiley & Sons, Inc.
- 3.Metzler D.E (2003). The chemical reactions of living cells (2nd ed), Academic Press.
- 4.Zubay G.L (1999) Biochemistry , (4th ed), Mc Grew-Hill.
- 5.Lubert Stryer (2010) Biochemistry,(7th ed), W.H.Freeman
- 6.Satyanarayan,U (2014) Biochemistry (4th ed), Arunabha Sen Books & Allied (P) Ltd, Kolkata.

CORE PAPER VI - CORE PRACTICAL – II

I. Titrimetric methods

1. Determination of saponification value of an edible oil.
2. Determination of acid number of an edible oil.
3. Determination of iodine value of an edible oil.

II. Qualitative analysis

1. Analysis of simple sugars- glucose, fructose, galactose, mannose, sucrose, lactose, maltose and starch.
2. Analysis of amino acids - tyrosine, tryptophan, arginine, cysteine and histidine
3. Tests for protein- Solubility, Biurette, Xanthoproteic, Million's tests. Denaturation by heat, pH change. Precipitation by heavy metals and by acidic reagents.

III. Colorimetry

1. Estimation of Protein by Biuret method.
2. Estimation of inorganic phosphorus by Fiske and Subbarow method.
3. Estimation of amino acids by Ninhydrin method.
4. Estimation of DNA
5. Estimation of RNA
6. Estimation of carbohydrate by Dubois method

V SEMESTER
CORE PAPER – VII - ENZYMES

UNIT-I

Enzymes- definition and chemical nature of enzymes. General properties; Nomenclature and classification; enzymes as catalysts- Activation energy. Enzyme specificity- Active site ; Lock and key hypothesis and Induced fit theory, Allosteric site, Regulatory enzymes- allosteric enzymes with suitable examples. Isoenzymes ; with reference to LDH and CK .

UNIT-II

Methods of isolation of enzymes: Homogenisation techniques, intracellular localization of enzymes ; isolation of intracellular enzymes ; separation procedure based on molecular size - dialysis , ultrafiltration , molecular exclusion chromatography methods based on solubility – isoelectric precipitation. Salting in and salting out – methods based on electric charge – electrophoresis, Ion exchange chromatography.

UNIT-III

Coenzymes , function and action of TPP , PLP , NAD / NADP, FMN, FAD , coenzyme A, lipoic acid and Biotin. Multienzyme complexes , Metallo enzymes, Industrial uses of enzymes – food and pharmaceutical industries. Biosensors and their applications, immobilized enzymes and methods of immobilization.

UNIT-IV

Enzyme Kinetics : Rate of enzyme catalyzed reacton, Derivation of Michaelis - Menten equation. Lineweaver Burk plot and Eadie Hofstee plot. Factors affecting enzyme activity - pH, temperature , activators , cofactors , concentration of enzyme and substrate. Determination of Km value by any 3 methods.

UNIT-V

Enzyme inhibition – reversible and irreversible inhibition – types of reversible inhibitors: competitive, non competitve , uncompetitive inhibitors. (derivation not required). Mechanism

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

Books recommended:

1. David L. Nelson and Michael M. Cox (2012) Lehninger Principles of Biochemistry (6th ed), W.H. Freeman
2. Voet. D and Voet. J.G (2010) Biochemistry , (4th ed), John Wiley & Sons, Inc.
3. Robert K. Murray, Darryl K. Granner, Peter A. Mayes, and Victor W. Rodwell (2012), Harper's Illustrated Biochemistry, (29th ed), McGraw-Hill Medical
4. Trevor Palmer (1995), Understanding Enzymes (4th ed), Ellis Horwood Ltd

CORE PAPER VIII – METABOLISM

UNIT-I

Biosynthesis and degradation of tyrosine, tryptophan and sulphur containing amino acids, Formation of melanin and epinephrine, nor-epinephrine from tyrosine.

UNIT-II

Metabolism of carbohydrates – reactions, inhibitors and energetics of glycolysis, Cori cycle, citric acid cycle, glyoxalate cycle, gluconeogenesis and HMP shunt pathway. Glycogenolysis, glycogenesis and regulation of glycogen metabolism.

UNIT-III

Metabolism of lipids. Degradation of saturated fatty acids. - β oxidation. Degradation of triglycerides, phospholipids (lecithin). Biosynthesis of saturated fatty acids, triglycerides, phospholipids (lecithin). Biosynthesis of cholesterol and ketone bodies.

UNIT-IV

Metabolism of amino acids – Amino acid pool. Oxidative deamination – role of dehydrogenases and oxidases. Non-oxidative deamination – role of pyridoxal phosphate with reference to serine and cysteine. ammonia detoxification. Decarboxylation – formation of histamine, cadaverine, gamma amino butyric acid and serotonin. Transamination reaction – mechanism and Schiff's base formation Transamidation-formation of creatine and transpeptidation– urea cycle – compartmentation and enzymes of urea cycle.

UNIT-V

Biological oxidation – Redox reactions, redox couples – redox potential – standard redox potential and its measurement. Electron transport in mitochondria – components of electron transport chain. Reactions, energetics and inhibitors of electron transport. Oxidative

phosphorylation – mechanism of chemi-osmotic theory. Inhibitors of oxidative phosphorylation – uncouplers and ionophores. Substrate level phosphorylation. High energy compounds – definition, structure and free energy of hydrolysis of phosphoenol pyruvate, 3- phosphoglycerate, creatine phosphate, ATP, GTP and acyl CoA. Lippman ATP cycle.

Books Recommended:

1. David L. Nelson and Michael M. Cox (2012) Lehninger Principles of Biochemistry (6th ed) W.H. Freeman.
2. Voet. D and Voet. J.G (2010) Biochemistry , (4th ed), John Wiley & Sons, Inc.
3. Lubert Stryer (2010) Biochemistry, (7th ed), W.H. Freeman
4. Denise R Ferrier (2013), Biochemistry (Lippincott's Illustrated Reviews), (6th ed), Lippincott Williams and Wilkins
5. Robert K. Murray, Darryl K. Granner, Peter A. Mayes, and Victor W. Rodwell (2012), Harper's Illustrated Biochemistry, (29th ed), McGraw-Hill Medical

CORE PAPER – IX - ANALYTICAL BIOCHEMISTRY

UNIT-I

Definition of Molality, Molarity, Normality, Osmolarity, Definition of pH, pOH, determination of pH- Glass electrode, , Isoelectric pH, Zwitter ion, buffers, Henderson–Hasselbalch equation, Tonicity, Donnan membrane equilibrium and application. Buffers in body fluids, Red blood cells, tissues . Measurement of oxygen consumption - the Clark oxygen electrode

UNIT-II

Basic principles of sedimentation, centrifugal force, centripetal force, sedimentation rate. Types of centrifuges, types of rotors – fixed angle, vertical , swinging bucket , zonal, elutriator rotors. Preparative centrifugation – differential centrifugation – fractionation of subcellular organelles, density gradient centrifugation – gradient preparation, separation and recovery of sample. Isopycnic centrifugation,. Isodensity centrifugation, analytical centrifugation.

UNIT-III

General principles of chromatography – partition and adsorption chromatography. Paper chromatography – principle, sample application, development – ascending , descending and radial, detection of amino acids and sugars. Thin layer chromatography – principle, instrumentation and applications (separation of alkaloids). Column chromatography – principle, factors affecting resolution. Basic principles and applications of Affinity chromatography.

UNIT-IV

General principle of electrophoresis, factors affecting migration rate – electrical potential, nature of the sample, nature of buffer, nature of the supporting medium. Tiselius moving boundary electrophoresis. Principle, procedure and application of paper, cellulose acetate, agarose and starch gel electrophoresis. Isoelectric focusing. Principle and applications of SDS-PAGE and Immuno electrophoresis.

UNIT-V

Basic principles of electromagnetic radiation, energy, wavelength, wave number and frequency. Absorption and emission spectrum. Beer Lambert law – UV and Visible range.

Colorimetry, Spectrophotometry- principle, instrumentation and applications.
Spectrofluorimetry- principle, instrumentation and applications with reference to riboflavin.
Flame photometry – atomic absorption and emission - principle, instrumentation and applications
with reference to sodium and potassium analysis.

Books Recommended:

1. Keith Wilson , John Walker (2010) Principles and Techniques of Biochemistry and Molecular Biology (7th ed) Cambridge University Press
2. David Sheehan (2009), Physical Biochemistry: Principles and Applications (2nd ed), Wiley-Blackwell
3. David M. Freifelder (1982) Physical Biochemistry: Applications to Biochemistry and Molecular Biology, W.H. Freeman
4. Rodney F. Boyer (2012), Biochemistry Laboratory: Modern Theory and techniques, (2nd ed), Prentice Hall
5. Kaloch Rajan (2011), Analytical techniques in Biochemistry and Molecular Biology, Springer

CORE ELECTIVE PAPER –I - PHYSIOLOGY

UNIT-I

Structure of digestive system, digestion and absorption of carbohydrates, lipids and protein, Mechanism of HCl formation in stomach, role of various enzymes and hormones involved in digestive process and defecation. Excretory system – structure and function of kidney, structure of a nephron, mechanism of urine formation.

UNIT-II

Composition of blood cells, plasma components, lymph and blood groups. Bleeding and clotting time. Mechanism of blood clotting. Circulatory system- basic anatomy of heart. Systemic, pulmonary and portal circulation. Heart beat, cardiac cycle and pacemaker.

UNIT-III

Nervous system – Brain (parts of brain and ventricles), spinal cord, central and autonomous nervous system (sympathetic and parasympathetic). Structure of a neuron, synaptic transmission. Reflex action and neurotransmitters. Muscular system- types of muscles, structure and composition of skeletal muscle structure of a myofibril, mechanism of muscle contraction and theories of muscle contraction.

UNIT-IV

Respiratory system- composition of air, significance of O₂, carbon dioxide and nitrogen in biological system. Partial pressure of oxygen and carbon dioxide. Gaseous exchange in the lungs, tissue, arterial and venal capillaries, Role of kidney and lungs in maintaining the pH of blood.

UNIT-V

Hormones- classification of hormones, endocrine glands and their secretion. Insulin, thyroxine, growth hormone. Structure and function. Steroid hormones. Corticosteroids- sex hormones – testosterone and estrogen, menstrual cycle.

Books Recommended:

1. John E. Hall (2010). Guyton and Hall Textbook of Medical Physiology (12th ed), Saunders
2. Best and Taylor (1990), Medical Physiology (12th ed), Lippincott Williams and Wilkins
3. Walter F. Boron, Emile L. Boulpaep (2012) Medical Physiology (2nd ed), Saunders
4. Anne Waugh (2010) Ross and Wilson Anatomy and Physiology in Health and Illness . Elsevier

VI - SEMESTER
CORE PAPER-X - CLINICAL BIOCHEMISTRY

UNIT-I

Scope of clinical biochemistry. Blood glucose homeostasis. Maintenance of blood glucose by hormone with special reference to insulin and glucagon. Abnormalities in glucose metabolism. Diabetes mellitus-types, causes, biochemical manifestations, diagnosis and treatment, Inborn errors of carbohydrate metabolism. Galactosemia, fructosuria and Glycogen storage diseases.

UNIT -II

Liver function test, Tests based on bile pigment metabolism. Carbohydrate metabolism, plasma proteins and lipids. Detoxification and excretory functions of liver, Jaundice - classification, biochemical changes and differential diagnosis for jaundice.

UNIT-III

Kidney function tests, measurement of urine pH, volume, specific gravity, osmolality, sediments in urine-RBC, WBC, epithelial cells, casts and calculi. Normal and abnormal constituents in urine, Inulin, urea and creatinine clearance tests. Concentration and dilution tests. Phenol red test. Levels of plasma protein and its significance related to kidney function. Proteinuria

UNIT-IV

Disorders of lipid metabolism-normal levels of cholesterol, triglycerides, phospholipids, free fatty acids and lipoprotein in blood. Abnormal levels of these lipids in diseases. Lipidosis, Atherosclerosis, hyper and hypo lipoproteinemias, sphingolipidoses, Niemann-Pick disease, Gaucher's and Tay-Sach's disease – causes and pathology.

UNIT-V

Hormonal disorders-Acromegaly, Cushing's syndrome, Addison's disease, Goitre, Grave's disease, Hyper para thyroidism - clinical features. Clinical enzymology - enzymes of

diagnostic importance : LDH, creatine kinase, transaminases, phosphatases, pancreatic lipase, amylase and choline esterase. Isoenzymes of lactate dehydrogenase.

Books Recommended:

1. Thomas M.Devlin (2014) Textbook of Biochemistry with Clinical Correlations (7th ed). John Wiley & Sons
2. Montgomery R, Conway TW, Spector AA (1996), Biochemistry: A Case-Oriented Approach (6th ed), Mosby Publishers, USA.
3. Tietz Fundamentals of Clinical Chemistry and Molecular Diagnostics (2014) (7th ed), Saunders
4. Dinesh Puri, (2002), Text book of Biochemistry : A clinically oriented approach - Churchill Livingstone Inc., India.
5. M.N.Chatterjee and Rana Shinde (2007). Textbook of Medical Biochemistry (7th ed)

CORE PAPER – XI- MOLECULAR BIOLOGY

UNIT-I

DNA as the unit of inheritance. Griffith, Avery, McLeod, McCarthy, Hershey and Chase experiments and their significance. Definition of gene, organization of gene and non-coding sequence in prokaryotes, mitochondrial DNA, plasmid DNA. Viral genome- bacteriophages (M13 and Φ X174), animal virus (influenza virus), plant virus (TMV).

UNIT-II

Prokaryotic replication- model of replication- semiconservative mode of replication- replication forks, semi-discontinuous replication, Okazaki fragments. Bacteriophages M13 and Φ X174 replication, rolling circle model of replication. Enzymology of replication- role of DNA polymerases I, II, III, gyrase, topoisomerases, helicase, ligases and SSB proteins. Theta replication in *E.Coli*- initiation events at Ori C, elongation events on the replication fork and termination- fidelity of replication- inhibition of replication.

UNIT-III

Transcription- prokaryotic RNA polymerases- role of sigma factor. TATA box, promoter, closed and open promoter complexes- initiation, elongation and termination of transcription, post transcriptional modifications in prokaryotes (tRNA and rRNA). Inhibitors of transcription.

UNIT-IV

Genetic code- characteristics of genetic code- Wobble hypothesis- protein biosynthesis- activation of amino acids, initiation, elongation and termination of translation in prokaryotes. Inhibitors of protein biosynthesis.

UNIT-V

DNA damage, Mutation- types of mutation with examples, causes- physical and chemical agents, site- specific mutagenesis and mutational hot spots. DNA repair by direct reversal of damage, photoreactivation, excision repair, recombination repair, SOS repair.

Books recommended:

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments (6th ed). John Wiley & Sons. Inc.
2. Bruce Alberts and Dennis Bray (2013), Essential Cell Biology, (4th ed), Garland Science.
3. De Robertis, E.D.P. and De Robertis, E.M.F. (2010). Cell and Molecular Biology. (8th ed). Lippincott Williams and Wilkins, Philadelphia.
4. James.D.Watson (2013) Molecular Biology of the Gene (7th ed), Benjamin Cummings
5. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. (5th ed). Sunderland, Mass. Sinauer Associates, Inc.
6. David Freifelder (1992) Essentials of Molecular Biology (2nd ed) Jones & Bartlett Pub

CORE PAPER – XII - CORE PRACTICAL III

1. Collection and preservation of urine sample.
2. Qualitative analysis of normal constituents of urine such as urea, creatinine, phosphorus, calcium and abnormal constituents such as calcium, sugar, protein, amino acid, ketone bodies and bile pigments with clinical significance.
3. Quantitative Analysis of Urine
 - a. Urea
 - b. Uric acid
 - c. Creatinine
 - d. Calcium
4. Paper chromatography: Separation and detection of amino acids and simple sugars
5. Separation of polar lipids by Thin layer chromatography

CORE PAPER – XIII - CORE PRACTICAL - IV

1. Collection and preservation of blood sample
2. Haematological studies
 - a. RBC counting
 - b. Total and differential count of white blood cells
 - c. Packed cell volume
 - d. Erythrocyte sedimentation rate
 - e. Blood clotting time
 - f. Blood grouping
3. Quantitative estimation in blood
 - a. Haemoglobin
 - b. Glucose
 - c. Cholesterol
 - d. Urea
 - e. Creatinine
 - f. Protein by Lowry's method.
4. Enzyme assay
 - a. AST
 - b. ALT
 - c. Alkaline phosphatase

CORE ELECTIVE PAPER – II - IMMUNOLOGY

UNIT-I

Types of immunity- innate and acquired. Humoral and cell mediated immunity. Immune system – functions and structural components – lymphoreticular system – lymphoid organs- primary and central lymphoid organs – structure and functions of lymphoid cells – types and functions of B, T and null cells. Role of phagocytes and mast cells.

UNIT-II

Antigens – definition – types – haptens, isoantigens, neoantigens. Factors affecting antigenicity and immunogenicity of antigens. Antibodies – definition and classification. General structure and functions of IgM, IgD, IgA, IgG and IgE, Isohemeagglutinins and natural antibodies. Clonal selection theory of antibody formation. Complement – biochemical functions. Activation by classical and alternative pathways.

UNIT-III

Antigen – antibody interaction – types – precipitation and agglutination mechanism. Applications of agglutination reaction in diagnosis of diseases – Vidal test – complement fixation test. Blood grouping- major and minor blood groups. Erythroblastosis fetalis, Blood transfusion. Mismatched blood transfusion and its consequences, Principle and applications of RIA and ELISA.

UNIT-IV

Immunization practices- passive and active immunization. Commonly used vaccines- killed and live attenuated. Vaccination schedule for children. Production of polyclonal and monoclonal antibodies- principle and applications.

UNIT-V

Disorders of immune system – hypersensitivity – causes, types and pathology of type I, II, III and IV hypersensitivity – Auto immunity – causes and the pathology of Rheumatoid arthritis, systemic lupus erythematosus, Hashimotos thyroiditis, thyrotoxicosis, autoimmune hemolytic anemia. Disorders of B-cells, T-cells and complement deficiency.

Books recommended

1. Judy Owen , Jenni Punt Kuby (2013) ,Immunology (Kindt, Kuby Immunology) (7th ed)
W. H. Freeman & Co
2. Janis Kuby (1997),Immunology (3rd ed), W. H. Freeman & Co
3. David Male (2012) , Immunology, (Immunology (Roitt) (8th ed), Saunders
4. Ivan Roitt and Peter Delves (2001), Roitts Essential Immunology (10th ed)
5. Donald M. Weir (1998), Immunology (8th ed) , Churchill Livingstone

CORE ELECTIVE-III - BIOTECHNOLOGY

UNIT-I

Scope and importance of biotechnology. Recombinant DNA technology- Definition, restriction endonucleases- types, role, recognition sequences, cleavage pattern, modification of cuts ends, vectors- plasmid, cosmid, phage. Enzymes used in rDNA technology- DNA ligases, Alkaline phosphatase, polynucleotide kinase, linkers, homopolymer tailing, end labeling and construction maps of PBR322, λ bacteriophage.

UNIT-II

Steps in genetic engineering- Construction of genomic library. Synthesis of cDNA Construction of cDNA library. Gene transfer methods- transformation, conjugation, transduction, microinjection and electroporation. Selection-selectable markers, chromogenic substrate and screening of clones- colony hybridization, screening with antibodies.

UNIT-III

Plant tissue culture- basic requirements for culture, M S medium, callus culture, protoplast culture. Vectors – Ti plasmid (cointegration vector and binary vector), Viral vectors- TMV, CaMV and their applications. Transgenic plants – pest resistant, herbicide resistant and stress tolerant plants.

UNIT-IV

Vectors for gene transfer in animal cells - SV 40 Vector. Basics of transfection methods- calcium phosphate precipitation, DEAE- dextran mediated transfection. Transgenic mice- retroviral transfer and stem cell mediated transfer, applications. Embryonic stem cell- definition, ES cell culture to produce differentiated cells, applications. PCR - application in clinical diagnosis and forensic science. Southern blotting, Northern blotting and ELISA – principle, method and applications.

UNIT-V

Production and applications of ethanol and streptomycin (industrial Biotechnology), Proteases (Enzyme biotechnology), Biogas, Biodiesel (Fuel biotechnology), Waste water treatment (Environmental Biotechnology), Vaccines and monoclonal antibodies (Medical biotechnology).

Books Recommended:

1. David Freifelder (1992) Essentials of Molecular Biology (2nd ed) Jones & Bartlett Pub
2. Click B.R. and Pasternak J.J (2010). Molecular Biotechnology: Principles and Applications of Recombinant DNA. (4th ed) American Society for Microbiology
3. James D. Watson , Amy A. Caudy , Richard M. Myers , Jan Witkowski (2006) , Recombinant DNA: Genes and Genomes - a Short Course (3rd ed), W.H. Freeman & Co
4. Satyanarayana U (2008), Biotechnology, Books & Allied (P) Ltd.
5. Casida L (2007) Industrial Microbiology , New Age International
6. Reed G (2004) Prescott and Dunn's Industrial Microbiology, CBS Publishers & Distributors

ALLIED BIOCHEMISTRY

PAPER –I

CREDITS: 3

UNIT I

Definition and classification of carbohydrates, linear and cyclic forms (Haworth projection) for glucose, fructose and mannose and disaccharides (maltose, lactose, sucrose).

UNIT I

General properties of monosaccharides and disaccharides. Occurrence and significance of polysaccharides.

UNIT III

Amino acids, various classifications, amphoteric nature, isoelectric point. Reactions of carboxyl and amino groups.

UNIT IV

Proteins- classification - biological functions ,physical properties- ampholytes, isoelectric point, salting in and salting out, denaturation, nature of peptide bond. Secondary structure, α -helix and β -pleated sheet, tertiary structure, various forces involved- quaternary structure. Deamination, transamination and urea cycle.

Books Recommended

1. David L.Nelson and Michael M.Cox (2012) Lehninger Principles of Biochemistry (6th ed) W.H. Freeman.
2. Voet.D & Voet. J.G (2010) Biochemistry , (4th ed), John Wiley & Sons, Inc.
3. Lubert Stryer (2010) Biochemistry,(7th ed), W.H.Freeman
4. Satyanarayan,U (2014) Biochemistry (4th ed), Arunabha Sen Books & Allied (P) Ltd, Kolkata.
- 5.Jain J.L.(2007) Fundamentals of Biochemistry,S.Chand publishers

ALLIED BIOCHEMISTRY

PAPER –II

UNIT I

Fats - function, classification, simple lipids, fatty acids (saturated and unsaturated), compound lipids, derived lipids, properties- saponification, rancidity, reduction, oxidation, halogenation. Functions of phospholipids, Cholesterol – biological importance, chemical properties.

UNIT II

Purine and pyrimidine bases, nucleosides, nucleotides, polynucleotides, DNA structure, various types, properties- absorbance, effect of temperature. Different types of RNA, structure and function, Genetic code.

UNIT III

Enzymes - definition, units of enzyme activity, enzyme nomenclature, specificity, isoenzymes, factors affecting enzyme activity- substrate concentration, pH, temperature. Michaelis and Menten equation. Lineweaver- Burk plot, Enzyme inhibition, competitive, uncompetitive and non competitive inhibition

UNIT IV

Vitamins, definition, classification, water soluble vitamins, B1, B2, B3, B6, B12 and Vitamin C. Deficiency diseases. Fat soluble vitamins- A, D, E and K- Deficiency diseases.

Books Recommended:

1. David L.Nelson and Michael M.Cox (2012) Lehninger Principles of Biochemistry (6th ed) W.H. Freeman.
2. Voet.D & Voet. J.G (2010) Biochemistry , (4th ed), John Wiley & Sons, Inc.
3. Lubert Stryer (2010) Biochemistry,(7th ed), W.H.Freeman
4. Satyanarayan,U (2014) Biochemistry (4th ed), Arunabha Sen Books & Allied (P) Ltd, Kolkata.
- 5.Jain J.L.(2007) Fundamentals of Biochemistry,S.Chand publishers

ALLIED BIOCHEMISTRY PRACTICALS
FOR PAPERS I & II

1. Volumetric analysis
 - a. Estimation of ascorbic acid using 2,6 – dichlorophenol indophenol as link solution.
 - b. Estimation of calcium in milk.
2. Qualitative analysis
 - a. Qualitative analysis of carbohydrates- glucose, fructose, galactose, lactose, maltose and sucrose.
 - b. Qualitative analysis of amino acids – arginine, cysteine, tryptophan and tyrosine.
3. Quantitative analysis: (demonstration)
 - a. Colorimetric estimation of protein by Biuret method.
 - b. Colorimetric estimation of phosphorus.
4. Biochemical preparations
 - a. Preparation of casein from milk.
 - b. Preparation of starch from potato.
