

**Devi Ahilya Vishwavidyalaya
Indore**

Syllabus for B.Sc. (Biochemistry) Semester System 2008-09

Semester I

Paper 1. Biomolecules I (50 marks, 2h/week teaching)

Paper 2. Biomolecules II (50 marks, 2h/week teaching)

Practical (50 marks, 6h/week)

Semester II

Paper-1. Biochemical Techniques I (50 marks, 2h/week teaching)

Paper-2. Biochemical Techniques II (50 marks, 2h/week teaching)

Practical (50 marks, 6h/week)

Semester III

Paper 1. Cell Biology (50 marks, 2h/week teaching)

Paper 2. Physiology (50 marks, 2h/week teaching)

Practical (50 marks, 6h/week)

Semester IV

Paper 1. Enzymology (50 marks, 2h/week teaching)

Paper 2. Molecular Biology (50 marks, 2h/week teaching)

Practical (50 marks, 6h/week)

Semester V

Paper 1. Metabolism I (50 marks, 2h/week teaching)

Paper 2. Metabolism II (50 marks, 2h/week teaching)

Practical (50 marks, 6h/week)

Semester VI

Paper 1. Microbial Biochemistry & Immunology (50 marks, 2h/week teaching)

Paper 2. Clinical and Nutritional Biochemistry (50 marks, 2h/week teaching)

Practical (50 marks, 6h/week)

B.Sc. I Semester I

Paper 1 Biomolecules I

Unit 1.

Introduction to Biochemistry, water as a biological solvent, Structure, occurrence and biological importance of monosaccharides and disaccharides Stereoisomerism and optical isomerism of sugars. Ring structure and anomeric forms, mutarotation. Important reactions of sugars. Important derivatives of monosaccharides.

Unit 2.

Structure, occurrence and biological importance of oligosaccharides and polysaccharides e.g. Cellulose, glycogen and starch, chitin, agar. Mucopolysaccharides, Blood group polysaccharides, Bacterial Cell wall Polysaccharides

Unit 3.

Fatty acids: Classification, structure and properties of saturated and unsaturated fatty acids. Essential fatty acids. Triacylglycerols: properties and characterization of fats – hydrolysis, saponification value, rancidity of fats, Reichert-Meissel number and reaction of glycerol.

Unit 4.

Glycerophospholipids (lecithins, lysolecithins, cephalins, phosphatidyl serine, phosphatidyl inositol, plasmalogens), sphingomyelins, glycolipids- cerebrosides, gangliosides. Cholesterol and Bile acids

Unit 5.

Structure, biological properties and role of fat soluble and water soluble vitamins, Coenzyme function of vitamins

B.Sc. I Semester I

Paper 2 Biomolecules II

Unit 1.

Amino acids: common structural features, stereoisomerism, classification and structure of amino acids as zwitterion in aqueous solutions, physical and chemical properties, titration of amino acids. Essential amino acids.

Unit 2.

Peptides: structure of peptide bond. Determination of the amino acid sequence of a polypeptide chain, chemical and enzymatic cleavage of a polypeptide chains and separation of peptides.

Classification of proteins, Isoelectric pH, Behaviour of proteins in solutions, salting in and salting out of proteins, Denaturation and renaturation of proteins.

Unit 3.

Protein structure: Levels of structure in protein architecture, primary structure of proteins, secondary structure of proteins – helix and pleated sheets, tertiary structure of proteins, forces stabilizing the tertiary structure and quaternary structure of proteins. Structure of fibrous proteins (keratins, collagen), globular proteins (hemoglobin, myoglobin).

Unit 4.

Composition of DNA and RNA. Features of DNA double helix. Denaturation and annealing of DNA, Basic concepts about the secondary structure of nucleic acids, 5' \rightleftharpoons 3' direction antiparallel strands, base composition, base equivalence, base pairing and base stacking in DNA molecule. T_m and buoyant density and their relationship with G C content.

Secondary and tertiary structure of DNA, Watson Crick model, A, B and Z type of DNA.

Different types of RNA and their role, Secondary and tertiary structure of RNA.

Unit 5.

Important Metalloporphyrins occurring in nature. Bile pigments- chemical nature and their physiological significance.

Hormones : Structure and biological functions of Insulin, Glucagon, Epinephrine, Thyroxine,

LIST OF PRACTICALS FOR SEMESTER I

1. Qualitative tests for-carbohydrates, proteins, amino acids and lipids.
2. Determination of saponification value and iodine number of fats.
3. Estimation of ascorbic acid.
4. Titration curve for amino acids and determination of pK value.
5. Sorenson-formol titration for amino acid estimation
6. Isolation and assay of glycogen from rat liver.

SCHEME OF PRACTICAL EXAMINATION

Duration 4 hrs

1. Identification of given sample (10 marks).
2. Quantitative estimation of given sample (20 marks)
3. Viva (10 marks)
4. Record (10 marks)

B.Sc. I Semester II

Paper 1 Biochemical Techniques I

Unit 1.

Weak acids and bases, pH, buffers, Henderson-Hasselbalch equation, physiological buffers. Measurement of pH – Glass and reference electrodes, types of electrodes, complications of pH measurement (dependence of pH on ionic strength, electrode contamination and sodium error).

Unit 2.

General principle of chromatographic separation. Technique and applications of: Column Adsorption and column partition chromatography, Paper chromatography, Thin-layer chromatography

Unit 3.

Technique and applications of:
Ion-exchange chromatography, Gas chromatography, Molecular-sieve chromatography

Unit 4.

Technique and applications of:
Affinity chromatography, Hydrophobic chromatography, HPLC.

Unit 5.

Basic principle and types of electrophoresis. Electrophoretic mobility. Factors affecting electrophoretic migration, Technique and uses of agarose electrophoresis, PAGE and SDS-PAGE, Two-dimensional electrophoresis and its importance. Isoelectric focussing.

Paper 2 Biochemical Techniques II

Unit 1

Beer-Lambert law and its limitations, Light absorption and transmission, Extinction coefficient, Basic design of photoelectric colorimeter and spectrophotometer. Applications of uv-visible spectroscopic techniques. Flame Photometry

Unit 2.

Atomic absorption spectrophotometry, Circular Dichroism and Optical Rotatory Dispersion, Principle and application of NMR and ESR techniques.

Unit 3.

Sedimentation- sedimentation velocity, preparative and analytical ultracentrifugation techniques, determination of molecular weight by hydrodynamic methods. Differential and density gradient centrifugation

Unit 4.

Characteristics of radioisotopes, units of radioactivity measurements, techniques used to measure radioactivity (gas ionization and scintillation counting), Autoradiography

Unit 5.

Isotopes commonly used in biochemical studies – ^{32}P , ^{35}S , ^{14}C and ^3H), Isotopic labelling of biomolecules. Biological hazards of radiation and safety measures in handling radioisotopes. Biological applications of Radioisotopes.

LIST OF PRACTICALS FOR SEMESTER II

1. Preparation of standard buffers and determination of pH.
2. Verification of Beer-Lambert's Law.
3. Estimation of carbohydrate by anthrone method.
4. Estimation of blood glucose by Folin-Wu method.
5. Estimation of amino acids by ninhydrin method.
6. Separation of amino acids and sugars using paper and thin layer chromatography.

SCHEME OF PRACTICAL EXAMINATION

Duration 4 hrs

1. Separation and identification of given sample using chromatographic method (10 marks).
2. Quantitative estimation of given sample (20 marks)
3. Viva (10 marks)
4. Record (10 marks)

B.Sc. II Semester III

Paper 1 Cell Biology

Unit 1

Morphology of cell, Prokaryotic and eukaryotic cell structure, Differences in plant and animal cell, Structure and composition of plant and bacterial cell wall

Unit 2

Structure and composition of plasma membrane, Transport of metabolites across plasma membrane, Passive and active transport

Unit 3

Structure and function of nucleus, mitochondria and chloroplast

Unit 4

Structure and functions of ribosomes, endoplasmic reticulum, golgi apparatus and peroxisomes, lysosomes, cytoskeleton

Unit 5

Light microscopy, Phase contrast microscopy, transmission and scanning electron microscopy, Freeze fracture technique in the study cell and cell organelles

B.Sc. II Semester III

Paper 2 Physiology

Unit 1.

Blood components and their functions, Blood groups: the ABO system, the rhesus system, Blood clotting factors, intrinsic and extrinsic pathways for blood clotting.

Unit 2.

Components of respiratory system (nasal cavity, trachea, pharynx, larynx, lungs, bronchi, bronchioles and alveoli) and their functions. Diffusion of oxygen and CO₂, transport of oxygen, role of hemoglobin, dissociation curve of oxyhemoglobin and its significance, Bohr's effect, transport of CO₂ and chloride shift.

Various buffer systems of the blood: Acid-base balance, factors affecting acid-base balance, acidosis and alkalosis, role of lung and kidney in regulation of acid-base balance.

Unit 3.

Kidney: Structure and its organisation. Functions of glomerular membrane and glomerular filtration rate (GFR). Structural and functional characteristics of tubules, selective reabsorption and secretion, active and passive transport of various substances (sugars, amino acids, urea and creatinine), mechanism of urine formation.

Unit 4.

Structure of myofilaments. Molecular organisation of actin, myosin, troponin and tropomyosin. Biochemistry of muscle contraction.

Unit 5.

Nerve cells, nerve fibers, nerve impulses and neurotransmission, synapses: chemical and electrical synapses, functional properties of nerve fiber, action potential, the reflex action and reflex arc.

LIST OF PRACTICALS FOR SEMESTER III

1. Detection of normal and abnormal constituents of urine
2. Separation of Blood, plasma and serum,
3. Estimation of proteins from serum by Biuret method.
4. Determination of albumin and A/G ratio
5. Estimation of total lipids
6. RBC and WBC count, Hb estimation, Blood group determination

SCHEME OF PRACTICAL EXAMINATION

Duration 4 hrs

1. Blood group determination
Or
Detection of urinary constituents(10 marks).
2. Quantitative estimation of given protein sample
Or
RBC/WBC Counting (20 marks)
3. Viva (10 marks)
4. Record (10 marks)

B.Sc. II Semester IV

Paper 1 Enzymology

Unit 1.

Nomenclature, IUB enzyme classification (rationale, overview and specific examples). Definitions with examples of holoenzyme, apoenzyme, coenzymes, cofactors, activators, inhibitors, active site, metallo-enzymes. Isoenzymes. Enzyme specificity, Enzyme active site structure

Unit 2.

Measurement and expression of enzyme activity-enzyme assays. Definition of IU, Katal, enzyme turn over number and specific activity. Enzyme purification methods, Criteria of purity.

Unit 3

Factors affecting enzyme activity: enzyme concentration, substrate concentration, pH and temperature. Derivation of Michaelis-Menten equation for uni-substrate reactions. K_m and its significance. Line Weaver-Burk plot and its limitations.

Unit 4

Reversible and irreversible inhibition, Types of inhibition : competitive, non-competitive, uncompetitive and mixed.
Enzyme Regulation : Various modes of regulation, Allosteric enzymes, Covalently modulated enzyme

Unit 5

Mechanism of enzyme action : Acid-base catalysis, covalent catalysis, proximity and orientation effects, strain and distortion theory. Role of metal ion Mechanism of action of chymotrypsin

B.Sc. II Semester IV

Paper 2 Molecular Biology

Unit 1

DNA replication in prokaryotes – conservative, semiconservative and dispersive types, experimental evidence for semiconservative replication. DNA polymerases, other enzymes and protein factors involved in replication. Mechanism of replication. Inhibitors of replication.

Unit 2.

Transcription in prokaryotes, RNA polymerase, promoters, initiation, elongation and termination of RNA synthesis, inhibitors of transcription. Reverse transcriptase, post transcriptional processing of RNA in eukaryotes.

Genetic code – Basic features, biological significance of degeneracy, Wobble hypothesis, gene within genes and overlapping genes.

Unit 3

Mechanism of translation – Ribosome structure, A and P sites, charged RNA, fmet – tRNA, initiator codon, Shine-Dalgarno consensus sequence, formation of 70S initiation complex, role of EF-Tu, EF-Ts, EF-G and GTP, non-sense codons and release factors, RF1 and RF2.

Regulation of gene expression in prokaryotes – Enzyme induction and repression, operon concept, Lac operon, Trp operon.

Unit 4

Mutation – Molecular basis of mutation, types of mutation, e.g. transition, transversion, frame shift, insertion, deletion, suppressor sensitive, germinal and somatic, backward and forward, true reversion and suppression, dominant and recessive mutations, spontaneous and induced mutations.

DNA repair – UV repair systems in E. coli, significance of thymine in DNA.

Unit 5

Recombinant DNA technology – Restriction endonucleases, brief description of steps in DNA cloning. Applications of recombinant DNA technology.

LIST OF PRACTICALS FOR SEMESTER IV

1. Preparation of starch from potato and its hydrolysis by salivary amylase.
2. Determination of achromatic point in salivary amylase.
3. Effect of sodium chloride on amylases.
4. Kinetic analysis of Salivary Amylase
5. Assay and kinetic analysis of serum alkaline phosphatase

SCHEME OF PRACTICAL EXAMINATION

Duration 4 hrs

1. To test salivary amylase activity (10 marks).
2. To analyse substrate concentration effect on enzyme activity (20 marks)
3. Viva (10 marks)
4. Record (10 marks)

B.Sc. III Semester V

Paper 1 Metabolism I

Unit 1.

Principles of thermodynamics, concepts of free energy, standard free energy, biological oxidation reduction reaction, redox potential, relation between standard reduction potential and free energy change, high energy phosphate compounds, free energy of hydrolysis and sugar phosphates.

Unit 2.

Electron transport chain, sequence of electron carriers, sites of ATP production, inhibitors of electron transport chain. Hypothesis of mitochondrial oxidative phosphorylation (basic concepts). Inhibitors and uncouplers of oxidative phosphorylation. Transport of reducing potentials into mitochondria.

Unit 3.

Digestion and absorption of carbohydrates, Reactions and energetics of glycolysis. Entry of fructose, galactose, mannose etc in glycolytic pathway, Alcoholic and lactic acid fermentations.. Reactions and energetics of TCA cycle. Regulation of glycolysis and TCA cycle

Unit 4.

Gluconeogenesis, glycogenesis and glycogenolysis. Reactions and physiological significance of pentose phosphate pathway, Glycogen storage diseases.

Unit 5

Digestion and absorption of proteins, General reactions of amino acid metabolism, transamination, oxidative deamination and decarboxylation. Urea cycle. Outline of degradation of amino acids. Glycogenic and ketogenic amino acids.

Inborn errors of amino acid metabolism, phenyl ketonuria, alkaptonuria and albinism.

B.Sc. III Semester V

Paper 2 Metabolism II

Unit 1.

Digestion and absorption of fats, hydrolysis of triacylglycerols, transport of fatty acids into mitochondria, B-oxidation of fatty acids, ATP yield from fatty acid oxidation

Unit 2.

Biosynthesis of saturated and unsaturated fatty acids. Formation of ketone bodies, Cholesterol
Biosynthesis

Unit 3.

Sources of the atoms in the pyrimidine molecules. Biosynthesis and degradation of pyrimidines in brief.
Regulation of pyrimidine biosynthesis.

Unit 4.

Sources of the atoms in the purine molecules. Biosynthesis and degradation of purines in brief.
Regulation of purine biosynthesis.

Unit 5

Biological role of minerals and trace elements : Ca, P, Fe, I, Mn, Zn, Cu & Mg Toxic effects of heavy metals

LIST OF PRACTICALS FOR SEMESTER V

1. Extraction of Proteins from biological materials
2. Estimation of Proteins by Lowry's method
3. Protein separation methods :
Precipitation, Chromatographic, Electrophoretic
4. Extraction and estimation of RNA
5. Extraction and estimation of DNA

SCHEME OF PRACTICAL EXAMINATION

Duration 4 hrs

1. Quantitative estimation of given protein sample (**15** marks).
2. Quantitative estimation of given RNA sample (**15** marks)
3. Viva (**10** marks)
4. Record (**10** marks)

B.Sc. III Semester VI

Paper 1 Microbial Biochemistry & Immunology

Unit 1.

Isolation of bacteria and pure culture techniques, Culture media, Nutritional types of bacteria, Bacterial Growth

Unit 2.

Bacterial fermentation, Aerobic and anaerobic respiration, Bacterial photosynthesis, Food spoilage and Preservation, Food borne infections, Disposal of domestic and industrial sewage,

Unit 3.

Structure and classification of viruses, Replication of RNA and DNA viruses, Virus host interaction, Types and life cycle of Bacteriophages.

Unit 4.

Types of Immunity, Innate, Acquired, Passive and Active Immunity, Humoral and cellular Immunity, Antigens, haptens, adjuvants, Structure and functions of immunoglobulins .

Unit 5.

Antigen-antibody reaction, Agglutination and precipitation, Immuno diffusion, Immuno electrophoresis, Immuno fluorescence, RIA and ELISA, Monoclonal antibodies.

B.Sc. III Semester VI

Paper 2 Clinical & Nutritional Biochemistry

Unit 1

Collection and preservation of biological fluids, blood, serum, plasma urine and CSF. Normal values for important constituents in blood, CSF and urine.

Hypo and hyperglycaemia,

Hyperlipidaemia, lipid malabsorption, steatorrhea, sphingolipidosis, role of lipoproteins in health and disease.

Gout and hyperuricemia

Unit 2

Defination of functional and non functional plasma enzymes, isoenzymes, enzyme pattern in health and disease for the enzymes alkaline and acid phosphatase, SGOT and SGPT, LDH and CPK.

Function tests of kidney, liver, pancreas and stomach.

Unit 3

Measurement of energy expenditure by direct and indirect calorimetry. Respiratory quotient. Basal metabolic rate. Specific dynamic action of foods, Energy requirements of various groups.

Unit 4

Nutritional aspects of carbohydrates, fats and proteins. Essential fatty acids and amino acids.

Protein calorie malnutrition (kwashiorkor and marasmus). Body water and its importance.

Unit 5

Outline of nutritional aspects of some vitamins (A, B1, B2, B12, C, D, and E) and minerals (calcium, phosphorus, iron and iodine). Recommended dietary allowance and composition of balanced diet for average Indian adult with different habits.

LIST OF PRACTICALS FOR SEMESTER VI

1. Estimation of calcium and phosphorus in serum and urine
2. Estimation of creatinine in serum and urine.
3. Estimation of bilirubin in serum
4. Estimation of hemoglobin
5. Serum enzyme analysis , amylase, GOT, GPT, acid and alkaline phosphatase

SCHEME OF PRACTICAL EXAMINATION

Duration 4 hrs

1. Serum enzyme activity determination (**12** marks).
2. Quantitative estimation of given sample (**18** marks)
3. Viva (**10** marks)
4. Record (10 marks)

Suggested Books for B.Sc. (Biochemistry)

1. Standard Methods of Biochemical Analysis by Thimmaiah.
2. Practical Biochemistry by Plummer, DT
3. Analytical Biochemistry by Holme & Peck
4. Cell & Molecular Biology by De Robertis
5. Food & Nutrition Vol I & II by M. Swaminathan
6. Biochemistry by West & Todd
5. Harper's Biochemistry, by Murray RK, Mayes PA, Granner DK, Rodwell VK, PrenticeHall I'nt
6. Physiology by Chatterjee
7. Text book of Medical Biochemistry by SRamakrishnan, KG Prasannan & R. Rajan, Orient Longman
8. Molecular Biology by David Freifelder Narosa Publishing House, N.Delhi
9. Text book of Molecular Biology by K. Sivarama Sastry, G Padmanaban & C. Subramanyam Macmillan India Ltd.
10. Modern Experimental Biochemistry by Rodney Boyer (LPED) Benjamin Cummins.Publication.
11. Biochemistry by U. Satyanarayan.
12. Practical Clinical Biochemistry (LP Ed.) by H. Varley.
13. Lehninger's Principles of Biochemistry by Nelson.David L and Cox, MM Macmillan/Worth
14. Fundamentals of Biochemistry by Donald Voet. Judith G Voet andCharlotte W Pratt, Jonh Wiley & Sons NY
15. Outlines of Biochemistr by Eric E Conn. PK Stumpt, G Bruening and Ray H Doi, Jonh Wiley & Sons, NY.
16. Molecular Biology of the gene, JD Watson, NH Hopkins, JW Roberts, JP Stertz, AM Weiner, Freeman, San Francisco.
17. Human Nutrition and Dietetics by S Davidson and JR Passmore : ELBS Zurich.
18. Microbiology by Pelczar
21. Text Book of Microbiology by Anantnarayan
22. Immunobiology by Janeway and Travers
23. Laboratory manual in Biochemistry by J Jayaraman
24. Biochemical methods for Agricultural Sciences by S. Sadasivam and A. Manickam