

**Devi Ahilya Vishwavidyalaya  
Indore**

**Syllabus for B.Sc. (Biochemistry) Semester System 2011-2014**

**Semester I (2011-12)**

**Paper: Biomolecules 1 (85+15 marks)**

**Practical (50 marks)**

**Semester II (2011-12)**

**Paper: Biochemical Techniques (85+15 marks)**

**Practical (100 marks)**

**Semester III (2012-13)**

**Paper: Cell Biology, Physiology and Microbial Biochemistry (85+15 marks)**

**Practical (100 marks)**

**Semester IV (2012-13)**

**Paper: Enzymology and Molecular Biology (85+15 marks)**

**Practical (50 marks, 6h/week)**

**Semester V (2013-14)**

**Paper: Metabolism (85+15 marks)**

**Practical (100 marks)**

**Project (50 Internal+50 External=100 marks)**

**Semester VI (2013-14)**

**Paper: Immunology, Clinical and Nutritional Biochemistry (85+15 marks)**

**Practical (100 marks)**

**(Passing marks Theory 28/85 and 05/15 in CCE, Practical 17/50)**

**DEVI AHILYA VISHWAVIDYALAYA**  
**INDORE**  
**Syllabus for B.Sc. (Biochemistry) (Admission 2011-2014)**

**B.Sc. I Year Semester I**

**Paper: Biomolecules**

**Unit 1.**

Introduction to Biochemistry, Water as a biological solvent.

Carbohydrates: Structure, occurrence and biological importance of monosaccharides and disaccharides Stereoisomerism and optical isomerism of sugars. Ring structure, epimers, anomers and mutarotation. Important reactions of sugars. Important derivatives of monosaccharides.

Structure, occurrence and biological importance of oligosaccharides and polysaccharides. e.g. Cellulose, glycogen and starch, chitin, agar. Mucopolysachharides.

**Unit 2**

Fatty acids: Classification, structure and properties of saturated and unsaturated fatty acids. Essential fatty acids. Triacylglycerols, properties and characterization of fats – hydrolysis, saponification, halogenation, Acetyl number, Rancidity of fats, Reichert-Meissel number. Reaction of glycerol.

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

**Unit 3**

Amino acids: Structure and classification of amino acids, stereoisomerism, zwitter ion in aqueous solutions, physical and chemical properties, titration of amino acids, Isoelectric pH, Essential amino acids.

Peptides: 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, behaviour of proteins in solutions, salting in and salting out of proteins, Denaturation and renaturation of proteins.

**Unit 4**

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 and bonds stabilizing the structure proteins. Structure of fibrous proteins (keratins and collagen), globular proteins (hemoglobin and myoglobin).

Composition of DNA and RNA. Features of DNA double helix. Denaturation and annealing of DNA,

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, Structure, properties and role of fat soluble and water soluble vitamins, Coenzyme functions of vitamins.

### 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

#### Scheme of examination

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 Year Semester II**

### **Paper: Biochemical Techniques**

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

#### **Unit 2.**

General principle of chromatographic separation. Technique and applications of: Column adsorption and column partition chromatography, Paper chromatography, Thin-layer Chromatography. Technique and applications of: Ion-exchange chromatography, Gas chromatography, Molecular-sieve chromatography.

#### **Unit 3**

Technique and applications of:

Affinity chromatography, Hydrophobic chromatography, HPLC.

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.

#### **Unit 4**

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.

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

#### **Unit 5**

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

Isotopes commonly used in biochemical studies –  $^{32}\text{P}$ ,  $^{35}\text{S}$ ,  $^{14}\text{C}$  and  $^3\text{H}$ , 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.

## **B.Sc. II Year Semester III (Admission 2011-14)**

### **Paper: Cell Biology, Physiology and Microbial Biochemistry**

#### **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.

Structure and composition of plasma membrane, transport of metabolites across plasma membrane, passive and active transport.

Structure and function of nucleus, mitochondria and chloroplast. Structure and functions of ribosomes, endoplasmic reticulum, golgi apparatus, peroxisomes, lysosomes and cytoskeleton.

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

#### **Unit 2**

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

Components of respiratory system (nasal cavity trachea. pharynx, lungs, bronchi, bronchioles and alveoli) and their functions, role of hemoglobin in oxygen transport, dissociation curve of oxyhemoglobin and its significance. Bohr's effect, transport of oxygen and carbon dioxide, 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 organization, functions of glomerular membrane and glomerular filtration rate (GFR), structural and functional characteristics of tubules, selective reabsorption and secretion, active passive transport of various substances ( sugars, amino acids, urea and creatinine), mechanism of urine formation.

Structure of myofilaments, molecular organization of actin, myosin, troponin and tropomyosin, biochemistry of muscle contraction.

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

#### **Unit 4**

Isolation of bacteria and pure culture techniques, culture media, nutritional types of bacteria bacterial growth, bacterial fermentation, aerobic and anaerobic respiration, bacterial photosynthesis.

#### **Unit 5**

Food spoilage and preservation, food borne infection, disposal of domestic and industrial sewage.

Structure and classification of viruses, replication of RNA and DNA viruses, virus host interaction, types and life cycle of bacteriophages.

## **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: Enzymology and Molecular Biology**

#### **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.

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.

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 2**

Reversible and irreversible inhibition, Types of inhibition: competitive, non-competitive, uncompetitive and mixed.

Enzyme regulation: Various modes of regulation, allosteric enzymes, covalently modulated enzymes.

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.

#### **Unit 3**

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.

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.

#### **Unit 4.**

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

Mechanism of translation – Ribosome structure, A and P sites, charged RNA, f-met – tRNA, initiator codon, Shine-Dalgarno consensus sequence, formation of 70 S 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 5.**

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.

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 analyse substrate concentration effect on enzyme activity (**15** marks)
2. To analyse effect of pH or temperature on enzyme activity (**15** marks)
3. Viva (**10** marks)
4. Record (**10** marks)

## **B.Sc. III Semester V (Admission 2011-14)**

### **Paper: Metabolism**

#### **Unit 1**

Principles of thermodynamics, concepts of free energy, standard free energy, biological oxidation reduction reaction, redox potential, high energy phosphate compounds,

Electron transport chain, sequence of electron carriers, sites of ATP production, inhibitors of electron transport chain, inhibitors and uncouplers of oxidative phosphorylation.

#### **Unit 2**

Digestion and absorption of carbohydrates, reactions and energetics of glycolysis, reactions and energetics of TCA cycle.

Gluconeogenesis, glycogenesis and glycogenolysis, reactions and physiological significance of pentose phosphate pathway, alcoholic and lactic acid fermentations.

#### **Unit 3**

Digestion and absorption of proteins, transamination, oxidative deamination and decarboxylation, urea cycle, glycolytic and ketogenic amino acids.

Inborn errors of amino acid metabolism, phenylketonuria, alkaptonuria and albinism.

#### **Unit 4**

Digestion and absorption of fats, hydrolysis of triacylglycerols, transport of fatty acids into mitochondria.

Beta-oxidation of fatty acids, ATP yields from fatty acid oxidation, formation of ketone bodies.

#### **Unit 5**

Biosynthesis and degradation of purines and pyrimidines in brief. regulation of purine and pyrimidine biosynthesis.

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) Record (**10** marks)



## **B.Sc. III Year Semester VI**

### **Paper: Immunology, Clinical and Nutritional Biochemistry**

#### **Unit 1**

Types of immunity, innate, acquired, passive and active immunity, humoral and cellular immunity, structure and functions of immunoglobulins.

Antigen-antibody reaction, agglutination and precipitation, immunodiffusion, immuno electrophoresis, immuno fluorescence, RIA and ELISA.

#### **Unit 2**

Fasting blood sugar, hypo and hyperglycaemia.

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

Gout and hyperuricemia.

#### **Unit 3**

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

#### **Unit 4**

Measurement of energy expenditure by direct and indirect calorimetry. basal metabolic rate, specific dynamic action of foods, energy requirements of various groups.

Nutritional aspects of carbohydrates, fats and proteins.

#### **Unit 5.**

Outline of nutritional aspects of some vitamins (A, B<sub>1</sub>, B<sub>2</sub>, B<sub>12</sub>, C, D, and E) and minerals (calcium, phosphorus, iron and iodine).

### **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 haemoglobin
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)

