

SOLAPUR UNIVERSITY, SOLAPUR**SYLLABUS****(Semester Pattern)****(w.e.f. June 2011)****B.Sc. Part II****BIOCHEMISTRY (IDS)**

General Structure:

There will be two theory papers, each of 2 hrs & 50 marks for every semester. There will be one practical course of 100 marks at the end of the year. Their titles and marks are as under:

SEMESTER-III

Paper - I: Biomolecules	50 Marks
Paper – II Biochemical Techniques	50 Marks

SEMESTER-IV

Paper - III: Nutrition and Metabolism	50 Marks
Paper - IV: Molecular Biochemistry & Diseases	50 Marks

III) Practical Course: 100 marks

Part I: 50 Marks

- 1) Chromatographic experiments 10 Marks
- 2) Colorimetric experiments 18 Marks
- 3) Preparation experiments 12 Marks
- 4) Journal and Study Tour 10 Marks

Part II: 50 Marks

- 1) Volumetric Estimations 16 Marks
- 2) Qualitative analysis
 - a) Carbohydrates 10 Marks
 - b) Enzymes/ Lipids 6 Marks
 - c) Urine (Abnormal components) 8 Marks
- 3) Oral 10 Marks

**IV) Practical examination to be taken at the end of the academic year.
Duration of Practical Examination: Two days (Six hours per day).**

- N. B i) Figures shown in bracket indicate the total number of lectures required for the respective topics.
- ii) The question paper should cover the entire syllabus. Marks allotted to question should be in proportion to the number of lectures allotted to the respective topics.
- iii) All topics should be dealt with SI units
- iv) Use of scientific calculator is allowed
- v) Industrial tour is compulsory.

**B.Sc. Part II Biochemistry syllabus
SEMESTER-III
Paper I
(BIOMOLECULES)**

1. **Carbohydrates:** (10)
Definition, classification, structures & role of -
- A] Monosaccharides-aldoses & ketoses
- i) Trioses-glyceraldehyde & dihydroxy acetone
 - ii) Tetroses-erythrose, erythrulose
 - iii) Pentoses-ribose, ribulose, xylose, xylulose
 - iv) Hexoses – glucose, mannose, galactose, fructose
- Reactions of monosaccharides, reducing properties (Fehling test,) oxidation, reduction, osazone formation
- B] Oligosaccharides: glycoside bond, maltose, isomaltose, lactose, sucrose, cellobiose, their hydrolysis.
- C] Polysaccharides-starch, glycogen, cellulose,
- D] Derived monosaccharides-Deoxy sugars (β D2 deoxy ribose), sugar acid (L-ascorbic acid), amino sugars (β D glucosamine, β D galactosamine, N-acetyl glucosamine)

2. **Amino acids & Proteins:** (10)

A] Amino acids- meaning, definition, structure & classification of amino acids. Behaviour of glycine, aspartic acid & lysine in neutral, acidic & basic solutions, zwitterion, pI, ninhydrin reaction.

B] Proteins- formation of peptide bond, definition of proteins.

- a) Simple proteins (albumin & globulin)
- b) Complex proteins
- c) Derived Proteins

Structural levels of proteins-

- a) Primary structure (oxitocin)
- b) Secondary structure (α helix and β pleated)
- c) Tertiary structure (myoglobin)
- d) Quaternary structure (hemoglobin)

Forces involved in stabilizing native structure of protein

3. **Enzymes:** (10)

Definition, apoenzyme, coenzyme, holoenzyme, prosthetic group, cofactor. Classification of enzymes with two examples of each class. IUB nomenclature and numbering of enzymes. Enzyme as a catalyst, concept of activation energy in enzyme catalysed reaction. Unit of enzyme activity, specific activity and turnover number. Active site of enzyme and its features. Types of enzyme specificity. Induced fit hypothesis. Factors affecting enzyme activity-pH, temperature and substrate concentration. Enzyme kinetics-derivation of Michaelis-Menten equation for single substrate. Significance of K_m and V_{max} . Lineweaver Burk plot. Enzyme inhibition- irreversible, competitive and non competitive inhibition. Isoenzymes of LDH and their clinical importance.

4. **Vitamins:** (6)

Definition, differences between fat soluble and water soluble vitamins. Source, requirement, biochemical role and deficiency disorders of vitamins- retinol, thiamine, niacin, riboflavin, pyridoxine and pantothenic acid, their coenzyme forms.

5. **Lipids:** (4)

Definition & classification with two examples of each class. Structure & functions of – a) Simple lipids- Fatty acids & triglycerides
 b) Compound lipids-phospholipids, spingolipids, glycolipids
 c) Derived lipids- steroids (cholesterol), terpenes, carotenes.
 Lipid bilayer-Fluid mosaic model of plasma membrane

Paper – II
(BIOCHEMICAL TECHNIQUES)

- 1. Chromatography: (10)**
Definition & classification, principle, technique & applications of
- i) Thin layer chromatography
 - ii) Gel permeation chromatography
 - iii) High pressure liquid chromatography.
- Selection of gel, preparation of plate / column packing, application of sample, mechanism of separation, important applications & advantages of the methods.
- 2. Electrophoresis: (8)**
Definition, electrophoretic mobility, factors affecting electrophoretic mobility. Principle, technique and applications of –
- 1) Starch gel electrophoresis
 - 2) SDS- polyacrylamide gel electrophoresis.
- Preparation of gel plates, application of sample, mechanism of separation, developing the plates, important applications and advantages of the methods.
- 3. Absorption Spectroscopy: (6)**
Beer- Lambert's law, it's mathematical derivation, meaning of the terms transmittance, absorbance, molar and specific absorbance. Construction, working and applications of photoelectric colorimeter & spectrophotometer. Limitations of colorimetric measurement. Absorption spectra of hemoglobin. Advantages of spectrophotometer over colorimeter.
- 4. Enzyme immobilization: (6)**
Definition, meaning, types of immobilization – adsorption on carriers, covalent binding to carriers, intermolecular cross-linking, entrapment within polymer gels, industrial applications of immobilization.
- 5. Modern techniques: (10)**
- A] Blotting techniques- Western, Southern & Northern blotting.
 - B] Polymerase chain reaction-technique & applications.
 - C] Enzyme linked immunosorbant assay (ELISA) -technique & applications
 - D] Hybridoma technology (formation of monoclonal antibodies & its significance).
 - E] Biotechnology & intellectual property rights (IPR), patents, copyright, trade secret, and trademarks.

SEMESTER-IV
Paper – III
(NUTRITION AND METABOLISM)

- 1. Nutrition and calorimetry:** (10)
Nutrition- definition, balanced diet, source, requirement. Nutritional aspects of carbohydrates, proteins (biological value, essential and non – essential amino acids, nitrogen balance). Lipids (essential and non essential fatty acids). A brief account of vitamins & minerals in diet.
Calorimetry – calorific values of food and its measurement (bomb calorimeter) respiratory quotient, basal metabolic rate (BMR), measurement of BMR (Douglas bag method). Factors affecting BMR and its significance.
- 2. Biological oxidation:** (8)
Bioenergetics- Exergonic and endergonic reactions, free energy, high energy compounds & their significance, ATP as a high energy compound.
Mitochondrial respiration – components of respiratory chain, respiratory chain, oxidative phosphorylation, mechanism of oxidative phosphorylation (Chemiosmotic coupling hypothesis), inhibitors of electron transport chain.
- 3. Carbohydrate metabolism:** (8)
Glycolysis & its energetics. Lactic acid and ethanol fermentation, TCA cycle and its energetics, glycogenesis and glycogenolysis
- 4. Amino acid metabolism:** (6)
General reactions of amino acid metabolism viz. transamination deamination, decarboxylation. Urea cycle. Inborn errors of amino acid metabolism phenylketonuria (PKU).
- 5. Lipid metabolism :** (4)
Biosynthesis of palmitic acid and its energetics, β - oxidation of palmitic acid & its energetics.
- 6. Electrolyte & acid base balance in body:** (4)
Functions of water, regulation of electrolyte balance in body, dehydration. Acid- base balance –production of acid & bases by body. Maintenance of blood pH. Blood buffers – bicarbonate, phosphate & protein buffer system in body. Respiratory mechanism of pH regulation. renal mechanism of pH regulation CO_2 as a central molecule of pH regulation, disorders of acid- base balance.

Paper – IV
(MOLECULAR BIOCHEMISTRY & DISEASES)

1. Nucleic acids: (16)

Meaning, distinction between DNA & RNA. Components of nucleic acids – nitrogenous bases, sugars, phosphoric acid, nucleosides & nucleotides phosphodiester linkage, representation of primary structure of polynucleotide. Watson-Crick model of DNA. Structure & function of t-RNA, m-RNA and r-RNA. Replication of DNA (semi conservative), mechanism of transcription in prokaryotes. Genetic code. Translation in prokaryotes. Regulation of gene expression, constitutive & inducible genes Operon concept, Lac operon in E. coli.

2. Genetic Engineering: (10)

Introduction, restriction endonucleases, S1 nucleases, reverse transcriptase, cloning vectors- pBR322 and λ phage. Preparation of c-DNA. Gene cloning technique illustrated with insulin gene cloning. Applications of genetic engineering.

3. Immunology: (4)

Natural & acquired immunity. Immune response to antigen. Clonal selection theory for formation of antibodies. Structure of IgG

4. Biochemistry of diabetes mellitus: (4)

Structure of insulin, formation of insulin from preproinsulin, factors stimulating insulin secretion, metabolic effects of insulin, mechanism of action of insulin.

Types of diabetes mellitus, metabolic changes in diabetes mellitus, long term effects of diabetes. Management of diabetes-dietary, hypoglycemic drugs and insulin.

5. Biochemistry of cancer: (3)

Types of tumor, agents causing cancer- chemical carcinogens, radiant energy, oncogenic viruses, tumor markers – α -fetoprotein (AFP) carcinoembryogenic antigen(CEA), Characteristics of tumor cells.

6. Biochemistry of AIDS: (3)

Structure of HIV, transmission of HIV, immunological abnormalities in AIDS. Lysis of CD4 cells. Consequences of immunodeficiency, natural course of AIDS- acute, chronic, crisis phases. Graphical representation. Anti AIDS drugs- AZT, didanosine (Structure & mechanism of action).

List of reference books

1. Outlines of Biochemistry--- Cohn and Stumpf
2. Biochemistry – O.P. Agarwal
3. Text book of Biochemistry and Human Physiology – G.P. Talwar
4. Harper's review of Biochemistry – H.A. Harper (ed)
5. Principals of Biochemistry – Lehninger
6. Biochemistry ---S.C. Rastogi
7. Text book of Biochemistry –A.V.S.S. Ramarao
8. Biochemistry – U. Satyanarayan
9. Cell and Molecular Biology – P.K.Gupta
- 10.Elements of Biochemistry - P.K.Gupta
- 11.Genetic Engineering –Sandhya Mitra
- 12.Instrumental Methods of Chemical Analysis –B.K. Sharma
- 13.Basic Biotechnology –S. Ignacimuthu
- 14.Fundamentals of Biochemistry – J.L. Jain
- 15.Elementary Biochemistry- J.L. Jain
- 16.Chromatography- B.K. Sharma

Laboratory Course (Practicals)

- Note: 1. Use of Electronic/ single pan /digital balance is allowed.
2. Use of scientific calculator is allowed.
2. Use SI units whenever possible.

Part I

1. a) Fundamentals of Biochemical analysis
b) Control and accuracy
2. Separation methods:
 - a) Paper chromatographic separation & identification of amino acids from binary mixture.
 - b) Paper chromatographic separation & identification of carbohydrates from binary mixture.
 - c) Uptake of Na⁺ ions by cation exchange resin.
 - d) Thin layer chromatographic separation and identification of amino acids/carbohydrates from binary mixture.
 - e) Immobilization of bakers yeast cells for invertase activity.
3. Preparation of biological samples:
 - a) Isolation and characterization of starch from potatoes
 - b) Isolation and characterization of casein from milk
 - c) Isolation and characterization of albumin & globulin from egg yolk.
 - d) Isolation and characterization of DNA from onion bulb.
4. Colorimetric estimations:
 - a) Estimation of protein by biurette method & verification of Beer-Lamberts law.
 - b) Estimation of inorganic phosphate in blood by Fiske – Subbarao method.
 - c) Estimation of glucose in blood by Folin-Wu method.
 - d) Estimation of RNA by Bial's Orcinol method.
 - e) Estimation of creatinine in urine.
 - f) Estimation of blood urea by DAM method.
 - g) Estimation of blood cholesterol by Liebermann-Burchard method.

Part II

5. Demonstration Experiments
 - a) Soxhlet extraction of lipids from ground nuts/egg yolk.
 - b) Separation of indicators / serum proteins by paper / cellulose acetate electrophoresis
 - c) Enzyme kinetics- effect of substrate concentration on enzyme (amylase) activity.
6. Volumetric estimations
 - a) Estimation of glycine by formal titration.
 - b) Estimation of lactose in milk by Fehlings method.
 - c) Estimation of serum calcium by Clark & Collips method.
 - d) Estimation of vitamin C in biological samples and tablets by 2,6 dichlorophenol indophenol method.
 - e)) Estimation of saponification value of oil.
 - f)) Estimation of iodine number of oil .
7. Qualitative analysis
 - a) Carbohydrates- xylose, glucose, fructose, lactose, maltose, sucrose, starch.
 - b) Lipids- oleic acid, palmitic acid, cholesterol, glycerol.
 - c) Abnormal constituents in urine (blood, reducing sugar, proteins, bilirubin , ketone bodies).
 - d) Detection of any four enzymes by qualitative tests (urease, invertase, amylase, phenol oxidase, alkaline phosphatase)
 - e) Estimation of amylase (diastase) activity in urine.

List of reference books for practicals

1. Laboratory manual in Biochemistry –J. Jayaraman
2. Practical Biochemistry – David Plummer
3. Hawk's physiological chemistry - Oser
4. A manual of laboratory technique (Ed)-N. Raghuramulu, K. Madhavan Nair & S. Kalyansundaram
5. Biochemistry methods- Sadasivan & Manikam
6. Introductory Practical Biochemistry – Sawhney S.K. and Ranabir Singh
7. Viva and Practical Biochemistry - A.C. Deb

Solapur University, Solapur

Nature of Question Paper For Semester Pattern

• Faculty of Science

(w.e.f. June 2011)

Time :- 2 hrs.

Total Marks-50

- Q. No.1) Multiple choice questions. (10)**
- 1) -----
a) b) c) d)
- 2)
3)
4)
5)
6)
7)
8)
9)
10)
- Q.No.2) Answer any Five of the following (10)**
- i)
ii)
iii)
iv)
v)
vi)
- Q.No.3) A) Answer any Two of the following (06)**
- i)
ii)
iii)
- B) Write the Answer/Solve/Problem/Note (04)**
- Q.No.4) Answer any Two of the following (10)**
- i)
ii)
iii)
- Q.No.5) Answer any Two of the following (10)**
- i)
ii)
iii)