Solapur University, Solapur

SYLLABUS Semester Pattern (CBCS)
(w.e.f. June 2017)
B.Sc. II
BIOCHEMISTRY (IDS)

General Structure:

There will be two theory papers, each of 3 hrs & 70 marks for every semester. There will be one practical course of 200 marks at the end of the year. Their titles and marks are as under.

SEMESTER III

Paper- I	Biomolecules	70 (UA) + 30 (CA)
Paper- II	Biochemical Techniques	70 (UA) + 30 (CA)

SEMESTER IV

Paper- III	Nutrition and Metabolism	70 (UA) + 30 (CA)
Paper- IV	Molecular Biochemistry and Diseases	70 (UA) + 30 (CA)

Practical Course

Part I	70
1) Chromatographic experiments	15
2) Colorimetric experiments	20
3) Preparation experiments	15
4) Journal	10
5) Study Tour	10
Part II	70
1) Volumetric Estimations	24
2) Qualitative Analysis	
a) Carbohydrates	14
b) Enzymes/Lipids	10
c) Urine (Abnormal components)	12
3) Oral	10

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 compulsory.

B.Sc. Part II Biochemistry Syllabus
SEMESTER-III: Paper I
(BIOMOLECULES)

Total marks: 100 (70+30) **Credits: 3** **Contact hours: 45**

1. **Carbohydrates -** **(11)**

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, lactone, 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 -** **(11)**

A) Amino acids- meaning, definition, structure & classification of amino acids. Behaviour of glycine, aspartic acid & lysine in neutral, acidic & basic solutions, zwitterions, 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 & β pleated)
   c) Tertiary structure (myoglobin)
   d) Quaternary structure (haemoglobin)

Forces involved in stabilizing native structure of protein.

C) **Enzymes -** Definition, apoenzyme, coenzyme, holoenzyme, prosthetic group, cofactor. Classification of enzymes with two examples of each class. IUB nomenclature and numbering of enzymes.

3. **Nucleic Acids-** **(8)**

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 and function of t-RNA, m-RNA and r-RNA.

4. **Vitamins** **(8)**

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

5. **Lipids** **(7)**

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.

Semester-III: Paper-II

(BIOMOLECULE TECHNIQUES)

Total marks: 100 (70+30) **Credits: 3** **Contact hours: 45**

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** **(9)**

Definition, electrophoretic mobility, factors affecting electrophoretic mobility. Principle, technique and applications of-

1) Starch gel electrophoresis
2) SDS-polyacrylamide gel electrophoresis
3) Agarose gel electrophoresis
4) 2-D 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** **(8)**

Beer-Lambert's law, its mathematical derivation, meaning of the terms- transmittance, absorbance, molar and specific absorbance. Construction, working and applications of photoelectric colorimeter and spectrophotometer. Limitations of colorimetric measurement. Absorption spectra of hemoglobin. Advantages of spectrophotometer over colorimeter.

4. **Enzyme immobilization** **(8)**

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 immunosorbent 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)

Total marks: 100 (70+30) Credits: 3 Contact hours: 45

1 **Nutrition and colorimetry: (11)**

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 effecting BMR and its significance..

2 **Biological oxidation: (9)**

Bioenergetics-Exergonic and endergonic reactions, free energy, high energy compounds and their significance, ATP as a high energy compound.

Mitochondrial respiration-components of respiratory chain , respiratory chain, oxidative phophorylation, mechanism of oxidative phosphorylation (Chemiosmotic coupling hypothesis), inhibitors of electron transport chain

3 **Carbohydrate metabolism: (9)**

Glycolysis & its energetic. Lactic acid and ethanol fermentation. TCA cycle and its energitics, 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: (5)**

Biosynthesis of palmitic acid and its energetic, β -oxidation of palmitic acid and its energetics.

6 **Electrolyte & acid base balance in body: (5)**

Functions of water, regulation of electrolyte balance in body, dehydration. Acid-base balance-production of 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.

Semester –IV: Paper-IV

(MOLECULAR BIOCHEMISTRY & DISEASES)

Total marks: 100 (70+30) **Credits: 3** **Contact hours: 45**

1. Enzymology: **(12)**

Enzyme as a catalyst, concept of activation energy in enzyme catalyzed 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 Km and Vmax. Lineweaver Burk plot. Enzyme inhibition-irreversible, competitive and non competitive inhibition. Isoenzymes of LDH and their clinical importance.

2. Molecular Biology and Genetic Engineering: **(10)**

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

3. Immunology: **(6)**

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

4. Biochemistry of diabetes mellitus: **(8)**

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: **(4)**

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: **(5)**

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

List of reference books-

1. Outlines of biochemistry--- Cohn & stumpf

2. Biochemistry – O. P. Agarwal

3. Text book of biochemistry & 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 & 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. Fundamental 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.
3. Use SI units whenever possible.

Part I

1. a) Fundamentals of Biochemical analysis.
   b) Control and accuracy.

2. **Separation methods:**

   a) Paper chromatographic separation and identification of amino acids from binary mixture.
   b) Paper chromatographic separation and 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 baker's 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 and globulin from egg yolk.
   d) Isolation and characterization of DNA from onion bulb.

4. **Colorimetric estimations:**

   a) Estimation of protein by biurette method and 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.
   h) Estimstion of DNA by Diphynylamine 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 methods.
c) Estimation of serum calcium by Clark and Collips method.
d) Estimation of vitamin C in biological samples and tablets by 2,6 dichlorophenol indophenols 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)

List of reference books for practicals

1. Laboratory manual in Biochemistry – J. Jaynaraman
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.

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Nature of Question Paper For Semester Pattern (CGPA)

Faculty of Science
(w.e.f. June 2015)

Time :- **3 hrs.** Total marks **70**

Q.No. 1 Multiple choice questions. **(14)**

1) ----------

a) b) c) d)

2)
3)
4)
5)
6)
7)
8)
9)
10)
11)
12)
13)
14)

Q. No.2 Attempt any seven of the following **(14)**

I)
ii)
iii)
iv)
v)
vi)
vii)
viii)
ix)

Q. No.3 A) Attempt any two of the following **(10)**

i)
ii)
iii)

B) Solve **(4)**

Q. No.4 Attempt any two of the following **(14)**

i)
ii)
iii)

Q. No. 5 Attempt any two of the following **(14)**

i)
ii)
iii)