

**PUNYASHLOK AHILYADEVII HOLKAR SOLAPUR UNIVERSITY, SOLAPUR**



**Name of the Faculty: Science & Technology**

**CHOICE BASED CREDIT SYSTEM**

**Syllabus: BIO-CHEMISTRY**

**Name of the Course: B.Sc. II (Sem.–III & IV)**

**(Syllabus to be implemented from w.e.f. June 2020)**

# PUNYASHLOK AHILYADEVJI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR

## SYLLABUS FOR B. Sc – II (BIO-CHEMISTRY)

### CHOICE BASED CREDIT SYSTEM (CBCS) SYLLABUS

#### Structure of the Course:

- Structure of B.Sc. course in faculty of science has total of 06 semesters for 3 years.
- B.Sc.-II comprises of total two semesters. Each semester will have **two** theory papers of 80 marks for university external examination and 20 marks for internal examination for each paper.
- At the end of academic year i.e. semester IV the practical examination will be conducted. The evaluation of practical exam is of 80 marks for university external practical examination and 20 marks for internal practical examination.
- The titles and marks distribution for each paper are as under.

Semester	Paper No.	Title of Paper	Total Lectures	Examination			Total Credit
				Univ. Exam	Internal Exam	Total Marks	
Semester III	I	Biomolecules	30	40	10	50	02
	II	Biochemical Techniques	30	40	10	50	02
Semester IV	III	Nutrition and Metabolism	30	40	10	50	02
	IV	Molecular Biochemistry and Diseases	30	40	10	50	02
Practical	I	Biochemistry		80	20	100	04

#### • University Examination

1. Theory Paper I : 40 Marks
2. Theory Paper II : 40 Marks
3. Theory Paper III : 40 Marks
4. Theory Paper IV : 40 Marks
5. Practical : 80 Marks

Practical paper has 80 marks for external university practical examination. Duration of practical examination is **two days**. Out of 80 marks for external university practical examination, the mark distribution is as follows.

**Practical Course**

<b>Part I</b>		<b>40</b>
1) Chromatographic experiments	10	
2) Colorimetric experiments	10	
3) Preparation experiments	10	
4) Journal	05	
5) Study Tour	05	
<b>Part II</b>		<b>40</b>
1) Volumetric Estimations	10	
2) Qualitative Analysis	20	
a) Carbohydrates/Lipids		
b) Enzymes/ Urine (Abnormal components)		
3) Journal	05	
4) Oral	05	

- **Continuous Internal Assessment for chemistry:**

- 1) Each theory paper has 10 marks for internal examination. There will be 05 marks for unit test and 05 marks for home assignment.
- 2) Practical paper has 20 marks for internal examination.

**SEMESTER-III**  
**PAPER - I: BIOMOLECULES**

**Total marks: 50 (40+10)**

**Credits: 2**

**Contact hours: 30**

Unit	Content	Lectures
<b>I</b>	<p><b>Carbohydrates -</b> Definition, classification, structures &amp; role of-</p> <p>A) Monosaccharides- aldoses &amp; ketoses</p> <p style="padding-left: 20px;">i) Trioses-glyceraldehyde &amp; dihydroxy acetone</p> <p style="padding-left: 20px;">ii) Tetroses-erythrose, erythrulose</p> <p style="padding-left: 20px;">iii) Pentoses-ribose, ribulose, xylose, xylulose</p> <p style="padding-left: 20px;">iv) Hexoses-glucose, mannose, galactose, fructose.</p> <p>Reactions of monosaccharides, Derivatives of monosaccharides</p> <p>B) Oligosaccharides: glycoside bond, maltose, isomaltose, sucrose, cellobiose</p> <p>C) Polysaccharides- starch, glycogen, cellulose.</p>	<b>07</b>
<b>II</b>	<p><b>Amino acids &amp; Proteins -</b></p> <p>A) Amino acids- classification of amino acids. Properties of amino acids: physical properties, chemical properties, zwitterions, pI, ninhydrin reaction. Nonprotein amino acids and their functions</p> <p>B) Proteins-Formation of peptide bond, definition of proteins.</p> <p style="padding-left: 20px;">i) Types of protein: Simple proteins (albumin &amp; globulin), Complex proteins &amp; Derived proteins</p> <p style="padding-left: 20px;">ii) Structure of proteins: Primary, Secondary (<math>\alpha</math> helix &amp; <math>\beta</math> pleated), Tertiary &amp; Quaternary structure, Forces involved in stabilizing native structure of protein.</p> <p>C) Enzymes - Definition, apoenzyme, coenzyme, holoenzyme, prosthetic group, cofactor. Classification of enzymes with two examples of each class.</p>	<b>07</b>
<b>III</b>	<p><b>Nucleic Acids:</b> Meaning, distinction between DNA &amp; RNA. Components of nucleic acids-nitrogenous bases, sugars, phosphoric acid, nucleosides &amp; 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.</p>	<b>06</b>
<b>IV</b>	<p><b>Vitamins:</b> Definition, differences between fat soluble &amp; water soluble vitamins. Source, requirement, biochemical role &amp; deficiency disorders of vitamins- retinol, thiamine, niacin, riboflavin, pyridoxine &amp; pantothenic acid, their coenzyme forms.</p>	<b>05</b>
<b>V</b>	<p><b>Lipids:</b> Definition &amp; classification with two examples of each class. Structure &amp; functions of-</p> <p style="padding-left: 20px;">a) Simple lipids- Fatty acids &amp; triglycerides.</p> <p style="padding-left: 20px;">b) Compound lipids- phospholipids, spingolipids, glycolipids</p> <p style="padding-left: 20px;">c) Derived lipids- steroids (cholesterol), terpenes, carotenes.</p> <p>Lipid bilayer- Fluid mosaic model of plasma membrane.</p>	<b>05</b>

## Reference Books:

1. Lehninger, Principles of Biochemistry. 5th Edition (2008), David Nelson & Michael
2. Biochemistry – Lubert Stryer, 5<sup>th</sup> Edition, W.H. Freeman and Company, New York.
3. Fundamentals of Biochemistry - Voet, Voet & Pratt.
4. Fundamentals of Biochemistry – J. L. Jain, S. Chand & Company Ltd, New Delhi.
5. Biochemistry – U. Satyanarayan, 3<sup>rd</sup> Edition, Books and allied (P) Ltd.
6. Biochemistry - S.C. Rastogi.
7. Text book of Biochemistry - R. C. Dubey.

**SEMESTER-III**  
**PAPER - II: BIOCHEMICAL TECHNIQUES**

**Total marks: 50 (40+10)**

**Credits: 2**

**Contact hours: 30**

Unit	Content	Lectures
<b>I</b>	<p><b>1. Chromatography</b> Definition &amp; classification, principle, technique &amp; applications of</p> <ul style="list-style-type: none"> <li>i) Thin layer chromatography</li> <li>ii) Gel permeation chromatography</li> <li>iii) High pressure liquid chromatography</li> </ul> <p>Selection of gel, preparation of plate/ column packing, application of sample, mechanism of separation, important applications &amp; advantages of the methods.</p>	<b>07</b>
<b>II</b>	<p><b>Electrophoresis:</b> Definition, electrophoretic mobility, factors affecting electrophoretic mobility. Principle, technique and applications of-</p> <ul style="list-style-type: none"> <li>1) Polyacrylamide gel electrophoresis: Native and denaturing</li> <li>2) Agarose gel electrophoresis</li> <li>3) 2-D gel electrophoresis</li> </ul> <p>Preparation of gel plates, application of sample, mechanism of separation, developing the plates, important applications and advantages of the methods.</p>	<b>07</b>
<b>III</b>	<p><b>Absorption Spectroscopy</b> 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.</p>	<b>05</b>
<b>IV</b>	<p><b>Estimation of Biomolecules</b></p> <ul style="list-style-type: none"> <li>A) Carbohydrates – DNSA, anthrone, phenol-H<sub>2</sub>SO<sub>4</sub>, resorcinol method.</li> <li>B) Protein – BCA assay, Bradford assay, Lowery's assay.</li> <li>C) Lipid – acid value, saponification value, ester value and iodine number. Liberman Burchard and Zak's method for cholesterol estimation.</li> <li>D) Nucleic acids – DPA method, orcinol method</li> </ul>	<b>05</b>
<b>V</b>	<p><b>Modern Techniques</b></p> <ul style="list-style-type: none"> <li>A) Blotting techniques- Western, Southern &amp; Northern blotting.</li> <li>B) Polymerase chain reaction-technique &amp; applications.</li> <li>C) Immunotechniques: Immunodiffusion, Immunoelectrophoresis, Enzyme linked immunosorbent assay (ELISA)-technique &amp; applications. Hybridoma technology (formation of monoclonal antibodies &amp; its significance).</li> </ul>	<b>06</b>

**Reference Books:**

1. Protein purification –Robert Scoopes
2. Instrumental Methods of Chemical Analysis – Gurudeep R. Chatwal, Sham K. Anand (Himalaya Publishing House).
3. Handbook on Analytical Instruments –R. S. Khandpur. (Mc Graw Hill).
4. Biophysical Chemistry - Upadhyay, Nath, Upadhyay (Himalaya Publishing House).
5. A Text Book of Biotechnology – R. C. Dubey.
6. Practical Biochemistry –Wilson & Walker.

## SEMESTER-IV

### PAPER - III: NUTRITION AND METABOLISM

Total marks: 50 (40+10)

Credits: 2

Contact hours: 30

Unit	Content	Lectures
<b>I</b>	<b>Nutrition and calorimetry:</b> A) 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. B) 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.	<b>07</b>
<b>II</b>	<b>Electrolyte &amp; acid base balance in body:</b> 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 <sub>2</sub> as a central molecule of pH regulation, disorders of acid-base balance.	<b>05</b>
<b>III</b>	<b>Biological oxidation:</b> 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 phosphorylation, mechanism of oxidative phosphorylation (Chemiosmotic coupling hypothesis), inhibitors of electron transport chain.	<b>06</b>
<b>IV</b>	<b>Metabolism of Carbohydrates and Amino acids</b> A) Carbohydrate metabolism: Glycolysis & its energetic, Fate of pyruvate, Lactic acid and ethanol fermentation, TCA cycle and its energetics B) Amino acid metabolism: General reactions of amino acid metabolism viz. transamination, deamination, decarboxylation. Urea cycle.	<b>07</b>
<b>V</b>	<b>Metabolism of Lipids and Nucleic acids</b> A) Lipid metabolism: Biosynthesis of palmitic acid and its energetic, $\beta$ -oxidation of palmitic acid and its energetics. B) Nucleotide metabolism: Sources of the atoms in the purine and pyrimidine molecules; Outline of biosynthesis and degradation of purines and pyrimidines	<b>05</b>

#### Reference Books

1. Lehninger's Principles of Biochemistry –Nelson & Cox, 5<sup>th</sup> Edition, W.H. Freeman and Company, New York.
2. Fundamentals of Biochemistry – Voet & Voet, 3<sup>rd</sup> Edition, W.H. Freeman and Company, New York.
3. Biochemistry – Lubert Stryer, 5<sup>th</sup> Edition, W.H. Freeman and Company, New York.
4. Nutritional Biochemistry - Dr.S.Ramkrishna & Dr. S. Vyankatrao.
5. Fundamentals of Biochemistry – J. L. Jain, S. Chand & Company Ltd, New Delhi.
6. Biochemistry – U. Satyanarayan, 3<sup>rd</sup> Edition, Books and allied (P) Ltd.

## SEMESTER-IV

### PAPER - IV: MOLECULAR BIOCHEMISTRY & DISEASES

Total marks: 50 (40+10)

Credits: 2

Contact hours: 30

Unit	Content	Lectures
<b>I</b>	<b>Enzymology:</b> A) Enzyme as a catalyst: concept of activation energy in enzyme catalyzed reaction, Lock & key model, Induced fit hypothesis. Active site of enzyme and its features. B) Enzyme activity: Definition & Unit of enzyme activity, specific activity and turnover number, Factors affecting enzyme activity-pH, temperature and substrate concentration. C) 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.	<b>07</b>
<b>II</b>	<b>Molecular Biology and Immunology:</b> A) Molecular biology: Replication of DNA (semi conservative), transcription in prokaryotes. Translation in prokaryotes. Regulation of gene expression: constitutive & inducible genes. Operon concept, Lac operon in E. coli. B) Immunology: Natural & acquired immunity. Immune response to antigen. Clonal selection theory for formation of antibodies. Structure of IgG.	<b>07</b>
<b>III</b>	<b>Genetic Engineering and Bioinformatics:</b> A) Genetic engineering: Restriction endonucleases, S1 nucleases, reverse transcriptase, cloning vectors-pBR322 and $\lambda$ phage. Preparation of c-DNA. Gene cloning technique illustrated with insulin gene cloning. Applications of genetic engineering. B) Bioinformatics: Introduction to bioinformatics, Databases, Information sources (NCBI, GDB, and MGD), Data retrieval tools (ENTREZ, OMIM and PubMed), Database similarity searching (BLAST), Applications of Bioinformatics	<b>05</b>
<b>IV</b>	<b>Biochemistry of Cancer and AIDS:</b> A) Cancer: Types of tumor, agents causing cancer-chemical carcinogens, radiant energy, oncogenic viruses, tumor markers- $\alpha$ -fetoprotein (AFP), carcinoembryogenic antigen (CEA), characteristics of tumor cells. B) AIDS: 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).	<b>06</b>
<b>V</b>	<b>Biochemistry of Diabetes Mellitus</b> 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, Symptoms, hyperglycemia, hypoglycemia, glucosourea and kidney threshold, Long term effects of diabetes: introduction to nephropathy, neuropathy, retinopathy and cardiovascular disease, Hypoglycemic drugs: metformin and sulfonylurea.	<b>(05)</b>



## Reference Books

1. Cell and Molecular biology - P. K. Gupta.
2. Molecular Biology; R. Weaver; 2nd Edition, McGraw Hill.
3. Molecular Cell Biology; Lodish; 6th Edition; W. H. Freeman & Company.
4. Gene VII; Benjamin Lewin; Pearson Education.
5. Elements of Biotechnology - P. K. Gupta.
6. Genetic engineering - Sandhya Mitra.
7. Biotechnology - B. D. Singh.
8. Immunology .- Kuby.
9. Essential Immunology- Roitt
10. Bioinformatics : Principle and applications - Harshawardhan P. Bal.
11. Introduction to Bioinformatics - T. K. Attwood & D. J. Parry- Smith

## B.Sc. – II Biochemistry

### Practical Course

- 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/characterization:**
  - a) Paper chromatographic separation and identification of amino acids from binary mixture.
  - b) Paper chromatographic separation and identification of carbohydrates from binary mixture.
  - c) Thin layer chromatographic separation and identification of amino acids/carbohydrates from binary mixture.
  - d) Immobilization of baker's yeast cells for invertase activity.
  - e) Effect of substrate concentration on enzyme (amylase) 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.
4. **Colorimetric estimations:**
  - a) Estimation of protein by Biuret method and verification of Beer-Lamberts law.
  - b) Estimation of inorganic phosphate in blood by Fiske-Subbarao method.
  - c) Estimation of reducing sugar by DNSA 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 DNA by Diphenylamine method.

## Part II

### 1. Demonstration Experiments:

- a) Soxhlet extraction of lipids from ground nuts/ egg yolk.
- b) Separation of indicators/ serum proteins by paper/ cellulose acetate electrophoresis.
- c) Antigen antibody interaction by Ouchterlony immunodiffusion procedure.

### 2. Volumetric estimations:

- a) Estimation of glycine by formal titration.
- b) Estimation of lactose in milk by Fehlings methods.
- c) Estimation of vitamin C in biological samples and tablets by 2,6 dichlorophenol indophenols method.
- d) Estimation of saponification value of oil.
- e) Estimation of iodine number of oil.

### 3. Qualitative analysis:

- a) Carbohydrates – xylose, glucose, fructose, lactose, maltose, sucrose, starch.
- b) Lipids – oleic acid, palmitic acid, cholesterol, glycerol.
- c) Detection of any three enzymes by qualitative tests (urease, invertase, amylase, phenol oxidase, alkaline phosphatase)
- c) Abnormal constituents in urine (blood, reducing sugar, proteins, bilirubin, ketone bodies).

### 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.

# **PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR**

## **B.Sc. Part-II**

### **PRACTICAL EXAMINATION IN BIOCHEMISTRY**

The practical examination of B.Sc. Part II in Biochemistry will be of 12 hours duration and will be conducted in two successive days, 6 hours per day.

The total practical examination will be of 80 Marks. The distribution of marks will be as follows.

1. Colorimetric estimation	10
2. Isolation of biological samples	10
3. Paper chromatography /Separation method	10
4. Volumetric estimation	10
5. Qualitative analysis of	20
a) Carbohydrate	
b) Lipid/enzyme	
c) Abnormal Urine components	
6 Oral	05
7 Journal	10
8 Study tour	05

The practical batch will be of maximum 24 candidates. The batch will be divided in two groups A & B. Group A will consist of 12 candidates while group B will have 12 candidates.

If the number of candidates in batch is less than 20 the number should be divided in two equal groups A & B. Any number remaining will be placed in group B.

Practical examination timing:

11.00 am to 2.00 pm

2.30 pm to 5.30 pm

Recess 2.00 pm to 2.30 pm

Sd/-  
Controller of examinations  
PAH Solapur University,  
Solapur.

# PUNYASHLOK AHILYADEVJI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR

Nature of Question Paper for choice based credit system (CBCS) Semester Pattern

•Faculty of Science •(w. e. f. June 2020)

Time: - 2 hrs.

Total Marks-40

## Instructions:

1. All questions are compulsory.
2. Draw **neat diagrams** and give **equations** wherever necessary.
3. Figures to the **right** indicate **full marks**.
4. Use of logarithmic table and calculator is allowed.

**Q. No.1) Multiple choice questions** (08)

- 1) -----  
a)      b)      c)      d)
- 2)
- 3)
- 4)
- 5)
- 6)
- 7)
- 8)

**Q.No.2) Answer any four of the following** (08)

- i)
- ii)
- iii)
- iv)
- v)
- vi)

**Q.No.3 A) Write notes on any one of the following** (03)

- i)
- ii)

**B) Solve / short answer** (05)

**Q. No.4) Answer any Two of the following** (08)

- i)
- ii)
- iii)

**Q.No.5) Answer any one of the following** (08)

- i)
- ii)