



SU/BOS/Science/349

Date: 24/06/2024

To,

The Principal,  
All Concerned Affiliated Colleges/Institutions  
Shivaji University, Kolhapur

**Subject:** Regarding Minor Change syllabi of B.Sc. Part-I (Sem.I & II) as per NEP-2020 (2.0) degree programme under the Faculty of Science and Technology.

**Ref:** SU/BOS/Science/877/ Date: 26/12/2023 Letter.

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the Minor Change syllabi, nature of question paper B.Sc. Part-I (Sem. I & II) as per NEP-2020 (2.0) degree programme under the Faculty of Science and Technology.

B.Sc.Part-I (Sem. I & II) as per NEP-2020 (2.0)			
1.	Food Science and Technology (Entire)	6.	Biochemistry
2.	Food Science	7.	Biotechnology (Optional/Vocational)
3.	Food Science and Quality Control	8.	Biotechnology (Entire)
4.	Food Technology & Management (Entire)	9.	Pollution
5.	Computer Science (Opt)	10.	Environmental Science (Entire)

This syllabus, nature of question and equivalence shall be implemented from the academic year 2024-2025 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website [www.unishivaji.ac.in](http://www.unishivaji.ac.in) NEP-2020@suk(Online Syllabus)

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October /November 2024 & March/April 2025. These chances are available for repeater students, if any.

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Dy Registrar  
Dr. S. M. Kubal

Copy to:

1	The Dean, Faculty of Science & Technology	4	B.Sc. Exam/ Appointment Section
2	Director, Board of Examinations and Evaluation	5	Computer Centre/ Eligibility Section
3	The Chairman, Respective Board of Studies	6	Affiliation Section (U.G.) (P.G.)

# **Shivaji University, Kolhapur**



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Accredited By NAAC with 'A' Grade

**CHOICE BASED CREDIT SYSTEM (CBCS)**

**Syllabus for Bachelor**

**of Science Part – I**

**(Sem I & II)**

**BIOCHEMISTRY**

**(Optional/Vocational)**

**(To be implemented from August, 2024-25 onwards as per NEP 2020)**

Level	Semester	1-Major		2-Major	3-OE	4-SEC	5-AEC, VEC, IKS			6-OJT, FP, CEP, CC, RP			Total Credits
		Major		Minor	IDC/MD C/ OE/GE	SEC	AEC (Language)	Value Education Courses (VEC)	IKS	CC	Summer Internship/ Field Project/ OJT	Research project/ Dissertation	
		DSC	DSE	MIN	OE								
	I	DSC-I(2) DSC-II(2) DSC- Pract.-I(2)		Minor-I(2) Minor-II(2) Minor pract-II(2)	IDC/MD C/OE-I (2) IDC/MD C/OE-II (2) (T/P)	SEC-I(2) SEC- Pract.- I(2)			IKS-I(2) Intro. to IKS			-	
	Credits	4+2=6		4+2=6	2+2=4	2+2=4			-			-	22
	II	DSC-III(2) DSC-IV(2) DSC- Pract.-II(2)		Minor-III(2) Minor-IV(2) Minor pract-II(2)	IDC/MD C/OE/III(2) IDC/MD C/OE-IV (T/P)(2)	SEC-II(2) SEC- Pract.- II(2)		VEC-I(2) Democracy				-	
	Credits	4+2=6		4+2=6	2+2=4	2+2=4		2					22
	1 <sup>st</sup> year cum.credits	12		12	8	8		2	2				44

# **Shivaji University, Kolhapur**

## **Revised Syllabus for Bachelor of Science Part – I: Biochemistry**

### **1. TITLE: Biochemistry**

**2. YEAR OF IMPLEMENTATION:** - Revised Syllabus will be implemented from June, 2024 onwards.

### **3. PREAMBLE:**

This syllabus is framed to give sound knowledge with understanding of Biochemistry to undergraduate students at first year of three years of B.Sc. degree course.

Students learn Biochemistry as a separate subject from B.Sc. I. The goal of the syllabus is to make the study of Biochemistry popular, interesting, and encouraging to the students for higher studies including research.

The new and updated syllabus is based on a basic and applied approach with vigor and depth. At the same time precaution is taken to make the syllabus comparable to the syllabi of other universities and the needs of industries and research.

The syllabus is prepared after discussion at length with number of faculty members of the subject and experts from industries and research fields.

The units of the syllabus are well defined, taking into consideration the level and capacity of students.

### **4. GENERAL OBJECTIVES OF THE COURSE/ PAPER:**

- 1) To make the students knowledgeable with respect to the subject and its practicable applicability.
- 2) To promote understanding of basic and advanced concepts in Biochemistry.
- 3) To expose the students to various emerging areas of Biochemistry.
- 4) To prepare students for further studies, helping in their bright career in the subject.
- 5) To expose the students to different processes used in industries and in research field.
- 6) To prepare the students to accept the challenges in life sciences.
- 7) To develop skills required in various industries, research labs and in the field of human health.

### **5. Program Specific Outcomes:**

- Understand basics of Biochemistry.
- Learn, design, and perform experiments in the labs to demonstrate the concepts, principles and theories learnt in the classroom.
- Develop the ability to apply the knowledge acquired in classroom and laboratories to specific problems in theoretical and experimental Biochemistry.
- Identify the area of interest in the academic research and development.
- Perform job in various fields like food, pharmaceutical, agriculture, health care, public services, and business etc.
- Be an entrepreneur with precision, analytical mind, innovative thinking, and clarity of thought, expression, and systematic approach.

## 6. DURATION

- The course shall be a full time course.

## 7. PATTERN:-

Pattern of Examination will be Semester

### **EQUIVALENCE IN ACCORDANCE WITH TITLES AND CONTENTS OF PAPERS- (FOR REVISED SYLLABUS)**

<b>Sr.No.</b>	<b>Title of Old paper</b>	<b>Title of New paper</b>
1	Paper I DSC-17A <b>Basics of cell biology</b>	Paper I DSC-I <b>Molecules of Life 1</b>
2	Paper II DSC-18A <b>Introduction to Amino acids and Carbohydrates</b>	Paper II DSC-II <b>Molecules of Life 2</b>
3	Paper III DSC-17-B: <b>Introduction to Lipids and Nucleic acids</b>	Paper III DSC-III: - <b>Molecules of Life 3</b>
4	PAPER IVDSC -18 B – <b>Introduction to Proteins and Enzymes</b>	PAPER IVDSC- IV – <b>Biochemical Techniques 1</b>

# Department of Biochemistry (Optional)

## Teaching and Evaluation scheme

### Three/ Four- Years UG Program

#### Department/ Subject Specific Core or Major (DSC)

#### First Year Semester-I & II

Level	Sem	1-Major		2-Major	3-OE	4-SEC	5-AEC, VEC, IKS			6-OJT, FP, CEP, CC, RP			Total Credits
		Major		Minor	IDC/MD C/OE/GE	SEC	AEC (Language)	Value Education Courses (VEC)	IKS	CC	Summer Internship/Field Project/OJT	Research project/Dissertation	
		DSC	DSE	MIN	OE								
	I	DSC-I (2) Molecules of Life 1  DSC-II (2) Molecules of Life 2  DSC-Pract.-I(2) Biochemistry Practical Course-I		Minor-I (2) Molecules of Life 1  Minor-II(2) Molecules of Life 2  Minor pract-II (2) Biochemistry Practical Course-I	IDC/MD C/OE-I (2)(T/P) Infectious diseases-I  IDC/MD C/OE-II (2) (T/P) Infectious diseases-II	SEC-I(2) Clinical Biochemistry -I  SEC-Pract.-I(2) Clinical Biochemistry Practical -I			IKS-I(2) Intro.toIKS			-	
	Credits	4+2=6		4+2=6	2+2=4	2+2=4			-			-	22
	II	DSC-III(2) Molecules of Life 3  DSC-IV(2)		Minor-III (2) Molecules of Life 3  Minor-IV	IDC/MD C/OE/III(2) Non-Infectious diseases-III	SEC-II(2) Biochemical Techniques-I		VEC-I(2) Democracy				-	

		Biochemical Techniques 1  DSC-Pract.-II(2) Biochemistry Practical Course-II		(2) Biochemical Techniques 1  Minor pract-II (2) Biochemistry Practical Course-II	IDC/MD C/OE-IV (T/P)(2) Non-Infectious diseases-IV	SEC-Pract.-II(2) Biochemical Techniques Practical-I							
	Credits	4+2=6		4+2=6	2+2=4	2+2=4		2					22
	1 <sup>st</sup> year cum.credits	12		12	8	8		2	2				44

## Paper- I- DSC-I Molecules of Life 1

### Objectives-

- To make students aware of fundamentals of Biochemistry.
- To make Students aware of biomolecules of living organism
- To introduce wide areas in Biochemistry

<b>Paper- I: -DSC-I MOLECULES OF LIFE 1</b>		
	<b>Credit – I</b>	
	<p><b>The foundations of biochemistry</b></p> <p>Definition of biochemistry and its importance.</p> <p>Overview of biomolecules and their significance.</p> <p><b>Water</b></p> <p>Molecular structure of water (H<sub>2</sub>O),</p> <p>Polarity of water molecules and hydrogen bonding,</p> <p>Unique properties, weak interactions in aqueous systems, ionization of water, water as a reactant and fitness of the aqueous environment</p> <p>Transport of nutrients, gases, and waste products in aqueous solutions.</p> <p><b>Vitamins</b></p> <p>Structure and active forms of water-soluble vitamins, deficiency diseases and symptoms, hypervitaminosis viz. Thiamine, Riboflavin, Niacin, Pyridoxine, Pantothenic acid</p>	15
	<b>Credit- II</b>	
	<p><b>Carbohydrates</b></p> <p>Definition, classification, and brief account of monosaccharides (aldoses and ketoses):</p> <p>Trioses – Glyceraldehyde, Dihydroxyacetone</p> <p>Tetroses – Erythrose, Erythrulose</p> <p>Pentoses – Ribose, Xylose, Ribulose, Xylulose</p> <p>Hexoses – Glucose, Fructose</p> <p>Conformations of glucose: alpha &amp; beta</p> <p>Disaccharides: Glycosidic bond, Maltose, Isomaltose, Lactose, Sucrose and Cellobiose</p> <p>Polysaccharides: Structure and biological role of Starch, Glycogen, Cellulose</p> <p>Mucopolysaccharides: Hyaluronic acid, Heparin</p>	15

### Learning Outcomes-

Students should be able to understand

- What is Biochemistry?
- About the biochemistry and its importance in life.
- Different areas in biochemistry
- Fundamentals of Carbohydrates, water, and vitamins.



## Paper-II-DSC-II Molecules of Life 2

### Objectives-

- This course introduces foundation of biochemistry
- Student will learn chemistry of water, amino acids, and Carbohydrates.

<b>Paper-II: -DSC-II MOLECULES OF LIFE 2</b>		
	<b>Credit—I</b>	
	<b>Amino Acids</b>  Definition, Nomenclature, Structure, and classification of amino acids: Neutral amino acids: - Glycine, Alanine, Valine, Leucine, Isoleucine Hydroxy amino acids - Serine, Threonine Sulphur containing amino acids - Cysteine, Methionine Aromatic amino acids - Phenylalanine, Tyrosine, Tryptophan Heterocyclic amino acids – Proline Acidic amino acids and its amides: Aspartic acid, Glutamic acid, Asparagine, Glutamine Basic amino acids: Lysine, Arginine, Histidine  Stereochemistry of amino acids Zwitterion and isoelectric pH Amino acid titration curve (Glycine and aspartic acid)	15
	<b>Credit—II</b>	
	<b>Proteins</b>  Definition, Classification (based on structure) Peptide bond and its nature. Structural studies of proteins – i) Primary structure ii) Secondary structure iii) Tertiary structure iv) Quaternary structure  Forces involved in maintaining different structural levels of proteins. Structure and function of oxytocin and myoglobin Techniques to isolate proteins- i) salt fractionation and ii) solvent fractionation,  Sequencing techniques–      i) Sanger, ii) Edman methods	15

**Learning Outcomes-**

Students should be able to understand

- Fundamentals of Biochemistry i.e., proteins.
- Structure, function, and types of amino acids.
- Classification, structure, and function of amino acids.

**Reference Books: -**

1. Nelson, D.L. and Cox, M. M. (2009). Lehninger`s Principles of Biochemistry.
2. Biochemistry - Lubert stryer.
3. Text book of Biochemistry and Human Physiology - G .P. Talwar.
4. Harper`s Review of Physiological Chemistry - H. A. Harper.
5. Fundamentals of Biochemistry - J. L.J ain.
6. Biochemistry - U. Satyanarayan.

## Minor Paper-I-Molecules of Life 1

### Objectives-

- To make students aware of fundamentals of Biochemistry.
- To make Students aware of biomolecules of living organism
- To introduce wide areas in Biochemistry

<b>Paper- I: - Minor -I MOLECULES OF LIFE 1</b>		
	<b>Credit – I</b>	
	<p><b>The foundations of biochemistry</b></p> <p>Definition of biochemistry and its importance.</p> <p>Overview of biomolecules and their significance.</p> <p><b>Water</b></p> <p>Molecular structure of water (H<sub>2</sub>O),</p> <p>Polarity of water molecules and hydrogen bonding,</p> <p>Unique properties, weak interactions in aqueous systems, ionization of water, water as a reactant and fitness of the aqueous environment</p> <p>Transport of nutrients, gases, and waste products in aqueous solutions.</p> <p><b>Vitamins</b></p> <p>Structure and active forms of water-soluble vitamins, deficiency diseases and symptoms, hypervitaminosis viz. Thiamine, Riboflavin, Niacin, Pyridoxine, Pantothenic acid</p>	15
	<b>Credit- II</b>	
	<p><b>Carbohydrates</b></p> <p>Definition, classification, and brief account of monosaccharides (aldoses and ketoses):</p> <p>Trioses – Glyceraldehyde, Dihydroxyacetone</p> <p>Tetroses – Erythrose, Erythrulose</p> <p>Pentoses – Ribose, Xylose, Ribulose, Xylulose</p> <p>Hexoses – Glucose, Fructose</p> <p>Conformations of glucose: alpha &amp; beta</p> <p>Disaccharides: Glycosidic bond, Maltose, Isomaltose, Lactose, Sucrose and Cellobiose</p> <p>Polysaccharides: Structure and biological role of Starch, Glycogen, Cellulose</p> <p>Mucopolysaccharides: Hyaluronic acid, Heparin</p>	15

### Learning Outcomes-

Students should be able to understand

- What is Biochemistry?
- About the biochemistry and its importance in life.
- Different areas in biochemistry

- Fundamentals of Carbohydrates, water, and vitamins.

## Minor Paper-II-Molecules of Life 2

### Objectives-

- This course introduces foundation of biochemistry
- Student will learn chemistry of water, amino acids, and Carbohydrates.

Paper-II: - Minor -II MOLECULES OF LIFE 2		
	Credit—I	
	<b>Amino Acids</b> Definition, Nomenclature, Structure, and classification of amino acids: Neutral amino acids: - Glycine, Alanine, Valine, Leucine, Isoleucine Hydroxy amino acids - Serine, Threonine Sulphur containing amino acids - Cysteine, Methionine Aromatic amino acids - Phenylalanine, Tyrosine, Tryptophan Heterocyclic amino acids – Proline Acidic amino acids and its amides: Aspartic acid, Glutamic acid, Asparagine, Glutamine Basic amino acids: Lysine, Arginine, Histidine Stereochemistry of amino acids Zwitterion and isoelectric pH Amino acid titration curve (Glycine and aspartic acid)	15
	Credit—II	
	<b>Proteins</b> Definition, Classification (based on structure) Peptide bond and its nature. Structural studies of proteins – i) Primary structure ii) Secondary structure iii) Tertiary structure iv) Quaternary structure Forces involved in maintaining different structural levels of proteins. Structure and function of oxytocin and myoglobin Techniques to isolate proteins- i) salt fractionation and ii) solvent fractionation, Sequencing techniques– i) Sanger, ii) Edman methods	15

**Learning Outcomes-**

Students should be able to understand

- Fundamentals of Biochemistry i.e., proteins.
- Structure, function, and types of amino acids.
- Classification, structure, and function of amino acids.

**Reference Books: -**

7. Nelson, D.L. and Cox, M. M. (2009). Lehninger's Principles of Biochemistry.
8. Biochemistry - Lubert stryer.
9. Text book of Biochemistry and Human Physiology - G .P. Talwar.
10. Harper's Review of Physiological Chemistry - H. A. Harper.
11. Fundamentals of Biochemistry - J. L.J ain.
12. Biochemistry - U. Satyanarayan.

### PAPER III DSC-III: - Molecules of Life 3

#### Objectives-

- This course introduces chemistry of lipids and nucleic acids.
- Student will learn identification and classification of biomolecules

<b>Paper-III DSC-III: - MOLECULES OF LIFE 3</b>		
	<b>Credit-I</b>	
	<p><b>Nucleic acids</b></p> <p>DNA as the carrier of genetic information</p> <p>Nitrogen bases, purines, pyrimidines, sugars (ribose and deoxyribos) phosphate</p> <p>Structure of nucleosides, nucleotides, and polynucleotide formation.</p> <p>Nucleic acid structure – Watson-Crick model of DNA.</p> <p>Types of genetic material, denaturation and renaturation, cot curves.</p> <p>Structure of major species of RNA -mRNA, tRNA and rRNA.</p> <p>Organelle DNA -- mitochondria and chloroplast DNA.</p> <p>Definition of a gene, organization of genes in viruses, bacteria, animals, and plants</p>	15
	<b>Credit- II</b>	
	<p><b>Lipids</b></p> <p>Definition and classification of lipids with two examples of each class</p> <p>Fatty acids – Properties, Classification, Essential &amp; non-essential fatty acids.</p> <p>A brief account of structure and functions of...</p> <p>I) Simple lipids: triglyceride and fatty acids</p> <p>II)Compound lipids: Phospholipids, viz. lecithin, cephalin, phosphatidylserine, sphingomyelin, glycolipids (cerebrosides &amp; gangliosides)</p> <p>Derived lipids: steroids (cholesterol).</p> <p>Lipid bilayer and Fluid mosaic model of membrane.</p>	15

#### Learning outcomes-

Students should gain knowledge about

- Basic concepts of foundation of biochemistry
- Chemistry of Biomolecules such as lipids and nucleic acid.

## PAPER IV DSC-IV – Biochemical Techniques 1

### Objectives-

- Students will acquire the skills necessary for accurate and precise measurements, sample preparation, and data analysis in a biochemical laboratory setting.
- Develop an understanding of fundamental laboratory techniques used in biochemistry, including spectrophotometry, chromatography, and electrophoresis.

PAPER IV DSC-IV– BIOCHEMICAL TECHNIQUES-1		
	Credit-I	
	<p><b>Buffers:</b></p> <p>pH and buffer: Hydrogen ion concentration, Handerson – Hasselbalch equation, Buffer- definition, Types &amp; its preparation, Buffers of biological importance such as carbonate-bicarbonate, phosphate, acetate, etc., Haemoglobin buffering capacity, Mechanism of action of buffers in biological system, pH meter –instrumentation and application.</p> <p><b>Electrophoresis:</b></p> <p>Definition of the terms: electrophoresis, electrophoretic mobility</p> <p>Factors affecting electrophoretic mobility</p> <p>Principle, technique and applications of Paper, PAGE and SDS –PAGE</p> <p>(The discussion should include preparation of mechanism of separation, important applications, and advantages of the method.)</p>	15
	Credit- II	
	<p><b>Chromatography:</b></p> <p>Definition Principle, technique, and applications of i) Paper ii) Thin layer, iii) Ion exchange, iv) Gel permeation chromatography</p> <p>(The discussion should include selection of matrix, preparation of plates, column packing, sample application, mechanism of separation, important applications, and advantages of each one of the methods)</p> <p><b>Absorption spectroscopy:</b></p> <p>Beer Lambert’s law, Limitations of Beer Lambert’s law</p> <p>Meaning of the term’s transmittance, absorbance, molar, and specific absorbance</p> <p>Construction, working and applications of i) colorimeter ii) uv spectrophotometer</p> <p>Advantages of spectrophotometer over colorimeter</p> <p>Absorption spectra of proteins, nucleic acids, cytochrome, and NAD+</p>	15

**Learning Outcomes-**

Students should gain knowledge about

- Buffer, preparations, and its mechanism
- Basic components of biochemical techniques.
- Methods of chromatography and electrophoresis.

**Reference books:-**

1. Nelson, D.L. and Cox, M. M. (2009). Lehninger`s Principles of Biochemistry
2. Biochemistry - Lubert Stryer.
3. Introduction to Chromatography theory and practice - Shrivastava.
4. Chromatography - B.K. Sharma.
5. Biophysical and biochemical technique: Nath and Upadhya
6. Fundamental of Biochemistry: A.C. Deb
7. Textbook of Biochemistry: Jain & Jain



## Practical syllabus

(Practical Examination to be conducted annually)

### I) Biochemistry Practical Course-I -

Sr No	Name of The Experiment
1	Fundamentals of Biochemical analysis
2	Demonstration of some lab equipment: - Colorimeter, Hot air Oven, Incubator, Centrifuge, Water bath, Water distillation unit.
3	<b>Separation methods:</b> Paper chromatographic separation & identification of amino acids from binary mixture.
4	<b>Isolations:</b> Isolation and characterization of starch from potatoes.
5.	<b>Colorimetric estimations:</b> <ul style="list-style-type: none"><li>• Verification of Beer Lambert's law and estimation of copper sulphate.</li><li>• Estimation of protein by Biuret method.</li><li>• Estimation of glucose from DNSA method.</li></ul>
<b>II) Practical Course - II</b>	
6.	<b>Volumetric Estimations:</b> Estimation of glycine by formal titration.
7.	Immobilization of baker's yeast cells by gel entrapment for invertase activity.
8.	Problems on DNA - RNA sequence, Genetic code
9.	<b>Qualitative Analysis</b> <ul style="list-style-type: none"><li>• Detection of Carbohydrates -Glucose, Starch.</li></ul>
10.	<b>Detection of enzymes (any two)</b> Urease, Amylase, Invertase, Phenol oxidase, Alkaline- Phosphatase.
11	<b>Demonstration Experiments</b> Extraction of lecithin from egg yolk.

### Practical outcome-

1. The students will get detailed and comprehensive knowledge on the various practical aspects of biochemical techniques.
2. The students will be able to analyze biochemically different biological samples.
3. Students will get practical knowledge regarding preparation of biochemically important buffers, estimating the biomolecules in each sample by using standard analytical techniques.

#### Books recommended for Practicals

- 1) Stains and Staining procedures by Desai and Desai.
- 2) Introduction to Practical Biochemistry by D. Plummer, J Wiley and Sons.
- 3) Bacteriological techniques by F. J.Baker.
- 4) Introduction to Microbial techniques by Gunasekaran.
- 5) Biochemical methods by Sadashivan and D.Manickam.
- 6) Laboratory methods in Biochemistry by J.Jayaraman.
- 7) Experimental Microbiology – Patel &Patel

#### List of the Laboratory equipment:

1. Colorimeter
2. pH meter
3. Electrophoresis apparatus
4. Computer with printer.
5. Water bath / Incubator
6. Mixer
7. Oven
8. Chemical balance / Single pan balance
9. Suction pump
12. Centrifuge machine
13. Heating mantle with magnetic stirrer
14. Soxhlet extraction apparatus.
15. Micropipettes
16. Glassware

#### Practical Examination

(A) The practical examination will be conducted on two consecutive days for three hours per day per batch of the practical examination.

(B) Each candidate must produce a certificate from the Head of the Department in her/his college, stating that he/she has completed in a satisfactory manner the practical course on lines laid down from time to time by Academic Council on the recommendations of Board of Studies and that the journal has been properly maintained. Every candidate must have recorded his/her observations in the laboratory journal and have written a report on each exercise performed. Every journal is to be checked and signed periodically by a member of teaching staff and certified by the Head of the Department at the end of the year. Candidates must produce their journals at the time of practical examinations.

Note:- At least 80% Practical should be covered in practical examination.

- **OTHER FEATURES:**

- (A) **LIBRARY:**

- References and Text Books, Journals and Periodicals, Reference Books. – List Attached

- (B) **LABORATORY SAFETY EQUIPMENTS:**

- 1) Fire extinguisher
    - 2) First aid kit
    - 3) Fumigation chamber
    - 4) Stabilized power supply
    - 5) Insulated wiring for electric supply.
    - 6) Good valves & regulators for gas supply.
    - 7) Operational manuals for instruments.
    - 8) Emergency exits

### PAPER III Minor -III: - Molecules of Life 3

#### Objectives-

- This course introduces chemistry of lipids and nucleic acids.
- Student will learn identification and classification of biomolecules

<b>Paper-III Minor -III: - MOLECULES OF LIFE 3</b>		
	<b>Credit-I</b>	
	<p><b>Nucleic acids</b></p> <p>DNA as the carrier of genetic information</p> <p>Nitrogen bases, purines, pyrimidines, sugars (ribose and deoxyribos) phosphate</p> <p>Structure of nucleosides, nucleotides, and polynucleotide formation.</p> <p>Nucleic acid structure – Watson-Crick model of DNA.</p> <p>Types of genetic material, denaturation and renaturation, cot curves.</p> <p>Structure of major species of RNA -mRNA, tRNA and rRNA.</p> <p>Organelle DNA -- mitochondria and chloroplast DNA.</p> <p>Definition of a gene, organization of genes in viruses, bacteria, animals, and plants</p>	15
	<b>Credit- II</b>	
	<p><b>Lipids</b></p> <p>Definition and classification of lipids with two examples of each class</p> <p>Fatty acids – Properties, Classification, Essential &amp; non-essential fatty acids.</p> <p>A brief account of structure and functions of...</p> <p>I) Simple lipids: triglyceride and fatty acids</p> <p>II)Compound lipids: Phospholipids, viz. lecithin, cephalin, phosphatidylserine, sphingomyelin, glycolipids (cerebrosides &amp; gangliosides)</p> <p>Derived lipids: steroids (cholesterol).</p> <p>Lipid bilayer and Fluid mosaic model of membrane.</p>	15

#### Learning outcomes-

Students should gain knowledge about

- Basic concepts of foundation of biochemistry
- Chemistry of Biomolecules such as lipids and nucleic acid.

## PAPER IV Minor-IV – Biochemical Techniques 1

### Objectives-

- Students will acquire the skills necessary for accurate and precise measurements, sample preparation, and data analysis in a biochemical laboratory setting.
- Develop an understanding of fundamental laboratory techniques used in biochemistry, including spectrophotometry, chromatography, and electrophoresis.

PAPER IV Minor -IV– BIOCHEMICAL TECHNIQUES-1		
	Credit-I	
	<p><b>Buffers:</b></p> <p>pH and buffer: Hydrogen ion concentration, Handerson – Hasselbalch equation, Buffer- definition, Types &amp; its preparation, Buffers of biological importance such as carbonate-bicarbonate, phosphate, acetate, etc., Haemoglobin buffering capacity, Mechanism of action of buffers in biological system, pH meter –instrumentation and application.</p> <p><b>Electrophoresis:</b></p> <p>Definition of the terms: electrophoresis, electrophoretic mobility</p> <p>Factors affecting electrophoretic mobility</p> <p>Principle, technique and applications of Paper, PAGE and SDS –PAGE</p> <p>(The discussion should include preparation of mechanism of separation, important applications, and advantages of the method.)</p>	15
	Credit- II	
	<p><b>Chromatography:</b></p> <p>Definition Principle, technique, and applications of i) Paper ii) Thin layer, iii) Ion exchange, iv) Gel permeation chromatography</p> <p>(The discussion should include selection of matrix, preparation of plates, column packing, sample application, mechanism of separation, important applications, and advantages of each one of the methods)</p> <p><b>Absorption spectroscopy:</b></p> <p>Beer Lambert’s law, Limitations of Beer Lambert’s law</p> <p>Meaning of the term’s transmittance, absorbance, molar, and specific absorbance</p> <p>Construction, working and applications of i) colorimeter ii) uv spectrophotometer</p> <p>Advantages of spectrophotometer over colorimeter</p> <p>Absorption spectra of proteins, nucleic acids, cytochrome, and NAD+</p>	15

### Learning Outcomes-

Students should gain knowledge about

- Buffer, preparations, and its mechanism
- Basic components of biochemical techniques.

- Methods of chromatography and electrophoresis.

**Reference books:-**

8. Nelson, D.L. and Cox, M. M. (2009). Lehninger`s Principles of Biochemistry
9. Biochemistry - Lubert Stryer.
10. Introduction to Chromatography theory and practice - Shrivastava.
11. Chromatography - B.K. Sharma.
12. Biophysical and biochemical technique: Nath and Upadhya
13. Fundamental of Biochemistry: A.C. Deb
14. Textbook of Biochemistry: Jain & Jain

## Practical syllabus

(Practical Examination to be conducted annually)

### Minor II-P-I

#### Biochemistry Practical Course-I -

Sr No	Name of The Experiment
1	Fundamentals of Biochemical analysis
2	Demonstration of some lab equipment's: - Colorimeter, Hot air Oven, Incubator, Centrifuge, Water bath, Water distillation unit.
3	<b>Separation methods:</b> Paper chromatographic separation & identification of amino acids from binary mixture.
4	<b>Isolations:</b> Isolation and characterization of starch from potatoes.
5.	<b>Colorimetric estimations:</b> <ul style="list-style-type: none"><li>• Verification of Beer Lambert's law and estimation of copper sulphate.</li><li>• Estimation of protein by Biuret method.</li><li>• Estimation of glucose from DNSA method.</li></ul>
<b>Practical Course - II</b>	
6.	<b>Volumetric Estimations:</b> Estimation of glycine by formal titration.
7.	Immobilization of baker's yeast cells by gel entrapment for invertase activity.
8.	Problems on DNA - RNA sequence, Genetic code
9.	<b>Qualitative Analysis</b> <ul style="list-style-type: none"><li>• Detection of Carbohydrates -Glucose, Starch.</li></ul>
10.	<b>Detection of enzymes (any two)</b> Urease, Amylase, Invertase, Phenol oxidase, Alkaline- Phosphatase.
11	<b>Demonstration Experiments</b> Extraction of lecithin from egg yolk.

#### Practical outcome-

4. The students will get detailed and comprehensive knowledge on the various practical aspects of biochemical techniques.
5. The students will be able to analyze biochemically different biological samples.
6. Students will get practical knowledge regarding preparation of biochemically important buffers, estimating the biomolecules in a given sample by using standard analytical techniques.

#### Books recommended for Practicals

- 8) Stains and Staining procedures by Desai and Desai.
- 9) Introduction to Practical Biochemistry by D. Plummer, J Wiley and Sons.
- 10) Bacteriological techniques by F. J.Baker.
- 11) Introduction to Microbial techniques by Gunasekaran.
- 12) Biochemical methods by Sadashivan and D.Manickam.
- 13) Laboratory methods in Biochemistry by J.Jayaraman.
- 14) Experimental Microbiology – Patel &Patel

#### List of the Laboratory equipment:

1. Colorimeter
10. pH meter
11. Electrophoresis apparatus
12. Computer with printer.
13. Water bath / Incubator
14. Mixer
15. Oven
16. Chemical balance / Single pan balance
17. Suction pump
16. Centrifuge machine
17. Heating mantle with magnetic stirrer
18. Soxhlet extraction apparatus.
19. Micropipettes
16. Glassware

#### Practical Examination

- The practical examination will be conducted on two consecutive days for three hours per day per batch of the practical examination.
- Each candidate must produce a certificate from the Head of the Department in her/his college, stating that he/she has completed in a satisfactory manner the practical course on lines laid down from time to time by Academic Council on the recommendations of
- Board of Studies and that the journal has been properly maintained. Every candidate must have recorded his/her observations in the laboratory journal and have written a report on each exercise performed. Every journal is to be checked and signed periodically by a member of teaching staff and certified by the Head of the Department at the end of the year. Candidates must produce their journals at the time of practical examinations.

Note:- At least 80% Practical should be covered in practical examination.



- **OTHER FEATURES:**

- **LIBRARY:**

- References and Text Books, Journals and Periodicals, Reference Books. – List Attached

- **LABORATORY SAFETY EQUIPMENTS:**

- 9) Fire extinguisher

- 10) First aidkit

- 11) Fumigation chamber

- 12) Stabilized power supply

- 13) Insulated wiring for electric supply.

- 14) Good valves & regulators for gas supply.

- 15) Operational manuals for instruments.

- 16) Emergency exits

## SEC-I Clinical Biochemistry -I

### Objectives-

- Develop a comprehensive understanding of the principles and methods used in clinical biochemistry laboratories for the analysis of blood, urine, and other body fluids.
- Apply biochemical concepts to the diagnosis, monitoring, and management of diseases. Understand the biochemical basis of various pathological conditions.
- Learn to correlate biochemical findings with clinical signs and symptoms to facilitate accurate diagnosis and patient management.

SEC-I Clinical Biochemistry -I		
	Credit-I	
	<p><b>Introduction</b> Organization of clinical laboratory, Introduction to instrumentation and automation in clinical biochemistry laboratories safety regulations and first aid. General comments on specimen collection, types of specimen for biochemical analysis. Precision, accuracy, quality control, precautions and limitations.</p> <p><b>Evaluation of biochemical changes in diseases</b> Basic hepatic, renal and cardiovascular physiology. Biochemical symptoms associated with disease and their evaluation. Diagnostic biochemical profile.</p> <p><b>Assessment of glucose metabolism in blood</b> Clinical significance of variations in blood glucose. Diabetes mellitus.</p>	15
	Credit- II	
	<p><b>Lipid profile</b> Composition and functions of lipoproteins. Clinical significance of elevated lipoprotein.</p> <p><b>Liver function tests</b></p> <p><b>Renal function tests and urine analysis</b> Use of urine strip / dipstick method for urine analysis.</p> <p><b>Tests for cardiovascular diseases</b> Involvement of enzymes in diagnostics of heart disease including aspartate transaminase, isoenzymes of creatine kinase and lactate dehydrogenase and troponin.</p>	15

### Learning Outcomes-

Students should gain knowledge about

- About conducting a range of biochemical tests commonly used in clinical settings with accuracy and precision.
- About to apply their knowledge of biochemical principles to diagnose and monitor diseases.
- The ability to select appropriate biochemical tests based on clinical scenarios, interpret results, and provide meaningful insights into patient conditions.

## **SUGGESTED READINGS**

1. Medical Laboratory Technology - a Procedure Manual for Routine Diagnostic Tests Vol. I (2010), Mukherjee, K.L., Tata Mc Graw–Hill Publishing Company Limited (New Delhi). ISBN:9780070076594 / ISBN:9780070076631
2. Medical Laboratory Technology - a Procedure Manual for Routine Diagnostic Tests Vol. II (2010), Mukherjee, K.L., Tata Mc Graw – Hill Publishing Company Ltd. (New Delhi), ISBN: 9780070076648.
3. Medical Biochemistry (2005) 2nd ed., Baynes, J.W. and Dominiczak, M.H., Elsevier Mosby Ltd. (Philadelphia), ISBN:0-7234-3341-0.
4. Experimental Biochemistry: A Student Companion (2005) Rao, B.S. and Deshpande, V., IK International Pvt. Ltd. (New Delhi), ISBN:81-88237-41-8.
- 5.
- 6.
- 7.

**Practical syllabus**

**(Practical Examination to be conducted annually)**

**SEC-Pract. -I**

**Clinical Biochemistry Practical -I**

<b>SEC-Pract. -I</b>		
	<b>Credit-I</b>	
	<ol style="list-style-type: none"><li>1. Collection of blood and storage.</li><li>2. Separation and storage of serum.</li><li>3. Estimation of blood glucose by glucose oxidase peroxidase method.</li><li>4. Estimation of triglycerides.</li></ol>	
	<b>Credit-II</b>	
	<ol style="list-style-type: none"><li>1. Estimation of bilirubin (direct and indirect).</li><li>2. Quantitative of serum creatinine and urea determination.</li><li>3. Estimation of creatine kinase MB.</li><li>4. Estimation of blood glucose by DNSA peroxidase method</li></ol>	

## SEC-II Biochemical Techniques-I

### Objectives-

- Students will acquire the skills necessary for accurate and precise measurements, sample preparation, and data analysis in a biochemical laboratory setting.
- Develop an understanding of fundamental laboratory techniques used in biochemistry, including spectrophotometry, chromatography, and electrophoresis.

SEC-II Biochemical Techniques-I		
	Credit-I	
	<b>Biochemical reagents and solutions</b> Safety practices in the laboratory. Preparation and storage of solutions. Concepts of solution concentration and storing solutions. Quantitative transfer of liquids. Concept of a buffer, Henderson-Hasselbach equation, working of a pH meter.	15
	Credit- II	
	<b>Spectrophotometric techniques</b> Principle and instrumentation of UV-visible and fluorescence spectroscopy.  <b>Introduction and importance of virtual labs in biochemistry</b>	15

### Learning Outcomes-

Students should gain knowledge about

- Buffer, preparations, and its mechanism
- Basic components of biochemical techniques.
- Methods of chromatography and electrophoresis.

### SUGGESTED READINGS

1. Physical Biochemistry: Principles and Applications (2010) 2nd ed., Sheehan, D., Wiley Blackwell (West Sussex), ISBN:978-0-470-85602-4 / ISBN:978-0-470-85603-1.
1. Physical Biochemistry: Applications to Biochemistry and Molecular Biology (1982) 2nd ed., Freifelder, D., W.H. Freeman and Company (New York), ISBN:0-7167-1315-2 / ISBN:0-7167-1444-2.
2. An Introduction to Practical Biochemistry (1998) 3rd ed., Plummer D. T., Tata McGraw Hill Education Pvt. Ltd. (New Delhi), ISBN:13: 978-0-07-099487-4 / ISBN:10: 0-07-099487-0.

## SEC-Pract. -I Biochemical Techniques-I

SEC-II Biochemical Techniques-I		
	<b>Credit-I</b>	
	<ol style="list-style-type: none"><li>1. Preparation of a buffer of given pH and molarity.</li><li>2. Determination of the absorption maxima and molar extinction coefficient (of a relevant organic molecule).</li><li>3. Paper chromatography</li><li>4. Thin Layer Chromatography (TLC)</li><li>5. Protein estimation by UV-VIS spectroscopy</li></ol>	
	<b>Credit- II</b>	
	<ol style="list-style-type: none"><li>1. Measurement of fluorescence spectrum.</li><li>2. Column chromatography</li><li>3. Ion exchange chromatography</li><li>4. Determination of concentration of a protein solution by Lowry/BCA method</li></ol>	

## OE-I (T) Infectious diseases-I

### Objectives-

- Develop a comprehensive understanding of various infectious agents, including bacteria, viruses, fungi, and parasites.
- Understand the principles of infectious disease epidemiology, including the spread, transmission routes, and risk factors associated with different pathogens.
- Gain proficiency in the laboratory and clinical methods used for the diagnosis of infectious diseases.

OE-I (T) Infectious diseases-I		
	<b>Credit-I</b>	
	<b>Classification of infectious agents</b> Bacteria, Viruses, protozoa and fungi. Past and present emerging and re-emerging infectious diseases and pathogens. Source, reservoir and transmission of pathogens, Antigenic shift and antigenic drift. Host parasite relationship, types of infections associated with parasitic organisms. Overview of viral and bacterial pathogenesis. Infection and evasion.	15
	<b>Credit- II</b>	
	<b>Overview of diseases caused by bacteria</b> Detailed study of tuberculosis: History, causative agent, molecular basis of host specificity, infection and pathogenicity, Diagnostics, Therapeutics, inhibitors, and vaccines. Drug resistance and implications on public health. Other bacterial diseases including Typhoid, Diphtheria, Pertussis, Tetanus, Typhoid and Pneumonia.	15

### Learning Outcomes-

Students should gain knowledge about

- able to make informed decisions about infectious disease prevention strategies, including vaccination, vector control, and public health measures
- Demonstrate the ability to critically analyze and communicate information about emerging infectious threats.

## OE-II (T) Infectious diseases-II

### Objectives-

- Understand the principles of infectious disease epidemiology, including the spread, transmission routes, and risk factors associated with different pathogens.
- Analyze the impact of social, environmental, and behavioral factors on the transmission and prevalence of infectious diseases.
- Explore the principles of diseases caused by Viruses and bacteria viz AIDS and Malaria.

OE-II (T) Infectious diseases-II		
	<b>Credit-I</b>	
	<b>Overview of diseases caused by Viruses</b> Detailed study of AIDS, history, causative agent, pathogenesis, Diagnostics, Drugs and inhibitors. Other viral diseases including hepatitis, influenza, rabies, chikungunya and polio.	15
	<b>Credit- II</b>	
	<b>Overview of diseases caused by bacteria</b> Detailed study of Malaria, history, causative agents, Vectors, life cycle, Host parasite interactions, Diagnostics, Drugs and Inhibitors, Resistance, Vaccine development. Other diseases including leishmaniasis, amoebiasis.	15

### Learning Outcomes-

Students should gain knowledge about

- able to make informed decisions about infectious disease prevention strategies, including vaccination, vector control, and public health measures
- Demonstrate the ability to critically analyze and communicate information about emerging infectious threats.



### OE-III (T) Non-Infectious diseases-I

#### Objectives-

- Equip students with knowledge about preventive strategies for non-infectious diseases, focusing on lifestyle modifications, health promotion, and public health interventions.
- Explore the role of risk factors such as diet, physical inactivity, genetics, and environmental exposures in the development of non-infectious diseases.
- Understand diagnostic methods used in identifying non-infectious diseases, including medical imaging and laboratory tests.

OE-III (T) Non-Infectious diseases-I		
	Credit-I	
	<b>Nutritional disorders</b> Overview of major and minor nutrient components in the diet. Balanced diet and the concept of RDA. Nutrient deficiencies; Kwashiorkor and Marasmus, Scurvy, beri beri, pellagra and B12 deficiency, Xerophthalmia and Night blindness, Vitamin D deficiency, Vitamin K deficiency. Discuss with relation to biochemical basis for symptoms.	15
	Credit- II	
	<b>Overview of diseases caused by bacteria</b> Obesity and eating disorders like Anorexia nervosa and Bulimia. Diabetes mellitus A metabolic syndrome and the relationship with hypertension, obesity, hypothyroidism, and stress. Cardio vascular disorders and Atherosclerosis-defining the broad spectrum of ailments that fall in this category, understanding the factors that contribute to the syndrome, stages of disorder and the management of the condition. Irritable bowel syndrome- biochemistry behind the disorder and the influence of diet, stress, and environment on the condition.	15

#### Learning Outcomes-

Students should gain knowledge about

- to advocate for health promotion and disease prevention strategies, both at an individual and community level.
- Demonstrate an understanding of the social determinants of health and their impact on the development of non-infectious diseases.

## OE-IV (T) Non-Infectious diseases-II

### Objectives-

- Develop a deep understanding of the etiology of non-infectious diseases, including genetic, environmental, and lifestyle factors.
- Understand non-infectious diseases e.g. Cancer and Diseases due to misfolded proteins

OE-IV (T) Non-Infectious diseases-II		
	<b>Credit-I</b>	
	<b>Multifactorial complex disorders and Cancer</b> Understanding the definition of multifactorial diseases. Polygenic diseases and the relationship of environmental factors and genetic makeup in the onset of diseases. Cancer: characteristics of a transformed cell, causes and stages of Cancer, molecular basis for neoplastic growth and metastasis, Proto-oncogenes and tumor suppressor genes; Cancer causing mutations; Tumor viruses; Biochemical analysis of cancer; Molecular approaches to cancer treatment. Disorders of mood : Schizophrenia, dementia and anxiety disorders. Polycystic ovarian syndrome, Parkinson's disease, ALS.	15
	<b>Credit- II</b>	
	<b>Diseases due to misfolded proteins</b> Introduction to protein folding and proteasome removal of misfolded proteins; etiology and molecular basis for Alzheimer's, Prion diseases, Huntington's Chorea, sickle cell anemia, Thalassemia.	15

### Learning Outcomes-

Students should gain knowledge about

- The importance of interdisciplinary collaboration in managing and preventing non-infectious diseases
- The common diseases like Alzheimer's, Prion diseases, Huntington's Chorea, sickle cell anemia, Thalassemia.

**Nature of Question Paper for B.Sc. Part – I (40 + 10 Pattern) according to  
Revised Structure  
as Per NEP – 2020 to be implemented from academic year 2024-25**

**Maximum Marks: 40**

**Duration: 2 hrs.**

**Q. 1 Select the most correct alternate from the following [8]**

i) to viii) MCQ one mark each with four options

A)                      B)                      C)                      D)

**Q.2 Attempt any TWO of the following [16]**

A)

B)

C)

**Q. 3 Attempt any FOUR of the following [16]**

a)

b)

c)

d)

e)

f)

---XXX---