

**As Per NEP 2020**

University of Mumbai



**Title of the program**

- A-** U.G. Certificate in Biochemistry
- B-** U.G. Diploma in Biochemistry
- C-** B.Sc. (Biochemistry)
- D-** B.Sc. ( Hons.) in Biochemistry
- E-** B.Sc. (Hons. with Research) in Biochemistry

**Syllabus for Semester – Sem I & II (Scheme – III)**

**Ref: GR dated 20<sup>th</sup> April, 2023 for Credit Structure of UG  
(With effect from the academic year 2024-25 Progressively)**

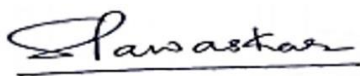
University of Mumbai



(As per NEP 2020)

Sr. No.	Heading	Particulars	
1	<b>Title of program</b>	A	<b>U.G. Certificate in Biochemistry</b>
	O: _____A		
	O: _____B	B	<b>U.G. Diploma in Biochemistry</b>
	O: _____C	C	<b>B.Sc. (Biochemistry)</b>
	O: _____D	D	<b>B.Sc. (Hons.) in Biochemistry</b>
O: _____E	E	<b>B.Sc. (Hons. with Research) in Biochemistry</b>	
2	<b>Eligibility</b>	A	A candidate for being eligible to the degree course of Bachelor of Science should have passed XII standard examination of the Maharashtra Board of Higher Secondary Education or its equivalent in Science with Biology as one of the subjects. OR Passed Equivalent Academic Level 4.0
	O: _____A		
	O: _____B	B	Under Graduate Certificate in Biochemistry Academic Level 4.5
	O: _____C	C	Under Graduate Diploma in Biochemistry Academic Level 5.0
	O: _____D	D	Bachelors of Biochemistry with minimum CGPA of 7.5 Academic Level 5.5
O: _____E	E	Bachelors of Biochemistry with minimum CGPA of 7.5 Academic Level 5.5	
3	<b>Duration of program R: _____</b>	A	One Year
		B	Two Years
		C	Three Years
		D	Four Years

		<b>E</b>	Four Years
<b>4</b>	<b>Intake Capacity R:</b> _____		
<b>5</b>	<b>Scheme of Examination</b> <b>R:</b> _____	NEP 40% Internal 60% External, Semester End Examination Individual Passing in Internal and External Examination	
<b>6</b>	<b>R:</b> _____ <b>Standards of Passing</b>	40% in each component.	
<b>7</b>	<b>Credit Structure</b> <b>Sem. I - R:</b> _____ <b>A</b> <b>Sem. II - R:</b> _____ <b>B</b>	Attached herewith	
	<b>Credit Structure</b> <b>Sem. III - R:</b> _____ <b>C</b> <b>Sem. IV - R:</b> _____ <b>D</b>		
	<b>Credit Structure</b> <b>Sem. V - R:</b> _____ <b>E</b> <b>Sem. VI - R:</b> _____ <b>F</b>		
<b>8</b>	<b>Semesters</b>	<b>A</b>	Sem I & II
		<b>B</b>	Sem III & IV
		<b>C</b>	Sem V & VI
		<b>D</b>	Sem VII & VIII
		<b>E</b>	Sem VII & VIII
<b>9</b>	<b>Program Academic Level</b>	<b>A</b>	4.5
		<b>B</b>	5.0
		<b>C</b>	5.5
		<b>D</b>	6.0
		<b>E</b>	6.0
<b>10</b>	<b>Pattern</b>	Semester	
<b>11</b>	<b>Status</b>	New	
<b>12</b>	<b>To be implemented from Academic Year Progressively</b>	From Academic Year: 2024-25	



Sign of the BOS Chairman  
Prof. Dr. Samidha M  
Pawaskar  
Biochemistry

Sign of the  
Offg. Associate Dean  
Dr. Madhav R. Rajwade  
Faculty of Science &  
Technology

Sign of the  
Offg. Dean  
Prof. Shivram S. Garje  
Faculty of Science &  
Technology

## Preamble

### 1) Introduction

Biochemistry is central to all areas of the “biological” and “life” science. It aims to provide an understanding of every aspect of the structure and function of living things at cellular level.

Being an interdisciplinary subject it is spanning a wide range of areas from microbiology to plant and animal sciences to pathology of diseases and nutrition. The impact of studies in biochemistry on modern life is enormous. Therefore, the syllabus is structured to touch upon broad base at the beginning. Unique physical and chemical characteristics of water enable it to function in ways essential to human and other life processes due to its structure and composition. Life on Earth began more than 3 billion years ago, evolving from the most basic of microbes into a dazzling array of complexity over time, which makes it necessary to study the origin of life and evolution of a modern species over span of years. After an in-depth understanding of how the first cells originated, students are introduced to detailed structural organization of basic unit of a living system “The Cell”. Biomolecules are the basic and important constituents of a living system. Hence, it is mandatory to study structure, occurrence and functions of large biomolecules like carbohydrates, lipids and proteins along with nucleic acids. In order to prepare the students for detailed course in Applied Nutrition in the higher education, the syllabus is made to understand human nutrition and its significance. In order to understand the biological processes occurring in the living body, processes as digestion, absorption, respiration and excretion are necessary to be studied. As stated earlier, life evolved from a small microbe, it is our aim to study living microscopic size organisms which include bacteria, fungi, protozoa and special type of microorganisms called extremophiles

### 2) Aims and Objectives

- Develop an adequate background to enable the first year students to study more advanced biochemistry topics.
- Acquaint the learners with the unique properties of the universal solvent - water, essential for life processes.
- Understand the life constituting bio molecules: proteins, carbohydrates, lipids, nucleic acids.
- Familiarize the learners about the origin of life and take them through the process of evolution.
- Focus on Cell as the basic unit of life which is the center for all biochemical processes.
- Familiarize the learners to the world of microorganisms which exist as independent cellular units.
- Appreciate the importance of the broad spectrum of biochemistry.
- Provide familiarity with basic biochemistry laboratory techniques.
- Develop the practical skills of students to enhance their observational skills and to
- use these skills for problem solving.

### 3) Learning Outcomes

After the successful completion of modules in different courses of B.Sc. Biochemistry, the learner will be able to:

PLO I: Strengthen the base in fundamental aspects of Biochemistry viz. Bio-organic and Biophysical Chemistry, Metabolism, Nutrition and Advanced Biochemical concepts viz., Genetics and Genetic engineering, Immunology, etc.

PLO II: sharpen practical skills in performing experiments involving latest protocols.

PLO III: gain competence for gainful employment in industry, research-oriented career and qualifying examinations.

PLO IV: To develop scientific temper and interest by exposure through Internet, computers, various databases, industrial visits and study/educational tours.

PLO V: To develop independent approach to design and implement a scientific study in the field

PLO VI: apply this knowledge to the greater benefit of the society at large; through public engagement via presentations and outreach activities.

#### **4) Credit Structure of the Program (Sem I, II, III, IV, V & VI)**

### 5) Under Graduate Certificate in Biochemistry

#### Credit Structure (Sem. I & II)

R: _____ A											
Level	Semester	Major		Minor	OE	VSC, SEC (VSEC)	AEC, VEC, IKS	OJT, FP, CEP, CC,RP	Cum. Cr. / Sem.	Degree/ Cum. Cr.	
		Mandatory	Electives								
4.5	I	2 Basic molecules of Life		-		VSC:2,  Microscopy and Colorimetry	AEC:2, VEC:2,I KS:2		22	UG Certificate 44	
	R: _____ B										
	II	2 Introduction to Lipids and Nucleic acids			2  Blood and blood disorder s	VSC:2,  Microscopy and Colorimetry	AEC:2,	CC:2	22		
	Cum Cr.	8	-		2	4+4	4+2+2	2	44		

**Exit option: Award of UG Certificate in Major with 40-44 credits and an additional 4 credits core NSQF course/ Internship  
OR Continue with Major and Minor**

## Under Graduate Diploma in Biochemistry

### Credit Structure (Sem. III & IV)

R: _____ C										
Level	Semester	Major		Minor	OE	VSC, SEC (VSEC)	AEC, VEC, IKS	OJT, FP, CEP, CC,RP Related to core	Cum. Cr. / Sem.	Degree/ Cum. Cr.
		Mandatory	Electives							
5.0	III	2 Enzymology		2 Enzymology	2 + 2	SEC:2, Centrifugation and Electrophoresis	AEC:2	CC:2 CEP/FP: 2	22	UG Diploma 88
		2 Origin of Life and Basic Concepts of Cell ultrastructure		2 Practical based on minor	Heart Health					
		2 Practical 3 based on Core course I & II								
R: _____ D										
	IV	2 Genetics		2 Genetics	2 + 2	VSC:2 Purification techniques	VEC:2	CC:2 CEP/FP: 2	22	
		2 Cell biology and Mendelian Genetics		2 Practical based on minor	Liver health Understa nding Diabetes Mellitus					
		2 Practical 4: based on Core course I & II								
	<b>Cum Cr.</b>	20			10	6+6	6+4+2	6+4	88	
<p align="center"><b>Exit option; Award of UG Diploma in Major and Minor with 80-88 credits and an additional 4 credits core NSQF course/ Internship OR Continuewith Major and Minor</b></p>										

## B.Sc. (Biochemistry)

### Credit Structure (Sem. V & VI)

R: _____ E										
Level	Semester	Major		Minor	OE	VSC, SEC (VSEC)	AEC, VEC, IKS	OJT, FP, CEP, CC,RP Related to core	Cum. Cr. / Sem.	Degree/ Cum. Cr.
		Mandatory	Electives							
5.5	V	2 Macro and Micro nutrients of diet		2 Introductio n to metabolis m		VSC: 2  Chromatogra phy & Radioactivity		CC:2  CEP/FP:  2	22	UG Degree 132
		2 Food calorimetry and other nutritional concepts								
		2 Biophysical chemistry								
		2 Human Physiology								
		2 Metabolism (Carbohydrates and Energetics)								
		2 Practical 5								
		2 Practical 6								
R: _____ F										
	VI	2 Plant Biochemistry						OJT :4	22	
		2 Lipid and Protein metabolism								
		2 Endocrinology								
		2 Genetic engineering and RDT								
		2 Immunology								



		2 Introduction to Biostatistics and Bioinformatics								
		2 Principles of Pharmacology								
		2 Practical 7								
		2 Practical 8								
	<b>Cum Cr.</b>	52		18	10	6+6+2	6+4+2	8+6+4	132	
<b>Exit option: Award of UG Degree in Major with 132 credits OR Continue with Major and Minor</b>										

**[Abbreviation - OE – Open Electives, VSC – Vocation Skill Course, SEC – Skill Enhancement Course, (VSEC), AEC – Ability Enhancement Course, VEC – Value Education Course, IKS – Indian Knowledge System, OJT – on Job Training, FP – Field Project, CEP – Continuing Education Program, CC – Co-Curricular, RP – Research Project ]**

Major Courses

Yr	Sem	T/P	Course Title	Credits	Hours	Total Credits
1	I	T	Basic molecules of Life	2	30	4
		P	Practical 1 based on Core course I and II	2	60	
	II	T	Introduction to Lipids and Nucleic acids	2	30	4
		P	Practical 2 based on Core course I and II	2	60	
2	III	T	Enzymology	2	30	6
		T	Origin of Life and Basic Concepts of Cell ultrastructure	2	30	
		P	Practical 3 based on Core course I,II & III	2	60	
	IV	T	Genetics	2	30	6
		T	Cell biology and Mendelian Genetics	2	30	
		P	Practical 4: based on Core course I,II & III	2	60	
3	V	T	Macro and Micro nutrients of diet (Carbohydrate +Bioenergetics)	2	30	14
		T	Food calorimetry and other nutritional concepts	2	30	
		T	Biophysical chemistry	2		
		T	Endocrinology	2	30	
		T	Human Physiology	2		
		P	Practical 5	2	60	
		P	Practical 6	2	60	
	VI	T	Plant Biochemistry	2	30	18
		T	Lipid and Protein metabolism	2	30	
		T	Endocrinology	2	30	
		T	Genetic engineering and RDT	2	30	
		T	Immunology	2	30	
		T	Introduction to Biostatistics and Bioinformatics	2	30	
		T	Principles of Pharmacology	2	30	
P	Practical 7	2	60			
P	Practical 8	2	60			

Yr: Year      Sem: Semester      T: Theory      P: Practical

**SEMESTER - I**

<b>Course – I: Basic molecules of life</b>			
<b>Course I</b>	<b>Module</b>	<b>Topics</b>	<b>Credits</b>
	I	Water and Carbohydrates	2
	II	Amino acids and Proteins	

<b>Course Practical</b>	<b>Practical 1 based on Course I and Course II</b>	<b>Credits</b> 2
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**SEMESTER - II**

<b>Course – I: Introduction to Lipids and Nucleic acids</b>			
<b>Course I</b>	<b>Module</b>	<b>Topics</b>	<b>Credits</b>
	I	Lipids	2
	II	Nucleic acids	

<b>Course Practical</b>	<b>Practical 2 based on Course I and Course II</b>	<b>Credits</b> 2
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<b>Vocational Skill Course: Microscopy and Colorimetry</b>			
<b>Course VSC</b>	<b>Module</b>	<b>Topics</b>	<b>Credits</b>
	I	Microscopy and Colorimetry	2

<b>Skill Enhancement Course: Instrumentation techniques</b>			
<b>Course SEC</b>	<b>Module</b>	<b>Topics</b>	<b>Credits</b>
	I	Applications of Microscopy and Colorimetry	2

# **Sem. - I**

## Syllabus

### F.Y. B. Sc. (BIOCHEMISTRY) SEMESTER I

#### COURSE TITLES:

#### Course 1: Basic molecules of life [2 Credits]

Sr.No.	Heading	Particulars	
1	<b>Description the course :</b> <b>Including but not limited to:</b>	This course describes the importance of the basic molecules of life.	
2	<b>Vertical :</b>	Major	
3	<b>Type :</b>	Theory	
4	<b>Credits :</b>	2 credits ( 1 credit = 15 Hours Theory in a semester )	
5	<b>Hours Allotted :</b>	30 Hours	
6	<b>Marks Allotted:</b>	50 Marks	
<b>Course – I Basic molecules of life</b>			
<b>Course Learning Objective and Outcome</b>			
<b>Learning Objective:</b>			
1) This course is intended to provide students with a basic understanding of the chemical nature and properties of biomolecules. i.e Water, Carbohydrates, Amino acids and proteins			
<b>Learning Outcomes:</b>			
2) The learner will be able to describe properties of water and its interaction with other biomolecules.			
3) The learner will be able to describe the classification, reactions and biochemical importance of biomolecules like carbohydrates, amino acids and proteins			
4) The learner will be able to explain the classification, structures of proteins including the forces stabilizing the protein structures			
Module	Topics	Credits	Lectures
<b>I</b>	<b>Module I : Water and Carbohydrates</b>  <b>Water</b> <ul style="list-style-type: none"> <li>• Effect of water on Biomolecules</li> <li>• Structure and properties of water (hydrogen bonding)</li> <li>• Entropy and dissolution of solute</li> <li>• Effect of non-polar compounds on the structure of water</li> <li>• Weak interactions of biomolecules in aqueous solutions</li> <li>• Concepts of mole, molar, molar equivalent and normal,</li> <li>• Dissociation and Ionic product of water</li> </ul>	2	15

	<p><b>Carbohydrates:</b></p> <ul style="list-style-type: none"> <li>• Monosaccharides –Definition and classification of carbohydrates (mono, oligo and poly), classification of monosaccharides in terms of – A) aldoses and ketoses. B) Number of carbon atoms.</li> <li>• Reactions of monosaccharides –       <ol style="list-style-type: none"> <li>1) Oxidation to produce aldonic, aldaric and Uronic acid (only w.r.t glucose),</li> <li>2) Osazone (only w.r.t glucose and fructose),</li> <li>3) Reducing action of sugar in boiling alkaline medium (enediol formation) -only w.r.t glucose and fructose,</li> </ol> </li> <li>Disaccharides - Occurrence and structure of maltose, lactose, sucrose.</li> <li>• Polysaccharides- Classification based on function (storage and structural), composition (homo and hetero) giving examples. Storage polysaccharides (Starch and Glycogen), action of amylases on starch.</li> <li>• Structural polysaccharides – Cellulose, Chitin (Structure and biochemical importance).</li> </ul>		
II	<p><b>Module II : Amino acids and Proteins</b></p> <p><b>Amino acids:</b></p> <ul style="list-style-type: none"> <li>• Classification of amino acids based on the polarity of R-groups (structure of 20 amino acids).</li> <li>• Chemical reactions of amino acids with following reagents –Ninhydrin, Sanger’s, Edman’s, Dansyl chloride.</li> <li>• Cleavage of polypeptide - Trypsin, Chymotrypsin, Pepsin, Aminopeptidase, Carboxypeptidase</li> </ul> <p><b>Proteins:</b></p> <ul style="list-style-type: none"> <li>• ASBC-APS classification on the basis of shape and function.</li> <li>• Formation and characteristics of peptide bond.</li> <li>• Primary structure, Secondary structure-alpha helix and beta sheet, Tertiary and Quaternary structure</li> <li>• Forces stabilizing protein structure. Protein denaturation.</li> </ul>		15

**F.Y. B. Sc. (BIOCHEMISTRY) SEMESTER I**  
**COURSE TITLE: Practicals based on Course I and Course II**  
**[CREDITS - 02]**

**Practicals based on Course I and Course II**

**Course Learning Objective and Outcome**

**Learning Objective:**

- 1) This course is intended to provide students with a basic understanding of the several concepts associated with practical Biochemistry

**Learning Outcomes:**

- 1) The learner will be able to understand and explain the use of various laboratory glassware and instruments
- 2) The learner will be able to calculate and makes solutions/reagents of different concentrations
- 3) The learner will be able to demonstrate the detection of the carbohydrates using qualitative methods
- 4) The learner will be able to explain about different cellular

Practical	Topics	Credits	Hours
<b>I</b>	<ol style="list-style-type: none"> <li>1. Good laboratory practices: Lab safety and introduction to common laboratory glassware and instruments</li> <li>2. Use of digital analytical weighing balance</li> <li>3. Validation of glass and micropipettes</li> <li>4. Preparation of solutions of different concentrations               <ol style="list-style-type: none"> <li>a. Concepts of w/v, v/v, percentage, ppm, ppb, moles/L, molarity, molality, normality</li> <li>b. Preparation and verification of solutions of desired strengths</li> </ol> </li> <li>5. Qualitative Analysis: Carbohydrates - Glucose, Fructose, Maltose, Lactose, Sucrose, Starch, Dextrin.</li> <li>6. Use of low power lenses and high power objectives to observe plant and animal cells and Use of oil immersion lens to observe bacteria</li> </ol>	2	60

# **Sem. – II**



**F.Y. B. Sc. (BIOCHEMISTRY) SEMESTER II**  
**COURSE TITLES:**  
**Course 1: Introduction to Lipids and Nucleic acids [2 Credits]**

Sr.No.	Heading	Particulars	
1	<b>Description the course : Including but not limited to:</b>	This course describes the importance of Lipids, Nucleic acids, Cell Biology and Mendelian genetics .	
2	<b>Vertical :</b>	Major	
3	<b>Type :</b>	Theory	
4	<b>Credits :</b>	2 credits (1 credit = 15 Hours Theory in a semester )	
5	<b>Hours Allotted :</b>	30 Hours	
6	<b>Marks Allotted:</b>	50 Marks	

**Course – I Introduction to Lipids and Nucleic acids**

**Course Learning Objective and Outcome**

**Learning Objective:**

1. This course is intended to provide students with a basic understanding of the chemical nature and properties of biomolecules. i.e Lipids and Nucleic acids

**Learning Outcomes:**

1. The learner will be able to describe the classification, reactions and biochemical importance of Lipids
2. The learner will be able explain different types ,structures, properties and reactions of nucleic acids

Module	Topics	Credits	Lectures
I	<b>Module II : Lipids</b> <ul style="list-style-type: none"> <li>• Definition and Bloor's Classification of lipids.</li> <li>• Fatty acids and TAG: Saturated fatty acids – definition, classification of C2 and C20 (only even C chain fatty acids) Unsaturated fatty acids – MUFA, PUFA (2,3,4 double bonds), Omega - 3, Omega - 6 and Omega - 9 fatty acids.</li> <li>• Triacylglycerol - Simple and mixed.</li> <li>• Chemical reactions - Saponification, Iodination, Ozonolysis, Auto-oxidation, Phospholipases, action of heat on glycerol and choline, Rancidity of fats.</li> <li>• Definition and significance - Acid Number, Saponification Number, Iodine Number and Reichert-Meissel Number.</li> <li>• Compound lipids – Structure and function of Glycerophospholipids (Cephalin, Lecithin and Phosphotidyl inositol)</li> </ul>	2	15

	<p>Phosphosphingolipids (Ceramide, Sphingomyelin), Glycolipids or Cerebrocides (Galacto and Glucocerebrocides).</p> <ul style="list-style-type: none"> <li>• Steroids and Lipoproteins</li> </ul>	
<b>II</b>	<p><b>Module II: Nucleic acids</b> Nucleic Acids:</p> <ul style="list-style-type: none"> <li>• Structure of purine and pyrimidine bases, ribose, deoxyribose, nucleosides and nucleotides. c AMP and formation of polynucleotide strand with its shorthand representation.</li> <li>• RNAs- (various type in pro and eukaryotes) rRNA, t- RNA (Clover – leaf model), m-RNA (general account) and action of alkali on RNA.</li> <li>• DNA-X-ray diffraction pattern (Physical evidence),</li> <li>• Chargaff's rules (Chemical evidence), Watson –Crick model of DNA and its characteristic features.</li> <li>• Physical properties of DNA - Ionisation, Viscosity, Buoyant density, UV absorption and Hypochromism, Hyperchromism, Denaturation of DNA, Tm.</li> </ul>	15

**F.Y. B. Sc. (BIOCHEMISTRY) SEMESTER II**  
**COURSE TITLE: Practicals based on Course I and Course II**  
**[CREDITS - 02]**

<b>Practicals based on Course I and Course II</b>			
<b>Course Learning Objective and Outcome</b>			
<b>Learning Objective:</b>			
1) This course is intended to provide students with a basic understanding of the several concepts associated with practical Biochemistry			
<b>Learning Outcomes:</b>			
1) The learner will be able to demonstrate the detection of the proteins using qualitative methods			
2) The learner will be able to differentiate between different stages of cell division			
<b>Practical</b>	<b>Topics</b>	<b>Credits</b>	<b>Hours</b>
<b>I</b>	1. Qualitative Analysis: Proteins - Albumin, Casein, Gelatine, Peptone. 2. Cytoplasmic streaming in Hydrilla 3. Observation of different stages of mitosis in onion root tip. 4. Localization of Nucleic acids (DNA and RNA) from onion peel using iodine 5. Demonstration experiment: RNA by Orcinol method	2	60

## Vocational Skill Course

**F.Y. B. Sc. (BIOCHEMISTRY) SEMESTER I and II**  
**Vocational Skill Course (VSC)**  
**COURSE TITLE: Microscopy and Colorimetry**  
**[CREDITS - 02]**

Sr. No.	Heading	Particulars	
<b>1</b>	<b>Description the course : Including but not limited to:</b>	This course describes the importance of microscopy and colorimetry in observation and analysis.	
<b>2</b>	<b>Vertical :</b>	Vocational Skill Course	
<b>3</b>	<b>Type :</b>	Theory	
<b>4</b>	<b>Credits :</b>	2 credits ( 1 credit = 15 Hours Theory in a semester )	
<b>5</b>	<b>Hours Allotted :</b>	30 Hours	
<b>6</b>	<b>Marks Allotted:</b>	50 Marks	
<b>Vocational Skill Course: Microscopy and Colorimetry</b>			
<b>Course Learning Objective and Outcome</b>			
<b>Learning Objective:</b>			
<ol style="list-style-type: none"> <li>1. This course aims to introduce learners to the principles, applications and skills of using Ultraviolet- Visible light spectrophotometer and light microscopy.</li> </ol>			
<b>Learning Outcomes:</b>			
<ol style="list-style-type: none"> <li>1) The learner will be able to demonstrate an understanding of the interaction of Electromagnetic radiation with Matter and its application in detection and estimating concentrations of biomolecules</li> <li>2) The learner will be able to Demonstrate an understanding of Beer-Lambert's law and its applications.</li> <li>3) The learner will be able to use a colorimeter and UV Visible spectrophotometer for different applications in the laboratory.</li> <li>4) Identify and describe the functions of different parts of a compound light microscope.</li> </ol>			
Module	Topics	Credits	Lectures
<b>I</b>	<b>Module I: Colorimetry, Spectrophotometry</b> <ul style="list-style-type: none"> <li>• Ultraviolet and Visible light Spectrophotometry, Electromagnetic radiation (EMR) and interaction of EMR with matter, types of molecular transitions.</li> <li>• Beer Lambert's Law- derivation and applications, Molar Extinction Coefficient, Numerical problems.</li> </ul>	2	15

	<ul style="list-style-type: none"> <li>• Colorimeter and UV-Visible spectrophotometer:</li> <li>• Types, components and basic setup <ul style="list-style-type: none"> <li>I. Light sources</li> <li>II. Monochromators</li> <li>III. Sample holders</li> <li>IV. Detectors.</li> </ul> </li> <li>• Applications in biological studies.</li> </ul>		
<p style="text-align: center;"><b>II</b></p>	<p><b>Module II: Microscopy</b></p> <p>Lenses and refraction of light, Aberration in lenses and corrections</p> <ul style="list-style-type: none"> <li>• Compound light microscope: <ul style="list-style-type: none"> <li>I. Magnification, resolution and numerical aperture</li> <li>II. Components: Objective lenses, Eye pieces, Condenser</li> </ul> </li> <li>• Methods of enhancing contrast: <ul style="list-style-type: none"> <li>I. Examples of stains</li> <li>II. Phase contrast</li> <li>III. Dark field microscopy</li> </ul> </li> <li>• Introduction to electron microscopy</li> </ul>		<p style="text-align: center;">15</p>

## Skill Enhancement Course

### F.Y. B. Sc. (BIOCHEMISTRY) SEMESTER I and II Skill Enhancement Course (SEC) COURSE TITLE: Instrumentation techniques [CREDITS - 02]

Sr. No.	Heading	Particulars	
1	<b>Description the course :</b> <b>Including but not limited to:</b>	This course describes the important applications and skills of microscopy and colorimetry in observation and analysis.	
2	<b>Vertical :</b>	Skill Enhancement Course	
3	<b>Type :</b>	Practical/Skill development	
4	<b>Credits :</b>	2 credits	
5	<b>Hours Allotted :</b>	60 Hours	
6	<b>Marks Allotted:</b>	50 Marks	
<b>Skill Enhancement Course: Instrumentation techniques</b>			
<b>Course Learning Objective and Outcome</b>			
<b>Learning Objective:</b>			
1. This course aims to introduce learners to the applications and skills of using Ultraviolet- Visible light spectrophotometer and light microscopy.			
<b>Learning Outcomes:</b>			
1) The learner will be able to understand and demonstrate the interaction of Electromagnetic radiation with Matter and its application in detection and estimating concentrations of biomolecules			
2) The learner will be able to demonstrate an understanding of Beer-Lambert's law and its applications.			
3) The learner will be able to use a colorimeter and UV Visible spectrophotometer for different applications in the laboratory.			
4) Identify and describe the functions of different parts of a compound light microscope.			
Practical	Topics	Credits	Hours
I	1. Introduction to the types, parts and working of colorimeters and spectrophotometers. 2. Determination of lambda max and validation of Beer's law. 3. Study of Limitation of Beer's law. 4. Group project (Colorimetry). 5. Demonstration of UV - visible spectrophotometer. 6. Absorption spectrum of plant pigments. 7. Introduction to the parts and working of a	2	60

	<p>compound light microscope.</p> <p>8. Care and maintenance of a compound light Microscope.</p> <p>9. Use of low power lenses and high-power objectives to observe plant and animal cells.</p> <p>10. Group project (Microscopy).</p>		
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### Suggested Reading

1. Principles of Biochemistry by Lehninger, Albert L., Nelson David and Cox, Michael M.; CBS publishers.
2. Biochemistry by Voet, Donald and Voet, Judith G.; John Wiley & sons publishers.
3. Biochemistry by Zubay, Geoffrey L.; Wm.C. Brown publishers
4. Biochemistry by Stryer, Lubert; W.H. Freeman publishers.
5. Principles of biochemistry by White, Abraham; Handler, Philip and Smith, Emil L.; Mc Graw and Hill publishers.
6. Harpers illustrated biochemistry by Murray, Robert K. *etal.*; Mc Graw Hill.
7. A biologist's guide to principles and techniques in practical biochemistry by William, B.L. and Wilson, K; Universities press publishers.
8. Principles and techniques of practical biochemistry by Wilson, Keith and Walker, John ; Cambridge University Press publishers
9. Tools of biochemistry by Cooper, Terence G.; Wiley & Sons publishers.
10. Outlines of Biochemistry by Conn, E.E. and Stumpf, P.K.; Wiley publication.
11. Introduction to practical biochemistry by Plummer, David T.; Tata Mc. Graw and Hill publishers.
12. Modern experimental biochemistry by Boyer, Rodney F.
13. Introductory practical biochemistry by Sawhney, S.K. and Singh, Randhir; Narosa Publishing House.
14. Biochemical calculation by Segel, Irwin H.; John Wiley & Sons publishers.
15. Text book of medical physiology by Guyton, Arthur C. and Hall, John E.; Harcourt Brace & Company Asia Pvt Ltd.
16. Human biochemistry by Orten, J.M. and Neuhaus, O.W.; Mosby publishers.
17. Molecular Biology of the Cell (2008) 5th Edition, Alberts, B.A., Johnson, A., Lewis, J., Roberts, M.R.K., Walters, P. Garland Science Publication
18. Molecular Cell Biology (2008) 6th Edition, Lodish, H., Berk, A., Kaiser, A.C. Krieger, M., Scott, M.P., Bretscher, A., Ploegh, A., Mortsudira, P. W.H. Freeman and Company, N.Y.
19. Cell and Molecular Biology-concepts and experiments (2005) 4th Edition, Karp, G. John Wiley and Sons Inc.
20. The World of Cell (2003) 5th Edition, Becker, W.M., Kleinsmith, L.J., Hardin, J. Pearson Education (Singapore)
21. The Cell - A molecular approach (2007) 4th Edition, Cooper, G.M., Hausman, R.E. ASM Press Washington, D.C.s
22. Prescott's Microbiology (2020) 11th edition, Willey, J. M., Sherwood, L Woolverton J. C. McGraw-Hill Education.
23. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology (2018) 8<sup>th</sup> edition, Wilson K., Hofmann A., Walker, J.M., Clokie S. Cambridge University Press
24. Experiments in biochemistry: a hands-on approach: a manual for the undergraduate laboratory. (2006). Taylor, L. E., Farrell, S. O., Ranallo, R. T. Cengage Learning. 5. Laboratory Manual in Biochemistry (2004) 2<sup>nd</sup> edition. Jayaraman, J. New Age International (P) Limited Publishers.
25. Introduction to Practical Biochemistry. (2001) 3<sup>rd</sup> edition. Plummer, D. T., Tata McGraw Hill Publishing Company.
26. Srilakshmi B. (2018). Nutrition Science, 6<sup>th</sup> ed. New Delhi: New Age International Publishers
27. Subalakshmi, G and Udipi, S.A.(2021), "Food processing and preservation", 2<sup>nd</sup> Edition, New Age International Publishers, New Delhi.



## Examination and Standard of Passing:

### A. Evaluation of the Major Theory courses:

**Course 1 – 50 marks**

**Course 2 - 50 marks.**

The evaluation of these courses would include continuous evaluation (internal assessment) and Semester end examinations (External assessment). The evaluation pattern would be as follows:

#### **Internal assessment of each course: 20 marks (total of 40 marks).**

- Class test 1: **10 marks**
- Quizzes, presentation, project, role play, creative writing, assignment etc. **5 marks**
- Attendance and active participation in academic and co-curricular activities: **5 marks.**

#### **External assessment of each course: – 30 Marks (total of 60 marks)**

- Duration: **1 Hour per course**
- Theory question paper pattern:

Question	Based on	Options	Marks
Q.1	Unit I	Any 5 out of 7 / Any 2 out of 3	10
Q.2	Unit II	Any 5 out of 7 / Any 2 out of 3	10
Q3.	Unit I and II	Any 5 out of 7 / Any 2 out of 3	10
		<b>Total</b>	<b>30</b>

### B. Evaluation for Major Practical Courses (2 Credits): 50 marks.

The evaluation of these courses would include continuous evaluation (internal assessment) and Semester end examinations (External assessment). The evaluation pattern would be as follows:

- Each practical course carries a **total of 25 Marks**, distributed as follows:

No.	Criterion	Marks
1	Journal	05
2	Viva / Spots / Application based questions	05 10
3	Experiments during exams	15 20
	Total Marks	25

- The duration of each practical course evaluation is **2 hours**.
- To be eligible for evaluation, students must complete a minimum of 80% of the practical work assigned in each core subject.
- It is mandatory for students to submit a certified journal at the time of the practical examination. The journal serves as a record of their practical work and is an essential component of the evaluation process.

### C. Evaluation for Vocational Skill Course: 50 Marks

The evaluation of these courses would include continuous evaluation (internal assessment) and Semester end examinations (External assessment). The evaluation pattern would be as follows:

#### Internal Assessment: 20 marks.

Quizzes, class test, presentation, project, role play, creative writing, assignments etc.

#### External Assessment: 30 marks.

#### Theory Component: 30 marks.

- Duration: **1 Hour**
- Theory question paper pattern:

Question	Based on	Options	Marks
Q.1	Unit I	Any 5 out of 7 / Any 2 out of 3	10
Q.2	Unit II	Any 5 out of 7 / Any 2 out of 3	10
Q3.	Unit I and II	Any 5 out of 7 / Any 2 out of 3	10
		<b>Total</b>	<b>30</b>

### D. Evaluation for Skill Enhancement Course: 50 Marks

The evaluation of these courses would include continuous evaluation (internal assessment, 20 marks) and Semester end examinations (External assessment, 30 marks).

Internal assessment will be evaluated on the basis of

1. Completion of 80% practical work assigned
2. Continuous monitoring of lab performance
3. Submission of certified journal

External assessment

- Practical course carries a **total of 30 Marks**, distributed as follows:

No.	Criterion	Marks
1	Viva / Spots / Application based questions	10
2	Experiments during exams	20
	<b>Total Marks</b>	<b>30</b>

- The duration of each practical course evaluation is **2 hours**.
- To be eligible for evaluation, students must complete a minimum of 80% of the practical work assigned in each core subject.
- It is mandatory for students to submit a certified journal at the time of the practical examination. The journal serves as a record of their practical work and is an essential component of the evaluation process.

Regulations regarding the scheme of exams, number of credits and standard of passing will be as prescribed by the University of Mumbai.

A student is said to have passed if he/she secures 40% of marks allotted in each head of passing. External evaluation of 30 marks and Internal evaluation of 20 marks are treated as separate heads of passing.




The Ten Point Grading System prescribed by the University of Mumbai will be as follows:




**Letter Grades and Grade Points:**

Semester GPA/Programme CGPA Semester/ Programme	% of Marks	Alpha-Sign/ Letter Grade Result	Grading Point
9.00 - 10.00	90.0 - 100	O (Outstanding)	10
8.00 - < 9.00	80.0 - < 90.0	A+ (Excellent)	9
7.00 - < 8.00	70.0 - < 80.0	A (Very Good)	8
6.00 - < 7.00	60.0 - < 70.0	B+ (Good)	7
5.50 - < 6.00	55.0 - < 60.0	B (Above Average)	6
5.00 - < 5.50	50.0 - < 55.0	C (Average)	5
4.00 - < 5.00	40.0 - < 50.0	P (Pass)	4
Below 4.00	Below 40.0	F (Fail)	0
Ab (Absent)	-	Ab (Absent)	0

**This syllabus is applicable to IDOL students as well, w.e.f. from 2025-26**

**Team for creation of Syllabus:**

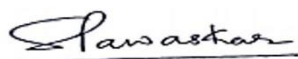
Name	College Name	Signature
<b>Prof. Dr. Samidha M. Pawaskar</b>	<b>K. J Somaiya College of Science and Commerce</b>	
<b>Dr. Prashant S. Ratnaparkhi</b>	<b>St. Xavier's College, Mumbai</b>	
<b>Dr. Deepali Kothekar</b>	<b>S. I. E. S. College, Mumbai</b>	
<b>Dr. Nupur Mehrotra</b>	<b>Mithibai College</b>	

<b>Dr. Sara Khan</b>	<b>Mithibai College</b>	
<b>Dr. Ketan Ranade</b>	<b>K. J Somaiya College of Science and Commerce</b>	
<b>Dr. Vainav Patel</b>	<b>N. I. R. R. C. H, Mumbai</b>	

## Justification for B.Sc. (Biochemistry)

1.	Necessity for starting the course:	Biochemistry is the branch of the life sciences devoted to understanding the mechanisms by which living organisms carry out their many functions in complete, molecular detail. It is inherently interdisciplinary in nature and fundamental to every other branch of the life and biomedical sciences. It is chemistry of life. It explores the chemical processes within and related to living organisms. With this knowledge, biochemists attempt to investigate and solve biological problems pertaining to the understanding of physiological processes and the diseases associated with their malfunctioning. Prevention and diagnosis is also an important component of this subject. Bachelor's degree in Biochemistry helps students to create knowledge pool and skilled manpower to take on the challenges that modern biological sciences poses in understanding the emerging dynamics of life processes.
2.	Whether the UGC has recommended the course:	Yes
3.	Whether all the courses have commenced from the academic year 2023-24	The course has already commenced in the university and in the academic year 2024-2025 it is restructured under NEP 2020
4.	The courses started by the University are self-financed, whether adequate number of eligible permanent faculties are available?	The self-financed courses would be run by permanent faculty and supported by visiting or guest faculty.
5.	To give details regarding the duration of the Course and is it possible to compress the course?	The course would be of four years for B.Sc.(Honours) and Three years for B.Sc. without honours It would not be possible to compress the course.
6.	The intake capacity of each course and no. of admissions given in the current academic year:	The intake capacity is variable from college to college based on sanctions received from the University

7.	Opportunities of Employability / Employment available after undertaking these courses:	<p>Graduates of this department are expected to exhibit the extensive knowledge of various concepts of Biochemistry and their applications thus contribute in research, development, teaching, government and public sectors. This programme will establish a foundation for student to further pursue higher studies in Biochemistry. The list below provides an overview of possible employment areas provided by an undergraduate training in Biochemistry. The list below provides a synoptic overview of possible career paths provided by an undergraduate training in Biochemistry:</p> <ol style="list-style-type: none"> <li>1. Research and Academics</li> <li>2. Clinical diagnostic industry</li> <li>3. Quality control and Quality assurance</li> <li>4. Food industry</li> <li>5. Pharmaceutical industry</li> <li>6. Cosmetic industry</li> <li>7. Forensic science</li> <li>8. Agrochemical industry</li> </ol>
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**Sign of the BOS Chairman  
Prof. Dr. Samidha M.  
Pawaskar  
Biochemistry**

**Sign of the  
Offg. Associate Dean  
Dr. Madhav R. Rajwade  
Faculty of Science &  
Technology**

**Sign of the  
Offg. Dean  
Prof. Shivram S. Garje  
Faculty of Science &  
Technology**