

University of Mumbai



क. वि.प्रा.स.से.(युजी)/आयसीसी/२०२४-२५/४

परिपत्रक :-

सर्व प्राचार्य/संचालक, संलग्नित महाविद्यालये/संस्था, विद्यापीठ शैक्षणिक विभागाचे संचालक/विभाग प्रमुख यांना कळविण्यात येते की, राष्ट्रीय शैक्षणिक धोरण २०२० च्या अमलबजावणीच्या अनुषंगाने शैक्षणिक वर्ष २०२४-२५ पासून एक्झिट पर्याय सह पदवी व पदव्युत्तर अभ्यासक्रम विद्यापिठेच्या दिनांक २७ डिसेंबर, २०२३, ३ फेब्रुवारी, २०२४, २० एप्रिल, २०२४ व २४ मे, २०२४ च्या बैठकीमध्ये मंजूर झालेले सर्व अभ्यासक्रम मुंबई विद्यापीठाच्या www.mu.ac.in या संकेत स्थळावर NEP २०२० या टॅब वर उपलब्ध करण्यात आलेले आहेत.

मुंबई - ४०० ०३२

११ जून, २०२४

Baliram

(प्रा. (डॉ.) बळीराम गायकवाड)

प्र. कुलसचिव

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8	The Deputy Registrar, Executive Authorities Section (EA) eau120@fort.mu.ac.in He is requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to the above circular.
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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

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

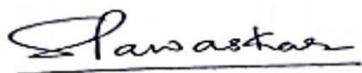
University of Mumbai



(As per NEP 2020)

Sr. No.	Heading	Particulars	
1	Title of program O: <u>SU-527A</u>	A	U.G. Certificate in Biochemistry
	O: <u>SU-527B</u>	B	U.G. Diploma in Biochemistry
	O: <u>SU-527C</u>	C	B.Sc. (Biochemistry)
	O: <u>SU-527D</u>	D	B.Sc. (Hons.) in Biochemistry
	O: <u>SU-527E</u>	E	B.Sc. (Hons. with Research) in Biochemistry
2	Eligibility O: <u>SU-528A</u>	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: <u>SU-528B</u>	B	Under Graduate Certificate in Biochemistry Academic Level 4.5
	O: <u>SU-528C</u>	C	Under Graduate Diploma in Biochemistry Academic Level 5.0
	O: <u>SU-528D</u>	D	Bachelors of Biochemistry with minimum CGPA of 7.5 Academic Level 5.5
	O: <u>SU-528E</u>	E	Bachelors of Biochemistry with minimum CGPA of 7.5 Academic Level 5.5
3	Duration of program R: <u>SU-566</u>	A	One Year
		B	Two Years
		C	Three Years
		D	Four Years
		E	Four Years

4	Intake Capacity R: <u>SU-567</u>	
5	Scheme of Examination R: <u>SU-568</u>	NEP 40% Internal 60% External, Semester End Examination Individual Passing in Internal and External Examination
6	Standards of Passing R: <u>SU-569</u>	40% in each component.
7	Credit Structure Sem. I - R: <u>SU-570A</u> Sem. II -R: <u>SU-570B</u>	Attached herewith
	Credit Structure Sem. III - R: <u>SU-570C</u> Sem. IV - R: <u>SU-570D</u>	
	Credit Structure Sem. V - R: <u>SU-570E</u> Sem. VI -R: <u>SU-570F</u>	
8	Semesters	A Sem I & II
		B Sem III & IV
		C Sem V & VI
		D Sem VII & VIII
		E Sem VII & VIII
9	Program Academic Level	A 4.5
		B 5.0
		C 5.5
		D 6.0
		E 6.0
10	Pattern	Semester
11	Status	New
12	To be implemented from Academic Year Progressively	From Academic Year: 2024-25



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

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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 2 Origin of Life and Basic Concepts of Cell ultrastructure 2 Practical 1 based on Core course I and II		-	2+2 Blood and blood disorder s Basics of food and nutrition	VSC:2, Microscopy and Colorimetry SEC:2 Instrumentati on techniques	AEC:2, VEC:2,I KS:2	CC:2	22	UG Certificate44
	R:_____B									
	II	2 Introduction to Lipids and Nucleic acids 2 Cell biology and Mendelian Genetics 2 Practical 2 based on Core course I and II		2	2+2 Heart health Liver Health	VSC:2, Microscopy and Colorimetry SEC:2 Instrumentati on techniques	AEC:2, VEC:2	CC:2	22	
	Cum Cr.	12	-	2	8	4+4	4+4+2	4	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 Majorand 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	Cum. Cr. / Sem.	Degree/ Cum. Cr.
		Mandatory	Electives							
5.0	III	2 Macro and Micro nutrients of diet 2 Enzymology 2 Biophysical chemistry 2 Practical 3 based on Core course I,II & III		4	2 Understa nding Diabetes Mellitus	VSC:2, Centrifugatio n and Electrophores is	AEC:2	FP: 2 CC:2	22	UG Diploma 88
	R: _____ D									
	IV	2 Food calorimetry and other nutritional concepts 2 Physiology 2 Genetics 2 Practical 4: based on Core course I,II & III		4	2 Food adulterati on and reservatio n	SEC:2 Purification techniques	AEC:2	CEP: 2 CC:2	22	
	Cum Cr.	28		10	12	6+6	8+4+2	8+4	88	
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.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	Cum. Cr. / Sem.	Degree/ Cum. Cr.
		Mandatory	Electives							
5.5	V	2 Metabolism (Carbohydrates and Energetics)	4	4		VSC: 2 Chromatogra phy & Radioactivity		FP/CEP: 2	22	UG Degree 132
	2 Plant Biochemistry									
	2 Endocrinology									
	2 Practical 5									
	2 Practical 6									
R: _____ F										
VI	2 Lipid and Protein metabolism	4	4					OJT :4	22	
2 Genetic engineering and RDT										
2 Immunology										
2 Practical 7										
2 Practical 8										
Cum Cr.	48	8	18	12	8+6	8+4+2	8+6+4	132		
Exit option: Award of UG Degree in Major with 132 credits OR Continue with Major and Minor										

[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	6
		T	Origin of Life and Basic concepts of Cell Ultrastructure	2	30	
		P	Practical 1 based on Core course I and II	2	60	
	II	T	Introduction to Lipids and Nucleic acids	2	30	6
			Cell Biology and Mendelian Genetics	2	30	
		P	Practical 2 based on Core course I and II	2	60	
2	III	T	Macro and Micro nutrients of diet	2	30	8
		T	Enzymology	2	30	
		T	Biophysical chemistry	2	30	
		P	Practical 3 based on Core course I,II & III	2	60	
	IV	T	Food Calorimetry and other nutritional concepts	2	30	8
		T	Physiology	2	30	
		T	Genetics	2	30	
		P	Practical 4: based on Core course I,II & III	2	60	
3	V	T	Metabolism (Carbohydrate +Bioenergetics)	2	30	10
		T	Plant Biochemistry	2	30	
		T	Endocrinology	2	30	
		P	Practical 5	2	60	
		P	Practical 6	2	60	
	VI	T	Lipid and Protein metabolism	2	30	10
		T	Genetic engineering and RDT	2	30	
		T	Immunology	2	30	
		P	Practical 7	2	60	
		P	Practical 8	2	60	

SEMESTER - I

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

Course – II: Origin of Life and Basic concepts of Cell Ultrastructure			
Course II	Module	Topics	Credits
	I	Origin of Life	2
	II	Basic Concepts of Cell Ultrastructure	

Course Practical	Practical 1 based on Course I and Course II		Credits 2
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SEMESTER - II

Course – I: Introduction to Lipids and Nucleic acids			
Course I	Module	Topics	Credits
	I	Lipids	2
	II	Nucleic acids	

Course – II: Cell Biology and Mendelian Genetics			
Course II	Module	Topics	Credits
	I	Cell Cycle	2
	II	Mendelian Genetics / Classical Genetics	

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

Skill Enhancement Course: Instrumentation techniques			
Course VSC	Module	Topics	Credits
	I	Applications of Microscopy and Colorimetry	2

SEMESTER - I			
Open Elective Course: Blood and Blood disorders			
Course OE	Module	Topics	Credits
	I	Blood.	
	II	Understanding the Diseases and Disorders of Blood.	2

SEMESTER - I			
Open Elective Course: Basics of food and nutrition			
Course OE	Module	Topics	Credits
	I	Understanding Food	
	II	Diet and Nutraceuticals	2

SEMESTER - II			
Open Elective Course: Heart Health			
Course OE	Module	Topics	Credits
	I	Overview of heart function	
	II	Disorders and Nutrition for Heart disorders	2

SEMESTER - II			
Open Elective Course: Liver Health			
Course OE	Module	Topics	Credits
	I	Overview of Liver function	
	II	Disorders and Nutrition for Liver disorders	2

Sem. - I

Syllabus

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

COURSE TITLES:

Course 1: Basic molecules of life [2 Credits]

Course 2: Origin of Life and Basic Concepts of Cell ultrastructure [2 Credits]

Sr.No.	Heading	Particulars	
1	Description the course : Including but not limited to:	This course describes the importance of the basic molecules of life.	
2	Vertical :	Major	
3	Type :	Theory	
4	Credits :	4 credits (1 credit = 15 Hours Theory in a semester)	
5	Hours Allotted :	60 Hours	
6	Marks Allotted:	100 Marks	
Course – I Basic molecules of life			
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 Water, Carbohydrates, Amino acids and proteins Learning Outcomes: 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
I	Module I : Water and Carbohydrates Water • Effect of water on Biomolecules • Structure and properties of water (hydrogen bonding) • Entropy and dissolution of solute • Effect of non-polar compounds on the structure of water • Weak interactions of biomolecules in aqueous solutions • Concepts of mole, molar, molar equivalent and normal, • Dissociation and Ionic product of water	2	15

	Carbohydrates: • 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. • Reactions of monosaccharides – 1) Oxidation to produce aldonic, aldaric and Uronic acid (only w.r.t glucose), 2) Osazone (only w.r.t glucose and fructose), 3) Reducing action of sugar in boiling alkaline medium (enediol formation) -only w.r.t glucose and fructose, - Disaccharides - Occurrence and structure of maltose, lactose, sucrose. • Polysaccharides- Classification based on function (storage and structural), composition (homo and hetero) giving examples. Storage polysaccharides (Starch and Glycogen), action of amylases on starch. • Structural polysaccharides – Cellulose, Chitin (Structure and biochemical importance).		
II	Module II : Amino acids and Proteins Amino acids: • Classification of amino acids based on the polarity of R-groups (structure of 20 amino acids). • Chemical reactions of amino acids with following reagents –Ninhydrin, Sanger's, Edman's, Dansyl chloride. • Cleavage of polypeptide - Trypsin, Chymotrypsin, Pepsin, Aminopeptidase, Carboxypeptidase Proteins: • ASBC-APS classification on the basis of shape and function. • Formation and characteristics of peptide bond. • Primary structure, Secondary structure-alpha helix and beta sheet, Tertiary and Quaternary structure • Forces stabilizing protein structure. Protein denaturation.		15

F.Y. B. Sc. (BIOCHEMISTRY) SEMESTER I
COURSE TITLE: Origin of Life and Basic concepts of Cell Ultrastructure
[CREDITS - 02]

Course – II Origin of Life and Basic concepts of Cell Ultrastructure

Course Learning Objective and Outcome

Learning Objectives:

- 1) This course is intended to provide students with a basic understanding of the theories on the origin of life on earth
- 2) This course intends to provide students with a basic understanding of the structure of a typical prokaryotic and eukaryotic cell.

Learning Outcomes:

- 1) The learner will be able to explain the various theories proposed for the origin of life on earth.
- 2) The learner will be able to describe the basic structure of a typical prokaryotic and eukaryotic cell and will be able to explain the functions of different cell organelles

Module	Topics	Credits	Lectures
I	Module I: Origin of Life • Process of origin of life- structure of cosmos • Primitive earth- Prebiotic soup • Theories on origin- Big bang theory, Theory of Abiogenesis, Panspermia hypothesis, Spontaneous generation, Oparin and Haldane theory of chemical evolution • Experimental support by-Pasteur, Francesco Redi, Urey and Miller • Origin of basic biological molecules, Formation of First cell, Proteinoid microsphere, Coacervates droplets, Cairns-Smith Model, RNA first model, Origin and evolution of RNA World, Origin and evolution of RNP world, DNA world, Retrograde evolution • Evolution of eukaryotes • Endosymbiotic theory • Lamarckism, Examples of Lamarckism, and critical analysis Darwinism- Darwin-Wallace theory of Natural selection, Examples of natural selection, Demerits of Darwinism • Modern Synthetic theory and Mutation theory • Paleontology and Evolutionary History • Evolutionary time scale; Eras, periods, and epoch; Major events in the evolutionary time scale	2	15

II	Module II: Basic Concepts of Cell Ultrastructure • Cell as a basic unit of life : organization and structure of prokaryotic and eukaryotic cells, Animal and plant cell. • Parts of the Cell : Plasma Membrane - Structure, functions of membrane proteins, membrane fluidity, membrane permeability, gradient and transport across the membrane. Cell wall and its function. • Cytoplasm : Cytosol and organelles -, Centromere, cilia and flagella, endoplasmic reticulum, Golgi apparatus, lysosomes, peroxisomes, proteasomes, mitochondria, Nucleus (Chromosomes, chromatin, histones). • Plant cells - Chloroplast, xylem, phloem and epidermal cells.		15
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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
I	1. Good laboratory practices: Lab safety and introduction to common laboratory glassware and instruments 2. Use of digital analytical weighing balance 3. Validation of glass and micropipettes 4. Preparation of solutions of different concentrations a. Concepts of w/v, v/v, percentage, ppm, ppb, moles/L, molarity, molality, normality b. Preparation and verification of solutions of desired strengths 5. Qualitative Analysis: Carbohydrates - Glucose, Fructose, Maltose, Lactose, Sucrose, Starch, Dextrin. 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	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	
1	Description the course : Including but not limited to:	This course describes the importance of microscopy and colorimetry in observation and analysis.	
2	Vertical :	Vocational Skill Course	
3	Type :	Theory	
4	Credits :	2 credits (1 credit = 15 Hours Theory in a semester)	
5	Hours Allotted :	30 Hours	
6	Marks Allotted:	50 Marks	
Vocational Skill Course: Microscopy and Colorimetry			
Course Learning Objective and Outcome			
Learning Objective: 1. This course aims to introduce learners to the principles, applications and skills of using Ultraviolet- Visible light spectrophotometer and light microscopy.			
Learning Outcomes: 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 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.			
Module	Topics	Credits	Lectures
I	Module I: Colorimetry, Spectrophotometry • Ultraviolet and Visible light Spectrophotometry, Electromagnetic radiation (EMR) and interaction of EMR with matter, types of molecular transitions. • Beer Lambert’s Law- derivation and applications, Molar Extinction	2	15

	Coefficient, Numerical problems. • Colorimeter and UV-Visible spectrophotometer: • Types, components and basic setup I. Light sources II. Monochromators III. Sample holders IV. Detectors. • Applications in biological studies.		
II	Module II: Microscopy Lenses and refraction of light, Aberration in lenses and corrections • Compound light microscope: I. Magnification, resolution and numerical aperture II. Components: Objective lenses, Eye pieces, Condenser • Methods of enhancing contrast: I. Examples of stains II. Phase contrast III. Dark field microscopy • Introduction to electron microscopy		15

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	Description the course : Including but not limited to:	This course describes the important applications and skills of microscopy and colorimetry in observation and analysis.	
2	Vertical :	Skill Enhancement Course	
3	Type :	Practical/Skill development	
4	Credits :	2 credits	
5	Hours Allotted :	60 Hours	
6	Marks Allotted:	50 Marks	
Skill Enhancement Course: Instrumentation techniques			
Course Learning Objective and Outcome			
Learning Objective: 1. This course aims to introduce learners to the applications and skills of using Ultraviolet- Visible light spectrophotometer and light microscopy.			
Learning Outcomes: 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	2	60

	parts and working of a compound light microscope. 8. Care and maintenance of a compound light Microscope. 9. Use of low power lenses and high-power objectives to observe plant and animal cells. 10. Group project (Microscopy).		
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Sem. – II

F.Y. B. Sc. (BIOCHEMISTRY) SEMESTER II

COURSE TITLES:

Course 1: Introduction to Lipids and Nucleic acids [2 Credits]

Course 2: Cell Biology and Mendelian Genetics [2 Credits]

Sr.No.	Heading	Particulars	
1	Description the course : Including but not limited to:	This course describes the importance of Lipids, Nucleic acids, Cell Biology and Mendelian genetics .	
2	Vertical :	Major	
3	Type :	Theory	
4	Credits :	4 credits (1 credit = 15 Hours Theory in a semester)	
5	Hours Allotted :	60 Hours	
6	Marks Allotted:	100 Marks	
Course – I Introduction to Lipids and Nucleic acids			
Course Learning Objective and Outcome			
Learning Objective: - 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: - The learner will be able to describe the classification, reactions and biochemical importance of Lipids - The learner will be able explain different types ,structures, properties and reactions of nucleic acids			
Module	Topics	Credits	Lectures
I	Module II : Lipids - Definition and Bloor's Classification of lipids. - 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. - Triacylglycerol - Simple and mixed. - Chemical reactions - Saponification, Iodination, Ozonolysis, Auto-oxidation, Phospholipases, action of heat on glycerol and choline, Rancidity of fats. - Definition and significance - Acid Number, Saponification Number, Iodine Number and Reichert-Meissel Number. - Compound lipids – Structure and function	2	15

	of Glycerophospholipids (Cephalin, Lecithin and Phosphatidyl inositol) Phosphosphingolipids (Ceramide, Sphingomyelin), Glycolipids or Cerebrocides (Galacto and Glucocerebrocides). • Steroids and Lipoproteins		
II	Module II: Nucleic acids Nucleic Acids: • Structure of purine and pyrimidine bases, ribose, deoxyribose, nucleosides and nucleotides. c AMP and formation of polynucleotide strand with its shorthand representation. • RNAs- (various type in pro and eukaryotes) rRNA, t- RNA (Clover – leaf model), m- RNA (general account) and action of alkali on RNA. • DNA- X- ray diffraction pattern (Physical evidence), • Chargaff's rules (Chemical evidence), Watson –Crick model of DNA and its characteristic features. • Physical properties of DNA - Ionisation, Viscosity, Buoyant density, UV absorption and Hypochromism, Hyperchromism, Denaturation of DNA, Tm.		15

F.Y. B. Sc. (BIOCHEMISTRY) SEMESTER II
Course- II
COURSE TITLE: Cell Biology and Mendelian Genetics
[CREDITS - 02]

Course – II Cell Biology and Mendelian Genetics			
Course Learning Objective and Outcome			
Learning Objective: 1) This course is intended to provide students with a basic understanding of several cellular processes and the disorders associated with them Learning Outcomes: 1) The learner will be able to explain various cellular processes such as cell division, cell cycle regulation, Apoptosis etc. 2) The learner will be able to describe the Mendelian laws, monohybrid and dihybrid ratios. 3) To differentiate between Mendelian inheritance and modifications of Mendel's law.			
Module	Topics	Credits	Lectures
I	Module I: Cell Cycle and Cell transport • Cell division: • Somatic cell division and reproductive cell division. • The cell cycle - Interphase and M phase, Mitosis and Meiosis, • Regulation of cell cycle, Cell cycle checkpoints and proteins associated with it. • Disorders associated with cell cycle irregularities. Cellular diversity. • Programmed Cell Death (apoptosis): Difference between necrosis and apoptosis. Pathways, regulators and effectors in apoptosis, onco-genes and tumour suppressor genes. • Cell transport: Simple diffusion, Facilitated diffusion, Active transport and secondary Active transport.	2	15
II	Module II: Mendelian Genetics / Classical Genetics • Mendelian genetics: Mendelian laws and basis of inheritance, genotype, phenotype. • Chromosomal theory of heredity, • Meischer, Griffith, Hershey-Chase; Avery; RNA as genetic material. • Non Mendelian genetics: Incomplete dominance, codominance, multiple alleles, pleiotropy, recessivity, sex determination, sex-linked traits, sex-linked inheritance, lethal genes. • Structure and characteristic of DNA & RNA: Base composition of DNA, double helical structure, Chargaff's rule, A, B & Z DNA,		15

	C-value paradox. • Types of RNA, structure & functions, genetic code & their characteristics. • Giant Chromosome:- lamp brush & polytene chromosomes.		
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F.Y. B. Sc. (BIOCHEMISTRY) SEMESTER II
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 demonstrate the detection of the proteins using qualitative methods 2) The learner will be able to differentiate between different stages of cell division			
Practical	Topics	Credits	Hours
I	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

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
		Total	30

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
		Total	30

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
	Total Marks	30

- 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.

E. Evaluation for Open Elective Course: 50 Marks each

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).

- d. Class test 1: **10 marks**
- e. Quizzes, presentation, project, role play, creative writing, assignment etc. **5 marks**
- f. 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
		Total	30

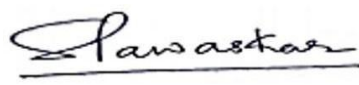
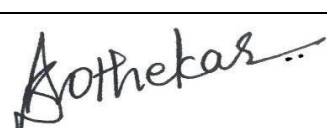
The Ten Point Grading System prescribed by the University of Mumbai will be as follows:

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

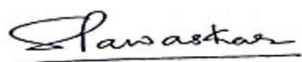
Team for creation of Syllabus:

Name	College Name	Signature
Prof. Dr. Samidha M. Pawaskar	K. J Somaiya College of Science and Commerce	
Dr. Prashant S. Ratnaparkhi	St. Xavier's College, Mumbai	
Dr. Deepali Kothekar	S. I. E. S. College, Mumbai	
Dr. Nupur Mehrotra	Mithibai College	
Dr. Sara Khan	Mithibai College	
Dr. Ketan Ranade	K. J Somaiya College of Science and Commerce	
Dr. Vainav Patel	N. I. R. R. C. H, Mumbai	

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:	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: 1. Research and Academics 2. Clinical diagnostic industry 3. Quality control and Quality assurance 4. Food industry 5. Pharmaceutical industry 6. Cosmetic industry 7. Forensic science 8. Agrochemical industry
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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**