



Date :- 01/08/2023

NOTIFICATION

Sub :- CBCS Syllabi of B. Sc. in Biochemistry (Sem. I & II)

Ref. :- Decision of the Academic Council at its meeting held on 26/07/2023.

The Syllabi of B. Sc. in Biochemistry (First and Second Semesters) as per **NATIONAL EDUCATION POLICY - 2020** and approved by the Academic Council as referred above are hereby notified for implementation with effect from the academic year 2023-24.

Copy of the Syllabi Shall be downloaded from the College Website
(www.kcesmjcollege.in)

Sd/-
Chairman,
Board of Studies

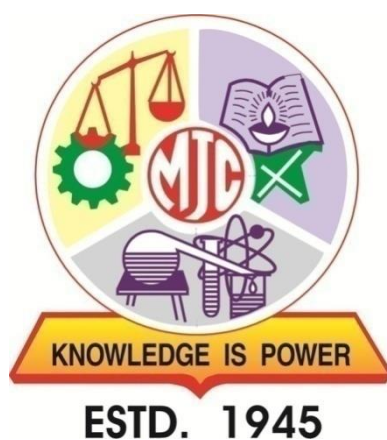
To :

- 1) The Head of the Dept., M. J. College, Jalgaon.
- 2) The office of the COE, M. J. College, Jalgaon.
- 3) The office of the Registrar, M. J. College, Jalgaon.

Knowledge is Power

Khandesh College Education Society's
Moolji Jaitha College, Jalgaon
An "Autonomous College"

Affiliated to
Kavayitri Bahinabai Chaudhari
North Maharashtra University, Jalgaon-425001



STRUCTURE AND SYLLABUS

B.Sc. Honours/Honours with Research (F.Y.B.Sc.Biochemistry)

**Under Choice Based Credit System (CBCS)
and
as per NEP-2020 Guidelines**

[w.e.f. Academic Year: 2023-24]

Preface

The cumulative demand for trained and skilled manpower in the area of Biochemistry requires in depth functional knowledge of modern biology through hands-on training to the students. The Moolji Jaitha College (Autonomous) has adopted a department-specific model as per the guidelines of UGC, NEP-2020 and the Government of Maharashtra. The Board of Studies in Biochemistry of the college has prepared the syllabus for the first-year undergraduate of Biochemistry.

The syllabus has been prepared anticipating the requirements of B.Sc. Biochemistry students under CBCS Program. The contents have been drawn to accommodate the widening horizons of the Biochemistry discipline and reflect the changing needs of the students. The detailed syllabus for each paper is appended with a list of suggested readings.

The degree of Bachelor of Science in Biochemistry (Choice Based Credit System) aims to introduce various aspects of Biochemistry and interdisciplinary subjects to the students. The program in Biochemistry as one of the core subject is designed to cultivate a scientific attitude and interest towards the modern areas of Biochemistry in particular and life science in general. This will help the students to become critical and curious in their outlook. The courses are designed to impart the essential basics in Biochemistry, Chemistry, Botany, Microbiology, Zoology and Biotechnology at the initial level of graduation. The basic courses are infused with application in modern life sciences, and awareness on Biochemistry and its influence in human life. The integration of various courses in the program is aimed to develop proficiency in the theory as well as practical experiments, common equipment, laboratory, along with the collection and interpretation and presentation of scientific data in proper manner. Beside this, the students will be equipped with knowledge in the newer areas of Biochemistry and its application in medical science, agriculture, industry, proteomics, genomics, metabolomics, bioinformatics, nano-biotechnology etc. This will create awareness about Biochemistry and contribution of Biochemistry among the society. At the end of the course, the students are expected to have good working knowledge in the field of Biochemistry and in addition knowledge gained from courses of interdisciplinary in nature. Students will surely have an urge to continue higher studies in Biochemistry and contribute significantly in the development.

The present syllabus is restructured anticipating the future needs of Biochemistry with more emphasis on imparting hands-on skills. The main thrust is laid on making syllabus compatible with developments in Education, Research and Industrial sectors. The Theory and Practical course in new restructured course will lead to impart skill-set essentials to further Biochemistry.

Hence, Board of Studies in Biochemistry in its meeting held on 13th July 2023 resolved to accept the revised syllabus for F. Y. B. Sc. (Biochemistry) based on Choice Based Credit System (CBCS) of UGC, NEP-2020 and the Government of Maharashtra guidelines.

Program Outcomes (PO) for B.Sc. Program:

Program outcomes associated with a B.Sc. degree are as follows:

PO No.	PO
1	Graduates should have a comprehensive knowledge and understanding of the fundamental principles, theories, and concepts in their chosen field of study.
2	Graduates should possess the necessary technical skills and competencies related to their discipline, including laboratory techniques and data analysis.
3	Graduates should be able to identify, analyze, and solve complex problems using logical and critical thinking skills. They should be able to apply scientific methods and principles to investigate and find solutions.
4	Graduates should be proficient in effectively communicating scientific information, both orally and in writing.
5	Graduates should have a basic foundation in research methods and be capable of designing and conducting scientific investigations.
6	Graduates should be able to work effectively as part of a team, demonstrating the ability to collaborate with others, respect diverse perspectives, and contribute to group projects.
7	Graduates should recognize the importance of ongoing learning and professional development. They should be equipped with the skills and motivation to engage in continuous learning, adapt to new technologies and advancements in their field, and stay updated with current research.

Programme Specific Outcome (PSO) for B.Sc. Biochemistry Honours/Honours with Research:

After completion of this program, students are expected to learn/understand the:

PO No.	PSO
1	Structure, properties, pathways and applications of biomolecules in various fields.
2	Isolation, purification, biochemical mechanisms, regulation and applications of enzymes in various sectors.
3	Isolation, identification and characterization of various microbes from diverse habitats.
4	Principle and applications of various bio-analytical tools and techniques.
5	Physiological Biochemistry and correlate it with clinical applications.
6	Applications of Biochemistry in various industrial sectors such as agriculture, medical, pharmaceuticals, food, cosmetic etc.

Multiple Entry and Multiple Exit options:

The multiple entry and exit options with the award of UG certificate/ UG diploma/ or three-year degree depending upon the number of credits secured;

Levels	Qualification Title	Credit Requirements		Semester	Year
		Minimum	Maximum		
4.5	UG Certificate	40	44	2	1
5.0	UG Diploma	80	88	4	2
5.5	Three Year Bachelor's Degree	120	132	6	3
6.0	Bachelor's Degree- Honours Or Bachelor's Degree- Honours with Research	160	176	8	4

Credit distribution structure for Three/ Four year Honors/ Honors with Research Degree Programme with Multiple Entry and Exit

Credit distribution structure for Three / Four year Honors/ Honors with Research Degree Programme with Multiple Entry and Exit										
Level 1	Sem	Major (Core). Subjects		Minor Subjects (MIN)	GE/ OE	VSC, SEC (VSEC)	AEC, VEC, IKS	CC, FP, CEP, OJT/Int, RP	Cumulative Credits/Sem	Degree/ Cumulative Cr.
		Mandatory (DSC)	Elective (DSE)							
4.5	I	DSC-1 (2T) DSC-2 (2T) DSC-3 (2P)	—	MIN-1 (2T) MIN-2 (2P)	OE-1 (2T)	SEC-1 (2T) SEC-2(1P)	AEC-1 (2T) (ENG) VEC-1 (2T) (ES) IKS (1T)	CC-1 (2)	22	UG Certificate 44
	II	DSC-4 (2T) DSC-5 (2T) DSC-6 (2P)	...	MIN-3 (2T) MIN-4 (2P)	OE-2 (2T)	SEC-3(2T) SEC-4(1P)	AEC-2 (2T) (ENG) VEC-2 (2T) (CI) IKS (1T)	CC-2 (2)	22	
	Cum. Cr	12	...	8	4	6	4+4+2	4	44	
Exit option: Award of UG Certificate in Major with 44 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor.										
5.0	III	DSC-7 (2T) DSC-8 (2T) DSC-9 (2P) DSC-10 (2P)	...	MIN-5 (2T) MIN-6 (2P)	OE-3 (2T) OE-4 (2P)		AEC-3 (2T) (MIL)	CC-3 (2) CEP (2)	22	UG Diploma 88
	IV	DSC-11 (2T) DSC-12 (2T) DSC-13 (2P) DSC-14 (2P)	...	MIN-7 (2T) MIN-8 (2P)	OE- 5 (2T) OE-6 (2P)		AEC-4 (2T) (MIL)	CC-4 (2) FP (2)	22	
	Cum. Cr	28	...	16	10	6	8+4+2	8+2+2	88	
Exit option: Award of UG Diploma in Major and Minor with 88 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor.										
5.5	V	DSC-15 (2T) DSC-16 (2T) DSC-17 (2T) DSC-18 (2P) DSC-19 (2P)	DSE-1 (2T) A/B DSE-2 (2P) A/B	MIN-9 (2T/P)	...	VSC-1 (2T) VSC-2 (2P)	...	OJT/Int(2)	22	UG Degree 132
	VI	DSC-20 (2T) DSC-21 (2T) DSC-22 (2T) DSC-23 (2P) DSC-24 (2P)	DSE-3 (2T) A/B DSE-4 (2P) A/B	MIN-10(2T/P)	—	VSC-3 (2T) VSC-4 (2P)	...	OJT/Int(2)	22	
	Cum. Cr.	48	08	20	10	8+6	8+4+2	8+2+2+4	132	
Exit option: Award of UG Degree in Major with 132 credits OR Continue with Major and Minor										
6.0	VII	DSC-25 (4T) DSC-26 (4T) DSC-28 (4T) DSC-27 (2P)	DSE-5 (2T) A/B DSE-6(2P) A/B	RM (4T)	—	...	...		22	UG Honors Degree 176
	VIII	DSC-29 (4T) DSC-30 (4T) DSC-32 (4T) DSC-31 (2P)	DSE-7 (2T) A/B DSE-8(2P) A/B		—	...	...	OJT/Int (4)	22	
	Cum. Cr.	76	16	20+4	10	8+6	8+4+2	8+2+2+8	176	
Four Year UG Honors Degree in Major and Minor with 176 credits										
6.0	VII	DSC-25 (4T) DSC-26 (4T) DSC-27 (2P)	DSE-5 (2T) A/B DSE-6 (2P) A/B	RM (4T)	...	...	...	RP (4)	22	UG Honors with Research Degree 176
	VIII	DSC-29 (4T) DSC-30 (4T) DSC-31 (2P)	DSE-7 (2T) A/B DSE-8 (2P) A/B		...	...	...	RP (8)	22	
	Cum. Cr.	68	16	20+4	10	8+6	8+4+2	8+2+2+8+12	176	
Four Year UG Honours with Research Degree in Major and Minor with 176 credits										

Note: 2 credit course on Major Specific IKS shall be included under major subject in F.Y. or S.Y. UG programme.

Sem- Semester, **DSC-** Department Specific Course, **DSE-** Department Specific Elective, **OE/GE-** Open/Generic elective, **VSC-** Vocational Skill Course, **SEC-** Skill Enhancement Course, **VSEC-** Vocation and Skill Enhancement Course, **AEC-** Ability Enhancement Course, **IKS-** Indian Knowledge System, **VEC-** Value Education Course, **T-** Theory, **P-** Practical, **CC-**Cocurricular **RM-** Research Methodology, **OJT-** On Job Training, **FP-** Field Project, **Int-** Internship, **RP-** Research Project, **CEP-** Community Extension Programme, **ENG-** English, **CI-** Constitution of India, **MIL-** Modern Indian Language

F. Y. B. Sc. Biochemistry Course Structure

Semester	Course Module	Credit	Hours/ week	TH/ PR	Code	Title
I	DSC	2	2	TH	BIC-DSC-111	Biomolecules with IKS
	DSC	2	2	TH	BIC-DSC-112	Basic Biochemistry-I
	DSC	2	4	PR	BIC-DSC-113	Practical based on Techniques in Biochemistry-I
	MIN	2	2	TH	BIC-MIN-111	Basic Biophysics and Biochemistry-I
	MIN	2	4	PR	BIC-MIN-112	Practical based on Biophysics and Biochemistry-I
	OE	2	2	TH	BIC-OE-111	Health Awareness
	SEC	2	2	TH	BIC-SEC-111	Fundamentals of Cell and Microbiology
	SEC	1	2	PR	BIC-SEC-112	Practical based on Cell and Microbiology
	AEC	2	2	TH	ENGs-AEC-111	English
	VEC	2	2	TH	ES -VEC-111	Environmental studies
	IKS	1	1	TH	IKS-111	Indian knowledge system
	CC	2	2	CC	NCC-CC-111 NSS-CC-111 SPT-CC-111 CUL-CC-111	NCC NSS Sports Cultural
II	DSC	2	2	TH	BIC-DSC-121	Biomolecules
	DSC	2	2	TH	BIC-DSC-122	Basic Biochemistry-II
	DSC	2	4	PR	BIC-DSC-123	Practical based on Techniques in Biochemistry-II
	MIN	2	2	TH	BIC-MIN-121	Basic Biophysics and Biochemistry-II
	MIN	2	4	PR	BIC-MIN-122	Practical based on Biophysics and Biochemistry-II
	OE	2	2	TH	BIC-OE-121	Infection Biology
	SEC	2	2	TH	BIC-SEC-121	Techniques in Microbiology
	SEC	1	2	PR	BIC-SEC-122	Practical based on Techniques in Microbiology
	AEC	2	2	TH	ENGs-AEC-121	English
	VEC	2	2	TH	CI-VEC-121	Constitution of India
	IKS	1	1	TH	IKS-121	Indian knowledge system
	CC	2	2	CC	NCC-CC-121 NSS-CC-121 SPT-CC-121 CUL-CC-121	NCC NSS Sports Cultural

Examination Pattern

Theory Question Paper Pattern:

- 30 (External) +20 (Internal) for 2 credits
 - External examination will be of 1½ hours duration
 - There shall be 3 questions: Q1 carrying 6 marks and Q2, Q3 carrying 12 marks each. The tentative pattern of question papers shall be as follows;
 - Q1 Attempt any 2 out of 3 sub-questions; each 3 marks
 - Q 2 and Q3 Attempt any 3 out of 4 sub-question; each 4 marks.

Rules of Continuous Internal Evaluation:

The Continuous Internal Evaluation for theory papers shall consist of two methods:

1. Continuous & Comprehensive Evaluation (CCE): CCE will carry a maximum of 30% weightage (30/15 marks) of the total marks for a course. Before the start of the academic session in each semester, the

subject teacher should choose any three assessment methods from the following list, with each method carrying 10/5 marks:

- i. Individual Assignments
- ii. Seminars/Classroom Presentations/Quizzes
- iii. Group Discussions/Class Discussion/Group Assignments
- iv. Case studies/Case lets
- v. Participatory & Industry-Integrated Learning/Field visits
- vi. Practical activities/Problem Solving Exercises
- vii. Participation in Seminars/Academic Events/Symposia, etc.
- viii. Mini Projects/Capstone Projects
- ix. Book review/Article review/Article preparation
- x. Any other academic activity
- xi. Each chosen CCE method shall be based on a particular unit of the syllabus, ensuring that three units of the syllabus are mapped to the CCEs.

2. Internal Assessment Tests (IAT): IAT will carry a maximum of 10% weightage (10/5 marks) of the total marks for a course. IAT shall be conducted at the end of the semester and will assess the remaining unit of the syllabus that was not covered by the CCEs. The subject teacher is at liberty to decide which units are to be assessed using CCEs and which unit is to be assessed on the basis of IAT. The overall weightage of Continuous Internal Evaluation (CCE + IAT) shall be 40% of the total marks for the course. The remaining 60% of the marks shall be allocated to the semester-end examinations. The subject teachers are required to communicate the chosen CCE methods and the corresponding syllabus units to the students at the beginning of the semester to ensure clarity and proper preparation.

Practical Examination Credit 2: Pattern (30+20)

External Practical Examination (30 marks):

- Practical examination shall be conducted by the respective department at the end of the semester.
- Practical examination will be of 3 hours duration and shall be conducted as per schedule.
- Practical examination shall be conducted for 2 consecutive days for 2 hr/ day where incubation conditionis required.
- There shall be 05 marks for journal and viva-voce. Certified journal is compulsory to appear for practical examination.
- External practical examination of SEC will be of 25 marks and there will be no internal exam for SEC practical.

Internal Practical Examination (20 marks):

- Internal practical examination of 10 marks will be conducted by department as per schedule given.
- For internal practical examination student must produce the laboratory journal of practicals completed along with the completion certificate signed by the concerned teacher and the Head of the department.
- There shall be continuous assessment of 30 marks based on student performance throughout the semester. This assessment can include quizzes, group discussions, presentations and other activities assigned by the faculty during regular practicals. For details refer internal theory examination guidelines.
- Finally 40 (10+30) marks performance of student will be converted into 20 marks.

SEMESTER-I

F.Y. B.Sc. Biochemistry (Major)
Semester-I
BIC-DSC-111: Biomolecules with IKS

Total Hours: 30

Credits: 2

Course Objectives	▪ To make students aware about rich Indian knowledge system of vedic science ▪ To accustom students with biochemistry and importance of carbohydrates ▪ To accustom students with biochemistry and importance of lipids ▪ To accustom students with biochemistry and importance of proteins	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Understand the rich heritage of IKS and scope of Biochemistry ▪ Understand biochemical importance of carbohydrates ▪ Understand biochemical importance of lipids ▪ Understand biochemical importance of proteins	
Unit	Contents	Hours
Unit I	History and scope of Biochemistry ▪ Vedic Life Science : Introduction ▪ Contribution of Sushrut, Charak, Patanjali, Parashara ▪ Contribution of scientists of modern India: Jagdish Chandra Bose, Srinivasa Ramanujan, C. V. Raman, Homi Jehangir Bhabha, Vikram Sarabhai, Har Gobind Khorana ▪ Historical development of Biochemistry: world-wide and in India. ▪ Scope of Biochemistry	08
Unit II	Carbohydrates ▪ Definition and biological importance of Carbohydrate ▪ Classification of Carbohydrates: Monosaccharides, Oligosaccharides and Polysaccharides (definition, general formulae, and examples). ▪ D and L forms of carbohydrates, epimers of glucose ▪ Cyclic structure of monosaccharides: pyranose and furanose form (glucose and fructose). ▪ Mutarotation: definition, example & mechanism ▪ Derivatives of monosaccharides: sugar alcohols, sugar acids, sugar phosphates, deoxy sugars and amino sugars ▪ Diasaccharides: sucrose, lactose, maltose ▪ Homopolysaccharides: Starch, Glycogen, Cellulose ▪ Heteropolysaccharides: Mucopolysaccharides, Hyaluronic acid, Chondroitin sulphate	07
Unit III	Lipids ▪ Classification of lipids: Simple lipids, Compound lipids and Derived lipids with examples ▪ Fatty acids: definition, nomenclature, Even & odd chain fatty acids, Saturated and unsaturated fattyacids ▪ Essential fatty acids: definition, examples, functions and deficiency ▪ Triacylglycerol: definition, occurrence, functions, structure (mono, di and tri-	08

	glycerols), simple and mixed triacylglycerol ▪ Properties of triacylglycerol: hydrolysis, saponification, rancidity, antioxidant, lipid peroxidation ▪ Purity evaluation of fats and oils: Iodine number, saponification number, Reichert-Meissl number, acid number ▪ Comparative account on animal and plant fat ▪ Functions of phospholipids ▪ Classification of phospholipids: Glycero-phospholipids; phosphatidic acid, lecithins, cephalins (structure and importance); Sphingo-phospholipids-structure and importance. ▪ Steroids: structure and functions of cholesterol and progesterone	
Unit IV	Amino acids, peptides and proteins ▪ Amino acids - definition, general structure, optical isomers, classification of amino acids based on structure, nutrition and metabolic fate. ▪ Peptides - definition and formation of peptide bonds, N- and C-terminals, representation of peptide chain, naming of peptide chain ▪ Protein - definition and levels of organization (primary, secondary, tertiary and quaternary). ▪ Bonds responsible for protein structure – covalent bonds (peptide and disulfide), non-covalent bonds (hydrogen, hydrophobic, and electro static bonds. Van der Waal's forces). ▪ Classification of proteins based on shape, composition and solubility, biological functions and nutrition. ▪ Denaturation of protein - agents and characteristics of denaturation	07
Study Resources	▪ Nelson, D. L. and Cox, M.M. (2021). Lehninger's Principles of Biochemistry 8th edition, W.H. Freeman and Company, New York, USA. ▪ Conn, E. E., Stumpf, P. K., Bruening G. and Doi R. H. (2008). Outlines of Biochemistry, Wiley India (P) Ltd., New Delhi. ▪ Stryer, L., Tymoczko, J. L. and Berg J. M. (2015). Biochemistry, W. H. Freeman and Company, New York, USA. ▪ Rastogi, S.C. (2019). Biochemistry, 4th edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi. ▪ Satyanarayana, U. and Chakrapani, U. (2020). Biochemistry, 5th edition, Books and Allied Pvt. Ltd., Kolkata, India. ▪ Agarwal, O. P. (2014). Text Book of Biochemistry (Physiological Chemistry), Goel Publishing House, A unit of, Krishna Prakashan Media Pvt. Ltd., Meerut, India. ▪ Jain, J.L., Jain, S. and Jain, N. (2016). Fundamentals of Biochemistry, 7th edition, S. Chand and Company Ltd., Delhi.	

F.Y. B.Sc. Biochemistry (Major)
Semester-I
BIC-DSC-112: Basic Biochemistry-I

Total Hours: 30

Credits: 2

Course Objectives	▪ To study the basic concepts of matter and its constituents ▪ To learn about solution and its concentration calculation ▪ To acquaint students with biological processes like diffusion, osmosis and adsorption ▪ To study various types of bonds present in biomolecules	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Understand concept of atom, subatomic particles and their masses. ▪ Differentiate between solutions and colloids and calculate solution concentration ▪ Understand importance of diffusion, osmosis and adsorption ▪ Understand various types of bonds present in biomolecules	
Unit	Contents	Hours
Unit I	Basic Concepts in Biochemistry ▪ Matter and its Classification ○ Classification ○ Properties of matter and their measurement ▪ Laws of chemical combination ▪ Dalton's atomic theory ▪ Concept of atom, subatomic particles (proton, neutron and electron), molecule, element and compound ▪ Isotopes, isobars and isotones ▪ Atomic and molecular masses: Atomic mass, Average atomic mass, molecular mass, formula mass, mole concept and molar mass ▪ Chemical equations and stoichiometry ▪ Isomerism and its types: structural and stereoisomerism ▪ Methods of analysis: qualitative and quantitative ▪ Mathematical operation and error analysis: scientific notation, precision and accuracy and significant figures	08
Unit II	Solutions and Colloids ▪ Definitions of solutes, solvents and solutions, types of solutions, capacity of solution to dissolve solute, solubility and factors affecting solubility ▪ Solvents: properties and types – protic and aprotic, polar and non-polar ▪ Concentration of solution: Mass percent, mole fraction, molarity, molality and normality, ppm, ppb ▪ Colloids: Introduction and examples, Classification based on physical state, affinity of phases and molecular size ▪ Properties of colloids: general properties, optical property (Tyndall effect), colour, kinetic property (Brownian motion) and electrical properties ▪ Applications of colloids ▪ Emulsions: types and properties ▪ Donnan membrane equilibrium	07

Unit III	Diffusion, Osmosis and Adsorption ▪ Diffusion: definition, diffusion- Fick's first law of diffusion co-efficient and its significance, types- simple, facilitated, active-primary and secondary diffusion ▪ Rate of diffusion and factors affecting it. ▪ Biological importance of diffusion ▪ Osmosis: definition, osmotic pressure, mechanism and salient features of osmotic pressure, Definition of osmole, osmolality and Osmolarity, Osmosis and plant cell, Importance of osmosis in medicine and biology ▪ Adsorption: Introduction, adsorbent, adsorbate, desorption, comparison between adsorption and absorption ▪ Types of adsorption: physisorption and chemisorption and their comparison ▪ Factors affecting adsorption ▪ Characteristics of adsorption ▪ Applications of adsorption	08
Unit IV	Types of Bonds ▪ Kossel- Lewis approach to chemical bond formation, Concept of electronegativity ▪ Inter-molecular forces: Definition, types- dipole-dipole interactions, ion-dipole interactions, dipole induced dipole interaction, London dispersion forces, hydrogen bonding ▪ Hydrophobic and hydrophilic interactions ▪ Ionic Bonding: Formation of ionic bonds, ▪ Covalent Bonding: sigma and pi bond, polar and non-polar covalent bond ▪ Co-ordination bond	07
Study Resources	▪ Nelson, D. L. and Cox, M.M. (2021). Lehninger's Principles of Biochemistry 8th edition, W.H. Freeman and Company, New York, USA. ▪ Stryer, L., Tymoczko J. L. and Berg, J. M. (2015). Biochemistry, W. H. Freeman and Company, New York, USA. ▪ Jain, J.L., Jain,S. and Jain,N. (2016). Fundamentals of Biochemistry, 7th edition, S. Chand and Company Ltd., Delhi. ▪ Puri, B. R., Sharma, L. R. and Pathaniya, M.S. (2021). Principles of Physical Chemistry, 48thedition, Vishal Publishing Co, Jalandhar, India ▪ Bahl, B. S., Tuli, G. D. and Bahl, A. (2020). Essentials of Physical Chemistry, 28thedition, S. Chand & Co Ltd. ▪ Daniels, F. (2010).Mathematical Preparation for Physical Chemistry, Mc Graw- Hill Publication. ▪ Barrow, G.M. (2008).Physical Chemistry, Tata McGrawHill ▪ Atkins, P., Paula, J. and Keeler, J. (2018).Atkins' Physical Chemistry, 11thedition, Oxford University Press ▪ Lee, J. D. (2008).Conciseinorganicchemistry, 5thedition, Blackwell Science Ltd. ▪ Satyaprakash,Tuli, G.D.,Basu, S.K. andMadan, R.D.(2017).AdvancedInorganicChemistry(VolI), 19thedition,S. Chand and CoLtd.	

F.Y. B.Sc. Biochemistry (Major)
Semester-I
BIC-DSC-113: Practical based on Techniques in Biochemistry-I

Total Hours: 60

Credits: 2

Course Objectives	▪ To make students familiar with safety measures in laboratory and common laboratory instruments ▪ To prepare normal and molar, and percent solutions ▪ To study biological process like diffusion and osmosis practically ▪ To study basic qualitative and quantitative tests for detection and estimation of biomolecules	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Understand safety measures in laboratory and principle and working of common laboratory instruments ▪ Prepare normal and molar, and percent solutions ▪ Understand biological process like diffusion and osmosis practically ▪ Perform qualitative and quantitative tests for detection and estimation of biomolecules	
Sr. No.	Contents	Hours
1	First aid, Hazardous Chemicals, Antidotes to hazardous and toxic chemicals, Safety measures in laboratory	4
2	Introduction of laboratory instruments- water bath, autoclave, hot-air oven, incubator, refrigerator, centrifuge, laminar air flow cabinet, pH meter, weighing balance, spectrophotometer	4
3	Problems based on preparation of normal and molar, and percent solutions	4
4	To prepare and standardize 0.1N HCl using sodium carbonate as primary standard	4
5	To prepare and standardize 0.1 N NaOH using Oxalic acid as primary standard	4
6	Estimation of acetic acid in commercial vinegar using standardized NaOH solution	4
7	Determination of diffusion of solute (sugar) across a semipermeable membrane	4
8	To demonstrate osmosis by potato osmometer	4
9	To prepare true solution, suspension and colloidal solutions and distinguish between them on the basis of transparency, filtration and stability criteria	4
10	Qualitative tests for carbohydrates- anthrone test, iodine test, Barfoed test, Seliwanoff's test, Fehling's test, Bial's test	4
11	Isolation of starch from potato	4
12	Qualitative tests for lipids- solubility test, acrolein test, presence of free fatty acids and unsaturated fatty acids	4

13	Qualitative tests for amino acids- Ninhydrin test, Xanthoproteic test, Ehrlich's test, Sodium nitroprusside test, Sullivan and McCarthy's test, Millon's test	4
14	Isolation of casein from milk	4
15	Estimation of protein by Biuret method	4
Study Resources	▪ Wilson, K. and Walker, J. (2003). Practical Biochemistry: Principles and techniques, 5th edition, Cambridge University Press, UK. ▪ Plummer, D. T. (2017). An Introduction to Practical Biochemistry, 3rd edition, Tata McGraw Hill Publishing Company Ltd., New Delhi. ▪ Oser, B. L. (ed.) (1965). Hawk's physiological chemistry, 14th edition, McGraw-Hill Book Company, New York, USA. ▪ Jayaraman, J. (2011). Laboratory Manual in Biochemistry, New Age International (P) Ltd. Publishers, New Delhi. ▪ Sadashivam, S. and Manikam, A. (2018). Biochemical Methods, 3rd edition, New Age International (P) Ltd. Publishers, New Delhi. ▪ Rao, B. S. and Deshpande, V. (2005). Experimental Biochemistry: A student companion, I. K. International Pvt. Ltd., New Delhi.	

Note: At least 12 experiments should be performed.

F.Y. B.Sc. Biochemistry (Minor)
Semester-I
BIC-MIN-111: Basic Biophysics and Biochemistry-I

Total Hours: 30

Credits: 2

Course Objectives	▪ To learn about solution and its concentration calculation ▪ To acquaint student with biological processes like diffusion, osmosis and adsorption ▪ To study various types of bonds present in biomolecules ▪ To accustom students with biochemistry and importance of carbohydrates, lipids and proteins	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Calculate solution concentration ▪ Understand importance of diffusion, osmosis and adsorption ▪ Understand various types of bonds present in biomolecules ▪ Understand biochemical importance of carbohydrates, lipids and proteins	
Unit	Contents	Hours
Unit I	Basic Concepts in Biochemistry ▪ Concept of matter and atom, subatomic particles (proton, neutron and electron), molecule, element and compound ▪ Atomic and molecular masses: Atomic mass, Average atomic mass, molecular mass, formula mass, mole concept and molar mass ▪ Definitions of solutes, solvents and solutions, types of solutions, capacity of solution to dissolve solute, solubility and factors affecting solubility ▪ Concentration of solution: Mass percent, mole fraction, molarity, molality and normality, ppm, ppb Types of Bonds ▪ Inter-molecular forces: Definition, types- dipole-dipole interactions, ion-dipole interactions, dipole induced dipole interaction, London dispersion forces, hydrogen bonding ▪ Hydrophobic and hydrophilic interactions ▪ Ionic Bonding: Formation of ionic bonds, ▪ Covalent Bonding: sigma and pi bond ▪ Co-ordination bond	08
Unit II	Diffusion, Osmosis and Adsorption ▪ Diffusion: definition, types- simple, facilitated, active-primary and secondary diffusion, ▪ Factors affecting diffusion. ▪ Biological importance of diffusion ▪ Osmosis: definition, osmotic pressure, mechanism and salient features of osmotic pressure, Definition of osmole, osmolality and Osmolarity, Osmosis and plant cell, Importance of osmosis in medicine and biology ▪ Adsorption: Introduction, adsorbent, adsorbate, desorption, comparison between adsorption and absorption ▪ Types of adsorption: physisorption and chemisorption and their comparison	07

	- Factors affecting adsorption - Characteristics of adsorption - Applications of adsorption	
Unit III	Carbohydrates - Definition of Biochemistry - Scope and significance of Biochemistry - Definition and biological importance of Carbohydrate - Classification of Carbohydrates: Monosaccharides, Oligosaccharides and Polysaccharides (definition, general formulae, and examples). - D and L forms of carbohydrates - Cyclic structure of monosaccharides: pyranose and furanose form (glucose and fructose). Lipids - Classification of lipids: Simple lipids, Compound lipids and Derived lipids with examples - Fatty acids: definition, nomenclature, Even & odd chain fatty acids, Saturated and unsaturated fatty acids - Triacylglycerol: definition, occurrence, functions, structure (mono, di and tri-glycerols), simple and mixed triacylglycerol - Classification of phospholipids: Glycero-phospholipids; phosphatidic acid, lecithins, cephalins (structure and importance); Sphingo-phospholipids-structure and importance. - Functions of phospholipids - Steroids: structure and functions of cholesterol	08
Unit IV	Amino acids, peptides and proteins - Amino acids - definition, general structure, optical isomers, classification of amino acids based on structure, nutrition and metabolic fate. - Peptides - definition and formation of peptide bonds, N- and C-terminals, representation of peptide chain, naming of peptide chain - Protein - definition and levels of organization (primary, secondary, tertiary and quaternary). - Bonds responsible for protein structure – covalent bonds (peptide and disulfide), non-covalent bonds (hydrogen, hydrophobic, and electrostatic bonds, Van der Waal's forces). - Classification of proteins based on shape, composition and solubility, biological functions and nutrition. - Denaturation of protein - agents and characteristics of denaturation	07
Study Resources	- Nelson, D. L. and Cox, M.M. (2021). Lehninger's Principles of Biochemistry 8th edition, W.H. Freeman and Company, New York, USA. - Stryer, L., Tymoczko, J. L. and Berg, J. M. (2015). Biochemistry, W. H. Freeman and Company, New York, USA. - Jain, J.L., Jain,S. and Jain,N. (2016). Fundamentals of Biochemistry, 7th edition, S. Chand and Company Ltd., Delhi. - Puri, B. R., Sharma, L. R. and Pathaniya, M.S. (2021). Principles of Physical Chemistry, 48thedition, Vishal Publishing Co, Jalandhar, India - Bahl, B. S., Tuli, G. D. and Bahl, A. (2020). Essentials of Physical Chemistry, 28thedition, S. Chand & Co Ltd.	

	▪ Daniels, F. (2010). Mathematical Preparation for Physical Chemistry, Mc Graw- Hill Publication. ▪ Barrow, G.M. (2008). Physical Chemistry, Tata McGrawHill ▪ Atkins, P., Paula, J. and Keeler, J. (2018). Atkins' Physical Chemistry, 11th edition, Oxford University Press ▪ Lee, J. D. (2008). Concise inorganic chemistry, 5th edition, Blackwell Science Ltd. ▪ Satyaprakash, Tuli, G.D., Basu, S.K. and Madan, R.D. (2017). Advanced Inorganic Chemistry (Vol II), 19th edition, S. Chand and Co Ltd.	
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F.Y. B.Sc. Biochemistry (Minor)
Semester-I

BIC-MIN-112: Practical based on Biophysics and Biochemistry-I

Total Hours: 60

Credits: 2

Course Objectives	▪ To make students familiar with safety measures in laboratory and common laboratory instruments ▪ To prepare normal and molar, and percent solutions ▪ To study biological process like diffusion and osmosis practically ▪ To study basic qualitative and quantitative tests for detection and estimation of biomolecules	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Understand safety measures in laboratory and principle and working of common laboratory instruments ▪ Prepare normal and molar, and percent solutions ▪ Understand biological process like diffusion and osmosis practically ▪ Perform qualitative and quantitative tests for detection and estimation of biomolecules	
Sr. No.	Contents	Hours
1	First aid, Hazardous Chemicals, Antidotes to hazardous and toxic chemicals, Safety measures in laboratory	4
2	Introduction of laboratory instruments-water bath, autoclave, hot-air oven, incubator, refrigerator, centrifuge, laminar air flow cabinet, pH meter, weighing balance, spectrophotometer	4
3	Problems based on preparation of normal and molar, and percent solutions	4
4	To prepare and standardize 0.1N HCl using sodium carbonate as primary standard	4
5	To prepare and standardize 0.1 N NaOH using Oxalic acid as primary standard	4
6	Estimation of acetic acid in commercial vinegar using standardized NaOH solution	4
7	Determination of diffusion of solute (sugar) across a semipermeable membrane	4
8	To demonstrate osmosis by potato osmometer	4
9	To prepare true solution, suspension and colloidal solutions and distinguish between them on the basis of transparency, filtration and stability criteria	4
10	Qualitative tests for carbohydrates – anthrone test, iodine test, Barfoed test, Seliwanoff's test, Fehling's test, Bial's test	4
11	Extraction of starch from potato	4
12	Qualitative tests for lipids – solubility test, acrolein test, presence of free fatty acids and unsaturated fatty acids	4

13	Qualitative tests for amino acids – Ninhydrin test, Xanthoproteic test, Ehrlich's test, Sodium nitroprusside test, Sullivan and McCarthy's test, Millon's test	4
14	Isolation of casein from milk	4
15	Estimation of protein by Biuret method	4
Study Resources	▪ Wilson, K. and Walker, J. (2003). Practical Biochemistry: Principles and techniques, 5th edition, Cambridge University Press, UK. ▪ Plummer, D. T. (2017). An Introduction to Practical Biochemistry, 3rd edition, Tata McGraw Hill Publishing Company Ltd., New Delhi. ▪ Oser, B. L. (ed.) (1965). Hawk's physiological chemistry, 14th edition, McGraw-Hill Book Company, New York, USA. ▪ Jayaraman, J. (2011). Laboratory Manual in Biochemistry, New Age International (P) Ltd. Publishers, New Delhi. ▪ Sadashivam, S. and Manikam, A. (2018). Biochemical Methods, 3rd edition, New Age International (P) Ltd. Publishers, New Delhi. ▪ Rao, B. S. and Deshpande, V. (2005). Experimental Biochemistry: A student companion, I. K. International Pvt. Ltd., New Delhi.	

Note: At least 12 experiments should be performed.

F.Y. B.Sc. Biochemistry (Open Elective)
Semester-I
BIC-OE-111: Health Awareness

Total Hours: 30

Credits: 2

Course Objectives	▪ To study the relationship between lifestyle and health. ▪ To make students aware about health problems faced during the college experience, and subsequently through out life. ▪ To make students able to cope up with stress. ▪ To accustom students with importance of fitness in life	
Course Outcomes	After successful completion of this course, students are expected to describe: ▪ Dimensions of health and wellness. ▪ Relationship between lifestyle and health. ▪ Physiological and psychological bases of stress. ▪ Key components of fitness.	
Unit	Contents	Hours
Unit I	Introduction to Health and Wellness ▪ Definition of Health and Wellness ▪ Personal Health Assessment ▪ Factors Contributing to Health Behavior Change Nutrition ▪ Introduction to Nutrition & Eating Right ○ Food Pyramid ○ Serving Size ▪ The Six Nutrients ▪ Eating for Good Health & Disease Prevention ○ Cancer/Heart Disease & Nutrition ▪ Obesity, Weight Management & Nutrition ▪ Diets and Dieting	08
Unit II	Fitness ▪ The Four Components of Fitness ○ Cardio-respiratory Endurance ○ Flexibility ○ Muscular Strength ○ Muscular Endurance ▪ Exercise, Health Promotion & Disease Prevention ▪ Eating for Fitness	07
Unit III	Stress ▪ Stress Definition ▪ Causes of Stress ○ Life Events and Daily Hassles ○ Social Stressors ○ Time Management Problems ○ College Stressors ▪ Coping with Stress	08

	○ Deep Breathing ○ Muscle Relaxation ○ Meditation ▪ Exercise & Physical Release	
Unit IV	Mental Health ▪ Definition of Mental Health ○ Characteristics of the Mentally Healthy ▪ Theories of Personality ▪ Major Mental Disorders ○ Depressive Disorders ○ Suicide ○ Eating Disorders ▪ Types of Therapy and Self-Help	07
Study Resources	▪ William, W Li. (2019). Eat to Beat Disease: The New Science of How Your Body Can Heal Itself, Grand Central Publishing ▪ Sreevani, R. (2023). A Guide To Mental Health & Psychiatric Nursing, 4th edition, Jaypee Brothers Medical Publishers Pvt Ltd ▪ Gupta, S., Jain Passi, S., Seth, R., Mahna, R., Puri, S. and Khanna, K. (2014). Textbook of Nutrition and Dietetics, 2nd edition, Elite Publishing House Pvt. Ltd ▪ Bamji, M.S., Rao, N.P. and Reddy, V. Eds. (2019). Textbook of Human Nutrition. 4th Edition. Oxford and IBH Publishing Co. Pvt. Ltd. ▪ Nutrition in Developmental Transition. (2006). NFI-WHO (SEARO) Symposium. NFI. ▪ ICMR. (2020). A brief note on Nutrient Requirements for Indians, the Recommended Dietary Allowances (RDA) and the Estimated Average Requirements (EAR), ICMR - NIN	

F.Y. B.Sc. Biochemistry (Major)
Semester-I
BIC-SEC-111: Fundamentals of Cell and Microbiology

Total Hours: 30

Credits: 2

Course Objectives	▪ To study ultra structure of prokaryotic and eukaryotic cell ▪ To study various types of microorganisms and their characteristics ▪ To study growth, nutrition and isolation of microorganisms ▪ To study various methods of controlling microorganisms	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Understand difference between prokaryotic and eukaryotic cells and cell organelles ▪ Understand various types of microorganisms and their characteristics ▪ Understand growth pattern, nutrition requirement and methods isolation of microorganisms ▪ Understand various methods of controlling microorganisms	
Unit	Contents	Hours
Unit I	Ultra structure of cell ▪ Definition of cell and its elemental composition ▪ Characteristics of prokaryotic and eukaryotic cell ▪ Comparative account on plant and animal cell ▪ Structure and functions of - cell wall, cell membrane (Fluid Mosaic model), cytoplasm, mitochondria, golgi complex, endoplasmic reticulum (smooth and rough), chloroplast, nucleus, ribosomes, lysosomes ▪ Cell cycle and division: Mitosis and meiosis	08
Unit II	Tissues and cell junctions ▪ Tissues- definition and types ▪ Epithelial tissues- general characteristics, functions and classification ▪ Simple and compound epithelial tissues- types, brief description, functions and locations ▪ Connective tissues- general characteristics and functions ▪ Types of connective tissues (cartilage, bone and blood)- brief overview, functions and locations ▪ Muscular tissues (skeletal, cardiac and smooth)- concise description, functions and locations ▪ Nervous tissues (neuron and neuroglia)- introductory description, functions and locations ▪ Cell junctions (complexes)- definition and types- tight junction, belt desmosome, spot desmosome and gap junction	07
Unit III	Characteristics of Microorganisms ▪ Types of microorganisms. General characteristics and significance of bacteria, algae, fungi, virus and protozoa. Classification based on nutrition and mode of reproduction. ▪ Major characteristics of microorganisms – morphological, chemical, metabolic, antigenic, and genetic characteristics.	08

	▪ Role of microorganisms in infection, fermentation, environment and agriculture. ▪ Morphology and fine structure of bacteria - size, shape, arrangements, structure of bacterial cell, ▪ Structure and functions of flagella, pilli, fimbriae, glycocalyx, capsule and cell wall of Gram positive and Gram negative bacteria.	
Unit IV	Microscopic Techniques ▪ Principle, working and applications of light microscope: ○ Lenses and ray diagram (bending of light) ○ Microscopic resolution ○ Bright-field microscope ○ Dark-field microscope ○ Phase contrast microscope ○ Fluorescence microscope ○ Inverted microscope ▪ Electron microscopy- Principle, working and applications: ○ Transmission Electron Microscope (TEM) ○ Scanning Electron Microscope (SEM)	07
Study Resources	▪ Stanier, R. Y., Ingraham, J. L., Wheelis, M. L. and Painter, P. R. (1999). General Microbiology, 5th edition, Macmillan Press Ltd. UK. ▪ Pelczar, M. J. Jr, Chan, E. C. S. and Krieg, N. R. (1985). Microbiology, 5th edition, Tata McGraw-Hill Education Pvt. Ltd, India ▪ Madigan, M. T., Martinko, J. M., Dunlap, P. V. and Clark, D. P. (2010). Brock Biology of Microorganisms 13th edition, Pearson Benjamin-Cummings, USA. ▪ Chincholkar, S. B., Chaudhari, A. B. and Patil, U. K. (2018). Foundation in Microbiology, 10th edition, Nirali Prakashan, Pune ▪ Wiley, J. M., Sherwood, L. M. and Woolverton, C. J. (2017). Prescott's Microbiology 10th edition, McGrawHill International, USA. ▪ Frobisher, M. Hinsdill, R., Crabtree, K. T. and Goodheart, C.R. (1974). Fundamentals of Microbiology, 9th edition, W. B. Saunder's Co. USA. ▪ Powar, C. B. and Dagainawala, H. F. (2010). General Microbiology Vol. I and II, 2nd edition, Himalaya Publishing House, Mumbai ▪ Powar, C.B. (2012). Cell Biology, 3rd edition, Himalaya Publishing House, Mumbai	

F.Y. B.Sc. Biochemistry (Major)
Semester-I
BIC-SEC-112: Practical based on Cell and Microbiology

Total Hours:30

Credits:1

Course Objectives	▪ To study compound microscope and its parts ▪ To visualize cell and cell organelles under microscope ▪ To study various phases of mitosis using microscope ▪ To study morphological characteristics of microorganisms using microscope
Course Outcomes	After successful completion of this course, students are expected to: ▪ Use, handle and take care of compound microscope ▪ Stain and visualize cell and cell organelles under microscope ▪ Identify various phases of mitosis under microscope ▪ Describe morphological characteristics of microorganisms
Sr. No.	Contents
1	Use, handling and care of compound microscope
2	Temporary mounting of available tissues
3	Visualization of mitochondria by Janus green stain
4	Differential staining for DNA and RNA in human cheek epithelial cells
5	Study of various phases of mitosis using suitable sample
6	Study of Fungus e.g.. Rhizopus/ Penicillium/ Aspergillus/ Fusarium using temporary mounts / permanent slides
7	Study of Algae/Blue Green Algae e.g. Spirogyra /Anabena / Nostoc/ Cyanobacteria using temporary mounts / permanent slides
8	Study of Protozoans e.g. Amoeba/Entamoeba/ Paramecium / Plasmodium using temporary mounts / permanent slides
Study Resources	▪ Cappuccino, J. G. and Sherman, N. (2014). Microbiology – a Laboratory Manual, 10thedition, Addison Wesley Publishing Company Inc., Boston, USA. ▪ Baker, F. J. (1967). Handbook of bacteriological techniques, 2nd edition, Butterworth & Co Publishers Ltd., UK. ▪ Oser, B. L. (ed.) (1965). Hawk's physiological chemistry, 14th edition, McGraw-Hill Book Company, New York, USA. ▪ Aneja, K. R. (2017). Experiments in Microbiology, Plant Pathology, and Biotechnology, 5thedition, New Age International (P). Ltd. Publishers, New Delhi. ▪ Gunasekaran, P. (2018). Laboratory Manual in Microbiology, 2ndedition, New Age International (P) Ltd. Publishers, New Delhi.

SEMESTER-II

F.Y. B.Sc. Biochemistry (Major)
Semester-II
BIC-DSC-121: Biomolecules

Total Hours: 30

Credits: 2

Course Objectives	▪ To accustom students with biochemical importance of enzymes ▪ To accustom students with biochemical importance of nucleic acids ▪ To accustom students with biochemical importance of vitamins ▪ To accustom students with biochemical importance of porphyrins, prostaglandins and secondary metabolites	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Describe classification and properties of enzymes and their industrial applications ▪ Discuss structure and function of DNA and RNA ▪ Differentiate between water and fat soluble vitamins and understand clinical significance of the vitamins ▪ Understand the biochemical importance of porphyrins, prostaglandins and secondary metabolites	
Unit	Contents	Hours
Unit I	Enzymes ▪ Definition and historical background of enzyme. ▪ Terminologies: intracellular enzymes, extracellular enzymes, holoenzymes, apoenzymes, prosthetic group, cofactor, coenzymes, isoenzymes, katal, international unit, turn over number and active site. ▪ Nomenclature on the basis of – substrate acted upon by enzyme, type of reaction catalysed, substrate acted upon and type of reaction catalysed, substance (product) that is synthesized, overall chemical reaction taken into consideration (Enzyme commission number). ▪ Classification of enzymes - six major classes with description and examples each with EC number and reaction. ▪ Factors affecting enzyme activity-effect of substrate concentration, enzyme concentration, product concentration, pH, temperature, activators, time, and inhibitors. ▪ Specificity of enzyme action - absolute specificity, group specificity, optical specificity and geometrical specificity. ▪ Active site - definition and salient features of active site. ▪ Mechanism of enzyme action – lock and key model, induced fit model. ▪ Industrial applications of enzymes	08
Unit II	Nucleic acids ▪ Definition and types of nucleic acid - DNA and RNA. ▪ Structural components of DNA and RNA - phosphoric acid, pentose sugar, nitrogenous bases - purines and pyrimidine (numbering of purine and pyrimidine rings and chemical names). ▪ Nucleosides - deoxyribonucleosides, ribonucleosides and nomenclature of	07

	nucleosides. ▪ Nucleotides - deoxyribonucleotides, ribonucleotides, nomenclature of nucleotides, mono-, di- and tri- ribo and deoxyribonucleotides, functions of nucleotides. ▪ DNA - formation of 5'-3'-phosphodiester bond, Watson and Crick model of DNA, Chargaff's rule. ▪ Forms of DNA - A-DNA, B-DNA, C-DNA and Z-DNA (condition, shape, helix diameter, rise per base pair, base pair per turn of helix, helix pitch, major and minor grooves). ▪ Denaturation of DNA: definition and its effect on UV absorption, viscosity, and specific optical rotation. ▪ Effect of pH and temperature on DNA denaturation, definition of renaturation of DNA. ▪ RNA - : structure, differences with DNA and types of RNA. rRNA - prokaryotic and eukaryotic rRNA and types. tRNA - cloverleaf structure. mRNA - hnRNA, exons, introns, splicing, 5' capping, 3' poly A tail.	
Unit III	Vitamins ▪ Definition, history and nomenclature. Classification - fat-soluble and water soluble vitamins. ▪ Fat-soluble vitamins - chemistry, dietary sources, recommended dietary allowance, biochemical functions, deficiencies, hypervitaminosis of vitamin A, D, E and K. ▪ Water-soluble vitamins - chemistry, dietary sources, recommended dietary allowance, biochemical functions, deficiencies, hypervitaminosis of vitamin C, B₁, B₆, and B₁₂.	08
Unit IV	Porphyrins, Prostaglandins and Secondary metabolites ▪ Porphyrins ○ Introduction to porphyrins of biological importance. ○ Hemoglobin, Chlorophyll, Cytochrome, their structure and significance. ▪ Prostaglandins ○ Introduction, structure and Synthesis of prostaglandins ○ Biochemical actions of prostaglandins ○ Biomedical applications of prostaglandins ▪ Secondary metabolites: ○ Introduction and biosynthetic pathway of secondary metabolites ○ Isoprenoid /terpenoids: classification, chemistry and role ○ Nitrogen containing secondary plant products: classification, chemistry and role ○ Plant phenolics: classification, chemistry and role	07
Study Resources	▪ Nelson, D. L. and Cox, M.M. (2021). Lehninger's Principles of Biochemistry 8th edition, W.H. Freeman and Company, New York, USA. ▪ Conn, E. E., Stumpf, P. K., Bruening, G. and Doi, R. H. (2008). Outlines of Biochemistry, Wiley India (P) Ltd., New Delhi. ▪ Stryer, L., Tymoczko J. L. and Berg, J. M. (2015). Biochemistry, W. H. Freeman and Company, New York, USA. ▪ Rastogi, S.C. (2019). Biochemistry, 4th edition, Tata McGraw-Hill	

	Publishing Company Ltd., New Delhi. ▪ Satyanarayana, U. and Chakrapani, U. (2020). Biochemistry, 5th edition, Books and Allied Pvt. Ltd., Kolkata, India. ▪ Agarwal, O. P. (2014). Text Book of Biochemistry (Physiological Chemistry)., Goel Publishing House, A unit of, Krishna Prakashan Media Pvt. Ltd., Meerut, India. ▪ Jain, J.L., Jain,S. and Jain,N. (2016). Fundamentals of Biochemistry, 7th edition, S. Chand and Company Ltd., Delhi.	
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F.Y. B.Sc. Biochemistry (Major)
Semester-II
BIC-DSC-122: Basic Biochemistry-II

Total Hours: 30

Credits: 2

Course Objectives	▪ To make students familiar with concept and significance of viscosity and surface tension in biological system ▪ To acquaint students with chemical, physical and ionic equilibrium ▪ To study the concept of electrolytes acids, bases and buffers ▪ To accustom students with first and second law of thermodynamics	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Understand significance of viscosity and surface tension in biological system and measure them ▪ Understand chemical, physical and ionic equilibrium and their importance ▪ Understand electrolytes acids, bases and buffers ▪ Discuss first and second law of thermodynamics	
Unit	Contents	Hours
Unit I	Viscosity and Surface tension ▪ Properties of water in relation to life process ○ Expansion on freezing ○ Uniquely high surface tension ○ Uniquely high heat capacity ○ High solvent power ▪ Viscosity-concept ○ Factors affecting viscosity ○ Measurement of viscosity • Capillary flow • Rotation of a cylinder immersed in solution • Rate of fall of a ball through solution ○ Applications of viscometry ○ Significance of viscosity in biological systems ▪ Surface tension-concept ○ Factors affecting surface tension ○ Measurement of surface tension	08
Unit II	Equilibrium ▪ Types of reaction: reversible and irreversible ▪ Equilibrium: Meaning, ▪ Equilibrium in physical processes: Liquid-vapour, solid-liquid and solid-vapour ▪ Equilibrium in chemical process: Rate of chemical reaction, law of mass action, equilibrium constant (Kc), characteristics of equilibrium constant, applications of equilibrium constant, factors affecting equilibrium	07
Unit III	Ionic equilibrium ▪ Introduction and definition	08

	- Types of electrolytes: strong and weak electrolytes, degree of dissociation - Acids and Bases: Arrhenius theory, Bronsted-Lowry theory, Lewis theory - Ionization of acids and bases, dissociation constant of weak acids and weak bases - Autoionization of water, pH scale, relationship between pH and pOH, Acidity, basicity and neutrality of aqueous solutions - Types of salts, hydrolysis of salts, buffers, Henderson-Hasselbalch equation, buffer action, properties and applications of buffers, Biological buffers	
Unit IV	Thermodynamics - Thermodynamics: definition, system and surroundings - System: Types and properties of systems, process and its types - Nature of heat and work - Internal energy - First law of thermodynamics: statement, formulation of first law - Enthalpy: definition, relationship between enthalpy and internal energy - Thermochemistry: enthalpy of chemical reaction, exothermic and endothermic reactions - Spontaneous process: energy and spontaneity, entropy, quantitative definition of entropy, entropy and spontaneity - Second law of thermodynamics - Gibb's energy: Gibb's energy and spontaneity, spontaneity and ΔH or ΔS, temperature of equilibrium, Gibb's function and equilibrium constant	07
Study Resources	- Nelson, D. L. and Cox, M.M. (2021). Lehninger's Principles of Biochemistry 8th edition, W.H. Freeman and Company, New York, USA. - Stryer, L., Tymoczko, J. L. and Berg, J. M. (2015). Biochemistry, W. H. Freeman and Company, New York, USA. - Jain, J.L., Jain,S. and Jain,N. (2016). Fundamentals of Biochemistry, 7th edition, S. Chand and Company Ltd., Delhi. - Puri, B. R., Sharma, L. R. and Pathaniya, M.S. (2021). Principles of Physical Chemistry, 48thedition, Vishal Publishing Co, Jalandhar, India - Bahl, B. S., Tuli, G. D. and Bahl, A. (2020). Essentials of Physical Chemistry, 28thedition, S. Chand & Co Ltd. - Daniels, F. (2010). Mathematical Preparation for Physical Chemistry, Mc Graw- Hill Publication. - Barrow, G.M. (2008). Physical Chemistry, Tata McGrawHill - Atkins, P., Paula, J. and Keeler, J. (2018). Atkins' Physical Chemistry, 11thedition, Oxford University Press - Lee, J. D. (2008).Conciseinorganicchemistry, 5thedition, Blackwell Science Ltd. - Satyaprakash,Tuli, G.D.,Basu, S.K. and Madan, R.D.(2017).AdvancedInorganicChemistry(VolI)., 19thedition, S. Chand and CoLtd.	

F.Y. B.Sc. Biochemistry (Major)
Semester-II
BIC-DSC-123: Practical based on Techniques in Biochemistry-II

Total Hours: 60

Credits: 2

Course Objectives	▪ To prepare buffer of desired molarity and pH ▪ To make students understand catalytic nature of enzymes ▪ To estimate biomolecules by spectrophotometric method ▪ To study viscosity and surface tension practically	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Prepare buffer of desired molarity and pH ▪ Understand catalytic nature of enzymes and effect of substrate concentration on enzyme activity ▪ Understand the working principle of spectrophotometer and use spectrophotometer for estimation of biomolecules ▪ Measure viscosity and surface tension	
Sr. No.	Contents	Hours
1	Preparation of buffer	4
2	Estimation of λ_{max} and extinction coefficient of a given chromophore	4
3	Qualitative test for amylase	4
4	Effect of substrate concentration on enzyme activity	4
5	Determination of density of liquid using specific gravity bottles	4
6	Determination of viscosity of suitable liquid using Ostwald viscometer	4
7	Measurement of surface tension of the given sample	4
8	Quantitative determination of DNA and RNA by spectrophotometric method	4
9	Thermal denaturation of DNA	4
10	Estimation of ascorbic acid by volumetric method	4
11	Estimation of ascorbic acid (Vitamin C) by spectrophotometric method	4
12	Estimation of chlorophyll pigments by spectrophotometric method	4
13	Hemoglobin estimation by using haematometer	4
14	Qualitative tests for detection of alkaloids	4
15	Qualitative tests for detection of phenolic compounds	4
Study Resources	▪ Wilson, K. and Walker, J. (2003). Practical Biochemistry: Principles and techniques, 5th edition, Cambridge University Press, UK. ▪ Plummer, D. T. (2017). An Introduction to Practical Biochemistry,	

	3rd edition, Tata McGraw Hill Publishing Company Ltd., New Delhi. ▪ Oser, B. L. (ed.) (1965). Hawk's physiological chemistry, 14th edition, McGraw-Hill Book Company, New York, USA. ▪ Jayaraman, J. (2011). Laboratory Manual in Biochemistry, New Age International (P) Ltd. Publishers, New Delhi. ▪ Sadashivam, S. and Manikam, A. (2018). Biochemical Methods, 3rd edition, New Age International (P) Ltd. Publishers, New Delhi. ▪ Rao, B. S. and Deshpande, V. (2005). Experimental Biochemistry: A student companion, I. K. International Pvt. Ltd., New Delhi.	
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Note: At least 12 experiments should be performed.

F.Y. B.Sc. Biochemistry (Minor)
Semester-II
BIC-MIN-121: Basic Biophysics and Biochemistry-II

Total Hours: 30

Credits: 2

Course Objectives	▪ To make students familiar with biophysical concepts of viscosity, surface tension and thermodynamics ▪ To acquaint students with ionic equilibrium ▪ To accustom students with significance of enzymes and nucleic acids ▪ To accustom students with significance of vitamins, porphyrins and secondary metabolites	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Understand significance of viscosity and surface tension in biological system and measure them ▪ Understand ionic equilibrium and importance of buffer in biological system ▪ Describe classification and properties of enzymes and structure and functions of DNA and RNA ▪ Understand clinical significance of the vitamins and biochemical importance of porphyrins and secondary metabolites	
Unit	Contents	Hours
Unit I	Viscosity and Surface tension ▪ Viscosity-concept ○ Factors affecting viscosity ○ Measurement of viscosity ○ Applications of viscometry ○ Significance of viscosity in biological systems ▪ Surface tension-concept ○ Factors affecting surface tension ○ Measurement of surface tension Thermodynamics ▪ Thermodynamics: definition, system and surroundings ▪ First law of thermodynamics: statement, formulation of first law ▪ Enthalpy: definition, relationship between enthalpy and internal energy ▪ Thermochemistry: exothermic and endothermic reactions ▪ Spontaneous process: energy and spontaneity, entropy, entropy and spontaneity ▪ Second law of thermodynamics ▪ Gibb's energy: Gibb's energy and spontaneity, spontaneity and ΔH or ΔS	08
Unit II	Ionic equilibrium ▪ Introduction and definition ▪ Types of electrolytes: strong and weak electrolytes, degree of dissociation ▪ Acids and Bases: Arrhenius theory, Bronsted-Lowry theory, Lewis theory ▪ Ionization of acids and bases, dissociation constant of weak acids and weak bases	07

	- Autoionization of water, pH scale, relationship between pH and pOH, Acidity, basicity and neutrality of aqueous solutions - Types of salts, hydrolysis of salts, buffers, Henderson-Hasselbalch equation, buffer action, properties and applications of buffers, Biological buffers	
Unit III	Enzymes - Definition and terminologies: intracellular enzymes, extracellular enzymes, holoenzymes, apoenzymes, prosthetic group, cofactor, coenzymes, isoenzymes, turn over number and active site. - Nomenclature of enzymes - Classification of enzymes - six major classes with description and examples each with EC number and reaction. - Factors affecting enzyme activity-effect of substrate concentration, enzyme concentration, product concentration, pH, temperature, activators, time, and inhibitors. Nucleic acids - Definition and types of nucleic acid - DNA and RNA. - Structural components of DNA and RNA - phosphoric acid, pentose sugar, nitrogenous bases - purines and pyrimidine - Nucleosides and nucleotides, functions of nucleotides. - Watson and Crick model of DNA, Chargaff's rule. - RNA: structure and types of RNA. rRNA - prokaryotic and eukaryotic rRNA and types. tRNA - cloverleaf structure. mRNA - hnRNA, exons, introns, splicing, 5' capping, 3' poly A tail.	08
Unit IV	Vitamins - Definition, Classification - fat-soluble and water soluble vitamins. - Fat-soluble vitamins - chemistry, dietary sources, recommended dietary allowance, biochemical functions, deficiencies, hypervitaminosis of vitamin A, D, E and K. - Water-soluble vitamins - chemistry, dietary sources, recommended dietary allowance, biochemical functions, deficiencies, hypervitaminosis of vitamin C, B₁, B₆, and B₁₂. Porphyrins and Secondary metabolites - Porphyrins - Introduction to porphyrins of biological importance. - Hemoglobin, Chlorophyll, Cytochrome, their structure and significance. - Secondary metabolites: - Introduction and biosynthetic pathway of secondary metabolites - Isoprenoid /terpenoids: classification, chemistry and role - Nitrogen containing secondary plant products: classification, chemistry and role - Plant phenolics: classification, chemistry and role	07
Study Resources	- Nelson, D. L. and Cox, M.M. (2021). Lehninger's Principles of Biochemistry 8th edition, W.H. Freeman and Company, New York, USA. - Stryer, L., Tymoczko, J. L. and Berg, J. M. (2015). Biochemistry, W. H. Freeman and Company, New York, USA. - Jain, J.L., Jain, S. and Jain, N. (2016). Fundamentals of Biochemistry, 7th	

	edition, S. Chand and Company Ltd., Delhi. ▪ Puri, B. R., Sharma, L. R. and Pathaniya, M.S. (2021). Principles of Physical Chemistry, 48th edition, Vishal Publishing Co, Jalandhar, India ▪ Bahl, B. S., Tuli, G. D. and Bahl, A. (2020). Essentials of Physical Chemistry, 28th edition, S. Chand & Co Ltd. ▪ Daniels, F. (2010). Mathematical Preparation for Physical Chemistry, McGraw-Hill Publication. ▪ Barrow, G.M. (2008). Physical Chemistry, Tata McGrawHill ▪ Atkins, P., Paula, J. and Keeler, J. (2018). Atkins' Physical Chemistry, 11th edition, Oxford University Press ▪ Lee, J. D. (2008). Concise inorganic chemistry, 5th edition, Blackwell Science Ltd. ▪ Satyaprakash, Tuli, G.D., Basu, S.K. and Madan, R.D. (2017). Advanced Inorganic Chemistry (Vol-I), 19th edition, S. Chand and Co Ltd.	
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F.Y. B.Sc. Biochemistry (Minor)
Semester-II
BIC-MIN-122: Practical based on Biophysics and Biochemistry-II

Total Hours: 60

Credits: 2

Course Objectives	▪ To prepare buffer of desired molarity and pH ▪ To make students understand catalytic nature of enzymes ▪ To estimate biomolecules by spectrophotometric method ▪ To study viscosity and surface tension practically	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Prepare buffer of desired molarity and pH ▪ Understand catalytic nature of enzymes and effect of substrate concentration on enzyme activity ▪ Understand the working principle of spectrophotometer and use spectrophotometer for estimation of biomolecules ▪ Measure viscosity and surface tension	
Sr. No.	Contents	Hours
1	Preparation of buffer	4
2	Estimation of λ_{max} and extinction coefficient of a given chromophore	4
3	Qualitative test for amylase	4
4	Effect of substrate concentration on enzyme activity	4
5	Determination of density of liquid using specific gravity bottles	4
6	Determination of viscosity of suitable liquid using Ostwald viscometer	4
7	Measurement of surface tension of the given sample	4
8	Quantitative determination of DNA and RNA by spectrophotometric method	4
9	Thermal denaturation of DNA	4
10	Estimation of ascorbic acid by volumetric method	4
11	Estimation of ascorbic acid (Vitamin C) by spectrophotometric method	4
12	Estimation of chlorophyll pigments by spectrophotometric method	4
13	Hemoglobin estimation by using haematometer	4
14	Qualitative tests for detection of alkaloids	4
15	Qualitative tests for detection of phenolic compounds	4
Study Resources	▪ Wilson, K. and Walker, J. (2003). Practical Biochemistry: Principles and techniques, 5th edition, Cambridge University Press, UK. ▪ Plummer, D. T. (2017). An Introduction to Practical Biochemistry,	

	3rd edition, Tata McGraw Hill Publishing Company Ltd., New Delhi. ▪ Oser, B. L. (ed.) (1965). Hawk's physiological chemistry, 14th edition, McGraw-Hill Book Company, New York, USA. ▪ Jayaraman, J. (2011). Laboratory Manual in Biochemistry, New Age International (P) Ltd. Publishers, New Delhi. ▪ Sadashivam, S. and Manikam, A. (2018). Biochemical Methods, 3rd edition, New Age International (P) Ltd. Publishers, New Delhi. ▪ Rao, B. S. and Deshpande, V. (2005). Experimental Biochemistry: A student companion, I. K. International Pvt. Ltd., New Delhi.	
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Note: At least 12 experiments should be performed.

F.Y. B.Sc. Biochemistry (Open Elective)
Semester-II
BIC-OE-121: Infection Biology

Total Hours: 30

Credits: 2

Course Objectives	- To study epidemiology, modes of disinfection and disease transmission of infectious diseases - To study important viral infections like HIV, hepatitis, ebolla etc - To study tuberculosis infection, its development, treatment and epidemiology - To study the important parasitic infections like Leishmaniasis, malaria, amoebiosis etc	
Course Outcomes	After successful completion of this course, students are expected to: - Understand epidemiology, modes of disinfection and disease transmission of infectious diseases - Understand development, treatment, and outbreak of important viral infections - Understand development, treatment and epidemiology of tuberculosis - Understand vector, transmission and treatment of important parasitic infections	
Unit	Contents	Hours
Unit I	Overview and introduction to infection biology - Historic perspectives - Kochs hypothesis - General events in establishment of infection, infectious dose, lethal dose, infectious disease epidemiology, nosocomial infections, antisepsis - Modes of disinfection/sterilization, modes of disease transmission, - Specific and non-specific defense responses	08
Unit II	Viral Infection - Development of HIV virus, HIV infection to humans - Structure of HIV virus, mechanism of HIV infection - Role of T cells in infection development, development of therapy against HIV, anti-retroviral therapy, HAART, economic loss by HIV at national & international level. - Hepatitis virus, types of hepatitis infection, viral outbreaks such as Corona, Ebolla, H1N1, and Zika virus.	07
Unit III	Bacterial Infection - Development of tuberculosis infection, - Diagnosis of tuberculosis - Epidemiology and geography of tuberculosis, - Treatment of tuberculosis, identification of drug targets, vaccine development for tuberculosis, mechanism of antituberculosis drug action, development of resistant, multidrug resistant - Economic loss by tuberculosis at national and international level - HIV-tuberculosis co-infection.	08

Unit IV	Parasitic Infection ▪ Leishmaniasis- epidemiology and geography of leishmaniasis, vector and transmission of leishmaniasis, host-pathogen interaction, diagnosis and treatment for leishmaniasis, genetics of leishmaniasis ▪ Mechanism of drug resistance and drug susceptibility for promastigotes and amastigotes, ▪ Malaria-History of malaria, life cycle of plasmodium, factors affecting transmission of parasite, vectors and epidemics, parasite metabolisms, secondary endosymbiosis, ▪ Drug resistant parasites, identification of drug targets ▪ Amoebiasis.	07
Study Resources	▪ Sherman, I. W. (1998). Malaria Parasite Biology, Pathogenesis, and Protection, American Society for Microbiology ▪ WHO technical series-949; Control of the leishmaniasis (ISBN 978 92 4 120949 6). ▪ Carter, J. and Saunders, V. A.(2013).Virology: Principles and Applications, 2nd edition,John Wiley & Sons ▪ Cole, S.T., Eisenach, K.D., McMurray, D.N. and Jacobs, W.R. (2005).Tuberculosis and the tubercle bacillus, ASM Press. ▪ Hacker, J.H. and Heesemann, J.(2002).Molecular infection biology: Interactions between microorganisms and cells. Wiley Blackwell Publishers	

F.Y. B.Sc. Biochemistry (Major)
Semester-II
BIC-SEC-121: Techniques in Microbiology

Total Hours: 30

Credits: 2

Course Objectives	▪ To accustom students with various microscopic techniques used for visualization of microbes ▪ To study various types of staining methods ▪ To acquaint students with various microbial isolation methods and biochemical techniques used for microbial identification ▪ To study sterilization and microbial preservation methods	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Understand and explore various microscopic techniques used for visualization of microbes ▪ Perform various types of staining methods for studying micro-organisms ▪ Isolate identify micro-organisms by various methods ▪ Sterilize the equipments and preserve micro-organisms	
Unit	Contents	Hours
Unit I	Growth, Nutrition and Isolation of Microorganisms ▪ Concept of growth. Growth curve – lag, log, stationary and death phase. ▪ Mathematical expression of growth – growth rate and generation time. ▪ Measurement of growth ○ Methods for determination of cell number- direct (breed method, counting chamber method, Coulter method) and indirect (total viable count) ○ Determination of cell mass – direct (measurement of dry weight of cell, measurement of cell nitrogen) and indirect (turbidometric) methods. ○ Determination of cell activity ▪ Nutritional classification of microorganisms. ▪ Media –ingredients, types on the basis of physical state, composition and use. ▪ Methods of isolation of bacteria on solid media – streakplate method, pour plate method, roll tube method and spread plate method.	08
Unit II	Staining Techniques ▪ Concepts of Dyes and Stains ▪ Types of stain (Acidic, Neutral and Basic) ▪ Mordant and fixative ▪ Preparation and fixation of smear ▪ Principles, procedures and interpretation of staining techniques: ○ Simple staining • Monochrome and Negative staining ○ Differential staining • Gram's staining and Acid fast staining (Ziehl Neelsen staining)	07

	○ Special staining • Spore staining & staining of metachromatic granules Biochemical and Molecular tests for Identification of Microorganisms ▪ Biochemical tests for Identification of microorganisms: Concepts, principles, procedures and interpretation: ○ Catalase Test ○ Starch hydrolysis test ○ Nitrate reductase test ○ Urease test ○ Casein hydrolysis test ○ Tyrosine hydrolysis test ○ IMViC test ○ TSI test ○ Sugar fermentation acid and gas production test ▪ Molecular test- 16s rRNA	
Unit III	Sterilization Techniques ▪ Definitions- sterilization, disinfection, antisepsis, sanitization, decontamination, pasteurization, preservation, germicidal and bactericides ▪ Sterilization ○ Heat- thermal death point, thermal death time, decimal reduction time • Moist heat- mode of action, steam underpressure, Fractional sterilization, Boilingwater, Pasteurization and canning • Dry heat- mode of action, incineration, hotair oven ○ Radiation- ionizing radiations, non-ionizingradiations ○ Chemical sterilization- ethylene oxide, formaldehyde ○ Filtration ▪ Factors influencing sterilization. ▪ Disinfection: characteristics of an ideal disinfectant ▪ Disinfectants- phenol and phenolic compounds, alcohol, heavy metals, halogens, dyes, detergents, hydrogen peroxide	08
Unit IV	Preservation Techniques ▪ Preservation: Concept, Definition and purpose ▪ Preservation in continuous metabolic active state: ○ Short-term preservation (Agar slants, Agar stabs), ○ Long-term preservation (Glycerol stocks, Mineral oil, Storage in soil), ▪ Suspended metabolic state: ○ Freeze drying (Lyophilization) ○ Drying in vacuum ○ Cryopreservation ○ Storage in silica gel ▪ Quality control of preserved stock cultures	07
Study Resources	▪ Madigan, M. T., Bender, K. S., Buckely, D. H., Sattley, W. M. and Stahl, D. A. (2018). Brock Biology of Microorganisms, NY Pearosn publisher. ▪ Talaro, K. P. and Chess, B. (2020). Foundations In Microbiology, 11th McGraw Hill. ▪ Tortora, G. J., Funke, B. R. and Case, C. L. (2018). Microbiology An Introduction, 13th edition, pearson Benjamin-Cummings Pub Co.	

	▪ Pelczar, M. J. Jr, Chan, E. C. S. and Krieg, N. R. (1985). Microbiology, 5thedition, Tata McGraw-Hill Education Pvt. Ltd, India ▪ Wiley, J. M., Sherwood, L. M. and Woolverton, C. J. (2017). Prescott's Microbiology 10thedition, McGrawHill International, USA. ▪ Aneja, K. R. (2017). Experiments in Microbiology, Plant Pathology, and Biotechnology, 5thedition, New Age International (P) Ltd. Publishers, New Delhi. ▪ Modi, H. A. (2019).A Handbook of Elementary Microbiology, Shanti Prakashan. ▪ Kale, V. and Bhusari, K. (2010). Practical Microbiology: Principles and Techniques, Himalaya Publishing House. ▪ Rajgopal, G. and Toora, B. D. (2020). Practical Biochemistry, 4thedition, Ahuja Publishing House. ▪ Maheshwari, D. K. (2012). Practical Microbiology, 3rd edition, S. Chand Publishing. ▪ Rajan, S. and Christy, S. R. (2015). Experimental procedures in Life Sciences, CBS Publishers and Distributors Pvt Ltd.	
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F.Y. B.Sc. Biochemistry (Major)
Semester-II
BIC-SEC-122: Practical based on Techniques in Microbiology

Total Hours:30

Credits:1

Course Objectives	▪ To acquaint students with micrometry ▪ To study various types of staining techniques ▪ To make students familiar with various biochemical tests for identification of microorganisms ▪ To accustom students with microorganism preservation techniques
Course Outcomes	After successful completion of this course, students are expected to: ▪ Determine the size of bacteria ▪ Perform various staining techniques like monochrome, negative, Gram staining etc. ▪ Identify micro-organisms using various biochemical tests ▪ Learn preservation of microorganism
Sr. No.	Contents
1	Preparation of culture media for bacterial cultivation (Nutrient broth and nutrient agar/ MacConkeys broth and MacConkeys agar).
2	Isolation and culture characterization of bacteria by streak plate techniques
3	Determination of viable count by spread plate method from water/soil sample
4	Study of bacterial morphology using Monochrome staining and negative staining
5	Study of Gram characteristics of bacteria using Gram's staining
6	Determination of microorganism size by micrometry
7	Biochemical Characterization of Bacteria– IMViC test
8	Preservation of bacterial culture by suitable method
Study Resources	▪ Cappuccino, J. G. and Sherman, N. (2014). Microbiology – a Laboratory Manual, 10th edition, Addison Wesley Publishing Company Inc., Boston, USA. ▪ Baker, F. J. (1967). Handbook of bacteriological techniques, 2nd edition, Butterworth & Co Publishers Ltd., UK. ▪ Oser, B. L. (ed.) (1965). Hawk's physiological chemistry, 14th edition, McGraw-Hill Book Company, New York, USA. ▪ Aneja, K. R. (2017). Experiments in Microbiology, Plant Pathology, and Biotechnology, 5th edition, New Age International (P) Ltd. Publishers, New Delhi. ▪ Gunasekaran, P. (2018). Laboratory Manual in Microbiology, 2nd edition, New Age International (P) Ltd. Publishers, New Delhi.

Equivalence F.Y. B.Sc. Biochemistry

Old syllabus AY 2019-20	NEP based syllabus AY 2023-24
SEM-I	
BC-111 Basic Biochemistry-I	BIC-DSC-111 Biomolecules with IKS
BC-112 Cell Biology	BIC-DSC-112 Fundamentals of Cell and Microbiology
BC-113 Practical course – Basic techniques in Biochemistry-I	BIC-DSC-113 Practical based on Techniques in Biochemistry-I
SEM-II	
BC-121 Basic Biochemistry-II	BIC-DSC-121 Biomolecules
BC-122 Basic Microbiology	BIC-SEC-122 Techniques in Microbiology
BC-123 Practical course – Basic techniques in Biochemistry-I	BIC-DSC-123 Practical based on Techniques in Biochemistry-II

AY: Academic Year

Skills acquired and Job prospects for the Biochemistry students

Biochemistry is the molecular basis of life. Degree program in Biochemistry teaches students the way several lifeless chemicals combine to produce a functional living organism. A significant attraction of the course is the ability to combine in-depth scientific knowledge with practical laboratory skills and the career opportunities in all sectors.

After successful completion of three years degree course in Biochemistry, student will be well versed with laboratory skills and transferable skills.

Laboratory Skills:

- Laboratory safety practices as well as aseptic techniques
- Accurate weighing and reagent preparation
- Skillful handling of basic and advanced instruments
- Calibration of basic instruments like pH meter, micropipettes etc
 - Advanced techniques like; Chromatography, Electrophoresis
 - Spectrometry, Polymerase Chain Reaction (PCR)
 - Plant Tissue Culture, Animal Tissue Culture
- Collection, organization and presentation of data
- Analysis, Logical thinking and interpretation of results

Transferable Skills:

During the course student will develop skills other than laboratory skills that are transferable across the number of career areas which include;

- Analytical skill, Observational skill
- Planning and Time management
- Mathematical and IT skills
- Creative thinking, Problem solving
- Report writing skill, Presentation skill

Job Opportunities:

After successful completion of B.Sc. in Biochemistry, student may continue further studies like M.Sc. in Biochemistry and then Ph.D. in Biochemistry and make career in research field. Students have opportunities in private as well as public (Government) sectors.

Private Sector:

Biochemist can work in quality control, quality assurance and R & D divisions of companies like-Biotech companies, Pharmaceutical companies, Chemical manufacturing companies, Food and Drink (includes brewing), Health and Beauty Care, Medical Instrument companies, Agricultural companies, Research Companies and Laboratories etc.

Public Sector:

Blood Service, Cancer research institutes, Environmental Pollution Control, Forensic Science, Hospitals, National Blood Services, Overseas Development, Public Health Entities, Public Health Laboratories, Agriculture and fisheries etc.

Job profiles:

Biochemist, Biologist, Biomedical Scientist, Biotechnologist, Chemical Examiners, Chemist, Clinical Scientist, Food Scientist, Forensic Scientist, Laboratory Technician, Microbiologist, Research Associates, Research Officers, Research Scientist etc.

Opportunities in higher studies

After successful completion of B.Sc. in Biochemistry, student may continue further studies like M.Sc. in Biochemistry / Biotechnology and pursue higher studies. Even students can pursue other courses where graduation is essential.

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