



Date :- 01/08/2024

NOTIFICATION

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

Ref. :- Decision of the Academic Council at its meeting held on 27/07/2024.

The Syllabi of B. Sc. in Biochemistry (First and Second Semesters) as per **NATIONAL EDUCATION POLICY – 2020 (2024 Pattern)** and approved by the Academic Council as referred above are hereby notified for implementation with effect from the academic year 2024-25.

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

Sd/-
Chairman,
Board of Studies

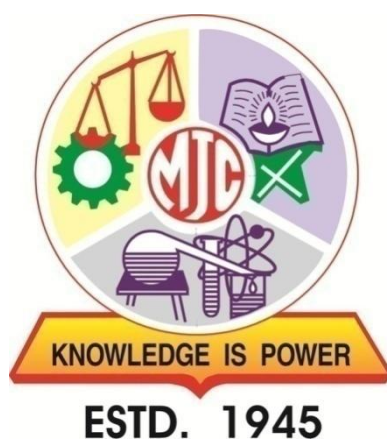
To :

- 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: 2024-25]

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 10th July 2024 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

F.Y. B.Sc.

Year (Lev el)	Sem	Subject-I (M-1)	Subject-II (M-2)	Subject-III (M-3)	Open Elective (OE)	VSC, SEC (VSEC)	AEC, VEC, IKS	CC, FP, CEP, OJT, RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
I (4.5)	I	DSC-1(2T) DSC-2(2P)	DSC-1(2T) DSC-2(2P)	DSC-1(2T) DSC-2(2P)	OE-1(2T)	---	AEC-1(2T) (Eng) VEC-1(2T) (ES) IKS(2T)	CC-1(2T)	22	UG Certificate
	II	DSC-3(2T) DSC-4(2P)	DSC-3(2T) DSC-4(2P)	DSC-3(2T) DSC-4(2P)	OE-2(2T) OE-3(2P)	---	AEC-2(2T) (Eng) VEC-2(2T) (CI)	CC-2(2T)	22	
	Cum. Cr.	8	8	8	6	---	10	4	44	
Exit option: Award of UG Certificate with 44 credits and an additional 4 credits core NSOF course/ Internship OR Continue with Major and Minor.										

S.Y. B.Sc.

Year (Level)	Sem	Subject-I (M-1) Major*		Subject-II (M-2) Minor #	Subject-III (M-3)	Open Elective (OE)	VSC, SEC (VSEC)	AEC, VEC, IKS	CC, FP, CEP, OJT/Int/RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
		Mandatory (DSC)	Elective (DSE)	(MIN)							
2 (5.0)	III	DSC-5(2T) DSC-6(2T) DSC-7(2P)	---	MIN-1(2T) MIN-2(2T) MIN-3(2P)	---	OE-4(2T)	SEC-1(2T)	AEC-3(2T) (MIL)	CC-3(2T) CEP(2)	22	UG Diploma
	IV	DSC-8(2T) DSC-9(2T) DSC-10(2P)	---	MIN-4(2T) MIN-5(2P)	---	OE-5(2T)	SEC-2(2T) SEC-2(2P)	AEC-4(2T) (MIL)	CC-4(2T) ⊗ FP(2)	22	
	Cum . Cr.	12	---	10	---	4	6	4	8	44	
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 & Minor.											

* Student must choose one subject as a Major subject out of M-1, M-2 and M-3 that he/she has chosen at First year

Student must choose one subject as a Minor subject out of M-1, M-2 and M-3 that he/she has chosen at First year (Minor must be other than Major)

⊗ OJT/Internship/CEP should be completed in the summer vacation after 4th semester

T.Y. B.Sc.

Year (Level)	Sem	Subject-I (M-1) Major		Subject-II (M-2) Minor	Subject-III (M-3)	Open Elective (OE)	VSC, SEC (VSEC)	AEC, VEC, IKS	CC, FP, CEP, OJT/Int/RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
		Mandatory (DSC)	Elective (DSE)	(MIN)							
3 (5.5)	V	DSC-11(2T) DSC-12(2T) DSC-13(2T) DSC-14(2P) DSC-15(2P)	DSE-1A/B (2T) DSE-2A/B (2P)	---	---	---	VSC-1(2T) VSC-2(2P)	---	OJT/Int (4)	22	UG Degree
	VI	DSC-16(2T) DSC-17(2T) DSC-18(2T) DSC-19(2T) DSC-20(2T) IKS DSC-21(2P) DSC-22(2P)	DSE-3A/B (2T) DSE-4A/B (2P)	---	---	---	VSC-3(2T) VSC-4(2P)	---	---	22	
	Cum . Cr.	24	8	---	---	---	8	---	4	44	
		Exit option: Award of UG Degree in Major with 132 credits OR Continue with Major and Minor									

Fourth Year B.Sc. (Honours)

Year (Level)	Sem	Major Core Subjects		Research Methodology (RM)	VSC, SEC (VSEC)	OE	AEC, VEC, IKS	CC, FP, CEP, OJT/Int/RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
IV (6.0)	VII	DSC-23(4T) DSC-24(4T) DSC-25(4T) DSC-26(2P)	DSE-5A/B (2T) DSE-6A/B (2P)	RM(4T)	---	---	---	---	22	UG Honours Degree
	VIII	DSC-27(4T) DSC-28(4T) DSC-29(4T) DSC-30(2P)	DSE-7A/B (2T) DSE-8A/B (2P)	---	---	---	---	OJT/Int (4)	22	
	Cum. Cr.	28	8	4	---	---	---	4	44	
Four Year UG Honors Degree in Major and Minor with 176 credits										

Fourth Year B.Sc. (Honours with Research)

Year (Level)	Sem	Major Core Subjects		Research Methodology (RM)	VSC, SEC (VSEC)	OE	AEC, VEC, IKS	CC, FP, CEP, OJT/Int/RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
IV (6.0)	VII	DSC-23(4T) DSC-24(4T) DSC-26(2P)	DSE-5A/B (2T) DSE-6A/B (2P)	RM(4T)	---	---	---	RP(4)	22	UG Honours with Research Degree
	VIII	DSC-27(4T) DSC-28(4T) DSC-30(2P)	DSE-7A/B (2T) DSE-8A/B (2P)	---	---	---	---	RP(8)	22	
	Cum. Cr.	20	8	4	---	---	---	12	44	
Four Year UG Honours with Research Degree in Major and Minor with 176 credits										

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-**Co-curricular **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

- Number in bracket indicate credit
- The courses which do not have practical 'P' will be treated as theory 'T'
- If student select subject other than faculty in the subjects M-1, M-2 and M-3, then that subject will be treated as Minor subject, and cannot be selected as Major at second year.

Details of F.Y. B.Sc. (Biochemistry)

Course	Course Type	Course Code	Course Title	Credits	Teaching Hours/ Week			Marks			
					T	P	Total	Internal		External	
								T	P	T	P
Semester I, Level – 4.5											
DSC-1	DSC	BIC-DSC-111	Cell Biology	2	2	---	2	20	---	30	---
DSC-2	DSC	BIC-DSC-112	Practical based on Cell Biology	2	---	4	4	---	20	---	30
OE-1	OE	BIC-OE-111	Health Awareness	2	2	---	2	20	---	30	---
Semester II, Level – 4.5											
DSC-3	DSC	BIC-DSC-121	Biomolecules	2	2	---	2	20	---	30	---
DSC-4	DSC	BIC-DSC-122	Practical based on Biomolecules	2	---	4	4	---	20	---	30
OE-2	OE	BIC-OE-121	Infection Biology	2	2	---	2	20	---	30	---
OE-3	OE	BIC-OE-122	Practical based on Health and Infection Biology	2	---	4	4	---	20	---	30

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: Cell Biology

Total Hours: 30

Credits: 2

Course Objectives	- To study ultra structure of prokaryotic and eukaryotic cell - To study the various phase of mitosis and meiosis - To study various types of plant and animal tissues - To study various types of microorganisms and their characteristics	
Course Outcomes	After successful completion of this course, students are expected to: - Differentiate between prokaryotic and eukaryotic cells; plant and animal cell - Understand structure and functions of various cell organelles - Understand various phases of mitosis and meiosis and their significance - Understand various types of plant and animal tissues - Understand various types of microorganisms and their characteristics	
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	07
Unit II	Cell division - Cell cycle: G₁, G₂, G₀ and S phase - Cell division: Mitosis- prophase, metaphase, anaphase, telophase and Cytokinesis - Significance of Mitosis - Cell division: Meiosis- Meiosis-I: Prophase-I (leptotene, zygotene, pachytene, diplotene, dikinesis), Metaphase-I, Anaphase-I, Telophase-I and Cytokinesis - Meiosis-II: Prophase-II, Metaphase-II, Anaphase-II, Telophase-II and Cytokinesis - Significance of meiosis	08
Unit III	Animal Tissues - Epithelial tissues- general characteristics, functions and classification - Simple and compound epithelial tissues- types, brief description, functions and locations - Connective tissues- general characteristics - Types of connective tissues (loose, dense, skeletal and vascular)- brief overview, functions and locations	08
Unit IV	Characteristics of Microorganisms - Viruses: Brief history, general properties, structure, multiplication, economic importance, viroids and prions - Bacteria:	07

	○ 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. ▪ Fungi: general characteristics, cell structure, growth, nutrition, reproduction ▪ Algae: general characteristics, habitat, thallus structure, nutrition, reproduction ▪ Protozoa: classification based on locomotion and general characteristics	
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: Practical based on Cell Biology

Total Hours: 60

Credits: 2

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	First aid, Hazardous Chemicals, Antidotes to hazardous and toxic chemicals, Safety measures in laboratory
2	Introduction of laboratory instruments- water bath, autoclave, hot-air oven, incubator, refrigerator, centrifuge, laminar air flow cabinet, pH meter, weighing balance, spectrophotometer
3	Use, handling and care of compound microscope
4	Temporary mounting of available tissues/cells and study of various tissues using permanent slides
5	Visualization of mitochondria by Janus green stain
6	Differential staining for DNA and RNA in human cheek epithelial cells
7	Study of various phases of mitosis using suitable sample and permanent slides
8	Study of bacterial morphology using Monochrome staining
9	Study of bacterial morphology using negative staining
10	Study of Gram characteristics of bacteria using Gram's staining
11	Study of acid fast characteristics of bacteria using Acid Fast staining
12	Determination of microorganism size by micrometry
13	Study of Fungus e.g., Rhizopus/ Penicillium/ Aspergillus/ Fusarium using temporary mounts / permanent slides
14	Study of Algae/Blue Green Algae e.g. Spirogyra /Anabena / Nostoc/ Cyanobacteria using temporary mounts / permanent slides
15	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, 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.

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	08

	○ College Stressors ▪ Coping with Stress ○ 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	

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 biochemistry and importance of carbohydrates ▪ To accustom students with biochemistry and importance of lipids ▪ To accustom students with biochemistry and importance of proteins ▪ To accustom students with biochemistry and importance of nucleic acids	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Understand biochemistry and importance of carbohydrates ▪ Understand biochemistry and importance of lipids ▪ Understand biochemistry and importance of proteins ▪ Understand biochemistry and importance of nucleic acids	
Unit	Contents	Hours
Unit I	Carbohydrates ▪ Definition, scope and importance 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, 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	08
Unit II	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-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	07

	- 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 III	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	08
Unit IV	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 and nucleotides – deoxy and ribo-nucleosides and tides. - Functions of nucleotides. - DNA - formation of 5'-3'-phosphodiester bond, Watson and Crick model of DNA, Chargaff's rule. - 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.	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-II
BIC-DSC-122: Practical based on Biomolecules

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	Problems based on preparation of normal and molar, and percent solutions	4
2	To prepare and standardize 0.1N HCl using sodium carbonate as primary standard	4
3	To prepare and standardize 0.1 N NaOH using Oxalic acid as primary standard	4
4	Preparation of buffer of desired molarity and pH	4
5	Qualitative tests for carbohydrates – anthrone test, iodine test, Barfoed test, Seliwanoff's test, Fehling's test, Bial's test	4
6	Extraction of starch from potato	4
7	Qualitative tests for lipids – solubility test, acrolein test, presence of free fatty acids and unsaturated fatty acids	4
8	Qualitative tests for amino acids – Ninhydrin test, Xanthoproteic test, Ehrlich's test, Sodium nitroprusside test, Sullivan and McCarthy's test, Millon's test	4
9	Isolation of casein from milk	4
10	Principle and Working of UV-Vis spectrophotometer	4
11	Estimation of λ_{max} and extinction coefficient of a given chromophore	4
12	Estimation of free fatty acids in the given lipid sample (Acid value)	4
13	Estimation of protein by Biuret method	4
14	Quantitative determination of DNA and RNA by spectrophotometric method	4
15	Thermal denaturation of DNA	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-OE-122: Practical based on Health and Infection Biology

Total Hours: 60

Credits: 2

Course Objectives	▪ To make students conscious about health ▪ To accustom students with basic health related tests	
Course Outcomes	After successful completion of this course, students are expected to: ▪ perform and understand importance of blood group detection, bleeding and clotting time, and blood pressure measurement ▪ detect the adulteration in the food material ▪ visualize micro-organisms under microscope	
Sr. No.	Contents	Hours
1	To measure the body mass index (BMI)	4
2	Blood group detection and cross matching of blood	4
3	To measure the blood pressure	4
4	To determine the bleeding time and clotting time	4
5	Meditation	4
6	Pranayam	4
7	Yognidra	4
8	To detect the adulteration in the given food material	4
9	Use, handling and care of compound microscope	4
10	Visualization of bacteria using monochrome stain	4
11	Visualization of bacteria using negative stain	4
12	Visualization of bacteria using Gram stain	4
13	Qualitative tests for carbohydrates – anthrone test and iodine test	4
14	Qualitative tests for proteins-Ninhydrin test and Biuret test	4
15	Visualization of microorganisms (Fungi/Protozoa/Algae) using permanent slides	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. ▪ 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.	
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Note: At least 12 experiments should be performed.

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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