M. G. Science Institute, Ahmedabad
(Autonomous)

Affiliated to Gujarat University, Ahmedabad

(Managed by the Ahmedabad Education Society)

Department of Biochemistry

Bachelor of Science (Hons.) in Biochemistry

B.Sc. (Hons.) Biochemistry

4 Year, 8 Semesters Full-Time Programme

Choice Based Credit System (CBCS) & Grading System

Outcome-Based Education Pattern

(Effective from Academic Year 2024-25)

1.0 Preamble

Biochemistry today, is considered as an application oriented integrated basic science that has emerged by confluence of principles of Chemistry, Physics and Mathematics to biology.

The programme endeavors to provide students a broad based training in biochemistry with a strong background of basic concept as well as exposing them to the exciting advancement in the field. Apart from theoretical knowledge an emphasis has been given to provide hands on experience to the students in the forefront areas of Biochemistry.

2.0 Definitions

Bachelor Degree

Bachelor's Degree is designed to offer the undergoing students a broad foundation necessary for a science-based career with a special focus on multidisciplinary learning.

Bachelor Degree (Hons.)

Bachelor's Degree (Hons.) aims at providing advanced and specialized theoretical and research skills in the chosen science subject, along with the overall knowledge in the sciences, to provide the students a strong platform for an advanced academic or professional career.

Choice Based Credit System

The Choice Based Credit System (CBCS) provides an opportunity for the students to choose courses from the prescribed courses comprising Core, minor, multi-disciplinary, or skill-based courses.

Credit

Credits means the value assigned to a course which indicates the level of instruction:

1 hour lecture per week equals 1 credit

2 hours practical per week equals 1 credit

Credit for a practical could be proposed as part of a course or as a separate practical course.

SGPA

SGPA means Semester Grade Point Average calculated for individual semesters.

CGPA

CGPA means Cumulative Grade Point Average calculated for all courses completed by the students at any point of time. CGPA is calculated for each year for both semesters clubbed together.

Course

A course is a specific subject in the academic programme taught in a particular semester for the specifically assigned number of credits.

Course Announcement

The college shall announce the elective courses it proposes to offer to the students out of the wider course basket. It is not mandatory to offer all the electives. The decision of the principal shall be final in this case. However, in the spirit of Choice Based Credit System, the college should offer choices to the students for the elective courses and not offer only the minimum number of electives.

Course Registration

It is mandatory for every student, to register every semester, for the elective courses opted for that semester. Each student, on admission, shall be assigned to a Faculty Advisor who shall advise him/her about the academic programs and counsel on the choice of courses considering the student's profile, career goals, and courses taken in the earlier semesters. With the advice and consent of the Faculty Advisor, the student shall register for a set of courses he/she plans to take up for the Semester. Students shall have to register for the courses for the semester within the first week of Semester I and immediately after the conclusion of the preceding term for subsequent Semesters II, III, IV, V, VI, VII, and VIII.

Course Outcomes

Course outcomes are the specific and measurable attributes defining the knowledge, skill and attitude of the learners are expected to demonstrate by the completion of the course.

Grading System

The Grading System is the 10-point standard scale system defined by the UGC comprising of the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA).

Letter Grade	Grade Point
O (Outstanding)	10
A+ (Excellent)	9
A (Very Good)	8
B+ (Good)	7
B (Above Average)	6
C (Average)	5
P (Pass)	4
F (Fail)	0
Ab (Absent)	0

Graduate Attributes

The Graduate Attributes are the generic abilities, attitudes and approaches expected to be demonstrated by the learner in the world around him/her in a longer period of the life time.

Learning Outcomes

Learning outcomes describe the measurable skills, abilities, knowledge, or values that students should be able to demonstrate as a result of completing a course.

Outcome Based Education (OBE) Approach

OBE is the approach focusing on the performance outcome comprising of the following:

a. The performer – the student (learner), not only the teacher.
b. The performable (thus demonstrable or assessable) to perform
c. The performance outcome, not the activity or task to be performed.

Outcome-Based Assessment

An assessment system that asks course teachers to first identify what it is that we expect students to be able to do once they have completed a course or program. It then asks course teachers to provide evidence that they are able to do so. In other words, how will each learning outcome be assessed? What **evidence of student learning** is most **relevant for each learning outcome** and **what standard or criteria** will be used to evaluate that evidence? Assessment is therefore a key part of outcome-based education and used to determine whether or not a qualification has been achieved.

Programme Educational Objectives

Programme Educational Objectives are a set of **broad future-focused student performance outcomes** that explicitly identify what students will be **able to do with what they have learned**, and what **they will be like** after they leave school and are **living full and productive lives**. Thus, PEOs are what the programme is preparing graduates for in their **career and professional life** (to attain within a **few years** after graduation).

Programme Outcomes

Programme Outcomes are a set of **narrow statements** that describe what learners of the programme are expected to know and be able to perform or attain by the time of graduation.

Programme Specific Outcomes

The PSOs are a set of narrow statements that describe what the learners of a particular specialization of the programme are expected to know and be able to perform or attain by the time of graduation. PSOs are also a function of the various course combinations offered by the college.

Semester

The Semester means the one half of the academic year comprising of the teaching days and examination & evaluation days as per the UGC/ University norms.

Teaching and Learning Activities

The set of **pedagogical tools and techniques** or the teaching and learning activities that aim to **help students to attain** the intended learning outcomes and engage them in these learning activities through the teaching process.

3.0 B.Sc. Programme Focus

3.1. Programme Educational Objectives (PEOs)

3.2 Program specific outcomes:

PSO1: Describe the nature and basic concepts of Life sciences and understand their interrelationship with Biochemistry. To help develop an interest and create a strong knowledge domain in the subject of Biochemistry and Biochemical research.

PSO2: Learn technical skills through hands on training in Instrumentation & Research methodology (discipline specific), laboratory sessions, mini research projects and develop self directed experimental learning.

PSO3: To be able to develop scientific approach, frame scientific hypothesis & design experiments, to investigate and document the findings. They learn to analyze, apply & develop critical thinking to answer scientific challenges in interdisciplinary fields.

PSO4: To apply appropriate tools & techniques in Biochemistry, to develop academic, professional, research competence so as to be able to pursue higher studies & join the industrial sectors. To develop employability in Hospitals, Pharma Industries, Clinical Laboratories, Nutrition & Dietetics, Medical Biochemistry & Biotechnology Sectors.

PSO5: To be able to explore entrepreneurial abilities & establish companies or laboratories based on Instrumentation, Biologics, Molecular Biology, Genetic Engineering, Biotechnology and Immunology.

PSO6: Ability to communicate and express scientific ideas. Develop interpersonal skills and other soft skills.

4.0 B.Sc.Programme Course Types and Evaluation Pattern

Sr. No.	Course Type	Credits	Nature	CCE Marks	ECE Marks	Total Marks
1	Major Course	4	Compulsory	50	50	100
2	Minor Course	4	Compulsory	50	50	100
3	Multidisciplinary Course	4	Elective	50	50	100
4	Skill Enhancement Course	2	Elective	25	25	50
5	Ability Enhancement Course	2	Elective	25	25	50
6	Indian Knowledge System/ Value Added Courses	2	Elective	25	25	50

Courses Types Definitions:

1. **Major Course (DSC-C)**
   Discipline-specific course core is a course that a student admitted to a particular programme must successfully complete receiving the degree and which cannot be substituted by any other course.

2. **Minor Course (DSC-M)**

A discipline Specific Minor Course refers to a set of academic courses that form a focused and specialized area of study within a particular discipline. Students have the option to

Pursue a minor alongside their major allowing them to gain additional expertise in a specific subject.

3. **Multidisciplinary Course (IDC)**
   A multidisciplinary course is a course chosen generally from a related discipline/subject, intending to seek exposure in the discipline relating to the core domain of the student.
4. **Skill Enhancement Course (SEC)**
   Skill Enhancement Course is designed to provide students with specific skills or knowledge in addition to their primary academic pursuits. The main purpose of the SEC is to provide students with practical skills, life skills, soft skills, hands-on training, etc. to increase their employability.
5. **Ability Enhancement Course (AEC)**
   The ability enhancement course is designed to improve students' communication, language, and personality development skills. The main purpose of the AEC is to introduce students to the theory, fundamentals, and tools of communication and to develop in them vital communication skills that should be integral to personal, social, and professional interactions.
6. **Indian Knowledge System (IKS)**
   Indian Knowledge System refers to the rich and diverse heritage of knowledge, wisdom, and traditions that have evolved over millennia within the Indian subcontinent.
7. **Value-aided Course (VAC)**
   Value-aided courses refer to those courses designed to enhance the standard of the students beyond those levels specified in the academic curriculum.

5.0 B.Sc. Programme Structure

B.Sc. (Hons.) Biochemistry is a four-year programme divided into eight semesters. A student is required to complete 176 credits for the completion of the programme and the award of B.Sc. (Hons.) Biochemistry degree.

The B.Sc. (Hons.) Biochemistry programme is aligned with the NEP-2020 structure as given in below Table.

Courses	No. of Papers	Credits Each	Total Credits
1. DSC-Major	22	4	88
2. DSC-Minor	8	4	32
3. IDC-Multi	3	4	12
4. AEC	5	2	10
5. SEC **Internship**	5 1	2 4	10 4
6. IKS/VAC **OJT/RP**	4 2	2 6	8 12
		Total	**176**

Details of Programme

Year	Semester	Course Type (Credits)						
1st Year	Sem-I	Major-1 (4)	Major-2 (4)	Minor-1 (4)	MDC-1 (4)	AEC-1 (2)	SEC-1 (2)	IKS-1 (2)
	Sem-II	Major-3 (4)	Major-4 (4)	Minor-2 (4)	MDC-2 (4)	AEC-2 (2)	SEC-2 (2)	VAC-1 (2)
2nd Year	Sem-III	Major-5 (4)	Major-6 (4)	Major-7 (4)	MDC-3 (4)	AEC-3 (2)	SEC-3 (2)	IKS-2 (2)
	Sem-IV	Major-8 (4)	Major-9 (4)	Major-10 (4)	Minor-3 (4)	AEC-4 (2)	SEC-4 (2)	VAC-2 (2)
3rd Year	Sem-V	Major-11 (4)	Major-12 (4)	Major-13 (4)	Minor-4 (4)	Minor-5 (4)	SEC-5 (2)	-
	Sem-VI	Major-14 (4)	Major-15 (4)	Major-16 (4)	Minor-6 (4)	AEC-5 (2)	Internship (4)	-
4th Year	Sem-VII	Major-17 (4)	Major-18 (4)	Major-19 (4)	Minor-7 (4)	-	OJT/RP-1 (6)	-
	Sem-VIII	Major-20 (4)	Major-21 (4)	Major-22 (4)	Minor-8 (4)	-	OJT/RP-2 (6)	-

6.0 Multiple Entry-Exit Option

The B.Sc. programme is fully compliant with the Curriculum and Credit Framework for Undergraduate Programmes issued by the UGC. Accordingly, the programme provides the exit option to the learners at the end of the first year with **UG Certificate** awarded, at the end of the second year with **UG Diploma** awarded, at the end of the third year with **UG Degree** awarded and at the end of the fourth year with **UG Honors Degree** awarded. The learners choosing to exit the programme at the end of the first year or at the end of the second year will be allowed to, subject to successful completion of the relevant portion of the curriculum, shall be allowed to re-enter within a period of three years and complete the degree programme within a period of maximum seven years from the year of the first admission. All the other details are as provided in Sec.3.2.3 of the Curriculum and Credit Framework for Undergraduate Programmes issued by the UGC in December 2022.

7.0 Internship Project

Every learner must undergo and complete the internships/apprenticeships in a firm/ industry/organization or training in labs with faculty or researchers in their own or other college/institute/research institution during the summer term. Completion of the Summer Internship shall be mandatory for every learner choosing to exit at the end of the first year with a UG Certificate or at the end of the second year with a UG Diploma. The Internship Project shall carry the weightage of 4 credits. Since the internship is categorized as Practice, every learner will have to actually produce the work for 120 hours during the internship.

Evaluation of the Internship Project:

It is mandatory for the student to seek advance written approval from the faculty guide and the HOD for the internship and organization before commencing the internship.

a. It is mandatory for the student to seek advance written approval from the faculty guide and the Director of the Institute about the topic and organization before commencing the SIP.
b. Students shall also seek a formal evaluation of their Internship Project from the external guide. The formal evaluation by the external guide shall be done for 50 marks and comment on the nature and quantum of work undertaken by the student, the effectiveness and overall professionalism. The learning outcomes of the Internship Project and utility

of the project to the host organization must be specifically highlighted in the formal evaluation by the external guide. The Internship Project evaluation sheet duly signed and stamped by the external guide shall be included in the final Internship report.

c. The completion of the SIP shall be certified by the respective Faculty Guide & approved by the Director of the Institute.
d. The college level evaluation shall be for 50 marks through the Viva-Voce conducted by the faculty guide and HOD of the respective department.
e. Copies of SIP report and records of evaluation shall be maintained by the college for a period of 5 academic years.

8.0 ComprehensiveInternal Evaluation (CIE)/Comprehensive Concurrent Evaluation (CCE)

1. The course teacher shall prepare the scheme of Comprehensive Concurrent Evaluation (Formative Assessment) before commencement of the term. The scheme of Comprehensive Concurrent Evaluation shall explicitly state the linkages of each CCE with the Course Outcomes and define the targeted attainment levels for each CO.
2. The Head of the Department shall approve the scheme of Comprehensive Concurrent Evaluation with or without modifications.
3. The course teacher shall display, on the notice board/ ERP, the approved CCE scheme of the course and the same shall also be hosted on the website, not later than the first week of the term.
4. Each CCE item shall be of minimum 25 marks.
5. For a 4 Credit Course there shall be a MINIMUM of three CCE items. The final scores shall be converted to 50, using an average or best two out of three formulae.
6. For 2 Credit Course there shall be a MINIMUM of two CCE items. The final scores shall be converted to 50.
7. CCE shall be spread through the duration of course and shall be conceptualized, executed, assessed and documented by the course teacher along with student-wise and class-wise attainment levels of the COs and the attainment levels of the course.
8. The assessment outcome of each CCE shall be duly signed by the course teacher & the programme coordinator / HOD of the college.
9. A copy of the duly signed CCE outcome shall be displayed on the notice boards/ ERP, within a week of the assessment and course teachers shall guide the students on a need basis.
10. The college may conduct additional make up / remedial CCE items at its discretion.
11. At the end of the term aggregate CCE scores/grades shall be calculated and the CO attainment levels shall be calculated by the course teacher. The same shall be displayed on the notice board/ ERP.
12. Records of CCE shall be retained for 5 years from the completion of the Academic Year. i.e. Current Academic Year (CAY) + 4 years.

The comprehensive internal evaluation shall be conducted by the college once a semester. The maximum marks for 4 credit courses shall be 50 and for 2 credit courses shall be 25 marks.

9.0 End-Semester Evaluation

1. The End Semester Evaluation (Summative Evaluation) for all the courses shall be conducted by the Examination Department/Committee of the college headed by a full-

time regular faculty member nominated by the Principal as Controller of the Examination.

2. The ESE for each course shall have the weightage as follows:
    - For a 4 Credit Course: 50 marks
    - For a 2 Credit Course: 25 marks
3. The ESE for each course shall have 5 questions each of 10 marks. In case of 2 Credit courses the aggregate marks out of 50 shall be converted to the level proportionate to 25 marks.
4. All questions shall be compulsory with internal choice within the questions.
5. The broad structure of the ESE question paper shall be as follows:

Question Number	COGNITIVEABILITIES EVALUATED	Nature
Q.1	REMEMBERING	Answer any5out of 8 (2markseach)
Q.2	UNDERSTANDING	Answer any2out of 3(5markseach)
Q.3	APPLYING	Answer 3(a) or 3(b) (10marks)
Q.4	ANALYSING	Answer 4(a) or 4(b) (10marks)
Q.5	EVALUATING	Answer 5(a) or 5(b) (10marks)
	CREATING	

10.0 Passing Standard

A learner shall be said to have earned the credits for a course if he/she earns minimum 36% marks.

Formative Evaluation and Summative Evaluation shall be separate head of passing.

Grading System

The Indirect and Absolute Grading System shall be used, i.e. the assessment of individual Courses in the concerned examinations will be on the basis of marks. However, the marks shall later be converted into Grades by a defined mechanism wherein the overall performance of the learners can be reflected after considering the Credit Points for any given course. The overall evaluation shall be designated in terms of Grade. The 10-point standard scale mandated by UGC shall be used.

The performance of a student will be evaluated in terms of two indices, viz.

(a) Semester Grade Point Average (SGPA) which is the Grade Point Average for a semester

(b) Cumulative Grade Point Average (CGPA) which is the Grade Point Average for all the completed semesters at any point in time

Letter Grade	Grade Point
O (Outstanding)	10
A+ (Excellent)	9
A (Very Good)	8
B+ (Good)	7
B (Above Average)	6
C (Average)	5
P (Pass)	4
F (Fail)	0
Ab (Absent)	0

Grade Point (Gi) (10 points scale) = Marks of each paper out of 100 / 10

Marks out of 100	Grade Point Range (Gi)	Letter Grade	Classification
96.0-100	10	O	Outstanding
86.0-95.9	9	A+	Excellent
76.0-85.9	8	A	Very Good
66.0-75.9	7	B+	Good
56.0-65.9	6	B	Above Average
46.0-55.9	5	C	Average
36.0-45.9	4	P	Pass
Below 36.0	0	F	Fail
Absent	0	Ab	Absent

The Semester Grade Point Average (SGPA) is the ratio of the sum of the product of the number of credits with the grade point scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.,

$$\text{SGPA (Si)} = \Sigma (Ci \times Gi) / \Sigma Ci$$

where Ci is the number of credits of the i^{th} course and Gi is the grade point scored by the student in the i^{th} course.

The cumulative grade point average (CGPA) is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.,

$$\text{CGPA} = \Sigma (Ci \times Si) / \Sigma Ci$$

where Si is the SGPA of the i^{th} semester and Ci is the total number of credits in that i^{th} semester.

The SGPA and CGPA shall be rounded off to 2 decimal points.

Scaling Down of the CIE Score

The marks obtained by the student for the CCE shall be scaled down, to the required extent, if the percentage of the marks of CCE exceeds the percentage of marks scored in the ESE (End Semester University Examination) by 25% for the respective course.

Degree Requirements

The degree requirements for the B.Sc. DSA programme are the completion of a minimum 136 credits and 180 credits in case of an Honours degree.

Maximum Duration for Completion of the Programme

The program of the study is four years of eight semesters. A candidate shall complete his/her degree within **seven (7)** academic years from the date of his/her admission to the first semester.

Grade Improvement

There shall be a provision for candidates to reappear for the examination for the concerned course of theory papers only (subject) in which the candidate wishes for improvement of his/ her grade point of SGPA in general and CGPA in a total of the program subject to the condition that:

a) The candidate shall be eligible to reappear for improvement of grade points only after successfully passing the program.
b) The candidate may opt for the examination for any number of courses (subject/paper)of the programme for improvement of grade points but not more than three times for eachcourse (subject/paper) as per the prevailing syllabus of the examination conducted inthe regular schedule of University examinations.
c) All such provisions are there within 04 years from successful completion of theprogramme, but not exceeding the period of 08 years of the duration of completion of the programme.
d) In all such cases grade points are considered if there is a progress in such improvements,otherwise, original grade points shall be retained.
e) No such candidates shall be eligible for the award of Rank, Gold Medal, Cash Prize, etc.
f) The validity of credits earned will be for a maximum period of seven years or as specified by the Academic Bank of Credits (ABC).

11.0 Attendance

The student must meet the requirement of 75% attendance per semester per course for grant of the term. The college may condone the shortage in attendance in exceptional circumstances, up to a maximum of 10%. The college shall have the right to withhold the student from appearing for examination of a specific course if the above requirement is not fulfilled.

12.0 Medium of Instruction

The medium of instruction and evaluation shall be English.

13.0 Detailed Course List for B. Sc. (Hons) Biochemistry: (Annexure-1)

Biochemistry Major Courses (Compulsory Course – 4 Credits Each)

Course Code	Course Title	Semester	Hours/Week
BIM111 (T)	Concepts of Biochemistry	1	4
BIM112 (P)	Biochemistry Practicals	1	8
BIM121 (T)	Cell Biology & Complex Biomolecules	2	4
BIM122 (P)	Biochemistry Practicals	2	8
BIM231 (T)	Analytical Biochemistry	3	4
BIM232 (T)	Functional Biomolecules	3	4
BIM233 (P)	Biochemistry Practicals	3	8
BIM241 (T)	Concepts in Biophysics, Biostatistics & Microbiology	4	4
BIM242 (T)	Human Physiology & Nutrition	4	4
BIM243 (P)	Biochemistry Practicals	4	8
BIM351 (T)	Metabolism	5	4
BIM352 (T)	Molecular Biology	5	4
BIM353 (P)	Biochemistry Practicals	5	8
BIM361 (T)	Advance Microbiology & Nutrition	6	4
BIM362 (T)	Immunology	6	4
BIM363 (P)	Biochemistry Practicals	6	8
BIM471 (T)	Research Methodology & Bioinformatics	7	4
BIM472 (T)	Genetics & Introduction to Forensic Science	7	4
BIM473 (P)	Biochemistry Practicals	7	8
BIM481 (T)	Metabolic Diseases & Metabolic Syndromes	8	4
BIM482 (T)	Animal & Plant Biotechnology	8	4
BIM483 (P)	Internship	8	8

Minor Courses: (Compulsory Course – 4 Credits Each)

Course Code	Course Title	Semester	Hours/Week
BIM354T	Enzymology	5	4
BIM355T	Techniques in Biotechnology	5	4
BIM364T	Applications of Biotechnology	6	4
BIM474T	Environmental Biochemistry	7	4
BIM484T	Plant Biochemistry	8	4

Skill Enhancement Courses: (Compulsory Course – 2 Credits Each)

Course Code	Course Title	Semester
BISEC116 (T+P)	Biocomposting	1
BISEC126 (T+P)	Instrumentation & Biotechniques	2
BISEC236 (T+P)	Media Preparation, Sterilization & Isolation of Microbes	3
BISEC246 (T+P)	Mushroom Cultivation - Spawn formation	4
BISEC356 (T+P)	Pathology & Clinical Training	5
BISEC	Internship	6

Common Value Added Courses: (6 Credits Each)

Course Code	Course Title	Semester
OJT/RP	Research Project	7
OJP/RP	Research Project	8

14.0 Detailed Course for B.Sc. (Hons) Biochemistry: (Annexure 2)

B. Sc., Biochemistry
Semester I (Major)

Discipline Specific Course Core (Major)

BIM111 (T)

Concepts in Biochemistry

Course Structure with respect to credit, hours and marks

Course Type	Course	Credit	Work Hours/ week	Exam hours	Marks		Total Mark
					Internal	External	
Discipline-specific Courses – Core	BIM111T Concepts in Biochemistry	4	4	4	50	50	100
	BIM112 P	4	8	8	50	50	100

* BIM 112 P = Biochemistry Practical Exam (3Hours+3Hours = 6 Hours)

N.B: Each practical batch should have 20 students

Number of students per batch during practical exam: 20

Course outcomes:

On successful completion of the course, students will be able to:

CO1: Learn about the importance of Biochemistry & its development as an independent discipline.

CO2: Get an overview on theories of Origin of Life and Evolution.

CO3: Get an understanding about the chemical and molecular foundations of life

CO4: Learn about the basic unit of life, i.e., Cell & Cell Theory

CO5: Will learn & understand about the structure, properties and roles of all major Biomolecules.

CO6: Apply the knowledge in understanding the role of bonds and spatial arrangements of molecules for proper functioning and stability.

BIM111 (T) : Concepts in Biochemistry

Unit No	Title of the Unit & Content	No. Of Hrs Total (60)
1	Introduction to Biochemistry and Origin Of Life	15
2	Introduction to Biomolecules	15
3	Advance Biomolecules –I: Carbohydrates and Lipids	15
4	Advance Biomolecules –II Amino acids & Peptides	15

UNIT 1: Introduction to Biochemistry

Introduction:
Definition, History, Foundation, Scope and Applications of Biochemistry,
Biochemistry as the molecular logic of living organisms, Axioms of living matter, Origin of life, RNA world, Brief Introduction to Evolution and Mutation
Major organic compounds of living organisms, including Enzymes, Hormones and Vitamins
Cell: Define Cell, Cell organization, Postulates of Cell theory, and Classification of Living organisms, Differences between Prokaryotes and Eukaryotes, Plant Cell and Animal Cell
Chemical bonds: Types, Covalent bonds, Non-covalent bonds (Hydrogen bond, Ionic bonds, Vander Waal forces, Ionic bonds), Co-ordinate bonds
Functional groups and Linkage: Carboxyl group, Amino group, Hydroxyl group, Sulphydryl group etc., Peptide Linkage, Phosphodiester linkage, Glycosidic linkage, Ester linkage

UNIT 2: Biomolecules

Carbohydrates:
Introduction, Classification Structure of Monosaccharide, Aldosugar, Ketosugar, Hexose, Glycosidic bonds.

Amino acids:
Introduction, Classification of Standard amino acids with structures
Non-protein Amino acids: Beta Alanine, GABA, Citrulline; Rare Amino acids: 4 Hydroxy Proline, Selenocysteine, Desmosine- Isodesmosine; (Three examples of each with structures); Essential Amino acids, Conditionally Essential Amino acids (/Semi-essential Amino acids), and Non-essential amino acids

Lipids:
Definition, Classification and Functions of Lipids
Classification and Structure of Fatty acids: Saturated, Unsaturated, Hydroxyl, Cyclic, Branched-chain, Essential fatty acids, MUFA, PUFA

Proteins:
Introduction, Functions of Proteins

Nucleic Acids:
Introduction, history and functions of Nucleic Acids (DNA& RNA),
Nucleic acid structure: Nitrogen Bases, Nucleoside and Nucleotide. (Including structures)
Differences between DNA and RNA

UNIT 3: Advance Biomolecules –I: Carbohydrates and Lipids

Carbohydrates:
Oligosaccharides: Structure, Function and Occurrence
Physical properties: Isomerism, Asymmetric carbon atom, Mutarotation.
Chemical properties: Hemiacetal, Hemiketal reaction, Fischer to Howarth conversion,
Oxidation and Reduction of Sugars

Lipids:
Physical properties of Fatty acids(State, Solubility, Melting point, Boiling point, Specific gravity, Polymorphism)
Differences between Liquid fats and Solid fats
Isomerism in fatty acids(Positional, Geometrical (Cis-Trans)
Chemical properties of Fatty acids: Salt formation- Soap formation and Action, Detergent formation, Esterification, Hydrogenation, Oxidation, Halogenation.
Triglycerides: Types, Chemical composition, Functions.
Chemical properties of Triglycerides: Hydrolysis, Saponification, Hydrogenation, Oxidation, Halogenation, Acetylation
Chemical constants of fats: Saponification number, Iodine number, Reichert Meissl number, Acetyl number, Acid number
Rancidity of fats: Hydrolytic, Oxidative and Lipolytic, Prevention of Rancidity
Waxes: Natural Waxes, Types, Properties, Importance

UNIT 4: Advance Biomolecules –II: Amino acids & Peptides

Amino acids:

Physical properties of amino acid: Stereoisomerism, Optical isomerism, Acid-base properties or Ampholytic property of amino acid; Isoelectric pH

Titration curve of Amino acids Alanine

Chemical reactions of amino acids:

Due to -COOH group: Decarboxylation, Amide formation.

Due to -NH_2 group: Sanger's reaction, Edman's reaction, Dansyl chloride reaction, Oxidative deamination by Ninhydrin.

Colour reactions of amino acids:

Ninhydrin reaction, Hopkin-Coles reaction, Ehrlich reaction, Nitropruside reaction, Sakaguchi reaction, Xanthoprotic reaction, Millon's reaction, Sullivan's reaction, Pauly's reaction, Folin- Phenol reaction

Peptides:

Structure, Formation & Characteristics of peptide bond

Brief Physiological role of peptides: Glutathione, Oxytocin, Insulin, Glucagon

Reference books :

1. Text Book of Biochemistry 4th Edition By West and Todd
2. Biochemistry (6th Edition) By; Breg J M Tymoczko T J Stryer L
3. BiochemistryD.Voet and Voet J 5th Edition
4. Concept in Biochemistry By Rodney Boyer 2nd Edition
5. Nelson DL and Cox MM; Lehninger's Principles of Biochemistry 6th edition
6. Fundamentals of Biochemistry By J.L.Jain, S.Jain and N.Jain 7th Edition
7. Biochemistry, U.Satyanarayan & U Chakrapani 6th Edition
8. Fundamentals of Biochemistry BY Deb A.C.

Semester I Biochemistry (Major)

BIM112 (P): Biochemistry Practicals

Course Outcomes:

By the end of the course, the students will be able to:

CO1: Get acquainted with different laboratory instruments & equipment

CO2: Use micropipettes and other glass wares

CO3: Understand micro units& conversions

CO4: Learn the use of a microscope

CO5: Learn to do calculations for reagent preparation & prepare laboratory solutions & reagents

CO6: Carry on analysis of Biomolecules from mixtures

CO7: Develop essential skills to analyze & demonstrate various Biomolecules

BIM112 (P): Biochemistry Practicals

I. Basic practical:

1. Introduction to biochemistry laboratory.-I
2. Introduction to biochemistry laboratory.-II
3. Biochemical reagent preparations for various solutions with respect to different Normality, Molarity, Molality, % Solution (W/V, W/W, V/V) and Numerical.
4. Use of Microscope and microscopic examination of osazone.

II. Qualitative analysis:

5. Introduction to qualitative analysis of Carbohydrates.: Colour reactions of carbohydrates:
6. Qualitative tests for Monosaccharide: Glucose
7. Qualitative tests for Monosaccharide: Fructose
8. Qualitative tests for Monosaccharide: Galactose
9. Qualitative tests for Disaccharide: Lactose
10. Qualitative tests for Disaccharide: Maltose
11. Qualitative tests for Disaccharide: Sucrose
12. Qualitative tests for Polysaccharide: Starch
13. Qualitative tests for sugar mixtures: Monosaccharide + Monosaccharide
14. Qualitative tests for sugar mixtures: Monosaccharide + Disaccharide

15. Qualitative tests for sugar mixtures: Disaccharide + Disaccharide
16. Qualitative analysis by color reactions of Amino acids
17. Analysis of physical properties of Lipids.

Reference books:

1. Juryman J Laboratory manual in Biochemistry
2. An Introduction to Practical Biochemistry by: David T Plummer
3. Biochemical Methods bySadasivan and Manickam
4. Laboratory Manual & Practical Biochemistry, 4th Edition by T. N. Pattabiraman
5. Laboratory Manual for Practical Biochemistry by Shivaraja Shankara Ym

B. Sc. Semester I, Biochemistry

Skill Enhancement Course (SEC)

BISEC116 (T+P)

Course Structure with respect to credit, hours and marks:

Course Type	Course	Credit	Work Hours/ week	Exam hours	Marks		Total Mark
					Internal	External	
Skill Enhancement course	BISEC116 (T+P) Bio-composting	2(1+1)	2	2	25	25	50

Course Title: Biocomposting

Course outcomes:

On successful completion of the course, students will be able to:

CO1: To provide scientific understanding of analytical techniques & detailed interpretations of results.

CO2: To learn & understand form hands on training the applications of instruments & techniques in isolation & separation of Biomolecules.

CO3: To learn to demonstrate & observe microbial samples under light compound microscope.

Bio-composting

	Title Of The Unit & Contents	Total No. Of Hrs (45)
Theory	Introduction to Bio – composting (Theory) Vermicomposting Technology (Theory	15
	Project:	
Practical	Minor Project on Bio- composting	30

Project Based:

Theory:

Introduction to Bio – composting (Theory) & **Vermicomposting Technology:**

Introduction to Bio-composting; Benefits from Bio-composting
Methods of Bio-composting Preparation: Compost Pile; Waste used in Vermicomposting
Factors affecting Composting: Carbon, Nitrogen, Oxygen and Water: C:N ratio, Presence of Urine; Microorganisms
Types of Bio-composting: Bio-dung Composting, Compost tea, Vermicomposting, Bokashi Composting, Industrial Composting

Working Mechanism of Vermicomposting
Importance of Vermicomposting
Physical qualities of Vermicomposting
Vermicomposting using earthworms
Benefits of Vermicomposting
Suppliers of Vermicompost in India

Practical: Minor Project on Bio- composting:

Students will be asked to collect different types of organic waste, make bio-compost, and finally analyze the same.

Reference:

Advanced Biotechnology by Dr. R C Dubey, Publisher: S Chand

M G Science Institute, Ahmedabad

B. Sc., Semester II, Biochemistry (Major)

Discipline Specific Course Core (Major)

BIM121 (T): Cell Biology & Complex Biomolecules

Course Structure with respect to credit, hours and marks

Course Type	Course	Credit	Work Hours/ week	Exam hours	Marks		Total Mark
					Internal	External	
Discipline-specific Courses – Core	BIM121 T Concepts in Biochemistry	4	4	4	50	50	100
	BIM122 P	4	8	8	50	50	100

* BIM122 P = Biochemistry Practical Exam (3Hours+3Hours = 6 Hours)

N.B: Each practical batch should have 20 students

Number of students per batch during practical exam: 20

BIM121 (T) - (Credits-4): Cell Biology & Complex Biomolecules

Course Outcome:

To enable the students on completion of the course to:

CO1: Familiarize with basic concepts of Cell and molecular biology to develop a strong foundation for the future courses

CO2: Gain knowledge of the complexity and harmony of the cell to perform various functions of life and to get an idea about the principles of basic molecular events in the cell.

CO3: Understand the structure, properties, organisation & role of complex Biomolecules, including Proteins, Complex Carbohydrates and Complex Lipids.

BIM121 (T)-(Credits-4): Cell Biology & Complex Biomolecules

UNIT NO	TITLE OF THE UNIT & CONTENTS	No. of Hours Total hrs = 60
1	Fundamentals of Cell Biology	15
2	Foundation of Molecular Biology	15
3	Proteins : Structure, Properties & Functions	15
4	Carbohydrates & Complex Lipids	15

UNIT 1: Fundamentals of Cell Biology

Cell Organelles:
Structure, Composition, and Functions of Plant and Animal Cell organelles:
Cytosol, Plasma membrane, Nucleus, Mitochondria, Endoplasmic reticulum (ER), Plastids-Chloroplasts, Ribosomes, Lysosomes
Cell wall, Golgi bodies, Peroxisomes and Glyoxysomes. (Brief outline of the organelles)
Cell Division & Cycle

UNIT 2: Foundation of Molecular Biology

The structure and properties of DNA:
Double helical structure of DNA:Watson & Crick Postulates
The structure, types and the role of RNA:

Ribosomal RNA (rRNA), Transfer RNA (tRNA), Messenger RNA (mRNA), other types of RNA (snRNA, scRNA, hnRNA, miRNA, siRNA)

Central Dogma of life; (Brief outline, mainly definitions): Replication, Transcription & Translation.

Nucleotide derivatives :(Structure & their two functions each):

ATP, cAMP, SAM, GTP, UDP- glucose, CDP- Choline

Chromosome structure:

Definitions: Gene, Genome, Chromatin, Chromatid, Chromosomes, Autosomes, Karyotype, Centromere, Telomeres, Histones, Nucleosomes, Super coiling, Informosome.

UNIT 3: Proteins: Structure, Properties & Functions

Classification based on solubility, shape and composition.

Structure of proteins: Primary, Secondary, Tertiary and Quaternary structures.

Quaternary Structure of Haemoglobin Protein

Determination of sequences of amino acids in proteins by Sanger's method

Physical Properties Of proteins: Isoelectric pH of proteins, Hydration, Behaviours in solution: Solubility, Salting in and Salting out of proteins, Precipitation of proteins by Acid reagents, Heavy metals, Denaturation by Heat, Extreme pH changes, and other agents and Renaturation of proteins.

Chemical properties of proteins: Oxidation Reduction of Disulfide bond,

Biological functions of Conjugated Proteins: Glycoproteins, Lipoproteins, Nucleoprotein

UNIT 4: Carbohydrates & Complex Lipids:

Chemical properties of carbohydrate:

Due to aldehyde and keto groups: Oxidation of sugars, Reduction of sugars, Lobry de Bruyn-von Ekenstein reaction, reducing action of sugars in alkaline medium, Action of mineral acids, Action of hydroxylamine, Action of hydrogen cyanide, Action of hydrazine Chemical properties of carbohydrate due to hydroxyl groups: Formation of esters, ethers and glycosides, Importance of glycosides.

Transformation of sugars:

Step up and step down synthesis, aldo and keto conversions, Sugars to Uronic acids, Sugars to vitamin Oligosaccharide and Poly sachharides their sourcs, structure and functions

Complex carbohydrates:

Poly Sachharides: Occurrence, Structure functions and importance of: Starch, Glycogen, Cellulose, Chitin, Inulin, Pectin, Agar-agar

Glycosaminoglycans:

Occurrence, Structure and functions of : Hyaluronic Acid, Heparin, Chondroitinsulphate A, Chondroitinsulphate B, and Chondroitinsulphate C

Carbohydrates derivatives of biological importance:

Amino sugar, Deoxysugar, Sugar Phosphate, Muramic acids, Mucopeptides

Complex Lipids and Sterols:

Phospholipids or Phosphorylated Lipids :

Classification, Structure, Properties and Functions:

Glycerophospholipids: Classification, Structure and functions of Lecithin, Cephalin and Sphingomyelins. Structure of Plasmalogens, Phosphatidyl Serine, Phosphatidylinositol

Nonphosphorylated Lipids:

Classification, Structure and Functions:

Structure and functions of Cerebrosides, Sulpholipids; Functions of Gangliosides, Lipoproteins & Proteolipids

Prostaglandins (**Brief outline**)

Sterols: Structure, properties and functions of Cholesterol.

Reference books :

1. Text Book of Biochemistry 4th Edition By West and Todd
2. Biochemistry (6th Edition) By; Breg J M Tymoczko T J Stryer L
3. BiochemistryD.Voet and Voet J 5th Edition
4. Concept in Biochemistry By Rodney Boyer 2nd Edition
5. Nelson DL and Cox MM; Lehninger's Principles of Biochemistry 6th edition
6. Fundamentals of Biochemistry By J.L.Jain, S.Jain and N.Jain 7th Edition
7. Biochemistry, U.Satyanarayan & U Chakrapani 6th Edition
8. Fundamentals of Biochemistry, Deb A.C.
9. Cell Biology , C B Powar, Third Edition.2008, Himalaya Publishing House
10. Cell & Molecular Biology, P K Gupta, Third Edition, Rastogi Publications

BIM122 (P) : Biochemistry Practicals

Course Outcomes:

By the end of the course, the students will be able to:

CO1: Prepare a primary standard solution.

CO2: Determine the molar concentration of solutions of compounds using data obtained from titration.

CO3: Understand physical and chemical properties of Biomolecules

CO4: Develop skill of extraction of Biomolecules from natural sources and how to quantify the Biomolecules from natural sources using colorimeter

CO5: To demonstrate different phases of mitotic cell division.

I. Basic Practical:

1. Biochemical reagent preparations for various solutions with respect to different Normality, Molarity, Molality, % Solution (W/V, W/W, V/V) and Numerical.

II. Titration Practicals:

2. Oxidometry: Estimation of Iron with the use of Potassium permanganate
3. Standardization of sodium Thiosulphate using potassium Dichromate solution.
4. Iodometry: Estimation of Copper.
5. Determination of Iodine number of oils.
6. Estimation of Sugar from Urine by Benedict's method.

III. Qualitative analysis :

7. Qualitative analysis of proteins: (1) Gelatin (2) Egg albumin by color reactions.
8. Precipitation/ Denaturation test for proteins Gelatin and Albumin by (a) Heat, (b) pH (acidic, basic and neutral), (c) Acids (TCA and Sulphosalicylic acid), (d) Heavy metals (Lead, Copper, Zinc, Barium Salts).
9. Analysis of Chemical Properties of Fats (Colour Reactions of Cholesterol)

IV Colorimetric Estimations:

10. Use of Single cell colorimeter, its construction and operation (Demonstration).
11. Estimation of Protein by Biuret method.
12. Estimation of DNA by DPA method.
13. Estimation of RNA by Orcinol method.
14. Estimation of Sugar by DNSA method

IV. Cell Biology:

15. Study of Mitosis in Onion root tip cell.
16. Extraction of DNA from Banana.

Reference books:

1. Juryman J Laboratory manual in Biochemistry
2. An Introduction to Practical Biochemistry by: David T Plummer
3. Biochemical Methods by Sadasivan and Manickam
4. Modern experimental biochemistry by Rodney Boyer
5. Introduction to basic molecular biology technique by Dr. G R Naik

B.Sc., Semester II Biochemistry

Skill Enhancement Course

BISEC126 (T+P): Instrumentation & Biotechniques

Course Structure with respect to credit, hours and marks

Course Type	Course	Credit	Work Hours/ week	Exam hours	Marks		Total Mark
					Internal	External	
Skill Enhancement course	BISEC 126 (T+P) Instrumentation & Biotechniques	2	2	2	25	25	50

Course Outcomes:

On successful completion of the course, students will be able to:

CO1 To provide scientific understanding of analytical techniques & detailed interpretations of results

CO2 To learn & understand form hands on training the applications of instruments & techniques in isolation & separation of Biomolecules.

CO3 To learn to demonstrate & observe microbial samples under light compound microscope

Skill Enhancement Course
BISEC126 (T+P) : Instrumentation & Biotechniques

Unit No.	Title Of The Unit & Contents	Total No. Of Hrs (45)
Theory	Study of parts, functions & applications : Centrifugation, Colorimeter Paper Chromatography, Microscopy	15
	Practicals:	
Practical	Use of instruments in Biochemical Laboratory	30

Theory:

Study of parts, functions & applications:

1. Centrifugation
2. Colorimeter
3. Paper Chromatography
4. Microscopy: Light Compound Microscope

Practicals:

Use of instruments in Biochemical Laboratory

1. Demonstration of microbial sample under light compound microscope
2. Separation of amino acids by Paper Chromatography
3. Separation of Protein Precipitants by Centrifugation
4. Quantification of proteins by Biuret method

References:

1. Biophysical Chemistry: Upadhyay, Upadhyay and Nath, Himalaya Publication 2022
2. Microbiology: M.P.Arora, Himalaya Publication 2016