ST. XAVIER'S COLLEGE (AUTONOMOUS), AHMEDABAD-9
FACULTY OF SCIENCE

DEPARTMENT OF BIOCHEMISTRY – BIOTECHNOLOGY

SEMESTER – I SYLLABUS

OF

BSc BIOTECHNOLOGY (HONOURS)

BASED ON UNDERGRADUATE CURRICULUM FRAMEWORK (NEP – 2020)

(Effective from Academic Year 2023)

Programme Outcomes

PO1. Create a strong knowledge domain/ expertise

PO2. Develop critical thinking, Problem solving and research aptitude

PO3. Skill development

PO4. Encouraging social interaction, service learning and develop equity centred national development (Social Extension work)

PO5. Self-directed and lifelong learning

PO6. Developing employability and entrepreneurial skills

PO7. Promoting Ecological sustainability development

PO8. Nurturing creativity and humane values

Programme Specific Outcome for BSc Biotechnology

PSO1. Comprehensive and Procedural Knowledge: Discuss and interpret the basic concepts of all subjects under the aegis of current multidisciplinary Biotechnology to translate and apply the same for professional, entrepreneurial and societal benefits.

PSO2. Skill development: Learn wide – ranging technical skills inclusive of digital learning skills through laboratory sessions/ research projects and develop self-directed experiential learning with an objective to associate biotechnology with improving life, industrial applications and environment.

PSO3. Critical thinking, Creativity and Problem Solving: Develop competence to solve problems in familiar and non – familiar context especially to alleviate stress in all life forms, develop an analytical mind to use information from various sources and create plans/models to come up with innovations in the field of Biotechnology.

PSO4. Communication and Collaboration: Ability to communicate the understanding of the learning to others confidently and precisely, interact with diverse multicultural groups working in the subject area as well as collaborate to achieve goals that have a wider outreach.

PSO5. Leadership, Lifelong learning and ethics: Extend the applicability of Biochemistry to service learning and nation development through awareness programmes/ action - oriented projects in health, nutrition, and environment; be accountable, responsible and conscientious in leading roles both in profession and personal space.

Curriculum Framework for Semester – I BSc (Hon.) Biotechnology

Course	Title	Content	Hours/ week	Credit
DSC-1 (Theory)	BT – 1501 Basic Chemistry of Biomolecules	U-1: Chemistry and Origin of Life U-2: Carbohydrates and Glycobiology U-3: Amino acids and Proteins U-4: Lipids and Nucleic Acids	4 hrs	4
DSC-1 (Lab)	BT – 1502 Analysis of Biomolecules	Practical based as per Theory syllabus.	8 hrs	4
Minor-1 (Theory + Lab) *Offered as Biochemistry subject*	BC – 1103 Theory: Nutrition - I	Unit 1: Assessment of Nutritional Status Unit 2: Nutritional Role of Biomolecules	2 hrs	2
	Lab: Basic Lab of Nutrition	Labs based on basic nutritional assessment	4 hrs	2
SEC	BT – 1650 Microscopy and Centrifugation	Unit 1: Microscopy Unit 2: Centrifugation	2 hrs	2
MDC *Offered by other Major Disciplines*	Choice from a basket	Offered by other departments	4 hrs	4
AEC	English	(To be offered by the concerned subject Department)		2
VAC	Value Added Courses	(To be offered by the concerned subject Department)		2
Total Credits				22

BSC. (HONS.) BIOTECHNOLOGY SYLLABUS

SEMESTER - I

Major Discipline Course – 1: Basic Chemistry of Biomolecules

Course Title & Code	Credit Distribution of The Course			Eligibility Criteria	Prerequisite(s) of the Course (if any)
	Lecture	Tutorial	Practical / Practice		
BT – 1501 Basic Chemistry of Biomolecules	4 (60 hr)	0	0	10 + 2 from a recognized board in any stream	Nil

I. Course Learning Objectives

The knowledge from this course can help in the following:

a) The students could pursue a career in clinical Biotechnology as maintaining levels of these biomolecules in the body are of utmost importance. The decrease or increase in the amount of some of the biomolecules can have clinical significance. For example, increased blood sugar levels are indicative of a person suffering from diabetes mellitus.
b) The students can carry out basic research in Biotechnology, which in turn can be of great help in the medical and diagnostic fields.
c) Students can also go in for Medical Laboratory Technique Courses, opening opportunities in hospitals and pathological laboratories.
d) Basic knowledge of Biotechnology is also required for Nutrition and Dietetics.
e) The understanding of proteins, its study, has opened up the field of Proteomics.
f) Many of the carbohydrates, proteins and lipids discussed have commercial value and thus, find a place in Industrial Biotechnology.

II. Course Learning Outcomes

The main objective of the course will be to build the basic foundation for studying Biotechnology.

By the end of the paper, a student should be able to:

CO 1: To integrate experiments and evidences to deduce origin of life
CO 2: To establish how proper conformations are needed for optimum functioning of the molecules and thereby the entire cell
CO 3: To analyze how biomolecules contribute to structural integrity of the cell as well as the biochemical reactions and a change in the structure of the molecules can lead to abnormalities, for eg. A mutated globin results in sickle cell anaemia
CO 4: To use both the physical as well as chemical properties of these biomolecules to carry out various studies

CO 5: Appreciate experiments carried out by scientists to enable understand the structure of biomolecules, understand their properties, design of experiments to prove the same and analyse the data and give interpretations.

III. Course Content

Unit 1: Chemistry of life and Origin of life

What is biotechnology, development of biotechnology, what is biotechnological approach, scope of biotechnology, applications of biotechnology, Carers in biotechnology, Biological Literature (How to conduct a literature search and how to read a research article).

Origin of life: Living matter, early history, Chemical evolution, Origin of living systems (molecules to first cell), RNA world, development of metabolic pathways, Central dogma of life, mutation and evolution. Biological evolution: prokaryotes to eukaryotes; Differences between plant and animal cells; Types of cells.

Unit 2: Carbohydrates and Glycobiology

Monosaccharides and Disaccharides: Structures, characteristics, functions and sources; Polysaccharides: Structure and influence of steric factors and hydrogen bonding; Examples of Homo and heteropolysaccharides and their functions in relation to the structures e.g. Starch, cellulose, Glycogen, Pectin, Hemicelluloses etc.; Glycoconjugates: Proteoglycans, Glycoproteins and Glycolipids; Carbohydrates as informational Molecules: Lectin – carbohydrate Interactions.

Unit 3: Amino Acids and Proteins

Structures and classification of amino acids; Uncommon amino acids; Amino acids as acids and bases – titration curves and its ampholytic nature; Peptide bond and its characteristics; Peptides and their ionization behaviour; Structure of proteins: Primary structure, Secondary structure, Tertiary structure and Quaternary structure; Amino acid sequencing of proteins and its significance; Protein denaturation and Folding; Protein functions – Transport:Structure and function relationship of myoglobin and hemoglobin; Complementary interactions between proteins and ligands, e.g. Antigen – antibody interaction,

Unit 4: Lipids and Nucleic Acids

Storage lipids: Structure, characteristics and functions of Fatty Acids, Triacylglycerols; Structural Lipids: Glycerophospholipids, Galactolipids and Sulpholipids, Sphingolipids and Sterols; Lipids as signal molecules; Lipids as cofactors; Lipids as pigments; Lipid extraction methods; Determination of lipid structures; Introduction to lipidomics.

Structures, characteristics and functions of nucleotides; Three dimensional structure of nucleic acids; DNA as a double helical structure; Unusual nucleotides and unusual structures of nucleic acids

IV. Recommended learning Resources

1. Biochemistry, 5th Edition. Garrett and Grisham
2. Biochemistry, 6th Edition. Berg, Tymoczko and Stryer
3. Molecular Cell Biology, 7th Edition. Lodish, et. al.
4. Textbook of Biochemistry with Clinical Correlations, 7th Edition by T. Devlin
5. Biochemistry, 4th edition. Donald Voetand Voet J
6. Harpers review of Biochemistry, 25th Edition. Murray RK, Rodwell VW.
7. Lehninger's Principles of Biochemistry, 5th Edition. Nelson DL and Cox MM
8. Concepts in Biochemistry, 3rd Edition. Rodney Boyer

V. Pedagogy

1. Classroom engagement through lectures and PowerPoints
2. Lecture videos and online resources
3. Workbooks/Group activities/Assignments/Class Tests

VI. Evaluation

The course paper is evaluated out of 100 marks, of which 50 percent weightage is of Internal Assessment and 50 percent weightage is of the End semester examination (External)

ASSESSMENT CRITERIA	INTERNAL EVALUATION	EXTERNAL EVALUATION
Continuous Internal Assassment (CIA) I and II	**35**	**-**
Assignment (Research element)*	**10**	**-**
Attendance	**05**	**-**
End Semester Exam	**-**	**50**
Total	**50**	**50**

**The assignment comprises searching literature or experiments carried out by scientists or labs across the globe elucidating the structural and functional aspects of biomolecules, and then representing the findings as a report or article or presentation or poster.*

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Total Credits				22

BSC. (HONS.) BIOTECHNOLOGY SYLLABUS

SEMESTER - I

Major Discipline Course – 2: Analysis of Biomolecules

Course Title & Code	Credit Distribution of The Course			Eligibility Criteria	Prequisite(s) of the Course (if any)
	Lecture	Tutorial	Practical / Practice		
BT – 1502: Analysis of Biomolecules	0	0	4 (120 hr)	10 + 2 from a recognized board in any stream	Nil

I. Course Learning Objectives

The learning objectives of this paper is as follows:

a. To be able to develop a skill set to do qualitative and quantitative analysis of biomolecules in given samples.
b. Students should evaluate the principles, theory, protocol and calculations for each experiment.
c. They should learn about the importance of precision and accuracy in reagent preparations and designing of experiments.
d. The analysis and interpretation of each laboratory experiment should be able to initiate logical thinking and accountability, especially if the samples being studied are related to clinical and nutritional studies.
e. The skill set should enhance their knowledge and employability.

II. Course Learning Outcomes

The main objective of the course will be to build the basic foundation as well as skill in the subject of biochemistry and biotechnology.
By the end of the paper, a student should be able to:

CO 1: To explain the importance of various instruments used in biochemistry and biotechnology.
CO 2: To establish basic concepts with lab sessions
CO 3: To analyse and to identify biomolecules
CO 4: To experimentally prove both the physical as well as chemical properties of these biomolecules, as these properties can be used to carry out various studies.
CO 5: Appreciate experiments carried out by scientists to enable understand the structure of biomolecules, understand their properties, design of experiments to prove the same and analyse the data and give interpretations.

III. Course Content for Lab Sessions

Basic Concepts

1. Normality, Molarity of solutions
2. pH and Buffer
3. Calibration of pipettes
4. Working of Microscope
5. Working of Centrifuges
6. Good Lab Practices and Safety Protocols

Qualitative Analysis

1. Qualitative tests for Monosaccharides
2. Qualitative tests for Disaccharides
3. Qualitative tests for Polysaccharides
4. Qualitative tests for Mixture of sugars
5. Physical and chemical properties of lipids
6. Qualitative tests for Lipids
7. Colour reactions of Cholesterol
8. Determination of saponification number of edible oil.
9. Estimation of unsaturated fat by iodine value of oil.
10. Use of microscope and microscopic examination of osazones.
11. Qualitative analysis of amino acids
12. Qualitative analysis of Protein
13. Denaturation of proteins

Titration Practicals

1. Estimation of sugar by Cole's method.
2. Use of potassium dichromate in the standardization of sodium thiosulphate

IV. Recommended learning Resources

1. Concepts in Biochemistry, 3rd Edition. Rodney Boyer
2. Introduction to Practical Biochemistry. T. Plummer.
3. Textbook of Biochemistry, 4th Ed. West and Todd.

V. Pedagogy

1. Explanation of each laboratory experiment emphasising on the use of different reagents and instruments
2. Problem solving, group activities and presentations. There are defined activities for every laboratory experiment in the journal, which encourages self-learning, peer learning, team work, developing presentation skills and reading from science articles and research papers.

3. Learning outcome based questions, which develops reading and writing skills and lab tests

VI. Evaluation

The course paper is evaluated out of 100 marks, of which 50 percent weightage is of Internal Assessment and 50 percent weightage is of the End semester examination (External)

ASSESSMENT CRITERIA	INTERNAL EVALUATION	EXTERNAL EVALUATION
Internal Practical Examination*	**35**	**-**
Assignment (Research element)**	**10**	**-**
Attendance	**05**	**-**
End Semester Practical Exam	**-**	**50**
Total	**50**	**50**

***The internal practical exam will entail the students to answer a question paper based on the experiments in their journal, to perform two experiments and give a viva voce (optional). The journal duly completed and signed will also carry weightage.*

***The assignment comprises group activities that need the students to review literature, collate and present the data or carry out a short project, collate, interpret and present the data either as an oral presentation or a poster presentation and/or a documented report.*