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

DEPARTMENT OF BIOCHEMISTRY – BIOTECHNOLOGY

SEMESTER – II SYLLABUS

OF

BSc BIOCHEMISTRY (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 Biochemistry

PSO1. Comprehensive and Procedural Knowledge: Discuss and interpret the basic concepts of all subjects under the aegis of current multidisciplinary Biochemistry 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 biochemistry 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 Biochemistry.

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 – II BSc (Hon.) Biochemistry and BSc Biochemistry with Vocational Biotechnology

Course	Title	Content	Hours/ week	Credit
DSC-1 (Theory)	BC – 2501 Concepts in Cell Biology	Unit 1: Membrane Structure and Cytoskeleton Unit 2: Cell organelles Unit 3: Cell – cell Interaction and Communication Unit 4: Cell cycle and Cell Death	4 hrs	4
DSC-1 (Lab)	BC – 2502 Basic Techniques in Cell Biology	Practical based as per Theory syllabus.	8 hrs	4
Minor-1 (Theory + Lab) *Offered to students of other Major Discipline (Chemistry)*	BC – 2101 Theory: Ultrastructure of Cell	Unit 1: Membrane Structure and Cytoskeleton Unit 2: Cell Organelles	2 hrs	2
	Lab: Basic Cell Biology Lab	Practical based as per Theory syllabus.	4 hrs	2
Minor-1 (Theory + Lab) *Offered to students with Voc Biotech*	BT – 2101 Theory: Environmental Biotechnology	Unit 1: Renewable energy and Biofuels Unit 2: Bioremediation and Biofertilizers	2 hrs	2
	Lab: Basic Techniques in Environmental Biotechnology	Labs based on environmental biotechnology	4 hrs	2
SEC	BC – 2650 Biophysical Techniques - II	U-1: Spectroscopy U-2: Chromatography	2 hrs	2
MDC *Offered to students of other Major Discipline*	MDC – 201_1C (Sem 3) Nutrition and Health	U-1: Food groups and diet U-2: Nutrients in food U-3:Food adulteration and Food safety standards U-4: Activity Modules	4 hrs	4
AEC	English	(To be offered by the concerned subject Department)		2
VAC	Value Added Courses	(To be chosen from a basket of courses)		2
Total Credits				22

BSC. (HONS.) BIOCHEMISTRY SYLLABUS

SEMESTER – II

Major Discipline Course – 1: Concepts in Cell Biology

Course Title & Code	Credit Distribution of The Course			Eligibility Criteria	Prerequisite(s) of the Course (if any)
	Lecture	Tutorial	Practical / Practice		
BC – 2501 Concepts in Cell Biology	4 (60 hr)	0	0	10 + 2 from a recognized board in any stream	Nil

I. Course Learning Objectives

The basic unit of life is a cell. Therefore, study of its structure and functions gives an insight into an intricately woven network of efficient and coordinated molecular mechanisms that renders a cell fit to not just survive but also to multiply, get differentiated and move around. Understanding various concepts like how cells originated, transport across membranes, transport within cells, cell division, regulation of cell cycle, cell senescence etc. opens up a lot of target areas for drugs and treatment. For example, today there are a lot of drugs that target the ribosomes, which has been possible because its structure and functions has been thoroughly studied.

The course will give a detailed description of

a) The assembly of biomolecules to form a cell, which has been the crux of origin of life and the evolutionary changes thereafter, especially, the role of RNA and genetic changes.
b) The detailed study of membrane biochemistry, transport across membranes and within cells by cytoskeleton
c) Studying the organization of the cell and the structure and functions of various organelles.
d) The structure and function of nucleus, cell division, cell cycle regulation and senescence

Thus, the knowledge from this course can help in the following:

a) Research in elucidation of molecular mechanisms within a cell
b) Research in cancer biology, tissue engineering, stem cells etc.
c) Drug discovery targeting various anomalies due to malfunction of organelles

II. Course Learning Outcomes

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

CO 1: Corelate the importance of semi permeable nature of plasma membrane in maintaining the integrity of a cell.

CO 2: Evaluate how proper conformations of lipids and proteins in a membrane are needed for optimum functioning

CO 3: Evaluate how important each organelle is to make cell the basic unit of life – the entire organization within a cell is a perfect example of division of labour with proper coordination and networking.

CO 4: Appraise why a cell cycle needs to be regulated and when a cell does need to die.

CO 5: Analyze experiments carried out by scientists to enable understand the working of a cell, design of experiments to prove the same and analyse the data and give interpretations.

III. Course Content

Unit 1: Membrane Structure and Cytoskeleton (1 credit)

Membrane structure: Singer – Nicholson's Fluid Mosaic Model, Structure and functions of membrane lipids and glycolipids – membrane fluidity and movement, lipid rafts.

Membrane proteins: structure and types; principles of membrane transport, Carrier proteins and active membrane transport, Ion channels

Membrane carbohydrates: Glycocalyx

Cytoskeleton: Nature of cytoskeleton, Intermediate filaments, Microtubules, Cilia and flagella, Actin filaments; Molecular motors associated with cytoskeleton

Unit 2: Cell Organelles (1 credit)

Detailed structure and functions of: Mitochondria and Chloroplast (Energy Conversions) and the Endosymbiont Theory, Endoplasmic reticulum: Rough and Smooth, Golgi apparatus, Ribosomes, Lysosomes, Peroxisomes, Nucleus; Endomembrane network system and its importance.

Unit 3: Cell – cell interaction and communication (1 credit)

Importance of cell – cell interaction and cell – environment interactions, Cell adhesion molecules – homophilic and heterophilic interactions, tight junctions, adherens junctions, Desmosomes, Gap junctions, Extracellular matrix,

Plant cell adhesion and plasmodesmata,

General principles of cell communication, autocrine action, paracrine action, endocrine action, communication through gap junctions, eg, heart and neurons,

Unit 4: Cell cycle and cell senescence (1 credit)

Cell Cycle: General strategy of cell cycle, Interphase (Different stages) and Mitosis; Generation time; Cell cycle regulation.

The Mechanics of Cell division; Introduction, an overview of different stages in Mitosis, meiosis and cytokinesis.
Cell Senescence: Difference between aging and necrosis; Programmed Cell Death.

IV. Recommended Learning Resources

1. Molecular Cell Biology, 7th Edition. Lodish, et. al.
2. Biochemistry, 4th edition. Donald Voet and Voet Judith
3. Lehninger's Principles of Biochemistry, 5th Edition. Nelson DL and Cox MM
4. Biochemistry, 5th Edition. Garrett and Grisham
5. Molecular Biology of Cell – Bruce Alberts
6. Gerald Karp's Cell and Molecular Biology
7. Origin of life on the earth and in the cosmos (2nded), Geoffrey Zubay:Academic Press
8. Molecular Biology of the Cell, 5th Edition, Bruce Alberts et. al.
9. Organelle structure and function, David E Sadava, Jones Bartlett publishers.
10. Cytology, P.S. Verma, V.K. Agarval, S. Chand Publications.
11. Cell and Molecular Biology, 8th Edition. De Robertis.
12. Cell and Molecular Biology, Sheeler and Bianchi
13. The Cell: A Molecular Approach, 6th Edition, G.M. Cooper
14. Introduction to Practical Biochemistry. T. Plummer.
15. Practical Biochemistry - Satyanarayan

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 Assessment (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.) BIOCHEMISTRY SYLLABUS

SEMESTER - II

Major Discipline Course – 2: Basic Techniques in Cell Biology

Course Title & Code	Credit Distribution of The Course			Eligibility Criteria	Prequisite(s) of the Course (if any)
	Lecture	Tutorial	Practical / Practice		
BC – 2502: Basic Techniques in Cell Biology	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 cell samples.
b. Students should understand the principles, theory, protocol and calculations for each experiment and apply them for research or small projects.
c. They should discern 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.
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.

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

CO 1: To appraise the importance of various instruments used in Cell Biology.
CO 2: To relate principles and protocols of the experiments
CO 3: To carry out experiments related to cell lysis and analysis of cell extracts
CO 4: To identify different stages of mitosis in a dividing cell
CO 5: Corelate the design of experiments with its application in diagnostics and therapy

III. Course Content (Laboratory Experiments)

1. Basic working of a Colorimeter
2. Staining and observation of yeast cells using Microscope
3. Growth curve of yeast cells by turbidometry
4. Growth curve of yeast cells by CFU Count
5. Cell count and Checking cell viability using Trypan blue
6. Staining and observation of buccal cells
7. Lipid extraction from yeast cells
8. Estimation of total lipids colorimetrically using phosphovanillic method
9. Cell Lysis methods and comparison by checking viscosity through capillary flow speed
10. Protein estimation by Biuret method
11. Protein extraction from yeast and its quantification
12. Sugar estimation by DNSA
13. Extraction of soluble sugar from plant tissue and its quantification
14. Observation of cells and mitotic stages using permanent slides
15. Observation of mitotic stages in onion root tips
16. Paper chromatography
17. Thin Layer Chromatography

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.*