St. Xavier's College (Autonomous), Ahmedabad
Syllabus of Semester – I of the following departments under Faculty of Science based on Under Graduate Curriculum Framework – 2023 (NEP) to be implemented from the Academic Year 2023-24.

FACULTY OF SCIENCE

DEPARTMENT OF BIOCHEMISTRY

Course	Title	Content	Hours/ Week	Credit
DSC-1 (Theory)	BC – 1501 Fundamentals of Biomolecules	U-1: Scope of Biochemistry and Origin of Life U-2: Carbohydrates U-3: Lipids U-4: Amino acids and Proteins	4 hrs	**4**
DSC-1 (Lab)	BC – 1502L Basic Biochemistry Lab	Practical based as per Theory syllabus	8 hrs	**4**
SEC	BC – 1650 Biophysical Techniques - I	U-1: Microscopy U-2: Centrifugation	4 hrs	**2**

BSC. (HONS.) BIOCHEMISTRY SYLLABUS

SEMESTER - I

Major Discipline Course – 1: Fundamentals of Biomolecules

Course Title & Code	Credit Distribution of The Course			Eligibility Criteria	Prerequisite(s) of the Course (if any)
	Lecture	Tutorial	Practical / Practice		
BC – 1501: Fundamentals 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 Biochemistry 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 Biochemistry, 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 biochemistry 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 Outcome

The main outcome of the course will be to build the basic foundation for studying biochemistry. 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: Scope of Biochemistry and Origin of life (1 credit)

What is biochemistry, development of biochemistry, what is biochemical approach, scope of biochemistry, applications of biochemistry, Careers in biochemistry, Biochemical literature (How to conduct a literature search and 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 (1 credit)

Introduction, natural occurrence and physiological importance; Classification and structure of carbohydrates: aldose and ketoses, Mono, oligo and polysaccharides, Structure of monosaccharide.

Configuration in sugars, reference carbohydrate, Fischer's projection formula and representation of various sugars, Haworth's representation of cyclic structure. Furanose and pyranose structures and representation of various sugars, Mutarotation, Conformation in sugars: boat and chair forms.

Oligosaccharides – Occurrence, structure, chemical name, function and importance of maltose, sucrose, lactose, cellobiose, trehalose, raffinose.

Polysaccharides – Occurrence, structure, chemical name, functions and importance of starch,

glycogen, cellulose, hemicellulose, dextrin, chitin, inulin, dextran, pectin, agar, alginic acid, mannans.
Carbohydrate derivatives of biological importance: Amino sugars, deoxysugars, sugar phosphates, blood group polysaccharides, cell wall polysaccharides, teichoic acids, muramic acids, sialic acid, mucopeptides.
Glycobiology: Glycosaminoglycans - Occurrence, structures and functions of hyaluronic acid, heparin, chondroitin sulphates (A, B and C), glycoproteins and proteoglycans, glycolipids.

Unit 3: Lipids (1 credit)

Lipids: Introduction, classification of lipids, fatty acids. **S**tructure, properties, functions and importance of saturated, unsaturated, hydroxyl, cyclic, branched chain fatty acids and PUFA; Physical properties, isomerism, geometrical isomerism, positional isomers, melting point, boiling point, solubility and absorption spectra; Chemical properties: salt formation, detergent, esterification, hydrogenation, halogenations, oxidation, saponification; Chemical constants of fats: saponification value, iodine number, Reichert Meissl number, acetyl number, acid number. Rancidity of fats due to hydrolysis, oxidation and lipolysis, prevention of rancidity; Waxes – natural waxes, properties and importance.
Complex lipids and Sterols: Glycerophospholipids – classification, properties and functions of lecithin, lysolecithin, cephalins, plasmalogens, phosphatidyl serine, phosphatidyl inositol; Sphingolipids: Classification, properties and functions of cerebrosides, gangliosides; Sulpholipids, gangliosides, proteolipids and prostaglandins;
Structure and properties of sterols; Colour reactions of cholesterol.

Unit 4: Amino acids and Proteins (1 credit)

Introduction, structure and classification of standard amino acids, introduction to rare amino acids, non-protein amino acids, essential vs Non-essential amino acids, Amino acids as ampholytes and its stereoisomerism.
Chemical reactions of amino acids: Sanger’s reaction, Edman’s reaction, Nitrous acid reaction, Siegfried’s carbamino reaction, Dansyl chloride reaction, oxidative deamination by oxides and ninhydrin.
Proteins: Peptides – structure, formation and characteristics of peptide bond; Classification based on solubility, shape and composition; Functions of proteins; Properties – isoelectric pH, hydration, behaviour in solution, solubility, salting in and salting out, precipitation of proteins by acid reagents, heavy metals, heat, extreme pH changes, denaturation and renaturation of proteins.
Structure of proteins – primary, secondary, super secondary, tertiary and quaternary structures; Determination of sequences of proteins (Protein sequencing); Biological functions of fibrous proteins, keratins, collagen, elastin, globular proteins – haemoglobin, myoglobin, glycoproteins, lipoproteins, nucleoproteins and metalloproteins.

IV. Recommended Learning Resources

1. Biochemistry, 5th Edition. Garrett and Grisham
2. Biochemistry, 3rd Edition. Matthews, van Holde, and Ahern
3. Biochemistry. 7th edition. Berg JM, Tymoczko JL, Stryer L. New York: W H Freeman; 2014
4. Lodish et al. Molecular Cell Biology. 8th Edition. W. H. Freeman and Company.
5. Textbook of Biochemistry with Clinical Correlations, 7th Edition by T. Devlin
6. Voet, D. and Voet, J.G. (2012) : Biochemistry 4th ed., (John Wiley & Sons Inc/, New York)
7. Harpers Review of Biochemistry, 25th Edition. Murray RK, Rodwell VW.
8. Lehninger's Principles of Biochemistry, Nelson and Cox (2012) : Principles of Biochemistry (Worth Publ. Inc. USA)
9. Biochemistry, 4th Edition. U. Satyanarayana and U. Chakrapani. Elsevier; 2013

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.*

BSC. (HONS.) BIOCHEMISTRY SYLLABUS

SEMESTER - I

Major Discipline Course – 2: Basic Biochemistry Lab

Course Title & Code	Credit Distribution of The Course			Eligibility Criteria	Prequisite(s) of the Course (if any)
	Lecture	Tutorial	Practical / Practice		
BC – 1502: Basic Biochemistry Lab	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 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, 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.
By the end of the paper, a student should be able to:

CO 1: To appraise the importance of various instruments used in biochemistry.
CO 2: To relate principles and protocols of the experiments
CO 3: To analyse results to identify carbohydrates
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: Analyze 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 (Laboratory Experiments)

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.*

BSC. (HONS.) BIOCHEMISTRY SYLLABUS

SEMESTER - I

Skill Enhancement Course – 1: Biophysical Techniques - I

Course Title & Code	Credit Distribution of The Course			Eligibility Criteria	Prequisite(s) of the Course (if any)
	Lecture	Tutorial	Practical / Practice		
BC – 1650: Biophysical Techniques - I	2 (30 hr)	0	0	10 + 2 from a recognized board in any stream	Nil

I. Course Learning Objectives

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

a) The students could pursue a career in industries that specialize in Instrumentation specifically for Life Science Research and Analysis
b) Avail jobs in Production, Quality Control and Rand D divisions of Pharmaceutical and Biotech companies.
c) The students can carry out basic research in various areas of biology due to their understanding of the techniques
d) Start up companies supplying basic instruments like colorimeters, pH meters, etc.

II. Course Outcome

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

CO 1: Corelate the concept of viscosity to various biological systems
CO 2: Correlate the use of centrifugation and microscopy to elucidate a fundamental or pathway or structure etc.
CO 3: Designing experiments using centrifugation and microscopy and analyze the data obtained
CO 4: Corelate the instrumentation design with its applications

III. Course Content

Unit 1: Centrifugation and Viscosity

Poiseuille's equation, unit of viscosity, relative viscosity and its determination, factors affecting viscosity, physiological importance

Principle of sedimentation, factors affecting sedimentation

Types of rotors used in centrifuges, separation methods in different rotors

Preparative centrifuges: Differential centrifugation, sub cellular fractionation, density gradient centrifugations; Applications, preparation of gradients, sample collection methods, zonal rotors

Analytical Centrifuges; Ultracentrifugation, working and applications

Unit 2: Microscopy

Parts of a compound microscope: condenser, objective, ocular lens systems; Basic principles of image formation; Relationship between magnification and numerical aperture; angular power and resolving power. Measurements and analysis through microscopy.

Principle, construction, working, limitations and applications of: dark-field microscopy, phase contrast microscopy, fluorescent microscopy, Inverted microscopy and Electron (TEM, SEM) microscopy.

Principle and applications of Confocal microscopy, AFM and Cryoelectric microscopy

IV. Recommended learning Resources

1. Berg JM, and Tymoczko TJ, Stryer L,: Biochemistry (6th Ed)
2. Daniel, C Harris: Quantitative Chemical Analysis
3. David Freifelder: Physical biochemistry (2nd Ed) WH Freeman, USA)
4. Donald Voet and Voet J: Biochemistry (4th Ed) 2011
5. Ghatak KL: Techniques and methods in Biology. PHI learning Pvt Ltd. 2011
6. Nelson DL and Cox MM: Lehninger's Principles of Biochemistry (5th Ed) 2008
7. Oser: Hawks Physiological Chemistry (4th Ed) 1965.
8. Upadhyay and Nath: Biophysical chemistry: Principles and Techniques (3rd Ed)
9. Van Holde KE: Physical Biochemistry. Prentice Hall, NJ.
10. Vogel AI: A text book of quantitative inorganic analysis (3rd Ed), 1975.
11. West and Todd: Text book of biochemistry ((4th Ed) 1970
12. Wharton and McCarty: Experiments and methods in Biochemistry
13. Willard and Merrit: Instrumental methods of analysis (4th Ed) 1971.
14. Wilson K and Walker J: Principles and Techniques of Biochemistry and Molecular Biology (6th Ed) 2006. Cambridge University Press.

V. Pedagogy

1. Classroom engagement through lectures and PowerPoints
2. Lecture videos and online resources
3. Workbooks/Group activities/Assignments/Class Tests
4. Using the basic instruments in the laboratory

VI. Evaluation

The course paper is evaluated out of 50 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	**15**	**-**
Assignment	**05**	**-**
Attendance	**05**	**-**
End Semester Exam	**-**	**25**
Total	**25**	**25**

**The internal evaluation of CIA II and Assignment will be based on evaluative modules prepared by the concerned faculty members, which will be outlined during the course work.*