

**Shree Manibhai Virani and Smt.Navalben Virani Science College, Rajkot
(Autonomous)
Affiliated to Saurashtra University, Rajkot**

B.Sc. BIOCHEMISTRY

Semester I Syllabus

For Students Admitted From A.Y.2021-2022 and Onwards

Foundation Course		
For the students admitted from A.Y. 2021-2022 & onwards		
Offering Department: Biochemistry	Offered to: B.Sc Biochemistry	
Semester – I		
Course Code	Course Title (F)	Course Credit and Hours
	Foundation of Biochemistry	4 Credits - 4 hrs/wk

Course Description:

This course introduces students to the principles of physics and chemistry with a focus on their applications to biochemical processes and biophysical interactions. This course will address the foundation of Biophysics, Biochemical calculations and Metabolism by studying Bio/chemical principles, Electrochemistry, Thermodynamics and Buffer systems.

Course Purpose:

Our life is dominated by the physical laws exerted on the individual molecules at microscopic scale. Inter and Intra molecular interactions are govern by chemical and physical principles. Course will provide basic knowledge about how physical methods can be applied to understand biological processes and develop an understanding of the relation between structure, function and dynamics of biological macromolecules. Knowledge of the physicochemical properties will lay a foundation to understand Biochemical control and biophysical applications in the living system

Course Outcomes: Upon completion of this course, the learner will be able to

CO No.	CO Statement	Blooms taxonomy Level (K ₁ to K ₆)

CO ₁	Describe and review the concept of structure of atom, molecules and different bonds involved in the biological compounds	K1, K2
CO ₂	Identify and apply redox reactions and the principles of Thermodynamics in biochemical reactions	K1, K2, K3
CO ₃	Define and calculate pH, buffers and explain buffer systems in the human body	K1, K2, K3
CO ₄	Understand and apply the principles of physical chemistry that govern the inter and intra molecular interactions in the biological system	K1, K3
CO ₅	Apply the knowledge on the preparation and importance of the various solution used in Biochemistry.	K2, K3

Course Content	Hours
Unit-I : Chemical Bonds	12 hrs
<ul style="list-style-type: none"> • Concepts of Atoms , Molecules and Electronegativity • Chemical Bonds and their importance in structure of Biomolecules. • Ionic Bonds, Covalent bond. Dipole moment and molecular structure. • Hydrogen bond, inter and intramolecular hydrogen bonds, Van der Waals forces. • Concepts of Electrophiles and Nucleophiles. 	
Unit-II: Electrochemistry and Thermodynamics	12 hrs
<ul style="list-style-type: none"> • Concepts of Oxidation, Reduction and Redox reactions • Introduction to Electrodes, Half cell, Electrochemical Cells and Electrolytic Cells • Structure, working and EMF calculations of Electrochemical cells • Laws of thermodynamics, Concept of Gibb's free energy, Equilibrium constant, coupled reactions • High energy phosphorylated compounds, Structure of ATP and its role as currency of cell. • Relationship between reduction potential and Gibb's free energy and its equilibrium constant 	
Unit- III: pH, Buffer and Physiological Buffers	12 hrs
<ul style="list-style-type: none"> • Definitions and properties of Acids and Bases. • Concept of K_a, pK_a, pH and pOH, numerical problems of pH , Various methods to determine pH • Components, principle and working of pH meter. • Buffers, buffer capacity and factors affecting buffering capacity • Henderson – Hasselbalch equation and coupled numerical problems 	

<ul style="list-style-type: none"> Types and physiological importance of Biological Buffers 	
Unit- IV: Osmosis, Viscosity, Diffusion and Adsorption	12 hrs
Basic principles, factors affecting, biological importance and applications of <ul style="list-style-type: none"> Osmosis Viscosity Diffusion and Adsorption in life sciences 	
Unit- V: Solutions	12 hrs
<ul style="list-style-type: none"> Concept of Mole, Avogadro number, density and specific gravity Normal, Molar, Molal and Percent Solutions and Numerical problems Preparation of w/v, v/v solutions Preparation of Stock, working solutions, dilutions and serial dilutions 	

Text books :

- Upadhyay, A., Upadhyay, K., & Nath, N. (2009). *Biophysical chemistry (principles and techniques)*. Mumbai: Himalaya Pub. House. (Unit 2,3 and 4)
- Satyanarayana, U., & Chakrapani, U. (2008). *Essentials of biochemistry*. Book and Allied, Kolkata, India,.(Unit 1 and 5)

Reference books:

- Van Holde, K. E., Johnson, W. C., & Ho, P. S. (2006). *Principles of physical biochemistry*. Prentice-Hall.
- Wilson K. and Walker J. (2010) *Principles and Techniques of Biochemistry and Molecular Biology* 7th Edition, Cambridge: Cambridge University Press.
- Cooper, T. G. (2010). *The tools of biochemistry*. New York: Wiley.

Pedagogic tools:

- Chalk and Board
- Power point presentation
- Seminar
- Videos

Methods of Assessment & Tools:

Components of CIE: 40 marks (Example as below)

Sr. No.	Component	Content	Duration (if any)	Marks	Sub Total
A	Test 1	1 st 2 units	1 ^{1/2} hours	5 (Set for 30)	20
	Test 2	All 5 units	3 hours	15 (Set for 60)	

B	Assignment			05	20
C	Class activity			05	
Grand Total					30
Assignment		<ul style="list-style-type: none"> • Abstract and executive summary • Case study writing • Concept mapping • Student generated handbook • Essay writing etc. 			
Class activity		<ul style="list-style-type: none"> • Reaction paper • Quiz • One-minute paper • Situation based question • Application card etc. 			

Note: Any other assessment tools or methods can be adopted as per requirement of the course.

Foundation Course		
For the students admitted from A.Y. 2021-2022 & onwards		
Offering Department: Biochemistry	Offered to: B.Sc Biochemistry	
Semester – I		
Course Code	Course Title (F)	Course Credit and Hours
	Molecules of Life	4 Credits - 4 hrs/wk

Course Description:

This course on Biomolecules is one of the basic courses for all students of Biological Sciences. It covers foundation of life. The course will outline the importance of water as a biological solvent and vitamins as vital ingredients of life. Emphasis will be on the association between structure and functions of various biomolecules at a chemical level with a biological perspective as well as hands on approach and laboratory techniques.

Course Purpose:

This course is designed to introduce the organic structure of living systems mainly dealing with biomolecules like carbohydrates, lipids, nucleic acids, etc. laying the foundation for other advanced courses like Physiology, Cell Biology, Bio-analytical Techniques, Molecular biology, Metabolism and Immunology.

Course Outcomes: Upon completion of this course, the learner will be able to		
CO No.	CO Statement	Blooms taxonomy Level (K₁ to K₆)
CO ₁	Understand the foundations of biochemistry to identify the physical and chemical properties of water that sustains life.	K ₁ , K ₂
CO ₂	Classify, recognize and illustrate the structures of biomolecules	K ₁ , K ₂ , K ₃
CO ₃	Examine and interpret the biochemical reactions of carbohydrates and lipids	K ₁ , K ₃
CO ₄	Express importance of vitamins and porphyrins in biology	K ₁ , K ₂
CO ₅	Understand the structure of nucleic acids, acknowledge the contribution of scientists and illustrate experiments demonstrating nucleic acid as genetic material	K ₁ , K ₂ , K ₃ ,

Course Content	Hours
Unit I: The foundations of biochemistry and Water	12hrs
<ul style="list-style-type: none"> • Chemical foundations of life • Physical and Chemical properties of water • Molecular interactions in aqueous systems • Importance of water in living organisms 	
Unit-II: Carbohydrates and glycobiology	12 hrs
<ul style="list-style-type: none"> • Monosaccharides –Occurrence, structure, functions and properties • Formation of disaccharides, reducing and nonreducing disaccharides. • Polysaccharides –types, structure and functions • Proteoglycans, glycoproteins and glycolipids--types, structure and functions 	
Unit- III: Lipids	12 hrs
<ul style="list-style-type: none"> • Building blocks of lipids - fatty acids, glycerol, sphingolipids • Classification of lipids • Storage lipids (triacylglycerol) and waxes. • Structural lipids in membranes – glycerophospholipids, galactolipids and sulpholipids, sphingolipids • Sterols, structure, distribution and role of membrane lipids. 	
Unit- IV: Nucleic acids	12 hrs
<ul style="list-style-type: none"> • Experimental evidences to reveal nature of Genetic material • Chemical elements and components of Nucleic Acids • Nucleic acid structure – Watson-Crick model of DNA, Different forms of DNA • Nucleic acid chemistry- UV absorption, effect of acid and alkali on DNA. • Structure of major species of prokaryotic and eukaryotic RNA 	

<ul style="list-style-type: none"> Molecular structure of prokaryotic and eukaryotic chromosome 	
Unit- V: Vitamins and Porphyrins	12 hrs
<ul style="list-style-type: none"> Classification of vitamins: water soluble and fat soluble vitamins Overview of structure and active forms, source, daily requirements, deficiency diseases and hypervitaminosis. Porphyryns: Porphyrin nucleus and classification of porphyryns. Important metallo-porphyrins occurring in nature. Heam synthesis and heam breakdown. Bile pigments- chemical nature and their physiological significance. Spectrophotometric detection and quantification of porphyryns 	

Text books (2 textbooks):

- Satyanarayana, U., & Chakrapani, U. (2008). Essentials of biochemistry. *Book and Allied, Kolkata, India.*
- Jain, J. L. Sunjay Jain and Nitin Jain (2004). Fundamentals of biochemistry. S. Chand Publishing, New Delhi.

Reference books (2 or 3 reference books):

- Nelson, D. L., & Cox, M. M. (2013). Lehninger Principles of Biochemistry. [6th edition] Freeman and Company, New York.
- Berg, J. M., Tymoczko, J. L., Gatto G.J. & Stryer, L., (2015) Biochemistry, [8th Revised edition] W H Freeman, New York.
- Devlin, T. M. (Ed.). (2010). Textbook of biochemistry: with clinical correlations. 7th Edition, John Wiley & Sons, New York.

Pedagogic tools:

- Chalk and Board
- Power point presentation
- Seminar
- Videos

Methods of Assessment & Tools:

Components of CIE: 40 marks (Example as below)

Sr. No.	Component	Content	Duration (if any)	Marks	Sub Total
A	Test 1	1 st 2 units	1 ^{1/2} hours	5 (Set for 30)	20
	Test 2	All 5 units	3 hours	15 (Set for 60)	
B	Assignment			5	10
C	Class activity			5	

Grand Total		30
Assignment	<ul style="list-style-type: none"> • Abstract and executive summary • Case study writing • Concept mapping • Student generated handbook • Essay writing etc. 	
Class activity	<ul style="list-style-type: none"> • Reaction paper • Quiz • One-minute paper • Situation based question • Application card etc. 	

Note : Any other assessment tools or methods can be adopted as per requirement of the course.

Foundation Course		
For the students admitted from A.Y. 2021-2022 & onwards		
Offering Department: Biochemistry	Offered to: B.Sc Biochemistry	
Semester – I		
Course Code	Course Title (F)	Course Credit and Hours
	Basic Biochemistry Practical	3 Credits - 6 hrs/wk

Course Description:

This practical course provides hand on training to operate basic instruments used in biochemistry laboratory. Learner will develop problem solving ability, preparation of lab reagents. The course includes operation and application of pH meter to measure the pH of various chemicals and qualitative-quantitative determination of various biomolecules.

Course Purpose:

1. To establish an understanding of the quantitative aspects of biochemical analyses.
2. To establish the importance of chemical safety and precautions in the biochemical laboratory.
3. To develop basic practical biochemical skills for the handling and analysis of biomolecules.
4. To develop comparative, observational and operational skills required in the laboratory/industry

Course Outcomes: Upon completion of this course, the learner will be able to		
CO No.	CO Statement	Blooms taxonomy Level (S₁ to S₆)
CO ₁	Acquaint with instruments used in biochemistry laboratory, basic laboratory practices and safety.	S ₁
CO ₂	Solve numerical problems and prepare various laboratory reagents	S ₃ , S ₄
CO ₃	Prepare the buffer solutions and know the acidic and basic nature of various chemicals and beverages.	S ₁ , S ₃
CO ₄	Undertake experiments for qualitative identification of biomolecules	S ₁ , S ₄
CO ₅	Estimate concentration of unknown macro and micro molecules.	S ₂

Suggested laboratory experiments:
<ol style="list-style-type: none"> 1. Safety measures and introduction to the instruments used in biochemistry laboratory 2. Importance of calibration of instruments and cleaning of glasswares 3. Principle and working of pH meter 4. Checking the pH of different biological and non biological samples (Fruit Juices, Soft drinks etc.) 5. Preparation of different buffer solutions. 6. Numerical problems for the preparation of Normal and Molar solutions. 7. Preparation of Normal solutions and Molar Solutions. 8. Numerical problems for the preparation of percent solution and dilutions. 9. Preparation of percent solutions and dilutions. 10. Effect of hypertonic, hypotonic and isotonic solutions on Tissue/cell. 11. Introduction to principle and working of colorimeter 12. Qualitative tests for carbohydrates. 13. Qualitative tests for lipids. 14. Estimation of reducing sugar by DNSA method 15. Estimation of Chlorophyll. 16. Estimation of Vitamin C: Titrimetric determination with DCPIP.

Pedagogic tools:

- Chalk and Board
- Laboratory Hands on training
- PowerPoint Presentation and Videos.
- Virtual Lab

Text books – Not applicable
<p>Reference Books:</p> <ul style="list-style-type: none"> • Sadasivam, S. and Manickam, A. 2010. <i>Biochemical Methods</i>. [Third Edition]. New Age International (P) Ltd., New Delhi. • Jayaraman, J. 2008. <i>Laboratory Manual in Biochemistry</i>. [First Edition Reprint]. New Age

International (P) Ltd., New Delhi
Laboratory Manual/ Book
<ul style="list-style-type: none"> Manual of Biochemistry Department, Shri M. & N. Virani Science College (Autonomous), Rajkot

Suggested reading / E-resources
<ul style="list-style-type: none"> Not Applicable

Suggested MOOCs
<ul style="list-style-type: none"> Not Applicable

Methods of assessing the Course Outcomes
The COs of the course will be assessed through
<ul style="list-style-type: none"> CIA (Test, Performance, Record book, Viva Voce) SEE

CIA Components	Marks
Test (After completion of 70-80% of accessible Practicals)	30
Performance and Record book	10
Grand Total	40

Sr. No.	SEE Component	Content	Duration (if any)	Marks	Sub Total
A	Test	After completion of course	6 hours	60	60
Grand Total					60