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

B.Sc. BIOCHEMISTRY

Semester IV Syllabus

Advanced Course For the students admitted from A.Y. 2021-2022 & onwards		
Offering Department: Biochemistry	**Offered to: B.Sc Biochemistry students**	
Semester – IV		
Course Code	**Course Title (Adv)**	**Credits**
21UBCCC401	Core 9: Intermediary Metabolism	**4 Credits- 4 hrs/wk**

Course Description: The course in Metabolism is aimed to give students an exposure to various biochemical processes and interactions happening inside the cells at molecular level. It provides deeper insight into properties and functions of different biomolecules as well as pathways for their synthesis and degradation in the living systems.

Course Purpose:

- Define metabolism, differentiate concepts of catabolism and anabolism and explain synthesis and degradation of biomolecules; carbohydrates, lipids, proteins and nucleic acids in living organisms.
- Describe role of various enzymes in different metabolic pathways and significance of various metabolic pathways in mammalian systems.
- Relate deviations or alterations in normal metabolic pathways that result in to metabolic diseases.
- Integrate concepts of metabolism with common lifestyle diseases and their management.

Course Outcomes: Upon completion of this course, the learner will be able to		
CO No.	**CO Statement**	**Blooms taxonomy Level (K_2 to K_6)**
CO_1	Relate synthesis and degradation pathways for biomolecules	K_2 , K_3 , K_4
CO_2	Identify the central metabolic pathways and their importance in cellular metabolism.	K_2 , K_3 , K_4
CO_3	Illustrate how various molecules are utilized as fuels for oxidation and production of energy in living organisms.	K_2 , K_3, K_4, K_5, K_6
CO_4	Apply concepts of metabolism in understanding biochemical basis for various metabolic and lifestyle diseases, their diagnosis, treatment and management.	K_2 , K_3, K_4, K_5, K_6
CO_5	Combine and correlate interplay in pathways of carbohydrates, amino acids, lipids and nucleic acid metabolism.	K_2 , K_3, K_4, K_5, K_6

Course Content	**Hours**
Unit 1: Basic design and metabolism of carbohydrate	**12 hrs**
• Metabolic pathways, catabolism and anabolism. • Glycolysis - reactions of glycolysis and control of glycolysis. • Synthesis of glucose from various non-carbohydrate sources,(Gluconeogenesis) • Pentose phosphate pathway and its importance. • Glycogenesis and glycogenolysis, Regulation of glycogen metabolism.	
Unit 2: Citric acid cycle and Glyoxylate pathway	**12 hrs**
• Different metabolic fates of pyruvate and acetyl CoA • TCA (citric acid cycle) as a central metabolic pathway and its importance. • Sub cellular localization and reactions of citric acid (TCA) cycle. • Anaploretic reactions and amphibolic role of TCA cycle. • Regulation of citric acid cycle- overview about key regulatory enzymes. • Glyoxylate pathway and its significance in plants.	
Unit 3: Metabolism of lipids	**12 hrs**
• synthesis and breakdown of triglycerides, Significance of fats (TAG) as major energy storage form of fuel in human body. • Fatty acid transport to mitochondria, Activation and enzymatic steps in β oxidation of fatty acids, overview of oxidation of unsaturated and odd numbered fatty acids • Fatty acid synthase complex as a multienzyme complex and reactions for synthesis of fatty acids. Comparison of fatty acid synthesis and fatty acid oxidation	

• Ketonebodies metabolism; synthesis and degradation of acetoacetate, beta hydroxyl butyrate and acetone. Causes for ketosis and ketoacidosis. • Important steps in synthesis of cholesterol and its regulation. Overview of different types of cholesterol lowering drugs. • Different types of lipoproteins and their role in transport of lipids.	
Unit 4: Overview of amino acid metabolism	**12 hrs**
• Importance and biological functions of different amino acids, peptides and proteins. Why proteins are not preferred as an energy source in human body? Glycogenic and ketogenic amino acids. Entry points of different amino acids in TCA cycle. • Oxidative deamination and transamination reactions in amino acid catabolism. Amino acid decarboxylation reaction and synthesis of different biologically important amines. • Ammonotelic, uricotelic and ureotilic organisms .Reactions of Urea cycle. Link between urea cycle and TCA cycle. • Role and pathway of conversion of tyrosine in synthesis of various biologically important pigments, hormones and neurotransmitters. • Essential v/s non essential amino acids. Overview of biosynthesis of non-essential amino acids.	
Unit 5: Metabolism of nucleic acids	**12 hrs**
• Chemical Structures of purine and pyrimidine bases, nucleoside and nucleotides. • Salvage and denovo synthesis of Purine and pyrimidine nucleotides • Conversion of ribonucleotides to deoxyribonucleotides and to triphosphates, • Degradation of nucleic acids, purine and pyrimidine nucleotides. • Inhibitors of nucleotide metabolism. • Brief descriptions of disorders of purine and pyrimidine metabolism – Lesch-Nyhan syndrome, Gout, SCID, adenosine deaminase deficiency.	

Text books (2 textbooks):
1. Nelson, D. L., Cox, M. M., & Lehninger, A. L. (2013) 6th ed., *Lehninger principles of biochemistry* Freeman and Company (New York), (Unit 1-5) 2. Deb, A. C. (2006). *Fundamentals of Biochemistry*. Calcutta, India: New Central Book Agency. (Unit 1-5)

Reference books:

1 Campbell, N. A., & Reece, J. B. (2016). *Campbell biology: Concepts & connections*. Boston: Pearson
2. Devlin, T. M. (2011) *Textbook of Biochemistry with Clinical Correlations*. 7th ed., John Wiley & Sons, Inc. (New Jersey).
3. Berg, J. M., Tymoczko, J. L., & Stryer, L (2012),*Biochemistry* , 7th ed., W.H. Freeman and Company (New York).
4. Garrett, R. H., & Grisham, C. M. (2013). *Biochemistry Belmont*, CA: Brooks/Cole, Cengage Learning.

Pedagogic tools:

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

Methods of Assessment & Tools:

Components of CIE:30 marks (Example as below)

Sr. No.	Component	Content	Duration (if any)	Marks	Sub Total
A	Test 1	1st 2 units	$1^{1/2}$ hours	5 (Set for 30)	20
	Test 2	All 5 units	3 hours	15 (Set for 70)	
B	Assignment			05	10
C	Class activity			05	
				Grand Total	**30**

Assignment	• Abstract and executive summary • Case study writing • Concept mapping • Student generated handbook • Chart preparation etc…
Class activity	• Reaction paper • Quiz • One-minute paper • Situation based questions • Application card etc..

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

Advanced Course: For the students admitted from A.Y. 2021-2022 & onwards		
Offering Department: **Biochemistry**	Offered to: **B.Sc Biochemistry**	
Semester – IV		
Course Code	Course Title (Adv)	Course Credit and Hours
21UBCCC402	**Molecular Biology**	**4 Credits - 4 hrs/wk**

Course Description: The course will mainly focus on the study of principal molecular events of cell incorporating DNA Replication, Transcription and Translation in prokaryotic as well as eukaryotic organisms. The course will also emphasize DNA sequencing , Post Transcriptional Modifications and Processing of Eukaryotic RNA covering the concepts of Split genes, Introns, Exons, Splicing Mechanisms and RNA Editing. During this course, the students will be imparted comprehensive understanding about key concept of DNA Repair Mechanisms and Recombination and transposable elements.

Course Purpose: To impart detailed understanding of key events of molecular biology comprising of mechanism of DNA Replication, Transcription and Translation in Prokaryotes and Eukaryotes. To provide adequate knowledge about Post Transcriptional Modifications and Processing of Eukaryotic RNA to the course learners.
To develop comprehensive understanding regarding DNA Repair Mechanisms in the course learners. To provide glimpse of types of recombination and transposable elements. After successful accomplishment of the course, the learners will be able to acquire better understanding and comprehensive knowledge regarding most of the essential aspects of Molecular Biology subject which in turn will provide a fantastic opportunity to develop professional skill related to the field of molecular biology.

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

CO No.	**CO Statement**	**Blooms taxonomy Level**
CO_1	Understand the basic concepts for DNA sequencing , replication and gene expression	K1 , K2
CO_2	Describe the general principles of gene organization and expression in both prokaryotic and eukaryotic organisms.	K2 , K3
CO_3	Demonstrate knowledge and understanding of the molecular machinery of replication, recombination and mutation in living cells.	K2, K3 and K4
CO_4	Compare and contrast the mechanisms of bacterial and eukaryotic Transcription, and Translation	K2, K3 and K4
CO_5	Understand the types of recombination and transposable elements and their applications.	K2, K3 and K4

Course Content	Hours
Unit-I : Sequencing and Replication of DNA in Prokaryotes and Eukaryotes	**12 hrs**
• Maxam-Gilbert's, Sanger's and automated methods for DNA sequencing. • Overview of Human genome project. • DNA polymerase & other enzymes and proteins in DNA replication • Stages of replication of *E. coli* chromosome. • Replication in eukaryotes. • Inhibitors of DNA Replication	
Unit-II: Transcription in Prokaryotes and Eukaryotes	**12 hrs**
• Enzymes and factors involved in transcription process. • Stages of transcription- initiation, elongation and termination • Post transcriptional modifications- capping, tailing and splicing. • Comparison between prokaryotic and eukaryotic transcription. • Inhibitors of transcription and their applications.	
Unit-III : Translation in Prokaryotes and Eukaryotes	**12 hrs**
• Genetic code and its characteristics. • Role of Ribosomes and different types of RNA. • Charging of tRNA and stages of translation-, initiation, elongation and termination • Comparison between prokaryotic and eukaryotic translation. • Post translational modifications • Inhibitors of protein synthesis and applications in medicine	
Unit IV: Molecular basis of mutations and various modes of DNA repair	**12 hrs**
• Types of mutations - transition, transversions, frame shift mutations, point mutation etc. • Physical & Chemical Mutagenic agents and Ames test. • Replication errors and mismatch repair system, • Repair of DNA damage: direct repair, base excision repair, nucleotide excision repair, recombination repair, SOS response, translesion DNA synthesis.	
Unit V: Recombination and transposable elements	**12 hrs**
• Recombination in bacteria- conjugation, transduction & transformation • Homologous and Non Homologus recombination • Site-specific recombination, • Transposable elements and their classes. • Importance of transposable elements in horizontal transfer of genes and evolution.	

Text Books:

1.Peter J. Russell (2016) iGenetics: A Molecular Approach Unknown Binding – Pearson Education India . (Unit 1-5)

2.Malacinski, G. M., & Freifelder, D. (2015). *Essentials of molecular biolo*gy. Boston, Mass:

Jones and Bartlett Publishers. (Unit 1-5)
3. Nelson, D. L., Cox, M. M., & Lehninger, A. L. (2013). *Lehninger principles of biochemistry*. New York: W.H. Freeman. (Unit 1-5)

Reference books

1. Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., & Losick, R. (2014).*Molecular biology of the gene*. Boston: Pearson.
2. Snustad, D. P., & Simmons, M. J. (2016). *Principles of genetics*. 5th ed., John Wiley & Sons Asia,
3.Weaver, R. F., & Wassarman, D. A. (2016). I *Molecular biology*. McGraw-Hill Education, New York.

Pedagogic tools:

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

Methods of Assessment & Tools:

Components of CIE:30 marks (Example as below)

Sr. No.	Component	Content	Duration (if any)	Marks	Sub Total
A	Test 1	1st 2 units	$1^{1/2}$ hours	5 (Set for 30)	20
	Test 2	All 5 units	3 hours	15 (Set for 70)	
B	Assignment			05	10
C	Class activity			05	
				Grand Total	**30**
Assignment		● Abstract and executive summary ● Case study writing ● Concept mapping ● Student generated handbook ● Chart preparation etc…			

Class activity	• Reaction paper • Quiz • One-minute paper • Situation based questions • Application card etc..

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

Core Practicals For the students admitted from A.Y. 2021-2022 & onwards		
Offering Department: **Biochemistry**	Offered to: **B.Sc Biochemistry**	
Semester – IV		
Course Code	**Course Title (Adv)**	**Course Credit and Hours**
21UBCCC403	**Semester IV Metabolism and Molecular Biology Practicals**	**3 credits- 6 hours/ Wk**

Course Description:
This laboratory course compliments the theory core courses by providing students with hands on experiences on various analytical techniques such as UV-Visible spectroscopy, centrifugation techniques, chromatography and electrophoretic techniques.

Course Purpose:

- Comprehend the role of various metabolites present in various body fluids of the human body.
- Correlate normal values and clinical significance of changes in levels of different metabolites in diagnosis, prognosis and management of various diseases.
- Compare the chemistry and significance of nucleic acids in living systems.
- Plan and perform bacterial recombination experiments

Course Outcomes: Upon completion of this course, the learner will be able to		
CO No.	**CO Statement**	**Blooms taxonomy Level (S_1 to S_5)**
CO_1	Develop skills for blood collection by vein puncture, isolation of plasma and serum for biochemical analysis.	**S_1, S_2 S_3, S_4**
CO_2	Compare pros and cons of chemical vs. enzymatic estimation methods for different analytes. Design and perform experiments to analyze various biochemical	**S_2 ,S_3, S_4, S_5**

	substances, metabolites from body fluids-plasma and serum.	
CO_3	Perform calculations and interpret the results of various biochemistry laboratory tests and derive conclusions and clinical correlations.	**S_1,S_2 ,S_3, S_4, S_5**
CO_4	Estimate DNA and RNA from various samples and compare and correlate chemical v/s physical methods of their estimation.	**S_1, S_2 S_3, S_4**
CO_5	Perform bacterial recombination experiment through conjugation and interpret the results.	**S_2 ,S_3, S_4, S_5**

Suggested laboratory experiments:

1. Introduction to clinical biochemistry practicals and significance of estimation of different biochemical compounds in blood /plasma.
2. Estimation of blood glucose by GOD/POD method.
3. Estimation of plasma urea by urease method.
4. Estimation of serum uric acid by uricase method.
5. Estimation of Total proteins from plasma by biuret method and albumin by BCG method.
6. Calculation of globulin content and A/G ratio.
7. Determination of total cholesterol from plasma sample by enzymatic method.
8. Estimation of triglycerides from plasma samples by enzymatic method.
9. Determination of HDL cholesterol from plasma sample by PTA and enzymatic method.
10 Isolation of chromosomal DNA from *E. coli* cells.
11. Ultraviolet absorption spectrum of DNA and RNA.
12. Determination of DNA and RNA concentration by A260nm.
13. Quantitative estimation of DNA by Diphenyl amine method.
14. Quantitative estimation of RNA by orcinol method.
15. Bacterial recombination through conjugation.

Pedagogic tools:

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

Text books – Not applicable

Reference Books:

1. Wilson, K., & Walker, J. M. (2000) *Principles and techniques of practical biochemistry*. Cambridge: Cambridge University Press.
2. J. *Jayaraman* (2011) *Laboratory Manual in Biochemistry New Age International Publishers, New Delhi.*
3. Thimmaiah S.R. (2004) *Standard Methods of Biochemical* Analysis. Kalyani Publishers, New

Delhi. •
Laboratory Manual/ Book
• Manual of Biochemistry Department, Shri M. & N. Virani Science College (Autonomous), Rajkot

Suggested reading / E-resources
• Not Applicable

Suggested MOOCs
• Not Applicable

Methods of assessing the Course Outcomes The COs of the course will be assessed through
• 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**

Core Elective I (Advanced Course) For the students admitted from A.Y. 2021-2022 & onwards		
Offering Department: **Biochemistry**	Offered to: **B.Sc. Biochemistry**	
Semester – IV		
Course Code	Course Title (Ad.)	Course Credit and Hours
21UBCDC401	**Microbiology**	**4 Credits - 4 hrs/wk**

Course Description:
Microbes may be invisible to the eye, but they dominate every environment on Earth. In this course, you'll explore a general introduction to microbiology and investigate the amazing diversity of microbial life. Learn aboutthe growth and cultivation of microbes. The course also deals with the role of microbes in human health.
Course Purpose:
The course aims to provide students with an understanding of general microbiology, contribution of

microbiology to human life for various daily needs. It provides comprehensive knowledge in the field of microbial disease and antimicrobial agents.

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	Identify various microorganisms, classify and compare the function of flagella and pili.	K1, K2, K3
CO_2	Understand the nutritional requirements of microbes and relate them with growth rate.	K1, K2, K3, K4
CO_3	Explain different microbial techniques and media to choose the correct practice of isolation of microbes.	K1, K2, K3, K4,K5
CO_4	Discern the replication strategies of representative viruses from the seven Baltimore classes; Comprehend the intricate interaction between viruses and host cells	K1, K2, K3, K4
CO_5	Identify and recognize microbial pathogens and understand the role of antimicrobial agents.	K1, K2, K3, K4

Course Content	**Hours**
Unit I: Introduction to Microorganism and Microbiology	**12hrs**
• Introduction of microorganisms, Development of microbiology as a discipline • Classification and Ultrastructure of bacteria, fungi, algae, and protozoa. • Structure and Composition of bacterial, fungal, and archaebacterial cell wall. • Flagella and pili. • Cell inclusion bodies.	
Unit II: Microbial Growth and Metabolism	**12 hrs**
• Microbial growth - definition. Mathematical expression of growth, growth curve, measurement of growth and growth yields, synchronous growth, continuous culture, factors affecting growth. • Bacterial Cell division • Nutritional-based microbial classification: Autotrophs, Heterotrophs, Chemolithotrophs, and Chemoorganotrophs. • Nitrogen metabolism, nitrogen fixation.	
Unit-III: Microbiological Techniques	**12 hrs**
• Determinative method-dependent identification of bacteria. • Pure culture techniques, Theory and practices of sterilization. • Types of culture media; simple, Defined, Selective, Differential and Enriched. • Cultivation of anaerobic organisms.	
Unit-IV: Viruses	**12 hrs**

• Cultivation of viruses; Cell line dependent, Embryonated egg. • Structure and Baltimore Classification of the virus. • Replication of Bacteriophage - Lytic cycle and lysogeny. • Herpes, Pox, TMV, Adenoviruses, Retroviruses, Viroids and Prions	
Unit- V: Medical Microbiology	**12 hrs**
• Infectious disease transmissions. Respiratory infections caused by bacteria and viruses; Tuberculosis. • Reproductive tract infections, and sexually transmitted diseases including AIDS. • Vector borne diseases, water borne diseases. • Pathogenic fungi: Rot, Smut and wilt, Candida and Aspergillus. • Antimicrobial agents: Types and mode of actions. • Resistance to antibiotics.	

Text books :

1.Atlas RM. (1997). *Principles of microbiology*. (ed. 2nd), W M.T.Brown Publishers.

2. Pelczar MJ, Chan ECS and Krieg NR. (1993). *Microbiology.* (ed. 5th), McGraw Hill

Book Company

Reference books:

1. Prescott, L. M., Harley, J. P., & Klein, D. A. (2005). Microbiology. 5th. *McGraw JHill Higher Education.*
2. Tortora, G. J., Funke, B. R., Case, C. L., & Johnson, T. R. (2004). *Microbiology: an introduction*. San Francisco, CA: Benjamin Cummings.
3. Ananthanarayan, R. (2006). *Ananthanarayan and Paniker's textbook of microbiology*. Orient Blackswan.

Pedagogic tools:

- Chalk and Board
- Powerpoint 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	1st 2 units	1 1/2 hours	5 (Set for 30)	20
	Test 2	All 5 units	3 hours	15 (Set for 70)	
B	Assignment			05	10
C	Class activity			05	
				Grand Total	**30**

Assignment	● Abstract and executive summary ● Case study writing ● Concept mapping ● Student generated handbook ● Essay writing etc.
Class activity	● Quiz ● Situation based question ● Application card etc.

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

Core Elective I (Advanced Course) For the students admitted from A.Y. 2021-2022 & onwards		
Offering Department: **Biochemistry**	Offered to: **B.Sc Biochemistry**	
Semester – IV		
Course Code	Course Title (Adv)	Course Credit and Hours
21UBCDC402	**Membrane Biology and Bioenergetics**	**4 Credits - 4 hrs/wk**

Course Description: This Course deals with in the basic and fundamental understanding of cell membranes, their components and how membrane and membrane-associated processes control numerous cellular functions. Energy generation and transformation by membranes is an essential feature of all cells: membrane electron transport processes will be discussed (with particular attention being given to respiratory and photosynthetic processes), together with the chemiosmotic theory for ATP synthesis by membranes.

Course Purpose: The course Membrane Biology and Bioenergetics has a multi-disciplinary application and encompasses core fundamental topics that will benefit students in the fields of life sciences, biochemistry, biophysics, molecular biology, bioengineering, biotechnology etc.

The main objectives of the course to familiarize the students with the fundamental concepts of cellular membranes, their structures and the chemical composition that are responsible for the unique functions of biomembranes with emphasis on membrane transport and to make the students understand the various energy transductions that occur within the cell.

Course Outcomes: Upon completion of this course,		
CO No.	**CO Statement**	**Blooms taxonomy Level (K_1 to K_6)**
CO_1	Describe the structure, organisation and biogenesis of biological membranes. Explain how physico-chemical properties of the lipids and proteins lead to the dynamic nature of biological membranes;	K1, K2, K3
CO_2	Demonstrate deep and rational understanding of how ions and solutes are transported across biological membranes, thus creating membrane gradients, demonstrate ability to solve practical problems related to membranes;	K1, K2,K3, K4
CO_3	Describe, Discuss and Classify different types of transport mechanism across membrane and list various transport proteins.	K1, K2, K3, K4
CO_4	Explain and interpret the organization of components of respiratory electron transport chain into complexes	K1, K2,K3, K4
CO_5	Interpret and Identify various types of phosphorylation and evaluate inhibitors of ETC and phosphorylation	K1, K2,K3,K4

Course Content	**Hours**
Unit 1: Introduction to biomembranes	**12 hrs**
• Composition of biomembranes - prokaryotic, eukaryotic, neuronal and subcellular membranes. • Fluid mosaic model with experimental proof. Monolayer, planer bilayer and liposomes as model membrane systems. • Polymorphic structures of amphiphilic molecules in aqueous solutions - micelles and bilayers.Membrane asymmetry-lateral diffusion and flip flop movement of phospholipids and proteins.FRAP experiment • Membrane fluidity, factors affecting membrane fluidity.	
Unit 2: Membrane transport	**12 hrs**
• Thermodynamics of transport. Simple diffusion and facilitated diffusion. • Passive transport -glucose transporter, anion transporter and aquaporins**.** • Primary active transport and Secondary active transport • Ion channels - voltage-gated ion channels (Na+/K+ voltage-gated channel), • Ligand-gated ion channels (acetyl choline receptor), • Ionophores – mobile carriers and channel formers with suitable examples.	
Unit 3: Vesicular transport and membrane fusion	**12 hrs**
• Exocytosis • Endocytosis: Pinocytosis and Phgocytosis.	

• Receptor mediated endocytosis of LDL • Liposome mediated drug delivery systems and its applications	
Unit 4: Electron transport chain	**12 hrs**
• Structure and Ultra structure , biogenesis and function of Mitochondria, • Components of Electron transport chain (ETC). • Redox potential and Organization of Electron transport chain • Glycerol phosphate and malate aspartate shuttle systems for transport of cytosolic NADH. • Inhibitors of ETC.	
Unit- 5: Types of Phosphorylation	**12 hrs**
• Substrate level phosphorylation • Oxidative phosphorylation o Basic Introduction to Peter Mitchell's chemiosmotic hypothesis. Proton motive force and ATP synthesis. o Fo F1-ATPase : structure and mechanism of ATP synthesis. • Uncouplers of ETC and phosphorylation • Overview of photophosphorylation.	

Text books:

1. Campbell, N. A., & Reece, J. B. (2016). *Campbell biology: Concepts & connections.* Boston: Pearson (Unit 4 and 5)
2. Deb, A. C. (2006). *Fundamentals of biochemistry*. Calcutta, India: New Central Book Agency. (Unit 1,2 and 3)

Reference books:

1. Nelson, D. L., Cox, M. M., & Lehninger, A. L. (2013) 6th ed., *Lehninger principles of biochemistry* Freeman and Company (New York).
2. Berg, J. M., Tymoczko, J. L., & Stryer, L (2012) ,*Biochemistry* , 7th ed., W.H. Freeman and Company (New York).
3. Garrett, R. H., & Grisham, C. M. (2013). *Biochemistry*. Belmont, CA: Brooks/Cole, Cengage Learning.
4. Lodish, H., Berk, A., Kaiser, C.A., Krieger, M.,Bretscher, A., Ploegh, H., Amon, A. and Scott, M.P., *Molecular Cell Biology* (2013) 7th ed., W.H. Freeman & Company (New York).

Pedagogic tools:

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

Methods of Assessment& Tools:
Components of CIE: 30 marks (Example as below)

Sr. No.	Component	Content	Duration (if any)	Marks	Sub Total
A	Test 1	1st 2 units	1 1/2 hours	5 (Set for 30)	20
	Test 2	All 5 units	3 hours	15 (Set for 70)	
B	Assignment			05	10
C	Class activity			05	
				Grand Total	**30**
Assignment	• Abstract and executive summary • Case study writing • Student generated handbook • Essay writing etc.				
Class activity	• Quiz • Open book test • Situation based question • Group discussion				

Core Elective Practical For the students admitted from A.Y. 2021-2022 & onwards		
Offering Department: **Biochemistry**	Offered to: **B.Sc Biochemistry**	
Semester – IV		
Course Code	Course Title (Ad)	Course Credit and Hours
21UBCDC403	**Core Elective Practical Microbiology**	**2 Credits - 4hrs/wk**

Course Description:
This course is to explore various methods and practices to study the microbial world like preparation and types of culture media, identification of different microbes by using various staining techniques and application of media composition to cultivate/differentiate bacteria.

Course Purpose:
The course is designed to acquaint the methods and importance of sterilization and biosafety. .It develops expertise in various techniques of basic microbiologywhich includes identification, cultivation of various microorganisms, staining procedures, qualitative analysis of enzyme producing microorganisms.

Course Outcomes: Upon completion of this course, the learner will be able to		
CO No.	**CO Statement**	**Blooms taxonomy Level (S_1 to S_6)**
CO_1	Master aseptic techniques and be able to perform routine culture handling tasks safely and effectively	**S1, S2, S3**
CO_2	Demonstrate theory and practical skills in microscopy and their handling techniques and staining procedures.	**S2, S3**
CO_3	Know the various Physical and Chemical growth requirements of bacteria and get equipped with a method of bacterial growth measurement.	**S1, S2, S3**
CO_4	Gain experimental knowledge to isolate the specific organism	**S1, S2, S3, S4**
CO_5	Check the effects of various antibiotics on growth of bacteria.	**S1, S2**

Suggested laboratory experiments:

1. Microbiology Laboratory Practices, the concept of sterilization and Biosafety.
2. Preparation and sterilization of culture media for bacterial cultivation
3. Study of different shapes of bacteria, fungi, algae and protozoa using permanent slides
4. Staining of bacteria- Simple staining and negative staining
5. Differential staining- Gram staining
6. Isolation of bacteria by different streaking methods.
7. Isolation of *Rhizobium* from root nodules.
8. Isolation of protease producers.
9. Measurement of the growth rate of bacteria.
10. Antibiotic sensitivity test (Disc diffusion methods).

Pedagogic tools:

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

Text books – Not applicable

Reference Books:

- Cappuccino, J. G. (2016). *Microbiology: a Laboratory manual*, Global Edition. Pearson Education Limited.

Laboratory Manual/ Book

- Sharma, K. (2007). *Manual of Microbiology*. Ane Books Pvt Ltd.

Suggested reading / E-resources

- Not Applicable

Suggested MOOCs

- Not Applicable

Methods of assessing the Course Outcomes The COs of the course will be assessed through
● 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 the course	6 hours	60	60
				Grand Total	**60**

Core Elective Practical

For the students admitted from A.Y. 2021-2022 & onwards

Offering Department: **Biochemistry**	Offered to: **B.Sc Biochemistry**

Semester – IV

Course Code	**Course Title (Adv)**	**Course Credit and Hours**
21UBCDC404	**Membrane Biology and Bioenergetics Practical**	**2 Credits - 4 hrs/wk**

Course Description:

The concepts studied in theory course of membrane biology and bioenergetics will be experienced during performing these lab experiments.

Course Purpose:

1. To establish an understanding of the structure, function of membranes.
2. To establish the importance of proper reagents and methodology in laboratoty.
3. To develop basic practical biochemical skills for the handling and analysis of membranes
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 (S_1 to S_6)**
CO_1	Isolate RBC from blood sample	**S3, S4, S5**
CO_2	Deduce and Illustrate effect of detergents on membranes	**S3, S4, S5**
CO_3	Prove that during photosynthesis oxygen is evolved	**S4, S5**
CO_4	Isolate and estimate the photosynthetic pigments	**S4, S5, S6**
CO_5	Isolation of mitochondria from rat liver	**S4, S5, S6**

Suggested laboratory experiments:

1. Preparation of RBC Ghost Cell
2. Study of the Effect of Detergents on Membrane
3. Study the Photosynthetic Oxygen (O2) Evolution in Hydrilla Plant
4. Isolation of Chloroplast from Spinach Leaves and Estimation of total Chlorophyll
5. Extraction and Separation of Photosynthetic Pigments by Partition Chromatography
6. Isolation of Mitochondria from Rat Liver

Pedagogic tools:

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

Text books – Not applicable

Reference Books:

- Sadasivam, S. and Manickam, A. 2010. *Biochemical Methods*. [Third Edition]. New Age International (P) Ltd., New Delhi.
- Jayaraman, J. 2008. *Laboratory Manual in Biochemistry*. [First Edition Reprint]. New Age International (P) Ltd., New Delhi

Laboratory Manual/ Book

- Manual of Biochemistry Department, Shri M. & N. Virani Science College (Autonomous), Rajkot

Suggested reading / E-resources

- Not Applicable

Suggested MOOCs
• Not Applicable

Methods of assessing the Course Outcomes The COs of the course will be assessed through
• 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**