SILVER OAK UNIVERSITY

EDUCATION TO INNOVATION

(Established under Gujarat Private Universities Act, 2009)

SEMESTER – I

- Cell Biology
- Biomolecules
- Microbial Physiology & Genetics
- Analytical Tools and Techniques in Biotechnology

- Lab-I: Cell Biology and Microbiology
- Lab-II: Biochemical Analysis and techniques

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Subject: - Cell Biology								
Program: M.Sc.				**Subject Code:**			**Semester: I**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
04	-	4	6	24/60	20/50	16/40	-	150

Course Objectives

- To understand basic and advanced Cell biology theories & concepts.
- Know about the cellular organelles and their functions in detail.
- Learn how to present Cell biology data and concepts to an audience.
- Understand current experimentation research in the field of Cell Biology.

UNIT-I

Cell cycle – Molecular events including cell cycle check points and Cdk – cyclin complexes and their role in cell cycle regulation. Mechanism of cell division: Mitosis, Meiosis and Cytokinesis. Cell Differentiation: stem cells, their differentiation into different cell types and organization into specialized tissues.

Learning Outcomes

- At the end of the unit the student should be able to understand Cell Cycle and Check point including regulation at the check points.
- Should learn different mechanisms and stages during cell division.

UNIT-II

Interactions between cells and their Environment: Extracellular matrix, Interaction of cells with other cells, Tight Junctions, Gap Junctions and Plasmadesmata, Cell wall. Ultra structure of plasmamembrane: Chemical composition of the membranes: Membrane lipids, Carbohydrates and Proteins, Membrane asymmetry, Dynamic nature of the plasma membrane. Movement of substances across cell membranes: Diffusion, Facilitated Diffusion & active transport.

Learning Outcomes:

- At the end of the unit the student should get familiarized with cellular membranes composition and functions of it.
- Should understand the dynamic nature of the plasma membrane.

UNIT-III

Ionophores and ion channels. Exo and endocytosis. Phago and pinocytosis. Endoplasmic reticulum: The Smooth Endoplasmic Reticulum, Functions of the Rough Endoplasmic Reticulum, Vesicular Transport from ER to Golgi complex. Signal hypothesis. Golgi Complex: Role of Golgi in protein secretion, Glycosylation in the Golgi Complex, Trans Golgi Network (TGN). Lysosomes and peroxisomes. Ribosomes: Eukaryotic and prokaryotic, Ribosomal proteins.

Learning Outcomes:

- At the end of the unit the student should know different mechanisms through which the cell exchange materials across the membrane.
- Should inference the inter relationship between Golgi and ER in secretion of proteins and post translational modifications and targeting.

UNIT-IV

The Cytoskeleton: Microtubules, Intermediate Filaments, Microfilaments, Muscle Contractility. Mitochondria: Structure and Function, biogenesis and enzymatic compartmentation, mechanism of oxidative phosphorylation (TCA Cycle), Organization of mitochondrial respiratory chain, Structure of ATP Synthase, Formation of ATP.

Learning Outcomes:

- At the end of the unit the student should be able to understand the cytoskeleton and its components including its importance
- Should do a detailed study about different pathways and mechanisms that play in Mitochondria

UNIT-V

Chloroplast: Structure and Function, the absorption of light, Photosynthetic units and Reaction centers, photophosphorylation. Carbon dioxide fixation and synthesis of Carbohydrates in C-3, C-4 and CAM plants. Photorespiration.

Learning Outcomes:

- At the end of the unit the student should be able to know the structure and functions of chloroplast and different pathways that occur in the chloroplast
- Should differentiate the mechanisms that occur in C-3, C-4 and CAM plants

Course Outcomes:

Upon successful completion of this course, participants will be able to

- Will have an insight on the structure and function of various organelles and macromolecular components of cells and their functions.
- Get familiarize with Cell Cycle and its regulatory check points and understand how cell grow, divide and die.
- Know the structure and function of Biological membrane and mechanism of exchange of compounds across the plasma membrane.
- Will be able to explain the morphology and physiological functions of ER, Ribosomes and protein targeting on ER.
- Understand Trans Golgi Network and protein secretion.
- Able to explain basic pathways and mechanisms in biological energy transduction from oxidation of metabolites to synthesis of ATP.

BOOKS RECOMMENDED:

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2008). Molecular Biology of the Cell (5th Ed.). New York: Garland Science.
2. Lodish, H. F. (2016). Molecular Cell Biology (8th Ed.). New York: W.H. Freeman

REFERENCE BOOKS:

1. Krebs, J. E., Lewin, B., Kilpatrick, S. T., & Goldstein, E. S. (2014). Lewin's Genes XI. Burlington, MA: Jones & Bartlett Learning.
2. Cooper, G. M., & Hausman, R. E. (2013). The Cell: a Molecular Approach (6th Ed.). Washington: ASM ; Sunderland.
3. Hardin, J., Bertoni, G., Kleinsmith, L. J., & Becker, W. M. (2012). Becker's World of the Cell. Boston (8th Ed.). Benjamin Cummings.

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Subject: - Biomolecules								
Program: M.Sc.				Subject Code:			Semester: I	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)-Theory	Continuous Internal Evaluation (CIE)-Practical	Total
04	-	4	6	24/60	20/50	16/40	-	150

Course Objectives:

- The objectives of this course are to build upon undergraduate level knowledge of biochemical principles with specific emphasis on different metabolic pathways.
- The course shall make the students aware about the four major complex biomolecules found in living cells and the basis for grouping of biomolecules into those four groups within the context of each topic.
- To learn the chemical foundation of Biology, classification, structure and properties of carbohydrates & lipids, Amino acids, nucleosides & vitamins.

UNIT-I

Basic aspects of the chemistry of life: bonding properties of carbon, asymmetry of carbon compounds, basic concept of pH, pKa, buffers, various bonds stabilizing biomolecules (peptide, glycosidic, ester, phosphodiester, disulfide, ionic, hydrogen, hydrophobic, Vander wall's force), Properties of water as a solvent of life.

Learning Outcomes

- To understand the bonding properties of carbon, asymmetry of carbon compounds.
- Learn the elements present in biomolecules, the difference monomers and polymers, pH, pKa, buffers.
- Explain the Properties of water as a solvent of life and various bonds.

UNIT-II

Classification, structure, properties and biological significance of carbohydrates. Monosaccharides, Disaccharides, and Polysaccharides. Biological role of peptidoglycans, glycosaminoglycans and Lectins. Lipids - classification, structure and properties of fatty acids, triglycerides, phospholipids, sphingolipids and cholesterol.

Learning Outcomes

- At the end of the unit the student should be able to understand the structure and function of the following carbohydrates and where they are found: glucose, glycogen, starch, cellulose and chitin.
- Will learn the three groups of lipids, saturated, mono-unsaturated, and poly-unsaturated fatty acids, Phospholipids, glycolipids, cholesterol, prostaglandins.
- To understand the biological role of peptidoglycans, glycosaminoglycans and Lectins.

UNIT-III

Amino acids - Classification, structure and physico-chemical properties. Chemical synthesis of peptides – solid phase peptide synthesis. Proteins - classification, purification and criteria of homogeneity. Structural organization, sequence determination and characterization of proteins. Conformation of proteins – Ramachandran plots. Denaturation of proteins. Hetero cyclic compounds – Heme and Chlorophylls.

Learning Outcomes

- At the end of the unit the student should be able to understand the structure of an amino acid and the peptide bond that connects di-, tri, and polypeptides. Recognize the presence of 20 amino acids and that not all are essential amino acids.
- Should learn the function of proteins and recognize the importance of the three dimensional shape of a protein on its function and the role of non-covalent bonds in maintaining the shape of a protein.
- To gain the knowledge about the structure and function of Heme and Chlorophylls.

UNIT-IV

Nucleic acid as genetic material, building blocks of nucleic acids- purines and pyramidines, nucleosides, nucleotides, DNA- double helix structure, properties and function, chromosomal organization; DNA super coiling. Types of RNA and covalent structure of t- RNA. Classification, structure and physiological roles of Vitamins.

Learning Outcomes

- At the end of the unit the student should be able to understand the structures of nitrogenous bases (adenine, guanine, thymine, cytosine and uracil), nucleotides and nucleosides.
- To learn the 2 types of nucleic acids: DNA and RNA.
- Should learn about the classification, structure and physiological roles of Vitamins.

UNIT-V

Hormones- classification and mechanism of action of steroid and protein hormones. Signal transduction cascade by cyclic AMP, Phosphoinositate and calcium (Ca+), G-proteins, growth factors and membrane receptor tyrosine kinases. Phytohormones and their physiological roles.

Learning Outcomes

- At the end of the unit the student should be able to understand the chemical nature of hormones and neurotransmitters and their function in cell communication.
- Gain fundamental knowledge about the modes of action of hormones and neurotransmitters and describe how drugs can be used to alter their action.
- Should learn the phytohormones and their physiological roles.

Course Outcomes: On completion of this course, students should be able to:

- Gain fundamental knowledge in biochemistry;
- Understand the molecular basis of various pathological conditions from the perspective of Biochemical reactions.
- Learn the saponification number, acid number and iodine number of fats.
- Learn the structure and classification of amino acids, proteins with functions.
- Understand the structure of DNA, RAN and its functions, and the structure of Hormones, Chlorophyll and its functions

BOOKS RECOMMENDED:

1. Chemistry of Biomolecules,R.J.Simond, Royal Society of Chemistry.
2. Biomolecules: Chemistry of Living System, V.K.Ahluwalia.
3. Biochemistry. Basic classes of biomolecules: (Principles of biochemistry)", Tom N Corles.
4. Chemistry of Biomolecules"; 5th revised edition. Chapman and Hall.

REFERENCE BOOKS:

1. Principles of Biochemistry by A.L.Lehninger, 2 Ed. (worth).
2. Biochemistry by L. Stryer 4 Ed. (Freeman-Toppan).
3. Text Book of Biochemistry by West et. al., (Mac Millan).
4. Principles of Biochemistry by Smith et. al., (McGraw Hill).
5. Harper's Biochemistry (Langeman).
6. Biochemistry by D.Voet and J.G.Voet (John weily).
7. Biochemistry by U.Satyanarayana (Books &alied (p) Ltd.

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Subject: - Microbial Physiology & Genetics								
Program: M.Sc.				Subject Code:			Semester: I	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)-Theory	Continuous Internal Evaluation (CIE)-Practical	Total
04	-	4	6	24/60	20/50	16/40	-	150

Course Objectives:

- To study the process of sterilization and classification, cultivation of bacteria
- To understand the economic importance of micro organisms.
- To study the genetics in prokaryotic gene and eukaryotic genetics.

UNIT-I

Discovery, Evolution and development of Microbiology. Contributions of Van Leuwenhoek, Joseph Lister, Pasteur, Koch, Jenner, Winogradsky, Beijerinck. Recent trends and development in modern microbiology.Methods of sterilization, pasteurization and disinfection. Microbes as pathological agents in plant and animals. Microbes and Environment: Ecological impacts of microbes; Symbiosis (Nitrogen fixation and ruminant symbiosis); Microbes and Nutrient cycles; Microbial communication system; Quorum sensing.

Learning Outcomes

- Define microbiology and Describe how scientific methodologies are used to do the experiments,
- Define and apply biohazards and safety precautions.

UNIT-II

Classification and cultivation of bacteria. Bacterial reproduction and growth curve. Preparation of bacteriological media. Staining techniques. Differences between gram positive and gram negative bacteria. Actinomycetes, spirochetes, rickettsiae, mycoplasma, Chlamydiae – TRIC agents and LGV Archaebacteria.Clinically important bacteria.Microbialfuel cellsPrebiotics and Probiotics;General characteristics, Classification, structure, reproduction and economic importance of fungi, algae. Bluegreen algae and Protozoa.

Learning Outcomes

- Identify the major categories of microbe classification and cultivation.
- Analyze bacteriological media and preparations.
- Identify and demonstrate the staining techniques.

UNIT-III

Chemical nature and classification of bacteriophages. Parasitic and temperate phages. Plant and animal viruses – multiplication of viruses. General characteristics of T Phage, φx174, SV40, TMV. Clinically important viruses, retroviruses, HIV, Hepatitis B Virus and viral infections.

Learning Outcomes

- Describe viral structure and its significance in microbiology,
- Discuss the different types of viral organisms
- Distinguish between the cellular organization of prokaryotic and eukaryotic cells.

UNIT – IV

Microbial genetics: Recombination in prokaryotes, Transformation - natural and artificial transformation, conjugation - F, F’, Hfr; F transfer; Hfr-mediated chromosome transfer, transduction and sexduction. Mapping of prokaryotic gene. Transposons, retrotransposons and mechanism of transposition. Viral genetics. Biology of plasmids. Extra chromosomal inheritance.

Learning Outcomes

- Give examples of genetic recombination prokaryotes,
- Identify the steps in a microbial reproduction,
- Describe the role of transposons in microbial genetics and development.

UNIT-V

Genetics of Eukaryotes: Gene & Environment, Genotype and phenotype, Mendel's experiments, Dominance relationships. Multiple alleles, Gene Interaction, Gene mutations- base pair changes; frame shift; insertions; deletions; tandem duplication; Reversion vs. suppression, Sex determination, Sex linkage, Linkage and recombination in diploids. Tetrad analysis. Elements of gene mapping, Pedigree analysis.

Learning Outcomes

- Describe different types Mendel experiments,
- Give the examples of mutations and mechanisms of mutations,
- Apply the knowledge in pedigree analysis.

- Course Outcomes:
- Define microbiology and describe how scientific methodologies are used to do the experiments, Define and apply biohazards and safety precautions.
- Identify the major categories of microbe classification and cultivation. Analyze bacteriological media and preparations. Identify and demonstrate the staining techniques.
- Describe viral structure and its significance in microbiology, Discuss the different types of viral organisms.
- Distinguish between the cellular organization of prokaryotic and eukaryotic cells.
- Give examples of genetic recombination prokaryotes, identify the steps in a microbial reproduction, Describe the role of transposons in microbial genetics and development.
- Describe different types Mendel experiments, Give the examples of mutations and mechanisms of mutations, Apply the knowledge in pedigree analysis.

BOOKS RECOMMENDED:

1. Text book of Microbiology by Pelczar and Reid (Mc Graw Hill).
2. Microbiology by Tortora, Funk & Case.
3. Microbiology by Prescott.

REFERENCE BOOKS:

1. Principles of Genetics by Sinnet et.al,., (Mc Graw Hill).

2. Principles of Heridity by Robert Tumarin.

3. Genetics by M.W.Strick Berger (Mac Millan).

4. Cell and Molecular Biology by E.D.P.De Roberties (International edition).

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Subject: - Analytical Tools and Techniques in Biotechnology								
Program: M.Sc.				Subject Code:			Semester: I	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)-Theory	Continuous Internal Evaluation (CIE)-Practical	Total
04	-	4	6	24/60	20/50	16/40	-	150

Course Objectives

- To impart the knowledge of various microscopes and their applications.
- To impart the knowledge of electronic, rotation, vibration. NMR, FTIR, ESR, spectroscopy and their applications.
- To learn the separation techniques by means of chromatography and centrifugation
- To study the principles and applications of electrophoresis
- To gain knowledge on blotting techniques and DNA Fingerprinting
- To understand use of radio isotopes in biology
- To gain knowledge on electrochemical techniques and electrodes

UNIT-I

Microscopy- Light microscopy- Phase Contrast Microscopy, Fluorescent microscopy, Modern Developments in Microscopy-Electron Microscopy- Transmission and Scanning Electron Microscopy- Principle and applications, Resolution of a Microscope; Flow cytometry

Learning Outcomes

- Will have an insight on the basic principle and working of microscopy
- Will learn about the various types of microscopes
- Will have a basic knowledge on the latest developments in microscopy

UNIT-II

Electromagnetic radiation- electromagnetic spectrum, photoreceptors- types of radiations- visible spectrum, absorption spectrum.Spectroscopy- various types of spectroscopic techniques, spectrophotometer- UVVisiblespectroscopy- Beer Lambert Law, IR spectroscopy, NMR spectroscopy-principle andapplication, Fluorescent spectroscopy- principle and application; ORD and CD, Xraydiffraction technique-principle and application; Mass Spectrometry

LearningOutcomes

- Will learn about the basics of EMR
- Will have a basic knowledge on different types of spectropy
- Will get expertise on characterizations of biomolecules using spectroscopic techniques and methods.

UNIT-III

Chromatography- Principle and application, Classification of Chromatography, Paper Chromatography, TLC, LiquidChromatography - ion exchange chromatography, Gel permeation chromatography,affinity chromatography, HPLC and GLC.
Centrifugation -Basic principles of sedimentation- sedimentationcoefficient, Svedberg unit.Applications of preparative and analytical ultra centrifuges; Dialysis, Principles and applications of lyophilization.

Learning Outcomes

- Will learn the basic principle and types of chromatographic techniques
- Will be able to understand the concept of centrifugation
- Gain knowledge on the specific technique to be applied for separation of compounds based on their physico-chemical properties.

UNIT-IV

Electrophoresis- principle and application, PAGE- Native and SDS-PAGE, Isoelectric focusing, 2D - gel Electrophoresis, immuno electrophoresis; Agarose gel electrophoresis of DNA and RNA.
Molecular hybridization Techniques- Southern blotting, Northern blotting and Western blotting;DNA fingerprinting.

Learning Outcomes

- Will attain basics of electrophoretic techniques
- Will have a basic understanding of the separation process of proteins and nucleic acids
- Will gain knowledge on techniques used for separation of nucleic acids

UNIT-V

Principle and applications of tracer technique in biology: Radioactive Isotopesand half life of isotopes; Effect of radiation on biological system; autoradiography;radiation dosimetry; scintillation counting, safety aspects; Non-isotopic tracer techniques.
Electrochemical instruments - Principles and range of electrochemical techniques. Operation of pH electrodes. Principles and applications of Ion-selective and gas sensing electrodes, Oxygen electraodes.

Learning Outcomes

- Will attain basics of radioactivity
- Will gain knowledge on electrochemical techniques
- Will understand the range and applications of various types of electrodes

Course Outcomes:

- Will gain knowledge in the use of different microscope for structural analysis
- Will have a theoretical basis and basic understanding of some of the technologies used in the area of biotechnology like spectroscopy, chromatography, electrophoresis, electrochemical techniques
- To get introduced to the tools and techniques available for studying biochemical and biophysical nature of life
- To be able to learn about principles and working of these technologies

- Enable the students to get sufficient knowledge on applications of bio-instruments

BOOKS RECOMMENDED:

1. Biophysical chemistry principles and techniques by Upadyay, Upadyay and Nath(Himalaya publishing).

2. Principles and techniques of Biochemistry and Molecular Biology by Keith Wilson and John Walker, Cambridge University Press

3. Instrumental methods of chemical analysis by Dr. G.R. Chatwal and Sham Anand, Himalaya Publishing House

REFERENCE BOOKS:

1. Analytical Biochemistry by David J.Holme (Long man).

2. A Biologists guide to Principles and techniques of practical Biochemistry. Ed.by.B.D. Williams (Edward Arnold).

3. Instrumental methods of chemical analysis by G.K.Sharma (Goel).

4. Modern experimental Biochemistry by Rodney Boyer (Pearson Education)

5. Physical Biochemistry by Frefielder (Freeman & Co).

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LAB - I: CELL BIOLOGY AND MICROBIOLOGY

Course Objectives:

- Become proficient at laboratory skills and safety procedures.
- Learn to follow experimental procedures.
- Develop skills to formulate answerable questions/hypotheses, predict expected results.
- Learn how to make careful observations, collect and analyze data, and draw appropriate conclusions.
- Utilize active learning opportunity in the laboratories.
- Demonstrate good lab citizenry and the ability to work with others.

1. Mitosis in onion root tip cells: All phases (Squash method).
2. Meiosis in onion flower buds: All phases including zygotene, diplotene and diakinesis of prophase I (Smear method).
3. Preparation of liquid and solid media for growth of microorganisms.
4. Slants and Stab cultures, Isolation and maintenance of microorganisms by plating, streaking and serial dilution methods.
5. Biochemical characterization of selected microbes.
6. Simple staining and Grams staining.
7. Acid fast and spore staining.
8. Microscopic examination of bacteria, yeast and molds.
9. Growth of a microorganism and growth curve.
10. Analysis of water for portability and determination of MPN.
11. Microbiological examination of milk.
12. Oligodynamic action of heavy metals.
13. Evaluation of disinfectants by phenol coefficient method.
14. Isolation of viruses.
15. Examination of thallus structure and reproductive bodies of algae.
16. Examination of external features and reproductive organs of fungi.
17. Representative species of protozoa.

Learning Outcomes:

- Demonstrate practical skills in microscopy and their handling techniques in staining procedures
- Know various Culture media preparations and their applications
- Understand various physical and chemical means of sterilization
- Know General bacteriology and microbial techniques for isolation of pure cultures of bacteria, fungi and algae
- Master aseptic techniques and be able to perform routine culture handling tasks safely and effectively
- Comprehend the various methods of disinfection
- Apply the potability of water and water testing methods
- Know the various Physical and Chemical growth requirements of bacteria and get equipped withvarious methods of bacterial growth measurement.

BOOKS RECOMMENDED:

1. Handbook of Microbiological Media by Atlas R.L.

2. Manual of Clinical Microbiology by Lennettee E.H.

3. Manual of Clinical Microbiology by Murray PR.

4. A Laboratory manual of Microbiology: Microbes in Action.

LAB-II: BIOCHEMICAL ANALYSIS AND TECHNIQUES

Course Objectives:

- The objective of this laboratory course is to introduce students to experiments in biochemistry.
- The course is designed to teach students the utility of set of experimental methods in biochemistry in a problem oriented manner.
- Will try to develop the skills required to design and interpret the data from scientific experiments.
- The importance of good experimental design, including the use of appropriate controls, will be highlighted in all experiments.
- Also, as an introductory lab course, the lab work will emphasize the learning of basic lab skills (including dilutions, good pipetting technique) and good lab practices (such as good notebook keeping).

1. Separation of amino acids by paper chromatography.
2. Separation of amino acids/ sugars/ lipids by Thin Layer Chromatography.
3. Ultra violet absorption spectra of nucleic acids and proteins.
4. Determination of molar extinction coefficient of tryptophane / tyrosine.
5. Gel filtration of proteins.
6. Ion exchange chromatography of amino acids.
7. Purification of enzyme by affinity chromatography.
8. Subcellular fractionation by differential centrifugation.
9. Polyacrylamide gel electrophoresis of proteins.
10. Determination of isoelectric point of glycine.
11. Estimation of glycine by formal titration.
12. Estimation of reducing sugars by Benedict's titrimetric method.
13. Estimation of total carbohydrates by anthrone method.
14. Estimation of proteins by Lowry and Bradford methods.
15. Estimation of ascorbic acid.
16. Determination of Iodine value of oils.
17. Estimation of cholesterol.

Course Outcomes:

Students should be able to

- To elaborate concepts of biochemistry with easy to run experiments.
- To familiarize with basic laboratory instruments and understand the principle of measurements using those instruments with experiments in biochemistry.

BOOKS RECOMMENDED:

1. Hawk's physiological chemistry Ed. by Oser (McGraw Hill).
2. Biochemical methods By Sadasivam and Manikam (Wiley Eastern limited).
3. An introduction to practical biochemistry by D.T.Plummer (McGraw Hill).
4. Laboratory manual in Biochemistry by J.Jayaraman (Wilety Eastern limited).