M.Sc. BIOCHEMISTRY
II SEMESTER
BC 2.1: MICROBIOLOGY

Course Outcomes:

CO1: To learn the world of microorganisms – their history, classification of bacteria according to Bergey's Manual of Systematic Bacteriology, modern taxonomical aspects, isolation, cultivation, culturing methods, maintenance, cultures' preservation, evolution of microbiology and human gut microbiome

CO2: Master in the preparation and sterilization of microbial medias, as well as identification of different types of microorganisms by various staining techniques.

CO3: To study classification, characteristics and reproduction of Fungi including Molds and Yeasts; to learn the general characteristics of Actinomycetes, Rickettsia, Spirochaetes and Mycoplasma

CO4: To understand the role of algae, the many positive and negative microbial interactions within ecosystems, and to comprehend the role of microorganisms in sewage disposal, fermentation of foods, food spoilage, food poisoning and control measures

CO5: To be knowledgeable onthe pathogenesis of various microbial diseases (bacterial, fungal, air-borne, Arthropod-borne, and direct contact)

CO6: To closely study the evolution of virology, classification, virus replication, transmission (vector/non vector), isolation, cultivation, characterization, identification, purification of viruses, sub genomic RNAs, Virusoids, Viroids and Prions

CO7: To be informed on the architecture of viruses, interactions between viruses, and host immune systems

CO8: To grow aware of the management of plant viruses, animal viruses, physiology of human viruses, inactivation, prevention, and their control strategies

Course Specific Outcomes:

CSO1: To theoretically learn how to isolate and cultivate bacteria through various methods, and to develop the ability to apply that knowledge to microbial diagnosis in laboratory or industry settings

CSO2: To learn maintenance, preservation, and handling of pure cultures, which should help pave the way to carry out research in any microbiology-related domain

CSO3: To get acquainted with the discovery of antibiotics and their targets, drug/antibiotic resistance, preventive and therapeutic approaches of infectious diseases, and hospital acquired infections

CSO4: Understanding the importance of microorganisms as model systems in genetics and biochemistry

CSO5: To gain exposure to the basic concepts of metabolic engineering and synthetic biology

CSO6: To know the contribution of gut microbiome in human health

CSO7: Students should be able to demonstrate and evaluate interactions between microbes, hosts, and their environment, with the additional ability to determine BOD, DO, and COD of different effluent samples in order to assess their microbial load and degree of organic pollution

CSO8: To appreciate and contribute to the fight against major killer diseases such as tuberculosis, HIV, and malaria

CSO9: Students should develop the necessary skills to isolate, cultivate, characterize, and identify viruses that are routinely studied in any virology laboratory, which will bolster their ability to seek employment in those settings

Learning Outcomes:

LO1: Students will know the historical discoveries made in the discipline of microbiology
LO2: Students will learn isolation techniques, cultivation of microorganisms (bacteria, fungi, viruses), culturing, identification, maintenance, preservation strategies, bacterial diversity, classification, and identification
LO3: Students will possess knowledge of the general characteristics of bacterial phyla and importance of human gut microbiome in health and disease
LO4: Students can identify the morphological differences of different microorganisms, recognize industrially and economically useful microorganisms, and apply their use in different fields
LO5: Students will master aseptic techniques and can perform routine culture-handling tasks aseptically
LO6: Students will also gain insight into cellular composition, function, and physiology of bacteria, fungi and viruses
LO7: Students will learn the economical and industrial applications of algae, microbial interactions in Agro-Ecological Perspectives, and importance of microorganisms in sewage disposal and fermentation of foods; they will know how microorganisms can spoil or poison food and be well-versed in preservation strategies
LO8: Students will be able to understand the pathogenesis of bacterial, fungal and virus diseases
LO9: Students will study virus replication strategies, sub genomic RNAs, Virusoids, Viroids and Prions
LO10: Students will gain management knowledge of plant, animal, and human viruses, including their inactivation, prevention and control

Unit - 1

Introduction to Microorganisms - Morphology and classification of bacteria – phenotype, numerical and phylogenetic tree - rRNA, DNA and Proteins, Microbial diversity, Major characteristics used in taxonomy – morphological, physiological and metabolic, ecological, genetic analysis and molecular characterizations- (protein, nucleic acid composition), Isolation and cultivation of bacteria, bacterial growth curves. Culture media and methods of maintenance of cultures, Preservation of cultures (Glycerol stocks, freeze drying), differences between Gram-positive and Gram-negative bacteria, Human gut microbiome and disease

Unit-2

Molds – characteristics, classification and reproduction. Yeasts – morphology, characteristics and reproduction. General characteristics of Actinomycetes, Rickettsiae, Spirochaetes and mycoplasma. Economical and industrial uses of algae.Microbial interactions – mutualism, protocooperation, commensalism, predation, parasitism, amensalism, competition, symbiosis in complex system.Role of microorganisms in domestic and industrial sewage.Microbiology of fermented foods, food spoilage and its control (Preservation). Food borne diseases – Botulism, Salmonellosis, *E.coli*diarrhoea, Shigellosis, Staphylococcal food poisoning

Unit-3

Microbial diseases-Pathogenesis of bacterial diseases – maintenance, transport, invasion and multiplication and regulation.Airborne diseases – Diphtheria, Meningitis, Pneumonia, Tuberculosis and Streptococcal diseases. Arthropod borne – Lyme, Plague. Direct contact – Anthrax, Gonerrea, Conjunctivitis, Gastritis, Syphilis, Tetanus, Leprosy, Staphylococcal diseases. Sepsis, Mycoses, Malaria, Amoebiasis, Candidiasis

Unit-4

Introduction to Virology-Origin and evolution of viruses, ICTV criteria for classification of viruses. Morphology, structure and chemical composition of viruses; replication, transmission (vector/non-vector) and purification of viruses. Isolation and cultivation of viruses
Characterization and identification of viruses and virus strains - Biological, physical, immunological and molecular approaches. Bacteriophages - Biology of T_4, lambda. Biology of sub-viral agents - Satellite viruses, sat-RNAs, Viroids and prions

Unit-5

Plant viruses - Tobacco mosaic virus, and tomato yellow leaf curl virus; control strategies for plant viruses, Animal viruses - Foot and mouth disease virus and Avian Influenza virus
Human viruses -Structure and physiology of:polio virus, rabies virus, Human Immunodeficiency Virus(HIV), human coronaviruses (SARS-CoV-2), chikungunya virus, dengue virus, hepatitis C virus, influenzas virus, Ebola virus, Zika virus and human papilloma virus (HPV)
Inactivation of viruses – Photodynamic inactivation. Prevention and control of animal and human viruses - Sanitation, vector control, vaccines and chemotherapy (antiviral drugs, Interferons)

Reference books:

1. Microbiology - Prescott (Willey, Sherwood,Woolverton)
2. Microbiology – Tortora, Funke, Case
3. Microbiology – R.Y.Stanier, E.A.Adelberg, J.L.Ingraham 4th ed.
4. Biology of Microorganisms - M.T. Medican, J.M. Martiniko and J. Parker 10th ed
5. Microbiology by Pelczar, Chan and Krieg 5thed Mc Grew-Hill
6. General Microbiology: Boyd R.F., Times Mirror/ Mosby College
7. A Textbook of Microbiology, R.C.Dubey and D.K.Maheswari, S.Chand Co
8. An Introduction to Viruses by S.B.Biswas, A.Biswas, Vikas Publishinghouse
9. Microbiology 4th ed, Prescott, Harley, Klein (Mc grawHill)
10. Fundamentals of Microbiology – M.Frobisher, 8th ed
11. Text book of Microbiology – WilliamBurrows, J.W.Moulder, R.M.Lewert, J.W.Rippon, 19th ed
12. Biology of Microorganisms – Sandes T.Lyles
13. Microbial Ecology – Atlas, Bartha 4th ed

M.Sc. BIOCHEMISTRY
II SEMESTER
BC 2.2: CELL BIOLOGY AND GENETICS

Course Outcomes:

CO1: To provide the knowledge about cellular architecture, cell cycle and its regulatory mechanisms
CO2: To understand the structure and dynamics of the biological membranes and transport mechanisms
CO3: To understand the proper function of cell receptors and cell signalling pathways
CO4: To know about the Mendelian Genetics and its extensions, chromosomes and inheritance
CO5: To provide the knowledge about linkage maps, quantitative inheritance and biochemistry of mutations

Course Specific Outcomes:

CSO1: The course covers the importance of cytoskeletal elements and extracellular matrix in maintaining cellular architecture
CSO2**:** Major emphasis was on cell cycle, characteristics of cancer cells and mechanism of apoptosis
CSO3: The course highlights the structure, composition, distribution of molecules and transport across the membrane
CSO4: More focus on cell-to-cell communication through the receptors and mechanism of generation and action of cell signalling molecules
CSO5: The course covers basic Mendelian principles and deviations, concept of alleles and inheritance of sex-linked characters
CSO6: The course gives knowledge about changing concept of gene
CSO7: Major emphasis was on chromosomal mapping and extra chromosomal inheritance and mutations and their mechanism of action

Learning Outcomes:

LO1: Students will understand the role of cytoskeleton and extracellular matrix in cellular organization
LO2: Students will learn about role of cyclins in cell cycle and its regulation and also about mechanism of apoptosis
LO3: Students will obtain a good knowledge about membrane structure, composition, transport of molecules and ions across the cell membrane
LO4: Students will acquire knowledge about cell receptors and their functions, signalling molecules and the mechanism of generation of signals
LO5: Students will learn the phenotypic and genotypic ratios and how these ratios differ during gene interactions
LO6: Students will acquire knowledge about sex determination with respect to sry gene in humans and sex-linked inheritance
LO7: Students will learn about concept of linkage and crossing, types of mutations, and their impact

Unit-1

Cytoskeleton – Microtubules, Intermediate filaments, Microfilaments; Extracellular matrix – Collagen, Elastin, Fibrillin, Fibronectin, Laminin, Proteoglycans, Integrins; Cell- Cell interactions – Tight Junctions, Gap Junctions, Desmosomes

Cell division by Mitosis and Meiosis; Cell cycle – Role of Cyclins, Cyclin dependent kinases in cell cycle progression; Apoptosis – Pro-apoptotic and Anti-apoptotic regulators, Mechanism of necrosis and autophagy

Biochemistry of Cancer – Carcinogenesis, Characteristics of cancer cell, Agents promoting carcinogenesis

Unit-2

Membrane structure: The lipid bilayer, Membrane lipids and Membrane Fluidity, Membrane carbohydrates, Asymmetric distribution of membrane proteins; Artificial membranes – Liposomes and its applications

Membrane transport: Channels and Pumps – Diffusion, Passive, Active and Facilitated transport, Role of Na^+ K^+ ATPase, Group translocation; Ionophores - Ligand gated ion channels, Ionic channels

Unit – 3

Cell communication and Types of signal molecules, Cell receptors - Nature and types of receptors and their structure, G protein linked cell surface receptors, Mechanism of signal transduction, Inositol phospholipid signalling pathway - IP3, DAG and Ca^{2+} as second messengers

GPCR - Regulation of cyclic nucleotide gated ion channels (eg.Smell and Vision), GPCR signal termination, Tyrosine kinase receptors mediated signalling (eg. Insulin, growth factors EGF, VEGF), Ras, MAPK pathways, Second messengers - cAMP, cGMP, Nitric Oxide- Mechanism of their generation and action, Role of different protein kinases

Unit – 4

Basic principles of Mendelian Genetics: Dominance, segregation, independent assortment; Extensions of Mendelian principles- Codominance, Incomplete dominance, Gene Interactions, Pleiotropy, Genomic imprinting, Penetrance and Expressivity

Concept of alleles - Complementation Test, Multiple alleles, Pseudo alleles, Benzer's rII alleles; Concept of Cistron, Recon, and Muton; Sex determination with special reference to genetic basis of sex determination in Humans-*Sry* gene, Sex linked inheritance

Modern concept of the gene - Split genes, overlapping genes, assembled genes, Repeated genes, Polyprotein genes, Nested genes

Unit-5

Linkage and crossing over: 2-point test cross, 3-point test cross, Recombination as a basis for variation; Quantitative inheritance – Polygenic inheritance; Extra chromosomal inheritance - Inheritance of mitochondrial and chloroplast genes, Maternal inheritance

Mutations: Types of mutations - Mutagens and their mechanism of action, Molecular mechanism of mutations; Structural and Numerical alteration of chromosomes – Deletion, Duplication, Inversion, Translocation, Ploidy and their genetic implications

Reference books:

1. Cell and Molecular Biology – E.D.P. De Roberties , E.M.F. DeRoberties, 8th ed
2. Cell biology - David E. Sadava
3. Karp's Cell and Molecular Biology - Gerald Karp, Janet Iwasa, Wallace Marshall, 9th ed
4. Molecular Cell Biology - Arnold Berk, Chris A. Kaiser, Harvey Lodish, et al., 8th ed
5. Molecular Biology of the Cell - Albert Bruce et al., 6th ed
6. Biological membranes: Their structure and function - Harrison R, 2nd ed
7. Comprehensive introduction to membrane biochemistry – Datta, Dipak B
8. Principles of Biochemistry by Lehninger- D.L.Nelson, M.M.Cox, 7th ed
9. An Introduction to Genetic Analysis - Griffiths, Wessler, Lewontin, et al., 11th ed
10. Genetics - M. W. Strickberger, 3rd ed
11. Principles of Genetics - E. J. Gardner, M. J. Simmons, D. P. Snustad, 8th ed
12. Genetics: A Conceptual approach. - Benjamin A. Pierce 5th ed
13. Genetics – G. Zubay
14. Genetics - P.K Gupta

M.Sc. BIOCHEMISTRY
II SEMESTER

BC 2.3: INTERMEDIARY METABOLISM

Course Outcomes:

CO1: To learn the intracellular process by which nutritive material is converted into cellular components, enzymatic digestion of large nutrient molecules such as carbohydrates, proteins, fats into smaller molecules like glucose, amino acids and fatty acids. Monosaccharides predominantly glucose to generate energy by the cells in both aerobic and anaerobic conditions, glycolysis, significance of TCA cycle in central carbon metabolism, importance of anaplerotic reactions, and redox balance, gluconeogenesis, glycogenesis, glycogenolysis, role of specific enzymes in regulation of above processes and diseases involved due to metabolic block in reaction sequences

CO2: To learn the management of biochemical reaction with enzymes is an important part of cellular maintenance and in turn enzymatic activity allows a cell to respond to changing environmental demands and regulate its metabolic pathways, essential to its survival

CO3: To learn the biosynthesis and degradation of glycogenic and ketogenic amino acids, regulation of the above pathways by enzymes, conversion of ammonia into urea by urea cycle and its regulation, disorders associated with protein metabolism due to deficiency of enzymes

CO4: To learn the importance of oxidation of fatty acids, biosynthesis and regulation of fatty acids, arachidonic acid, phospholipid, sphingolipid and cholesterol metabolisms, diseases of lipid metabolism

CO5: To learn the biosynthesis, regulation and degradation pathways of purines, pyrimidines, ribonucleotides, deoxyribonucleotides, polynucleotides, and heme, Formation of bile pigments, bile acids, role of inhibitors in nucleic acid biosynthesis and disorders of nucleic acid and porphyrin metabolism

Course Specific Outcomes:

CSO1: The students will be able to gain conceptual knowledge on Intermediary metabolism as highly integrated network of biochemical reactions that provides cells with forms of energy for immediate use (i.e., metabolic energy), reducing power and biosynthetic intermediates

CSO2: To learn the chemical principles governing classical metabolic pathways of intermediary metabolism were firmly established, as were the mechanistic principles behind the energy transducing processes and further in understanding of Intermediary metabolism regulation

CSO3: To understand the importance of lipids as storage molecules and as structural component of biomembranes

CSO4: Understanding the importance of high energy compounds, electron transport chain, synthesis of ATP in aerobic and anaerobic conditions

CSO5: To gain knowledge on crucial role of intermediary metabolism at the crossroads of all aspects of cellularfunction,from cell growth, proliferation and death to epigenetics and immunity

CSO6: To provide broad concept of study of intermediate metabolismis crucial for understanding of many diseases, ranging from the classical metabolic diseases, such as type 2 diabetes and obesity, to cancer. Students will be exposed with the fact that perturbations in carbon metabolism can lead to various disorders such as diabetes and cancer

CSO7: To offer a deep knowledge of intermediary metabolism has also undeniable practical value, as exemplified by the production of highvalue products, such as fuels and drugs, through rational metabolic manipulation. Appreciation of the fact that differences in the properties of metabolic enzymes of the host and pathogens can be exploited for the

development of new drugs and further to gain insights into metabolic engineering for the production of useful biomolecules

CSO8: To gain insights into Inborn errors of carbohydrate, protein, lipid, nucleic acids, and porphyrin metabolism are rare genetic (inherited) disorders in which the body cannot properly turn food into energy due to lack of specific enzymes that help break down (metabolize) parts of food

Learning Outcomes:

LO1: The students will be able to understand the digestion of macromolecules (Carbohydrates, Proteins, Lipids into monomers (glucose, amino acids, fatty acids) in the humans by enzymes, absorption and assimilation of the products to other parts of the body

LO2: The students will be able to understand how glucose can be converted to generate ATP, the principal molecule for storing and transferring energy in cells required for biosynthetic processes and role of specific enzymes in regulating the above process and disorders involved due to metabolic block in reaction pathways

LO3: The students will be able to understand the importance of glucose as the main source of energy for the brain, under low blood glucose levels the liver tissue can synthesize glucose by gluconeogenesis and it will supply glucose to brain and role of glucose-6-phosphate, a metabolic intermediate in giving NADPH for fatty acid biosynthsis and formation of different sugar intermediates consumed in various metabolic reactions

LO4:The students will be able to understand the role of transaminase enzymes in the over all degradation of amino acids and making use of various metabolic products for synthesis of amino acids in cells and understanding how microorganisms and plants are able to synthesize all the amino acids, the importance of amino acids in the synthesis of complex porphyrins as well as various important hormones in the body and regulation of various biosynthetic processes

LO5:The students will be able to know the importance of amino acids in the synthesis of complex porphyrins as well as various important hormones in the body

LO6: The students will be able to understand the degradation of fatty acids in the cells for the production of acetyl Co A, to deliver the acetyl group to the citric acid cycle to be oxidised for energy production and lipid derivatives as functional units in cellular architecture, importance of cholesterol and its role in formation of important vitamins

LO7:The students will be able to know the importance of nucleotides, ribo and deoxyribonucleotides, their biosynthesis and metabolism in cells. Biosynthesis and regulation of pyrimidine and purine nucleotides and role of tetrahydrofolate in one carbon metabolism as well as the disorders associated with nucleotide metabolism will be understood

LO8: The students will be able to understand the types of reactions involved in porphyrin metabolism and their significance

Unit-1

Carbohydrate Metabolism - Approaches for studying intermediary metabolism. Glucose as fuel, glucose transporters, Glycolysis and its regulation. Substrate cycling, TCA cycle – function and regulation, Glyoxylate cycle, Gluconeogenesis and its regulation, HMP shunt and its significance, Uronic acid pathway, Glycogen metabolism and its regulation with special reference to phosphorylase and glycogen synthase, Metabolism of fructose, galactose and lactose, Biogenesis of amino sugars, peptidoglycans, glycosyl aminoglycans and glycoproteins.In born errors of carbohydrate metabolism – Hemolytic Anemia, Galactosemia

Unit-2

Protein Metabolism - General metabolic reactions of amino acids. Catabolism of individual amino acids Ketogenic and glycogenic amino acids. Formation of creatinine, ammonia and urea. Regulation of urea cycle. Essential and non- essential amino acids. Biosynthesis and regulation of branched chain amino acids, aromatic amino acids, histidine and methionine. In born errors of amino acid metabolism – Phenylketonuria, Alkaptonuria.Proteins turn over – Role of ubiquitin

Unit-3

Lipid Metabolism - Fats as energy stores, Oxidation of fatty acids, Formation and utilization of ketone bodies. Biosynthesis of fatty acids and regulation. Metabolism of arachidonic acid – formation of prostaglandins, thromboxanes, leucotrienes. Biosynthesis of triglycerides. Metabolism of phospholipids, sphingolipids. Biosynthesis of cholesterol and its regulation.Role of liver and adipose tissue in lipid metabolism. In born errors of lipidmetabolism - Niemann-pick disease, Gaucher’s disease

Unit-4

Nucleic acid Metabolism - Biosynthesis and regulation of purines and pyrimidines.Catabolism of purines and pyrimidines Structure and regulation of ribonucleotide reductase. Biosynthesis of ribonucleotides, deoxyribonucleotides and polynucleotides. Inhibitors of nucleic acid biosynthesis. In born errors of nucleic acid metabolism–Lesch-Nyhan syndrome, OroticAcidurias

Unit-5

Porphyrin Metabolism - Biosynthesis and Regulation of heme, catabolism of heme to bile pigments, Formation of bile acids, Jaundice – Classification of jaundice,In born errors of porphyrin metabolism– Porphyrias: Types of porphyrias – Acute intermittent porphyria, congenital erythropoietic porphyria

Reference books:

1. Biochemistry – J.M.Berg, J.L.Tymoczko, G.J.Gatto Jr., LubertStryer 9th ed
2. Lehninger - Principles of Biochemistry- D.L.Nelson, M.M.Cox, 7th ed
3. Text Book of Biochemistry Authors ES West, WR Todd, HS Mason and JT Van Bruggen, 4th ed
4. Review of Physiological Chemistry - Harold Anthony Harper
5. Principles of Biochemistry, White. A, Handler, P,Smith et al., 6th ed
6. Biochemistry, David E.Metzler, 2nd ed
7. Outlines of Biochemistry, E.E. Conn, P.K. Stump, 3rd ed
8. Chemical pathways of Metabolism–Greenberg, 1st ed
9. The Structure of Mitochondria- E.A. Munn
10. Biochemistry-G.L.Zubay, 4th ed

M.Sc. BIOCHEMISTRY

II SEMESTER

BC 2.4: MOLECULAR BIOLOGY

Course outcomes:

CO1: Acquiring in-depth knowledge in Molecular Biology course is an added advantage to the students who are curious and excited about the cellular, genetic, and molecular mechanisms in living organisms

CO2: By providing a comprehensive training in Molecular Biology to the students will enable them well prepared to pursue rewarding careers in healthcare, genetic technologies, pharmacology, neuroscience, basic and applied research, agricultural science, food science and technology and forensics

CO3: Study the discovery of DNA as genetic material, DNA replication, transcription, DNA repair and translation

CO4: Exposure to the concepts of DNA repair and their importance in human health

CO5: Acquire information about the DNA and, RNA from bacteria, Viral, yeast and plant

Course Specific Outcomes:

CSO1: Students will acquire knowledge related to the fundamentals of molecular biology like nucleic acids as genetic material, replication, transcription and translation, gene organization and its regulation etc

CSO2: Information about coding and non-coding regions of eukaryotic genome and their importance will be gained

CSO3: Expose the students to a wide range of careers that combine biology, plants and medicine

CSO4: Develop the student the ability to apply the molecular biology knowledge that they acquired to the solution of specific industrial, health and environment problems

CSO5: The application of the course lays the foundation to understand the disease processes at molecular level

Learning Outcomes:

At the end of the course, the student will be able to acquire the knowledge related to

LO1: Discovery of DNA as genetic material, Prokaryotic and Eukaryotic DNA Replication, repair and DNA Recombination

LO2: Students will get hold of basic knowledge related to processes of transcription and translation in prokaryotes and eukaryotes

LO3: They will develop understanding of the molecular basis of RNA processing and RNA splicing and the ways in which the biological processes are regulated and the significance of regulation in maintaining different life forms

LO4: The student will understand the fundamentals of translation in prokaryotes and Eukaryotes, Properties of Genetic code, Ribosomes, formation of initiation complex, transpeptidation and translocation and protein targeting

LO5: The student will be able to learn about the classes of DNA sequences, Tandem repeats, prokaryotic and Eukaryotic Transposable elements

Unit-1

DNA Replication in Prokaryotes: Origin and Direction of replication, Semi-discontinuous replication, DNA polymerases of prokaryotes and their mechanism of action; Helicase, Primase, Ligase, Single strand binding proteins and DNA Topoisomerases and their types Replication strategies for replicating circular DNA: 'ϕ' mode of replication, σ mode or Rolling circle mode of replication and D-loop mode of replication. Eukaryotic DNA Replication: Eukaryotic DNA Polymerases, Reverse transcriptase, Strategies for replicating linear DNA, Fidelity and Processivity of replication, Inhibitors of replication

Unit-2

DNA Repair mechanisms: Photo reactivation, Excision repair mechanism, Post replication repair mechanisms- Recombinationrepair, Mismatchrepairsystem,SOSresponse, Transcription-repair coupling
DNA Recombination - Models of general recombination; Holyday model, asymmetric strand transfer model, double strand break repair model: Site-specific recombination Transposition of DNA-Types and Properties of Transposable elements
Prokaryotic transposons, Eukaryotic transposons

Unit-3

Principles of Transcription, Prokaryotic RNA polymerase, Conserved sequences of prokaryotic promoters, Initiation of transcription, Chain elongation, Chain termination, Eukaryotic RNA polymerases, Conserved sequences of eukaryotic promoters, Transcriptional factors and basal eukaryotic transcription complex, Enhancers, Transcriptional termination in eukaryotes

Unit -4

Post Transcriptional Modifications: Modifications of pre-mRNA - 5' end capping, 3'polyadenylation, Significance; Heterogeneous Nuclear RNA Splicing; Introns and Exons, Self-splicing mechanism of group-1 and group-11 Introns, Alternative splicing and its importance, Processing of ribosomal RNA, transfer RNA, Regulation of RNA processing: RNA editing-types of changes

Unit-5

General features of Genetic code: Structural components of prokaryotic and eukaryotic ribosomes, Mechanism of protein synthesis in prokaryotes and eukaryotes-aminoacylation of tRNA, protein synthesis initiation, elongation and chain termination, Protein synthesis inhibitors, Translational control in eukaryotes: Protein targeting and processing-Signal sequences, signal recognition particle, signal hypothesis, Molecular chaperons

Reference books:

1. Molecular Biology of the Gene - J. D. Watson et al., 7th ed
2. Molecular Biology of the Cell – H. Lodish, Arnold Berk et al.,7th ed
3. Molecular Biology of the Cell – Bruce Alberts, Alexander D.Johnson et al.,
4. Molecular biology: a comprehensive introduction to prokaryotes and eukaryotes – D.Frefeilder, 2nd ed
5. Fundamental Molecular Biology – Lizabeth A. Allison
6. Leininger's Principles of Biochemistry- Nelson and Cox, Worth Publish., Inc. New York
7. Biochemistry - L. Stryer., 4th ed, W.H. Freeman Press, San Fransisco, USA
8. Principal of Genetics - E.J. Gardner and D.P. Snustad. John Wiley & Sons, Ney York

M.Sc. BIOCHEMISTRY
II SEMESTER
PRACTICAL – I
BC 2.5: MICROBIOLOGY, CELL BIOLOGY AND GENETICS

Course Outcomes:

CO1: To acquire hands on experience on various sterilization techniques such as Autoclaving, hot-air oven sterilization, Sieve filtration, membrane filtration; Preparation of culture media such as Nutrient Broth, Nutrient Agar, Blood agar MacConkey's agar, Potato dextrose agar; Isolation of bacteria by Streak plate, pour plate methods and Motility of Bacteria by "Hanging drop" technique
CO2: To learn on how to identify microorganisms by staining techniques such as simple, differential, Gram staining, acid-fast staining; Identification of bacteria by Morphological, cultural and biochemical characteristics
CO3: To learn how to perform bacteriological examination of water, milk; bacterial growth curve; Analysis of domestic and industrial effluents such as MPN, BOD, COD and DO; Isolation of phage and plaque formation units (PFU); Microbiological assay of a vitamin/amino acid
CO4: To gain hands on experience on sectioning of onion root tip cells to study various stages of mitosis and sectioning of onion flower buds to study various stages of meiosis
CO5: To learn how to do karyotyping, problems in genetics on monohybrid ratio, dihybrid ratio, gene interaction, linkage and crossing over – 2 point test cross

Course Specific Outcomes:

CSO1: To isolate microbes from provided samples and to perform bacterial cultures in different Media
CSO2: To get trained in performing routine microbiological practices such as sterilization, media preparation, maintenance of microbial culture, staining, etc.
CSO3: To acquire expertise to culture and screen microbes for antibiotic resistance
CSO4: Students should learn the handling of microscope
CSO5: Obtain hands-on training in basic separation techniques in biochemistry
CSO6: Gain expertise in the isolation of various cell organelles and staining of cellular biomolecules
CSO7: To gain knowledge on experiments to determine Mendel's law
CSO8: Students should be able to demonstrate monohybrid and dihybrid cross using plants

Learning Outcomes:

LO1: The students will learn techniques on various sterilization techniques such as Autoclaving, hot-air oven sterilization, Sieve filtration, membrane filtration; Preparation of culture media such as Nutrient Broth, Nutrient Agar, Blood agar MacConkey's agar, Potato dextrose agar; Isolation of bacteria by Streak plate, pour plate methods and Motility of Bacteria by "Hanging drop" technique

LO2: The students will develop skills to perform various staining techniques such as simple, differential, Gram staining, acid-fast staining and how to identify bacteria by Morphological, cultural and biochemical characteristics

LO3: The students will be able to learn how to perform bacteriological examination of water, milk; bacterial growth curve; Analysis of domestic and industrial effluents such as MPN, BOD, COD and DO; Isolation of phage and plaque formation units (PFU); Microbiological assay of a vitamin/amino acid

LO4: The students will develop skills on sectioning of onion root tip cells for studying various stages of mitosis and sectioning of onion flower buds for studying various stages of meiosis

LO5: The students will be able to learn how to perform karyotyping, to develop problem solving skills in genetics on monohybrid ratio, dihybrid ratio, gene interaction, linkage and crossing over – 2 point test cross

MICROBIOLOGY (A)

Sterilization Techniques-Autoclaving, hot-air oven sterilization, Sieve filtration, membrane filtration.
Preparation of culture media – Nutrient Broth, Nutrient Agar, Blood agar MacConkey's agar, Potato dextrose agar.
Isolation of bacteria – Streak plate and pour plate methods.
Motility of Bacteria – "Hanging drop" technique
Identification of bacteria by staining techniques – simple, differential, Gram staining and acid-fast staining
Bacterial growth curve
Identification of bacteria – Morphological, cultural and biochemical characteristics
Microbiological assay of a vitamin/amino acid
Bacteriological examination of water and milk
Analysis of domestic and industrial effluents - MPN, BOD, COD and DO
Isolation of phage and plaque formation units (PFU)

CELL BIOLOGY AND GENETICS (B)

Mitosis in onion root tip cell
Meiosis in onion flower buds
Karyotyping
Problems on monohybrid ratio, dihybrid ratio, gene interaction, linkage and crossing over, 2 point test cross

Reference books:

1. Laboratory Experiments in Microbiology-M.Gopal reddy et al.,
2. Microbiology-A laboratory Manual-Cappuccino, Sherman, 7th ed
3. Practical Microbiogy-R.C.Dubey, D.K.Maheswari
4. Microbiology-A laboratory Manual-Cappuccino, Sherman, 7th ed
5. Cell Biology : Practical Manual – Dr. Renu Gupta, Dr. Seema Makhija et al.,
6. Problems on Genetics Molecular Genetics and Evolutionary Genetics – Pranab Kumar Banerjee

M.Sc. BIOCHEMISTRY
II SEMESTER
PRACTICAL – II

BC: 2.6: QUANTITATIVE ANALYSIS AND MOLECULAR BIOLOGY

Course Outcomes:

CO1: To learn about various good lab practices, bacterial handling etc.
CO2: To become familiar with the basic quantitative methods used for analysis in biochemistry
CO3: To understand the basic principles of colorimetry and titrimetric analysis in biochemistry
CO4: To impart training on tools and techniques used in molecular biology lab
CO5: To apply appropriate methods for induction of mutations for strain improvement

Course Specific Outcomes:

CSO1: The course gives in depth knowledge in understanding various methods used in estimation of proteins, carbohydrates and nucleic acids.
CSO2: It gives knowledge about isolation of DNA and RNA from different sources
CSO3: To gain knowledge about strain improvement in bacteria

Learning Outcomes:

LO1: Students will acquire hands on practical training in molecular biology tools
LO2: Students will learn how to extract and purify DNA and RNA from different samples
LO3: Students will gain detailed insight in learning quantitative techniques
LO4: Students will gain knowledge about applying molecular aspects in R and D industries

QUANTITATIVE ANALYSIS (A)

Determination of P^{ka} and P^{I} values of an amino acid by titrimetric method
Estimation of proteins by Lowry, Bradford methods
Determination of carbohydrates by Anthrone method
Determination of RM value and polensky number of oils
Estimation of pyruvate by 2,4 Dinitrophenyl hydrazine method
Estimation of Ca^{++}/Zn^{++} by EDTA titrimetric method

MOLECULAR BIOLOGY (B)

Determination of melting temperature (T_m) of DNA
Isolation of DNA from bacterial, plant and animal cells.
Estimation of DNA by Diphenylamine method.
Isolation of RNA from yeast cells.
Estimation of RNA by Orcinol method.
Estimation of DNA and RNA by UV absorption method and determination of purity of

nucleic acids.

Determination of sugar and phosphate ratios in DNA and RNA samples.

Conjugation: Use of broad host range plasmid RP in demonstrating conjugation transfer of plasmid bacteria.

Catabolite repression: Evidence of *B*-Galactosidase induction in presence of lactose in *E.coli lac* strains.

Mutations: UV damage and repair mechanism in *Escherichia coli* Or *Seratia marcesens*

Strain improvement of *Aspergillus niger* using chemical mutagen – Ethidium bromide

Reference books:

1. Experimental Biochemistry-B.Sashidhar Rao, Vijay Deshpande
2. Techniques in Molecular biology - J.Walker (Goom Helns, London).
3. Practical methods in molecular - R.F.Shecleif and P.C.Wensik (Springer veriag)