



M. Sc. Biotechnology Semester - 4

BIOCHEMISTRY – III  
IBT – 401

Unit No.	Topic
1	<b>ENZYMES</b> 1.1 Enzyme: Introduction, Cofactor, Coenzymes, Apoenzymes 1.2 Characteristics of enzymes 1.3 Chemical and Physical properties of enzymes 1.4 Nature and mechanism of enzyme action 1.5 Nomenclature & IUPAC Classification 1.6 Factors affecting enzyme activity 1.7 M.M. equation, derivation of M. M. equation, graphical procedure for the estimation of $K_m$ & $V_{max}$ 1.8 Inhibition of enzyme action 1.9 Regulation of enzyme activity and synthesis
2	<b>METABOLISM</b> 2.1 Introduction to metabolism and metabolic pathway 2.2 ATP as universal currency of energy in biological system 2.3 Role of reducing power in metabolism 2.4 Role of precursors in metabolism 2.5 Central and peripheral pathway, Integration of metabolic pathway 2.6 Methods of studying biosynthesis; Use of biochemical mutants and isotopic labelling
3	<b>CATABOLISM</b> 3.1 Catabolic pathways of carbohydrates 3.1.1 Glycolysis and its regulation 3.1.2 Entner Doudroff Pathway 3.1.3 Pentose Phosphate Pathway 3.1.4 TCA and its regulation (Glyoxylate Pathway) 3.1.5 Other pathway Supplying acetyl CoA 3.2 Oxidative Phosphorylation and Electron Transport Chain 3.3 Anaerobic Respiration in yeast, muscles and <i>Lactobacillus</i> and fermentation 3.4 Lipid Catabolism ( $\beta$ -oxidation of fatty acids) 3.5 Catabolism of protein and amino acids (General reaction of aminoacid catabolism, Stickland reactions).
4	<b>ANABOLISM</b> 4.1 Gluconeogenesis 4.2 Lipid Biosynthesis (Palmitic Acid, Triacylglycerol) 4.3 Biosynthesis of Amino Acids; glutamate family, aspartate family, aromatic family, serine and pyruvate family, and histidine. 4.4 Biosynthesis of Nucleotides

**Microbiology - II : Microbial Physiology and Metabolism**  
**IBT – 402**

Unit No.	Topic
<b>1</b>	<p><b>Bacterial cell division and growth</b></p> <p>1.1 Bacterial Cell Division 1.2 Physiology of Bacterial Growth 1.3 Phases of Growth 1.4 Synchronous Growth 1.5 Continuous culture 1.6 Quantitative measurement of bacterial growth</p>
<b>2</b>	<p><b>Antimicrobial agents</b></p> <p>2.1 Introduction to Antibiotics 2.2 Characteristics of Antibiotics and their mode of action 2.3 Antifungal antibiotics 2.4 Antiviral chemotherapeutic agents 2.5 Development of resistance to antibiotics 2.6 Microbiological assay of antibiotics. 2.7 Non Medical uses of antibiotics</p>
<b>3</b>	<p><b>Bacterial Membranes</b></p> <p>3.1 Membrane lipids, membrane carbohydrates membrane proteins, membrane transport of small molecules and macromolecules. 3.2 Signal transduction 3.3 Phosphotransferases system 3.4 Heat shock response:     3.4.1 Heat shock protein, Regulation of sigma factor 32, Functions of <i>E. coli</i> heat shock protein</p>
<b>4</b>	<p><b>Some selected aspects of metabolism in specific microbial systems:</b></p> <p>4.1 Archaeobacteria:     4.1.1 Energy metabolism and Carbon Assimilation in Methanogens     4.1.2 Photophosphorylation in Halo bacterium 4.2 Photosynthetic bacteria     4.2.1 Purple bacteria, Green bacteria 4.3 Chemo-autotrophs     4.3.1 Nitrifying bacteria, Sulfur oxidizers, Iron bacteria, Hydrogen bacteria 4.4 Unicellular Endospore formers     4.4.1 Endospore formation, Biochemical events related to sporulation, Activation, Germination, and Outgrowth of endospores</p>

**Genetics**  
**IBT – 403**

Unit No.	Topic
<b>1</b>	<p>1.1 <b>Genetics and the organisms;</b> Genes as a determinant of the inherent properties of species, Genetic variation, Methodologies used in genetics, Genes, the Environment, and the Organisms, concept of population genetics.</p> <p>1.2 <b>Patterns of Inheritance:</b> Mendelian genetics, laws of dominance, segregation &amp; independent assortment; Incomplete dominance, complementary genes, epistasis, lethal genes, duplicate genes, and multiple allelism. Extrachromosomal inheritance: mitochondrial &amp; chloroplast inheritance, Sex chromosomes &amp; sex linked inheritance.</p> <p>1.3 <b>Human Genetics:</b> Medical genetics, genetic disorders, Cancer genetics, Euphenics, Eugenics and Euthenics.</p>
<b>2</b>	<p>2.1 <b>Mutation:</b> Types of mutations, transposon Mutagenesis, site-directed mutagenesis, Molecular mechanism of mutations, Mutagens.</p> <p>2.2 DNA repair Mechanisms</p> <p>2.3 <b>Recombination;</b> Models of recombination</p> <p>2.4 <b>Microbial gene transfer mechanisms:</b> conjugation, transduction, transformation:</p>
<b>3</b>	<p>3.1 <b>DNA Replication:</b> DNA: The genetic material, Replication of DNA, Semi conservative replication, Mechanism of DNA Replication process; Initiation, Elongation &amp; Termination of replication, Models of DNA replication</p> <p>3.2 <b>Transcription and mRNA processing:</b> Components of transcriptional machinery in prokaryotes and eukaryotes; Initiation, Elongation &amp; Termination of transcription; Capping, Polyadenylation, Splicing.</p>
<b>4</b>	<p>4.1 <b>Translation:</b> The Genetic Code, tRNA &amp; aminoacyl synthetases, Ribosomes, Translation process, Initiation, Elongation &amp; termination of transcription; Post translation modifications and targeting of Protein.</p> <p>4.2 <b>Regulation of gene expression:</b> General aspects of Gene regulation in prokaryotes and Eukaryotes, Discovery of the <i>lac</i> System: Negative Control, Catabolic repression of <i>lac</i> Operon: Positive Control, Positive and Negative Control, Dual Positive and Negative Control: The Arabinose Operon, Metabolic pathways, Additional example of Control: Attenuation, An overview of gene regulation in Eukaryotes</p>

**Immunology**  
**IBT – 404**

<b>Unit No.</b>	<b>Topic</b>
<b>1</b>	<p><b>IMMUNITY</b></p> <p>1.1 Historical background</p> <p>1.2 Types of immunity: Active, Passive and Herd</p> <p>1.3 Innate (Non Specific Immunity)</p> <p style="padding-left: 20px;">1.3.1 Anatomic Barrier,</p> <p style="padding-left: 20px;">1.3.2 Physiological Barrier,</p> <p style="padding-left: 20px;">1.3.3 Phagocytic barrier,</p> <p style="padding-left: 20px;">1.3.4 Inflammatory Barrier</p> <p>1.4 Adaptive (Specific Immunity)</p> <p>1.5 Cellular Immunity (T &amp; B Lymphocytes)</p> <p>1.6 Generation and functions of Humoral Immunity</p>
<b>2</b>	<p><b>Antigen and Antibody</b></p> <p><b>2.1 Antigen:</b></p> <p style="padding-left: 20px;">2.1.1 Immunogenicity versus Antigenicity, Factors influencing Immunogenicity, Contribution of biological systems to Immunogenicity:</p> <p style="padding-left: 20px;">2.1.2 Genotype of recipient animal, Immunogen Dosage and route of administration, Adjuvant</p> <p style="padding-left: 20px;">2.1.3 Epitopes and Haptenes</p> <p style="padding-left: 20px;">2.1.4 Antigen processing and Presentation</p> <p><b>2.2 Antibody:</b></p> <p style="padding-left: 20px;">2.2.1 Basic structure of antibodies</p> <p style="padding-left: 20px;">2.2.2 Immunological classes and Biological activities of IgG, IgA, IgM, IgD and IgE.</p> <p style="padding-left: 20px;">2.2.3 Antigenic determinants and B cell receptors on Immunoglobulins,</p> <p style="padding-left: 20px;">2.2.4 Antibody diversity and clonal selection theory</p> <p style="padding-left: 20px;">2.2.5 Monoclonal antibodies</p>
<b>3</b>	<p><b>Antigen-antibody Reactions</b></p> <p>3.1 Strength of Antigen-Antibody Reactions (Antibody Affinity, Avidity and Cross Reactivity)</p> <p>3.2 In Vivo Antigen-Antibody Reactions</p> <p>3.3 In Vitro Antigen-Antibody Reactions</p> <p style="padding-left: 20px;">3.3.1 Precipitation (In Fluid and In Gel Immunoelectrophoresis),</p> <p style="padding-left: 20px;">3.3.2 Agglutination (Heamagglutination, Bacterial agglutination, Passive agglutination and Agglutination Inhibition).</p> <p style="padding-left: 20px;">3.3.3 Radioimmuno Assay (RIA)</p> <p style="padding-left: 20px;">3.3.4 Enzyme Linked Immunosorbant Assay (ELISA),</p> <p style="padding-left: 20px;">3.3.5 Western Blot</p> <p style="padding-left: 20px;">3.3.6 Immuno Fluorescence</p>
<b>4</b>	<p><b>Immune Response:</b></p> <p>4.1 Cells and Organs of the Immune System:</p> <p style="padding-left: 20px;">4.1.1 Heamatopoesis</p> <p style="padding-left: 20px;">4.1.2 Cells of Immune System(Lymphoid Cells, Mononuclear cells, Granulocytes, Mast cells, Dendric cells)</p> <p style="padding-left: 20px;">4.1.3 Organs of the Immune System</p> <p style="padding-left: 40px;">4.1.3.1 Primary Lymphoid Organs; Thymus and Bone Marrow</p> <p style="padding-left: 40px;">4.1.3.2 Secondary Lymphoid Organs; Lymph node and Spleen</p> <p>4.2 Immunodeficiency diseases</p> <p>4.3 Hypersensitivity</p>

**Environmental Biology**  
**IBT – 405**

<b>Unit No.</b>	<b>Topic</b>
<b>1</b>	1.1 Introduction: Basic ecological principles, Scope, importance and application. 1.2 Ecosystem: Concepts of an ecosystem, regulation and control mechanisms, Structure and functional aspects of an ecosystem. Producers, consumers and decomposers. 1.3 Energy flow in the ecosystem, food webs, ecological pyramids. 1.5 Material cycling in ecosystems: Concept of geochemical cycles of essential elements, Carbon, Nitrogen, phosphorous, Sulphur.
<b>2</b>	2.1 Ecological succession: Development and evolution of ecosystem. 2.2 Characteristic features of Terrestrial ecosystem (forest). Aquatic ecosystem (marine, fresh water, estuarine). 2.3 Biology of extreme environments: Thermal spring, Saline, Deep sea.
<b>3</b>	3.1 Environmental pollution: causes and effects of Air pollution, Water pollution, Soil pollution, Marine pollution, Radioactive pollution, Noise pollution and Thermal pollution. 3.2 Solid waste management: Causes, effects and control of urban and industrial waste.
<b>4</b>	4.1 Biodiversity and its Conservation: Genetic, species and ecosystem diversity, Biodiversity at global, National and local levels, Hot spots of biodiversity. 4.2 Threats to biodiversity: Habitat loss, poaching of life. Endangered and endemic species of India, In-situ and ex - situ conservation of biodiversity. 4.3 Concept of sustainable development. 4.4 Global environmental problems, International summits on environmental issues.

**Biochemistry PRACTICALS**  
**IBT – 406**

<b>Unit No.</b>	<b>Topic</b>
	<b>Biochemistry</b>
<b>1</b>	Assay of amylase enzyme.
<b>2</b>	Assay of invertase enzyme.
<b>3</b>	Effect of pH on invertase activity.
<b>4</b>	Effect of temperature on invertase activity.
<b>5</b>	To study time course of alkaline phosphatase enzyme (Rectangular parabola graph)
<b>6</b>	To study Km and Vmax-Lineweaver Burk Plot.
<b>7</b>	To study effect of enzyme concentration on its activity.
<b>8</b>	To study the effect of substrate concentration on enzymes
<b>9</b>	To study enzyme inhibition
<b>10</b>	Estimation of blood sugar by GOD/POD method
<b>11</b>	Determination of Blood sugar by Folin's Wu's Method.

**Microbiology & Immunology Practicals**  
**IBT – 407**

Unit No.	Topic
	<b>MICROBIOLOGY</b>
<b>1</b>	Growth curve of bacteria by turbidometric method ( <i>E. coli</i> ), Study of various phases of growth curve of <i>E. coli</i> in nutrient broth. Measurement of O.D and Demonstration of colony forming units.
<b>2</b>	Determination of generation time and growth rate of <i>E. coli</i> in nutrient broth.
<b>3</b>	To study diauxic growth curve of <i>E. coli</i> .
<b>4</b>	Effect of following factors on growth of <i>E. coli</i> using turbidometric method 4.1 Temperature 4.2. pH 4.3 Substrate concentration 4.4 Salt concentration
<b>5</b>	Determination of antibiotic resistance by plate method (Agar cup method and Filter paper disc method).
<b>6</b>	Estimation of glucose by Cole's method.
<b>7</b>	Estimation of Carbohydrates by DNSA Method.
<b>8</b>	Estimation of Protein by Folin – Lowry Method
<b>9</b>	Study of proteolytic enzyme activity on following biochemical media 9.1 Proteins – Casein and gelatin 9.2 Amino acids – phenyl alanine 9.3 Other nitrogenous compound – peptone, peptone nitrate
<b>10</b>	Study of saccharolytic enzyme activity on following media 10.1 Starch 10.2 Sugars – Glucose, Lactose, Sucrose, Mannitol, Maltose, Xylose, TSI 10.3 Other carbohydrates – Citrate
<b>11</b>	Study of lipolytic enzyme activity on the following biochemical media 11.1 Trybutyrin agar
	<b>IMMUNOLOGY</b>
<b>1</b>	Preparation of Plasma and Serum.
<b>2</b>	To study precipitin reaction by Ring Test.
<b>3</b>	To study of precipitin reaction by Immunodiffusion. 3.1 Simple Immunodiffusion 3.2 Double Immunodiffusion (Ouchterlony technique)
<b>4</b>	To study of ABO & Rh Grouping by Rapid Slide Method & tube method.
<b>5</b>	To study serodiagnosis of Syphilis by RPR Test.
<b>6</b>	To study agglutination reaction for Enteric fever (WIDAL). 6.1 Slide agglutination test 6.2 Dreyer's double dilution technique
<b>7</b>	To study compatibility test.

<b>8</b>	Quantitative determination of Anti-D antibodies titer.
<b>9</b>	To study COOMB's Test (Direct & Indirect).

**Genetics Practicals**  
**IBT – 408**

<b>Unit No.</b>	<b>Topic</b>
<b>No.</b>	<b>GENETICS</b>
<b>1</b>	Estimation of Protein by Bradford Method.
<b>2</b>	Estimation of RNA by Orcinol Method.
<b>3</b>	Estimation of RNA by spectrophotometry.
<b>4</b>	Estimation of DNA by DPA method.
<b>5</b>	Estimation of DNA by spectrophotometry.
<b>6</b>	Isolation of RNA from appropriate source.
<b>7</b>	Isolation of DNA from appropriate source.
<b>8</b>	Analysis of given photographs of DNA/Protein gel electrophoresis.
<b>9</b>	Agarose electrophoresis for the separation and characterization of DNA.
<b>10</b>	SDS-PAGE for the separation and Characterization of Protein