

Department of Biochemistry
ELMC&H, Era University
Final Basic Course Teaching Schedule of Ph.D. Students
(Medical Biochemistry)

S.No.	Topic
1.	Cell Biology-I
	<ul style="list-style-type: none"> • Definition of cell • Difference between Plants and Animals. • Cell Theory, Structure, function, types, organelles, Cytoskeleton, and cell wall.
2.	Cell Biology-II
	<ul style="list-style-type: none"> • Genome Organization • Cell division: Mitosis and Meiosis
3.	Cell Biology-III
	<ul style="list-style-type: none"> • Membrane Structure and Function • Diffusion, facilitated diffusion, active and passive transport • Osmosis and osmotic pressure.
4.	Cytogenetics
	<ul style="list-style-type: none"> • Mendelian Genetics: Laws of Inheritance, crossing over • Post-Mendelian genetics: Linkage and Recombination • DNA Staining dyes, Gram Staining
5.	Bioenergetics
	<ul style="list-style-type: none"> • Laws of thermodynamics • Concept of free energy, exergonic and endergonic processes, uphill and downhill transport, endothermic and exothermic reactions • Enthalpy and entropy, phosphate group transfer potential, reduction potential
6.	Study of Biomolecular Structure: Chemistry of Carbohydrates-I
	<ul style="list-style-type: none"> • Definition, Classification and Chemical properties of monosaccharides, disaccharides, and polysaccharides. • Heteropolysaccharides polysaccharides: Cellulose and chitin.
7.	Study of Biomolecular Structure: Chemistry of Carbohydrates-II
	<ul style="list-style-type: none"> • Storage polysaccharides: Starch and Glycogen. • Extracellular matrix, Glycosaminoglycans • Glycoconjugates: Proteoglycans, Glycoproteins, and Glycolipids. Their Structure, Function, and Importance.

8.	<p style="text-align: center;">Metabolism of Carbohydrates-I Digestion and absorption</p> <ul style="list-style-type: none"> • Route and Process • Related Enzymes • Source: pancreas and liver. • Organs involved in absorption and their route.
9.	<p style="text-align: center;">Metabolism of Carbohydrates-II</p> <ul style="list-style-type: none"> • Medical conditions that affect carbohydrate metabolism • Related Disorders
10.	<p style="text-align: center;">Metabolism of Carbohydrates-III</p> <ul style="list-style-type: none"> • Glycolysis • TCA cycle • Regulation of the above pathways
11.	<p style="text-align: center;">Metabolism of Carbohydrates-IV</p> <ul style="list-style-type: none"> • Gluconeogenesis • Pentose Phosphate pathway • Regulation of the above pathways
12.	<p style="text-align: center;">Metabolism of Carbohydrates-V</p> <ul style="list-style-type: none"> • Glycogenesis • Glycogenolysis • Regulation of the above pathways
13.	<p style="text-align: center;">Oxidative Phosphorylation</p> <ul style="list-style-type: none"> • Electron transport chain: Oxidation of Reduced NADPH and NADH from carbohydrate, lipid and protein metabolism. • ATP synthesis. • Metabolic uncouplers and poisons.
14.	<p style="text-align: center;">Study of Biomolecular Structure: Chemistry of Proteins-I</p> <ul style="list-style-type: none"> • Definition, Classification and Chemical properties of amino acids and proteins • Peptide bond and its properties. Flexibility of polypeptide chains, Ramachandran plot
15.	<p style="text-align: center;">Study of Biomolecular Structure: Chemistry of Proteins-II</p> <ul style="list-style-type: none"> • Hierarchy of three-dimensional structure of proteins. • Primary structure of proteins: Identification of the N-and C terminal residues, Determination of primary structure of proteins, assignment of disulfide bonds.

	<ul style="list-style-type: none"> Secondary structure of proteins: α-helices, β sheets, β-turns, and other helical structures.
16.	<p style="text-align: center;">Study of Biomolecular Structure: Chemistry of Proteins-III</p> <ul style="list-style-type: none"> Tertiary structure of proteins: General structure of globular proteins. Super secondary structural motifs and domains Quaternary structure of proteins: Symmetry in protein structure Determination of quaternary structure of proteins: X-ray crystallography and NMR
17.	<p style="text-align: center;">Metabolism of Proteins-I</p> <ul style="list-style-type: none"> Digestion and absorption of Proteins Route and process Related Enzymes: Source and Site of secretion, and functions. Organs involved in absorption and their route
18.	<p style="text-align: center;">Metabolism of Proteins-II</p> <ul style="list-style-type: none"> Disorders related to amino acids and protein metabolism: Phenylketonuria, Alkaptonuria, Hartnup's disease, maple syrup disease, albinism, etc.
19.	<p style="text-align: center;">Metabolism of Proteins-III</p> <ul style="list-style-type: none"> Biosynthesis of amino acids; biosynthesis of α-keto glutarate, oxaloacetate, pyruvate family of amino acids and control of their synthesis
20.	<p style="text-align: center;">Metabolism of Proteins-IV</p> <ul style="list-style-type: none"> Transamination, deamination, decarboxylation and urea cycle
21.	<p style="text-align: center;">Metabolism of Proteins-V</p> <ul style="list-style-type: none"> Oxidative degradation of glucogenic and ketogenic amino acids
22.	<p style="text-align: center;">Study of Biomolecular Structure: Chemistry of Lipids-I</p> <ul style="list-style-type: none"> Fatty Acids and Lipids: Definition, Structure, classification and properties of fatty acids Functions of Triacylglycerides and Phosphoglycerides
23.	<p style="text-align: center;">Study of Biomolecular Structure: Chemistry of Lipids-II</p> <ul style="list-style-type: none"> Structure and functions of sphingolipids, cholesterol, steroids, eicosanoids, lipoproteins

24.	<p style="text-align: center;">Metabolism of Lipids-I</p> <ul style="list-style-type: none"> • Digestion and absorption of lipids • Route and process • Related Enzymes: Source and Site of secretion and functions • Organs involved in absorption and their route
25.	<p style="text-align: center;">Metabolism of Lipids-II</p> <ul style="list-style-type: none"> • Medical conditions that affect lipid metabolism • Related Disorders
26.	<p style="text-align: center;">Metabolism of Lipids-III</p> <ul style="list-style-type: none"> • Biosynthesis of saturated and unsaturated fatty acids • Breakdown of saturated and unsaturated fatty acids
27.	<p style="text-align: center;">Metabolism of Lipids-IV</p> <ul style="list-style-type: none"> • Biosynthesis of triglycerides, glycerophospholipids, cerebrosides, etherlipids, galactolipids and sulpholipids • Regulation of lipid metabolism
28.	<p style="text-align: center;">Metabolism of Lipids-VI</p> <ul style="list-style-type: none"> • Cholesterol biosynthesis and its regulation • Ketogenesis • Lipoprotein metabolism: pathways involved
29.	<p style="text-align: center;">Biological Oxidation</p> <ul style="list-style-type: none"> • Definition, Types of Reactions • Enzymes and Co-enzymes involved
30.	<p style="text-align: center;">Study of Biomolecular Structure: Chemistry of Nucleic Acid-I</p> <ul style="list-style-type: none"> • Definition, History, Occurrence, nomenclature and Types of Nucleic acid
31.	<p style="text-align: center;">Study of Biomolecular Structure: Chemistry of Nucleic Acid-II</p> <ul style="list-style-type: none"> • Molecular Composition and Size • Topology, Linking number • DNA supercoiling and role of topoisomerases
32.	<p style="text-align: center;">Metabolism of Nucleic Acids-I</p> <ul style="list-style-type: none"> • Synthesis of Purine and Pyrimidines: De novo and Salvage pathways • Related Disorders

33.	<p style="text-align: center;">Metabolism of Nucleic Acids-II</p> <ul style="list-style-type: none"> • Regulation of Purine and Pyrimidine Metabolism • Breakdown of Purine and Pyrimidines: pathways involved
34.	<p style="text-align: center;">Molecular Biology-I Replication in Prokaryotes</p> <ul style="list-style-type: none"> • Models and mechanism of replication • Enzymes involved: DNA polymerases, etc. • Inhibitors of prokaryotic replication
35.	<p style="text-align: center;">Molecular Biology-II Replication in Eukaryotes</p> <ul style="list-style-type: none"> • Mechanism • Enzymes involved: DNA polymerases, etc. • Inhibitors of eukaryotic replication
36.	<p style="text-align: center;">Molecular Biology-III Transcription in Prokaryotes</p> <ul style="list-style-type: none"> • Mechanism • Polycistronic m-RNAs • Enzymes involved: RNA polymerase, etc. • Inhibitors of prokaryotic replication
37.	<p style="text-align: center;">Molecular Biology-IV Transcription in Eukaryotes</p> <ul style="list-style-type: none"> • Mechanism • Monocistronic m-RNAs • Enzymes involved: RNA polymerases, etc. • Inhibitors of eukaryotic replication
38.	<p style="text-align: center;">Molecular Biology-V Translation in Prokaryotes</p> <ul style="list-style-type: none"> • Mechanism • Role of r-RNA and t-RNAs • Enzymes involved • Inhibitors of prokaryotic replication
39.	<p style="text-align: center;">Molecular Biology-VI Translation in Eukaryotes</p> <ul style="list-style-type: none"> • Mechanism • Role of r-RNA and t-RNAs • Enzymes involved • Inhibitors of eukaryotic replication • Genetic code

40.	<p style="text-align: center;">Molecular Biology-VII Translation in Eukaryotes</p> <ul style="list-style-type: none"> • Genetic Code • Wobble Hypothesis • Codon Bias
41.	<p style="text-align: center;">Molecular Biology-VIII</p> <ul style="list-style-type: none"> • DNA mutations: Types • DNA polymorphism: Types • Hardy Weinberg equilibrium
42.	<p style="text-align: center;">Molecular Biology-IX</p> <ul style="list-style-type: none"> • Gene regulation in prokaryotes • Lac Operon and Tryptophan operon
43.	<p style="text-align: center;">Molecular Biology-X</p> <ul style="list-style-type: none"> • Gene regulation in Eukaryotes • Pre-transcription level-chromatin remodelling. • RNA editing and splicing • Post transcription level-RNA silencing.
44.	<p style="text-align: center;">Signal Transduction-I</p> <ul style="list-style-type: none"> • Introduction to cell signalling • Cell surface and intracellular receptors • Types of signalling
45.	<p style="text-align: center;">Signal Transduction-II</p> <ul style="list-style-type: none"> • Signal transduction pathways • G-protein coupled receptors • Secondary messengers • Regulation of signalling pathways
46.	<p style="text-align: center;">Hormonal Regulation-I</p> <ul style="list-style-type: none"> • Mechanism of action • Metabolic and physiological roles of hormones secreted by pituitary, thyroid, parathyroid, adrenals, pancreas and gonads
47	<p style="text-align: center;">Hormonal Regulation-II</p> <ul style="list-style-type: none"> • Locally acting hormones • Clinical disorders due to over and under-secretion

48.	<p style="text-align: center;">Cell Cycle and Cancer</p> <ul style="list-style-type: none"> • Cell Cycle: Overview and Control • Cyclins, CDKs and Ubiquitin-proteasome dependent control of cell cycle checkpoints • Apoptosis: Pathways and hallmarks of apoptosis. Role of caspases and Bcl2 family of proteins • Cancer: Definition and Characteristics • Oncogenes and retroviruses. P53 and associated proteins as tumour suppressors • Cancer: Definition and Characteristics • Oncogenes and retroviruses. P53 and associated proteins as tumour suppressors
49.	<p style="text-align: center;">Molecular Technologies-I</p> <ul style="list-style-type: none"> • Recombinant DNA technology: historical perspective • DNA Modification and restriction • Restriction Endonuclease: general properties, nomenclature, types (Class I, II and III), and mode of action • DNA methylation • Enzymes used in recombinant DNA technology
50.	<p style="text-align: center;">Molecular Technologies-II</p> <ul style="list-style-type: none"> • PCR and its variants • Applications
51.	<p style="text-align: center;">Molecular Technologies-III</p> <ul style="list-style-type: none"> • Plasmid as cloning vector: plasmid types, properties of typical plasmid cloning vector, control of plasmid copy number. Expression vectors • Phage as a cloning vector: Lambda and M13-based vectors • Hybrid vectors: Cosmids and Phagemids. • Yeast based vectors: YEP, YRP, YCP, YIP, YAC
52.	<p style="text-align: center;">Molecular Technologies-IV</p> <ul style="list-style-type: none"> • Blotting and Hybridisation Techniques • DNA and Protein Microarrays
53.	<p style="text-align: center;">Molecular Technologies-V</p> <ul style="list-style-type: none"> • DNA Probe labelling and detection methods
54.	<p style="text-align: center;">Enzymology-I</p> <ul style="list-style-type: none"> • Enzyme definition, nomenclature, classification, and characteristics • Factors (pH, temperature etc.) affecting the rate of enzyme catalysis • Enzyme assay; isolation, purification, and characterization of enzymes • Enzyme-specific activity; units of enzyme activity • Isozymes and multiple forms of enzymes

55.	<p style="text-align: center;">Enzymology-II</p> <ul style="list-style-type: none"> • Types of enzyme catalysis: Acid-base catalysis, covalent catalysis, proximity, orientation effect • Strain and distortion theory • Lock and key and induced fit concepts
56.	<p style="text-align: center;">Enzymology-III</p> <ul style="list-style-type: none"> • Kinetics of single substrate enzyme catalysed reactions: Michaelis Menten initial rate equation based on equilibrium assumption • Briggs- Haldane steady-state approach, V_{max}, K_m and K_{cat} and their significance, methods for the determination of K_m, V_{max} • Derivation of Michaelis Menten equation for Unisubstrate reactions. Lineweaver-Burk equation and plot
57.	<p style="text-align: center;">Enzymology-IV</p> <ul style="list-style-type: none"> • Enzyme Regulation: General mechanisms of enzyme regulation, reversible and irreversible covalent modifications of enzymes • Feedback inhibition product inhibition • Allosteric regulation of enzyme activity
58.	<p style="text-align: center;">Enzymology-V</p> <ul style="list-style-type: none"> • Chemical modification of active site groups, Site-directed mutagenesis of enzymes. • Physicochemical properties and mechanism of action of two substrate-catalysed enzymes: chymotrypsin, lysozyme, hexokinase, and alcohol dehydrogenase
59.	<p style="text-align: center;">Immunology-I</p> <ul style="list-style-type: none"> • Introduction to Immunology: Innate and Acquired Immune System • Cells, Tissues and Organs of Immune System • Antigen and Antibody • Inflammatory Mediators • Cell Surface Receptors
60.	<p style="text-align: center;">Immunology-II</p> <ul style="list-style-type: none"> • Host-Pathogen Interaction and Intervention Mechanisms I: Antigen processing, presentation, and recognition • Mechanisms involving cell-mediated and humoral immune response
61.	<p style="text-align: center;">Immunology-III</p> <ul style="list-style-type: none"> • Mucosal immune system • Complement system and associated deficiencies • Hypersensitivity reactions
62.	<p style="text-align: center;">Immunology-IV</p> <ul style="list-style-type: none"> • Host Pathogen Interaction and Intervention Mechanisms II: Aspects of • Microbial Pathogenesis and Host Défense Mechanisms • Mechanisms of Immunological Tolerance Immunodeficiency diseases: primary

	<p>and secondary</p> <ul style="list-style-type: none"> • Autoimmunity and autoimmune disorders
63.	<p style="text-align: center;">Immunology-V</p> <ul style="list-style-type: none"> • Host Pathogen Interaction and Intervention Mechanisms III: Basic Transplantation Strategies and Graft Rejection Mechanisms • Mechanisms of Tumor Formation and Evasion Strategies of Host • Vaccination: Principle and Types
64.	<p style="text-align: center;">Immunology-VI</p> <ul style="list-style-type: none"> • Immunology Techniques and Methodologies: Strategies of Antigen and Antibody Purification • Immunoblotting, Agglutination, Precipitation Reactions • Complement Fixation Assays • Fluorescence, Dyes, ELISA, RIA, Microscopy • Concept and Applications of Flow Cytometry
65.	<p style="text-align: center;">Vitamins-I</p> <ul style="list-style-type: none"> • Definition, Types, Nomenclature, Classification • Dietary requirement, Sources • Structure and their importance
66.	<p style="text-align: center;">Vitamins-II</p> <ul style="list-style-type: none"> • Biochemical Functions • Hypervitaminosis, Hypovitaminosis, Related Disorders and Role in Metabolism
67.	<p style="text-align: center;">Minerals</p> <ul style="list-style-type: none"> • Definition, Types, Classification, Dietary requirements, Sources, and Importance • Biochemical Functions • Excess and Deficiency disorders and Role in Metabolism
68.	<p style="text-align: center;">Food and Nutrition-I</p> <ul style="list-style-type: none"> • Components of a balanced diet, role of carbohydrates, fibre, lipids and proteins in diet and their RDAs, • Specific dynamic action of foods • Methods for assessment of nutritional quality, digestibility, efficiency, and biological value of proteins, nitrogen balance
69.	<p style="text-align: center;">Food and Nutrition-II</p> <ul style="list-style-type: none"> • Basal metabolic rate, respiratory quotient • Dietary guidelines and advices in infancy, adolescence, adulthood, diabetes mellitus, CHD, pregnancy. • Starvation and Obesity, Fed and non-Fed state, Diabetes type-I and type-II, glycemic index and glycemic load and complications, diabetic ketoacidosis: symptoms and causes

70.	<p style="text-align: center;">Food and Nutrition-III</p> <ul style="list-style-type: none"> • Nutritional Deficiencies and Malnutrition • Protein energy malnutrition: Marasmus • Protein malnutrition: Kwashiorkor
71.	<p style="text-align: center;">Clinical Biochemistry-I</p> <ul style="list-style-type: none"> • Fluid and Electrolytes: Role, source, function, Importance and Disorders. • Acid-base balance and Homeostasis • Concept of pH and buffers. • Major buffer systems in the body
72.	<p style="text-align: center;">Clinical Biochemistry-II</p> <ul style="list-style-type: none"> • Role of Lungs, kidneys and haemoglobin in the regulation of blood pH. • Respiratory and metabolic acidosis Respiratory and metabolic alkalosis • Anion Gap • Blood gas analysis: pH, pCO₂, pO₂, hematocrit, etc.
73.	<p style="text-align: center;">Clinical Biochemistry-III</p> <ul style="list-style-type: none"> • Detailed Biochemistry and pathways of Blood • Blood Analysis: TLC and DLC • Blood Analysis: Blood sugar, glucose tolerance tests, blood urea and clearance, serum creatinine and clearance, serum uric acid, serum proteins and A:G ratio, serum bilirubin, serum cholesterol
74.	<p style="text-align: center;">Clinical Biochemistry-IV</p> <ul style="list-style-type: none"> • Detailed Biochemistry and pathways of Blood: Blood Coagulation pathways: Intrinsic and Extrinsic • Blood Analysis: Major serum Enzymes and their diagnostic values • Blood Analysis: Lipid Profile in terms of HDL-C, LDL-C estimation and HDL-C: LDL-C ratio • Blood Analysis: Serum calcium and phosphorus • Blood Analysis: Assessment of Thyroid Functions: T3 and T4, TSH assays
75	<p style="text-align: center;">Clinical Biochemistry-V</p> <ul style="list-style-type: none"> • Detailed Biochemistry of Urine • Urine Analysis: Normal and abnormal constituents • Urine Culture: R/M Analysis
76	<p style="text-align: center;">Clinical Biochemistry-VI</p> <ul style="list-style-type: none"> • Biochemistry and Histology of Liver • Assessment of Liver Functions: Tests based on excretory, intermediary metabolic, synthetic, and detoxification functions of liver. • Tests for cellular damage and obstruction to bile flow

77	<p style="text-align: center;">Clinical Biochemistry-VII</p> <ul style="list-style-type: none"> • Biochemistry and Histology of Kidney • Assessment of Renal Functions: tests for glomerular filtration capacity, glomerular filtration barrier integrity and tubular function
78	<p style="text-align: center;">Clinical Biochemistry-VIII</p> <ul style="list-style-type: none"> • Inherited metabolic disorders and newborn screening. • Therapeutic drug monitoring
79	<p style="text-align: center;">Biological Tools and Techniques-I</p> <ul style="list-style-type: none"> • Potentiometry • pH meter • Major staining dyes used in biology • ABG analyser
80	<p style="text-align: center;">Biological Tools and Techniques-II</p> <ul style="list-style-type: none"> • Electromagnetic Spectrum and its applications: X-ray, UV, VIS, IR, microwave and radio wave regions • Emission and Absorption Spectroscopy • AAS • Fluorescence spectroscopy
81	<p style="text-align: center;">Biological Tools and Techniques-III</p> <ul style="list-style-type: none"> • Colorimetry: Principle and Applications • Spectrophotometry: Principle and Applications • Working and parts of colorimeter and UV-VIS spectrophotometer
82	<p style="text-align: center;">Biological Tools and Techniques-IV</p> <ul style="list-style-type: none"> • IR Spectroscopy: Principle and Applications • Working and parts of an IR spectrophotometer • ESR spectroscopy: Principle and Applications • Working and parts of an ESR spectrophotometer
83	<p style="text-align: center;">Biological Tools and Techniques-V</p> <ul style="list-style-type: none"> • NMR spectroscopy: Principle and Applications • Working and parts of a NMR spectrophotometer • C^{13} and proton NMR: Understanding the spectra
84	<p style="text-align: center;">Biological Tools and Techniques-VI</p> <ul style="list-style-type: none"> • Chromatographic techniques: Principle, Classification and Applications • Types: Partition, Ion exchange, Gel filtration, Hydrophobic, Affinity, etc.

85	<p style="text-align: center;">Biological Tools and Techniques-VII</p> <ul style="list-style-type: none"> • Automated Chromatographic techniques: HPLC and UPLC: Characteristics and Applications • Preparative and Analytical Modes.
86	<p style="text-align: center;">Biological Tools and Techniques-VIII</p> <ul style="list-style-type: none"> • Electrophoresis techniques: Principle, Classification and Applications • DNA electrophoresis: AGE and working parts of an electrophoresis unit
87	<p style="text-align: center;">Biological Tools and Techniques-IX</p> <ul style="list-style-type: none"> • Protein electrophoresis: Native-PAGE, SDS-PAGE, Isoelectric focusing, 2D-E, etc. • Preparative and Analytical Modes
88	<p style="text-align: center;">Biological Tools and Techniques-X</p> <ul style="list-style-type: none"> • Centrifugation: Principle, Classification and Applications • Differential, isopycnic and rate zonal centrifugation • Ultracentrifuge: Parts and Working • Preparative and Analytical Modes
89	<p style="text-align: center;">Biological Tools and Techniques-XI</p> <ul style="list-style-type: none"> • Microscopic Techniques: Principle, Classification and Applications • Light, phase contrast, fluorescence, confocal, SEM and TEM • Working and parts of a compound, phase contrast and fluorescence microscope

90

Biological Tools and Techniques-XII

- Radioactive techniques: Principle and Applications
- Measurement of Radioactivity: Scintillation and Geiger Muller Counters
- RIA: Principle, Types and Applications
- Radioisotopes used in biology