



TEERTHANKER MAHAVEER UNIVERSITY

(Established under Govt. of U. P. Act No. 30, 2008)

Delhi Road, Moradabad (U.P.)

PhD PROGRAMME

SYLLABUS FOR DISCIPLINE-SPECIFIC COURSE MEDICAL BIOCHEMISTRY

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Objective:	To equip the research scholars to apply knowledge, critical thinking, methodologies, and skills to address the fundamental questions in the respective areas of study and to pursue research of significance in the core discipline or an interdisciplinary area under the guidance of an advisor				
Course Outcomes:	On completion of the course, the outcome should be to:				
CO 1	Equip the research scholars to conduct innovative research in the area of molecular biology, with a specific focus on pathogenic RNA viruses				
CO 2	Conduct original research addressing the global challenge on disease management and developing sustainable solutions				
CO 3	Elucidate the secondary metabolite biosynthetic pathways and formulate strategies towards enhancing the production of these high-value low volume metabolites				
CO 4	Provide advanced skills in the field of non-coding RNAs and cancer biology and equip the scholar to achieve competence in the latest molecular biology skills				
CO 5	Equip research scholars to understand, innovate, and conduct research on cancer biomarkers, RNP, and non-coding RNA signaling				
CO 6	Provide research training on targeting immunomodulation, inflammation, and cancer by natural and synthetic bioactive compounds				
Course Code: PDS240142	CORE/ELECTIVE - 1: CHEMISTRY OF BIOMOLECULES & METABOLISM				
Unit I	Chemistry of Biomolecules: Carbohydrate: classification: monosaccharides, disaccharides: reducing and non-reducing disaccharides, homo and heteropolysaccharides mucopolysaccharides. Proteoglycans and glycoproteins. Lipids: Fatty acids: nomenclature, definition, function, saturated classification and unsaturated Physical and chemical properties, simple Lipids. Fats, Triacylglycerols:				

	<p>structure, function. Stereochemical numbering, prochirality, waxes, complex lipids, derived lipids.</p> <p>Amino Acids: classification, structure, and nomenclature. Proteins: Definition, classification, functions, properties, and their higher orders of structure. Introduction of enzymes.</p>
Unit II	<p>Metabolism of carbohydrates:</p> <p>Glucose transporters, glycolysis, oxidation of pyruvate, TCA cycle, gluconeogenesis, Cori's cycle Metabolism of glycogen (glycogenesis, glycogenolysis, storage disorders), HMP shunt pathway. Metabolism of fructose, galactose, uronic acid pathway, inborn Errors associated with carbohydrate metabolism. Glycemic index. Blood glucose regulation. Glucose tolerance test and glucose challenge test.</p>
Unit III	<p>Metabolism of lipids:</p> <p>Oxidation of fatty acids—alpha, beta, omega – beta-oxidation of odd chain and even chain fatty acids along with metabolic disorders. Formation and utilization of ketone bodies and ketosis. De novo synthesis of fatty acids, elongation, and desaturation. De novo synthesis of cholesterol. Metabolism of cholesterol and compounds derived from cholesterol. Lipoproteins – classification, metabolism, functions and disorders. Atherosclerosis and the role of PUFA in preventing atherosclerosis</p>
Unit IV	<p>Metabolism of amino acids and proteins:</p> <p>Metabolism of amino acids; Transamination, deamination, transmethylation. Formation, transport, and disposal of ammonia (urea cycle). Inborn errors; Porphyrins: Chemistry, properties and porphyrias. Biosynthesis of heme, breakdown & its regulation. Hemoglobin degradation. Jaundice, different types of Jaundice, and biochemical investigations</p>
Unit V	<p>Integration and regulation of metabolism:</p> <p>Integration of carbohydrate, protein, and lipid metabolisms. Role of transaminases. Metabolic regulation by hormones in starvation, well-fed state, and diabetes mellitus.</p> <p>SUGGESTED READING:</p> <ol style="list-style-type: none"> 1. Nelson D and Cox M. Lehninger Principles of Biochemistry, 5th Edition. Macmillan. 2. Voet D and Voet J. Biochemistry, 4th Edition. John Wiley & Sons. 3. Brändén C and Tooze J. Introduction to Protein Structure, Taylor & Francis. 4. Bowden AC. Principles of Enzyme Kinetics, Butterworths & Co Ltd. 5. Haynie D. Biological Thermodynamics, 2nd Edition, Cambridge University Press.

Course Code: PDS240143	CORE/ELECTIVE- 2: MOLECULAR BIOLOGY
Unit I	DNA and RNA: DNA as genetic material; primary, secondary, and three-dimensional structure of DNA; supercoiling; forms of DNA; properties of DNA in solution; reassociation reactions: COT curves; types of RNAs and their primary and secondary structure; the role of RNA; unusual bases in RNA, Nucleosome, Histone proteins, Hetrochromatin, Euchromatin. Physical and chemical properties of nucleic acid. Prokaryotic and eukaryotic gene structure; transposable elements in bacteria; mobile elements in eukaryotes; regulatory region. Prokaryotic and eukaryotic gene structure; transposable elements in bacteria; mobile elements in eukaryotes;
Unit II	Replication: The central dogma of molecular biology. Replication, transcription & translation in prokaryotes and eukaryotes. Post-transcriptional and post-translation modification. Topoisomerases, telomeres, repair mechanism in prokaryotes and eukaryotes; role of methylation; replication of viral RNA viruses.
Unit III	Gene and mutations: Classification and genetic basis of mutation; site-directed mutagenesis.
Unit IV	Gene expression & regulation: Gene expression in prokaryotes; enzyme induction and repression; negative and positive control; concept of operon; regulation of gene expression in eukaryotes; promoters, enhancers, and response elements; regulation at transcriptional level; role of chromatin structure in gene expression; cytoplasmic regulation of gene expression.
Unit V	PCR and DNA fingerprinting: Polymerase chain reaction: principles, process, design, and optimization; Taq DNA polymerase; types of PCR; application of PCR; ligase chain reaction; SNP and the application in molecular diagnostics; DNA fingerprinting: applications and prospects; restriction fragment length polymorphism (RFLP) and its uses; FISH; prenatal diagnosis. SUGGESTED READING: 1. Watson JD, Baker TA, Bell SP, Gann AAF. Molecular Biology of the Gene, 6th Edition, Benjamin Cummings Publishing Company Inc. 2. Lewin B. Gene IX, 9th Edition, Jones and Barlett Publishers. 3. Alberts B, Bray D, Watson J, Lewis J, Raff M. Molecular Biology of the Cell, Garland Science. 4. Primrose SB, Tyman RM, Old RW. Principles of Gene Manipulation, 6th Edition, Blackwell Publishing.

Course Code: PDS240144	CORE/ELECTIVE 3: CLINICAL BIOCHEMISTRY
Unit I	<p>Quality assurance in clinical biochemistry:</p> <p>Anticoagulants, Biological samples: types, collection, processing, stability and storage; chemical composition of biological fluids: blood, urine and cerebrospinal fluid; reference range; quality control and quality assurance; accuracy and precision; factors influencing the accuracy of results; Levy Jennings's chart; reliability of laboratory methods, Westgard quality control rules, Automation in Biochemistry, Preanalytical, analytical and post-analytical errors in clinical biochemistry laboratory.</p>
Unit II	<p>Biochemical tests and disease diagnosis:</p> <p>Biochemical tests in clinical medicine: basic concepts, criteria for selecting a method for biochemical analysis; enzymes and isoenzymes as diagnostic tools; methods for the detection of isoenzymes; Clinical presentation and diagnosis of liver and kidney.</p>
Unit III	<p>Organ functions tests:</p> <p>Liver function tests; Hepatitis, cirrhosis; jaundice, hepatic coma. Tests for the assessment of liver functions. Kidney functions and kidney function tests: Urea, Creatinine, GFR, Creatinine clearance, and inulin clearance. Cardiac function tests: Enzymatic and non-enzymatic markers. Thyroid function test; T3, T4, TSH, FT3, FT4, hypothyroidism, hyperthyroidism, and subclinical hyper and hypothyroidism. Gastric function test, pancreatic function test, and tests for adrenal insufficiency.</p>
Unit IV	<p>Inborn errors of Metabolism:</p> <p>Phenylketonuria, alkaptonuria, homocystinuria and albinism, Hartnup's disease, galactosemia, TaySach's disease and Niemann Pick's disease, Hunter and Hurler Syndrome, Lesch-Nyhan syndrome,</p> <p>SUGGESTED TEXT BOOKS:</p> <ol style="list-style-type: none"> 1. Clinical diagnosis and management by laboratory methods- Author: John Bernard Henry 2. Textbook of Biochemistry with Clinical Correlations (2010) by Thomas M. Devlin. 8th edition, Wiley- Liss 3. Clinical Chemistry William J Marshall, Stephen Bangert 4. Biochemistry- a care-oriented approach- Author: Montgomery

Course Code: PDS240145	CORE/ ELECTIVE 4: TOOLS AND TECHNIQUES IN BIOCHEMICAL RESEARCH
Unit I	<p>Proteins:</p> <p>Fractionation of proteins, Differential centrifugation, Chromatographic techniques, Gel permeation, ion exchange, Affinity, HPLC, FPLC. Electrophoretic techniques: PAGE, SDS-PAGE, Capillary electrophoresis. Proteomics: Proteome, 2D electrophoresis, MALDI-TOF/TOF, LCMS, Protein databases, BLAST.</p>
Unit II	<p>Nucleic acids:</p> <p>Isolation and identification of DNA and RNA, Preparation of cDNA, amplification and sequencing, Hybridization techniques, cloning and expression of genes, PCR, RT-PCR, Transcriptome, Genome, Gene silencing and knockouts, Microarray.</p>
Unit III	<p>Enzymes:</p> <p>Methods of enzymatic analysis, katal, and international enzyme units, immobilization techniques, Application of enzymes.</p>
Unit IV	<p>Immunobiology:</p> <p>Immune response, Antigen-antibody interactions, Blotting techniques, Immunofluorescence, FACS, ELISA and ELISPOT.</p> <p>SUGGESTED READINGS:</p> <ol style="list-style-type: none"> 1. D.L. Nelson, & M.M Cox, 2007, Lehninger's Principles of Biochemistry, 5th Edition, MacMillan Worth. 2. Lodish et al., 2008, Molecular Cell Biology, 6th Edition, Freeman. 3. Donald, Voet and J.G Voet, 2004, Biochemistry, 4th Edition, John Wiley & Sons Inc., USA. 4. Lewin, Benjamin, 2008, Genes IX, Jones, and Bartlett's Publishers Inc. 5. T. A. Brown, 2007 Genomes, 3rd Edition, Garland Science Publishing. 6. Sambrook & Russell, 2001, Molecular cloning-a Laboratory Manual, 3rd Edition, CSHL Press. 7. Dixon and Webb, 1979, Enzymes, 3rd Edition, Academic Press. 8. Alan Wisemen, Handbook of Enzyme Biotechnology, 2nd Edition, John Wiley & Sons, New York. 9. Kindt et al. 2007, Kuby's Immunology, 6th Edition, Freeman. 10. Ivan M. Roitt, and Peter J. Delves, 2003, Essential Immunology, Blackwell Publishers. 11. Lorette C. Javois, 1999, Immunocytochemical Methods and Protocols, 2nd Edition, Humana Press Inc, New Jersey. <p>*The latest editions of all the suggested books are recommended.</p>