

**Tantia University**  
Sri Ganganagar  
Ph.D. Course Work Syllabus  
(Revised as Per UGC Regulation 2022)  
Medical Biochemistry

Maximum Marks-120

Minimum Marks-66

**PART-A**

**Part A- 60 Marks**

**Total Credits = 6**

**Total Hours=6x45= 270 Hours**

**Introduction to Research**

Introduction of Research, Research methodology, Defining Research problem and formulation of hypothesis, research design, sampling design, measuring and scaling techniques, methods of data collection.

Pure and Applied Research, Exploring or Formulative Research, Descriptive Research, Diagnostic Research/Study, Evaluation Research/Studies, Action Research, Experimental Research, Historical Research, Surveys, Case Study, Field Studies

Research Ethics: Characteristics and format of research paper, article, thesis writing, review of Related Literature, Purpose of the review, Identification of the related literature. Organizing the related literature.

**Statistics**

Concept of statistics, relevance in research, parametric and non-parametric data; graphical representation of data: histogram, frequency polygon, ogive and pie chart; Measures of Central Tendency, Correlation, t-test chi square test

**Computer Application**

Basic and fundamental knowledge of Computer and its Applications. Introduction, Application Area, Operating System, Windows, Office, Internet.

**PART-B**

**Part B- 60 Marks (Subject based)**

**Total Credits = 6**

**Total Hours=6x45= 270 Hours**

- 1. MOLECULES AND THEIR INTERACTION RELEVANT TO BIOCHEMISTRY**
  - Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties).

- Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers.
- Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes.
- Conformation of proteins (Ramachandran plot, secondary, tertiary and quaternary structure; domains; motif and folds).
- Conformation of nucleic acids (A-, B-, Z-,DNA), t-RNA, micro-RNA).
- Stability of protein and nucleic acid structures.
- Metabolism of carbohydrates, lipids, amino acids, nucleotides and vitamins, acid base balance and disbalance, minerals, concept of human nutrition, xenobiotics, hormone
- Clinical and applied biochemistry, interpretation of clinical laboratory data and concept of quality control

## **2. CELLULAR PROCESSES**

- Membrane structure and function: Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, ion pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes.
- Structural organization and function of intracellular organelles
- Organization of genes and chromosomes: Operon, interrupted genes, gene families, structure of chromatin and chromosomes, unique and repetitive DNA, heterochromatin, euchromatin, transposons.
- Cell division and cell cycle: Mitosis and meiosis, their regulation, steps in cell cycle, and control of cell cycle.
- Microbial Physiology: Growth, yield and characteristics, strategies of cell division, stress response.

## **3. FUNDAMENTAL PROCESSES**

- DNA replication, repair and recombination: Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extra chromosomal replicons, DNA damage and repair mechanisms.
- RNA synthesis and processing: Transcription factors and machinery, formation of initiation complex, transcription activators and repressors, RNA polymerases, capping, elongation and termination, RNA processing, RNA editing, splicing, polyadenylation, structure and function of different types of RNA, RNA transport.
- Protein synthesis and processing: Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, translational proof-reading, translational inhibitors, post- translational modification of proteins.

- Control of gene expression at transcription and translation level: Regulation of phages, viruses, prokaryotic and eukaryotic gene expression, role of chromatin in regulating gene expression and gene silencing.

#### **4. CELL COMMUNICATION AND CELL SIGNALING**

- Host parasite interaction: Recognition and entry processes of different pathogens like bacteria, viruses into animal and plant host cells, alteration of host cell behavior by pathogens, virus-induced cell transformation, pathogen-induced diseases in animals and plants, cell-cell fusion in both normal and abnormal cells.
- Cell signaling: Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two-component signaling systems, bacterial chemotaxis and quorum sensing.
- Cellular communication: Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation.
- Cancer: Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth.
- Innate and adaptive immune system: Cells and molecules involved in innate and adaptive immunity, antigens, antigenicity and immunogenicity. B and T cell epitopes, structure and function of antibody molecules, generation of antibody diversity, monoclonal antibodies, antibody engineering, antigen-antibody interactions, MHC molecules, antigen processing and presentation, activation and differentiation of B and T cells, B and T cell receptors, humoral and cell-mediated immune responses, primary and secondary immune modulation, the complement system, Toll-like receptors, cell-mediated effector functions, inflammation, hypersensitivity and autoimmunity, immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections, congenital and acquired immunodeficiencies, vaccines.

#### **5. METHODS IN BIOCHEMISTRY**

- Molecular biology and recombinant DNA methods: Isolation and purification of RNA, DNA (genomic and plasmid) and proteins, different separation methods; analysis of RNA, DNA and proteins by one and two dimensional gel electrophoresis, isoelectric focusing gels; molecular cloning of DNA or RNA fragments in bacterial and eukaryotic systems; expression of recombinant proteins using bacterial, animal and plant vectors; isolation of specific nucleic acid sequences; generation of

genomic and cDNA libraries in plasmid, phage, cosmid, BAC and YAC vectors; in vitro mutagenesis and deletion techniques, gene knock out in bacterial and eukaryotic organisms; protein sequencing methods, detection of post-translation modification of proteins; DNA sequencing methods, strategies for genome sequencing; methods for analysis of gene expression at RNA and protein level, large scale expression analysis, such as micro array based techniques; isolation, separation and analysis of carbohydrate and lipid molecules; RFLP, RAPD and AFLP techniques

- Histochemical and immunotechniques: Antibody generation, detection of molecules using ELISA, RIA, western blot, immunoprecipitation, flow cytometry and immunofluorescence microscopy, detection of molecules in living cells, in situ localization by techniques such as FISH and GISH.
- Biophysical methods: Analysis of biomolecules using UV/visiblespectroscopy, fluorescence, circular dichroism, NMR and ESR spectroscopy, structure determination using X-ray diffraction and NMR; analysis using light scattering, different types of mass spectrometry and surface plasma resonance methods.
- Separation techniques: chromatography and electrophoresis
- Preparation of analytical quality solutions and dilution series ; determination of concentrations of biological molecules by, and understand relative advantages of, a range of methods(clinical biochemical method)

Methodology of clinical biochemistry laboratory