

Syllabus for Biomedical Research SCPH03

Note:

- i. There will be one Question Paper which will have 100 questions.
- ii. All questions will be compulsory.
- iii. The Question Paper will have two Parts i.e. Part A and Part B
- iv. Part A will have 50 questions based on Research Methodology
- v. Part B will have 50 questions based on Subject-Specific Knowledge.

- ❖ Reactive Intermediates in Organic Reactions
- ❖ Stereochemistry of Organic compounds
- ❖ Mechanism and stereochemistry of following reactions
- ❖ Asymmetric synthesis
- ❖ Heterocyclic chemistry

CELL BIOLOGY

- ❖ Bio membranes
- ❖ Organelles of eukaryotic cells
- ❖ Nucleus and Chromosome Structure
- ❖ The Cytoskeleton
- ❖ ECM Proteins and Cell Adhesion
- ❖ Eukaryotic Cell Cycle
- ❖ Cell to Cell Signaling
- ❖ Cell death
- ❖ Cellular Stress Response

BIOCHEMISTRY OF MACROMOLECULES

- ❖ Protein Structure
- ❖ Enzymology
- ❖ Protein purification, physical separation & Analysis
- ❖ Regulation of protein function
- ❖ DNA Replication in Prokaryotes and Eukaryotes
- ❖ Translation

CONCEPTS IN GENETICS

- ❖ Introduction to the Science of Genetics and Mendelian Basics
- ❖ Chromosomal basis of inheritance and data analysis:
- ❖ Deviations from Mendelian Genetics I:
- ❖ Mutation and mutational analysis:
- ❖ Linkage as a deviation from Mendelian Genetics:
- ❖ Bacterial and Phage genetics:
- ❖ Genetic Variation
- ❖ Deviations from Mendelian Genetics II
- ❖ Genetic control mechanisms and generation of cellular asymmetry:
- ❖ Sex determination in Drosophila and humans:
- ❖ Introduction to human Genetics:
- ❖ Population Genetics

MEDICAL MICROBIOLOGY

- ❖ Introduction and Techniques
- ❖ Bacteriology

- ❖ Mycology
- ❖ Parasitology
- ❖ Virology

MOLECULAR BIOLOGY

- ❖ Transcription in Prokaryotes and Eukaryotes
- ❖ Regulation of gene expression in Prokaryotes
- ❖ Regulation of Gene expression in Eukaryotes
- ❖ Chromatin remodeling

HUMAN PHYSIOLOGY

- ❖ Membrane and muscle physiology:
- ❖ Respiratory system
- ❖ Body fluid and excretory system
- ❖ Gastrointestinal system
- ❖ Reproductive system: Anatomical and functional aspects of human genital system
- ❖ Endocrine system

RECOMBINANT DNA TECHNOLOGY AND BIOTECHNOLOGY

IMMUNOLOGY

- ❖ Introduction to the Immune system
- ❖ Priming of the Immune response
- ❖ Antibody Generation, Structure and Function
- ❖ Major Histocompatibility Complex
- ❖ Antigen recognition, Presentation and Cell Mediated Immunity

- ❖ Regulations of the Immune system: Pathology, Hypersensitivity and Tolerance
- ❖ Immunological techniques and Vaccines

BIOLOGICAL CHEMISTRY II

- ❖ Molecules and macromolecules in biological systems
- ❖ Synthetic macromolecules and polymers in biology
- ❖ Mechanisms in Biological Chemistry
- ❖ Enzyme, Coenzyme systems and Mechanism of coenzyme catalysis
- ❖ Hammett and Taft equation

PRINCIPLES OF MEDICINAL CHEMISTRY

- ❖ Role of Medicinal Chemistry in discovery of drugs
- ❖ Drug Design
- ❖ Receptors
- ❖ Introduction of various classes of drugs based on their interaction with target site with suitable examples, the drugs interacting with
- ❖ Structure activity relationship illustrated with examples from
- ❖ Drug Metabolism

HUMAN PHYSIOLOGY-II

- ❖ Cardiovascular system
- ❖ Overview of the Nervous System
- ❖ Motor System
- ❖ Cognitive System
- ❖ Learning and Memory
- ❖ Sensory Physiology
- ❖ The Autonomic Nervous

- ❖ Central Regulation of Visceral Function
- ❖ Blood physiology
- ❖ Electrophysiology (using appropriate hardware and software)

ANALYTICAL & BIOMEDICAL TECHNIQUES AND INSTRUMENTATION

- ❖ Optical Methods and their applications in Biomedical Sciences
- ❖ Separation Methods
- ❖ Nuclear Magnetic Resonance Spectroscopy
- ❖ Magnetic Resonance Imaging
- ❖ Mass Spectrometry
- ❖ Flow Cytometry, Magnetic Assisted Cell Sorting:
- ❖ Miscellaneous TECHNIQUES

PHARMACOLOGY AND TOXICOLOGY

- ❖ Introduction to pharmacology
- ❖ Pharmacokinetics
- ❖ Pharmacodynamics
- ❖ Pharmacological classification of drugs; the brief introduction of drugs should emphasize the ADME profile of following systems
- ❖ Principles of Toxicology
- ❖ Types of toxicity and its measurement
- ❖ Epidemiology of toxicity
- ❖ Organ toxicities
- ❖ Tests for evaluation of toxicities in different organs

BIOETHICS AND BIOSAFETY

- ❖ Introduction to Bioethics, Codes, Covenants, Declarations and Guidelines

- ❖ Issues concerning good life and healthy life
- ❖ Justice, Law and Society & Legal and Ethical accountability of Doctors
- ❖ Doctor-Patient relationship
- ❖ Medical errors and negligence
- ❖ Clinical research and ICMR guidelines:
- ❖ Biosafety

APPLICATION OF STATISTICS FOR BIOLOGY

- ❖ Measures of central Tendency
- ❖ Correlation and Regression analysis
- ❖ Probability
- ❖ Probability Distribution
- ❖ Methods of Sampling of biological data and analysis using

MOLECULAR ONCOLOGY

- ❖ The Cancer Problem
- ❖ Mechanisms of Carcinogenesis
- ❖ Tumor types and leukemia
- ❖ Modulation of the Eukaryotic Cell Cycle and cell death in cancer L15:
- ❖ Cell-cell Interactions in Development of cancer
- ❖ ANGIOGENESIS
- ❖ Tumor suppressor genes and viral oncogenes
- ❖ Growth factor-signaling pathways in cancer

STEM CELL BIOLOGY FOR DEVELOPMENTAL AND TRANSLATIONAL RESEARCH

MEDICAL BACTERIOLOGY AND PARASITOLOGY

- ❖ Bacteriology Introduction

- ❖ Virulence determinants and their regulation
- ❖ Epidemiology and Modes of Infection and Diagnosis
- ❖ Therapeutics, Immunity and Drug Resistance.
- ❖ Parasitology
- ❖ Pathophysiology of protozoan parasites:
- ❖ Pathophysiology of Re-emerging protozoan infections

NEW METHODS IN ORGANIC SYNTHESIS

- ❖ Methods in nucleotide synthesis
- ❖ Methods in peptide synthesis
- ❖ Alkene metathesis

GREEN CHEMISTRY

BIOINFORMATICS, COMPUTATIONAL BIOLOGY AND DRUG DESIGN

- ❖ Biological databases, Sequence Alignment and Phylogenetic Analysis. Student will be able to learn biological and bioinformatics databases, sequence alignments, scoring the alignment, phylogeny analysis and basics of Next Gen sequencing techniques.
- ❖ Structural Biology: Student will learn various aspects of Protein structure. Students will be familiarized with secondary structures elements, the visualization using various online softwares, cavity analysis, methods of protein structure determination, predicting protein secondary and tertiary structure, oligomeric proteins.
- ❖ Systems Biology: Student will learn basics of system biology networks, graph theory, uses etc. Topology of networks, different types of networks, computational tools for analysing networks, clustering etc,
- ❖ Molecular modelling and molecular dynamics: Student will learn how molecular modelling methods have evolved and integrate into modern, multidisciplinary structure- based design. Summarise the key concepts surrounding the potential energy surface, including methods of energy calculation and exploration, and appreciate the advantages and limitations of these methods, describe various molecular dynamics methods.
- ❖ Drug design using case studies Describe computer-based 2D and 3D approaches to drug design and discovery, including functional group mapping, virtual screening, de novo design, quantitative-structure activity relationships and database analysis.

- ❖ Structure Activity Relationships. Compare and contrast 2D and 3D approaches QSAR and Other computer-aided drug design, giving examples of their use in drug discovery projects.
- ❖ Biological databases, Sequence Alignment and Phylogenetic Analysis
- ❖ Structural Biology
- ❖ Systems Biology:
- ❖ Molecular Modeling and Molecular Dynamics
- ❖ Drug design using case studies
- ❖ Structure Activity Relationship:

GENOME BIOLOGY

- ❖ Human genetics in pre-genomic era: Pedigree Analysis and deviations from basic pedigree patterns:
- ❖ Human Genome Project:
- ❖ Whole genome mapping strategies
- ❖ Web based data analysis
- ❖ Organization of the Human Genome:
- ❖ Functional Genomics

ADVANCED IMMUNOLOGY

- ❖ Introduction and Recap of Basic Immunology
- ❖ T cell Differentiation, Activation and Functions
- ❖ B lymphocyte Differentiation, Activation and Functions
- ❖ APC-T Cell Interactions via Costimulation and Immune Synapse
Mucosal Immunity and Allergy
- ❖ Immunity to pathogens
- ❖ Regulation and Deregulation of Immune Responses
- ❖ Transplantation and Tumor Immunology

- ❖ Immuno-Therapeutics and Vaccines
- ❖ Organogenesis and Lymphoid Development

ADVANCED CONCEPTS IN MEDICINAL CHEMISTRY

- ❖ Receptor Chemistry and Biology:
- ❖ Drugs acting on Novel Targets
- ❖ Metal Complexes in Medicine
- ❖ Role of Biotechnology in Drug Discovery
- ❖ Combinatorial Drug Synthesis:
- ❖ Personalized Drug Development-

CLINICAL PATHOPHYSIOLOGY

- ❖ General patient assessment
- ❖ Methods for patient assessment
- ❖ Genetic Diseases
- ❖ Pulmonary disorder
- ❖ Cardiovascular Disorders
- ❖ Nervous System Disorders with case studies
- ❖ Endocrinal Disorders
- ❖ Gastrointestinal Disease
- ❖ Renal Diseases
- ❖ Disorders of Reproductive Tract

ADVANCED TOXICOLOGY

- ❖ Adverse drug reaction and therapeutic drug monitoring
- ❖ Toxicology of heavy metals
- ❖ Toxicology of pesticides

- ❖ Applied toxicology
- ❖ Occupational and industrial toxicology
- ❖ Toxicokinetics and molecular mechanisms of toxicity
- ❖ Drug safety

MEDICAL VIROLOGY AND MYCOLOGY

- ❖ Introduction to medical virology
- ❖ Reproduction and Growth of viruses
- ❖ Epidemiology and Pathogenicity of viruses
- ❖ Diagnosis, Treatment and Prevention of viruses
- ❖ Immunity to viral infections

INTRODUCTION TO MEDICAL MYCOLOGY

- ❖ Detail study of human fungal infections
- ❖ Prevention and control of fungal diseases

ADVANCES IN PROTEIN SCIENCE

Basic Principles of protein folding in cell

- ❖ Chaperones
- ❖ Protein Quality control
- ❖ Protein misfolding and diseases
- ❖ Understanding Protein aggregation

NEUROBIOLOGY

- ❖ Neural signaling at molecular level
- ❖ Neural Induction, Pattern Formation, and Cell Specification
- ❖ Cellular differentiation
- ❖ Neurogenesis, Neurotrophism, and Regeneration

- ❖ Methods in neuroscience research

DRUG DISCOVERY AND PROCESS DEVELOPMENT

- ❖ Introduction to Drug Discovery as a Process
- ❖ Pre-Discovery Process
- ❖ Drug target identification
- ❖ Drug target Validation
- ❖ Computer-Aided Drug Design
- ❖ Lead Identification
- ❖ Drug Delivery
- ❖ Pre-Clinical Toxicology and Clinical testing
- ❖ Ethics of Human and Animal Experimentation
- ❖ Intellectual Property
- ❖ Commercial Considerations in Drug Development