Course Name: RESEARCH METHODOLOGY - I

Mode: Offline
Credits: 4 (3L+1T)
BMICCT 601

Aim of the course:

The aim of this course is to provide students with a foundational understanding of research principles and methodologies. It equips them with the essential skills to design, conduct, analyze, and interpret research in a systematic and ethical manner.

Course Objective:

- To understand the fundamental concepts and significance of research in academic and professional contexts.
- To develop the ability to identify research problems and formulate appropriate research questions and hypotheses.
- To gain knowledge of various research designs, methods, and techniques applicable to different types of research studies.
- To acquire skills in data collection, sampling methods, and the use of tools and techniques for data analysis.

Sr no.	Graduate attributes	Mapped Modules
CO 1	Fundamentals of Research	MODULE I
CO 2	Research Problems and Objectives	MODULE II
CO 3	Research Design and Planning	MODULE III
CO 4	Literature Review Techniques, Ethical Considerations in Research	MODULE IV
CO 5	Data Collection Methods, Data Analysis and Interpretation	MODULE V

Learning objectives:

- Understand the Fundamentals of Research
- Identify and articulate a clear research problem.
- Comprehend the concept of research design and its importance.
- Learn how to conduct an effective literature review.

Module Number	**Content**	**Total Hours**	**% of questions**	**Bloom Level (applicable)**	**Remarks, if any**
THEORY					
M I	Fundamentals of Research	9	20		NA
M II	Research Problems and Objectives	9	20		NA
M III	Research Design and Planning	9	20		NA
M IV	Literature Review Techniques, Ethical Considerations in Research	9	20		NA
M V	Data Collection Methods, Data Analysis and Interpretation	9	20		NA
Total Theory		45	100		
TUTORIAL		30			
TOTAL		75			

Detailed syllabus:

MODULE I: FUNDAMENTALS OF RESEARCH

Unit 1: Introduction to Research - Definition and significance of research, Objectives and characteristics of research, Types of research (basic, applied, and exploratory);

Unit 2: Research Process - Steps involved in the research process, Identifying and defining a research problem;

Unit 3: Research Design - Concept and types of research designs, Exploratory, descriptive, and experimental designs.

MODULE II: RESEARCH PROBLEMS AND OBJECTIVES

Unit 1: Introduction to Research Problems - Definition and characteristics of a research problem, Importance of identifying a research problem in the research process, Sources of research problems (academic, practical, social, or industrial issues).

Unit 2: Research Objectives - Difference between research problems and research objectives, Types of research objectives (general vs. specific);

Unit 3: Hypothesis Development - Relationship between research problems and hypotheses, Types of hypotheses (null, alternative, directional, non-directional), Role of a hypothesis in achieving research objectives.

MODULE III: RESEARCH DESIGN AND PLANNING

Unit 1: Introduction to Research Design - Definition and purpose of research design, Importance of research design in ensuring valid and reliable results.

Unit 2: Types of Research Design - Exploratory Research Design: Objectives, methods, and applications; Descriptive Research Design: When and how to use it; Experimental Research Design: Concepts, types, and applications; Causal Research Design: Cause-and-effect relationships

Unit 3: Key Components of Research Design - Selection of research problem; Identifying variables: Independent, dependent, and control variables; Setting research objectives and hypotheses; Research questions and scope.

MODULE IV: LITERATURE REVIEW TECHNIQUES, ETHICAL CONSIDERATIONS IN RESEARCH

Unit 1: Purpose of a Literature Review - Role of literature reviews in research, Identifying research gaps and defining the theoretical framework; Steps in Conducting a Literature Review - Defining the scope and objectives, Searching and identifying relevant literature.

Unit 2: Principles of Research Ethics - Respect for autonomy, beneficence, non-maleficence, and justice; Informed Consent - Importance of obtaining consent, Components of informed consent (voluntariness, information, and comprehension); Confidentiality and Privacy - Data protection and anonymization, Maintaining participant confidentiality during and after research; Plagiarism and Academic Misconduct - Types of plagiarism and how to avoid it, Ethical implications of falsifying or fabricating data.

MODULE V: DATA COLLECTION METHODS, DATA ANALYSIS AND INTERPRETATION

Unit 1: Overview of Data Collection - Importance of data collection in research, Primary Data and its collecting method, Secondary data and its collecting method; Tools for Data Collection - Designing effective questionnaires, Scales and measurements (Likert scale, semantic differential scale, etc.), Use of digital tools for data collection (Google Forms, SurveyMonkey, etc.); Sampling in Data Collection - Sampling methods: Probability (random, stratified, cluster) vs. Non-probability (convenience, quota, purposive)

Unit 2: Introduction to Data Analysis - Difference between qualitative and quantitative data analysis, Role of data analysis in achieving research objectives; Common Challenges in Data Analysis - Handling missing data, avoiding overgeneralization and misinterpretation of results; Ethical Issues in Data Analysis - Avoiding data manipulation, Transparency and reproducibility of results

Suggested Books:

- **Research Methodology: Methods and Techniques** by C.R. Kothari and Gaurav Garg
- **Research Design: Qualitative, Quantitative, and Mixed Methods Approaches** by John W. Creswell
- **Qualitative Inquiry and Research Design: Choosing Among Five Approaches** by John W. Creswell

Course Name: CELLULAR BIOPHYSICS

Mode: Offline

Credits: 5 (3L+2T)

BMICCT 602

Aim of the course:

The aim of the Cellular Biophysics course is to provide a comprehensive understanding of the physical principles and mechanisms underlying cellular processes.

Course Objective:

- To provide a foundational understanding of the physical principles governing cellular processes.
- To explore the biophysical mechanisms behind molecular interactions, membrane dynamics, and cellular structures.
- To develop skills in applying mathematical and computational tools to analyze cellular behavior and biophysical phenomena.
- To investigate the physical properties of cell membranes, including lipid bilayers, ion channels, and membrane transport systems.

Sr no.	**Graduate attributes**	**Mapped Modules**
CO 1	Cell Organization	MODULE I
CO 2	Cell Cycle & Growth	MODULE II
CO 3	Cell Differentiation & Cell-Cell Interactions	MODULE III
CO 4	Basics Of Cell Signalling	MODULE IV

Learning objectives:

- Understand the Physical Principles Governing Cells
- Analyze Membrane Biophysics
- Study Molecular Transport
- Investigate Cellular Mechanics

Module Number	**Content**	**Total Hours**	**% of questions**	**Bloom Level (applicable)**	**Remarks, if any**
THEORY					
M I	Cell Organization	12	25		NA
M II	Cell Cycle & Growth	12	25		NA
M III	Cell Differentiation & Cell-Cell Interactions	11	25		NA
M IV	Basics Of Cell Signalling	10	25		NA
Total Theory		45	100		
TUTORIAL		30			
TOTAL		75			

Detailed Syllabus:

MODULE I: CELL ORGANIZATION

Cell as the basic structural unit, Origin & organization of Prokaryotic and Eukaryotic cell, Cell size & shape, Fine structure of Prokaryotic & Eukaryotic cell organization Internal architecture of cells, cell organelles, compartment & assemblies membrane system, Ribosome, Polysomes, Lysosomes & Peroxisomes, Connection between cell & its environment, Extracellular Matrix

MODULE II: CELL CYCLE & GROWTH

The Cell Cycle, Interphase-G1,S,G2,M molecular events at different cell cycle phases, A cytoplasmic clock times, Growth Factors & Control of cell proliferation. Mitosis & Cell Division-Molecular mechanism, Events in mitosis, significance of mitosis, Meiosis & Sexual reproduction, Molecular mechanism of meiosis, significance of meiosis.

MODULE III: CELL DIFFERENTIATION & CELL-CELL INTERACTIONS

General characteristics of cell differentiation, Localization of cytoplasmic determinants, Molecular mechanism of cell differentiation, Morphological movements & the shaping of body plains, Cell memory, Concept of positional values. Connection between the cell and its environment, Glycocalyx, Extracellular Matrix, collagen, Elastin, Fibronectin, Lamin, Integrins, Cell Junctions, Desmosomes, Gap junction, connexins, Tight Junctions, Plasmodesmata

MODULE IV: BASICS OF CELL SIGNALING

Cell Signalling, General principle of cell signalling, Paracrine, Autocrine, Endocrine &synaptic signalling, Heat Shock Proteins, G-Protein structure and role in signalling, Intracellular Cyclic AMP, Role Ca++ in cell signalling, CAM Kinases, (Calmodulin/Ca++ dependent protein kinases), Interaction between cyclic AMP & Ca++. Synapse and synaptic vesicles, Role of Methylation in adaptation & bacterial chemotaxis

Suggested Books:

- Cellular Biophysics, Volume 1: Transport by Thomas F. Weiss
- Cellular Biophysics, Volume 2: Electrical Properties by Thomas F. Weiss
- Molecular and Cellular Biophysics by Meyer B. Jackson

Course Name: BIOCHEMICAL TECHNIQUE

Mode: Offline

Credits: 5 (3L+2P)

BMICCT 603

Aim of the course:

The aim of a course on Biochemical Techniques is typically to provide students with an understanding of the various laboratory methods and instruments used in the study of biochemistry.

Course Objectives:

- To Understand the principles of various biochemical techniques used in research and diagnostics.
- To Learn techniques for protein analysis, including protein quantification, purification, and characterization.
- To Explore techniques for nucleic acid analysis, such as PCR, gel electrophoresis, and DNA sequencing.

Sr no.	**Graduate attributes**	**Mapped Modules**
CO 1	Separation & Identification of Techniques	MODULE I
CO 2	Instrumentation And Biochemical Techniques	MODULE II
CO 3	Quality Assurance	MODULE III
CO 4	Isolation Of Human DNA& RNA	MODULE IV
CO 4	Enzymes & Isoenzymes	MODULE V

Learning Objectives:

- Understand the principles
- Gain proficiency
- Study cell fractionation and analysis methods
- Explore techniques for nucleic acid analysis

Module Number	**Content**	**Total Hours**	**% of questions**	**Bloom Level (applicable)**	**Remarks, if any**
THEORY					
M I	Separation & Identification of Techniques	9	20		NA
M II	Instrumentation And Biochemical Techniques	9	20		NA
M III	Quality Assurance	9	20		NA
M IV	Isolation Of Human DNA& RNA	9	20		NA
M V	Enzymes & Isoenzymes	9	20		NA
Total Theory		45	100		
PRACTICAL		30			
TOTAL		75			

Detailed Syllabus:

MODULE 1: SEPARATION & IDENTIFICATION OF TECHNIQUES

Separation & Identification of Techniques

i. Electrophoresis: Definition, Principle, Types, Clinical Applications (Special emphasis on Agarose Gel electrophoresis, PAGE, Paper electrophoresis)
ii. Chromatography: Definition, Principle, Types, Clinical Applications
iii. ELISA: Definition, Principle, Types, Clinical Applications
iv. Chemiluminiscence: Definition, Principle, Types, Clinical Applications
v. Blotting Techniques (Elementary idea on Western, Southern, Northern Blotting)
vi. PCR: Definition, Principle, Types, Clinical Applications

MODULE II: INSTRUMENTATION AND BIOCHEMICAL TECHNIQUES

Principle and applications of Semi auto analyzer, Random Auto analyzer, Ion selective electrodes

MODULE III: QUALITY ASSURANCE

i. Introduction to Quality assurance; Requirements of quality control programme - Organization, quality manual, work instruction. Concept of external & internal quality control, proficiency testing.
ii. Quality control measurement- Accuracy, precession, reliability, pre and post analytical Variables.
iii. Mean, Median, Mode, Standard deviation, Normal distribution curve and Laboratory result correlation

MODULE IV: ISOLATION OF HUMAN DNA& RNA

Principles of Isolation of human DNA& RNA

MODULE V: ENZYMES & ISOENZYMES

Biomarkers, Enzymes & isoenzymes of clinical importance (Part II): Prostate specific antigen, Creatinine kinase, Cardiac troponins, Acid phosphatase, LDH, Lipase, Amylase, Carbonic anhydrase etc.

BMICCT 693: PRACTICAL

1. Assay of T3/T4/TSH/LH/FSH/Insulin/Glucagon/ Estrogens/ Progesterone/Prolactin hormones/ SGOT/SGPT in blood by ELISA Technique.
2. Estimation of Amylase, Lipase, Creatinine kinase, LDH
3. Thin Layer chromatography

Suggested Books:

- Principles and Techniques of Biochemistry and Molecular Biology Edited by Keith Wilson and John Walker
- Biochemical Techniques: Theory and Practice Authored by John F. Robyt and Bernard J. White.