

Department of Biochemistry and Molecular
Biology

Central University of Kerala (CUK)



SYLLABUS FOR COURSE WORK PHD BIOCHEMISTRY

SYLLABUS FOR COURSE WORK

PhD Biochemistry Program

**Department of Biochemistry and Molecular Biology
(BCMB)**

Central University of Kerala

Periye, Kasaragod -671316

Program Outcome

- 1. To equip the research scholars to apply knowledge, critical thinking, methodologies and skills to address the fundamental questions in the respective areas of study.**
- 2. To pursue research of significance in the core discipline or an interdisciplinary area under the guidance of an advisor**
- 3. To follow the ethical guidelines of research in the respective areas of study**
- 4. To extend the core value of the discipline of research to academy and community at large through service**

Program Specific Outcomes

- 1. Equip the research scholars to conduct innovative research in the area of molecular virology, with specific focus on pathogenic RNA viruses**
- 2. Conduct original research addressing the global challenge on plant disease management and developing sustainable solutions**
- 3. Elucidate the secondary metabolite biosynthetic pathways and formulate strategies towards enhancing the production of these high value low volume metabolites**
- 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**
- 5. Equip research scholars to understand, innovate and conduct research on cancer biomarkers, RNP and non-coding RNA signaling**
- 6. Provide research training on targeting immunomodulation, inflammation and cancer by natural and synthetic bioactive compounds**

BBM-711 RESEARCH METHODOLOGY

Course Outcomes:

The course will help to,

- 1: Equip the scholar to conduct research by enabling them to acquire knowledge in the area of research design and data analysis**
- 2. Enhance scientific writing skills**
- 3. Develop technical knowledge to execute scientific experiments**

Introduction to Research:

Definition of problem : necessity of defining problem. Techniques involved in defining a problem. Surveying the available literature.

Techniques involved in solving the problem: Different methods used to solve a problem

Research design: Subject of study: place of study: reason of such study: types of data required: methods of data collection: periods of study: style of data preservation.

Developing a research plan: Research objective, information required for solving the problem. Each major concept should be defined in operational terms. An overall description of the approach should be given and assumption if considered should be clearly mentioned in research plan. The details of the techniques to be adopted.

Methods of data collection: Experimental methods.

Analysis of data: Various measures of relationship used in research studies. Correlation coefficients.

Computers in Research

Basic of computer operating system: Using Windows: directory structures, command, structure (Document preparation, EXCEL, Power point preparation) : Word processing : basics of editing and word processing. Numerical analysis, figure plotting: Figure insertion on documents.

Web Browsing for research: Usage of webs as a tool for scientific literature survey. Error analysis : basics of a measurement and its interpretation , mean, Standard deviation, ,Variance, Correlation coefficients, : usage of packages,(e.g.SPSS: EXCEL) for data analysis : curve fitting : Linear and nonlinear fitting of data.

Presentation tools: Introduction, features and functions, Presentation of power point presentation, customizing presentation, showing presentation tools : Microsoft power point or similar.

Biostatistics:

Measures of central tendency and dispersion probability distribution: Binomial, poisson and Normal Parametric and non-parametric statistics, Confidence, Interval, errors.

Quantitative Techniques: levels of Significance, regression and correlation. Use of statistics in Biosciences. Use of computers in quantitative analysis.

Scientific writing:

An Insight in to Research : Definition and basic concept s, Objectives, significance and techniques of research, finding research materials-literature survey, compiling records

- a) Definition and kinds of scientific documents-research paper, review paper, , book reviews, thesis, conference and project reports (for scientific community and for funding agencies).
- b) Components of research paper: The IMRAD system, title, authors and addresses, abstract, acknowledgement, references, tables and illustrations.
- c) Dealing with publishers: submission of manuscript, ordering, reprints.
- d) Oral and poster presentation of research papers in conferences /symposia.
- e) Preparation and submission of research project proposals to funding agencies.

Cell Culture techniques

Introduction to course and lab safety: brief review of basic lab techniques. Introduction of Microscope use: light and Fluorescence microscope. Cell culture.Introduction to sterile cell culture technique.Counting viable cells and subculture in to multi well plates.Cell counting using Hemocytometers. Cell attachment (adhesion) and growth .Cell attachment (Adhesion) and growth.Cell staining techniques. Culturing of primary cells, preparation of human chromosome.Application of primary cell culture techniques.Isolation of Chromosomal DNA.preparation of cellular extract.isolation of nuclear extract and cytoplasmic extract.

Techniques in Molecular Biology

Identification and characterization of DNA, RNA, Plasmids. Agarose Gel Electrophoresis. Ethidium bromide staining. Southern, Northern, Western blotting. RAPD, RFLP. Sequencing. RTPCR, Cloning, Library construction.

Research Techniques

Enzyme assay, Enzyme activity and specific activity determination. Cell disintegration and extraction techniques, separation of proteins by fractionation (Ammonium sulphate,Organic solvents). Ion exchange chromatography. Molecular sieve chromatography. Affinity

Chromatography, Paper chromatography, Thin layer chromatography, Ultra filtration, Ultra centrifugation, Gel electrophoresis, Iso electric focusing and Immuno-electrophoresis.

BBM-712 MOLECULAR AND CELLULAR BIOCHEMISTRY

Course Outcomes:

The course will help to,

1: Develop foundational knowledge in the area of basic molecular biology and cell signaling

2. Equip the scholar to visualize the biochemical process in terms molecular events

Genome organization: Organization of bacterial genome. Structure of Eukaryotic chromosomes. Heterochromatin and Euchromatin. DNA reassociation kinetics (cot curve analysis) Repetitive and unique sequences. Satellite DNA. DNA melting and buoyant density. Nucleosome phasing. DNase I. hypersensitive regions. DNA methylation & Imprinting.

DNA structure: Replication. Repair and recombination. Structure of DNA, A, B, Z and triplex DNA. Replication: Initiation elongation and termination in prokaryotes and Eukaryotes. Enzymes and accessory proteins, Fidelity. Replication of single stranded circular DNA. Gene stability and DNA repair, enzymes, photoreactivation, Nucleotide excision repair, mismatch correction, SOS repair. Recombination. Homologous and non-homologous site specific recombination. Chi sequences in prokaryotes. Gene targeting. Gene disruption. FLP/FRT and Cre/Lox recombination.

Prokaryotic and Eukaryotic transcription : prokaryotic transcription , Transcription unit, promoters, constitutive and inducible. Operators, regulatory elements, Initiation. Attenuation. Termination, Rho dependent and independent. Anti termination. Transcriptional regulation, positive and negative. Operon concept, Lac, Trp, Ara, His, and Gal operons. Transcriptional control in Lamda phage. Transcript processing. Processing of tRNA and rRNA . Eukaryotic transcription and regulation. RNA polymerase structure and assembly. RNA polymerase I, II, III. Eukaryotic promoters and enhancers. General transcription factors. TATA binding proteins and (TBP) and TBP associated factors(TAF). Activators and repressors. Transcriptional and post transcriptional gene silencing. Post transcriptional modifications. Processing of hnRNA, tRNA, rRNA, 5'-cap formation: 3'-end processing and poly adenylation, splicing , RNA editing. Nuclear export of mRNA, mRNA stability, catalytic RNA

Translation and transport: Translation machinery: Ribosomes: composition and assembly:

Universal genetic code: degeneracy of codons: termination codons: Isoaccepting tRNA, Wobble hypothesis: Mechanism of initiation , elongation and termination: Co and translational modifications. Genetic code in Mitochondria: Transport of proteins and molecular chaperons: protein stability: Protein turn over and degradation

Mutations: Oncogenes and tumor suppressor genes, Nonsense: Missense and point mutations:

Intragenic and intergenic suppression: frameshift mutation: physical: chemical and biological mutagens; Transposition- transposable genetic elements in prokaryotes and Eukaryotes: Mechanisms of transposition : role of transposomes in mutation: Viral and cellular oncogenes: Tumor suppressor genes from humans: Structure , function and mechanism of action of pRB and p53 tumor suppressor proteins: Activation of oncogenes and dominant negative effect: Suppression of tumor suppressor genes: Oncogenes as transcriptional activators.

Cell junctions, Cell Adhesion and the extracellular matrix-cell junctions, cell-cell adhesion, the extra cellular matrix of animals, integrins, Plant cell wall: The cytoskeleton-the self assembly and dynamic structure of cyto skeletal filaments, how cells regulate their cyto skeletal filaments, molecular motors, the cytoskeleton and cell behavior. Cell communication : General principle s of cell communication, signaling through G-protein linked cell surface receptors, signaling through enzyme linked cell surface receptors, signaling pathways that depend on regulated proteolysis.

Cell communication concepts of signal molecules : Receptors – G protein linked receptors and G protein mediated signaling. Second messengers. Role of Calcium, Lipid signaling, phospholipase and phosphoinositides signalling. Signaling through enzyme linked cell surface receptors- cytokine receptors and JAK-STAT pathway. Receptor Tyrosine kinases. Map Kinase pathways. Down modulation of a signal integration of signals and Gene controls. Experimental approaches for building a comprehensive view of signal induced responses, responses of cells to environmental influences.