DEPARTMENT OF BIOCHEMISTRY
UNIVERSITY OF KERALA

M. Phil. PROGRAMME IN BIOCHEMISTRY

SYLLABUS
(Under Credit and Semester systems w.e.f 2016 Admissions)
M. Phil. Programme in Biochemistry

Syllabus

**Programme Aim**

The course aim to provide understanding of research methodologies, principles and applications of biological techniques and knowledge of various aspects of specialized areas in biochemistry.

**Programme Objective**

The objective of the course is to nurture students:

- Knowledge and awareness of analytical and statistical skills on various aspects of research in biochemistry.

- To make students aware on basic equipment and to expose them to various advanced laboratory techniques in the area of biochemistry and molecular biology.

- To make student able to build knowledge and understandings in aspects of enzymes, lifestyle diseases, phytochemical analysis, toxicological evaluation/studies, as well as the basics of the research topics for laboratory work and research project.
## Structure of the Programme

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SYLLABUS FOR M. Phil. PROGRAMME IN BIOCHEMISTRY

Semester : I
Course Code : BCH-711
Course Title : RESEARCH METHODOLOGY
Credits : 4

Aim: The aim of this course is to make students aware of fundamentals of research and issues of ethics and plagiarism.

Objectives: To nurture analytical skills and awareness on various aspects of research in biochemistry.

Course Content

Module I - Foundations of Research
Definition, purpose - Relevance and scope, Motivation and objectives - Research methods vs Methodology. Types of research- pure versus applied, incremental versus innovative; multidisciplinary research.

Module II - Research Process and Design
Steps involved in research process; Identifying and defining research problems; Importance of literature review in defining a problem, Formulation of research objectives; Hypothesis, Research design- Meaning and need- Induction - Deduction. Features of good design- important concepts and different types; basic principles of experimental design.

Module III- Data Collection and Analysis
Observation and Collection of data - Methods of data collection – Sampling Methods- Data Processing and Analysis strategies – Measures of central tendency, standard deviation and standard error, ANOVA, Correlation, T test, Data Analysis with Statistical Packages, Bioinformatics tools (an outline)–Generalisation and interpretation of results.

Module IV - Scientific Reporting
Types of scientific reports – journal articles – Presentation at conferences- Thesis and dissertations – Books. Structure and components of scientific reports – Layout, Illustrations and tables - Bibliography, referencing and footnotes - Oral presentation – Planning – Preparation – Practice – Making presentation – Use of visual aids - Importance of effective communication. Publication of scientific reports, Impact factor of
Journals, h-index, i10-Index, g-index.

Module V – Application of Results and Research Ethics

Commercialization – Copyright and Copyleft – royalty - Intellectual property rights and patent law – Ethical issues - Ethics in human and animal experimentation. Guidelines for using animals in biological research- The Prevention of Cruelty to Animals Act, India. Scientific misconduct such as Fabrication, Falsification, Plagiarism and Self-Plagiarism; software for checking plagiarism. Conflicts of interests; Citation and acknowledgement - Reproducibility and accountability.

References


Additional References

Semester : I
Course Code  : BCH-712
Course Title  : ADVANCED BIOLOGICAL TECHNIQUES
Credits : 4

**Aim:** The purpose of this course is to familiarize students with the principle and applications of all biochemical equipments.

**Objectives:** The objectives of this course are to make students aware on basic laboratory equipments and to expose them to various advanced laboratory techniques in areas of biochemistry and molecular biology.

**Course Content**

**Module I: Techniques in Biochemistry**

Centrifugation:- Principle; Types - Preparative, Analytical; Ultra centrifugation. Microscopy – Light microscopy, Bright field microscopy, phase contrast microscopy; Electron Microscopy – Transmission and Scanning electron microscopy; Confocal Microscopy; Fluorescent Microscopy; Preparation of samples for different microscopic techniques. Separation Techniques: Chromatography – Paper, TLC, HPTLC, Affinity, HPLC; Electrophoresis - Native PAGE, SDS PAGE, AGE, Blotting techniques, 2D-gel electrophoresis, Isoelectric focusing; Flow cytometry

**Module II: Cell Culture**

Principles of cell culture; Aseptic techniques, Sterilization, Equipment and materials, Media Preparation; Types of culture, primary culture - isolation and maintaining cells in culture, subculture; cell lines; Microbial contamination-monitoring and eradication. Cell quantitation-counting, DNA estimation, protein estimation. Estimation of cell viability by Trypan blue exclusion method and cytotoxicity by MTT assay, Cryopreservation of cells; Applications primary and cell line culture techniques

**Module III : Techniques in Molecular Biology**

Module IV : Immunological and Histochemical Techniques

Production of antibodies; Immunoprecipitation techniques, Immunoassay – RIA, ELISA, Immunofluorescence. Histochemical Techniques – Enzyme histochemistry, Immunohistochemistry, in situ hybridization; staining – Basic, Acidic, Metachromasia (toluidine blue staining), Preparation of tissues – Fixation techniques, Tissue Sectioning, Smear and spread preparation; Freeze etching.

Module V: Spectrometry

Mass spectrometry – Working principle; types of ionizations, Mass analysers, Detectors; Tandem Mass spectrometry, Quadrupole and Time of Flight Mass spectrometry; MALDI-ToFIR and NMR spectrometry. {NMR, FTIR, HPLC, HPTLC, GCMS, LCMS, MSMS, Flow cytometry,

References


Additional References

Semester  : I  
Course Code  : BCH-713  
Course Title  : SPECIAL PAPER IN BIOCHEMISTRY  
Credits  : 4

Aim : The aim of this course is to make students aware of various aspects of biochemistry.

Objectives : This course enables students to acquire a specialized knowledge and understanding of the aspects of enzymes, life style diseases, phytochemical analysis, toxicological studies and the basics of their research topic which are essential for laboratory work and research project.

Course Content

Module I – Enzymology

Enzymes, Enzyme Kinetics, Mechanism of enzyme action, Enzyme inhibition, Isoenzymes and Coenzymes, Enzyme regulation.

Module II – Lifestyle Diseases

Oxidative stress, Free radicals and antioxidants. Pathogenesis, causes, risk factors, preventive measures and disease management of Atherosclerosis, Diabetes, Hypertension, Obesity, Cancer, Cataract and Arthritis. Interrelationship between lifestyle diseases and inflammation; inflammatory markers

Module III – Phytochemical Analysis

Plant secondary metabolites – types and structure of alkaloids, phenolic acids, tannins, lignins, flavonoid, terpenes; Extraction – traditional solvent extractions, supercritical fluid extraction, Isolation of secondary metabolites – Choice of solvents, Method of Fractionation; Bioactivity guided Isolation and Fractionation; Characterization of secondary metabolites – Qualitative and quantitative analysis

Module IV – Toxicological Studies

Toxicity - Factors that influence toxicity, Dose response relationships, synergism and antagonism, determination of ED50 & LD50, Toxicity testing - Acute, Chronic, and Sub-chronic toxicity test; Mutation studies – Ames test; Toxicity evaluation in cultured hepatocytes.

Module V : Optional Unit (Any one from the following)

a) Bacteremia and Acute Inflammation

Bacterial endotoxins: lipopolysaccharide (LPS) and lipoteichoic acid (LTA). LPS-biochemistry and signalling mechanism. LPS mediated acute inflammatory response. Signaling pathways of LPS mediated activity. Acute inflammatory mediators – macrophage

b) Nutrition in Health and Disease


c) Phytohemagglutinins

Agglutinins, agglutination assay, Lectins: Animal and plant, Isolation, Purification and characterization of lectins, Biological properties of Lectins: Antitumor, Antibacterial, Antiviral, Antioxidant, Antilipidemic activities, Phytohemagglutinins- Sources, biological functions and applications in medical and research field.

d) Tissue Engineering and Biocomposites

Principle, definition and biomaterials used in tissue engineering, Definition for scaffolds and implants, biodegradable polymeric scaffolds, hydrogels, Bioceramics and biocomposites. Design, synthesis and applications of Biomaterials, Cell- Biomaterial Interaction; Biocompatibility. Applications of tissue engineering.

e) Nanoscience and Nanobiotechnology

Nanomaterials- Definition, Types- Carbon based, Metal based; Nanocomposites, Nano rods, Gold Nano rods; Polymeric nanocapsules, Nano-films, quantum dots; Classification based on dimension of nanomaterial; Synthesis of nanomaterial- Chemical, Physical and Green methods; Characterization methods of nanomaterials; Nanotoxicology

f) Inflammatory Diseases

Cells and organs of immune system, innate immunity, Phagocytosis, Complement system, Acute and chronic inflammatory reaction, Adaptive immunity – B cell, T cell activation, proliferation, differentiation, and effector function. Lipid mediators, Cytokines, Cell adhesion molecules, MMPS, oxidative stress, Clinically important inflammatory biomarkers, Toll like receptors, Scavenger Receptors, nuclear Factor Kappa B, JAK/STAT, IRF, MAPK, Akt, RANKL, Molecular biology of Chronic Inflammatory Diseases

g) Cancer Biology

h) **Cataract Biology**  
Structure of eye, Lens- structure and function, Lens fibers, Composition of lens, Lens proteins, Crystallins, Types of cataract- Nuclear cataract, cortical cataract, Symptoms and causes of cataract, Oxidative stress and cataract, Calcium and cataract, Lenticular antioxidants, Diabetic cataract, Treatment of cataract- phacoemulsification, extracapsular cataract extraction, intracapsular cataract extraction, complications of cataract surgery, Experimental models of cataract studies.

i) **Diabetes**  
Diabetes Mellitus – classification, pathophysiology, glucose homeostasis, hormonal regulation of diabetes mellitus, insulin synthesis and secretion, insulin receptors, insulin signaling pathways, glucose transporters, insulin resistance. Metabolic changes in diabetes.

j) **Extracellular Matrix Remodeling and Epigenetics**
Cell-cell and cell matrix interaction, ECM remodeling enzymes –Matrix metalloproteinases (MMPS), A disintegrin and metalloproteinase with thrombospondin motifs(ADAMTS)-structure, function, regulation and role of these enzymes in atherosclerosis. Tissue inhibitors of metalloproteinases. Cell signaling, Role of NFκB, PPAR-γ

**Epigenetics**- Chromatin structure, DNA methylation, Histone modifications, acetylation/ deacetylation, methylation/ demethylation, phosphorylation/dephosphorylation, enzymes involved and mechanism. Epigenetics in atherosclerosis and inflammation.

**References**
- Lippincott, Disease & Drug Consult: Neurologic Disorders, Williams & Wilkins, 2009.

Additional References

• David W Mount (2005) Bioinformatics: Sequence and Genome Analysis - CBS publishers; 2nd edition
• Introductory Nanoscience, Physical & Chemical Concepts, MsaruKuno GS: Garland Science, Taylor & Francis group
• Bishop, Michael L., Edward P. Fody, and Larry E. Schoeff, eds. 2013. Clinical Chemistry: Principles, Techniques, and Correlations. Lippincott Williams & Wilkins,
• Sreeram Ramakrishna, Kazutoshi Fujihara, wee Eong Teo, Teik cheng Lim, Zuwei ma (2005) An introduction to Electrospinning and Nanofibres, World Scientific, Singapore
• A. Pusztai (2012) Chemistry and Pharmacology of Natural Products, Cambridge University Press
Semester : II
Course Code : BCH-721
Course Title : DISSERTATION
Credits : 20

Aim : The aim of this course is to expose students to different aspects of research methodology, molecular and biochemical research and data analysis.

Objectives : The primary objective of a dissertation work is to act as an introduction to biological research and its various aspects. Students shall carry out a research project specific to individual laboratory of the supervision teacher they are assigned with.