M.Phil. GENETICS AND GENOMICS
DEGREE PROGRAMME – CSS

SYLLABUS
(w.e.f 2016 Admissions)

DEPARTMENT OF BIOCHEMISTRY
UNIVERSITY OF KERALA
University of Kerala
Department of Biochemistry

M.Phil Degree in Genetics and Genomics

Distribution of marks

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Marks</th>
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</thead>
<tbody>
<tr>
<td>GAG 711</td>
<td>Research methodology</td>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>GAG 712</td>
<td>Advanced biological techniques</td>
<td>4</td>
<td>100</td>
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<tr>
<td>GAG 713</td>
<td>Special Paper in Genetics and Genomics</td>
<td>4</td>
<td>100</td>
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<tr>
<td>GAG 714</td>
<td>M Phil Dissertation in biochemistry</td>
<td>20</td>
<td>250</td>
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<td>Viva voce</td>
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<td>50</td>
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Total: 600

(Dissertation work can be theoretical/computer-based, experimental or both)
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 reading

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 reading

Module I: Chromosomes and Mendelism
Chromosomes; Chromosomal organization of genes; Higher order chromatin structure; chromosome abnormalities; Mendelian genetics; Dominance, segregation, independent assortment, deviation from Mendelian inheritance. Codominance, incomplete dominance, multiple alleles, Pedigree patterns; Characteristics of Mendelian pattern of inheritance.

Module II: Replication, Transcription and Translation
Replication - Prokaryote and eukaryote; events at the replication fork; details of enzymes; protein factors – cellular control. Mechanisms of repair.
Transcription - Prokaryote and eukaryote RNA polymerases; transcription factors; post transcriptional modifications; splicing; small RNAs; regulation of gene expression.
Translation - Biosynthesis of proteins, role of RNAs in protein biosynthesis; genetic code; post translational modification; protein targeting; regulation of protein biosynthesis.

Module III: Genetic and Computational Analysis
Genetic Analysis: Physical mapping, restriction mapping; sequence tagged mapping; molecular markers for mapping; marker sequences: RFLPs, microsatellites and SNPs. Linkage analysis; Hybridization mapping, DNA microarrays, SAGE and cluster analysis; Nucleic acid sequencing methods; Human genome project. Bioinformatic tools: Sequence and structure databases; Sequence Analysis; Scoring matrices, Pair wise sequences alignments and multiple sequence alignments (MSA); Tools for the analysis of phylogenetic trees;

Module IV: Genomics

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

a) Bacteremia and Acute Inflammation
Role in extracellular signaling and cytokine cascade. Common agonists and antagonists.

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 effect 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.

Reference Books

Additional reading
9. Sreeram Ramakrishna, Kazutoshi Fujihara, wee Eong Teo, Teik cheng Lim, Zuwei ma (2005) An introduction to Electrospinning and Nanofibres, World Scientific, Singapore