



**Avinashilingam Institute for Home Science and Higher Education for Women  
Coimbatore – 43**

**Department of Biochemistry, Biotechnology and Bioinformatics  
M.Phil/Ph.D Biochemistry**

**M.Phil Programme Specific Outcomes**

1. Provide knowledge base as to how to design a research project and about different aspects involved in carrying out research
2. Student will be able to search, read and understand the applicable primary literature
3. Ability to identify societal problems and recognize the importance of designing scientifically sound and ethical research to solve societal problems

**Ph.D Programme Specific Outcomes**

1. Prepare a scholar to become a good academician, author of necessary papers and able to take minor research projects to become project associate
2. Formulate societal problems into good quality research questions with optimal utilization of state of the art technologies
3. Publication of their results from the research work in the peer reviewed journals benefit the society and career in research

**Scheme of Instructions and Examination  
(Applicable for M.Phil/Ph.D Scholars admitted from 2020-2021 & onwards)**

Subject Code	Name of the Paper/ Component	Hours of Instruction / Week	Scheme of Examination				
			Duration of Exam	CIA	CE	Total	Credits
19MPBC01/ 19PHBC01	Research Techniques for Biochemistry	7	3	40	60	100	5
19MPBC02/ 19PHBC02	Advanced Biochemistry	7	3	40	60	100	6
	Specialization Paper		3	40	60	100	5
20MMPRP04/ 20PHRP04	Research and Publication Ethics	2	3	100	-	100	2
	Thesis			100	100	200	12
<b>Total Credits</b>							<b>30</b>

## M.Phil/Ph.D Biochemistry

### 19MPBC01/19PHBC01- RESEARCH TECHNIQUES FOR BIOCHEMISTRY

Hours of instruction per week: 7

#### Objectives:

- To become familiar with all the major biochemical, biotechnological, biophysical and immunological techniques used in research and industry to analyse the structure and functions of biomolecules.
- To understand the principle and applications of animal cell culture, plant cell culture and recombinant DNA technology.
- To gain knowledge about various computational tools in biological analysis.
- To introduce the students to the intricacies of scientific writing

#### Unit I:

Principles and applications of light, phase contrast, scanning and transmission electron and fluorescence microscopy, confocal microscopy, micrometry, flow cytophotometry, FACS, fixation and staining. Preparative centrifugation -ultra centrifugation.

Analytical methods– principles and applications of gel filtration, column, ion-exchange, affinity chromatography, HPLC, TLC, HPTLC, GLC, GC-MS, LC-MS, MALDI, SELDI, TOF, Electrophoresis - PAGE, pulse field, isoelectric focusing, 1D and 2D gel electrophoresis.

#### Unit II:

Molecular methods for structural determination –UV, Infra red, Atomic absorption, plasma emission, NMR, ESR, Mass, fluorescence spectroscopy, X ray diffraction, ORD, CD, hydrodynamic methods.

Immunotechniques – Antigen antibody interactions and applications, primary and secondary interaction, precipitation, agglutination- applications. Radio immuno assay, ELISA, immunofluorescence, immuno electron microscopy, immuno diffusion, immunoelectrophoresis, isolation of pure antibodies, assays for complement, effectors cell assays. Monoclonal antibody production and uses, applications in biomedical research and clinical uses, engineered monoclonal antibodies-chimeric and hybrid antibodies from Ig – gene libraries-Abzymes

#### Unit III:

Cell and tissue culture in plants and animals - Plant tissue and organ culture, establishment and maintenance of callus, somatic embryogenesis and haploid production, anther and microspore culture, embryo culture, triploid production, artificial seeds. Protoplast isolation, culture and fusion, applications of plant tissue culture.

Animal tissue culture – types – media requirements and composition, primary culture, cell lines, cell clone, embryo culture, transplantation, stem cell culture, organ culture, artificial blood, transgenesis- gene transfer, knock outs, somatic cell fusion, somatic cell genetics. Mammalian cell fusion – allopheny – applications of animal tissue culture.

#### Unit IV:

Recombinant DNA technology – Isolation and methods of detection of nucleic acids and proteins, blotting techniques – Southern, Western, Northern, South Western, North Western, dot and slot blot, DNA sequencing, mutation analysis, autoradiography, fluorography, *in situ* hybridization, FISH, GISH. DNA fingerprinting, DNA footprinting, Yeast two-hybrid system, CRISPR/Cas9. Nuclear run-off transcription, PCR, chromosome walking, isolation and identification of diseased genes – positional, functional cloning, DNA and cDNA microarrays, SAGE, RFLP, AFLP, RAPD. Use of genetic engineering in industry, agriculture and environmental management.

#### Unit V:

Data bases in gene and genome analysis – data retrieval tools, sequence homology search, proteomics - protein microarrays.

Principles and practice of statistical methods in biological research, samples and populations; Basic statistics average, dispersion, coefficient of variation; Standard error; Confidence limits; Probability distributions (binomial, Poisson and normal); Tests of statistical significance; Simple correlation of regression. Hypothesis testing – Null hypothesis, Alternate hypothesis.

Research Methodology: Introduction, Definition, Objectives of research, Types of research, Research approaches, Significance of research, Research methods, Criteria of good research, Need for research design: Basic principles of experimental design and writing a Research proposal for financial assistance from National and International funding agencies.

#### Course Outcomes:

- Comprehend the basics of biochemical, biotechnological, biophysical and immunological techniques for the analysis of biomolecules.
- Gain knowledge on cell and tissue culture of plants and animals and recombinant DNA technology.
- To address the biological research questions using appropriate computational tools.
- Ability to evaluate the suitability of statistical tools and techniques appropriate to their research needs and create sound research methodology to conduct original research in biosciences.

#### References:

1. **Pranav Kumar** (2014). **Fundamentals and Techniques of Biophysics and Molecular Biology**, 2nd Edition, Pathfinder Publication.
2. **Freshney, R.I.** (2016). **Culture of Animal Cells – A Manual of Basic Technique and Specialized Applications**, 7<sup>th</sup> Edition, John Wiley and Sons, New York.
3. **Gurdeep, R. Chatwal and Anand. S.K.** (2018). **Instrumental Methods of Chemical Analysis**, Fifth Edition, Himalaya publishing House, New Delhi.
4. **Judy Owen, Jenni Punt and Sharon Stanford**, (2018), **Kuby Immunology**, 8<sup>th</sup> edition, W.H.Freeman and Company, New York, USA.
5. **David Irvine** (2018). **Introduction to Genetic Engineering**, 3<sup>rd</sup> edition, Syrawood Publishing House.
6. **Pattabhi, V. and Gautham, N.** (2015). **Biophysics**, Narosa Publishing House PVT Ltd, New Delhi.
7. **Wilson. K and Walker. J.** (2018), **Practical Biochemistry – Principles and techniques of Biochemistry and Molecular Biology**, 8<sup>th</sup> Edition, Cambridge University Press, New York, USA.

## M.Phil/Ph.D Biochemistry

### 19MPBC02/19PHBC02 - ADVANCED BIOCHEMISTRY

Hours of instruction per week: 7

#### Objectives:

- To impart knowledge to the students about the energy metabolism
- To make students to understand the structural organization of cell, cell signalling and communication
- To impart knowledge to the students about replication, transcription and translation

#### Unit I:

**Energy metabolism** - concept of free energy - Thermodynamic principles in biology, Energy rich bonds, coupled reactions and oxidative phosphorylation, Group transfers, Biological energy transducers, Bioenergetics

**Organization of genes and chromosomes** - structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons, unique and repetitive DNA, interrupted genes, gene families. Cell division and cell cycle-Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle.

**DNA replication and Transcription**- Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms. RNA synthesis and processing-transcription-factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation and termination, RNA processing, RNA editing, splicing and polyadenylation.

#### Unit II:

**Protein synthesis and regulation of gene expression**- Genetic code, ribosome, formation of initiation complex, initiation factors and their regulation, elongation, termination, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase and translational proof-reading, translational inhibitors, post-translational modification of proteins. Control of gene expression at transcriptional and translational level - operon model, prokaryotic and eukaryotic genes, role of chromatin in gene expression and gene splicing.

#### Unit III:

**Advanced Immunology**- Organs and cells of the immune system; activation and differentiation of B and T cells, B and T cell receptors, Antigens, Haptens-structure and functions, Innate and adaptive immunity, humoral and cell-mediated immune responses, primary and secondary immune responses, the complement system, Generation of antibody diversity, monoclonal antibodies, antigen-antibody interactions, MHC molecules, antigen processing and presentation, antibody engineering, Hypersensitivity and autoimmunity, immune response during infection, Immunodeficiency, vaccines.

## Unit IV:

**Genetics-** Mendelian principles-dominance, segregation, independent assortment. Concept of gene-allele, multiple allele, pseudoallele, complementation tests. Extension of Mendelian principles. Gene mapping methods- linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants. Human genetics- pedigree analysis, lod score for linkage testing, karyotype, genetic disorders. Mutation- types, causes and detection, mutant types- lethal, conditional, biochemical, loss of function, gain of function, insertional mutagenesis-deletion, duplication, inversion, translocation, ploidy and their genetic implications. Recombination- homologous and non-homologous recombination including transposition.

**Genetic engineering-** Principle of rDNA technology-Vectors-plasmid (pBR 322, pUC vectors), phages- $\lambda$ , M13, cosmids, phagemids, yeast vectors, BAC, HAC, expression vectors, Restriction enzymes, DNA manipulative enzymes, genomic and cDNA libraries, DNA transfer methods. Applications of genetic engineering in medicine, agriculture and industry - transgenic animals, transgenic plants, ethical issues and intellectual property rights.

## Unit V:

**Cell signalling and cell communication-** Glycoconjugates and proteins in membrane systems; ion transduction Na-K ATPase; Adenylylcyclase; protein kinase systems; Neurotransmitters. Acetyl choline systems. Hormones and their receptors, cell surface receptor, signalling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signalling pathways, bacterial and plant two component systems, light signalling pathways, bacterial chemotaxis and quorum sensing. Cellular communication-regulation of hematopoiesis, general principle of cell communication, cell adhesion and roles of different adhesion molecules, gap junction, extracellular matrix, integrins, neurotransmission and its regulation.

## Course Outcomes:

- Explain the process of thermodynamics
- Know the concepts of immunology, genetics and genetic engineering.
- Able to comprehend the ethical issues associated with biological research and intellectual property rights

## References:

1. **Nelson, D.L. and Cox, M.M.** (2017), **Lehninger Principles of Biochemistry**, 7<sup>th</sup> Ed reprint, W.H. Freeman and Company, New York
2. **Cambell, M.K. and Farrell, S.O.** (2018) **Biochemistry**, Ninth Edition, Cengage Learning
3. **Voet, D., Voet, J.G. and Pratt, C.W.** (2018) **Principles of Biochemistry**, John Wiley & Sons. Inc, New York.
4. **Lodish, H., Berk, A., Matsudair, P., Kaiser, C.A., Krieger, M., Scott, P.M., Bretscher, A., Ploegh, H. and Matsuirra, P.** (2016) **Molecular Cell Biology**, Seventh Edition, W.H Freeman and Company, New York.
5. **Watson, J.D.** (2017) **Molecular Biology of the Gene**, Seventh Edition, Pearson Publisher
6. **Roitt, I., Brostoff, J. and Male, D.** (2017). **Essential Immunology**, Thirteenth Edition, Wiley Blackwell Publishers, New York.
7. **Benjamin Pierce** (2017). **Genetics: A Conceptual Approach**, 6th edition, WH Freeman publishers.