COURSES OFFERED FOR Ph.D. CURRICULUM

2024 onwards

Department of Biochemistry
Faculty of Interdisciplinary and Applied Sciences
University of Delhi South Campus
Benito Juarez Road New Delhi-110021

Passed in DRC held on 25th April 2024

Passed in BRS held on 20th May 2024

The courses offered for the Ph.D. curriculum aim to provide the students with excellent knowledge in various Tools, Techniques and Research methodologies in Biochemistry emphasizing on solid background of basic concepts as well as rapid advancement in the field, providing them an initiation into their respective research fields. The department will offer the following three papers for Ph.D. course work:

Paper I (BIOCHEM P-I): RESEARCH METHODOLOGY
Paper II (BIOCHEM P-II): TOOLS AND TECHNIQUES IN BIOCHEMISTRY - I
Paper III (BIOCHEM P-III): TOOLS AND TECHNIQUES IN BIOCHEMISTRY - II

These courses are also open for Ph.D. students from other departments in FIAS. The Ph.D. students of the biochemistry department are also free to choose from Ph.D. courses offered by the other departments. A student has to pass all the three papers in one academic year (two semesters) to successfully complete the Ph.D. course work.

Evaluation: All the papers will have components of continuous evaluation and end semester examination. The total marks for each paper will be 100. A student has to score minimum 50 marks to pass a paper. The distribution of marks will be as follows:

Paper	Continuous evaluation	End-semester evaluation	Total Marks
BIOCHEM P-I	50	50	100
BIOCHEM P-II	30	70	100
BIOCHEM P-III	30	70	100

Ph.D. COURSEWORK SYLLABUS FOR BIOCHEMISTRY
RESEARCH METHODOLOGY (BIOCHEM P-I)

CREDITS: 4

Unit 1. Biosafety and Bioethics in Research

Guidelines for Biosafety and Bioethics; Safety practices and Bio-waste in the laboratory; Radioactivity and safety; Fire hazards and safety; Institutional Biosafety, Ethics and Animal Ethics compliance and concerns; Genetically modified organisms; Patents and Intellectual property rights; Plagiarism; Guidelines for Ph.D. thesis.

Unit 2. Defining the Research Problem

Identification of broad area of research; Review of literature using appropriate sources – reviews, patents, research papers, books; Utilization of tools for literature source – web and libraries; Defining a research problem

Unit 3. Experimental Approaches and Methodology

Experimental designs to address the research problem; Pros and cons of the experiments; Alternative plans for experimental design; Tools and techniques to execute experiments; Means to validate and analyze data; Methods of record keeping.

Unit 4. The art of Presentation

Development of writing skills – Plan of research, Research project, Research report, Research article and review, Term paper; Bibliography, referencing and footnotes; Creation of reference libraries; Plagiarism check; Development of Oral presentation skills – Planning, Preparation, Practice, Oration; Use of visual aids and software like MS Word, MS powerpoint, MS Excel, EndNote; Importance of effective Communication.

Students are expected to undertake the following assignments, exercises and evaluations.

1. Identify the broad area of research in consultation with Ph.D. supervisor.
2. Review literature, collate information, identify scope of research, formulate a research plan and prepare and submit a term paper including references.
3. Present and defend their research plan orally.
4. Evaluation will be based on term paper and oral presentation.

SUGGESTED READINGS

1. Research Methodology - Methods and Techniques (2004) 2nd ed., Kothari C.R., New Age International Publishers.
2. Research Methodology: A Step-by-Step Guide for Beginners (2005) 2nd ed., Kumar R., Pearson Education.

Ph.D. COURSEWORK SYLLABUS FOR BIOCHEMISTRY
TOOLS AND TECHNIQUES IN BIOCHEMISTRY- I (BIOCHEM P-II)

CREDITS: 4

Unit 1. Gene expression profiling technologies (24 Hours)

Estimation and Quality check of DNA and RNA, Single gene expression analysis, Southern and Northern blotting, Global expression profiling; Whole genome analysis of mRNA and protein expression; Real time PCR, concept of Ct, Real time PCR to monitor changes in expression levels; Applications of real time PCR in research and diagnostics. Concept of microarrays, Design and use of microarrays for global expression analysis for DNA, RNA and proteins. ChIP on chip technology for DNA-protein interaction studies.

Unit 2. Recombinant DNA Technology (20 Hours)

Use of Restriction and modification enzymes in cloning, Plasmid/Phagemid vector, Ligation, Transformation and Plasmid isolation, Design of primers; PCR: Standard PCR, Hot Start PCR, Allele-Specific PCR, Colony PCR, Nested PCR, Applications of PCR in research.

Unit 3. Genome Sequencing and Editing (20 Hours)

Basic DNA sequencing methods. Sanger's chain termination method, and automated DNA sequencing, Introduction to next generation sequencing (NGS) methods including base calling, sequence alignment, and variant calling. CRISPR-Cas technology for gene editing and gene silencing.

SUGGESTED READINGS

1. Physical Biochemistry: Applications to Biochemistry and Molecular Biology (1982) 2nd ed., Freifelder, D., W.H. Freeman and Company (New York), ISBN:0-7167-1315-2 / ISBN:0-7167-1444-2.
2. An Introduction to Practical Biochemistry (1998) 3rd ed., Plummer D. T., Tata McGraw Hill Education Pvt. Ltd. (New Delhi), ISBN:13: 978-0-07-099487-4 / ISBN:10: 0-07-099487-0.
3. Molecular Cloning: A laboratory Manual (2012) Vol. 1-3, 4th ed., Green M.R. and Sambrook J., Cold Spring Harbour Laboratory Press (New York). ISBN: 978-1-936113-41-5 / ISBN: 978-1-936113-42-2.

Ph.D. COURSEWORK SYLLABUS FOR BIOCHEMISTRY
TOOLS AND TECHNIQUES IN BIOCHEMISTRY- II (BIOCHEM P-III)

CREDITS: 4

Unit 1. Growth, Maintenance and Genetic engineering of Mammalian cells (20 Hours)

Classification of cell culture; Requirements for *in vitro* cell culture, determination of doubling time, replicative senescence, Hayflick's limit, live cell staining and counting, freezing, thawing and synchronization of mammalian cells. Validation methods for ascertaining cell cycle phases. Components of mammalian expression vectors (constitutive and inducible expression systems). Various ways of overexpressing and silencing genes in mammalian cells; Generation of transient and stable lines. Discussion of research articles related to the above topics. Use of various radioisotopes in cell biology and their safety protocols.

Unit 2. Concepts of vaccine development (22 Hours)

Vaccine development history, Vaccine generations, types of vaccines, protein and nucleic acid-based vaccines, Vaccines and immunological memory, adjuvants, mechanism and need of adjuvant, vaccine engineering, antigen and antigenicity, Immune epitope database (IEDB), epitope mapping, vaccine preparation and protein expressions, vaccine testing and clinical trials.

Unit 3. Purification, Characterization of proteins and Drug discovery (22 Hours)

Expression vectors; Expression, isolation and purification of heterologous proteins; Chromatography techniques for protein purification; Mapping of protein interactions: two hybrid, Protein fragment complementation, IP and Pull-down assays. Concepts of drug discovery including various approaches such as repurposing, virtual screening and whole cell-based screening. Mass spectrometry, principle and its biological applications.

SUGGESTED READINGS

1. Animal Cell Culture & Technology (2004) 1st ed., Butler, M., Tailor & Francis Publishers (UK), ISBN-1: 859960499.
2. Principles and Techniques of Biochemistry and Molecular Biology (2010) 7thed., Keith Wilson and John Walker, Cambridge University Press India Pvt. Ltd., ISBN-13: 978-0-521-17874-7 / ISBN:10: 0-07-099487-0.
3. Molecular Cloning: A laboratory Manual (2012) Vol. 1-3, 4th ed., Green M.R. and Sambrook J., Cold Spring Harbour Laboratory Press (New York). ISBN: 978-1-936113-41-5 / ISBN: 978-1-936113-42-2.
4. R. Burgess, M. P. Deutcher. 2009. Guide to Protein Purification, Academic Press, San Diego, USA.
5. System vaccinology: The history, the translational challenge and the future (2022); Academic Press Inc; ISBN-10: 0323859410.
6. Vaccine Design: Methods and Protocols, Volume 3. Resources for Vaccine Development: 2412 (Methods in Molecular Biology); Springer-Verlag New York Inc.; 2nd ed. 2022 edition; ISBN-10 1071618946.