

**PONDICHERY UNIVERSITY**  
**SCHOOL OF LIFE SCIENCES**

**DEPARTMENT OF BIOCHEMISTRY &  
MOLECULAR BIOLOGY**



**COURSE OF STUDIES FOR Ph.D.  
PROGRAMME**  
*In*  
*Biochemistry & Molecular Biology*

**2019-20 onwards**

### **Pre-PhD Curriculum:**

The Pre-PhD Curriculum **has three components/papers, each bearing Four Credits.**

Of these the papers, BCMB-601 – Research Methodology and BCMB - 602 – Biochemical and Molecular Techniques, are compulsory for all students registering for PhD in Biochemistry and Molecular Biology.

**Paper – I – BCMB – 601 - Research Methodology** – The syllabus for Paper – I – Research Methodology is detailed herein.

**Paper –II – BCMB – 602 – Biochemical and Molecular Techniques** - The syllabus will be recommended by the departmental members of the Board of Studies and will cover the basic and advanced techniques essential for conducting research in |Biochemistry and Molecular Biology.

**Paper –III – Guide Paper** – A distinct theory paper specific for each student based on their respective PhD research problem that will address the necessary theoretical background and methodologies as essential for comprehensive assessment of knowledge of the research scholar in their respective research domain.

# BCMB 601 - RESEARCH METHODOLOGY

4 Credits

## COURSE OBJECTIVES:

*To understand the fundamentals of designing a scientific problem and experiments to answer the same.*

*To demonstrate the ability to analyze, present and interpret scientific data to draw accurate and appropriate conclusions and identify implications and future directions of the research.*

*To know good laboratory practices, ethical issues in research, intellectual property rights, patents and patentability.*

## **UNIT I: Foundations of Research:**

**11h**

Identification and formulation of scientific problem: Research Question – Defining aims and objectives – hypothesis generation - Concept of theory, empiricism, deductive and inductive theory – validation and interpretation of data - Characteristics of scientific method – Basic and applied research problems -Research Design: Concept and Importance in Research – Features of a good research design – Exploratory and Descriptive Research Designs – concept, types and uses – Reading and interpretation of research papers, Critical analyses of research problems, Patent search - Use of Encyclopedias, Research Guides, Handbooks and Manuals, Academic Databases etc.-translational approach in research.

## **UNIT II: Experimental Design:**

**10h**

Concept of Independent & Dependent variables– concept of positive and negative controls – Quality Controls- Single and Double Blind Studies-Measurement Issues – Hypothesis – Qualities of a good Hypothesis –Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & its importance - Qualitative and Quantitative research – Concept of measurement, causality, generalization, replication - Problems in measurement in research – Validity, Reliability and Reproducibility.

## **UNIT III: Concepts of Statistical Methods:**

**12h**

Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non Response - Characteristics of a good sample - Probability Sample – Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining size of the sample – Practical considerations in sampling and sample size- Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association - p-value, ANOVA (analysis of variance), cluster analysis – SPSS.

## **UNIT IV: Interpretation of Data and Presentation skills:**

**10h**

Data mining and analysis, preparation and interpretation - Layout of a Research Paper and other communications, Journals in Life Sciences, Open Access Journals, Predatory Journals, Impact factor of Journals, When and where to publish ? - Oral and written presentations- Document preparation, Excel - Power Point Presentation, Scientific editing tools - Hand-outs and Brochures, Paper, Abstract and grant writing skills, Thesis writing - Reference Management and Plagiarism detection softwares.

## **UNIT V: Good Laboratory Practices, Ethical Issues & IPR:**

**12h**

Good Laboratory Practices – Data management in laboratory – Regulations for recombinant DNA and toxic compounds research - safety and bio- and radio- hazards, disposal of biological and chemical waste, Accuracy of liquid transfer, Preparation of reagents, chemicals and buffers, Handling of sophisticated instruments- Animal handling and ethics, Maintenance of animals, Various routes of injections and sample collection, CPCSEA guidelines; Institutional ethics and safety committees,

Ethical consideration in research on human beings, Regulation of clinical trials and transfer of biological samples - Copyright, Royalty, Intellectual property rights and Patent laws, Reproduction of published material, Ethical issues related to publishing, Plagiarism and Self-Plagiarism, Citation and acknowledgements, Reproducibility and accountability, Conflict of Interest - IPR-related issues, trademarks, copy rights, patents, geographical indicators.

**References:**

1. Gall, M.D., Gall, J.P. Borg, W.R. (2006) Educational research: An introduction, Pearson, London.
2. Willis, J. (2004) Data Analysis and Presentation Skills: An Introduction for the Life and Medical Sciences, Wiley, New Jersey.
3. Green. R.H. (1979) Sampling Design and Statistical Methods for Environmental Biologists. John Wiley & Sons, New Jersey.
4. Ruxton, G.D. and Colegrave, N. (2017) Experimental design for the life sciences, Oxford University Press, Oxford.
5. Snedecor, G.W. and Cochran, W.G. (1989) Statistical methods, Iowa State Press, Iowa.
6. Mitchell, K. and Glover, T. (2001) Introduction to Biostatistics, McGraw-Hill Publishing Co., New York.
7. Padma, N. (2017) An Introduction to Ethical, Safety and Intellectual Property Rights Issues in Biotechnology, Academic Press, Cambridge.
8. Shomini, P. and Deepa, G. (2013) IPR, Biosafety and Bioethics, Pearson, London.
9. Bouchoux, D.E. (2013) Intellectual Property Rights: The Law of Trademarks, Copyrights, Patents and Trade Secrets, Cenage Learning, Boston, Massachusetts.

**Suggested reading:**

1. Ministry of Environment, Forest and Climate Change, Govt. of India (2018) Compendium of CPCSEA.
2. ICMR. (2008) Guidelines for Good Clinical Laboratory Practices (GCLP).
3. ICMR (2017) National Ethical Guidelines For Biomedical and Health Research Involving Human Participants. (<https://www.icmr.nic.in/guidelines>).

**COURSE OUTCOME:**

*Demonstrate intellectual independence, knowledge about good research practice and ability to make scientific judgments based on such principles.*

*Have better understanding of the nature of science and values at stake in the practice of science.*