Name of the Programme: Ph.D. (Biochemistry)
Course Code: CHB-700
Title of the course: Research Methodology
Number of Credits: 04
Effective from AY: 2022-23

Pre-requisites for the Course:	Provisional registration for PhD in Biochemistry	
Course Objectives:	1. To introduce research students to various aspects of research methodology 2. To provide an understanding of various databases used in biochemistry 3. To introduce the fundamental roles of computers in biochemical research. 4. To provide understanding and importance of lab safety to make students aware of the statistical methods used in biochemical research 5. To understand the usefulness of various techniques in the characterization and purification of biochemical compounds	
Content:	**1. Introduction to Research Methodology** a) Research- meaning, objectives, motivation, types and methodology. b) Process- formulating the research problem; literature survey; developing the hypothesis and the research design; sample design and collection of the data; execution of the project; analysis of data; testing of hypothesis; generalizations and interpretation, and preparation of the report or presentation of the results & conclusions. c) Nature of scientific information- types of books, types of presentations published in journals, standard format for reporting original research, introduction to various scientific (chemistry) databases & sources from the internet.	10 Hours
	2. Role of Computers in Research and Biochemistry a) Role of Computers in Research and chemistry b) Applications of computers in research. c) Applications of computer in Chemistry - Need of computers in chemistry-introduction & history; Introduction to programming & programming languages; Solving a problem with computers-algorithm, flowchart and program; Use of software for data handling, plotting graphs and drawing molecular structures, visualisation of 3-D data; Software for literature survey, software for reference citing d) Optimisation techniques and applications in molecular geometry optimization	10 Hours
	3. Safety in biochemistry a) Introduction to lab safety. b) Handling of various chemicals, solvents and glassware c) Fires and fighting with fires d) Hazardous substances and their classification and handling e) Biosafety procedures for handling of biological samples f) Preventing laboratory acquired infections	8 Hours
	4. Introduction to Statistical Methods a) Errors & their types, precision & accuracy in chemical analysis. b) Application of statistical methods to data treatment & evaluation. c) Confidence limits; hypothesis testing. d) F-tests, Chi square test, correlation and linear regression.	10Hours

	e) Use of software for statistical analysis. **5. A. Introduction to Basic concepts** a) Sterilization and disinfection b) Sample collection c) Biological sample maintenance **B. Purification and characterization techniques in biochemistry research** a) Purification techniques: agarose and polyacrylamide gel electrophoresis, gel filtration, ion exchange; affinity chromatography techniques, HPLC, GC b) Methods of DNA analysis: Extraction and purification of nucleic acids, PCR, DNA sequencing and cloning techniques c) Spectroscopic techniques: Ultraviolet-Visible (UV-Vis), basics of Infrared (IR), Nuclear magnetic resonance NMR and Mass spectroscopy (MS). d) Introduction to Hyphenated techniques: GC-MS, LC-MS, ICP-MS e) Microscopic techniques: Optical Microscopy (light, dark, phase contrast, Fluorescence), AFM, SEM, TEM	22Hours
Pedagogy:	Lectures, Discussions, seminars, internal exams, assignments/self-study or a combination of some of these can be used. ICT mode should be preferred sessions should be interactive in nature to enable peer group learning.	
References/ Readings:	1. Research Methodology: Methods and Techniques by C.R. Kothari. New Age International Pvt. Ltd., 2004. 2. The ACS Style Guide: Effective Communication of Scientific Information, Edited by Anne M. Coghill and Lorrin R. Garson, American Chemical Society Washington, DC and Oxford University press New York Oxford, 2006. 3. Fundamentals of Research Methodology and Statistics by Y K Singh, New Age International Pvt. Ltd., 2006. 4. Prudent practices in the laboratory: handling and management of chemical hazards, The National Academies Press, USA, 2011. 5. Spectrometric Identification of Organic Compounds (5th Ed) by R M Silverstein, G C Bassler and TC Morrill. John Wiley, Singapore. 6. Principles of Biochemistry (7th Ed). D L Nelson, M M Cox, Lehninger. WH Freeman, 2017. 7. An introduction to practical biochemistry (3rd Ed). D T Plummer. Tata McGraw Hill, 2006 8. Principles and Techniques of Practical Biochemistry (7 th Ed) Wilson K, Walker J. Cambridge University Press, 2010 9. Analytical Chemistry (7th Ed) Christian G D, Dasgupta P K, Schug K A. John Wiley & Sons, 2013 10. Analytical Biochemistry, Homes D J, Peck H. Pearson education Limited, 1998. 11. Principles of Instrumental Analysis, (7th Ed) Skoog D A, Holler F J, Crouch S R, Cengage Learning. 2016. 12. Molecular cloning: a laboratory manual (2nd edition) J Sambrook, E F Fritsch, T Maniatis, Cold Spring Harbor Laboratory Press, New York, 1989. 13. Modern Quantum Chemistry Introduction to Advanced Electronic Structure Theory, Attila Szabo, Neil S. Ostlund, Dover Publications, Inc. Mineola, New York 1989 14. Introduction to Organic Spectroscopy Fifth Edition, D. Pavia, G. Lampman, G.	

	Kriz and J. Vyvyan, Cengage Learning, 2015. 15. Computer Programming in Fortran 90 And 95, V. Rajaraman, PHI Learning Pvt. Ltd., 2013
Course Outcomes:	1. Students will be familiar with research methodology concepts. 2. Students will be able to use computers to solve their research problems in biochemistry. 3. Students will know in advance the safety precautions to be taken in the biochemistry lab. 4. Students will apply statistical methods of data handling in their research. 5. Students will gain fundamental knowledge of characterization and purification techniques.