Ph.D. Course Work

	Course/ Module	Credits			
1.	Unit-I	04			
	Definition and Type of Research				
	Definition and Characteristics of Research: Research - Definition; Concept of Construct,				
	Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Philosophy and validity of				
	research. Objective of research. Various functions that describe characteristics of research				
	such as systematic, valid, verifiable, empirical and critical approach.				
	Types of Research: Pure and applied research. Descriptive and explanatory research. Qualitative and quantitative approaches. Formulating the Research Problem, Literature Review, Developing the objectives, Preparing the research design including sample				
	Design, Sample size.				
	Unit-II				
	Probability Distribution and Hypothesis Testing: Theoretical: binomial, poisson,				
	normal, exponential, hyper geometric, uniform distributions. Type I and II error, testing of				
	mean, proportion, tests for equality of mean and variances of two populations, confidence				
	interval, Z test and χ2 test for goodness of fit, ANOVA (one way classification), Non				
	parametric tests: sign test, U test.Karl Pearson's and Rank Correlation coefficient, simple				
	linear regression: least squares method.				
	Unit-III				
	Outcome of Research:				
	Scientific writing. Different types of journal and categories of publication, Peer review				
	journals. Printed and on-line publications. Communications, research papers, research				
	notes, case study, Review articles and textbooks. Abstract, papers and lecture in national				
	and international conferences, Citations, quality of journals,				
	Preparation of the Report on conclusions reached, Testing validity of research outcomes,				
	Suggestions and recommendations, identifying future scope, Reporting practical and				
	project work, record maintenance of laboratory work, Writing literature surveys and				
	reviews, Organizing a poster display, giving and oral presentation. Writing scientific				
	papers: Justification of scientific contributions, bibliography, description of methods,				
	conclusion, the need for illustration, style, publication of scientific work, writing ethics,				

avoiding plagiarism, Basics of IPR, policy abuse of IPR, piracy.

Unit IV

Lab Safety and Ethics: Safe working procedure and protective environment, protective apparel, emergency procedure and first aid, laboratory ventilation, safe storage and use of hazardous chemicals, procedure for working with substances that hazards, flammable or explosive hazards, procedure for working with gases at pressures above or below atmospheric safe storage and disposal of waste chemicals, recovery, recycling and reuse of laboratory chemicals, procedure for laboratory disposal and explosives, identification, verification and segregation of laboratory waste, disposal of chemical in sanitary sewer system, incineration and transportation of hazardous chemicals. Biosafety and their rules.

15 hrs

15 hrs

Computer Applications: Graphical data analysis: generating charts/ graphs and other features. Introduction to tools: Tools used may be Microsoft Excel, Open office, Microsoft Powerpoint or similar tools.

Reference books:

- 1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers' Distributors.
- 2. Kothari, C.R.,1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.

15 hrs

- 3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nd.ed), Singapore, Pearson Education.
- 4. Shrivastava, Shenoy& Sharma, Quantitative Techniques for Managerial Decisions, Wiley
- 5. Goode W J & Hatt P K, Methods in social research, McGraw Hill
- 6. Basic Computer Science and Communication Engineering R. Rajaram (SCITECH)
- 7. How to use Origin Softwarehttps://www.originlab.com/doc/Tutorials/Create-Graph
- 8. Chemical safety matters- IUPC-IPCS, Cambridge Univ Press, 1992.
- 9. Research methodology: methods and techniques (2019) by C.R. Kothari and Gaurav Garg.