Subject Code CW-702	Research Methodology (For Ph.D. Programme in Natural Sciences)	L	T	P	C	
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Prerequisites	Master's Degree in Science
Objectives	1. To instruct methods of scientific research. 2. To introduce the concept of design of experiment. 3. To familiarize data collection, analysis, interpretation and report making.
Expected Outcomes	Selection of an independent research problem and execution, preparation of manuscripts, reports and project proposal for funding agencies

Modules	Topics	Hours	SLO
	Common to all Departments		
1	**Basic Concept:**Importance of research, objectives of research, motivation in research, understanding research and its goal, types of research, research approaches, research methods versus methodology, research and scientific method, research process, criteria of good research.	9	1
2	**Research Ethics:** Ethical and moral issues in research, treatment of human subjects and animals in research, copy right laws,authorship issues in publications, intellectual property rights, patent rights, accountability and reproducibility in research.	8	7
3	**Research Design:** Need for research design, features of good design, concepts related to research design, basic principle of experimental design and theoretical estimation, design tools.	8	2,3,9
4	**Data Collection:** Primary data and secondary data, methods of data collection, important data available for scientists in World Wide Web, reliability of public domain data bases and its implication in research.	8	4
5	**Data Analysis:** Data preparation – univariate analysis: frequency tables, bar charts, pie charts, percentages. Bivariate analysis: cross tabulations and chi-square test, hypothesis of association, error analysis.	9	6,10,12
6	**Interpretation and Report writing:**Importance of interpretation, techniques of interpretation: precautions in interpretation, significance of report writing, different steps in writing report, layout of the research report, types of reports, oral presentation, writing a good research report.	7	10,13
7	**Publication and Project proposal preparation:** Role of scientific journal in research, different ways of citing a research article in manuscripts, Impact factor of journals, importance of citations, h-index, $i10-$ index, cite score, plagiarism - software to detect plagiarism,reviewer comments.Funding agencies in India for Science, Engineering and Technology, preparation of a project proposal forfunding.	9	8,10
8	**Lectureby experts**	2	
	Total Lecture Hours	60	

Proposed by	Dr K Chanda	
Mode of Evaluation: Assignment / Case Study discussion / FAT / Seminar		

References:

1. Research Methodology Methods and Techniques, by C R Kothari, (2014) 3rd Edition, New Age International Publishers.

2. Research Methodology A step-by-step guide for beginner, by Ranjit Kumar,(2011), SAGE Publication, New Delhi, India.

3. Research design and methods a process approach, by Kenneth.S. Bordens& Bruce B.Abbott, (2002), Tata Ma-Graw-Hill companies Inc.USA.

4. Research Methodology, by Bill Taylor, Gautham Sinha &TaposhGhoshal, (2006) PHI Learning Private Ltd., New Delhi, India.

STUDENT LEARNING OUTCOMES (SLO)

1. Clear understanding of the subject related concepts and of contemporary issues
2. Design thinking capability
3. Ability to design a component or a product applying all the relevant standards and with realistic constraints
4. Computational thinking (Ability to translate vast data in to abstract concepts and to understand database reasoning)
5. Virtual Collaborating ability
6. Problem solving ability
7. Clear understanding of professional and ethical responsibility
8. Interest in lifelong learning
9. Adaptive thinking and adaptability
10. Ability to analyze and interpret data
11. Good working knowledge of communicating in English
12. Ability to use techniques and skills
13. Critical thinking and innovative skills
14. Good cognitive load management skills
15. Good digital footprint