Research Methods (CT804-C04)   **Credits: 4**

Level : M. Sc.   Year : I
Program : MSNCS   Part : I

This course will provide an opportunity for participants to establish or advance their understanding of research through critical exploration of research language, ethics, and approaches. The course introduces the language of research, ethical principles and challenges, and the elements of the research process within quantitative, qualitative, and mixed methods approaches. The aim of this course is to equip students with skills on how to formulate a research hypothesis, review literature, design research projects, acquire & analyze data and report the research findings through research writing.

Course Objective:

The purpose of research is to discover answers to questions through the application of scientific procedures. The main aim of research is to find out the truth which is hidden and which has not been discovered as yet. Though each research study has its own specific purpose, we may think of research objectives as falling into a number of following broad groupings:

- To generate new knowledge or to gain familiarity or to develop a new insight into some phenomenon.
- To investigate some existing situation or problem.
- To construct or create a new procedure or system.
- To explore and analyze more general issues.
- To investigate some existing situations or problems.
- To test a hypothesis or theory.
- To identify patterns or trends related to the problem

Learning Outcomes	Chapter Contents	Credit Hours	Teaching Methods
• Understand the definition, purpose, and importance of research in engineering. • • Identify different types of research methodologies. • • Formulate research questions, problems, objectives, and hypotheses. • • Design research frameworks based on conceptual and operational principles.	**1 Introduction to Research** 1.1 Scientific Methods and Research: Definitions of research; Purpose, importance, steps levels and rigor of research in Engineering discipline 1.2 Basic Types of Researches: Quantitative /Qualitative research, Fundamental/Applied research, Descriptive/Analytical research, Conceptual/Empirical research, Diagnostic/Hypothesis testing research, Conclusion oriented/Decision oriented research, Theoretical /Action research, Longitudinal /Cross sectional research 1.3 Research Question, Research Problem, Research Objective, Research Hypothesis 1.4 Designing of Research work: Principles of designing a	10	• Lectures with real-world examples. • • Case studies of engineering research projects. • • Group discussions and brainstorming activities. • • Interactive presentations on different research designs.

	research, Conceptual framework and its operationalization, engineering research design		
• Recognize different phases of research from desktop research to validation. • Understand theoretical modeling and conceptual frameworks. • Learn ethical considerations in research.	**2 Phases and Methods of Engineering Research** 2.1 Desktop Research 2.2 Literature Study 2.3 Theoretical Modelling and Conceptual Frameworks 2.4 Experimental and Study Design 2.5 Data Collection 2.6 Evaluation, Validation and Verification 2.7 Research Ethics	8	• Hands-on exercises in literature review and desktop research. • • Workshops on research ethics and integrity. • • Demonstration of experimental and study design techniques. • • Peer review activities for research proposals.
• Differentiate between primary and secondary data collection methods. • Understand various data collection techniques such as interviews, questionnaires, and observations. • Evaluate the effectiveness of different data collection strategies.	**3 Data Collection** 3.1 Collection of Primary Data 3.2 Observation Method 3.3 Interview Method 3.4 Collection of Data through Questionnaires 3.5 Collection of Data through Schedules 3.6 Difference between Questionnaires and Schedules 3.7 Some Other Methods of Data Collection	5	• Role-playing activities for interview and observation techniques. • Surveys and questionnaire design exercises. • Case studies on effective data collection. • Group discussions on challenges in data collection.

	3.8 Collection of Secondary Data, 3.9 Selection of Appropriate Method for Data Collection.		
• Understand the steps in data processing and analysis. • • Learn statistical methods such as central tendency, dispersion, and regression analysis. • • Interpret research data effectively.	**4 Processing and Analysis of Data** 4.1 Processing Operations 4.2 Elements/Types of Analysis 4.3 Statistics in Research 4.4 Measures of Central Tendency 4.5 Measures of Dispersion 4.6 Measures of Asymmetry (Skewness) 4.7 Measures of Relationship 4.8 Simple Regression Analysis	10	• Hands-on practice with statistical tools. • • Data analysis exercises using real-world datasets. • • Visual presentations of different data processing techniques. • • Group discussions on data interpretation challenges.
• Understand hypothesis formulation and testing procedures. • • Learn different statistical tests such as z-test, t-test, chi-square test, and F-test. • • Identify limitations and appropriate applications of hypothesis testing.	**5 Testing of Hypotheses** 5.1 Definition of Hypothesis 5.2 Basic Concepts Concerning Testing of Hypotheses 5.3 Procedure for Hypothesis Testing 5.4 Important Parametric Tests (z-test, t-test, χ^2-test, F-test) 5.5 Hypothesis Testing of	10	• Problem-solving sessions using statistical software. • • Guided exercises on hypothesis testing. • • Group analysis of sample research studies. • • Peer review of hypothesis

	Means		formulation exercises.
	5.6 Hypothesis Testing for Comparing Two Related Samples		
	5.7 Hypothesis Testing of Proportions		
	5.8 Testing the Equality of Variances of Two Normal Populations		
	5.9 Hypothesis Testing of Correlation Coefficients		
	5.10 Limitations of the Tests of Hypotheses		
• Understand the applications and conditions for chi-square tests. • • Learn how to apply ANOVA techniques in research. • • Analyze variance and interpret statistical results.	**6 Chi-Square Test and ANOVA** 6.1 Chi-square as a Test for Comparing Variance 6.2 Chi-square as a Non- parametric Test 6.3 Conditions for the Application of $\chi 2$ Test 6.4 Steps Involved in Applying Chi-square Test 6.5 Analysis of Variance (ANOVA) and ANOVA Technique 6.6 Setting up Analysis of Variance Table 6.7 Coding Method 6.8 Two-way ANOVA	7	• Case studies of research using chi-square and ANOVA. • • Hands-on practice with statistical software. • • Lecture demonstrations with step-by-step problem-solving. • • Interactive quizzes on hypothesis testing methods.

• Learn the steps of scientific publishing and research reporting. • Understand project management in research. • Explore open science and continuous scientific research practices. • Develop skills in presenting and writing research findings.	**7 Reporting and Managing Research** 7.1 Reporting Results 7.2 Reporting in Multidisciplinary Fields 7.3 Scientific Publishing 7.4 Steps of continuous scientific research 7.5 Open Science 7.6 Project Management 7.7 Demo Lecture Gantt Charts 7.8 Seminar	10	• Seminar presentations on selected research topics. • Hands-on practice in writing research reports. • Demonstrations of Gantt charts and project management tools. • Interactive peer feedback sessions on research reports.

References Books:

1. Kothari, C.R., Research Methodology: Methods and Techniques. New Age International. 418p.
2. Practical Research Methods, Dawson, C., UBSPD Pvt. Ltd. 5. Research Methodology, Sharma, N. K., KSK Publishers, NewDelhi.
3. Garg, B. L., Karadia, R., Agarwal, F. and Agarwal, U. K., An introduction to Research Methodology, RBSA Publishers.
4. Sinha, S. C. and Dhiman, A. K., Research Methodology, Ess Publications. 2 volumes.

Seminar:

In Seminar the students are required to choose a topic of their interest, find a high-quality recent journal related to that topic and make a presentation based on that paper.

Evaluation Scheme:

The question will cover all the chapter of the syllabus. The evaluation scheme will be approximately as indicated in the table below. There can be slight variation in marks allocation as per the need of exam.

Chapter	1	2	3	4	5	6	7
Topics	All	All	All	All	All	All	All
Marks	10	8	5	10	10	7	10