

Course Code	Course Name	Credits
26PH555	RESEARCH METHODOLOGY IN PHYSICS	04

Course Objectives

- To acquire the fundamental knowledge on different types of renewable energy resources and storage systems
- To understand the basic concept of different forms of energy conversion.
- To apply the fundamental concept of physics to different energy conversion devices.
- To identify the merits and demerits of different renewable energy resources.
- To analyse the various forms of energy resources based on its reliability and economic aspects.

Learning Outcomes

Upon successful completion of this course it is intended that a student will be able to:

- Understand the basic principles of various renewable energy sources such as solar, biomass, wind, wave, and geothermal energy.
- Explain the working and applications of different renewable energy technologies and systems.
- Analyze the performance and efficiency of renewable energy devices and conversion methods.
- Evaluate the feasibility and environmental impact of different renewable energy sources.
- Apply appropriate energy storage methods and propose sustainable energy solutions for real-world needs.

Unit 1 - Introduction to Research Methodology (12 Hrs.)

Definition and importance of research in Science - Types of research - fundamental - applied research - Scientific method: Observation – hypothesis – experimentation – conclusion - Identifying research gaps in science - Framing hypotheses and objectives - Importance of literature review in research - Tools for finding relevant research papers - evaluation and critical analysis of existing work.

Unit 2 – Research Design, Planning and Methodology (12 Hrs.)

Choosing a research problem in science - Formulating research objectives and specific goals - Creating a timeline for research work - Types of sampling methods - Tools and techniques for data collection in science experiments - Ethical considerations in scientific research - Plagiarism, falsification, and fabrication - Ensuring transparency and reproducibility in research - Quantitative Research Methods in Science - Qualitative Methods in science - Data Visualization and Interpretation - Experimental Research - Computational Research.

Unit 3 - Writing a Research Paper (12 Hrs.)

Structure of a Scientific Paper: Sections of a research paper (Abstract, Introduction, Methods, Results, Discussion, Conclusion) - Writing tips for clarity and precision. Citing Sources and Referencing: Proper citation formats - Using reference management tools. Peer Review Process: Importance of peer review in scientific research - How to write and respond to peer reviews. Data Interpretation and Presentation: Analyzing Results - Presenting Research Findings.

Unit 4 – Intellectual Property Rights (IPR) (12 Hrs.)

Intellectual Property - Types of IPR - Importance of IPR in science and innovation - The role of IPR in academic and industrial collaborations – Patents - Patent Search and Filing - Copyrights in Scientific Research - Trade Secrets and Confidentiality.

Unit 5 - Licensing and Commercialization of Research (12 Hrs.)

Licensing Agreements - Commercialization of Research - Legal and Ethical Considerations in IPR - IPR in Academia vs Industry - IPR Enforcement and Litigation - Case Studies and Recent Developments in IPR and Research - Emerging Trends in IPR.

Reference Books:

1. Michael Alley (2018), The Craft of Scientific Writing (3rd Ed.), Springer.
2. Ranjit Kumar, Research Methodology: A Step-by-Step Guide for Beginners
3. Lee and Wills, Intellectual Property and Innovation Management in Small Firms
4. Howard G. Birnberg, Patent Law for Researchers and Engineers
5. Frederick J. R. P, Introduction to Scientific Research.
6. Geoffrey Marczyk, David DeMatteo and David Festinger (2005), Essentials of Research Design and Methodology, John Wiley & Sons, Inc.

Websites and eLearning Sources:

1. <https://paperpal.com/blog/academic-writing-guides/what-is-research-methodology>
2. <https://www.indeed.com/career-advice/career-development/research-methodology>
3. <https://www.youtube.com/watch?v=nJza2kfl8GU>

COs and Bloom's Taxonomy Mapping – 26PH555

Course Outcomes	On successful completion of this course, students will be able to	BTL
CO1	Recall and explain the fundamental concepts of research methodology, types of research, and the scientific method.	K1, K2
CO2	Apply research design principles, sampling techniques, and data collection methods with ethical considerations in scientific research.	K3
CO3	Analyze and interpret research data and develop structured scientific research papers with proper citation and referencing.	K4
CO4	Evaluate the role of Intellectual Property Rights (IPR) in scientific research and innovation, including patents and copyrights.	K5
CO5	Design and propose research commercialization strategies, licensing models, and solutions considering legal and ethical aspects.	K6

BTL (Bloom's Taxonomy Level) - K1 – Remembering, K2 – Understanding, K3- Applying, K4 – Analyse, K5- Evaluate and K6 - Create

Relationship Matrix – 26PH555

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)						Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	
CO1	3	2	2	1	1	1	2	1	2	1	1	1	1.58
CO2	3	3	2	3	2	2	3	2	2	1	1	1	2.08
CO3	2	3	2	3	1	1	2	2	3	2	2	1	2.00
CO4	2	2	1	1	1	3	2	3	2	2	2	2	1.92
CO5	2	3	3	1	1	3	2	3	3	2	2	2	2.25
Total													1.97

Mean Score: 3- High, 2- Medium/Moderate, 1-Low

