MANGALORE UNIVERSITY

DEPARTMENT OF POSTGRADUATE STUDIES & RESEARCH IN PHYSICS
SYLLABUS FOR Ph.D. COURSE WORK

SCHEME OF EXAMINATION FOR Ph.D. COURSE WORK IN PHYSICS

Course	Particulars	Hours of Instruction per Week	Duration of Exam (hrs.)	Marks			
				IA	Theory	Total	Credits
Course 1	Research Methodology	4	3	30	70	100	4
Course 2	Research and Publication Ethics (RPE)	2	3	30	70	100	2
Course 3	Review of Literature	14	--	-		150	6
	Review report Viva					50	2
					Total	**400**	**14**

Note: The IA will be based on internal tests/Assignments/Seminars/Group Discussion.

Learning objectives of Ph.D. Programme

The Ph.D. programme in the department admits students with master's degree in physics and master's degree in related interdisciplinary subjects into research. The student admitted into this programme undergoes 6 months of course work related to research methodology, research and publication ethics and advanced topics relevant to their research work. The course work enables them to grasp the research methodology, research and publication ethics and understand the basics of the advanced techniques to be used in their research work. Students work on their thesis problem under the supervision of a research guide. The broad areas of thesis work are on experimental or theoretical with thin film studies, crystal growth and characterization, nonlinear optical materials, dye sensitised solar cells, environmental radioactivity, radiation biophysics, magnetic materials, polymer microstructural studies using positron annihilation spectroscopy, condensed matter physics, semiconductor physics, radiation processing of materials and devices, photon & neutron activation analyses, Photo-fission studies, radiation dosimetry and Microtron based research studies, polymers biomaterials and effects of ionizing radiations on polymers, natural and synthetic fibres, nanocomposites, transport property, optical, electrochemical cell parameters and supercapacitor of polymer electrolyte, liquid crystals and astrophysics. After completing the Ph.D. degree, the students are well trained to take up a career in academics and/or research.

Ph.D. Programme Outcome (PO)

PO1. **Physics knowledge:** Apply the knowledge of physics to propose new innovative problems in physics.

PO2. **Problem analysis:** Identify and formulate research-based knowledge and research method to design experiments and analyse and interpret the data and synthesize the information to provide valid conclusions.

PO3. **Design/development of solutions:** Design solutions for complex problems through research.

PO4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods to conduct investigations on complex problems.

PO5. **Modern tool usage:** To create, select and apply appropriate techniques of physics to predict and model advanced problems in physics.

PO6. **Physics and society:** Apply the assessed knowledge to understand the health, safety, and cultural issues of the society relevant to the professional knowledge of physics.

PO7. **Environment and sustainability:** Apply the professional knowledge of physics to society and environment and demonstrate the knowledge for sustainable development.

PO8. **Ethics:** Apply and commit to professional ethics of research in physics.

PO9. **Communication:** To communicate effectively on physics research to the physics community and society.

PO10. **Project management:** To demonstrate the research knowledge of physics to multidisciplinary environments.

PO11. **Life-long learning:** Recognise the need to engage in independent and life-long research in the broadest context of scientific/ technological change.

Ph.D. Programme Specific Outcome (PSO)

PSO1. The Ph.D. programme in physics aims to educate researchers in contemporary research fields.

PSO2. Achieve a comprehensive understanding of the physics of their chosen field of research.

PSO3. Dissemination of the original research findings to the scientific community following scientific ethics.

PSO4. Contribution to the advancement of domain knowledge in the chosen area of research.

PSO5. Demonstrate progress in the selected research project.

COURSE 1: Research Methodology (52 hrs.)

Course objective

- To understand literature review and identification of a research problem.
- To discuss experimental setup, data collection and interpretation of the results.
- To learn various statistical theories and models used in scientific research.
- To understand how to write and publish a scientific research article.
- To learn error analysis and numerical methods in scientific research.
- To learn advanced nuclear techniques such as Neutron activation analysis, Gamma spectrometry, Proton induced X-ray emission and Positron annihilation.
- To discuss experimental Techniques and material preparation.
- To give principle and working of instruments such as XRD, SEM, TEM, AFM and STM.

Course outcome

CO1. Knowledge to the research student to do the literature review and to identify a research problem.
CO2. Understanding of the experimental setup, data collection and interpretation of the results.
CO3. Knowledge of various statistical theories and models used in scientific research.
CO4. Capability to write and publish scientific papers.
CO5. Knowledge of error analysis and numerical methods in scientific research.
CO6. Understanding of advanced nuclear techniques such as Neutron activation analysis, Gamma spectrometry, Proton induced X-ray emission and Positron annihilation.
CO7. Knowledge of experimental techniques and material preparation.
CO8. Understanding of the principle and working of instruments such as XRD, SEM, TEM, AFM and STM.

UNIT I (13 hrs.)

Introduction to Research Methods: Identification of a problem and literature survey. Collection of data and analysis, experimental findings and interpretations. Sources of Research problems. Outcome of research. Introduction to probability - kinds of probability. Random variables; Definition, probability distribution function, probability density function, continuous, discrete and mixed random variables. Functions of random variables. Solving problems, expectation and introduction to estimation. Paper writing and publishing a scientific paper.

UNIT II (13 hrs.)

Error Analysis and Numerical Methods: Least Square Fitting. Newton's Interpolation, Chi-Square fit, Standard Deviation, error propagation, Statistical Evaluation - Solution of Differential Equations using Runge-Kutta method of order 4.

UNIT III (13 hrs.)

Advanced nuclear techniques: Neutron activation analysis – Principle, Instrumentation and application, Gamma spectrometry – Energy calibration, efficiency calibration and activity determination. Proton induced X-ray emission (PIXE)-Experimental details and applications.

Positron annihilation - principle, sources, experimental details, angular correlation of annihilation radiation and Fermi momentum of conduction electrons in metals, Positron lifetime and lattice defects in metals, Gamma-ray spectroscopy.

UNIT IV (13 hrs.)

Experimental and characterization Techniques: Vacuum Techniques – rotary pump, turbo molecular pump, ion pump, gas transfer pumps and pressure gauges. Cryogenics - Production, storage and measurement of low temperature. Synthesis of thin films and nanomaterials - Physical and chemical methods of thin films and nanomaterials synthesis. Characterization techniques - XRD, SEM, TEM, AFM, STM, Resistivity and dielectric measurements.

Reference Books

1. R L Dominowski: Research Methods (Prentice Hall of India, N J 1980)
2. Henry Stark & John Woods: Probability and random processes with applications to SignalProcessing (3rd Edition, Pearson Education Asia, 2002).
3. Sneddon I A: Elementary Partial Differential Equations (Mc Graw Hill, 1957).
4. L S Pipes: Applied Mathematics for Engineers and Physicists..
5. Andrew Guthree: Vacuum Technology.
6. L G Carpenter: Vacuum Technology - An Introduction
7. Barron R F: Cryogenics Systems (2nd Edition (Oxford university Press 1985)
8. Roth A: Vacuum Technology (2nd Edition North Holland, 1982)
9. O'Hanlon J F: A User Guide to Vacuum Technology (John Wiley, 1980).
10. Harris N S: Modern Vacuum Practice (McGraw Hill, 1989).
11. Mathews and Walker R L: Mathematical Methods of Physics, (WA Benjamin, Inc, 1979). 12. JainM K, Iyengar S R K and Jain R K: Numerical Methods for Engineers (Mc Graw Hill,TMH).
12. John R Rice: Numerical Methods, Software and Analysis (Mc Graw Hill ISE, 1985)
13. C Kittel: Introduction to solid state Physics.
14. Ashcroft and Mermin: Solid State Physics
15. Ibach and Luth: Solid State Physics.
16. B D Cullity: Elements of X-ray diffraction.
17. J C Brice: Growth of crystals from liquids.
18. Pamplin: Crystal growth.
19. Ajay Gathak: Optical electronics.
20. B B Laud: Lasers and non-linear optics.
21. A Goswami: Thin film Fundamentals.
22. K L Chopra: Thin film Phenomena.
23. B G Streetman: Solid State Electronic Devices.
24. S M Sze: Semiconductor Devices.
25. John H Davies: The Physics of Low-Dimensional Semiconductors.
26. Knoll G F, Radiation Detection and Measurement', 2nd Edn. (John Wiley, 1989).
27. Kapoor S S and Ramamurthy V 5, 'Nuclear Radiation Detectors' (Wiley Eastern Ltd., New Delhi,1986).

COURSE 2: Research and Publication Ethics (RPE) (30 hrs.)

Course objective

- To introduce the basics of philosophy of science and ethics.
- To inculcate research integrity.
- To discuss publication ethics.
- To educate on how to identify research misconduct and predatory publications.
- To discuss Indexing and citation databases.
- To provide information on open access publications and research metrics.
- To introduce various plagiarism tools.

Course Outcome

CO1.Understanding of basics of philosophy of science and ethics.
CO2.Knowledge of research integrity.
CO3.Understanding of publication ethics.
CO4.Knowledge of identifying research misconduct and predatory publications.
CO5.Knowledge of Indexing and citation databases.
CO6.Knowledge of open access publications and research metrics.
CO7.Knowledge of various plagiarism tools.

THEORY (15 hrs.)

RPE 01: PHILOSOPHY AND ETHICS (3 hrs.)

1. Introduction to philosophy: definition, nature and scope, concept, branches
2. Ethics: definition, moral philosophy, nature of moral judgements and reactions

RPE 02: SCIENTIFIC CONDUCT (5 hrs.)

1. Ethics with respect to science and research
2. Intellectual honesty and research integrity
3. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP)
4. Redundant publications: duplicate and overlapping publications, salami slicing
5. Selective reporting and misrepresentation of data

RPE 03: PUBLICATION ETHICS (7 hrs.)

1. Publication ethics: definition, introduction and importance
2. Best practices/standards-setting initiatives and guidelines: COPE, WAME, etc.
3. Conflicts of interest
4. Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types
5. Violation of publication ethics, authorship and contributorship
6. Identification of publication misconduct, complaints and appeals
7. Predatory publishers and journals

PRACTICE (15 hrs.)

RPE 04: OPEN ACCESS PUBLISHING (4 hrs.)

1. Open access publications and initiatives
2. SHERPNR oMEO online resource to check publisher copyright & self-archiving policies
3. A software tool to identify predatory publications developed by SPPU
4. Journal finder/ journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer
5. Journal Suggester, etc.

RPE 05: PUBLICATION MISCONDUCT (4 hrs.)

A. Group Discussions (2 hrs.)
   1. Subject-specific ethical issues, FFP, authorship
   2. Conflicts of interest
   3. Complaints and appeals: examples and fraud from India and abroad

B. Software tools (2 hrs.)
   1. Use of plagiarism software like Turnitin, Urkund and other open-source software tools

RPE 06: DATABASES AND RESEARCH METRICS (7 hrs.)

A. Databases (4 hrs.)
   1. Indexing databases
   2. Citation databases: Web of Science, Scopus, etc.

B. Research Metrics (3 hrs.)
   1. Impact Factor of a journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score
   2. Metrics: h-index, g-index, i10-index, Altmetrics

References

1. Bird, A. (2006). Philosophy of science. Routledge.
2. MacIntyre, Alasdair. (1967). A Short History of Ethics. London.
3. P. Chaddah. (2018). Ethics in Competitive Research: Do not get scooped; do not get plagiarized, ISBN:978-9387480865
4. National Academy of Sciences, National Academy of Engineering and Institute of Medicine. (2009). On Being a Scientist: A Guide to Responsible Conduct in Research: Third Edition. National Academies Press.
5. Resnik, D. B. (2011). What is ethics in research & why is it important. National Institute of Environmental Health Sciences, 1-10. Retrieved from

https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm
6. Beall, J. (2012). Predatory publishers are corrupting open access. Nature, 489(7415), 179-179. https://doi.org/10.1038/489179a
7. Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance. (20 19), ISBN: 978-81-939482-1-7. http://www.insaindia.res.in/pdf/Ethics Book.pdf

COURSE 3: Review of Literature (14 hrs./week)

Course Objective

- To introduce the various methods of review literature.
- To learn how to identify research gaps in the chosen research field based on the review of the literature.
- To understand how to formulate a research hypothesis based on the research gap identified.
- To study the instrumentation and experimental setup.
- To learn the scientific methodology and data collection.
- To learn how to arrive at the novelty of the proposed study and expected outcome.
- To understand how to contribute new scientific information to enhance the domain knowledge.

Course Outcome

CO1.Understanding on how to review literature.
CO2.Knowledge on how to identify the gap area in the chosen research field to find a research problem.
CO3.Knowledge of how to formulate a research hypothesis.
CO4.Understanding of instrumentation and experimental setup needed for the proposed study.
CO5.Knowledge of scientific methodology and data collection.
CO6.Will be able to find the novelty of the proposed study and expected outcome.
CO7.Will be able to foresee the new scientific information that can enhance the domain knowledge.