MANGALORE UNIVERSITY

DEPARTMENT OF POST GRADUATE STUDIES & RESEARCH IN PHYSICS

SYLLABUS FOR PhD COURSE WORK

Learning objectives of PhD Programme

The PhD 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 under go 6 months course work related to research methodology and advanced topics relevant to their research work. The course work enables them to grasp the research methodology 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 is on experimental or theoretical with topic in theoretical particle physics X-ray fluorescence, Compton profile, and thin film studies, crystal growth and characterization, nonlinear optical materials**,** dye sensitised solar cells, environmental radioactivity, radiation biophysics, polymer micro structural studies using positron Annihilation Spectroscopy, growth and characterisation of NLO crystals, 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, nano composites., Transport Property, Optical, Electrochemical cell parameters and super capacitor of Polymer Electrolyte. After completing the PhD degree, the students are well trained to take up carrier in academics and/or research

PhD Programme outcome (PO)

PO1.**Physics knowledge:** Apply the knowledge of physics to propose the 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 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.

PhD: Programme specific outcome

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

PSO2 Achieve a comprehensive understanding of physics of their chosen field of research. Draw to a conclusion of the original research in their chosen field that can be disseminated to the physics community.

PSO3 Demonstrate progress in the selected research project.

PAPER I: RESEARCH METHODOLOGY

Course outcome

CO1 The PhDresearch studentgain the basic knowledge about the in the contemporary research fields.

CO2 Achieve understanding on research methodology.

CO3 Gain comprehensive understanding on materials synthesis and characterization techniques.

UNIT I

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. Plagiarism and scientific ethics (qualitative).

UNIT II

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

Advanced nuclear techniques: Neutron activation analysis – Principle, Instrumentation and application, 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, Ion beam analysis –Rutherford back scattering, channelling, Nuclear reaction analysis.

UNIT IV

Experimental Techniques- Vacuum technology, rotary pump, Turbo Molecular Pump (TMP), Ion pump, Cryo pump. Cryogenics. Solid State material preparation- characterization, XRD, SEM, TEM, AFM, STM. Measurement of temperatures.

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 Signal

Processing (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. Jain M K, Iyengar S R K and Jain R K: Numerical Methods for Engineers (Mc Graw Hill,

TMH).

13. John R Rice: Numerical Methods, Software and Analysis (Mc Graw Hill ISE, 1985)

14. C Kittel: Introduction to solid state Physics.

15. Ashcroft and Mermin: Solid State Physics

16. Ibach and Luth: Solid State Physics.

17. B D Cullity: Elements of X-ray diffraction.

18. J C Brice: Growth of crystals from liquids.

19. Pamplin: Crystal growth.

20. Ajay Gathak: Optical electronics.

21. B B Laud: Lasers and non-linear optics.

22. A Goswami: Thin film Fundamentals.

23. K L Chopra: Thin film Phenomena.

24. B G Streetman: Solid State Electronic Devices.

25. S M Sze: Semiconductor Devices.

26. John H Davies: The Physics of Low-Dimensional Semiconductors.

27. Knoll G F, Radiation Detection and Measurement', 2nd Edn. (John Wiley, 1989).

28. Kapoor S S and Ramamurthy V 5, 'Nuclear Radiation Detectors' (Wiley Eastern Ltd., New Delhi, 1986).

PAPER II REVIEW OF LITTERATURE

CO1 The PhD student researchers gain the basic knowledge about the selected research topic.

CO2 Achieve understanding on research methodology to be applied for the selected research field.