MANGALORE UNIVERSITY

DEPARTMENT OF POST GRADUATE STUDIES & RESEARCH IN PHYSICS

PhD COURSE WORK SYLLABUS

PAPER I: RESEARCH METHODOLOGY

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.

UNIT II

Fundamentals of computers and programming: FORTRAN, C-Programming - structures and unions, pointer, file management, dynamic memory allocation, linked list, preprocessors, features. Basics of MATHEMATICA & MATLAB, programming in MATLAB, applications.

UNIT III

Fourier series and Fourier transforms. Matrices and complex variables. Introduction to group theory. Solving of ordinary differential equations by power series method. Introduction to Green's functions.

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. Rudra Pratap: Getting Started with MATLAB, (Oxford University Press).
4. Chattopadhyaya P K: Mathematical Physics (Wily Eastern, 1990).
5. Joshi A W: Group Theory (Wiley eastern 1995).
6. Spiegel M R: Vector Analysis (Schaum Series, McGraw Hill).
7. Ayres I A: Elementary partial Differential Equations (Schaum Series, Mc Graw Hill, 1957).
8. Sneddon I A: Elementary Partial Differential Equations (Mc Graw Hill, 1957).
9. L S Pipes: Applied Mathematics for Engineers and Physicists.

10. Rajaram V: Computer Programming in FORTRAN IV (Prentice Hall of India).
11. M G Chopra: FORTRAN Programming.
12. Andrew Guthree: Vacuum Technology.
13. L G Carpenter: Vacuum Technology - An Introduction
14. Barron R F: Cryogenics Systems (2nd Edition (Oxford university Press 1985)
15. Roth A: Vacuum Technology (2nd Edition North Holland, 1982)
16. O'Hanlon J F: A User Guide to Vacuum Technology (John Wiley, 1980).
17. Harris N S: Modern Vacuum Practice (McGraw Hill, 1989).

PAPER II: THEORETICAL FOUNDATIONS

UNIT I

Classical Mechanics: Review of analytical mechanics. Central forces and mechanics of rigid bodies. Advanced Techniques - Problem solving. Introduction to Classical field theory. electrodynamics - Review of Maxwell's Equations. Relativistic electrodynamics. Transformation of fields. Four Vectors, Einstein summation. Field Tensor. Fields of point charge and Power Radiated by point charge using Four-vector notation.

UNIT II

Quantum Mechanics Review of Matrix formulation of Quantum Mechanics and Angular Momentum - Clebsch-Gordan Coefficients - 3-j Symbol and 6-j Symbol. Pauli Spin Matrices. Relativistic Quantum Mechanics and Elements of Second Quantization. Problem Solving.

UNIT III

Introduction Quantization rule for Fermions and Bosons. Quantization of Electromagnetic field. Introduction to Quantum Electrodynamics. The Feynmann rule for Quantum Electrodynamics (QED). Introduction to Quantum Chromo Dynamics (QOR) and Gauge theory.

UNIT IV

Error Analysis and Numerical Methods. Least Square Fitting. Chi-Square fit, Standard Deviation, error propagation, Statistical Evaluation - Solution of Differential Equations using PC.

Reference Books

1. Goldstein H: Classical Mechanics, 2nd Edition (Wiley Eastern, 1985).
2. Griffiths D J: Introduction to Electrodynamics 3rd Edition (PHI, 1999).
3. Takwale R G and Puranik P S: Introduction to Classical Mechanics (Tata Mc Graw Hill, 1979).
4. Reitz J R, Milord F J, Christy R W: Foundations of Electromagnetic Theory, 3rd Edition (Narosa Publishing House, 1990).
5. Schiff L I: Quantum Mechanics, 3rd Edition (Mc Graw Hill, 1969).
6. Shankar R: Principles of Quantum Mechanics (Plenum, 1980).
7. Sakurai J J: Modem Quantum Mechanics, Revised Edition (Addison - Wesley, 1994).
8. Edmonds: Angular Momentum in Quantum Mechanics (Princeton University Press, 1960).
9. Merzbecher E: Quantum Mechanics, 3rd Edition. (John Wiley & Sons, 1998).
10. Greinn & Reinhardb: Field Quantization, (Springs, 2003).
11. Haung K: Quarks, Leptons & Gauge Fields, (World Scientific, Singapore, 1993).
12. Lewin H Ryder: Quantum Field Theory, (Cambridge University Press, 2002).
13. Lee T D: Particle Physics & Introduction to Field Theory, (Harwood Academic Press, 1988).
14. Mathews and Walker R L: Mathematical Methods of Physics, (WA Benjamin, Inc, 1979).
15. Jain M K, Iyengar S R K and Jain R K: Numerical Methods for Engineers (Mc Graw Hill, TMH).
16. John R Rice: Numerical Methods, Software and Analysis (Mc Graw Hill ISE, 1985).

PAPER III (I) CONDENSED MATTER PHYSICS

UNIT I

Crystal structures. Reciprocal space. Diffraction theory. Crystal defects. Real crystals. Disordered systems, Aspects of surface physics. Band theories: Nearly free electron model, Tight-binding approximation, Augmented plane wave method, Pseudo-potential method. Hartree approximation, Hartree-Fock theory of free electrons. Screening. Fermi surfaces and Brillouin zones. Semi-classical dynamics of electrons.

UNIT II

Crystal growth: Solution growth - High temperature crystal growth techniques-hydrothermal method. Nonlinear optical materials (Organic and inorganic): characterization - X-ray diffraction, UV-VIS, IR, Thermal, micro-mechanical. Optical microscopy.

UNIT III

Nanomaterials: Introduction, fabrication methods, Characterization techniques, Physical properties, Applications. Thin films: Thin film deposition - Physical and chemical vapour deposition techniques, chemical deposition methods, characterization, Electrical and optical properties. Applications.

UNIT IV

Semiconductor fundamentals band structure, electron hole statistics, intrinsic and extrinsic semiconductors, energy band diagrams, drift-diffusion transport, generation- recombination, optical absorption and emission. Basic semiconductor devices: p-n junctions, MOS capacitors, optical detectors and emitters. Low dimensional semiconductors materials - Introduction, fabrication and characterization techniques, physical properties, devices, and applications. Organic semiconductors - Introduction, synthesis and doping, electrical and optical properties, devices, and applications. Amorphous semiconductors.

Reference Books

1. C Kittel: Introduction to solid state Physics.
2. Ashcroft and Mermin: Solid State Physics
3. Ibach and Luth: Solid State Physics.
4. B D Cullity: Elements of X-ray diffraction.
5. J C Brice: Growth of crystals from liquids.
6. Pamplin: Crystal growth.
7. Ajay Gathak: Optical electronics.
8. B B Laud: Lasers and non-linear optics.
9. A Goswami: Thin film Fundamentals.
10. K L Chopra: Thin film Phenomena.
11. B G Streetman: Solid State Electronic Devices.
12. S M Sze: Semiconductor Devices.
13. John H Davies: The Physics of Low-Dimensional Semiconductors.

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5. J C Brice: Growth of crystals from liquids.
6. Pamplin: Crystal growth.
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8. B B Laud: Lasers and non-linear optics.
9. A Goswami: Thin film Fundamentals.
10. K L Chopra: Thin film Phenomena.
11. B G Streetman: Solid State Electronic Devices.
12. S M Sze: Semiconductor Devices.
13. John H Davies: The Physics of Low-Dimensional Semiconductors.