BHARATHIAR UNIVERSITY, COIMBATORE – 641 046

PART – I M.Phil. / Ph.D. – PHYSICS

(Syllabus Effective from the academic year 2007 – 2008 onwards)

PAPER – I – Research Methodology

Unit – I

Maxwell's equations: – Magnetic field of a spherically symmetric current – A travelling field – The speed of light – Solving Maxwell's equations; the potentials and wave equation – Maxwell's equations for waves in free space, plane waves – Three dimensional waves – Spherical waves - Maxwell's equations for light and electromagnetic waves – Spherical waves from a point source – The fields of an oscillating dipole – The potentials of a moving charge – The potentials for a moving charge with constant velocity

Unit – II

Quantum behavior: Atomic mechanics – An experiment with bullets, waves and electrons – The interference of electron waves – Probability wave amplitudes – The laws of combining amplitudes – Scattering from crystal – The scattering electrons with parallel and anti-parallel spin - Schrödinger's equation in a magnetic field – The equation of continuity for probabilities – Two types of momentum – The meaning of the wave function – Superconductivity – The Meissner effect – Flux quantization – The dynamics of superconductivity

Unit – III

Ordinay differential equations: Runge Kutta IV order method for first order differential equation – RK4 method for simultaneous first order differential equations – RK4 method for second order differential equation – Milne's Predictor – Corrector method
Partial differential equations(PDE): Difference quotients – Graphical representation of Partial quotients – Classification of PDE of the second order – Elliptic equations – Standard five point formula – Diagonal five-point formula – Solution of Laplace's equation by Liebmann's iteration

Unit – IV

Numerical Integration: Trapezoidal and Simpson's $1/3^{rd}$ rule for single integrals – Error estimates – Trapezoidal and Simpson's rule for double integrals
Interpolation: Two points Gaussian quadrature – Three points Gaussian quadrature – Cubic spline interpolation
Eigen values: Power method – Jacobi method (Only 2 x 2 and 3 x 3 matrices)

Unit – V

Programming in C: Constants – Variables – Data types – Operators and Expressions – Input/Output Statements – Control statements – Functions – Arrays – One, two, multidimensional array declarations and initializations

Simple applications using C – Program: Program to integrate tabulated function using Trapezoidal rule – Program to integrate tabulated function using Simpson's 1/3 rule – Program to compute the solution of first order differential equation of the type y' = f(x,y) using RK4 mehtod - Program to compute first order differential equation y' = f (x,y) using Milne's method – Program to compute the interpolation value at a specified value from a set of table points using natural cubic spline interpolatin.

Books for study:

1. The Feynman Lectures on Physics (Volume 2 and 3) – Richard P. Feynman, Robert B. Leighton, Matthew Sands; Narosa publishing House, New Delhi.
2. Numerical methods – P. Kandasamy, K. Thilagavathy and K. Gunavathi, S. Chand and Company Ltd., (2007)
3. Numerical methods – E. Balagurusamy, Tata Mcgraw Hill Publishing Company Ltd,. New Delhi, (2006)
4. Ansi C – E. Balagurusamy, Tata Mcgraw Hill Publishing Company Ltd,. New Delhi, (2004)

BHARATHIAR UNIVERSITY, COIMBATORE – 641 046

PART – I M.Phil. / Ph.D. – PHYSICS

(Syllabus Effective from the academic year 2009 –2010 onwards)

PAPER – II Advanced Physics

Unit–I: Crystal Physics and Physical Properties of Crystals

Representation of physical quantities by scalars, vectors and tensors – Tensors of second rank- Transformations of components of a second-rank tensor – Representation quadric – Simplification of equations referred to principal axes – Effect of crystal symmetry on crystal properties: Neumann's principle – Magnitude of a property in a given direction – Geometrical properties of the representation quadric – Equilibrium properties represented by second-rank tensor: Electric Polarization: relations between D, E and P in a parallel plate condenser – Stress tensor: homogeneous and inhomogeneous stresses – Strain tensor: homogeneous three-dimensional strain.

Unit–II: Crystal Optics and Non-Linear and Electro-Optical Effects in Crystals

Double refraction: Optical indicatrix – Effect of crystal symmetry on optical indicatrix – Wave surface: Uniaxial and Biaxial crystals – Non-Linear Optics: Harmonic generation – Second Harmonic Generation – Phase matching – Third Harmonic Generation – Optical Mixing: Sum and difference frequencies – Parametric generation of light – Self-focusing of intense light beams – Electro-Optic Effect: Phase retardation – Longitudinal electro-optic modulators: Amplitude modulation – Phase modulation of light – Transverse electro-optic modulators – Electro-optic beam deflection.

Unit– III: Nanomaterials and their applications

Properties of metallic and semiconducting Nanoparticles – various physical and chemical methods of preparation –self assembly and catalysis assisted growth methods - synthesis of carbon nanostructures and their applications –nanostructured ferromagnetism–size and dimensionality effects in nanostructures – biological application of nanomaterials.

Unit – IV: Surface analysis techniques

Atomic Collision and Backscattering Spectrometry: – Energy loss of Light Ions and Backscattering Depth Profiles – Sputter Depth Profile and Secondary Ion Mass Spectroscopy – Channeling: Basics and its application in Thin Film analysis - X-ray Photoelectron Spectroscopy – Electron Microprobe analysis of surface – Nonradiative Transitions and Auger Electron Spectroscopy.

Unit – V: Spectroscopic methods

Spectrophotometer – UV –VIS Near IR, - Basic concepts of FTIR and Raman and its applications to various materials - NMR and ESR and its applications – Thermal analysis (TG/DTA, DSC) of different Materials.

X-ray Method

The Bragg Law – X- ray Spectroscopy – Diffraction Directions – Diffraction Methods – Powder Method – Particle size Calculation – X ray scattering by electrons, atomic and unit cells.

Books for Study for

1. 'Physical Properties of Crystals: Their Representation by Tensors and Matrices' by J.F. Nye, 1985, Oxford University Press, New York.
2. 'Lasers and Non-Linear Optics' by B.B. Laud, Chapter-13, Wiley Eastern Ltd., 1985,
3. 'Quantum Electronics' by Amnon Yariv, Chapter-14, John Wiley & Sons, Inc., 1975, New York.
4. Introduction to Nanotechnology by C.P Pool Jr. and F.J Owens, John Wiley & Sons
5. Nanostructures & Nanomaterials Synthesis, Properties and Applications by Guozhong Cao (World Scientific Publishing)
6. Fundamentals of surface and thin film analysis – Leonard C. Feldman and James W. Mayer
7. Basic Principles of Spectroscopy – Raymond Chang, McGraw Hill International book company
8. Elements of x-Ray Diffraction (Second Edition) BD Cullity
9. Fundamentals of Molecular Spectroscopy by Banwell
