

Annexure No.	21 D
SCAA Dated	29.02.2008

BHARATHIAR UNIVERSITY, COIMBATORE-641 046

**M. Sc. PHYSICS DEGREE COURSE
(SCHOOL OF DISTANCE EDUCATION)**

(For Candidates Admitted During the Academic Year 2007-2008 Batch Onwards)

SCHEME OF EXAMINATION

Year	TITLE OF PAPER		Exam Duration Hrs	Record Marks	Total Marks
FIRST	PAPER I	Classical Mechanics & Mathematical Physics	3		100
	PAPER II	Quantum Mechanics	3		100
	PAPER III	Electromagnetic Theory & Optical Physics	3		100
	PAPER IV	Nuclear Physics & Spectroscopy	3		100
		PRACTICAL I General Physics	3	10	50
		PRACTICAL II Electronics	3	10	50
SECOND	PAPER V	Advanced Electronics	3		100
	PAPER VI	Condensed Matter Physics	3	15	100
	PAPER VII	Electrodynamics and Plasma Physics	3	15	100
	PAPER VIII	Computational Methods & Programming	3		100
		PRACTICAL III Advanced Physics	3	10	50
		PRACTICAL IV Advanced Electronics	3	10	50
Total					1000

Question Paper Pattern:

Theory:

- Maximum Marks: 100
- Open Choice
- Each Question carries 20 marks
- To answer and 5 out of 8

Practicals:

- Maximum marks (2X50):100Marks
- Record Marks: 20 Marks

PAPER-I: CLASSICAL MECHANICS & MATHEMATICAL PHYSICS

Unit I:

Canonical Transformation

Equations of Canonical Transformations-Lagrange and Poisson's Brackets-Invariance-Equation of Motion in Poisson Bracket Notation.

Hamilton-Jacobi Theory:

H-J Equation for Hamilton's Principle Function-Hamilton's Characteristic Equation-Separation of Variables-Harmonic Oscillator Problem in H-J Method-Action Angle Variables-Kepler Problem in Action Angle Variables.

Unit II:

Rigid Body Dynamics

Generalized coordinates for Rigid Body Motion-Euler Angles-Angular Velocity, Angular Momentum of a rigid body-Moments and Products of Inertia-Principal Axes Transformation-Rotational Kinetic Energy-Moment of Inertia of a Rigid Body-Equation of Motion of a Rigid Body-Euler's Equations

Unit III:

Mechanics of Small Oscillations

Stable and Unstable Equilibrium-Two Coupled Oscillators-Formulation of the Problem-Properties of T, V and ω -Normal Coordinates and Normal Frequencies of Vibration-Systems with few Degrees of Freedom-Parallel Pendula-Double Pendulum-Triple Pendulum(degenerate system)-Linear Triatomic Molecule.

Unit IV:

Special Functions

Legendre's Polynomials and Functions- Differential Equations and Solutions-Rodriguez Formula-Generating Functions-Orthogonality-Relation between Legendre Polynomial and their Derivatives-Recurrence Relations-Bessel's Function-Differential Equation and Solution-Generating Functions-Recurrence Relations

Complex Variable Theory:

Functions of a Complex Variable-Single and Multivalued Functions-Cauchy-Reimann Differential Equation-Analytical Line Integrals of Complex Function-Cauchy's Integral Theorem and Integral Formula-Derivatives of an Analytic Function-Taylor's Variables-Residue and Cauchy's Residue Theorem-Application to the Equation of Definite Integrals-Conformal Transformations-Invariance of the Laplacian.

Unit V:

Linear Space

Definition of Vector Space-Linear Dependence-Linear Independence-Basis-Dimension of a Vector Space-Representation of Vectors and Linear Operators with respect to Basis-Schmidt Orthogonalization Process-Inner Product.

Fourier Series & Laplace Transforms:

Fourier Series-Dirichlet's Theorem-Change of Interval-Complex Form-Fourier Series in the Interval $(0, \theta)$ - Uses of Fourier Series.-Laplace Transform-Definition-Properties-Translation Property-Inverse Laplace Transform-Properties

Books for study and reference

1. Classical Mechanics- S.L.Gupta, V. Kumar & H.V.Sharma-Pragati Prakashan- Meerut.
2. Classical Mechanics- H. Goldstein-Addison Wesley, London
3. Classical Mechanics of Particles & Rigid Bodies-Kiran C.Gupta-Wiley Eastern Ltd.
4. Classical Mechanics-S.N. Gupta
5. Mathematical Physics- Sathya Prakash-Sultan Chand & Sons
6. Mathematical Physics-B.S. Rajput- Pragati Prakashan- Meerut
7. Mathematical physics by P.K. Chattopadhyay-New Age International-New Delhi.
8. Mathematical Physics-P.P. Gupta, Yadav & Malik-Kedarnath Ramnath-Meerut
9. Numerical Methods in Science & Engineering-M.K. Venkataraman-National Publishing-Chennai
10. Numerical Methods-A. Singaravelu-Meenakshi Publishing

PAPER II: QUANTUM MECHANICS**Unit I:****Equation of Motion & Application of Schroedinger's Equation**

State Vectors-Hilbert Space-Dirac Notation-Dynamical Variables as Operators-Change of Basis-Unitary Transformation-Equation of Motion in Schroedinger Picture, Heisenberg Picture & Dirac Picture-Representation of Operators by Matrices-One Dimensional Linear Harmonic Oscillator in Matrix Mechanics.-Kronig Penny Model

Unit II:**Approximate Methods**

Time Independent Perturbation Theory in Non-Degenerate Case-Ground State of Helium Atom-Degenerate Case-Stark Effect in Hydrogen-Variation Method & its Application to Hydrogen Molecule-WKB Approximation.

Time Dependent Perturbation Theory:

Time Dependent Perturbation Theory-First and Second Order Transitions-Transition to Continuum of States-Fermi Golden Rule-Constant and Harmonic Perturbation-Transition Probabilities-Selection Rules for Dipole Radiation-Collision-Adiabatic Approximation

Unit III:**Angular Momentum**

Orbital Angular Momentum-Spin Angular Momentum-Total Angular Momentum Operators-Commutation Relations of Total Angular Momentum with Components-Ladder Operators-Commutation Relation of J_z with J_+ and J_- - Eigen Values of J^2 , J_z -Matrix Representation of J^2 , J_z , J_+ and J_- - Addition of Angular Momenta- Clebsch Gordon Coefficients-Properties.

Relativistic Wave Equation:

Klein Gordon Equation-Plane Wave Equation-Charge and Current Density-Application to the Study of Hydrogen Like Atom-Dirac Relativistic Equation for a Free Particle-Dirac Matrices-Dirac Equation in Electromagnetic Field-Negative Energy States-Dirac's Equation in a Central Field(Electron Spin)-Spin Orbit Energy.

Unit IV:**Scattering Theory**

Scattering Amplitude-Expression in terms of Green's Function-Born Approximation and its Validity-Partial Wave Analysis-Phase Shifts-Scattering by Coulomb and Yukawa Potential

Application to Atomic Structure

Central Field Approximation-Thomas Fermi Model-Hartree's Self Consistent Model-Hartree Fock Equation-Alkali Atoms-Doublet Separation-Intensities-Complex Atoms-Coupling Schemes

Application to Molecular Structure

Hydrogen Molecule Ion-Hydrogen Molecule-Heitler London Method-Covalent Bond-Spin Orbit Interaction as Correction to Central Field Approximation- Hartree Fock Self Consistent Field Method for Molecules-Hybridisation.

Unit V:**Theory of Radiation (Semi Classical Treatment)**

Einstein's Coefficients-Spontaneous and Induced Emission of Radiation from Semi Classical Theory-Radiation Field as an Assembly of Oscillators-Interaction with Atoms-Emission and Absorption Rates-Density Matrix and its Applications

Quantum Field Theory

Quantization of Wave Fields- Classical Lagrangian Equation-Classical Hamiltonian Equation-Field Quantization of the Non-Relativistic Schroedinger Equation-Creation, Destruction and Number Operators-Anti Commutation Relations-Quantization of Electromagnetic Field Energy and Momentum.

Books for study and References:

1. Quantum Mechanics-Gupta, Kumar & Sharma
2. Quantum Mechanics-Satyaprakash
3. Quantum Mechanics-L.I. Schiff- McGraw Hill
4. Quantum Mechanics-E. Merzbacher-Wiley and Sons
5. A Text Book of Quantum Mechanics-P.M. Mathews & K. Venkatesan-Tata McGraw Hill
6. Introduction to Quantum Mechanics-A.K. Chandra-Tata McGraw Hill
7. Quantum Mechanics-A.K. Ghatak and S. Loganathan-McMillan India
8. Quantum Mechanics-Messiah(North Holland)

PAPER III: ELECTROMAGNETIC THEORY AND OPTICAL PHYSICS

Unit I:

Electrostatics

Potential and Field due to an Electric Dipole-Dielectric Polarization-External Field of a Dielectric Medium-Guass' Theorem in a Dielectric-Electric Displacement Vector **D**-Linear Dielectrics-Relations connecting Electric Susceptibility χ_e , Polarization **P**, Displacement **D** and Dielectric Constant-Boundary Conditions of Field Vectors.

Molecular Field-Clausius Mosotti Relation for Non-Polar Molecules-Langevin Debye Formula for Polar Molecules, Electrostatic Energy and Energy Density

Magnetostatics:

Biot-Savart Law- Statement-Lorentz Force Law and Definition of B-General Proof of Ampere's Circuital Law-Divergence and Curl of B-Magnetic Scalar Potential (derivation of expression only)-Equivalence of Small Current Loop and Magnetic Dipole-Magnetic Vector Potential (derivation of expression only).

Unit II:

Field Equations

Equation of Continuity-Displacement Current-Derivation of Maxwell's Equations-Physical Significance-Poynting Vector-Momentum in EM Field-Electro Magnetic Potentials-Maxwell's Equations in terms of EM Potentials-Lorentz Gauge-Coulomb Gauge-Radiation Produced by a Low Velocity Accelerated Charged Particle(Larmor's Formula)-Oscillating Electric Dipole-Radiation due to a Small Current Element-Linear Half Wave Antenna

Interaction of EMW with Matter:

Boundary Conditions at Interfaces-Reflection and Refraction-Fresnel's Laws-Brewster's Law & Degree of Polarization-Total Internal Reflection and Critical Angle-Reflection from a Metal Surface-Wave Guides-Rectangular Wave Guide

Unit III:

Scattering of EMW

Scattering and Scattering Parameters-Scattering by a Free Electron (Thomson Scattering)-Scattering by a Bound Electron (Rayleigh Scattering)-Dispersion in Gases-Normal and Anomalous Dispersion in Liquids and Solids.

Coherence and Interference

Theory of Partial Coherence-Coherence Time and Coherence Length-Spectral Resolution of a Finite Wave Train-Coherence and Line Width-Spatial Coherence-Extended Sources-Measurement of Stellar Diameter-Hanbury Brown Twiss Intensity Interferometry-Fabry Perot Interferometer-Theory of Multi Layer Films.

Unit IV:

Optics of Solids

General Wave Equation-Propagation of Light in Conducting Media-Reflection and Refraction at the Boundary of an Absorbing Medium-Propagation of Light in Crystals-Double

Refraction at a Boundary-Optical Activity-Faraday Rotation in Solids-Magneto Optic and Electro Optic Effects.

Optical Fibres:

Propagation of Light in an Optical Fibre-Acceptance Angle-Numerical Aperture-Step and Graded Index Fibres-Fibre Fabrication Techniques-Optical Fibre as a Cylindrical Wave Guide-Wave Guide Equations-Wave Equations in Step Index Fibres-Flow of Power in SI Fibres-Fibre Losses and Dispersion-Applications.

Unit V:

Lasers

Characteristics of Laser Light-Atomic Basis for Laser Action-Laser Pumping-Creating a Population Inversion-Laser Resonator-Single Mode Operation-Q Switching-Mode Locking-Helium-Neon Laser-Argon Ion Laser-Carbon dioxide Laser-Solid State Lasers-Semiconductor Laser-Applications.

Books for study and References:

1. Electromagnetic Theory-Chopra & Agarwal-Nath & Co.
2. Electromagnetic Theory & Electrodynamics-Satyaprakash-Kedarnath Ramnath & Co. -Meerut
3. Classical Electrodynamics-J.D. Jackson-Wiley Eastern
4. Principles of Electrodynamics-M. Schwartz-McGraw Hill
5. Introduction to EM Fields & Waves-Carson & Lorrain
6. Introduction to Modern Optics-G.R. Fowles, Holt, Rinehart & Winston Inc-N.Y.
7. Principles of Optics-Born and Wolf-Pergamon Press
8. Fibre Optics technology & Applications-Stewart D. Personick-Khanna Publishers-Delhi
9. Optical Physics-S.G. Lipson, H. Lipson, D.S. Tannhanser-Cambridge University Press
10. Contemporary Optics-Nassbaum & Philips-Prentice Hall
11. Modern Interferometers-Wolf-London
12. Introduction to Lasers & their Applications-D.C.O. Shea, W. Russell Callen and W.T. Rhodes-Addison Wesley

PAPER IV: NUCLEAR PHYSICS AND SPECTROSCOPY

Unit I:

Nuclear Structure

Distribution of Nuclear Charge-Nuclear Mass-Mass Spectroscopy-Bainbridge and Jordan, Neir, Mass Spectrometer-Theories of Nuclear Composition (proton-electron, proton-neutron)- Bound States of Two Nucleons-Spin States-Pauli's Exclusion Principle-Concept of Hidden Variables-Tensor Force-Static Force-Exchange Force.

Radioactivity

Alpha Decay: Properties of α Particles-Gamow's Theory of α Decay-Geiger Nuttal Law- α Ray Energies-Fine Structure of α Rays- α Disintegration Energy-Long Range α Particles.

Beta Decay: Properties of β Particles-General Features of β Ray Spectrum-Pauli's Hypothesis-Fermi's Theory of β Decay-Forms of Interactions and Selection Rules-Fermi and Gamow Teller Transitions.

Gamma Decay: Absorption of γ Rays by Matter-Interaction of γ Rays with Matter-Measurement of γ Ray Energies-DuMond Bent Crystal Spectrometer Method-Internal Conversion.

Unit: II

Nuclear Models

Liquid Drop Model: Bohr Wheeler Theory of Fission-Condition for Spontaneous Fission-Activation Energy-Seaborg's Expression.

Shell Model: Explanation of Magic Numbers-Prediction of Shell Model-Prediction of Nuclear Spin and Parity-Nuclear Statistics-Magnetic Moment of Nuclei-Schmidt Lines-Nuclear Isomerism.

Collective Model: Explanation of Quadrupole Moments-Prediction of Sign of Electric Quadrupole Moments.

Unit III:

Nuclear Reactions

Kinds of Reactions and Conversion Laws-Energy of Nuclear Reaction-Iso Spin-Continuum Theory of Nuclear Reaction-Resonance-Breit and Wigner Dispersion Formula-Stages of a Nuclear Reaction-Statistical Theory of Nuclear Reaction-Kinematics of Stopping and Pickup Reaction-Surface Reaction.

Particle Physics

Leptons-Hadrons-Mesons-Hyperons-Pions-Meson Resonances-Strange Mesons and Baryons-Gell-Mann Okuba Mass formula for Baryons-CP Violation in Neutral Kaons (K^0) Decay- Symmetry and Conversion Laws-Quark Model-Reaction and Decays-Quark Structure of Hadrons.

Unit IV:**Atomic & Microwave Spectroscopy**

Spectra of Alkali Metal Vapours-Normal Zeeman Effect-Anomalous Zeeman Effect-Magnetic Moment of Atom and the G Factor-Lande's 'g' Formula-Paschen Back Effect-Hyperfine Structure of Spectral Lines.

Microwave Spectroscopy-Experimental Method-Theory of Microwave Spectra of Linear, Symmetric Top Molecules-Hyperfine Structure-Quadrupole Moment-Inversion Spectrum of Ammonia.

Infrared & Raman Spectroscopy

IR Spectroscopy: Practical Aspects-Theory of IR Rotation Vibration Spectra of Gaseous Diatomic Molecules-Applications-Basic Principles of FTIR Spectroscopy.

Raman Spectroscopy: Classical and Quantum Theory of Raman Effect-Rotation Vibration Raman Spectra of Diatomic and Polyatomic Molecules-Applications-Laser Raman Spectroscopy.

Unit V:**NMR & NQR Spectroscopy:**

NMR Spectroscopy: Quantum Mechanical and Classical Description-Bloch Equation-Relaxation Processes-Experimental Technique-Principle and Working of High Resolution NMR Spectrometer-Chemical Shift

NQR Spectroscopy: Fundamental Requirements-General Principle-Experimental Detection of NQR Frequencies-Interpretation and Chemical Explanation of NQR Spectroscopy

ESR & Mossbauer Spectroscopy:

ESR Spectroscopy: Basic Principles-Experiments-ESR Spectrometer-Reflection Cavity and Microwave Bridge-ESR Spectrum-Hyperfine Structure

Mossbauer Spectroscopy: Mossbauer Effect-Recoilless Emission and Absorption-Mossbauer Spectrum-Experimental Methods-Hyperfine Interaction-Chemical Isomer Shift-Magnetic Hyperfine and Electric Quadrupole Interaction

Books for study and Reference:

1. Concepts of Nuclear Physics-Bernard L. Cohen-Tata McGraw Hill- New Delhi
2. Introductory Nuclear Physics-Kenneth S. Krane-John Wiley & Sons
3. Nuclear Physics-J.C. Tayal-Umesh Prakashan-Gujarat
4. Physics of Nucleus and Particles-Volume I & II-B. Nermeir & Sheldon
5. Auto Nuclear-Evan-McGraw Hill
6. Fundamental of molecular spectroscopy – C.B.Banwell
7. Introduction to molecular spectroscopy - G.M.Barrow
8. Spectroscopy: Volumes I, II and III-B.P. Straugham & S. Walker
9. Atomic Physics - J.B.Rajam, S.Chand Publications.

PRACTICAL I - GENERAL PHYSICS**Any Twelve Experiments**

1. Young's Modulus-Elliptical Fringes (Cornu's Method)
2. Young's Modulus-Hyperbolic Fringes (Cornu's Method)
3. Viscosity of a Liquid-Mayer's Oscillating Disc
4. Stefan's Constant
5. Rydberg's Constant-Solar Spectrum
6. Thickness of Wire by Air Wedge and Diffraction
7. Determination of Audio Frequencies-Bridge Method
8. Thermionic Work Function
9. Thermal Conductivity-Forbe's Method
10. Electronic Charge 'e' by Millikan's Oil Drop Method
11. Electronic Specific Charge 'e/m' by Thomson's Method
12. Thermistor-Temperature Coefficient and Band Gap Energy Determination
13. Specific Heat of a Liquid-Ferguson's Method
14. Biprism on Optical Bench-Determination of Wavelength
15. He-Ne Laser –Measurement of Wavelength using Ruler and Thickness of a Wire with Laser
16. Babinet's Compensator
17. LG Plate-Resolving Power
18. Diffraction at a Prism Table-Determination of Wavelength
19. Fabry-Perot Interferometer-Study of Fine Structure
20. Geiger Muller Counter-Determination of Half Life of 'In'

PRACTICAL II-ELECTRONICS**Any Fifteen Experiments**

1. Regulated and Dual Power Supply Construction
2. Basic Logic Gates-Digital IC's
3. Parameters of Op-Amp
4. Wave Form Generators- Op-Amp
5. Phase-Shift Oscillator- Op-Amp
6. Wein's Bridge Oscillator- Op-Amp
7. Active Filters- Op-Amp
8. Differential Amplifier- Op-Amp
9. Frequency Response of an Op-Amp
10. Sign Changer, Scale Changer, Adder and Subtractor- Op-Amp
11. Analog Computer Setup-Solving Simultaneous Equations
12. UJT Relaxation Oscillator
13. CRO-Differentiating, Integrating, Clipping and Clamping Circuits, Square Wave Testing
14. Source Follower
15. SCR-Characteristics and an Application
16. A.C. Amplifier-Inverting, Non-Inverting, Voltage Follower- Op-Amp
17. Electronic Switch-IC 555
18. Measurement of Hall Coefficient of given Semiconductor-Estimation of Charge Carrier Concentration
19. Shift Register-Digital IC's
20. Schmitt Trigger

PAPER V : ADVANCED ELECTRONICS

Unit I:

Semiconductor Devices

FET as a Voltage Variable Resistor-Common Source Amplifier at High Frequencies-Common Drain Amplifier at High Frequencies-Silicon Controlled Rectifier (SCR)-Characteristics-SCR Power Control-Tunnel Diode

Optoelectronics: Photo Resistor-Photo Diode-Photo Transistor-LED-Photo Voltaic Effect-Solar Cells

Operational Amplifier:

Frequency Response of an Op-Amp-Parameters of an Op-Amp-Sign Changer-Scale Changer-Adder-Subtractor-Phase Shifter-Differential Amplifier-Integrator-Differentiator-Analog Computer Setup to Solve Linear Simultaneous Equation-Differential Equations in Physics-Logarithmic & Exponential Amplifiers-Active Filters.

Unit II:

Digital Circuits & Devices

Logic Families-Combinational Logic-Function of Combinational Logic-Flip Flops and other Multivibrators-Counters

Shift Registers-Memories RAM, ROM, PROM, EPROM-Charge Coupled Devices (CCD)

Unit III:

Signal Processing & Data Acquisition

Wave Form Generators and Wave Shaping Circuits-Sinusoidal Oscillators-Phase Shift Oscillator-Wein Bridge Oscillator-Crystal Oscillator Multivibrators Comparators-Schmitt Trigger-Square Wave & Triangular Wave Generators-Pulse Generators-IC 555 Timer and its Application-Signal and Signal Processing-Analog Multiplexer and Demultiplexer-Sample and Hold System-D/A Converters-A/D Converters.

Unit IV:

Antennas & Wave Propagation

Terms and Definition-Effect of Ground on Antennas-Grounded $\lambda/4$ Antenna-Ungrounded $\lambda/2$ Antenna-Antenna Arrays-Broadside and End Side Arrays-Antenna Gain-Directional High Frequency Antennas-Wideband and Special Purpose Antennas-Sky Wave Propagation-Ionosphere-Ecles & Larmor Theory-Magneto Ionic Theory-Ground Wave Propagation.

Microwaves

Microwave Generation-Multicavity Klystron-Reflex Klystron-Magnetron-Travelling Wave Tubes (TWT) and other Microwave Tubes-Microwave Transistors-MASER-Tunnel Diode-Gunn Diode.

Unit V:**Radar and Television**

Elements of a Radar System-Radar Equation-Radar Performance Factors-Radar Transmitting Systems-Radar Antennas-Duplexers-Radar Receivers and Indicators-Pulsed Systems-Other Radar Systems-Black & White TV Transmission and Reception-Colour TV Transmission and Reception.

Communication Electronics

Analog and Digital Signals – Modulation – Types of Modulation- Amplitude modulation theory – Frequency spectrum of the AM wave – Representation of AM – Power relations in the AM wave – Generation of AM – Basic requirements- Description of frequency and phase modulation – Mathematical representation of FM – Frequency spectrum of the FM wave- Effects of noise on carrier – pre emphasis and de emphasis -other forms of interference- intersystem comparisons- comparison of wide band and narrow band FM – Generation of FM– Pulse Modulation Techniques

Books for study and Reference:

1. Physics of Semiconductor Devices-Wiley Eastern
2. Integrated Electronics-Millman & Halkias-Tata McGraw Hill
3. Microelectronics-Millman & Grabel-McGraw Hill
4. Digital Fundamentals-Floyd-UBS
5. Digital Principles and Applications-Malvino- McGraw Hill
6. Electronic Communication Systems-George Kennedy & Davis -Tata McGraw Hill
7. Principles of Communication Systems-Taub Schilling-TMH
8. Electronics & Radio Engineering-F.E.Terman- McGraw Hill
9. Communication Systems-Carlson- McGraw Hill
10. Communication Systems-Simon Haykin-John Wiley & Sons

PAPER VI: CONDENSED MATTER PHYSICS**Unit I:****Crystal Structure & Diffraction**

Lattice Constant and Density-Reciprocal Lattice Concept-Graphical Construction-Vector Development of Reciprocal Lattice-Properties-Reciprocal Lattice to BCC, FCC Lattices-Bragg Condition in terms of Reciprocal Lattice-Rotary Crystal Method of X-Ray Diffraction-Neutron Diffraction-Principle-Advantage-Experiment

Crystal Defects & Dislocations

Defects: Classification-Point Defects-Schottky Defect-Frenkel Defect-Colour Centers-F Centre-Other Colour Centers-Production of Colour Centers by X-Rays and Irradiation.

Dislocations: Slip and Plastic Deformation-Shear Strength of Single Crystals-Edge Dislocation-Screw Dislocation-Stress Field around an Edge Dislocation

Unit II:**Metals & Superconductors**

Heat Capacity of Electron Gas-Experimental Electrical Resistivity of Metals-Superconductivity-Electron Phonon Interaction-Cooper Pairs-BCS Theory-Energy Gap and its Temperature Dependence-London Equation-Josephson Effect & Applications-High Temperature Superconductivity.

Magnetism

Langevin Theory of Paramagnetism-Quantum Theory of Paramagnetism-Curie Law-Ferromagnetism-Weiss Molecular Field Theory-Domain Theory-Anti Ferromagnetism-Neel Theory-Ferrimagnetism-Ferrites-Spin Waves-Experimental Techniques to Study Magnetic Properties.

Unit III:**Fundamentals of crystal growth**

Significance of Single Crystal- Crystal Growth Techniques-Chemical Physics of Crystal Growth- Crystal Growth Phenomena-Nucleation-Gibb's Thomson Equation-For Vapour-For Solution-Spherical Nucleus-Heterogeneous Nucleation-Cap Shaped Nucleus-Disc Shaped Nucleus

Kinetics of Crystal Growth

Singular & Rough Faces-Models on Surface Roughness-Joss Stranshi Volmer (JSV) Theory-Burton Cabrera & Frank (BCF) Theory- BCF Theory of Solution Growth-Periodic Bond Chain Theory-Miller Krumbhaar Model

Unit IV:**Growth from Melt**

Bridgman & Related Techniques-Crystal Pulling Techniques-Connection in Melts-Modeling & Simulation of Bulk Crystal Growth Considering Melt Dynamics-Melt Growth of Oxide Crystals for SAW, Piezo Electric and Non-Linear Optical Applications-Liquid Encapsulated & Czochralski Technique-Zone Melting Technique-Skull Melting Process-Heat Exchange Method

Solution Growth

Low Temperature Solution Growth- Crystal Growth System-Growth of KDP & ADP-Non-Linear Phenomena in KDP Family Crystals-Solubility of KDP & ADP-Seed Preparation, Mounting & Seasoning-High Temperature Solution Growth-Practical Aspects-Growth of Potassium Titanyl Phosphate

Unit V:**Other Growth Techniques**

Vapour Growth: Physical Vapour Deposition-Chemical Vapour Deposition-Chemical Vapour Transport-Stationary Temperature Profile-Oscillating Temperature Profile

Hydrothermal Growth: Design Aspect of Autoclave-Electro Crystallization-Nernst Relation-Electrochemical Reaction

Gel Growth: Various Types of Gel-Structure of Gel- Growth of Crystals in Gels-Experimental Procedure

Books for study and Reference:

1. Introduction to Solid State Physics-C. Kittel-Wiley Eastern-New Delhi
2. Solid State Physics-B.S. Saxena, R.C. Gupta & P.N. Saxena-Pragati Prakashan- Meerut
3. Solid State Physics-A.J. Dekker-Macmillan India
4. Solid State Physics-H.E. Hall-John Wiley & Sons
5. An Introduction to Solid State Physics & Its Applications-R.J. Elliot & A.P. Gibson-ELBS & Macmillan
6. Fundamentals of Solid State Physics-J.R. Christmann- John Wiley & Sons
7. Crystal Growth-P. Santhanaraghavan & P. Ramasamy
8. Crystal Growth Processes-J.C. Brice-John Wiley & Sons-New York
9. The Growth of Crystals from Liquid- J.C. Brice-North Holland Publishing Company
10. Crystal Growth-H.C. Buckley-Chapman & Hall-London
11. Crystal Growth-C.D. Branda-Pergamon Press-Oxford

PAPER VII : ELECTRODYNAMICS AND PLASMA PHYSICS

UNIT – I

Review of Four-Vector and Lorentz Transformation in Four-Dimensional Space, Electromagnetic Field Tensor in Four Dimensions and Maxwell's Equations, Dual Field Tensor, Wave Equation for Vector and Scalar Potential and Solution Retarded Potential and Lienard-Wiechert Potential, Electric and magnetic fields due to a Uniformly Moving Charge and An Accelerated Charge, Linear and Circular Acceleration and Angular Distribution of Power Radiated, Bremsstrahlung, Synchrotron Radiation and Cerenkov Radiation, Reaction Force of Radiation.

Unit II

Motion of charged particles in electric and magnetic fields: Uniform E and B fields, Nonuniform E and B fields, magnetic mirrors, time varying E and B fields, adiabatic invariants, first, second and third.

Unit III

Fluid equations for plasma, equilibrium and stability: Relation of plasma physics to ordinary electromagnetics, the fluid equations for plasma, fluid drifts perpendicular and parallel to B, the plasma approximation. Hydromagnetic equilibrium, the concept of β , diffusion of magnetic field into a plasma, Classification of instabilities, two stream and gravitational instabilities.

Unit IV

Waves in plasma: Representation of waves, group velocity, plasma oscillations, electron plasma waves, sound waves, ion waves, validity of plasma approximation, comparison of ion and electron waves, electrostatic electron oscillations perpendicular to B, electrostatic ion waves perpendicular to B, the lower hybrid frequency, electromagnetic waves with $B_0=0$, experimental applications, electromagnetic waves perpendicular to B_0 , cutoffs and resonances, the CMA diagram, hydromagnetic waves, Alfvén waves and their measurement.

Unit V

Kinetic theory for plasma: The meaning of the distribution function $f(v)$, equations of kinetic theory, Vlasov equation, Fokker-Plank equation, derivation of fluid equations, plasma oscillations and Landau damping, the meaning of Landau damping, kinetic energy of a beam of electrons, BGK and Van Kampen modes, experimental verification.

Books for study and References:

1. Electrodynamics –Gupta and Kumar
2. Electromagnetic waves-R.N.Singh, Tata-McGraw Hill Publishing Company, New Delhi.
3. F.F.Chen: Introduction to Plasma Physics and Controlled Fusion: Volume I Plasma Physics, Plenum Press, New York, 1984
4. Panofsky&Phillips- Classical Electricity and Magnetism
5. Bitten Court –Plasma Physics
6. J.D.Jackson, Classical Electrodynamics-Wiley Eastern Limited, New Delhi

PAPER VIII : COMPUTATIONAL METHODS & PROGRAMMING

Unit I:

Numerical Methods I

Finding Roots of a Polynomial-Bisection Method-Newton Raphson Method-Solution of Simultaneous Linear Equation by Gauss Elimination Method-Solution of Ordinary Differential Equation by Euler, Runge-Kutta Fourth Order Methods-Evaluation of Integrals by means of Simpson's One Third Rule-Girafe's Root Squaring Method for solving Algebraic Equation.

Unit II:

Numerical Methods II

Solving Partial Differential Equations- Finite difference method – Explicit and Implicit methods – Stability analysis – Application to diffusion equation – Solving Poisson equation – Introduction to finite volume and finite element methods- Random number generator – Importance sampling – Metropolis algorithm – Monte Carlo simulation

Unit III:

Matlab Fundamentals

Introduction-Matlab Features-Desktop Windows: Command, Workspace, Command History, Array Editor and Current Directory -Matlab Help and Demos- Matlab Functions, Characters, Operators and Commands.

Basic Arithmetic in Matlab-Basic Operations with Scalars, Vectors and Arrays-Matrices and Matrix Operations-Complex Numbers- Matlab Built-In Functions-Illustrative Examples

Unit IV:

Matlab Programming

Control Flow Statements: *if, else, else if, switch* Statements-*for, while* Loop Structures-*break* Statement-Input/Output Commands-Function m Files-Script m Files-Controlling Output

Unit V:

Matlab Graphics:

2D Plots-Planar Plots, Log Plots, Scatter Plots, Contour Plots-Multiple Figures, Graph of a Function- Titles, Labels, Text in a Graph- Line Types, Marker types, Colors-3D Graphics-Curve Plots-Mesh and Surface Plots-Illustrative Examples

Books for Study & Reference

1. Engineering and Scientific Computations Using Matlab- Sergey E. Lyshevski-JohnWiley & Sons
2. A Guide to Matlab for Beginners & Experienced Users-Brian Hunt, Ronald Lipsman, Jonathan Rosenberg-Cambridge University Press
3. Matlab Primer-Timothy A. Davis & Kermit Sigmon-Chapman & Hall CRC Press-London
4. Matlab Programming-David Kuncicky-Prentice Hall
5. Getting Started With Matlab-Rudra Pratap-Oxford University Press-New Delhi
6. An Introduction to Programming and Numerical Methods in MATLAB- S.R. Otto and J.P. Denier- Springer-Verlag-London
7. Numerical Methods Using Matlab-John Mathews & Kurtis Fink-Prentice Hall-New Jersey
8. Numerical methods in Science and Engineering- M.K. Venkataraman-National Publishing Co. Madras
9. Introductory Methods of Numerical Analysis- S.S. Sastry-Prentice Hall

PRACTICAL III - ADVANCED PHYSICS

Any Twelve Experiments

1. AIO Band
2. CN Band]
3. Arc Spectra-Constant Deviation Spectrograph-Copper, Iron & Barium
4. Michelson Interferometer- λ , $d\lambda$ and Thickness of Mica Sheet
5. Susceptibility-Guoy and Quincke's Method
6. Compressibility of a Liquid-Ultrasonic Method
7. Hall Effect
8. e/m-Zeeman Effect
9. e/m-Magnetron Method
10. B-H Curve-Anchor Ring
11. B-H Curve-Solenoid
12. Double Slit-Wavelength Determination
13. G.M Counter-Characteristics
14. Kelvin's Double Bridge-Determination of Very Low Resistance & Temperature Coefficient of Resistance.
15. Study of Faraday's Effect using He-Ne Laser
16. Photo Cell-Determination of Planck's Constant
17. Study of Fluorescent Spectrum of DCN Dye and Determination of Quantum Yield of Fluorescence Maxima and Full Width Maxima using Monochromator.
18. Matlab Programming-Radioactive Decay
19. Matlab Programming-Numerical Integration
20. Matlab Programming-Double Integration

PRACTICAL IV - ADVANCED ELECTRONICS

Any Ten Experiments

1. Op-Amp: Simultaneous Addition & Subtraction
2. Op-Amp: Instrumentation Amplifier-Temperature Measurement
3. Op-Amp: Instrumentation Amplifier-Light Intensity-Inverse Square Law
4. Op-Amp: V to I & I to V Converter
5. Op-Amp: Circuits Using Diodes-Half Wave, Full Wave, Peak Value, Clipper, Clamper
6. Op-Amp: Log and Antilog Amplifier
7. Op-Amp: Analog Computation-Second Order Differential Equation
8. Op-Amp Comparator-Zero Crossing Detector, Window Detector, Time Marker
9. IC 555 Timer Application-Monostable, Linear & Astable
10. A/D Converters-Any One Method
11. D/A Converters-Binary Weighted & Ladder Methods
12. IC Counters with Feedback
13. Microprocessor: LED Interfacing
14. Microprocessor: Stepper Motor Interfacing
15. Microprocessor: Traffic Control Simulation
16. Microprocessor: ADC Interface-Wave Form Generation
17. Microprocessor: Hex Keyboard Interfacing
18. Microprocessor: Musical Tone Generator Interface