M.Sc. PHYSICS

SEMESTER-IV

Course Code: (Phy.Core: IV-1.1)

SPECIAL CONDENSED MATTER PHYSICS-I

Module-1: **(13 Hours)**

Energy Bands in Solids - Consequences of Periodicity - Bloch Theorem and Proof - Bloch Function - and their Eigen Values - Kronig Penny Model - Nearly Free Electron Model - Zone Scheme - Energy Band in General Periodic Potential - Tight Binding Approximation - Weigner Sitz, Cellelar Method

Fermi Surfaces - Concept of Hole - Effective Mass - Construction of Fermi Surfaces - Electrons Uniform Magnetic Field - Anomalous Skin Effect - Cyclotron Resonance - Closed Orbits and Open Orbits - De-Hass-Van Alphen Effect

Module-2: **(13 Hours)**

Atomic Cohesion and Crystal Binding - Primary and Secondary Bonds - Expression for Cohesion Energy in Ionic - Calculation of Repulsive Exponent from Compressibility Data and Nobel Gas Crystals - Born Hyber Cycle - Atomic Radii vs. Lattice Constant. Properties of Covalent, Ionic, Metallic and Hydrogen Bonds

Lattice Vibrations -Vibration Modes of 1-d Lattice –Mono and Diatomic Linear Lattice – Dispersion Relation - Acoustical and Optical Modes - Phase and Group Velocity - Brillouin Zone - Derivation of Force Constant - Quantization of Elastic Waves.

Module-3: **(13 Hours)**

Thermal Properties of Solids - Specific Heat of Solids - Classical, Einstein, Debye Models, Density of States. Phonon interactions: Normal and Umklapp Process, Thermal Conductivity of insulators at High and Low Temperatures, Effect of Impurity and Imperfections on Thermal Conductivity, Effect of Finite Size of Specimen, Derivation of the Expression for the Conductivities of Metals, Comparison of the Conductivities of Metals due to Electrons and Phonons - Anhormonic Effects -Thermal Expansion - Phonon Collision Process

Optical Properties of Solids - Classical Model - Ionic Conduction - Refractive index - Optical Absorption – Photoconductivity - Photo Electric and Photovoltaic Effect- Optical Properties of Fibers - Optical Properties of Semiconductors

Module-4: **(13 Hours)**

Superconductivity - Review of Experimental Survey - Mechanism of Superconductivity- Properties Dependent on Energy Gap -Thermodynamics of Superconductivity - Flux Quantization - London Equations - Penetration Depth - Ginzberg-Landau Theory - BCS Theory - Qualitative Approach - Important Predication of BCS Theory - Tunnelling- dc and ac Josehpson Effect- SQIUDS - Applications

References:

1. Ali Omar, (2000) **Elementary Solid State Physic, Addison Wiesly**
2. Asckroft F W and N D Mermin, (1976) **Solid State Physics**, Saunders College
3. Dekkar A J, (2000) **Solid State Physics**, MacMillan india Ltd,
4. Kittle C, (1996) **Solid State Physics**, Wiely Eastern,
5. Pillai S O, (2001) **Solid State Physics**, New Age int. Publishers
6. Srivastava J P, (2008) **Elementary Solid State Physics, PHI**
7. Wahab M A, (2009)**Essential of Crystallography, Narosa** Publications

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M.Sc. PHYSICS

SEMESTER-IV

Course Code: (Phy.Core: IV-2.1)

SPECIAL CONDENSED MATTER PHYSICS –II

Module-1: **(13 Hours)**

Crystal Physics - Elementary Symmetry Elements of Crystals, Concepts of Point Groups, Space Groups, Derivation of Equivalent Point Position, Experimental Determination of Space Groups, Powder Diffraction, interpretation, Expression for Structure Factor - Analytical indexing - Wisenbrg and Rotating Method, Determination of Relative Structures, Amplitudes from Measured intensities - Lorentz Polarization Factors.

Module-2: **(13 Hours)**

Ferromagnetism -Weiss Theory of Ferromagnetism - Weiss Field - Spontaneous Magnetization-Curies-Weiss Law - Heisenberg Exchange interaction - ising Model - Ferromagnetic Domains - Anisotropy Energy - Bloch Wall- Spin Waves - Magnons-Bloch 3/2 Law , High Temperature Properties: Corrections to Curie Law, Analysis of Critical Point, Mean Field Theory, Effect of Dipolar interactions, Demagnetization Factors.

Antiferromagnetism- Two Sub Lattice Model - Molecular Field Theory - Neel Temperature. Ferrimagnetisms, Structure of Ferrites, Saturation Magnetization, Curie Temperature, Susceptibility of Ferrimagnets, GMR and CMR Materials

Module-3: **(13 Hours)**

Ferroelectrics-Classification and Properties - Crystal Types of Ferroelectrics - Properties of Roshelle Salt and $BaTiO_3$ - Dipole Theory - Dielectric Constant near Curie Temperature-Microscopic Source of Ferro Electricity- -Thermodynamics of Ferroelectric Phase Transition-Second and First Order - Ferroelectric Domains. Piezoelectricity –Properties, Structure and Applications

Module-4: **(13 Hours)**

Electrical Transport in Metals-Boltzmann Equation - Relaxation Time Approximation-Electrical Conductivity -Thermal Conductivity-Thermoelectric Effect-Calculation of Relaxation Time-Scattering due to Impurities and Lattice-Mattheisen Rule-Temperature Dependence of Resistivity.

Elastic Properties of Solids-Stress Strain Tensor - Elastic Constant-Hooks Law-Strian Energy-Reduction of Elastic Constant from Symmetry - isotropy for Cubic Crystals - Experimental Determination of Elastic Constant by Ultrasonic interferometer.

References:

1. Ali Omar, (2000) **Elementary Solid State Physic,** Addison Wiesly
2. Asckroft F W and N D Mermin, (1976) **Solid State Physics**, Saunders College
3. Dekkar A J, (2000) **Solid State Physics**, MacMillan india Ltd,
4. Kittle C, (1996) **Solid State Physics**, Wiely Eastern,
5. Pillai S O, (2001) **Solid State Physics**, New Age int. Publishers
6. Srivastava J P, (2008) **Elementary Solid State Physics**, PHI
7. Wahab M A, (2009)**Essential of Crystallography**, Narosa Publications

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M.Sc. PHYSICS

SEMESTER-IV

Course Code: (Phy.Ele: IV-3.1)

(Any one of the following Elective1 courses to be chosen)

LASER PHYSICS

Module-1: Laser Characteristics **(13 Hours)**

Review of Fundamentals of Lasers- Population inversion, Pumping Techniques and Types. Characteristics of Laser Beams- Gaussian and its Properties. Stable Two - Minor Optical Resonators. Modes of Laser Oscillations of a Laser Cavity - Longitudinal and Transverse. An Expression for The Number of Modes of Oscillation in Terms of Frequency and the Cavity Length. Mode Selection, Mode Locking. Gain in a Regenerative Laser Cavity. Threshold for 3 and 4 Level Laser Systems - Mode Locking, Pulse Shortening. Line Broadening Mechanism. Spectral Narrowing and Stabilization. Continuous Lasers and Pulsed Lasers.

Module-2: Laser Systems **(13 Hours)**

High Powered Lasers and Low Powered Lasers - Pumping Techniques for Population inversion. Mechanism and Energy Levels of the Following Lasers - Ruby Laser, Nd:YAG Laser. Semiconductor Lasers. Diode Pumped Solid State Lasers- Homogeneous and Heterogeneous, Double Heterogeneous Lasers. Carbon Dioxide Laser, Excimer Lasers, Dye Laser, Argon Ion Laser. Qualitative Treatment of Engineering and Medical Applications of Lasers.

Module-3: Laser Spectroscopic Techniques **(13 Hours)**

Spectral Characteristics of Laser Emission- Active Resonators, Gain Saturation, Spatial Hole Burning. Laser Fluorescence and Raman Scattering and their Application in Pollution Studies. Non-Linear Spectroscopy- Non-Linear interaction of Light with Matter. Laser induced Multiphoton Processes and their Applications. Ultrahigh Resolution Spectroscopy with Lasers and its Applications.

Module-4: Lasers in Fiber Optics **(13 Hours)**

Review of Optical Fibers. Propagation of Light in a Medium with Variable Refractive index. Optical Fiber as a Waveguide. Types of Optical Fibers and their Applications - Optical Switches, Optical Couplers. Transmission Characteristics of Optical Fibers. Types of Losses- Attenuation Loss, Dispersion Loss, Splice Loss Etc. intermodal Dispersion and Material Dispersion. EDOF as an Amplifier- Optical Fiber Communications Using Lasers. WDM Optical Fibers. Modal Analysis for Step index and Parabolic index Medium. Attenuation of Lasers in Optical Fibers.

References:

1. Thyagarajan K., A.K. Ghatak, (1981) **Lasers: Theory and Applications**, McMillan india
2. Swelto O., (1998) **Principles of Lasers**, Springer
3. Sigman A.E., (1986) **Lasers,** University Press
4. Koechner W., (1992) **Solid State Laser Engineering**, Springer verlag
5. Demtroder W., (2002)**Laser spectroscopy**, Springer international
6. Laud BB, (1991)**Laser & Nonlinear Optics**, Wiley Eastern Limited
7. Amn, Yariv on, (1985) **Optical Electronics**, Holt Rinehart and Winston
8. Fiber Djafar K. Myubaev, and Lowell L. Scheiner, **Optic Communication**
9. Ghatak A.K., K. Thyagarajan, (1997) **introduction to Fiber Optics**, Cambridge University Press
10. Ghatak A.K., K. Thyagarajan, (1997) **Optical Electronics**, Cambridge University Press

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M.Sc. PHYSICS

SEMESTER-IV

Course Code: (Phy.Ele: IV-3.2)

NANOMATERIALS

Module-1:

(13 Hours)

Topics in Condensed Matter: Density of States-Variation with Energy. Variation of Density of States and Band Structure with Size of Crystal. Density of States for Different Dimensions.

introduction to Nanomaterials: (Definition, Reason for interest in Nanomaterials, Classification of Nanostructures – 1D, 2D and 3D Confinement, Effect of Nanostructure on Structural and Mechanical Properties, Chemical Reactivity and Stability, Thermal, Magnetic, Optical and Electronic Properties, Nano processes in Bio systems) - Overview.

Mechanical Behaviour of Nanostructured Systems: Effect of Grain Size on Elasticity and Hardness – Empirical Hall-Petch Equation – Models to Explain it – Modification for Small Grain Sizes.

Gas Reactive Applications of Nanostructured Materials : Catalysis: Electrocatalysis Processes, Impact of Nanostructure, **Gas Sensors:** Physical Principles of Semiconductor Sensors and Nanostructure Design, **Hydrogen Storage:** Properties of Hydrogen Storage Compounds and Nanostructure Design.

Nanomagnetic Materials and Applications: Domain and Domain Walls – Bulk and Nanostructures, Magnetization Processes in Particulate Nanomagnets and Layered Nanomagnets, Applications, Magnetoresistance, Giant Magnetoresistance, Spin Valves and Tunnelling Magnetoresistance

Module-2:

(13 Hours)

Overview of Semiconductors: Electronic Band Structure, Concept of the Effective Mass, Optical Processes, Direct and indirect Band Gap Semiconductors, Exaction Formation, Superlattice-Heterostructure.

Quantum Size Effect: Quantum Confinement in One Dimension: Quantum Wells: Electron Confinement in infinitely Deep Square Well Square, Square Well of Finite Depth, Optical Absorption in Quantum Well in the Case of Heterostructure Consisting of Thin Layer of Gaas Sandwiched Between Thick Layers of Algaas.

Quantum Confinement in 2 Dimensions: Quantum Wires
Quantum Confinement in 3 Dimensions: Quantum Dots
Applications of Wires and Dots

Tunnelling Transport T Matrices for Potential Step and Square Barrier, Current and Conductance

Resonant Tunnelling, Charging Effects, Coulomb Blockade and Coulomb Blockade Devices

Module-3: Methods for Preparation of Nano-Materials **(13 Hours)**

Bottom Up: Nano Particles (Metal and Semiconductor) – Nucleation – Growth – Chemical Bath Deposition – Capping Techniques.

Nano Structures – Quantum Dots, Quantum Well Structures- Thin Film Deposition Techniques. – Molecular Beam Epitaxy –MOVPE - MOCVD , Cluster Beam Evaporation-Cluster Nucleation – Theory of Condensation from Super Saturated Vapor – Cluster Formation.

Top Down: Ball Milling – Details, Shaker Mills, **Lithography** –Electron Beam/Ion Beam.

Self Assembled Molecular Materials – Principles of Self Assembly – Micellar and Vesicular Polymerization – Colloidal Nanoparticle Crystals – Self Organizing inorganic Nanoparticles.

Thin Organic Films – Spin Coating of Polymers – Multilayers – Layer by Layer Deposition – Langmuir Blodgett Techniques.

Module-4: Characterization of Nanomaterials **(13 Hours)**

Diffraction Techniques: X-ray Diffraction (XRD) – Crystallinity, Particle/Crystallite Size Determination and Structural Analysis

Microscopic Techniques: Scanning Electron Microscopy (SEM) – Morphology, Grain Size and EDX ; Transmission Electron Microscopy (TEM)– Morphology, Particle Size and Electron Diffraction.

Scanning Probe Techniques: Scanning Tunneling Microscopy (STM) – Surface Imaging and Roughness; Atomic Force Microscopy (AFM) - Surface Imaging and Roughness; Other Scanning Probe Techniques.

Spectroscopy Techniques: Photoluminescence – Emission (PL) and Excitation (PLE) Spectroscopy; infrared (IR) and Raman Spectroscopy; X-ray Absorption (XAS) and X-ray Photoelectron (XPS) Spectroscopy with Depth Profiling.

References:

1. Charles Kittel, (1996) **introduction to solid State Physics**, VII edition.
2. Carl. C. Koch, (Ed) (2004) **Nanostructured Materials-Processing, Properties & Applications,** William andrew Publishing, Norwich, New York, USA.
3. Robert W Kersall, Ian W Hamley & Mark Geoghegan, (Ed) (2005) **Nanoscale Science & Technology,** John Wiley & Sons, UK.
4. Jain K P, (1997) **Physics of Semiconductor Nanostructures**, Narosa.
5. Crandall B C, (1996) **Nanotechnology: Molecular Speculations on Global Abundance, MIT Press.**
6. John H Davies, (1997) **Physics of Low Dimensional Semiconductor Nanostructures,** Cambridge University Press.
7. Edelsteins A S, R C Cammarata, (Ed) (1996) **Nano Materials: Synthesis, Properties and Applications,** institute of Physics Publishing, Bristol & Philadelphia.
8. Fendler J H, (Ed.) (1998) **Nano Particles and Nano Structured Films: Preparation, Characterization and Applications**, John Wiley & Sons.
9. Bimerg D, M Grundmann & N N Ledentsoy, **Quantum Dot Heterostructures**, John Wiley and Sons

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M.Sc. PHYSICS

SEMESTER-IV

Course Code: (Phy.Ele: IV-3.3)

ATMOSPHERIC PHYSICS

Module-1: **(13 Hours)**

Physical Meteorology: Atmospheric Composition, Laws of Thermodynamics of the Atmosphere. Adiabatic Process, Potential Temperature. The Clausis Clapyeron Equation, Laws of Black Body Radiation, Solar and Terrestrial Radiation, Albedo, Green House Effect, Heat Balance of Earth-Atmosphere System.

Dynamic Meteorology: Fundamental Forces, Non-inertial Reference Frames and Apparent Forces, Structure of Static Atmosphere. Momentum, Continuity and Energy Equations, Thermodynamics of the Dry Atmosphere, Elementary Applications of The Basic Equations. The Circulation Theorem, Voracity, Potential Vorticity, Vorticity and Potential Vorticity Equations.

Module-2: Monsoon Dynamics **(13 Hours)**

Wind, Temperature and Pressure Distribution Over india in the Lower, Middle and Upper Atmosphere During Pre, Post and Mid-Monsoon Season. Monsoon Circulation in the Meridonal (Y-Z) and Zonal (X-Y) Planes, Energy Cycle of Monsoon. Dynamics of Monsoon Depressions and Easterly Waves. intra Seasonal and internal Variability of Monsoon. Quasi-Be Weekly and 30-60 Day Oscillations. ENSO and Dynamical Mechanism for their Existence.

Module-3: **(13 Hours)**

Numerical Methods for Atmospheric Models: Filtering of Sound and Gravity Waves, Filtered Forecast Equations, Basic Concepts of Quasigeostrophic and Primitive Equation Models, One Level and Multi-Level Models. Basic Concepts of initialization and Objective Analysis for Wave Equation, Advection Equation and Diffusion Equation.

Atmospheric Pollution: Role of Meteorology on Atmospheric Pollution, Atmospheric Boundary Layer, Air Stability, Local Wind Structure, Ekman Spiral, Turbulence Boundary Layer Scaling. Residence Time and Reaction Rates of Pollutants, Sulphur Compounds, Nitrogen Compounds, Carbon Compounds, Organic Compounds, Aerosols, Toxic Gases and Radio Active Particles Trace Gases.

Module-4: **(13 Hours)**

Atmospheric instrumentation Systems: Ground Based instruments for the Measurement of Temperature, Pressure, Humidity, Wind and Rainfall Rate. Air Borne instruments-Radisonde, Rawinsonde, Rockestsonde-Satellite instrumentation (Space Borne instruments)

Radar Meteorology: Basic Meteorology-Radar Principles and Technology-Radar Signal Processing and Display-Weather Radar-Observation of Precipitating Systems-Estimation of Precipitation-Radar Observation of Tropical Cyclones, Use of Weather Radar in Aviation, Clear Air Radars-Observation of Clear Air Phenomena-Other Radar Systems and Applications.

References

1. Frederick K.Lutgens and Edward K. Tarbuk (1992) **The Atmosphere** (for chapter I and VI) Dynamic Meteorology by Holton, J.R., 3rd edition, Academic Press N.Y.
2. Haltiner G.J. and R.T.Villians, (1980) **Numerical Weather Prediction**, John Wiley and Sons, (for chapter 4)
3. Henry Saugageot, **Radar Meteorology**
4. Keshvamurthy R.N.and M.Shankar Rao, (1992) **The Physics of Monsoons**, Allied Publishers, (for chapter 3)
5. Tom Lyons and Prillscott, **Principles of Air Pollution Meteorology** by CBS Publishers & Distributors (P) Ltd.

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M.Sc. PHYSICS

SEMESTER-IV

Course Code: (Phy.Ele: IV-4.1)

(Any one of the following Elective 2 courses to be chosen)

CRYSTAL PHYSICS

Module-1: **(13 Hours)**

Scattering of X-Ray: General Description of the Scattering Process: Scattering from a Pair of Points, Scattering from a General Distribution of Point Scatterers, Thomson Scattering, Compton Scattering, Scattering of X-Ray by Atoms. Diffraction from a Crystal: Diffraction from a One Dimensional, Two Dimensional and Three Dimensional Array of Atoms, Crystal Structure Factor, Schematic Absence due to Lattice Type and Symmetry Elements, Diffraction and Fourier Transformation, Electron Density Equation.

Module-2: **(13 Hours)**

Determination of Crystal Structure: Trial and Error Methods, the Patterson Function, isomorphous Replacement Method, Heavy Atom Method, Anomalous Scattering and Applications, inequality Relationships, Sign Relationships, a General Survey of Methods.
Refinement Techniques: Cyclic Fourier Refinement, Difference Fourier Synthesis, Correction for Series Termination, Least Square Refinement, Assessment of Accuracy, Thermal Vibrations.

Module-3: **(13 Hours)**

Crystallography of Macro Molecules: Crystallization, Preparation of isomorophous Heavy Atom Derivatives, Collection of Data, Data Processing, Determination of Heavy Atoms Positions, Calculation of Phases, interpretation of The Electron Density Maps and Refinements.

Module-4: **(13 Hours)**

Crystal Imperfections and Diffusion in Solids: Review of Crystalline Imperfections- Schottky and Frenkel Defects- Equilibrium Concentrations. Line Imperfections- Edge and Screw Dislocations- interactions of Dislocations. Surface Imperfections- Grain Boundary- Tilt and Twin Boundaries- Volume Imperfections. Diffusion in Solids- Fick's Laws of Diffusion- Solution to Fick's Second Law– Error Function. Determination of Diffusion Coefficients- Diffusion Couple. Applications Based on Second Law. Atomic Model of Diffusion- Electrical Conductivity of Ionic Crystals.

References:

1. Azaroff L.V., (1968) **Elements of X-ray Crystallography**, McGraw Hill, New York.
2. Blundell T.L. and L.N. Johnson, **Protein Crystallography**.
3. Burger M.J., (1952) **X-ray Crystallography,** John Wiley, New York.
4. Charles Kittel, (1984) **Solid State Physics**, Wiley Eastern.
5. Dennis Sherwood, **Crystals, X-rays and Proteins.**
6. Duncan M and C. Mike, (1997) **Crystalline Solids,** Nelson, London
7. Michael M Woolfen, (1997) **An introduction to Crystallography**, Cambridge University Press.
8. Santhana Raghavan and Ramaswamy, **Crystal Growth Processes and Methods,** KRU Publications, Kumbakonam.
9. Verma and Srivastava, (1997) **Crystallography for Solid State Physics**, New Age international Ltd.

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M.Sc. PHYSICS

SEMESTER-IV

Course Code: (Phy.Ele: IV-4.2)

SOLAR AND OTHER FORMS OF ENERGY

(13 Hours)

Module-1:

Solar Energy: Fundamentals of Photovoltaic Energy Conversion Physics and Material Properties Basic to Photovoltaic Energy Conversion: Optical Properties of Solids. Direct and indirect Transition Semiconductors, interrelationship Between Absorption Coefficients and Band Gap Recombination of Carriers.

(13 Hours)

Module-2:

Solar Cells

Types of Solar Cells, p n Junction Solar Cell, Transport Equation, Current Density, Open Circuit Voltage and Short Circuit Current, Brief Descriptions of Single Crystal Silicon and Amorphous Silicon Solar Cells, Elementary Ideas of Advanced Solar Cells e.g. Tandem Solar Cells Solid Liquid Junction Solar Cells, Nature of Semiconductor, Electrolyte Junction, Principles of Photoelectrochemical Solar Cells.

(13 Hours)

Module-3:

Hydrogen Energy: Relevance in Relation to Depletion of Fossil Fuels and Environmental Considerations.

Hydrogen Production: Solar Hydrogen Through Photoelectrolysis and Photocatalytic Process. Physics of Material Characteristics for Production of Solar Hydrogen.

Storage of Hydrogen: Brief Discussion of Various Storage Processes, Special Features of Solid State Hydrogen Storage Materials, Structural and Electronic Characteristics of Storage Materials. New Storage Modes.

(13 Hours)

Module-4:

Safety and Utilisation of Hydrogen: Various Factors Relevant to Safety, Use of Hydrogen as Fuel, Use in Vehicular Transport, Hydrogen for Electricity Generation, Fuel Cells, Elementary Concepts of Other Hydrogen Based Devices Such as Air Conditioners and Hydride Batteries.

Other Renewable Clean Energies: Elements of Solar thermal Energy, Wind Energy and Ocean thermal Energy Conversion. Tidal Energy.

References:

1. Chandra, **Photoeloectrochemical Solar Cells**
2. Fahrenbruch & Bube, **Fundamentals of Solar Cells Photovoltaic Solar Energy**
3. Fonash, **Solar Cell Devices**, Physics
4. Winter & Nitch (Eds.), **Hydrogen as an Energy Carrier Technologies Systems Economy,**

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M.Sc. PHYSICS

SEMESTER-IV

Course Code: (Phy.Ele: IV-4.3)

SPACE PHYSICS

Module-1: **(13 Hours)**

The Sun and Its Emissions.

Solar Atmosphere, Solar Corona, EM Radiations from the Sun, Solar Cycles, Solar Energy Particles, Solar Wind, Solar Flares, Coronal Mass Ejections, The Planetary System

Major Characteristics of Planets, Bulk Atmospheric Composition, Planetary Magnetism, Magnetic Dipole, Tilted Dipole Models, Spherical Harmonic Models, Magnetic Fields of Outer Planets

Module-2: **(13 Hours)**

Solar Wind Interactions

MHD Equations, Alfven Waves, Frozen in Field, Planetary Bow Shocks, interaction with Magnetized Planets, Plasma Sources in Magnetosphere, Plasma Acceleration, Jovian Magnetosphere, Plasma Flow in Magnetosphere, Magnetosphere-Ionosphere Coupling, Interaction with Non-Magnetised Planets, Motion of Charged Particles in Electromagnetic Field.

Module-3: **(13 Hours)**

Energy Deposition by Charged Particles

Collision Cross Section, Fermi Golden Rule, Semi Empirical Electron Impact Cross Sections, Energy Deposition Techniques, Analytic Loss Functions, Montecarlo Techniques, Analytical Yield Spectrum, Charge Transfer, Electronic Recombination.

Module-4: **(13 Hours)**

Planetary Atmospheres

Hydrostatic Equation, Eddy and Molecular Diffusion, Eddy Diffusion Coefficient, thermal Structure, Radiative Transfer Concepts, Density of Radiation, Emission and Absorption Coefficients,

Equation of Transfer, Plane Parallel Atmosphere, Occultation Techniques, Atmospheric Gravity Waves, Atmospheric Temperature of Planets, Upper Atmospheric Composition

References:

1. Clemmow and Dougherty, (1969) **Electrodynamics of Particles and Plasmas,** Addison Wesley.
2. Fundamentals of Aeronomy, (1971) Wiley, NY.
3. Grant Athay R, (1976) **The Solar Chromosphere and Corona** , D Reidel Publishing,
4. Kuiper G P, (1952) **The Atmospheres of Earth and Planets,** University of Chicago.
5. Singhal R P, (2009)Elements of Space Physics, PHI,.

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Course Code: (Phy.Pra: IV-1)

SPECIAL CONDENSED MATTER PHYSICS LAB

List of Experiments

1. Analysis of X-ray diffractogram and estimation of R-factor (Sample: NaCl)
2. Analysis of X-ray diffractogram and estimation of R-factor (Sample: KCl)
3. Analysis of X-ray powder photograph (Cu-backward reflection)
4. Analysis of X-ray powder photograph (KBr)
5. Analysis of X-ray powder photograph (NaCl)
6. Electrical resistivity of thin films by four probe method and its temperature dependence (Cu, Al, Si)
7. Determination of a) optical constants and k b) energy gap using transmission data of ZnO-B_2O_3-V_2O_5 thin film
8. Determination of a) optical constants and k b) energy gap using transmission data of ZnO-P_2O_5 -V_2O_5 thin film
9. Temperature variation of dielectric constant and determination of Curie point of a Ferro electric solid-Lead Ziconate Titanate.
10. Magnetic susceptibility of Ferrous ammonium sulphate by Gouy's balance method.
11. Experimental determination of hall coefficient and charge carriers.

SEMESTER-IV

Course Code: (Phy.Ele: IV-2)

ATMOSPHERIC AND ENERGY PHYSICS LAB

List of Experiments

1. Measurement of temperature by wet and dry bulb thermometers and estimation of humidity of the atmosphere.
2. Measurement of relative humidity of the atmosphere using whirling hygrometer and comparison with theoretical values.
3. Measurement and analysis of atmospheric pressure and isobars.
4. Study and plotting of temperature, pressure and humidity contours using the given experimental data.
5. Study of isobaric maps and pressure gradient from the given experimental data.
6. Estimation of saturation vapour pressure, dew point temperature, relative humidity and mixing ratio by measuring temperature and humidity.
7. Measurement and analysis of solar radiation as a function of time using sunshine recorder.
8. Measurement and analysis of wind speed by anemometer and wind direction by wind wane.
9. Estimation of abundance of sodium in solar atmosphere using Fraunhofer absorption lines in solar spectrum.
10. Measurement of absorption spectrum of the earth's atmosphere for O_2, O_3, H_2O, CO_2 etc.
11. Determination of extinction coefficient of earth's atmosphere using Beer's law with the help of given data.
12. Analysis and plotting of Meteorological data obtained from sensors.
13. Analysis of satellite data of vegetation, soil and water bodies of the earth's surface.
14. To study the I-V characteristics of a solar cell.
15. Efficiency of solar cells
16. Solar constant determination

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