GOBI ARTS & SCIENCE COLLEGE (AUTONOMOUS) : GOBICHETTIPALAYAM

SCHEME OF EXAMINATIONS - M.Sc. (PHYSICS) (17 BATCH)

No.	Code	Subject Title	Hrs	CIA	EOSE	Total	Credit
		SEMESTER : 1					
1	17P3PH01	CLASSICAL MECHANICS AND STATISTICAL MECHANICS	3	30	70	100	5.0
2	17P3PH02	MATHEMATICAL PHYSICS - I	3	30	70	100	5.0
3	17P3PH03	NUCLEAR AND PARTICLE PHYSICS	3	30	70	100	5.0
4	17P3PH04	SPECIAL ELECTRONICS-I (ANALOG & DIGITAL ELECTRONICS)	3	30	70	100	5.0
		SEMESTER : 2					
5	17P3PH05	MATHEMATICAL PHYSICS - II	3	30	70	100	5.0
6	17P3PH06	ELECTROMAGNETIC THEORY AND ELECTRODYNAMICS	3	30	70	100	5.0
7	17P3PH07	MODERN OPTICS	3	30	70	100	5.0
8	17P3PH08	ELECTIVE - I	3	30	70	100	5.0
9	17P3PHPA	PRACTICAL - I GENERAL EXPERIMENTS	4	30	70	100	4.0
10	17P3PHPB	PRACTICAL - II ELECTRONICS EXPERIMENTS	4	30	70	100	4.0
		SEMESTER : 3					
11	17P3PH09	QUANTUM MECHANICS – I	3	30	70	100	5.0
12	17P3PH10	CONDENSED MATTER PHYSICS	3	30	70	100	5.0
13	17P3PH11	ATOMIC AND MOLECULAR SPECTROSCOPY	3	30	70	100	5.0
14		SUPPORTIVE PAPER	3	30	70	100	4.0
		SEMESTER : 4					
15	17P3PH12	QUANTUM MECHANICS – II	3	30	70	100	5.0
16	17P3PH13	ELECTIVE-II	3	30	70	100	5.0
17	17P3PHPC	PRACTICAL - III ADVANCED EXPERIMENTS	6	30	70	100	4.0
18	17P3PHPD	PRACTICAL - IV SPECIAL ELECTRONICS EXPERIMENTS	6	30	70	100	4.0
19	17P3PHV1	PROJECT VIVA-VOCE			100	100	5.0

TOTAL CREDITS : 90

LIST OF ELECTIVE PAPERS:

1. THIN FILM PHYSICS & NANO SCIENCE
2. CRYSTAL GROWTH TECHNIQUES
3. PLASMA PHYSICS
4. NUMERICAL METHODS AND PROGRAMMING

SEMESTER - I
PAPER - I
CLASSICAL MECHANICS AND STATISTICAL MECHANICS

Instructional Hrs: 75

Objectives:
1. **Learn to use Newton's Laws of motion to solve advanced problems involving the dynamic motion of classical mechanical system.**
2. **Know to use conservation of energy and linear angular momentum to solve dynamic problems.**
3. **Study to use the equation of motion for complicated mechanical systems using Lagrangian and Hamiltonian formulation.**

Unit – I **15Hrs**

Lagrangian Formulation:

Basic concepts of constraints and Generalized Co-ordinates: D'Alembert's principle and Lagrangian equation – Velocity dependent potential – Application of Lagrangian formulation - Simple Harmonic Motion - Wood Machine.

Motion under central force:

Equivalent one body problem – the equation of motion and first integrals – condition for closed orbits –Inverse square law of force – Kepler's law of planetary motion-Virial theorem.

Hamiltonian Formulation

Cyclic co-ordinates and conservation theorem (linear momentum, angular momentum)- significance of translation and rotation cyclic co-ordinates- Hamiltonian function (H)- conservation of energy- Hamilton's equation of motion, applications (Harmonic oscillator, Motion of particles in a central force field).

Unit – II **15 Hrs**

Rigid Body Dynamics and small oscillations, Hamiltonian mechanics:

Space and body fixed axis – Angular momentum & torque – Euler angels – Moments and products of Inertia – Principle axes transformation – Rotational kinetic energy – The motion of a Symmetric top, Expression for slow & fast precession only.

Small Oscillations:

Formulation of the problem – The Eigen value equation and the principle axis transformation – Frequencies of free vibration and normal co-ordinates – Linear triatomic molecule.

Hamiltonian Dynamics:

Cyclic co ordinates-Hamilton's canonical equation of motion-generating function - condition for transformations –Poisson bracket – invariance of Poisson bracket with respect to canonical transformation- Hamilton Jacobi theory

UNIT - III **15Hrs**

Ensembles:

Phase space - concepts of ensembles-types of ensembles-Micro canonical ensembles: ideal gas - Gibb's paradox- Entropy & probability-Canonical ensemble- ideal gas in canonical ensemble-grand canonical ensemble-ideal gas in grand canonical ensembles

Partition Function:

Canonical partition function – Molecular partition function- Translation partition function – rotational partition function-Vibrational partition function.

UNIT – IV **15Hrs**

Classical Statistics:

Introduction:

Phase space - volume in phase space - volume occupied by a quantum state - number of cells in a given energy range of Harmonic oscillator- numbers of phase cells in the given energy range - constraints and accessible states -Boltzmann entropy relation.

Maxwell - Boltzmann Distribution:

Microstates and Macro states - Number of microstates accessible to macroscope system (eg. Particle in one dimensional box) - Maxwell-Boltzmann distribution law - Evaluation of constants - Condition for the applicability of M-B statistics -Limitations of M-B statistics.

Applications:

Total internal energy and specific heat at constant volume - M-B speed distribution law - Most probable, Mean and Root mean square speeds - Entropy and Equation of state of an ideal gas.

UNIT-V **15Hrs**

Quantum Statistics:

Bose-Einstein Statistics:

Bose-Einstein distribution law - Energy distribution for energies in the range E and E+dE - Condition for the B-E distribution to approach classical M-B distribution - B-E condensation- Derivation of Plank's law from B-E distribution.

Fermi- Dirac Statistics:

Fermi-Dirac distribution law -F-D law for energies in the range E and E+dE -Fermi energy- Effect of temperature - Energy distribution curve - Fermi energy for free electron in a metal - Expression for mean kinetic energy of electrons in a metal at absolute zero.

Books for Study:

UNIT- I & II

1. Classical Mechanics - Herbert Goldstein, Charles Poole & John Safko 3rd Edition, Pearson Education in South India
2. Classical Mechanics -Gupta, Kumar and Sharma, 21St Edition, Pragati prakasan, Meerut.

UNIT - III

1. Classical Mechanics - J.C.Upadhyaya, lst Edition, Himalaya publishing House.

UNIT –III, IV& V

1. Statistical Mechanics , B.K.Agarwal,Melvin Eisner,2nd Edition ,New Age international (P) Ltd.
2. Statistical Mechanics & properties of matter by ESR Gopal- Student Edition (Ellis Horwood)
3. Elements of Statistical Mechanics by Miss Kamal singh and S.P.Singh 3rd Edition, S.Chand & Company
4. Statistical Mechanics - Gupta, Kumar, Pragati pragasan, Meerut.

Books for Reference:

1. Classical Mechanics - Sathya Prakash, Kedar Nath and Ram Nath & co
2. Classical Mecanics - K.Sankara Rao

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SEMESTER -I
PAPER-II

MATHEMATICAL PHYSICS - I

Instructional Hrs: 75

Objectives: 1. To understand the fundamental concepts in Vector calculus and Linear vector space.

2. To lay a strong foundation in Fourier & Laplace transforms.

3. To know the need and the use of numerical methods in solving Physics problems.

Unit-I **15Hrs**

Vector Calculus and Linear Vector Space:

Line, surface and Volume integrals - Important vector Identities - Gauss divergence theorem - proof- Stoke's theorem -proof-Green theorem- proof-Green theorem in a plane - Classification of vector fields.

Orthogonal curvilinear Co-ordinates - Gradient, divergence, Curl, Laplacian in curvilinear Co-ordinates - Differential operators in spherical Polar Co-ordinates & Cylindrical Co-ordinates.

Linear Vector space - Linear independence of Vectors & Dimensions - Basis and expansion theorem - inner product and unitary spaces - Orthonormal sets - Schmidt Orthogonalization method

Unit-II **15Hrs**

Laplace Transforms and Fourier Series

Definition of Laplace transform - properties of Laplace transforms -Linearity property - Translation property - Inverse Laplace Transformation -properties of inverse Laplace Transform - solving simple second order differential equation.

Fourier series - Dirichlet's theorem - change of interval - complex form - Fourier series the interval (O, T)- uses of Fourier series.

Unit-III **15Hrs**

Complex Variable Theory:

Functions of a complex variable single and multivalued functions- The Cauchy - Riemann differential equation- analytic functions -line integrals of complex function- Cauchy's integral theorem and integral formula - derivatives of an analytic function - Taylor's variable - Laurent's series - Residue and Cauchy's residue theorem - application to the equation of definite integral - Conformal transformation.

Unit-IV **15Hrs**

Special Functions and their Properties:

Legendre's polynomials and functions - Differential equations and solutions - Rodrigue's formula - Generating functions - Orthogonality - Relation between Legendre polynomial and their derivatives - recurrence relations - Bessel's functions - Differential equation and solution - generating functions - recurrence relations.

Unit-V **15Hrs**

Curve Fitting & Numerical Methods:

The method of least squares – curve fitting - straight line, non–linear equations - Bisection and Newton- Raphson method of finding roots of the equations - solution of simultaneous linear equation by Guass elimination method- solution of ordinary differential equation by Euler method and Runge -Kutta second and fourth order method - Evaluation of integral by means of Simpson's one third rule - Trapezoidal rule.

Books for study:

Unit I, II, III & IV - Mathematical physics - Sathya Prakash - Sultan Chand & Sons -2000
Unit - V - Numerical methods - P.Kandasamy, K.Thilagavathy, K.Gunavathy, (First edition), S. Chand & Company Ltd.

Books for Reference:

1. Mathematical Physics - B.D.Gupta (Second Revised Edition), Vikas Publishing house (P) Ltd.
2. Mathematical Physics - B.S.Rajput - Pragati Prakashan - Meerut - 1996.
3. Mathematical Physics - H.K.Dass - S.Chand & Co.
4. Essential Mathematical methods for Physicists - Hans. J. Weber and George B. Arfken Academic Press (ELSEVIER)
5. Mathematics for Physicists, Susan M. Lea, Thomson Brooks / Cole.
6. Mathematical methods of Physics (second edition) - Jon Mathews, R.L. Walker Pearson Education.
7. Mathematical Methods in the Physical sciences (Third Edition) - Mary L. Boas Wiley India Pvt. Ltd., New Delhi.
8. Mathematical methods for Physics and Engineering (Second Edition) K.F. Riley, M.P. Hobson, S.J. Bence, Cambridge university press.
9. Applied Mathematics for Engineers &Physicists -Pipes and Harvill McGraw Hill International Book company .
10. Higher Engineering Mathematics (37^{th} Edition) - Dr. B.S. Grewal, Khanna Publishers, New Delhi.
11. Advanced Engineering Mathematics -R.K.Jain and S.R.K Iyengar Narosa Publishing house, New Delhi.
12. Advanced Engineering Mathematics - Erwin Kreyszig, Willey Eastern Ltd.
13. Numerical Methods - A. Singaravelu, Meenakshi Publishing - 2000.
14. Numerical Methods in Science & Engineering - M.K.Venkataraman ,National Publishing Co., Chennai.

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SEMESTER - I

PAPER - III

NUCLEAR AND PARTICLE PHYSICS

Instructional Hrs: 75

Objectives: 1. To understand the concept of nuclear binding energy and calculate the binding energy for different nuclei.

2. To distinguish between the different types of radioactive decays and compute the daughter nuclei for these decays.

3. To appreciate nuclear interactions and interaction with matter.

Unit - I General properties of Atomic Nucleus: 15 Hrs

Distribution of Nuclear charge - Scattering of α particles (Rutherford's Scattering formula and its Experimental verification) - Nuclear size and its determination: life time of α emitters, Anomalous scattering of α particles, Scattering of neutrons - nuclear reaction by charged particles - Mass spectroscopy: Bainbridge & Jordan Mass spectrograph - Neir's Mass Spectrometer - Theories of Nuclear composition (Proton - electron, proton - neutron) - Binding energy (Nuclear Stability) - Semi empirical mass formula - Quantum numbers for Individual nucleons - Quantum properties of Nuclear states.

Unit - II Radio Activity: 15 Hrs

Alpha decay: Properties of α particles - velocity and energy of α particles - Gamow's theory of α decay - Geiger Nuttal law - α ray energies and fine structure of α rays.

Beta decay: Properties of β particles - General features of β decay spectrum - Pauli's hypothesis - Fermi's theory of β decay (neutrino's theory of β decay) - forms of interaction & selection rules - K capture.

Gamma decay: Properties of γ particles - The absorption of gamma rays by matter - interaction of Gamma rays with matter - measurement of Gamma ray energies - Dumond bent crystal spectrometer method - Internal conversion.

Unit - III Nuclear Models:

15Hrs

Introduction to nuclear models - The liquid drop model - The shell model - Collective model.

Nuclear Reaction: Kinds of Nuclear reactions - Conservation laws - Nuclear reaction Kinematics - Nuclear cross section - cross section of a Nuclear reaction - continuum theory of Nuclear reactions - resonance: Breit - Wigner dispersion formula - different stages of Nuclear reaction - statistical theory of Nuclear reactions - Kinematics of stripping & pickup reactions.

Unit - IV Nuclear Fission Reactors: 15 Hrs

General aspects of reactor design-classification of Reactors:Research Reactors (Water boiler,swimming pool,Light water moderator)-Production Reactors-Power Reactors (Pressurized water,Boiling water,Heavy water moderated,Organic moderated,Gas cooler)-Fast Reactors.

Unit - V Particle Physics: 15 Hrs

Introduction to particle physics - classification of elementary particles - Fundamentals interaction - Properties of Elementary particles - Bosons - Leptons - Mesons - π mesons - K mesons - C.P. Violation in neutral K-meson decay - Baryons - Detection of Antiproton - The eight fold way - Quarks.

Books for Study:

UNIT I,II, III,IV - Nuclear Physics - D.C.Tayal, Himalaya Publishing House.
UNIT III,V - Elements of Nuclear Physics - M.L.Pandya & R.P.S.Yadav, Kedar Nath & Ram Nath & Co.

Book for Reference:

1. Nuclear & Particle Physics - K.L. Kakani, Viva Book Private Limited.
2. Concept of Nuclear physics - Bernard L.Cohen Tata McGraw Hill Publishing Company.
3. Nuclear Physics - Irving Kaplan - Narosa Publishing house.
4. Basic Nuclear physics - N.N.Srivasta - Pragati Prakashan - Meerut.
5. Nuclear Physics Theory and Experiment - R.R.Roy & B.P.Nigam - New Age International (P) Limited, Publishers.
6. Modern Physics - R.Murugeshan - S.Chand & Company Ltd, New Delhi.
7. Nuclear Physics - R.C.Sharma - K.Nath & Co.

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SEMESTER -I
PAPER-IV
SPECIAL ELECTRONICS - I

(Analog and Digital Electronics)

Instructional Hrs: 75

Objectives: 1. To gain the knowledge of applications of transistor at low & high frequencies.

2. To have strong foundation in designing analog circuits.

3. To be familiar with various uses of Op-Amps.

Unit - I Transistor at Low Frequencies: 15Hrs

The hybrid parameters - Determination of h-parameters - h-parameter equivalent circuit - performance of a linear circuit in h- parameters - the h-parameters of a transistor - Nomenclature for transistor h- parameters- transistor circuit performance in h-parameters- Experimental determination of h- parameters- Limitations of h-parameters.

Transistor at High Frequencies:

The Hybrid - pi (**π**) common - emitter Transistor model - Hybrid (**π**) conductances hybrid (**π**) capacitances - validity of hybrid (**π**) model - variation of hybrid (**π**) parameters - CE short circuit current gain- single stage CE Transistor Amplifier Response.

Unit -II Feedback Amplifier: 15Hrs

Feedback concept - general characteristics of negative - feedback amplifiers - input and output resistance - method of analysis of a feedback amplifier - voltage series feed back - current- series feedback - current- shunt feedback - voltage- shunt feedback.

Oscillators :

Sinusoidal Oscillators : Introduction-Hartley Oscillator- Colpitt's oscillator -Crystal oscillator - phase shift oscillator – Wein's bridge oscillator

Non-Sinusoidal Oscillators: Multivibrators - Schmitt Trigger - square wave and triangular wave generators.

Field Effect Transistors and Thyristors:

JFET- Formation of depletion region-Operation of JFET- Characteristics of JFET- JFET parameters- Comparison between JFET and BJT- MOSFET- Depletion type and Enhancement type MOSFET- Characteristics of Depletion type MOSFET-SCR- Operation-Turning ON and OFF of SCR- V-I Characteristics - IMPATT Diode.

Unit -III Operational Amplifier and its Applications: 15Hrs

Parameters of OP - AMP- sign changer - phase shifter- Adder - Subtractor - Integrator – Differentiator- Active filters - solving linear simultaneous equation - solving linear differential equations.

Log amplifier - Antilog amplifier - Voltage to current converter - current to voltage converter - Instrumentation Amplifier-Triangular Wave Oscillator-Square Wave relaxation

oscillator.

Unit - IV Data Processing and Data Acquisition: 15Hrs

555 IC Timer -555 IC as Schmitt Trigger - Multiplexer and Demultiplexer - Decoder- Encoder- Sample and Hold system - Binary Weighted Resistor D/A converter - R-2R Resistive ladder D/A converter - Counter type A/D Converter - Successive approximation A/D Converter - Dual slope ADC- Parallel comparator A/D converter.

Unit -V Counters, Registers and Memory: 15Hrs

Counters: Asynchronous counter operation - Mod 4 counters - synchronous counter operation - Mod 3, Mod 5Counters - Up / down synchronous counters - cascaded counters.
Registers: Basis shift register functions - serial in / serial out shift registers- serial in / parallel out shift registers - Bidirectional shift registers - shift register counters.

Memory and storage: Random access memories - Read only Memories - Programmable ROMs (PROMs and EPROMs) - Flash Memories - Memory Expansion.

Books for Study:

UNIT I -1. Integrated Electronics - Milliman & Halkias

2. Principles of Electronics - V.K.Mehta & Rohit Mehta S.Chand & Co, New Delhi

UNIT II & III - A Text Book of Applied Electronics- Dr.R.S.Sedha S.Chand & Co, New Delhi.

UNIT III,IV &V - Introduction to Integrated Electronics - V.Vijayendran

Book for Reference:
1. Digital Fundamentals - Floyd
2. Fundamentals of Digital Electronics - Malvino & Leach

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SEMESTER - II
PAPER - V
MATHEMATICAL PHYSICS - II

Instructional Hrs: 75

Objectives: 1. To acquire mathematical knowledge and apply it to various physical problems.

2. To practice Mathematical methods for Physics through Matrices, tensors.

3. To develop problem solving ability related to physical problems.

UNIT - I Matrices 15 Hrs

Various types of Matrices (Review only)- Consistency of linear system of Equations and their solutions-Solution of Simultaneous Equations -Types of Linear Equations -Homogeneous Equations -Cramer's Rule - Characteristic roots or Eigen values- Cayley - Hamilton theorem - Characteristic Vectors or Eigen Vectors - properties of Eigen Vectors - Orthogonal Vectors - Diagonalisation of a Matrix - Theorem on Diagonalisation of a Matrix - Hermition , Skew Hermition and Unitary Matrices.

UNIT - II Tensors 15 Hrs

Introduction - n-dimensional space - Subscripts & superscripts- Co-ordinate Transformation - Indicial & Summation conventions - Dummy & Real indices- Kronecker Delta symbol - Scalars - Contravariant Vectors & Covariant Vectors - Tensors of Higher ranks - Algebric operations of Tensors - Symmetric & Antisymmetric Tensors - Invariant Tensors - Levi civita symbol - applications to physical problems.

UNIT - III Differential Equations 15 Hrs

Linear Differential equations of second order with constant co-efficients - Introduction - Complementary function - Particular integral - Method of finding the Complementary function - Rules to find Particular integrals - Linear Partial Differential Equations - Method of Seperation of Variables - Examples: Equation of Vibrating string - One Dimensional Heat flow - Laplace Equation.

UNIT - IV Hermite, Laguerres Function, Gamma,Beta functions 15 Hrs

Hermite's Equation - Generating function - Orthogonal Property - Recurrence Relation -Laguerre's function -Generating function - Orthogonal Property - Recurrence Relation - Gamma function - Transformation of Gamma function - Beta function - Evaluation of Beta function - A property of Beta function - Transformation of Beta function - Relation between Beta & Gamma functions - Problems involving Gamma & Beta Functions.

UNIT -V Group Theory 15 Hrs

Concept of a Group- Abelian Group - The cyclic Group - The Group multiplication table - Rearrangement theorem - Isomorphism and Homomorphism - Permutation Groups - Cayley's Theorem - The Group of symmetry of equilateral Triangle - Group of symmetry of a square - Representation of Groups - Reducible and irreducible Representations - Schur's Lemma I and II - Orthogonality Theorem.

Books for study:

Unit I , III & IV : Mathematical Physics - H.K.Dass - S.Chand & Co.

Unit II & V : Mathematical Physics - Sathya Prakash - Sultan Chand& Sons Co.

Book for Reference:

1. Mathematical Physics - B.D.Gupta (Second Revised Edition), Vikas Publishing house (P) Ltd.
2. Mathematical Physics - B.S.Rajput - Pragati Prakashan - Meerut - 1996.
3. Mathematical Methods in the Physical sciences (Third Edition) - Mary L. Boas Wiley India Pvt. Ltd., New Delhi.
4. Mathematical methods for physics and Engineering (Second Edition) K.F. Riley, M.P. Hobson, S.J. Bence, Cambridge university press.
5. Applied Mathematics for engineers &Physicists -Pipes and Harvill McGraw Hill International Book company.

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SEMESTER – II
PAPER-VI

ELECTROMAGNETIC THEORY AND ELECTRODYNAMICS

Instructional Hrs: 75

Objectives: 1. To gain an insight into the physical nature of elastic & magnetic phenomena.

2. To understand the relationship between electric & magnetic fields.

3. To appreciate the study of Electromagnetic wave propagation.

Unit - I Electrostatics and Magneto Statics: 15Hrs

Potential and field due to an electric dipole - dielectric polarization - external field of a dielectric medium - Gauss's theorem in a dielectric - the electric displacement vector(D)- linear dielectrics - relations connecting electric susceptibility and dielectric constants- Clausius -Mosotti relation.

Electrostatic energy and energy density- Biot - Savart's law statement -Applications: Magnetic field due to a Long straight wire, Circular coil, Solenoid - Ampere's circuital law - Applications: Magnetic field due to a Long straight wire, Solenoid, Toroid - Divergence and curl of B - Magnetic scalar potential (derivation of expression only) - Equivalence of a small current loop and a magnetic dipole - Magnetic vector potential (derivation of expression only)

Unit - II
Field Equation and Conservation laws 15Hrs

Equation of continuity - Displacement currents - The Maxwell's equation derivation - Physical significance - Poynting vector - Momentum in electromagnetic field - Electromagnetic potentials - Maxwell's equation in electro magnetic potentials - Concept of gauge - Lorentz gauge - Coulomb gauge - radiation produced by a low velocity accelerated charged particle (Larmour formula)

Unit - III Propagation of electromagnetic waves: 15Hrs

Electro Magnetic waves in free space poynting vector of free space (energy flow) - electromagnetic waves in matter - isotropic dielectric - anisotropic dielectric - conducting media - poynting vector in conducting media - propagation in ionized gases.

Interaction of Electromagnetic waves with matter on Macroscopic scale & Microscopic scale:

Boundary conditions at interfaces - reflection and refraction - Frenel's law - Brewster's law and degree of polarization - total internal reflection and critical angle - Scattering and Scattering parameters - Scattering by a free electron (Thomson Scattering) - Scattering by a bound electron (Rayleigh Scattering)

Unit - IV The fields of Moving charges and Radiations: 15Hrs

Retarded potentials - Lienard - Wiechert potentials - field of a point charge in uniform rectilinear motion - Radiation from an accelerated charged particle at low velocity - Radiation from an accelerated charged particle at high velocity.

Radiating system:

Oscillating electric dipole - Radiation from an oscillating dipole - Radiation from small current element.

Unit - V Relativistic Electrodynamics: 15Hrs

Four Vectors and Tensors - Transformation equation for charge density δ and current density J - Transformation equation for A and φ - The Electromagnetic field Tensor - Transformation equations for field vector E and B - covariance of Maxwell equations in 4 - vector from - covariance and Maxwell equations in 4 tensor form - covariance and transformation law of Lorentz force.

Book for study:

UNIT I,II,III,IV,V - Electromagnetic theory - Chopra & Agarwal (K.nàth & Co)

Book for Reference:

1. Foundations of Electro magnetic theory - Reitz Milliford & Christy
- Narosa Publishing house
2. Introduction to Electrodynamics - David J. Griffiths
- Pearson education, Prentice Hall of India.
3. Electrodynamics - Gupta, Kumar, Singh (Pragati Prakashan, Meerut)
4. Electromagnetic theory & Electrodynamics - Satya Prakash - Kedar Nath Ram Nath & Co.
5. Classical Electrodynamics - J.D.Jackson - Willey - Eastern Ltd.

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SEMESTER - II
PAPER - VII
MODERN OPTICS

Instructional Hrs: 75

Objectives: 1. To know the phenomena of Coherence and interference.

2. To understand the Concept of fiber optics.

3. To appreciate the study of Nonlinear optics and Laser Optics.

Unit -I Propogation and nature of Light 15 Hrs

Phase Velocity- Group Velocity - Doppler effect- Energy Flow - Linear Polarization - Matrix Representation of Polarization(Jones Calculus) - Reflection and Refraction at a plane Boundary - Amplitudes of reflected and Refracted waves - Brewster angle - Phase changes in total internal Reflection.

Unit - II Coherence and Interference 15 Hrs

Theory of Partial Coherent light - Visibility of fringes - Coherent Time and Coherent Length - Spatial Coherence - Fourier Transform Spectroscopy - Interference with multiple beam - Theory of Multilayer films.

Unit – III Laser Optics 15 Hrs

Laser rate equations - Three level system - Four level system - Population Inversion - Optical Resonators - Ruby Laser - He-Ne Laser- Carbon dioxide Laser- Four level solid Laser - Semiconductor Laser- Holography - Theory of Holography - Applications: Communication and Medicine.

Unit - IV Nonlinear Optics 15 Hrs

Nonlinear Response - Nonlinear phenomenon and harmonic Generation - Phase Matching - Susceptibility Tensors - Parametric Amplifications - Monley- Row Relation - Self Focusing - Theory of Self Focusing - Theory of Laser Raman Spectroscopy.

Unit - V Fiber Optics 15 Hrs

Basic Optical Laws and Definition - Optical Fiber Modes and Configuration - Step index and Graded index fiber structure - Fiber Materials - Fiber Fabrication - Mechanical properties of Fibers - Fiber Optic Communication - Wavelength Division Multiplexing (WDM) - Local Area Network (LAN) - Optical Fiber Bus - Nonlinear Optical Effects.

Books for Study:

UNIT I, II - Introduction to Modern Optics - Grant R.Fowles, Halt, Rineharand Winston, Inc New York.

UNIT III - Lasers Theory and Applications - Thyagarajan and Ghatak, Macmillan Publishers.

UNIT IV - Essential of Laser and Nonlinear Optics - G.D.Barugh, Pragati Prakasan Meerut,2000.

UNIT V - Optical Fiber Communication - Gerd Keiser - Mc GrawHill.

Books for Reference:

1. Principles of Optics - Born and Wolf - Pergman Press, 1997.
2. Introduction to Optical Fibers - Cherin, Mc GrawHill, 1997.

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PRACTICAL - I GENERAL EXPERIMENTS

(Examination at the End of II Semester)

Instructional Hrs: 40
Objectives: 1. To learn some basic experimental techniques.

2. To verify some fundamental laws of physics and to measure different physical quantities.

Any Twelve Experiments:

1. Young's Modulus - Elliptical Fringes by Cornu's Method.

2. Young's Modulus - Hyperbolic Fringes by Cornu's Method

3. Viscosity of liquids - Mayer's Oscillating Disc

4. Thermal Conductivity - Forbe's Method

5. Copper Arc Spectrum - Constant Deviation Spectrograph

6. Iron Arc Spectrum - Constant Deviation Spectrograph

7. Determination of the specific charge 'e/m' - Thomson's Method

8. Temperature Co-efficient and Band gap energy of a Thermistor

9. Rotational Power of liquids using Polarimeter

10. Determination of λ and d λ of Sodium Light - Fabry -Perot Interferometer

11. Determination of Plank's Constant

12. Study of Laser Beam parameters

13. Laser Diffraction at a Circular Aperture

14. Characteristics of Geiger-Muller tube

15. Determination of Solar Constant

16. Determination of Dipole moment for various Liquids.

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PRACTICAL -II ELECTRONICS EXPERIMENTS

(Examination at the End of II Semester)

Instructional Hrs: 40

Objectives: 1. To construct different electronic circuits using Op – Amp.

2. To study the function of logic gates using digital IC's.

3. To construct the Monostable, Astable and Linear oscillator and study its output waveforms.

Any Twelve Experiments:

1. IC Regulated Dual Power Supply construction

2. Logic Gates related experiments using digital IC's

3. UJT Relaxation Oscillator

4. Parameters of Op-Amp

5. IC 7483 - Arithmetic Operations.

6. Sign changer, Scale changer, Adder and Subtractor - Op-Amp

7. Half & Full wave, Pear value, Clipper, Clamper - Op-amp

8. Differential Amplifier - Op-Amp

9. Current Amplifier - Op-Amp

10. Wave form generators - 8038 Chip

11. Phase Shift oscillator - Op-Amp

12. Wein's bridge oscillator - Op-Amp

13. Active Filters - Op-Amp

14. Schmitt Trigger - Op-Amp

15. Differentiating, Integrating, Clipping, Clamping - Op-Amp

16. Source Follower and Voltage follower- Op-Amp

17. Solving Simultaneous Equations - Op-Amp

18. Astable & Monostable Multivibrators - IC 555

19. Parity Generator and Checking

20. Shift Register - Digital IC's

21. Characteristics of FET

22. Decade Counter

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SEMESTER - III
PAPER -VIII
QUANTUM MECHANICS – I

Instructional Hrs: 75
Objectives: 1. To appreciate the development of Wave Mechanics for the description

of particles.

2. **To understand the perturbation methods.**
3. **To understand quantum theory of scattering.**

Unit -I The Schröedinger Equation and Stationary States: 15Hrs

Introduction – operators: Hermitian operators – properties – Heisenberg'sUncertainty Principle -Schröedinger equation – Physical interpretation and conditions on the wave function–postulates – Expectation values and Ehrenfest theorem – stationary states and energy spectra – Linear harmonic oscillator.

Unit -II Application of Schröedinger Equation to Three Dimensional Problems: 15Hrs

The free particle -particle in a box- Free axis rigid rotator - Quantum numbers - spherically symmetric system -The hydrogen atom (Hydrogen like atoms) -The normal state of hydrogen atom - Hydrogen like wave functions and their discussion - Total angular momentum and spherical harmonics - Three dimensional square well potential - Free particle in spherical polar Co-ordinates -Expansion of a plane wave in spherical harmonics - Three dimensional harmonic oscillator - solution in spherical Co-ordinates.

Unit -III Time independent perturbation theory and approximate methods: 15Hrs

Time independent perturbation theory for Non-degenerate levels - perturbed harmonic oscillator - normal helium atom - first order peturbation theory for degenerate level - first order stark effect in Hydrogen - W.K.B approximation - validity of W.K.B approximation - Turning points & Connection formulae - variation method and its application to the ground state energy of the hydrogen atom.

Unit - IV Time dependent perturbation theory 15Hrs

Time dependent perturbation theory - first and second order transitions -transition to continum (Fermi Golden Rule) - Harmonic perturbation - emission and absorption of radiation - selection rules for simple harmonic oscillator - Adiabatic & sudden perturbations Scattering by a potential & inelastic scattering.

UNIT- V Quantum Theory of Scattering: 15Hrs

Scattering amplitude - Definitions of cross-sections: Differential scattering cross-section- Total scattering cross-section - Scattering by spherically symmetric potentials: Partial wave analysis - Born approximation - validity of Born Approximation - applications of Born

Approximation: Scattering by square well potential - Scattering by a screened coulomb potential.

Books for study:

UNIT I: Introduction to Quantum Mechanics- David J. Griffiths

UNIT II,III,IV&V:1. Quantum Mechanics - Gupta. Kumar. Sharma, Jai Prakash

Nath&Co.

2. Quantum Mechanics - Satya Prakash, Kedar Nath Ram Nath & Co.

Books for Reference:

1. Quantum Mechanics - Satya Prakash, Kedar Nath Ram Nath & Co.
2. Quantum Mechanics - Leonard I Schiff, McGraw - Hill Book Company.
3. Quantum Mechanics - Merzbacher 1966
4. A Text book of Quantum Mechanics - P.M. Mathews & K. Venkatesan, 1600 Tata Mc Graw Hill.

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SEMESTER - III
PAPER - IX
CONDENSED MATTER PHYSICS

Instructional Hrs: 75

Objectives: 1. To develop a clear concept of the crystal classes and know the relation between real & reciprocal lattices.

2. **To analyse the crystal structure by X-ray diffraction.**

3. **To study the electrical conduction in Conductors, Semiconductors and understand the concept of Superconductivity.**

UNIT – I
Crystal Structure, Reciprocal Lattice & Diffraction 15Hrs

Fundamental types of lattices (Bravias lattices) - Interplanar distance of lattice planes - separation between lattice planes in simple , BCC and FCC lattices - Experimental methods in X-ray diffraction: The Laue method - Rotating Crystal method and Powder photographic method - diffraction of electrons - Determination of unit cell dimensions - The reciprocal lattice: Properties of reciprocal lattice - reciprocal lattice to BCC and FCC lattice.

UNIT – II
Crystal Defects, Dislocations & Lattice Vibrations 15Hrs

Classification of imperfections - Point defect: Schottky Defect ; Frenkel Defect , colour centres (F-centres) - Line Defects - plastic information : slip and yield - shear strength of single crystal - edge dislocation , screw dislocation : Burgers vector - Stress field around dislocation.

Lattice vibrations - wave motions in one dimensional atomic lattice - group & phase velocity - Brillouin Zones - lattice with two atoms per primitive cell - optical properties in the infrared - Inelastic scattering of neutrons by phonons - local phonon model - umklapp and normal process.

UNIT – III
Band theory of solids & Semiconductors 15Hrs

Free electrons model - wave motions in a periodic potential and Bloch theorem - the Kronig - penny model - Acceleration of the electron moving in the periodic lattice and effective mass of the electron - Free electron approximation - Tight bonding approximation - Constructions of fermi surfaces - Experimental methods in Fermi surface studies.

Forbidden Energy gap, Valence & Conduction bands - Mobility, drift velocity and conductivity of intrinsic semiconductor - Carrier concentration in intrinsic semiconductor: Calculation of electron & hole concentration - density of electrons in conduction band & density of holes in valence band - Impurity semiconductor: Thermal ionization of impurities - Impurity States: Energy band diagram and Fermi level - Rectifier equation.

UNIT – IV
Thermal & transport properties of solids , Free electron theory of metals and super conductors 15Hrs

The classical calculations of lattice specific heat - The Einstein's theory of specific heats - Debye's model lattice specific heat - Boltzmann transport equation.

Free electron gas - Drude Lorentz free electron theory - electrical conductivity - themal conductivity - Wide mann and Franz ratio - The Sommerfield model - Thermionic emission and Richardson equation - Hall effect.

Critical field - Meissner effect - Type I & Type II super conductors - thermodynamic effects : Entropy - Specific heat - Thermal conductivity - Josephson effect - super conducting Quantum Interface device - London equations - BCS theory- Application of super conductors.

UNIT – V

Magnetic and Dielectric properties 15Hrs

Magnetic permeability - Theory of Diamagnetism - Langevin's theory of para magnetism - Weiss theory - Paramagnetic Susceptibility of a solid - Calculation of Susceptibility - Quantum theory of Paramagnetism - Determination of a Susceptibility - Para & Dia magnetic materials - Ferromagnetism - Spontaneous Magnetism in Ferromagnetism - Curie - Weiss law - Ferromagnetic Domains - Domain theory - Antiferromagnetism - Structure of Ferrites.

Dielectric polarization - Clausius - Mossotti relation , atomic or molecular polarizability - Types of polarizability - Elecrostriction and Piezoelectricity - ferro electricity - Antiferroelectric crystals.

Books for Study:

Solid State Physics - Gupta, Kumar - K.Nath & Co Educational Publishers, Meerut, 9th reprint edition.

Books for Reference:

1. Introduction to Solid State Physics -C.Kittel, Wiley Eastern Ltd, New Delhi.
2. Fundamentals of Solid State Physics - Saxena, Gupta- Saxena, Pragati Prakashan, Meerut.
3.Solid State Physics - S.O.Pillai
4. Solid Slate Physics - A.J. Dekker, Macmillan India Ltd.
5. Materials Science - V. Raghavan.

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SEMESTER -III
PAPER-X
ATOMIC AND MOLECULAR SPECTROSCOPY

Instructional Hrs: 90

Objectives: 1. To understand the origin of spectral lines from an excited state of

matters.

2. To study the rapid development of Spectroscopic techniques.

3. To introduce the different Spectroscopic instruments and its uses.

UNIT – I **18 Hrs**

Atomic Spectra: Hydrogen atom and Three Quantum Numbers – Spectra of hydrogen atom – broad features of Alkali spectra - Fine structures – Elements with more than one valance electron – Forbidden transitions and selection rules – Space Quantization –Stern Gerlach(S- G)Experiment – Coupling schemes – Spectral terms &Term symbols, Ground states based on electron configuration –LS coupling – JJ coupling – Pauli's exclusion principle – Hund's rule of multiplicity - Equivalent and non-equivalent electronic systems – Width of the spectral lines – Spectrometer – Applications of atomic spectra.

UNIT - II Diatomic Molecular Spectroscopy - Rotational Spectra 18 Hrs

Introduction – Rotational spectra, Vibrational, Electronic spectra of diatomic molecules – Types of molecules – Linear , Symmetric top, Asymmetric top and Spherical top molecules – Rotational spectra of diatomic molecule as rigid rotator – Energy level and spectra of non-rigid rotator – Intensity of rotational lines – Rotational spectra of poly atomic molecule – Rotational analysis of electronic spectra – Evaluation of rotational constants – Effect of isotopic substitution on rotational levels – Stark splitting rotational lines – Stark modulated microwave spectrometer- Applications of molecular structure, dipole moment, atomic mass , nuclear quadruple moment – Microwave oven.

UNIT - III Diatomic Molecular Spectroscopy - Vibrational Spectra 18 Hrs

Introduction – Vibrational spectra of diatomic molecule – Diatomic molecule as a Simple Harmonic oscillator – Anharmonic oscillator – Energy levels and spectrum – Molecule as vibrating rotator – PQR branches – Progressions and sequences – Vibrational analysis of electronic spectra- Deslander's table – Evaluation of vibrational constants – Morse potential energy curve – Frank-Condon principle - Intensity distribution in absorption and emission spectra – Effect of isotopic substitution on Vibrational bands – IR spectrometer – FTIR spectroscopy – Principle – Interferometer arrangement – advantages – Applications of vibrational spectroscopy : Identification of molecular constituents – Elucidation of molecular structure – Biological applications.

UNIT - IV Raman spectroscopy **18 Hrs**

Raman effect – Polarizability theory – Pure rotational Raman spectra – Linear top molecules, Asymmetric top Molecules – Vibrational Raman spectra: H_2O and CO_2 molecule – Rule of mutual exclusion - Overtone and combination vibrations – Theory of Vibrational

Raman spectra – Rotational fine structure - Structure determination from Raman and IR spectroscopy – Techniques and Instrumentation of Raman spectrometer - Near Infrared FT Raman spectroscopy.

UNIT - V **18 Hrs**

NMR: Principle – Experimental Techniques – Relaxation process – Bloch equations – Chemical shift – Applications

NQR : Principle – Experimental techniques – Transitions for axially symmetric system & non – axially symmetric systems – Regenerative continuous wave oscillator method – Chemical bonding – Applications

ESR: Principle – ESR spectrometer – Fine and hyperfine structure - ESR spectra of free radicals: Radicals with one unpaired electron , CH_3 radical Benzene anion, C_6H_6,Nitrobenzoate Di anion – Applications.

Books for Study:

1 Introduction to Atomic Spectra –H.E. White, McGraw –Hill Koga kusha.Ltd ,New Delhi.

2 Fundamentals of Molecular spectroscopy – CN Banwell and E.M.Mc Cash ,Tata Mc Graw-Hill publications, Co.Ltd ,New Delhi

3 Spectrometer Volume I &II – BP Strughan & S. Walker , John wiley & Sons,Inc.,Newyork,1976

4 Introduction to Molecular spectroscopy , G.M.Barrow, McGraw – Hill Book Co,1976.

5 Spectra of Diatomic Molecules, G.Herlsberg , D.Van Nostrand – Company Inc, New york.

6 Molecular Structure &Spectroscopy, G.Aruldhas , Prentice – Hall of India,Pvt.,Ltd,2005

7 Elements of Diatomic molecular Spectra by H.Dunford – Addison – Wisely,1957.

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SEMESTER –IV
PAPER – XI
QUANTUM MECHANICS-II

Instructional Hrs: 90

Objectives: 1. To understand the matrix formulation of Quantum mechanics.

2. To appreciate the relativistic of Schröedinger's equation.

3. To analyse the consequence of quantization.

Unit -I Matrix Formulation of Quantum theory: 18Hrs

Linear Vector spaces (Hilbert space) - Linear operators - form of an operator - Column representation of the wave function - Normalization & Orthogonality of wave functions in matrix form - Dual space - Dirac's bra & ket notation - change of basis, unitary and similarity transformations - Schröedinger equation and the eigen value problem - Quantum Dynamics - Schröedinger picture- Heisenberg picture -Interaction picture- One dimensional harmonic oscillator in matrix mechanics**.**

Unit - II Angular Momentum: 18Hrs

Commutation rules for angular momentum- Eigen values of L_z - generation of eigen functions of L_z & L^2 - Eigen values of the Total Angular momentum - Eigen functions of L^2 & L_z - Angular momentum in general - Allowed values of angular momentum; J- Eigen values or matrix elements of J_+ and J_- - matrix elements of J_x &J_y in the representation in which J^2 and J_z are diagonal -Angular momentum matrices - Addition of angular momentum & Clebsch Gorden Coefficients - Clebsch Gorden Co-efficients for J_1 = 1 & J_2 = ½.

UNIT - III Identical Particles and Spin: 18Hrs

The Indistinguishability of identical particles - principle of Indistinguishability of identical particles - Exchange symmetry of wave functions: Symmetric and Anti symmetric wave functions - Construction of Symmetric and Anti symmetric wave functions - Distinguishability of identical particles - Pauli exclusion principle -Collision of identical particles - Pauli spin operators.

UNIT - IV Relativistic Quantum Mechanics: 18Hrs

Schröedinger's relativistic equation (Klein Gorden equation for free particle) - Probability and Current densities - Application of Klein Gorden equation of Hydrogen atom - Dirac's relativistic equation for a free electron - Free particle solutions - Negative energy states - Dirac's equation in Electromagnetic Field - Dirac's Equation in central field (the electron spin) -spin orbit energy.

UNIT - V Quantization Field Theory: 18Hrs

Quantization of wave fields - Classical Lagrangian equation - Classical Hamiltonian Equation - Quantization Field Equations - second quantization - Quantization Schroedinger equation (Non - Relativistic case) - Creation - Destruction and operators

Books for Study:

UNIT I,II,III,IV&V:

1. Advanced Quantum Mechanics - Sathya Prakash,Kedar Nath&Ram Nath

2. Quantum Mechanics - Gupta Kumar, Sharma

3. Introduction to Quantum Mechanics- David J. Griffiths

Books for Reference:

1. A text book of Quantum Mechanics - P.M.Mathews and K.Venkatesan (Tata McGraw Hill).
2. Quantum Mechanics -Merzbacher (John Willey and Sons)
3. Quantum Mechanics - A.K.Ghatak and S.Loganathan (Mcmillar & Co)
4. Quantum Mechanics and Field theory - B.K.Agarwal
5. Quantum Physics of atoms, molecules, solids, nuclei and particles (second edition) - Robert Eisberg, Robert Resnick - John Wiley and Sons.
6. Physics of atoms & molecules - J.C.Jochain & Bransden.
7. Quantum Chemistry - Irain Levine.
8. Quantum Mechanics - Schiff McGraw Hill Book Company.
9. Introductory Quantum Chemistry - A.K.Chandra - Tata Mcgraw Hill.

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PRACTICAL – III ADVANCED EXPERIMENTS

(Examination at the End of IV Semester)

Instructional Hrs: 55

Objectives: 1. To perform some historically important experiments in the development of physics.

2. To design experiments and learn to extract meaningful physics principles from the experimental observation.

3. To verify some fundamental laws of physics and to measure different physical quantities.

Any Ten Experiments:

1. Susceptibility of Liquids - Quinke's Method
2. Susceptibility of Liquids - Guoy's Method
3. HaIl Effect in Semiconductors
4. Stefan's Constant
5. Determination of the charge 'e' - Millikan's Oil Drop Method
6. Brass Arc Spectrum - Constant Deviation Spectrograph
7. MO Band - Constant Deviation Spectrograph
8. CN Band - Constant Deviation Spectrograph.
9. Determination of λ and dλ of Sodium Light - Michelson Interferometer
10. Compressibility of Liquids - Ultrasonic Diffraction Method
11. Determination of the specific charge 'e/m' - Magnetron Method
12. Find the thickness of the wire by Air Wedge and Laser Diffraction
13. Find the wavelength of Laser Source using Double Slit
14. Verification of Inverse Square Law - G M Counter
15. Absorption Co-efficient of Aluminum- G M Counter
16. Half Life Period of Radiation Source - GM Counter
17. Resistivity of semiconductor thin film - Four Probe Method
18. Solar Spectrum - Hartmann's Interpolation Formula

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PRACTICAL - IV SPECIAL ELECTRONICS EXPERIMENTS

(Examination at the End of IV Semester)

Instructional Hrs: 55

Objectives: 1. To create the students about the awareness of new developments in electronics.

2. To train the students in basic workshop practice to acquire the competence about design, fabricate and repair some basic devices and equipment.

3. To develop an in-depth understanding of the operation of Microprocessor machine language programming & interfacing techniques.

Any Ten Experiments:

1. Simultaneous Addition and Subtraction - Op-amp
2. Voltage to Current and Current to Voltage Converters - Op-amp
3. Voltage to Frequency Converter - Op-amp
4. Zero Crossing Detector, Window Detector, Time Marker - Op-amp Comparator
5. Instrumentation Amplifier - Op-amp
6. A/D Converters any one method
7. D/A Converter - Binary Weighted, Ladder Methods
8. Multiplexer and Demultiplexer
9. Study of Flip-Flop
10. Gray Code Conversion
11. Digital Counter
12. Microprocessor - LED interfacing
13. Microprocessor - Stepper Motor interfacing
14. Microprocessor -Traffic Control Simulation
15. Microprocessor - ADC interface Waveform Generation
16. Microprocessor - Hex Key board interfacing
17. Microprocessor - Musical Tone Generator interface
18. Shift Registers and Ring Counter using Flip - Flops

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ELECTIVE - I

THIN FILM PHYSICS AND NANOSCIENCE

Instructional Hrs: 75

Objectives: 1. To understand different methods in thin films.

2. To learn the different characterization studies.

3. To perform different application in thin films.

UNIT - I Preparation of Thin film: 15 Hrs

Nature of thin film - Deposition Technology - Distribution of Deposit - Thermal Deposition in Vacuo - Resistance heating : Thermal Evaporation - Flash Evaporation - Substrate cleaning- Chemical Vapour Deposition (CVD): Thermal Decomposition or Pyrolysis - Vapour phase reaction - Vapour Transporation method - Disproportionation method - Mass methods Microbalance Technique- Crystal oscillator.

UNIT - II 15 Hrs

Epitaxy - Thin film structure - Substrate effect - Epitaxial deposit - Phase transition - Dissociation - Film thickness effect - Film growth - Incorporation of defects, Impurities etc, in film - Deposition parameters and grain size - Optical method Photometric - Ellipsometry - Interferometry -Crystal Growth process- Nucleation stage- Epitaxial stage- Intermediate stage -Final stage.

UNIT - III 15 Hrs

Introduction: Nanomaterials - Properties of Nanomaterials - carbon nanomaterials- Graphite- Carbon nanocones- Fullerenes- Carbon nanotubes- Quantum wells, wires & dots: Introduction - preparation of quantum nanostructures - Methods of measuring properties: particle size determination - surface structure - Sol-gel synthesis method.

UNIT - IV 15 Hrs

Introduction of Nanotubes- types of nanotubes - properties of carbon nanotubes - Introduction of nanowires: types of nanowires - properties of nanowires- Production of nanowires- Structure of nanowires- Use of nanowires- potential risks of nanotechnology health & environmental impact of nanoparticles & nanomaterials- Carbon nanotube Fuel cells to store Hydrogen - Types of materials used for Hydrogen storage.

UNIT - V Characterization Techniques and Applications 15 Hrs

Electron diffraction technique - High energy electron diffraction - Low energy electron diffraction - Electron microscopy - Scanning electron microscopy - FE-SEM-Field ion Microscopy- Transmission Electron Microscopy - X ray photoelectron spectroscopy - Mass spectroscopy.

Applications of Thin Films:Discrete passive component- Thermistor, Varistor, Strain Gauge Element- Microelectronics, Integrated circuits and other applications- Applications of nanotechnology: plastic solar cells - carbon nanotubes in solar cells - fuel

cell electrodes - nanotechnology: in textile developments - smart materials - Nano computers quantum computers - robots & nanobots - nano electronics - current research areas.

Books for study and Reference:

UNIT I&II: Thin film fundamentals - A.Goswami New age international (P) Ltd, New Delhi - 1996

UNIT III&IV: 1.Nanotechnology Fundamentals and Application - Manasi Karkaie - I. K International Publishing House (P) Ltd, - New Delhi - 2008

2. Introduction to Nanotechnology - Charles P. Poole Jr. and Frank J.Owens - A John Wiley & Sons, Inc, Publications - New Jersey - 2003.

UNIT V: 1.Thin film fundamentals - A.Goswami New age international (P) Ltd, New Delhi - 1996

2. Nanotechnology Fundamentals and Application - Manasi Karkaie - I. K International Publishing House (P) Ltd, New Delhi - 2008.

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ELECTIVE II
CRYSTAL GROWTH TECHNIQUES

Instructional Hrs: 75

Objectives: 1. To understand about the classification of crystal growth.

2. To study the different phases.

3. To learn the different characterization studies.

UNIT I

Crystal Growth Phenomena 15Hrs

Introduction - Nucleation - Theories of nucleation - Classical theory of nucleation Gibbs Thomson equation for vapour- Modified Thomson's equation for melt - Gibbs Thomson equation for solution - Energy of formation of a nucleus- Spherical nucleus- Cylindrical nucleus - Heterogeneous nucleation - cap shaped nucleus -Disc shaped nucleus.

UNIT II

Kinetics of Crystal growth 15Hrs

Introduction- Singular and rough faces - models on surface roughness - The Kossel, Stanski, Volmer(KSV) theory - The Burton, Cabrera and Frank(BCF) theory - Periodic Bond Chain theory.

UNIT III

Solution Growth and Slow Evaporation Techniques 15Hrs

Low Temperature solution growth: Solution, Solubility and super solubility - Expression of super saturation- methods of crystallization - crystallization by slow cooling of solutions - crystallization by solvent evaporation - Temperature gradient method - Crystal growth system: Constant temperature bath - Crystallizer - filtration assembly - seed, seed mount platform and crystal revolution unit - Seed preparation mounting and reasoning: Solution preparation and reasoning - Initial growth and cooling rate.

Gel growth:-

Introduction - principle of gel growth - various types of gel - structure of gel - Growth of crystals in gel - Importance of gel technique.

UNIT IV 15Hrs

Crystal growth techniques at high temperature and Crystal growth from the melt

Bridgeman Technique - Czochralski Technique, Verneuil Technique - Zone melting technique.

Vapour Growth

Physical vapour deposition - Chemical Vapour deposition - MOCVD - Advantages of CVD - Disadvantages of CVD.

UNIT V Characterization of Crystals 15Hrs

X – Ray Diffraction (XRD) – Powder and single crystal - Fourier transform Infrared analysis (FTIR) – Elemental analysis – Elemental dispersive X-ray analysis (EDAX) - Scanning Electron Microscopy (SEM) – UV-Vis-NIR Spectrometer – Etching (Chemical) – Vickers Micro hardness.

Applications: NLO studies - Piezoelectric materials and applications - Solar Cell, Liquid crystals and medicinal crystals.

Book for study:-

1. Crystal Growth processes and methods - Dr. P. Santhana Raghavan - Dr. P. Ramaswamy - KRV Publications.

REFERENCES

1. Williard H. H., Merritt L. L., Dean J., and Settle F. A., Instrumental Methods of Analysis , 6 th Edition, CBS Publishers & Distributors, 1986.
2. Goodman C. H. L., Crystal Growth- Theory and Techniques, Plenum Press, Pennsylvania State University, Cambridge University Press, 2005.
3. Brice J. C., Crystal Growth Processes , John Wiley and Sons, 1986.
4. Hans J. Scheel, Peter Capper, Peter Rudolph, Crystal Growth Technology: Semiconductors and Dielectrics, John Wiley & Sons, 2010.
5. Vere A.W., Crystal Growth, Plenum Press, 1987.
6. Heinz K. Henisch, Crystals in Gels and Liesegang Rings, Cambridge University Press ,2005.
7. Govindhan Dhanaraj, Kullaiah Byrappa, Vishwanath Prasad, Handbook of Crystal Growth , Michael Dudley, Springer, 2010.

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ELECTIVE – III

PLASMA PHYSICS

Instructional Hrs: 75

Objectives: 1. To know the motion of plasma particles in electric & magnetic field.

2. To produce and characterize hot dense magnetized plasmas and laser produced plasmas.

3. To develop ultrafast optical probing techniques for matter and plasma characterization.

Unit - I Fundamental Concept About Plasma: 15Hrs

Kinetic pressure in a partially ionized gas - Mean free path and collision cross section- Mobility of charged particles- Effect of magnetic field on the mobility of ions and electrons - Thermal conductivity- Effect of magnetic field, Dielectric constant of plasma – Quasi neutrality of plasma - Debye shielding distance- optical properties of plasma.

Unit-II Motion of Charged Particles in Electric and Magnetic Field: 15Hrs

Particle description of plasma; Motion of charged particle in an electrostatic field - Motion of charged particle in uniform magnetic field - Motion of charged particles in electric and magnetic fields- Motion of charged particles in homogenous magnetic field -Motion of charged particles in a magnetic mirror confinement - Motion of an electron in a time varying electric field -Magnetohydrodynamics - Magnetohydrodynamic equations- Interpretation of the equations - Condition for magnetohydrodynamic behaviour.

Unit - III Plasma Oscillations and Waves: 15Hrs

Introduction: Theory of simple Oscillations- Electron Oscillations in a Plasma - Derivation of Plasma Oscillations by utilizing Maxwell's Equation - Ion Oscillations and Waves - Oscillations and waves in a magnetic field - Thermal effects on Plasma Oscillations - Landau damping - Hydromagnetic waves - Magnetosonic waves - Oscillations in electron beam.

Unit - IV Plasma Diagnostics Techniques: 15Hrs

Single probe method - Double probe method - Use of probe technique for measurement of plasma parameters in magnetic field - microwave method - spectroscopic method - Laser as a tool for plasma diagnostics - X- ray diagnostics of plasma - Acoustic method - Conclusion.

Unit - V Possible Applications of Plasma Physics: 15Hrs

Magnetohydrodynamic generator - Basic Theory - Magnetohydrodynamic generator- Principle of working - The Fuel in M.H.D - Magnet in M. H. D generator - Generation of Microwaves Utilizing high density plasma - Plasma diode.

Book for Study:

1. Plasma Physics - Plasma State of Matter - S. N. Sen, Pragati Prakashan Meerut-I

Reference Books:

1. Introduction to Plasma Physics - FF Chen 1600 Plenum Press, London

2. Principles of Plasma Physics - Krvail and Trivelpiece 1976

3. Introduction to Plasma theory - DR Nicholson, 1600

4. The Plasma state - IL Shohet, 1600

5. Introduction to Plasma Physics - M.Uman

6. Principles of Plasma Diagnostic - IH Hutchinson, 2002

7. Plasma Diagnostic Techniques - RH Huddleston and SL Leonard, 1600

8. Plasma The fourth state of Matter - D.A.Frank - Kamenetskii - Macmillan Press Ltd, London.
9. Introduction to unmagnetized Plasmas - Chanchal Uberoi

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ELECTIVE - IV

NUMERICAL METHODS AND PROGRAMMING

Instructional Hrs: 75

Objectives: 1. To understand the basic concept of mathematical modeling.

2. To understand the structure & concept of C- language with programs.

3. To study the basic concepts of object oriented programming with examples.

Unit - I Numerical Methods: 15Hrs

Methods for determination of Zeroes of linear and non linear algebraic equations and transcendental equations convergence of solutions- Solutions simultaneous Linear equations - Gaussian elimination- pivoting- interactive method Matrix inversion.

Unit - II Eigen values and eigenvectors of matrices Power and Jaccobi Method: 15Hrs

Finite differences - interpolation with equally spaced and unevenly spaced points-Curve fitting - Polynomial least squares and cubic fitting - Spline fitting Numerical differentiation and integration, Newton - Cotes formulae - error estimates - Gauss method .

Unit -III Random variate Monte cario evaluation of integrals: 15Hrs

Importance sampling, Random walk and Metropolis method Numerical solution of ordinary differential equations Euler and Runge Kutta methods, Predictor and corrector methods - Elementary ideas of solutions of partial differential equations.

Unit - IV C Programming: 15Hrs

C Programming, Flow Charts, Integer and Floating Point Arithmetic expression - Built - in functions executable and non executable statements, assignment control and input- output elements**,** Sub routines and functions, operation with files.

Unit V Application of C Programming and physics: 15Hrs

Runge kutta method - Interpretation - Euler method Simpson's $1/3^{rd}$ rule - curve fitting - Ordinary Differential equation.

Reference books:

1. Sastry: Introductory Methods of Numeric Analysis, 1600, 2000, 2032.
2. Rajaraman: Numerical Analysis,
3. Rajaraman: Fortran Programming.
4. Vetterming, Teukolsuky, Press and Flannery; Numerical Recipes, 1600.

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QUESTION PAPER PATTERN

Section - A (10 x 1 = 10)

Multiple Choice questions : 5

Definitions : 5

Section - B (5 x 4 = 20)

Medium Answer

Either or type

Two Questions from each unit

Section - C (5 x 8 = 40)

Long Answer

Either or type

Two Question from each unit

SEMESTER III

SUPPORTIVE PAPER
ENVIRONMENTAL PHYSICS

UNIT - I

Universe **18Hrs**

Introduction –solar system-Rotation of planets- space exploration and search for extra-terrestrial life-moon –Mercury-Venus-Mars –Outer planets-Asteroids-Comets-Meteorites. Sun: Surface –Temperature-Composition of the sun, surface energy, stars: Identification –magnitude of the stars –Distance an absolute brightness of stars - Physical properties of stars: Stellar spectra - Interpretation of stellar spectra - Radii of stars - Milky way.

Size and shape - Interstellar matter- star clusters- structure. Rotation and mass-expanding universe- Big Bang theory.

UNIT – II

Rockets and Satellites **18Hrs**

Introduction- Launch vechicles -Rocket fuel-Shape of rocket-Take off the rocket – salvaging the various stage rockets- satellites - Condition for a satellite to be placed in a orbit - Launching of satellite-Weight and size of a satellite-Duration of satellite's existence –Return of artificial satellite.

Seismology

Introduction-seismic waves: Preliminary waves: Primary waves-secondary waves, surface waves: Rayleigh waves – love waves, seismography and seismographs, vertical & horizontal pendulum seismographs –Galitzins seismograph –Location of epicenter and the focus of seismic waves –Application of seismology.

UNIT - III

Low Temperature Physics **18Hrs**

Joule Thomson effect –Joule Kelvin porous plug experiment –Results –Temperature of Inversion –Theory of porous plug experiment-Relation connecting Boyle Temperature – Inversion temperature and critical temperature.

Definitions of critical constants –Liquefaction of Air Linde's process – Liquefaction of Helium – K.Onnes method –Properties of Liquid Helium- λ point-He I and He II – Adiabatic Demagnetization (Qualitative treatment only) - Production of low temperature Refrigeration - Cryogenic engine.

UNIT - IV **18Hrs**

Electrical charges – kinds of electrical charges – Conductors and Insulators or Dielectrics – Voltmeter - Ammeter – Electrical power – Wattmeter to measure electrical power – Magnetic field and Magnetic flux – Magnetic field of the earth- Principle of A.C generator in dynamo-Three phase A.C-Distribution of Three phase A.C-Three phase four wire system.

Magnetic elements of the earth – To measure the declination at a place – To locate the geographic meridian -To locate the magnetic meridian – Measure of the value of dip at a place on the earth using a dip circle – Magnetic charts – Variation of magnetic elements of the earth.

UNIT –V **18Hrs**

Electromagnetic waves – Ground wave propagation – Space wave (or) Tropospheric propagation – Effect of Earth's imperfections on space wave propagation – Effect on obstacles on space wave propagation – Effect of Atmosphere on space wave propagation.

Modulation –AM & FM – Demodulation – Superheterodyne receiver – Principles of T.V. Transmission and Reception – Scanning – Block diagram of T.V. Transmitter and Receiver.

Books for Study:

UNIT – I

Properties of Matter – Brijlal & N.Subramaniam.

UNIT – II

1.Properties of Matter - Brijlal & N.Subramaniam.
2.Properties of Matter – R.Gulathi

UNIT – III

Heat & Thermodynamics - Brijlal & N.Subramaniam.

UNIT – IV

Electricity & Magnetism - Brijlal & N.Subramaniam.

UNIT – V

1. Electromagnetic Waves – Ajay sharma & Dr. R.K. Sinha, Dhanpat Rai Publishing Co.
2. Principles of Electronics – V.K.Metha.

Books for reference:

1. Properties of Matter – D.S.Mathur, S.Chand & Co
2. Properties of Matter – J.C.Upadhyaya
3. Thermodynamics & Statistical Physics – Singhal, Agarwal & Prakash, Pragati Prakashan, Meerut.
4. Heat & Thermodynamics – D.S.Mathur, S.Chand & Co.
5. A Text Book of Heat & Thermodynamics – J.B.Rajam & C.L.Arora
6. Thermodynamics & Statistical Physics – D.P. Khandel Wal & S.Lokanathan.

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