SEMESTER - I

CORE PAPER - I

CLASSICAL MECHANICS

Instructional Hrs. : 75 **Sub. Code : 16PHPC101**

Max. Marks : CIA -25; ESE -75 **Credits: 4**

Objective : To provide depth of knowledge in classical mechanics and applications. To equip the students to face the national level physics examinations.

Unit - I **15 Hrs.**

Mechanics of Single and Systems of Particles

Newton's laws of motion - Mechanics of a particle - Equation of motion of a particle - Motion of a particle under constant force and alternating force - Mechanics of systems of particles - Angular momentum of the system - Potential and kinetic energies of the system - Motion in a central force field - Motion of two particles equivalent to single particle - Equation of motion of centre of mass with respect to centre of force - Motion in an inverse-square law force field - Classification of orbits

Unit - II **15 Hrs.**

Collisions of Particles and Motion of Rigid Body

Elastic and inelastic scattering - Laboratory and centre of mass systems - Relations between different quantities in the laboratory and centre of mass systems -Kinematics of elastic scattering in the laboratory system- Inelastic scattering in the laboratory frame - Motion of a rigid body - Euler's theorem - Angular momentum and kinetic energy - *Inertia tensor* - Euler's equation of motion - Torque Free Motion - Euler's angles.

Unit - III

Lagrangian and Hamiltonian Formulations **15 Hrs.**

Hamilton's variational principle - Lagrange's equations of motion -Conservation theorems and symmetry properties - Cyclic coordinates - Application of Lagrange's equation; Linear harmonic oscillator, particle moving under a central force, Atwood's machine - Hamilton's equations of motion - Application of Hamiltonian's equations of motion; Particle moving in an electromagnetic field - *Phase space* - Principle of least action

Unit - IV **15 Hrs.**

Canonical Transformations and Poisson Brackets

Canonical transformations - Generating function - Properties of canonical transformations - Poisson brackets - Properties of Poisson brackets - Constant of motion using Poisson brackets - Poisson brackets of canonical variables - Poisson's Theorem - Invariance of Poisson bracket

under canonical transformation - Motion as successive canonical transformation (Infinitesimal generators) - Liouville's theorem - The Hamilton-Jacobi equation -*Action and angle variables*

Unit - V **15 Hrs.**
Small Oscillations

Small oscillations - *Stable and unstable equilibrium* - Lagrange's equation of motion for small oscillations - Normal coordinates and normal frequencies - Small oscillations of particles on string - Free vibrations of linear triatomic molecule - Two carts connected with three springs - Triple pendulum - Double pendulum

Note: *Italics* denotes Self Study Topics

TEXT BOOKS

1. **R. G. Takwale and P. S. Puranik**,*Introduction to Classical Mechanics*, Tata McGraw-Hill (2006), New Delhi
2. **Charles Poole and John SafkoHerbert Goldstein,** *Classical Mechanics*, Pearson Education and Dorling Kindersley (2007), New Delhi
3. **Gupta, Kumar and Sharma**,*Classical Mechanics*Pragati Prakashan (2001), New Delhi
4. **J.C. Upadhyaya,** *Classical Mechanics*, Himalaya Publishing House (2005) India

REFERENCE BOOKS

1.**John R. Taylor,***Classical Mechanics*, University Science books (2005), India
2. **R. Douglas Gregory,***Classical Mechanics*, Cambridge University press, (2008) India

SEMESTER - I

CORE PAPER -II

MATHEMATICAL PHYSICS - I

Instructional Hrs. : 75 **Sub. Code : 16PHPC102**

Max. Marks : CIA -25; ESE -75 **Credits: 4**

Objective : Mathematics is aptly called the language of physics. The paper provides the core concepts of mathematical physics. The syllabus is so framed that it fulfills the requirements of CSIR / GATE / NET Exams.

Unit-I **15 Hrs.**

Matrices and Determinants

Properties of matrix addition and multiplication- different type of matrices and their properties - Rank of a Matrix and some of its theorems - Solution to linear homogeneous and non homogeneous equations - Cramers rule - eigenvalues and eigenvectors of matrices - differentiation and integration of matrix.

Unit-II **15 Hrs.**

Solving of differential equations

Homogeneous linear equations of second order with constant coefficients and their solutions - ordinary second order differential with variable coefficients and their solution by power series and Frobenius methods -*extended power series method for indicial equations.*

Unit-III **15 Hrs.**

Special differential equations and their solutions

Legendre's differential equation: Legendre polynomials -*Generating functions*- Recurrence Formulae-Rodrigue's formula-orthogonality of Legendre's polynomial;Bessel's differential equation: Bessel's polynomial -generating functions-Recurrence Formulae-orthogonal properties of Bessel's polynomials- Hermite differential equation- Hermite polynomials - generating functions - recurrence relation.

Unit-IV **15 Hrs.**

Laplace Transforms

Laplace transforms: Linearity property, first and second translation property of LT - Derivatives of Laplace transforms - Laplace transform of integrals - Initial and Final value theorems; Methods for finding LT:direct and series expansion method, Method of differential equation;

Inverse Laplace transforms: Linearity property, first and second translation property, *Convolution property*- Application of LT to differential equations and boundary value problems.

Unit-V **15 Hrs.**

Fourier series and integrals

Fourier series definition and expansion of a function x - Drichlet's conditions - Assumptions for the validity of Fourier's series expansion and its theorems - Complex representation of Fourier series - problems related to periodic functions - graphical representation of FS - Fourier integrals -*convergence of FS*- some applications of Fourier transforms.

Note: *Italics* denotes Self Study Topics

TEXT BOOKS

1.**B.D.Gupta**, *Mathematical Physics*, Vikas Publishing House Pvt ltd. 3rd Edition 2006
2.**Parthasarathy H**, *Topics in Mathematical Physics*, Ane Books Pvt. Ltd 2007
3.**G. Arfken,** *Mathematical methods for physics*, Elsevier 6th edition 2010
4.**Sathya Prakash,***Mathematical Physics*-S. Chand & Sons, New Delhi, 1985.

REFERENCE BOOKS

1.**Rajput,** *Mathematical Physics*, Pragati Prakasam, Meerut, 17th Edition 2004
2.**Erwin Kreyszig,** *Advanced Engineering mathematics*, Wiley Eastern Limited Publications 7th Edition 1993
3.**W.W.Bell,** *Special Function*, 1968

SEMESTER - I

CORE PAPER - III

ANOLOG AND DIGITAL ELECTRONICS

Instructional Hrs. : 75 **Sub. Code : 16PHPC103**

Max. Marks : CIA -25; ESE -75 **Credits: 4**

Objective : The approach is to stress the fundamental concepts in the analysis and applications of analog and digital electronics.

Unit-I **15Hrs.**

Semiconductor Devices

JFET- Structure and working - I -V Characteristics - CS amplifier design - MOSFET: Depletion and Enhancement type MOSFFT - Operation principle of UJT - UJT - Relaxation oscillator - SCR characteristics - application in power control- DIAC,TRIAC

Unit-II **15 Hrs.**

Operational Amplifier

Frequency Response of an Op-Amp - Parameters of an OP-Amp - Sign changer - Scale changer - *Adder*- Subtractor - Integrator - Differentiator - Phase shifter - Differential Amplifier -Voltage Regulator - Analog computer setup to solve Linear Simultaneous Equation - Differential equations in Physics - Logarithmic & Exponential Amplifier - Active filters.

Unit-III **15 Hrs.**

Digital Circuits and Devices

Binary Adders: Half Adder-Parallel Operation-Full Adder-MSI Adder-Serial Operation; Decoder/Demultiplexer: BCD to Decimal Decoder-4-to-16 line Demultiplexer; Data Selector/Multiplexer:16-to-1 *Multiplexer*; Encoder; - Edge triggered and Master slave flip flop - Synchronous, Asynchronous and Cascade counter - Shift registers: four types - Memories:- RAM, ROM, PROM, EPROM.

Unit-IV **15 Hrs.**

Signal Processing & Data acquisition

Wave Form Generators and wave shaping circuits - Sinusoidal oscillators -*Phase shift oscillators*- Comparators - Schmitt Trigger - Square wave & Triangular wave generators - IC 555 Timer and its application - Signal and Signal Processing - Analog Multiplexer and Demultiplexer - Sample and Hold Systems - D/A Converters- A/D Converters.

Unit-V **15 Hrs.**

Microwave Oscillators: Microwaves Generation -*Multicavity Klystron*- Reflex Klystron - Magnetron - Traveling Wave Tubes (TWT) - Crossed field amplifier and Backward wave oscillator - Microwave Transistors - Gunn Diode

Note: *Italics* denotes Self Study Topics

TEXT BOOKS

1.**Floyd**, *Digital fundamentals*, Universal Book Stall, New Delhi, 2003.
2.**Jacob mill Mann, Arvin Grabel**, *Microelectronics*, Tata McGraw Hill, New Delhi, 2003.
3.**Mill Mann & Hal kais**, *Integrated Electronics*, Tata McGraw Hill, New Delhi, 2005.
4. **S. Chattopadhyay,** *Text Book of Electronics*, New Central Book Agency P.Ltd., Kolkata, 2006.
5. **A.P. Malvino and D.P. Leach**, *Digital Principles and Applications*, Tata McGraw-Hill, Publishing Co., New Delhi.
6. **A.B. Bhattacharya,** *Electronics Principles and Applications*, New Central Book Agency P.Ltd., Kolkata, 2007.

REFERENCE BOOKS

1. **Jacob Millman, Christos C Halkins and Chetan**, *Integrated Electronics Analog and Digital Circuits and Systems*, Parikh, 2nd Edition, Tata McGraw Hill Educatio Private Limited, New Delhi, 2010.
2. **Anil K. Maini and VarshaAgarwal,** *Electronic Devices and Circuits*, Wiley India Pvt. Ltd. New Delhi, 2009.

SEMESTER - I

CORE PAPER - IV

QUANTUM MECHANICS - I

Instructional Hrs. :75 **Sub. Code :16PHPC104**
Max. Marks : CIA -25; ESE -75 **Credits: 4**

Objective: To introduce the students to the concepts of quantum mechanics.

To make them to prepare for state & national level examinations

Unit -I **15 Hrs.**

General formalism of quantum mechanics

Linear Vector Space- Linear Operator- Eigen Functions and Eigen Values- Hermitian Operator- Postulates of Quantum Mechanics- Simultaneous Measurability of Observables- General Uncertainty Relation- Dirac's Notation- Equations of Motion; Schrodinger, Heisenberg and Dirac representation- *momentum representation*.

Unit -II **15 Hrs.**

Energy Eigen value problems

Particle in a box -*Linear Harmonic oscillator*- Tunnelling through a barrier- particle moving in a spherically symmetric potential- System of two interacting particles-Rigid rotator- Hydrogen atom

Unit -III **15 Hrs.**

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.

Unit- IV **15 Hrs.**

Approximate Methods:

Time Independent Perturbation Theory in Non-Degenerate Case -- Degenerate Case-*Stark Effect in Hydrogen atom*- Spin-orbit interaction - Variation Method - Born-Oppenheimer approximation -- WKB Approximation.

Unit- V **15 Hrs.**

Many Electron Atoms

Indistinguishable particles -*Pauli principle*- Inclusion of spin - spin functions for two-electrons- The Helium Atom - Central Field Approximation - Thomas-Fermi model of the Atom - Hartree Equation- Hartree -Fock equation.

Note: *Italics* denotes Self Study Topics

TEXT BOOKS

1.**P.M. Mathews & K. Venkatesan**,*A Text Book of Quantum Mechanics*, Tata McGraw Hill 2010.

2.**G. Aruldhas**, *Quantum Mechanics*, Prentice Hall of India 2006

3.**David J.Griffiths,***Introduction to Quantum Mechanics*, Pearson Prentice Hall 2005

REFERENCE BOOKS

1. **L.I Schiff,** *Quantum Mechanics*McGraw Hill 1968

2.**A. Devanathan**, *Quantum Mechanics*, Narosa Publishing-New Delhi

3.**R.Shankar,** *Principles of Quantum Mechanics*, Springer 2005

SEMESTER - II

CORE PAPER - V

MATHEMATICAL PHYSICS - II

Instructional Hrs. : 90 Sub. Code : 16PHPC205

Max. Marks : CIA -25; ESE -75 Credits: 4

Objective : Mathematics is aptly called the language of physics. The paper provides the core concepts of mathematical physics. The syllabus is so framed that it fulfills the requirements of CSIR / GATE / NET Exams.

Unit -I 18 Hrs.

Probability

Probability-Addition rule of Probability - Multiplication Law of Probability- Probability distribution-Binomial distribution - mean Binomial distribution - Standard deviation of binomial distribution -Poisson distribution - Normal distribution - characteristics of normal distribution - Applications of normal distribution.

Unit- II 18 Hrs.

Complex variables

Complex Algebra- Cauchy-Riemann Conditions-Cauchy's Integral Theorem- Cauchy's Integral formula-Laurent expansion-singularities-*Mapping*- Conformal mapping- Calculus of residues.

Unit - III 18 Hrs.

Group Theory

Definition of Group - Subgroup, invariant group, *abeliangroup*, orthogonal and unitary groups - Homomorphism, isomorphism - Reducible and irreducible representations - Generators of Continuous groups.

Unit - IV 18 Hrs.

Linear vector spaces

Definition and Examples-Real Linear vector space-Uniqueness of Null and Reversed vectors-*Scalar Products of Vectors*- : Definition of Scalar Product of two vectors, Scalar product for real linear vector spaces, Cauchy-Schwartz inequality-Metric Spaces-Linear Independence of vectors and basis for a vector space-Dimension of a vector space-Orthonormal basis-Vector Subspaces-Direct sum decomposition.

Unit - V 18 Hrs.

Tensor Analysis

Definition of Tensors -*Contravariant, covariant and mixed tensors*- addition and subtraction of Tensors - Summation convention- Symmetry and Anisymmmetry Tensor - Contraction and direct product - Quotient rule- Pseudotensors, Levi-Civita Symbol - Dual tensors, irreducible tensors-Metric Tensors-Christoffel symbols - Geodesics.

Note: *Italics* denotes Self Study Topics

TEXT BOOKS

1. **Arfken & Weber,** *Mathematical Methods for Physicists*, Elsevier 6th edition 2010.
2. **Parthasarathy H**, *Topics in Mathematical Physics*, Ane Books Pvt. Ltd 2007
3. **S.D. Joglekar,** *Mathematical Physics*, Universities Press Pvt.Ltd. 1st Edition 2005
4. **H.K. Dass and R. Verma**, *Mathematical Physics*, S. Chand &Company 2nd Ed. 2001

REFERENCE BOOKS

1. **Erwin Kreyszig**, *Advanced Engineering mathematics*, Wiley Eastern 7th Edition 1993
2. **B.D. Gupta**, *Mathematical Physics*,Vikas Publishing House Pvt.Ltd 3rd Edition 2006

SEMESTER - II

CORE PAPER - VI

ADVANCED COMPUTATIONAL PHYSICS

Instructional Hrs. : 90 Sub. Code : 16PHPC206

Max. Marks : CIA -25; ESE -75 Credits: 4

Objective : The syllabus provides a base for students in high performance computation and visualization software

UNIT - I

Roots of equation 18 Hrs.

Bisection method- False position method - Newton Raphson method - Basic Gauss elimination method - Gauss elimination with partial pivoting - Gauss Jacobi iteration method - Gauss Seidal iteration method - Inversion of a matrix using Gauss elimination method - LU decomposition.

UNIT - II 18 Hrs.

Eigen values and Interpolation

Power method to find dominant eigen value - Inverse power method to find all eigen values - Jacobi method - (only 2x2 and 3x3 matrices) Forward and Backward differences - Gregory Newton forward and backward interpolation formula for equal intervals - Divided difference - *properties of divided differences*- Newton's divided differences formula - Lagrange's interpolation formula for unequal intervals.

UNIT - III 18 Hrs.

Numerical integration and differences

Method of least squares - straight line, parabola , $y = ax^n$, $y = ae^{bx}$, $y = a+bx^n$ type curves - sum of squares of residuals for straight line and parabola fit - Newton's forward and backward differences formula to get the derivatives (First and Second order) - Divided differences table to calculate derivatives for unequal intervals Newton - cotes formula - (Trapezoidal rule, Simpson's rule, Simpson's 3/8 rule, Boole's rule) -*Error estimates in trapezoidal and Simpson's rule.*

UNIT - IV 18 Hrs.

Differential Equation

Basic Euler method - Improved Euler method -*Modified Euler method*- Runge Kulta fourth order method - RK4 method for simultaneous first order differential equation RK4 Method for second order differential equation - partial differential equation - Difference - quotients - Graphical representations of partial quotients - Classification of partial differential equation of the second

order - standard and diagonal five point formula for laplace equations - solution of laplace's equation (Liebmann's iterations process).

UNIT - V

Matlab Fundamentals **18 Hrs.**

Introduction - Matlab Features - Desktop Windows: Command History, Workspace, 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 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.

Programming

Charging of a capacitor in an RC circuit with three times constant -Plotting input and output characteristics of an NPN transistor

Note: *Italics* denotes Self Study Topics

TEXT BOOKS

1. **K. Venkataraman**, *Numerical methods in science and engineering*, National publishing company, Madras - 1996.
2. **P. Kandasamy, K. Thilgavathy, K. Gunavathy**, *Numerical methods*, S. Chand & Company Ltd., New Delhi, 2007.
3. **E. Balagurusamy**, *Numerical methods*, Tata McGraw Hill Publishing Company Ltd, New Delhi, 2006.
4. **Rudra Pratap,** *Getting Started with Matlab*, Oxford University Press, New Delhi, 2005.

REFERNCE BOOKS

1.**John H. Mathews**, *Numerical methods for mathematics science and Engineering*, Prentice Hall of India Pvt. Ltd., New Delhi 2000.

2.**T.Veerarajan and T. Ramachandran**, *Numerical methods*, Tata McGraw Hill, New Delhi, 2008.

3. **Brain Hunt, Ronald lipsman, Jonathan Rosenberg,** *A Guide to Matlab for Beginners & Experienced Users*, Cambridge University Press, 2006.

SEMESTER - II

CORE PAPER - VII

QUANTUM MECHANICS - II

Instructional Hrs. :90 **Sub. Code :16PHPC207**

Max. Marks : CIA -25; ESE -75 **Credits: 4**

Objective: To introduce the students to the concepts of quantum mechanics.

To make them to prepare for state & national level examinations

Unit -I **18 Hrs.**

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- Collision-Adiabatic and Sudden Approximation- A Charged Particle in an Electromagnetic Field.

Unit -II **18 Hrs.**

Scattering Theory

Scattering Amplitude - Expression in terms of Green's Function - Born Approximation and Its validity- Partial wave analysis - *Phase Shifts*- Asymptotic behaviour of Partial Waves-The Scattering Amplitude in Terms of Phase Shift- Scattering by Coulomb Potential and Yukawa Potential.

Unit- III **18 Hrs.**

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*.

Unit -IV **18 Hrs.**

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.*

Unit- V **18 Hrs.**

Quantum Field Theory

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

Note: *Italics* denotes Self Study Topics

TEXT BOOKS

1. **P.M. Mathews & K. Venkatesan,** *Text Book of Quantum Mechanics*, Tata McGraw Hill 2010
2. **G Aruldhas**, *Quantum Mechanics,* Prentice Hall of India 2006
3. **David J.Griffiths**, *Introduction to Quantum Mechanics,* Pearson Prentice Hall, 2005
4. **A Devanathan**, *Quantum Mechanics,* Narosa Publishing-New Delhi

REFERENCE BOOKS

1. **L.I Schiff**, *Quantum Mechanics,* McGraw Hill 1968
2. **A.K. Ghatak and S. Loganathan**, *Quantum Mechanics,* McMillan India
3. **R.Shankar**, *Principles of Quantum Mechanics,* Springer 2005
4. **Satya Prakash- Kathar Nath Ramnath**,*Quantum Mechanics,* Meerut

SEMESTER - II

CORE PRACTICAL - I

GENERAL EXPERIMENTS

Instructional Hrs: 113 **Sub. Code: 16PHPCP01**

Max. Marks: CIA -40; ESE -60 **Credits: 4**

Any Fifteen Experiments

1. Young's modulus- elliptical fringes (Cornu's method)
2. Young's modulus-hyperbolic fringes (Cornu's method)
3. Stefan's constant.
4. Thickness of wire by air wedge and diffraction.
5. Thermal conductivity - Forbe's method.
6. Electronic charge 'e' by Millikan's oil drop method.
7. Electronic specific charge 'e/m' by Thomson's method.
8. Thermistor - temperature coefficient and band gap energy distribution.
9. Specific heat of a liquid-Ferguson's method.
10. Biprism on optical bench-determination of wavelength.
11. Determination of Viscosity of Liquid.
12. Diffraction at a prism face-determination of wavelength.
13. Photo Electric Cell -Planck 's constant.
14. e/m- Helical Method.

Matlab programming

15. Roots of a quadratic equation, solution of a system of linear equations .
16. Newton-Raphson method and Runge Kutta method .
17. Curve fitting and interpolation.
18. Charging of a capacitor in an RC circuit with three time constants.
19. NPN transistor - Input and Output Characteristics.
20. Frequency response of a low pass filter.

SEMESTER - II

CORE PRACTICAL - II

ELECTRONICS

Instructional Hrs: 112 **Sub. Code: 16PHPCP02**

Max. Marks: CIA -40; ESE -60 **Credits: 4**

Any Fifteen Experiments

1. Regulated and Dual power supply Construction.
2. Parameters of Op-amp.
3. Wave form generators-Op-amp.
4. Wein's bridge oscillator-Op-amp.
5. Phase Shift Oscillator- Op-amp
6. Active filters-Op-amp.
7. Frequency response of an Op-amp
8. Sign, scale changer, adder and subtractor-Op-amp.
9. OP-Amp : Voltage to current and current to voltage converter
10. Analog computer setup for solving simultaneous equations.
11. UJT relaxation oscillator& Schmitt trigger using IC 555.
12. Construction of Half - Adder and Full - Adder circuits using NAND gates.
13. Construction of Half - Subtractor and full - Subtractor circuits using NAND gates.
14. A.C amplifier-inverting, non-inverting, voltage follower-op-amp.
15. Multiplexer and Demultiplexer.
16. Decode and Encoder
17. Construction of amplitude modulation circuit and to calculate the modulation index.
18. Two stage amplifier
19. SCR -Characteristics and its applications
20. Source Follower- FET.

MESTER - III

CORE PAPER - VIII

CONDENSED MATTER PHYSICS

Instructional Hrs: 75 **Sub. Code: 16PHPC308**

Max. Marks: CIA -25; ESE -75 **Credits: 4**

Objective: The syllabus is of immense use for students aspiring for research and other competitive Examinations.

Unit -I **15 Hrs.**

Crystal Structure and Diffraction

Crystalline state - Basic definitions and crystal systems-elements of Symmetry - Crystal directions -Miller indices - Simple crystal structures(NaCl, CsCl, Hexagonal closed packed structure, Diamond structure, Cubic ZnS structure) -*Bragg's law*- The Laue method- Reciprocal lattice- Brillouin zones -. **Defects and dislocations:** Elementary ideas about crystal defects - Schottkey defect - Frenkel defect - Dislocations - Edge and screw dislocation - Grain boundaries - Dislocations in crystal growth.

Unit -II **15 Hrs.**

Lattice Vibrations and Thermal Properties

Vibrations of one dimensional monoatomic linear lattices - Vibrations of one dimensional diatomic linear lattice - Quantization of lattice vibrations - Forbidden frequency band- Phonon momentum - Inelastic scattering of neutrons by phonons -Einstein model of the lattice specific heat of solids - Debye model of lattice heat capacity -Thermal conductivity.

Unit -III **15 Hrs.**

Free electron theory, Energy bands and Semiconductor Crystals

Energy levels and density of orbital - Fermi Dirac distribution - Free electron gas in 3-D Heat Capacity of electron gas - Electrical conductivity and Ohm's law - Motion in magnetic fields - Hall effect - Nearly free electron model -*Bloch functions*- Kronig - Penny model - Semiconductors - Band gap - Effective mass - Intrinsic carrier concentration.

Unit- IV **15 Hrs.**

Dielectrics and Ferroelectrics

Macroscopic electric field - Local electric field at an atom - Dielectric constant and Polarizability - Clausius Mossotti equation - Ferroelectric crystals - Polarization Catastrophe -*Ferroelectric domains*.**Diamagnetism and Para magnetism:** Langevin diamagnetic equation - Quantum theory of Para magnetism - Rare earth ions - Hund's rules - Demagnetization of a paramagnetic salt - Paramagnetic susceptibility of conduction electrons.

Unit -V **15 Hrs.**

Ferromagnetism and Anti ferromagnetism

Ferromagnetic order - Curie point and the exchange integral - Temperature dependence of saturation magnetization - Magnons - Thermal excitation - Ferromagnetic order -*Anti ferromagnetic order*- Anti ferromagnetic magnons - Ferromagnetic domains - Origin of domains - Coercive force and hysteresis. **Superconductivity:** Occurrence of superconductivity - Meissner effect - Thermodynamics of superconductivity transition - London equation - Coherence length - BCS theory - Flux quantization - Type I and Type II superconductors - Josephson superconductor tunneling - DC and AC Josephson effect.

Note :*Italics* denotes Self Study Topics

TEXT BOOKS

1. **Gupta and Kumar,***Solid State Physics*,Pragathi Prakashan, Meerut,2005. (Unit I,II andIII) .
2. **Kittel. C,***Introduction to Solid State Physics*, 5th Edition, Wiley Eastern, New Delhi, 1977. (Unit IV and V).
3.**Dekkar. A.J.,***Solid State Physics*, Mac. Millan, Madras, 1971.

REFERENCE BOOKS

1. **A.M.Wahab.,** *Solid State Physics: Structure and properties of materials*,2nd Edition, Narosa Publishing House, New Delhi, 2007.

2. **Blackmore.J.S.,** *Solid State Physics*,2nd Edition, Cambridge University Press, Cambridge London, 1974.
3. **Gupta.H.C.,***Solid State Physics*, Vikas Publishing House, 1995.
4. **Woolfson.M.N.,***An introduction to X- Ray crystallography*, Vikas Publishing limited, 1978.
5. **Saxena.B.S.,Gupta.R.C. and Saxena.P.N.,** *Solid State Physics*, Pragati Prakasham Meerut,2005.

SEMESTER - III

CORE PAPER -IX

ELECTROMAGNETIC FIELDS AND WAVES

Instructional Hrs. :90 **Sub. Code : 16PHPC309**

Max. Marks : CIA -25; ESE -75 **Credits: 4**

Objective : To introduce the students to the basic concepts of Electromagnetic theory .To make them prepare for state & national level physics examinations.

Unit- I **18 Hrs.**

Electrostatics

Columb's law- surface, line and volume charge distributions - Gauss' Law and its applications; Electrostatic potential - Laplace and Poisson equations - Potential of a localised charged distributions- Laplace equation in one, two and three dimensions - Boundary conditions and Uniqueness theorems.

Unit- II **18 Hrs.**

Magnetostatics

Lorentz force law- Biot-Savart law - condition for steady electric current - Ampere's law - *Application of Ampere's law*-Ampere's circuital Law - Magnetic vector and Scalar potential - Magneto static boundary conditions- comparison of Magnetostatics and Electrostatics

Unit -III **18 Hrs.**

Electrodynamics

Electromotive force -*ohms law*- Faradays law - Induced electric field - Energy in magnetic fields - Maxwell's equation in free space - Magnetic charge - Maxwells equation in matter - Boundary conditions - Conservation laws -Conservation of energy- Poynting's theorem - conservation of momentum .

Unit -IV **18 Hrs.**

Electromagnetic waves & interaction with matter

Electromagnetic waves in vacuum - Energy and momentum of EMW - EMW in matter - Propagation in linear media - Reflection and transmission at Normal incidence - Reflection and Transmission at Oblique incidence - Implications: Laws of incidence and reflectance, snell's law, *Brewster law*- Freshnel's equations.

UNIT V **18 Hrs.**

Relativistic electrodynamics: *Four vectors*- Transformation relation for charge and current densities - for electromagnetic potentials -Covariant from of inhomogeneous wave equations - Field equations in terms of four vectors - Transformation selection for field vector E and B covariant form of Lorenz force law.

Note: *Italics* denotes Self Study Topics

TEXT BOOKS

1. **Griffiths.D.**, *Introduction toElectrodynamics* , Percentice Hall of India , 1984.
2**. Richard Feyman,***Lectures*, Vol. 2,
3.**Jackson** ,*Classical electrodynamics*, Wiley & sons, New York ,2004.
4. **Sathya Prakash**, *Electromagnetic theory and Electrodynamics*, K.N.Ram Nath & Co, Meerut, 2006.
5. **Chopra&Agarwal,***Electromagnetic theory*, Nath & co, Meerut 2004,

REFERENCE BOOKS

1. **Jordon & Balenar, Prentice,***EMW radiating systems*, Percentice Hall of India, New Delhi, 2004.
2. **Julius Adams Stratton,** *Electromagnetic theory*, IEEE Press, Piscataway, 2007.
3**. J.D. Jackson**, *Classical Electrodynamics*
4**. Hans Ohanian,** *Classical Electrodynamics*, (ISBN-13:9780977858279) (ISBN-10:0977858278)

SEMESTER - IV

CORE PAPER - X

NUCLEAR AND PARTICLE PHYSICS

Instructional Hrs. :90 **Sub. Code : 16PHPC410**

Max. Marks : CIA -25; ESE -75 **Credits: 4**

Objective : To introduce the students to the basic concepts of Thermodynamics .To make them prepare for state & national level physics examinations.

Unit -I **18 Hrs.**

Nuclear force and Binding

Properties of Nuclear Force - Ground state properties of Deuteron - Square well solution of Deuteron - Low energy, neutron proton scattering - Limits of energy for the scattering of different partial waves - Binding energy - Weizacker's semi empirical mass formula - Application of semi empirical formula for alpha decay - mass parabola for stability of nuclei against beta decay - Evidence of shell effects - Single particle energy levels for infinite square well, harmonic oscillator with spin orbit potential - Application of shell model for spin and parity

Unit -II **18 Hrs.**

Radioactive disintegration

Properties of radioactive rays - Law of radioactivity - Half life and mean life-Radioactive equilibrium - Radioactive series - Range of alpha particles - Alpha spectrum and Fine structure - Alpha-Particle Disintegration Energy- Gamow's theory of Alpha decay - Energetics of Beta decay - Beta-Ray Spectra- Pauli's neutrino hypothesis - Properties of neutrino - Gamma emission - Selection rules - internal conversion - Fission process on the basis of liquid drop model - Nuclear fission energetics - Stability limits against spontaneous fission - Potential for fission - Bohr-Wheeler model

Unit -III **18 Hrs.**

Nuclear reactions

Types of nuclear reaction - Conservation laws in nuclear reactions - Balance of Mass and Energy in nuclear reactions - The Q equation and its solution - Proton, deuteron, neutron and alpha induced reactions - Cross section of nuclear reactions - Separation of center of mass motion in two body problem - Partial wave method for scattering and reaction cross section - Compound nucleus hypothesis - Breit Wigner one level formula

Unit -IV **18 Hrs.**

Neutron Physics and detectors

Properties of neutron - Classification of neutrons according to energy - Sources of neutron - Neutron detectors - Neutron multiplication and fission chain reaction - Four factor formula - Reactor materials - Geiger Muller counter -Semi conductor detectors (Diffused junction detector, Surface barrier detector) - Uses of semiconductor detectors - Scintillation detector

Unit- V **18 Hrs.**

Particle Physics

Meson Physics - Yukawa's hypothesis - Properties of Pi mesons - Classification of elementary particles -- Particle Interaction types - Feynman diagram for electromagnetic interaction, np interaction, weak decays - Symmetry and Conservation laws - Energy and momentum - Angular momentum - Parity - Baryon number - Lepton number - Isospin - Strangeness and Charm - Quark model - Isospin versus strangeness chart (Super multiplet) of mesons and baryons, three quark triplet, quark anti quark couplings

Note: *Italics* denotes Self Study Topics

TEXT BOOKS

1. **S.N. Ghosal**,*Nuclear Physics*, S. Chand Company Ltd (2010)
2. **D.C. Tayal**,*Nuclear Physics*, Himalaya Publishing House Ltd.,
3. **Pandya and Yadav,** *Elements of Nuclear Physics*, Nath & Co, Meerut, 1983,

REFERENCE BOOKS

1. **S.B. Patel,** *Nuclear Physics an Introduction*, New Age international Publishers, 2009
2. **K.S. Krane,** *Introductory Nuclear Physics*, Wiley India Ltd.,
3. **I. Kaplan**,*Nuclear Physics*, Narosa Publishing House 2002

SEMESTER - IV

CORE PAPER - XI

MOLECULAR SPECTROSCOPY

Instructional Hrs. :90 **Sub. Code : 16PHPC411**

Max. Marks : CIA -25; ESE -75 **Credits: 4**

Objective : To introduce the students to the basic concepts of Spectroscopy .To make them prepare for state & national level physics examinations.

Unit-I **18 Hrs.**

Microwave and Raman Spectroscopy

Rotation of molecules and their spectra - diatomic molecules - intensity of line spectra - the effect of isotropic substitution - non-rigid rotator and their spectra - polyatomic molecules (linear and symmetric top molecules) - Classical theory of Raman effect - pure rotational Raman spectra (linear and symmetric top molecules).

Unit-II **18 Hrs.**

Infra-red and Raman Spectroscopy

The energy of diatomic molecules - Simple Harmonic Oscillator -the Anharmonic oscillator - the diatomic vibrating rotator - vibration-rotation spectrum of carbon monoxide - breakdown of Born-Oppenheimer approximation - the vibrations of polyatomic molecules - influence of rotation on the spectra of polyatomic molecules (linear and symmetric top molecules) - Raman activity of vibrations - vibrational Raman spectra - vibrations of Spherical top molecules.

Unit-III **18 Hrs.**

Electronic Spectroscopy of Atoms

Electronic wave function and atomic quantum numbers - hydrogen spectrum -orbital, spin and total angular momentum - fine structure of hydrogen atom - many electron spectrum: Lithium atom spectrum, angular momentum of many electrons - term symbols - the spectrum of helium and alkaline earths - equivalent and non equivalent electrons - basics of X-ray photoelectron spectroscopy.

Unit-IV **18 Hrs.**

Electronic Spectroscopy of Molecules

Diatomic molecular spectra: Born-Oppenheimer approximation - vibrational spectra and their progressions - Franck-Condon principle - dissociation energy and their products - rotational fine structure of electronic-vibration transition - molecular orbital theory - the spectrum of molecular hydrogen - change of shape on excitation - chemical analysis by electronic spectroscopy - reemission of energy - fundamentals of UV photoelectron spectroscopy.

Unit-V **18 Hrs.**

Spin Resonance Spectroscopy

Spin and magnetic field interaction - Larmor precession - relaxation time - spin-spin relaxation - spin-lattice relaxation - NMR chemical shift - coupling constants - coupling between nuclei - chemical analysis by NMR - NMR for nuclei other than hydrogen - ESR spectroscopy - fine structure in ESR.

Note :*Italics* denotes Self Study Topics

TEXT BOOKS

1. **Aruldhas.G**, *Molecular structure and spectroscopy,* PHI Learning Pvt Ltd, New Delhi,2008.

REFERENCE BOOKS

1. **Gupta., Kumar., Sharma**., *Spectroscopy*, Pragati Prakashan, Meerut, 2006.
2. **Gurdeep R.Chatwal,***Spectroscopy(Atomic and Molcular)*,Himalaya Publishing House, New Delhi,2006.
3. **Straughan and S.Walker**.,***Spectroscopy,*** Vol 1, 2, 3, Chapman & Hall, Chennai, 1976.
4. **Banwell**. **C.N.**, *Spectroscopy*,, III edition, Tata McGraw Hill, New Delhi, 1980.
5. **Barrow**. **G.M.**, *Introduction to molecular spectroscopy* , Tata McGraw Hill, New Delhi, 1962.

SEMESTER-IV

CORE PRACTICAL - III

ADVANCED EXPERIMENTS

Inst.Hrs:120 **Sub.Code: 16PHPCP03**

Max. Marks: CIA-40; ESE-60 **Credits: 4**

Any Ten Experiments

1. Arc Spectra
2. Self inductance and Mutual inductance of the coil - Anderson's Bridge
3. Michelson Interferometer - λ, d λ
4. Susceptibility - Guoy`s method
5. Susceptibility - Quincke's method
6. Deposition of thin film by Dip coating method
7. Compressibility of a liquid - Ultrasonic method
8. Hall Effect
9. e/m - Magnetron Method
10. B - H curve - Anchor ring method
11. B - H curve - Solenoid, Tracer
12. Wavelength and refractive index of liquid - Diode laser
13. Kelvin's Double Bridge - Determination of very low resistance & Temperature coefficient of resistance.
14. Refractive index of liquid- Biprism.
15. Polarizability of liquid-Spectrometer.
16. Thickness of the material using diode laser.
17. Measurement of resistivity and Hall coefficient - Vander Pauw method

SEMESTER-IV

CORE PRACTICAL - IV

SPECIAL ELECTRONICS

Inst.Hrs:120 **Sub.Code:16PHPCP04**

Max.Marks: CIA-40; ESE-60 **Credits: 4**

Any Twelve Experiments

1. OP-Amp : Circuits using diodes - Half wave, full wave, clipper and clamper
2. IC 555 timer application - Monostable and Astable Multivibrator
3. A/D Converters - any one method.
4. D/A Converters - Binary weighted and Ladder methods
5. Modulation Counter
6. 7473 -Up/Down Counter ,Shift Register, Ring Counter and Johnson Counter
7. Instrumentation amplifier
8. Tunnel diode - characteristics
9. Square and Square root of a single byte , two digit BCD number.
10. Code Conversions - (i) Decimal to Hexadecimal (ii) Hexadecimal to Decimal (iii) Hexadecimal to ASCII and (iv) ASCII to Hexadecimal.
11. Largest /Smallest number in an array and Ascending / descending order of N numbers.
12. LED Interfacing.
13. Stepper Motor Interfacing.
14. Traffic control simulation.
15. Hex Key board interfacing.
16. Musical Tone Generator.
17. ADC Interface.
18. DAC Interface.

SEMESTER-III

ELECTIVE PAPER-I

COMMUNICATION ELECTRONICS & MICROPROCESSOR

Instructional Hrs: 75 **Sub Code: 16PHPE301**

Max. Marks: CIA -25; ESE -75 **Credits: 4**

Objective: To provide a comprehensive approach to the students in the design and analysis of communication electronic circuit and an understanding of Microprocessor and its applications.

UNIT I **15 Hrs.**

Antennas & Wave Propagation: Terms and definitions - Effect of Ground on antennas - Directional High frequency Antennas - Wideband and special purpose Antennas - Wave Guides - Rectangular waveguide - Circular and other waveguides - Propagation of Waves - Ground (Surface) Waves - Sky wave Propagation-The Ionosphere - Space Waves - Tropospheric Scatter Propagation - Extraterrestrial Communications.

UNIT II **15 Hrs.**

Communication Electronics: Communication systems - Information - Transmitter Channel-Noise - Receiver. - Pulse Communications System - Information Theory - Pulse Modulation - Pulse System - Digital Communications - Fundamentals of Data Communication Systems - Data Sets and Interconnection Requirements - Network and Control Considerations.

UNIT III **15 Hrs.**

Broad band communication system -Multiplexing -FDM -TDM - Short and Medium Haul Systems - Coaxial cables -Fiber optic links-Microwave links - Tropospheric scatter links -Long Haul Systems - Submarine cables - Satellite communications - Elements of Long Distance Telephony

UNIT IV **15 Hrs.**

Microprocessor - 8085: Architecture of 8085 -*Pin configuration* - Instruction set of 8085-Instruction types - based on number of bytes, based on operation - Simple programs using arithmetic and logical instructions - Interrupts: Maskable and non-maskable, vectored interrupts. Programmable peripheral interface (8255A) - Interfacing data converters.

UNIT V **15 Hrs.**

Microprocessor - 8086: Introduction - Architecture - Instruction classification - Instruction format - Data transfer operation - Arithmetic operations -*Logic operations*- rotate, compare - Writing assembly language programmes - Addition, Subtraction, Multiplication, Division, comparison of two numbers.

Note: *Italics* denotes Self Study Topics

TEXT BOOKS

1. **Kennedy.***Electronic Communication*, Tata McGraw Hill, New Delhi, 2006.
2. **Taub & Schilling.***Principle of communication system*, Tata McGraw Hill, New Delhi, 2003.
3. **Goankar.,***Microprocessor & architecture programming and application with 8085/8080*, New World International (P) Ltd, 1995.
4. **V.Vijayendran.** , *Fundamentals of Microprocessor -8086,* S.Viswanathan (Printers & Publisher), Pvt. Ltd., 2002**.**

REFERENCE BOOKS

1. **Gupta & Kumar.,***Handbook of Electronics* , Pragati Prakashan, Meerut, 1995.
2. **Roddy and Coolen.,***Electronic Communication*, Pearson Education, New Delhi, 2004.
3. **Mathur.,***Introduction to Microprocessor*, Tata McGraw Hill, New Delhi, 1999.
4. **V.Vijayendran.** , *Fundamentals of Microprocessor -8085* ,S.Viswanathan (Printers & Publisher), PVT .LTD, 2002.
5**. Douglas V.Hall**, *Microprocessors and Interfaces*, Tata McGraw Hill Company.

SEMESTER - IV

ELECTIVE PAPER-II

THERMODYNAMICS AND STATISTICAL MECHANICS

Instructional Hrs. :90 **Sub. Code : 16PHPE402**
Max. Marks : CIA -25; ESE -75 **Credits: 4**

Objective : To introduce the students to the basic concepts of Thermodynamics.To make them prepare for state & national level physics examinations.

Unit - I **18 Hrs.**

Thermodynamics, Microstates and Macrostates

Basic postulates of thermodynamics - Fundamental relations and definition of intensive variables - Intensive variables in the entropic formulation - Equations of state - Euler relation, densities - Gibbs-Duhem relation for entropy - Thermodynamic potentials - Maxwell relations - Thermodynamic relations - Microstates and macrostates - Ideal gas - Microstate and macrostate in classical systems - Microstate and macrostate in quantum systems -*Density of states*- Volume occupied by a quantum state

Unit - II **18 Hrs.**

Microcanonical, Canonical and Grandcanonical Ensembles

Microcanonical distribution function - Two level system in microcanonical ensemble - Gibbs paradox and correct formula for entropy - The canonical distribution function -*Contact with thermodynamics* - Partition function and free energy of an ideal gas - Distribution of molecular velocities - Equipartition and Virial theorems - The grand partition function - Relation between grandcanonical and canonical partition functions - One-orbital partition function

Unit - III **18 Hrs.**

Bose-Einstein, Fermi-Dirac and Maxwell-Boltzmann Distributions

Bose-Einstein and Fermi-Dirac distributions - Thermodynamic quantities - Fluctuations in different ensembles - Bose and Fermi distributions in microcanonical ensemble - Maxwell-Boltzmann distribution law for microstates in a classical gas - *Physical interpretation of the classical limit*- Derivation of Boltzmann equation for change of states without and with collisions - Boltzmann equation for quantum statistics - Equilibrium distribution in Boltzmann equation

Unit - IV **18 Hrs.**

Bose Gas and Fermi Gas

Non-interacting Bose gas and thermodynamic relations - Chemical potential of bosons -pressure and energy density of bosons - Black body radiations and Planck's distribution law - Number density of photons and Bose condensation - Thermodynamic relations for non-interacting Fermi gas -*Fermi gas at zero temperature*- Fermi energy and Fermi momentum - Pressure and energy density - Fermi gas at low temperature - Massless Fermi gas at any temperature, Particles and antiparticles

Unit - V **18 Hrs.**

Heat capacities, Ising model and Phase Transitions

Heat capacities of heteronuclear diatomic gas - Heat capacities of homonuclear diatomic gas - Heat capacities of solids; Dulong and petit law, Einstein temperature and Debye theory - Heat capcities of metals - Heat capacitiy of Bose gas - One-dimensional Ising model and its solution by variational method - Exact solution for one-dimensional Ising model - Phase transitions and criterion for phase transitions - Classification of phase transitions by order and by symmetry - *Phase diagrams for pure system*

Note: *Italics* denotes Self Study Topics

TEXT BOOKS

1. **Palash B. Pal,** *An Introductory Course of Statistical Mechanics*, Narosa Publishing House (2008), New Delhi
2. **Kamal Singh & S.P. Singh**,*Elements of Statistical Mechanics*, S. Chand & Company, New Delhi.

REFERENCE BOOKS

1. **Avijit Lahiri**, *Statistical Mechanics An Elementary Outline*, University Press - 2002- Hyderabad