SCHEME & SYLLABUS
M.Sc Physics

Department of Physical Sciences

University Institute of Sciences and Humanities (UISH)

Sant Baba Bhag Singh University

2017 onward

Scheme for M.Sc. -Physics

Semester-I

I. Theory Subjects

S No.	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	PHY501	Electronics	4:0:0	4:0:0	4	4
2	PHY503	Mathematical Physics	4:0:0	4:0:0	4	4
3	PHY505	Classical Mechanics	4:0:0	4:0:0	4	4
4	PHY507	Computational Techniques	4:0:0	4:0:0	4	4

II. Practical Subjects

1	PHY509	Electronics Lab	0:0:4	0:0:2	4	2
2	PHY511	Computer Lab	0:0:4	0:0:2	4	2
Total					24	20

Total credit: 20

Semester-II

I. Theory Subjects

1	PHY502	Quantum Mechanics-I	4:0:0	4:0:0	4	4
2	PHY504	Electrodynamics-I	4:0:0	4:0:0	4	4
3	PHY506	Condensed Matter Physics-I	4:0:0	4:0:0	4	4
4	PHY508	Atomic & Molecular Spectroscopy	4:0:0	4:0:0	4	4

II. Practical Subjects

1	PHY510	Condensed Matter Lab-I	0:0:4	0:0:2	4	2
2	PHY512	Spectroscopy Lab	0:0:4	0:0:2	4	2
Total					24	20

Total credit: 20

Semester-III

I. Theory Subjects

1	PHY601	Quantum Mechanics-II	4:0:0	4:0:0	4	4
2	PHY603	Electrodynamics-II	4:0:0	4:0:0	4	4
3	PHY605	Condensed Matter Physics-II	4:0:0	4:0:0	4	4
4	PHY607	Nuclear Physics	4:0:0	4:0:0	4	4

II. Practical Subjects

1	PHY609	Condensed Matter Physics Lab-II	0:0:4	0:0:2	4	2
2	PHY611	Nuclear Physics Lab	0:0:4	0:0:2	4	2
Total					24	20

Total credit: 20

Semester-IV

I. Theory Subjects

1	PHY602	Particle Physics	4:0:0	4:0:0	4	4
2	PHY604	Statistical Physics	4:0:0	4:0:0	4	4
3	PHY606	Seminar & Assignment	4:0:0	4:0:0	4	4
4	PHY	Elective I	4:0:0	4:0:0	4	4
5	PHY	Elective II	4:0:0	4:0:0	4	4
Total					20	20

List of Elective Subjects

1	PHY608	Physics of Materials	4:0:0	4:0:0	4	4
2	PHY610	Radiation Physics	4:0:0	4:0:0	4	4
3	PHY612	Reactor Physics	4:0:0	4:0:0	4	4
4	PHY614	Plasma Physics	4:0:0	4:0:0	4	4
5	PHY616	Geophysics	4:0:0	4:0:0	4	4
6	PHY618	Nano Technology	4:0:0	4:0:0	4	4

Total credit: 20

Summarized report of Course scheme for M.Sc Physics					
Sem	**L**	**T**	**P**	**Contact hrs/wk**	**Credits**
1	**16**	**0**	**4**	**24**	**20**
2	**16**	**0**	**4**	**24**	**20**
3	**16**	**0**	**4**	**24**	**20**
4	**20**	**0**	**0**	**20**	**20**
Total	**68**	**0**	**12**	**92**	**80**

Course Code	**PHY501**
Course Title	**Electronics**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B Sc with physics and mathematics as major subjects
Course Objective (CO)	The aim of the subject is to enhance the knowledge of students in electrostatics, electrodynamics and mechanics.

Syllabus

UNIT I

Electronic Devices: MESFETs and MOSFETs, Charge Coupled(CCDs) devices, Unijunction transistor (UJT), four layer (PNPN) devices, construction and working of PNPN diode, Semiconductor controlled rectifier (SCR) and Thyristor.

UNIT II

Electronic Circuits: Multivibrators (Bistable Monostable and Astable), Differential amplifier, Operational amplifier (OP-AMP), OP-AMP as inverting and non-inverting, scalar, summer, integrator, differentiator. Schmitt trigger and logarithmic amplifier, Electronic analog computation circuits

Digital Principles: Binary and Hexadecimal number system,Binary arithmetic, Logic gates, Boolean equation of logic circuits, Karnaugh map simplifications for digital circuit analysis, and design, Encoders & Decoders, Multiplexers and Demultiplexers, Parity generators and checkers, Adder-Subractor circuits.

UNIT III

Sequential Circuits:Flip Flops, Registers, Up/Down counters, Basics of semiconductor memories: ROM, PROM, EPROM, and RAM,D/A conversion using binary weighted resistor network, Ladder, D/A converter, A/D converter using counter, Successive approximation A/D converter.

UNIT IV

Microprocessors:Basic architecture of INTEL 8085, Instructions for simple mathematical operations e.g., Addition , Subtraction, Multiplication and Division.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Electronic Devices and Circuits	Millma n and Halkias	Tata McGraw-Hill
2	Solid State Electronic Devi ces -	Ben G Streetman	Prentice-Hall of India
3	Digital Principles and Applications	A.P.Malvino and D.P.Leach	Tata McGraw-Hill

Course Code	**PHY503**
Course Title	**MATHEMATICAL PHYSICS**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B Sc with physics and mathematics as major subjects
Course Objective	The main objective of this course is to familiarize students with a range of mathematical methods that are essential for solving advanced problems in theoretical physics.

Syllabus

UNIT I

Fourier Transformation: Fourier decomposition, Fourier series and convolution theorem. Fourier transformations and its applications to wave theory. Coordinate Systems: Curvilinear coordinates, differential vector operators in curvilinear coordinates. Spherical and cylindrical coordinate systems. General coordinate transformation, Tensors: covariant, contravari
ant and mixed, Algebraic operations on tensors, Illustrative applications.

UNIT II

Differential Equations: Second order differential equations. Frobenius method. Wronskian and a second solution, the Sturm Lioville problem. One dimensional Greens function. Special functions:Gamma function. The exponential integral and related functions. Bessel functions of the first and second kind. Legendre polynomials, associated Legendre polynomials and spherical harmonics. Generating functions for Bessel, Legendre and associated Legendre polynomials.

UNIT III

Complex Analysis: The Cauchy-Reimann conditions, Cauchy integral theorem, Cauchy integral formula. Taylor, and Lorent series, singularities and residues. Cauchy residue theorem. Calculation of real integrals.

UNITIV

Group Theory: Definition of a group, multiplication table, conjugate elements and classes of groups, direct product. Isomorphism, homeomorphism, permutation group. Definitons of the three dimensional rotation group and SU(2).

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Mathematical Methods for Physicists	George Arfken	New York Academy, 1970.
2	Advanced Mathematical Methods for Engg. and Science Students	: George Stephenson and P.M. Radmore	Cambridge Uni Press, 1990
3	Applied Mathematics for Engineers & Physicists	Pipes and Harvil	Prentice Hall

Course Code	**PHY505**
Course Title	**Classical Mechanics**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B Sc with physics and mathematics as major subjects
	The course has the major objectives: • To develop familiarity with the physical concepts and facility with the mathematical methods of classical mechanics.

Syllabus

UNIT I

Lagrangian Mechanics: Newton’s laws of motion, mechanic s of a systemof particles,constraints, D' Alembert's principle and Lagrange equationsof motion. Velocity dependentpotentials and dissipation function. Some applications of Lagrangian formulation, Hamiltonsprinciple, derivation of Lagrange equations from Hamilton’s principle. Conservationtheorems and symmetry properties.

UNIT II

Central Force Problem:Two body central force problem, reduction to equivalent one bodyproblem, the equation of motion and first integrals, the equivalent one dimensional problem,and classification of orbits. The differential equation for the orbit and integrable power-lawpotential. The Kepler problem. Scattering in a central force.

UNIT III

Rigid Body Dynamics:The independent coordinates of a rigid body, orthogonal transformation, the Euler's angles. Eulers' theorem on the motion of rigid body, finite and infinitesimal rotations, rate of change of a vector, angular momentum and kinetic energyabout a point for a rigid body, the inertia tensor and moment of inertia, the eigen values of the inertia tensor and the principal axis transformation. Euler's equations of motion, torque free motion of a rigid body.

UNIT IV

Canonical Transformations: Legendre transformation and Hamilton equations of motion,cyclic coordinates and conservation theorems, derivation of Hamiltons equations from avariational principle, the principle of least action.The equations of canonical transformation,examples of canonical transformations, Poisson brackets. Equations of motion, infinitesimalcanonical transformations and conservation theorems in the Poisson bracket formulation

Recommended books:-

S. No	**Name**	**Author(S)**	**Publisher**
1	Classical Mechanics	Herbert Goldstei n-	Narosa Pub. House, New Delhi, 1970
2	Mechanics	L.D. Landau	Pergamon Press, Oxford, 1982
3	Classical Mechanics	Rana and Joag	Tata Mc Graw Hill, New Delhi,

Course Code	**PHY507**
Course Title	**COMPUTATIONAL TECHNIQUES**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B Sc with physics and mathematics as major subjects
Course Objective (CO)	The objective of the course Computational Methods is to endow students with knowledge and experience in the application of computer.

Syllabus

UNIT I

Interpolation: Interpolation, Newton's formula for forward and backward interpolation, Divided differences, Symmerty of divided differences, Newton's general interpolation formula, Lagranges interpolation formula.

UNIT II

Numerical Differentiation and Integration: Numerical integration, A general quadrature formula for equidistant ordinates, Simpson, Weddle and Trape rules, Monte- Carlo Method.

UNIT III

Roots of Equation: Approximate values of roots, Bisection Method, Regula-Falsi Method, Newton-Raphson method, Bairstow method. Simultaneous Linear Algebraic Equations: Solution of Simultaneous Linear equations, Gauss elimination method, Gauss-Jordon method, Matrix inversion.

UNIT IV

Ordinary Differential Equation : Euler's method, Modified Euler's method, Runge-Kutta Method.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Programming with Fortran-77	Ram Kumar	Tata McGraw Hill
2	Programming with Fortran-77	R.S. Dhaliwal	Wiley-Eastern Ltd

Course Code	**PHY509**
Course Title	**ELECTRONICS LAB**
Type of course	Practical
L T P	0 0 4
Credits	2
Course prerequisite	B Sc with physics and mathematics as major subjects
Course Objective (CO)	The aim of this course is to impart practical knowledge to the students about the

1. To Study the D C characteristics and applications of DIAC.
2. To study the D C characteristics and applications of SCR.
3. To study the D C characteristics and applications of TRIAC.
4. Investigation of the D C characteristics and applications of UJT.
5. Investigation of the D C characteristics of MOSFET.
6. Study of bi-stable, mono-stable and astable, multivibrators.
7. Study of Op-Amps and their applications suchas an amplifier (inverting, non-inverting), scalar, summer, differentiator and integrator.
8. Study of logic gates using discrete elements and universal gates.
9. Study of encoder, decoder circuit.
10. Study of arithmetic logic unit (ALU) circuit.
11. Study of shift registers.
12. Study of half and full adder circuits.
13. Study of A/D and D/A circuits.
14. Study of pulse width and pulse position modulation.
15. Study of microprocessor 8085 for simple programming: addition, subtraction, multiplication and division

Course Code	**PHY511**
Course Title	**COMPUTER LAB**
Type of course	Practical
L T P	0 0 4
Credits	2
Course prerequisite	B Sc with physics and mathematics as major subjects
Course Objective (CO)	The objective of the course Computational Methods is to endow students with knowledge and experience in the application of computer.

1. Determination of Roots:
(a) Bisection Method
(b) Newton Raphson Method
(c) Secant Method
2. Matrix Manipulation
(a) Matrix Multiplication
(b) Determinant
(c) Gauss Elimination
(d) Matrix Inversion
(e) Gauss Jordan
3. Integration
(a) Trapezoidal rule
(b) Simpson 1/3 and Simpson 3/8 rules
(c) Gaussian Quardrature
4. Differential Equations
(a) Euler's method
(b) Runge Kutta Method
5. Interpolation
(a) Forward interpolation, Backward interpolation
(b) Lagrange's interpolation
6. Applications
(a) Chaotic Dynamics, logistic map
(b) One dimensional Schrondinger Equation
(c) Time period calculation for a potential
(d) Luminous intensity of a perfectly black body vs. temperature

Course Code	**PHY502**
Course Title	**QUANTUM MECHANICS - I**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B Sc NM
Course Objective	To connect the historical development of quantum mechanics with previous knowledge and learn the basic properties of quantum world.

Syllabus

UNIT I

Basic Formulation and quantum Kinematics: Stern Gerlach experiment as a tool to introduce quantum ideas, analogy of two level quantum system with polarisation states of light. Complex linear vector spaces, ket space,bra space and inner product, operators and properties of operators. Eigenkets of an observable, eigenkets as base kets, matrix representations. Measurement ofobservable, compatible vs. incompatible observable, commutators and uncertainty relations. Change of basis and unitary transformations.

Diagonalisation of operators. Position, momentumand translation, momentum as a generator of translations, canonical commutation relations . Wave functions as position representation of ket vectors. Momentum operator in position representation, momentum space wave function.

UNIT II

Quantum Dynamics: Time evolution operator and Schorodinger equation, special role of the Hamiltonian operator, energy eigen kets, time dependence of expectation values, spin precession. Schrodinger vs. Heisenberg picture, unitary operators, state kets and observable in Schrodinger and Heisenberg pictures, Heisenberg equations ofmotion, Ehrenfest's theorem.

UNIT III

One Dimenstional Systems: Potential Step, potential barrier,potential well. Scattering vs. Bounds states. Simple harmonic oscillator, energy eigen states, wave functions and coherent states.

UNIT IV

Spherical Symmetric Systems and Angular momentum: Schrodinger equation for a spherically symmetric potential. Orbital angular momentum commutation relations. Eigen value problem for L2, spherical harmonics. Three dim harmonic oscillator, three dim potential well and the hydrogen atom. Angular momentum algebra, commutation relations. Introduction to the concept of representation of the commutation relations in different dimensions. Eigen vectors and eigen functions of J2and Jz. Addition of angular momentum and C.G. coefficients.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Modern Quantum Mechnics	J.J. Sakurai	Pearson Educaton Pvt. Ltd., New Delhi, 2002
2	Quantum Mechanics	L I Schiff	Tokyo Mc Graw Hill, 1968
3	Feynmann lectures in Physics Vol. III	Addison Wesly, 1975	Prentice Hall

Course Code	**PHY504**
Course Title	**ELECTRODYNAMICS-I**
Type of course	Theory
L T P	4 0 0
Credits	4
Course objective	The objectives of the course are (i) to introduce the student to electrodynamics at a theoretically sophisticated level; (ii) develop problem solving skills; (iii) develop the techniques of mathematical physics to solve problems in E&M as well as other areas of physics

Syllabus

UNIT I

Electrostatics: Coulomb's law, Guass's law, Poisson's equation, Laplace equation. Solution of boundary value problem: Green's function, method of images and calculation of Green's function for the image charge problem in the case of a sphere, Laplace equation, uniqueness theorem. Electrostatics of dielectric media,multipole expansion. Boundary value problems in dielectrics; molecular polarisability, electrostatic energy in dielectric media.

UNIT II

Magnetostatics: Biot and Savart's law. The differential equation of Magnetostatics and Ampere's law, vector potential and magnetic fields of a localised current distribution. Magnetic moment, force and torque on a magnetic dipole in an external field. Megnetic materials, Magnetisation and microscopic equations.

UNIT III

Time-varying fields: Time varying fields, Maxwell's equations, conservation laws: Faraday's law of induction, Energy in a magnetic field. Maxwell's displacement current, vector and scalar potential, Gauge transformations; Lorentz gauge and Coulomb gauge. Poynting theorem, conservation laws for a system of charged particles and electromagnetic field, continuity equation.

UNIT IV

Electromagnetic Waves: Plane wave like solutions of the Maxwell equations. Polarisation, linear and circular polarisation. Superposition of waves in one dimension. Group velocity. Illustration of propagation of a pulse in dispersive medium. Reflection and refraction of electromagnetic waves at a plane surface between dielectrics. Polarisation by reflection and total internal reflection. Waves in conductive medium, Simple model for conductivity.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Classical Electrodynamics	J.D. Jackson	John &Wiley Sons Pvt. Ltd. New York, 2004
2	Introduction to Electrodynamics	D.J. Griffiths	Pearson Education Ltd., New Delhi
3	Classical Electromagnetic Radiation	J.B. Marion	Academic Press, New Delhi, 1995.

Course Code	**PHY506**
Course Title	**CONDENSED MATTER PHYSICS-I**
Type Course	Theory
L T P	4 0 0
Credits	4
Course Pre-requisite	B Sc
Course Objective :	The objectives are to provide understanding of the enormously rich behaviour of condensed matter systems under a wide variety of conditions.

Syllabus

UNIT I

Dia-Para and Ferromagnetism: Classification of magnetic materials, the origin of permanent magnetic dipoles, diamagnetic susceptibility, classical theory of para magnetism, Quantum theory of paramagnetism, Quenching of orbital angular momentum, cooling by adiabatic demagnetization. Paramagnetic susceptibility of conduction electrons. Ferromagnetism, the Weiss molecular field, theinterpretation of the Weiss field. Ferromagnetic domains, Spin waves, quantization of spin waves, Thermal excitations of magnons.

UNIT II

Antiferro-Ferrimagnetism and Superconductivity: The two sublattice model, superexchange interaction, the structure of ferrites,saturation magnetisation, Neel's theory of ferrimagnetism,Curie temperature and susceptibility of ferrimagnets. Superconductivity, zeroresistivity, critical temperature, Meissner effect, Type I and Type II superconductors, specific heat and thermal conductivity, BCS theory, Ginzsburg-Landou theory, Josephson effect: dc Josephson effect, ac Josephson effect, macroscopic quantum interference, high temperature superconductivity (elementry).

UNIT III

Defects and Diffusion in Solids: Point defects: Impurities, Vacancies- Schottky and Frankel vacancies, Color centers and coloration of crystals, F-centres, Line defects (dislocations), Edge and screw dislocations, Berger Vector, Planar (stacking) Faults, Grain boundaries, Low angle grain boundaries, the Hydration energy of ions, Activation energy for formation of defects in ionic crystals, Ionic conductivity in pure alkali halides.

UNIT IV

Lattice Vibrations and Phonons: Vibrations of one dimensional linear monoatomic lattice, Normal modes of vibrations in a finite length of the lattice, The linear diatomic lattice, Excitation of optical branch in ionic crystals – the infra red absorption, Quantization of lattice vibrations – concept of phonons, Phonon momentum, In elastic scattering of photons by phonons, Inelastic scattering of neutrons by phonons.

Text and Reference Books

S.No.	Author(S)	Title	Publisher
1	C. Kittel-Wiely	An Introduction to Solid State Physics	Wiely Estem Ltd., New Delhi, 1979
2	A.J. Dekkar	Solid State Physics	Maemillan India Ltd., New Delhi, 2004
3	R.A. Levy	Principles of Solid State Physics	New York Academy, 196

Course Code	**PHY508**
Course Title	**ATOMIC AND MOLECULAR SPECTROSCOPY**
Type of Course	Theory
L T P	4 0 0
Credits	4
Course Prerequisite	B Sc NM
Course Objectives	To learn the atomic and molecular structure. To understand the different Spectroscopic techniques To know the application of spectroscopic techniques

Syllabus

UNIT I

Spectra of one and two valance electron systems: Magnetic dipole moments; Larmor's theorem; Space quantization of orbital, spin and total angular momenta; Vector model for one and two valance electron atoms; Spin-orbit interaction and fine structure of hydrogen, Lamb shift, Spectroscopic terminology; Spectroscopic notationsfor L-S and J-J couplings; Spectra of alkali and alkaline earth metals; Interaction energy in L-S and J-J coupling for two electron systems; Selection and Intensity rules for doublets and triplets

UNIT II

Breadth of spectral line and effects of external fields: The Doppler effect; Natural breadth from classical theory; natural breadth and quantum mechanics; External effects like collision damping, asymmetry and pressure shift and stark broadening; The Zeeman Effect for two electron systems; Intensity rules for the Zeeman effect;
The calculations of Zeeman patterns; Paschen-Back effect; LS coupling and Paschen –Back effect; Lande's factor in LS coupling; Stark effect

UNIT III

Microwave and Infra-Red Spectroscopy: Types of molecules, Rotational spectra of diatomic molecules as a rigid and non-rigid rotator, Intensity of rotational lines, Effect of isotopic substitution, Microwave spectrum of polyatomic molecules, Microwave oven, The vibrating diatomic molecule as a simple harmonic and anharmonic oscillator, Diatomic vibrating rotator, The vibration-rotation spectrum of carbon monoxide, The interaction of rotation and vibrations, Outline of technique and instrumentation, Fourier transform spectroscopy.

UNIT IV

Raman and Electronic Spectroscopy: Quantum and classical theories of Raman Effect, Pure rotational Raman spectra for linear and polyatomic molecules, Vibrarional Raman spectra, Structure determination from Raman and infra-red spectroscopy, Electronic structure of diatomic molecule, Electronic spectra of diatomic molecules, Born Oppenheimer approximation-The Franck-Condon principle, Dissociation and pre-dissociation energy, The Fortrat diagram, example of spectrum of molecular hydrogen.

Text and Reference Books

S.No.	Author(S)	Title	Publisher
1	C.B. Banwell	Introduction to Atomic Spectra	Tata Mc Graw Hill, 1986

2	C.B. Banwell	Fundamentals of Molecular spectroscopy	Tata Mc Graw Hill, 1986
3	Walker & Straughe	Spectroscopy Vol. I, II & III:	-

Course Code	**PHY510**
Course Title	**CONDENSED MATTER LAB-I**
Type of course	Practical
L T P	0 0 4
Credits	2
Course prerequisite	B Sc with physics and mathematics as major subjects
Course Objective (CO)	The course is to impart practical knowledge to the students (i) the design and development of advanced experimental systems suitable for measurements using high pressure, low temperature and high magnetic field, and (ii) to process new materials and study their macroscopic and microscopic properties.

1.To determine Hall coefficient by Hall Effect.
2. To determine the band gap of a semiconductor using p-n junction diode..
3. To determine the magnetic susceptibility of a material using Quink's method.
4. To determine the g-factor using ESR spectrometer.
5. To determine the energy gap and resistivity of the semiconductor using four probe method.
6. To trace hysteresis loop and calculate retentivity, coercivity and saturation magnetization.
7. To determine dielectric constant.
8. To study the series and parallel characteristics of a photovoltaic cell.
9.To study the spectral characteristics of a photovoltaic cell.

Course Code	**PHY512**
Course Title	**SPECTROSCOPY LAB**
Type of course	Practical
L T P	0 0 4
Credits	2
Course prerequisite	B Sc
Course Objective (CO)	The purpose of this lab is to further understanding of atomic structure and its relation to the production of light.

1. To find the wavelength of monochromatic light using Fabry Perot interferometer.
2. To find the wavelength of sodium light using Michelson interferometer.
3. To calibrate the constant deviation spectrometer with white light and to find the wavelength of unknown monochromatic light.
4. To find the grating element of the given grating using He-Ne laser light.
5. To find the wavelength of He-Ne laser using Vernier calipers.
6. To verify the existance of Bohr's energy levels with Frank-Hertz experiment.
7. To determine the charge to mass ratio (e/m) of an electron with normal Zeeman Effect
8. To determine the velocity of ultrasonic waves in a liquid using ultrasonic interferometer

Course Code	**PHY601**
Course Title	**QUANTUM MECHANICS-II**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B. Sc N.M
Course Objective (CO)	To connect the historical development of quantum mechanics with previous knowledge and learn the basic properties of quantum world.

Syllabus

UNIT I

Perturbation Theory: First and second order perturbation theory for nondegenerate and degenerate systems. erturbation of an oscillator and anharmonic oscillator, the variation method. First order time dependent perturbation theory, constant perturbation, Calculation of transition probability per unit time for harmonic perturbation. The Helium atom problem. Stark effect.

UNIT II

Scattering Theory: Born approximation, extend to higher orders. Validity of Born approximation for a square well potential. Optical theorem. Partial wave analysis, unitarity and phase shifts. Determination of phase shift, applications to hard spherescattering. Low energy scattering in case of bound states. Resonance scattering.

UNIT III

Relativistic Quantum Mechanics: Klein Gordon equation. Dirac Equation, Lorentz covariance of Dirac equation. Positive and negative energy solutions of Dirac equation, positrons. Properties of gamma matrices. Parity operator and its action on states. Magnetic moments and spin orbit energy.

UNIT IV

Identical Particles : Brief introduction to identical particles in quantum mechanics (based on Feynmann Vol.III) symmetrisation postulates. Application to 2-electron systems. Pauli exclusion principle. Bose Einstein and Fermi Dirac Statistics.

Text and Reference Books

S. No	**Name**	**Author(S)**	**Publisher**
1	Modern Quantum Mechnics	.J. Sakurai	Pearson Educaton Pvt. Ltd., New Delhi, 2002
2	Quantum Mechanics	L I Schiff-Tokyo	Mc Graw Hill, 1968
3	Feynmann lectures in Physics Vol. III	Addison Wesly, 1975	-

Course Code	PHY603
Course Title	ELECTRODYNAMICS – II
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B Sc NM
Course Objective (CO)	The objectives of the course are (i) to introduce the student to electrodynamics at a theoretically sophisticated level; (ii) develop problem solving skills; (iii) develop the techniques of mathematical physics to solve problems in E&M as well as other areas of physics

Syllabus

UNIT I

Wave Guides: Field at the surface of and within a conductor. Cylindrical cavities and wave-guides, modes in a rectangular wave guide, energy flow and attenuation in wave guides. Perturbation of boundary conditions, resonant cavities, power loss in cavity and quality factor.

UNIT II

Relativistic formulation of electrodynamics: Special theory or relativity, simultaneity, length, contraction, time dilation and Lorenz's transformations. Structure of space-time, four scalars, four vectors and tensors, relativistic mechanics. Relativistic electrodynamics. Magnetism as a relativistic phenomena and field transformations. Recasting Maxwell equations in the language of special relativity, covariance and manifest covariance, field tensor. Lagrangian formulation for the covariant Maxwell equations.

UNIT III

Radiation Systems: Fields of radiation of localized oscillating sources, electric dipole fields and radiation, magnetic dipole and electric quadrupole fields, central fed antenna, brief introduction to radiation damping
and radiation reaction.

UNIT IV

Fields of moving charges: Lienard Wiechert potential, field of a moving charge. Radiated power from an accelerated charge at low velocities, Larmour's power formula and its relativistic generalisation ; Angular distribution of radiation emitted by an accelerated charge.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Classical Electrodynamics	J.D. Jackson-Wiley, 1967	
2	Electricity and Magnetics	D.J. Griffiths	Prentice hall, 1996
3	Classical Electromagnetic Radiation	J.B. Marian	Academic Press, 1965

Course Code	**PHY605**
Course Title	**CONDENSED MATTER PHYSICS-II**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B Sc
Course Objective (CO)	The objectives are to provide understanding of the enormously rich behaviour of condensed matter systems under a wide variety of conditions.

Syllabus

UNIT I

Lattice Specific Heat and Elastic Constants: The various theories of lattice specific heat of solids. Einstein model of the Lattice Specific heat. Density of modes of vibration, Debye model of Lattice specific heat, Born cut-off procedure, specific heat of metals, Elastic strain and stress component. Elastic compliance and stiffness constants. Elastic constants of cubic crystals. Elastic waves in cubic crystals.

UNIT II

The conductivity of Metals and Luminescence: Electrical conductivityof metals, Drift velocity and relaxation time, the Boltzmann transport equation. The Sommerfield theory of conductivity, Mean free path in metals, qualitative discussion of the features of the resistivity, Mathiesson's rule Luminescence, exitation and emission, Decay mechanisms, Thallium activated alkali halides. The Sulphide phosphors. Electro Luminescene.

UNIT III

Plasmons, Polaritons and Opticals Properties: Dielectric function of the electron gas, plasma optics, transverse and longitudinal modes in plasma, plasmons. Electrostatic screening, polaritons and LST relations, Electron- phonon interaction, polarons, Kramer-Kroning relations, Conductivity of collissionless electrons.

UNIT IV

Dielectrics and Ferro Electrics: Macroscopic field, The local field, Lorentz field. The Claussius-Mossotti relations, Different contribution to polarization: dipolar, electronic and ionic polarizabilities, General properties of ferroelectric materials. The dipole theory of ferroelectricity, objection against dipole theory, Thermodynamics of ferroelectric transitions.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	An Introduction to Solid State Physics	C. Kittle-Wiley, 1958	Wiley, 1958
2	Solid State Physics	A.J. Dekker	Prentice Hall, 1965
3	Principles of Solid State Physics	R.A. Levey	Academic Press, 1968

Course Code	**PHY607**
Course Title	**NUCLEAR PHYSICS**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B Sc NM
Course Objective (CO)	The objective of this course is to: introduce students to the fundamental principles and concepts governing nuclear and• particle physics and have a working knowledge of their application to real-life problems.

Syllabus

UNIT I

Nuclear Interactions and Nuclear Reactions Nuclear Forces: Two nuclear system, deutron problem, binding energy, nuclear potential well, pp and pn scattering experiments at low energy, meson theory of nuclear forces, e.g. Bartlett, Heisenberg, Majorans forces and potentials, exchanges forces and tensor forces, effective range theory-spin dependence of nuclearforces-Charge independence and charge symmetry of nuclear forces-Isospin formalisim- Yukawa interaction.

UNIT II

Nuclear Models: Liquid drop model, Bohr-Wheeler theory of fission, Experimental evidence for shell effects, Shell Model, Spin-Orbit coupling, Magic-Applications of Shell model like Angular momenta and parities of nuclear ground states, Quantitative discussion and estimates of transition rates-magnetic moments and Schmidt lines, Collective model, Nuclear vibrations spectra and rotational spectra, applications, Nilsson model.

UNIT III

Nuclear Decay: Beta decay, Fermi theory of beta decay, shape ofthe beta spectrum, Total decay rate, Angular momentum and parity selection rules, Comparative half-lives, Allowed and forbidden transitions, selection rules, parity violation, Two component theory of neutrino decay, Detection and properties of neutrino, Gamma decay, Multipole transitions in nuclei, Angular momentum and parity selection rules, Internal conversion, Nuclear isomerism.

UNIT IV

Nuclear Reactions: Direct and compound nuclear reaction mechanisms, cross sections in terms of partial wave amplitudes, Compound nucleus, scattering matrix, Reciprocity theorem, Breit Winger one level formula, Resonance scattering.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Nuclear Structure, Vol.1(1969) and Vol.2	A. Bohr and B.R. Mottelson	Benjamin, Reading, A.1975
2	Introductory Nuclear Physics	Kenneth S. Krane	Wiley, New York, 1988
3	Atomic and Nuclear Physics Vol.2	G.N. Ghoshal	S. Chand and Co., 1997

Course Code	**PHY609**
Course Title	**CONDENSED MATTER PHYSICS LAB.II**
Type of course	Practical
L T P	0 0 4
Credits	2
Course prerequisite	B Sc NM
Course Objective	The course is to impart practical knowledge to the students (i) the design and development of advanced experimental systems suitable for measurements using high pressure, low temperature and high magnetic field, and (ii) to process new materials and study their macroscopic and microscopic properties.

1. To determine the energy loss in transformer and ferrite cores using B-H curve.
2. To determine Stefan's constant using Boltzmann's Law.
3. To determine temperature coefficient of junction voltage and energy band gap in a p-n junction diode.
4. To study the depletion capacitance and its variation with reverse biasin a p-n junction.
5. Experiments with Microwaves set up.
6. To determine the lattice dynamics and dispersion relation for the monatomic and diatomic lattices.
7. To determine Curie temperature of ferrites.
8. To determine the energy loss in the ferrites at room temperature.
9. Experiments on Nanotechnology.
10. Study of Thermoluminescence of f-centres in Alkali Halide Crystals.

Course Code	**PHY611**
Course Title	**NUCLEAR PHYSICS LAB**
Type of course	Practical
L T P	0 0 4
Credits	2
Course prerequisite	B. Sc NM
Course Objective (CO)	To know the main applications of Nuclear Physics in different aspectects of technology and Science. In particular, material analysis of technological and environmental samples. To do analysis of various samples with different nuclear techniques.

1. Pulse-Height Analysis of Gamma Ray Spectra.
2. Calibration of Scintillation Spectrometer.
3. Least square fitting of a straight line.
4. Study of absorption of gamma rays in matter.
5. Study of Compton Scattering Effect.
6. To study the characteristics of a G.M. Counter.
7. To determine the Dead time of a G.M. Counter.
8. Absorptions of Beta Particles in Matter.
9. Source strength of a Beta Source.
10. Window thickness of a G.M. Tube.
11. To investigate the statistics of radioactive measurements.
12. Study of Poisson Distribution.
13. Study of Gaussian Distribution.

Course Code	**PHY602**
Course Title	**PARTICLE PHYSICS**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B Sc NM
Course Objective	The objectives of particle physics are to identify the most a simple object out of which all matter is composed and to understand the forces which cause them to interact and combine to make more complex things.

Syllabus

UNIT I

Elementary Particles and Their Properties: Historical survey of elementary particles and their classification, determination of mass, life time, decay mode, spin and parity of muons,pions, kaons and hyperons. Experimental evidence for two types of neutrinos, production and detection of some important resonances and antiparticles.

UNIT II

Symmetries and Conservation Laws: Conserved quantities and symmetries, the electric charge, baryon number, leptons and muon number, particles and antiparticles, hypercharge (strangeness), the nucleon isospin, isospin invariance, isospin of particles, parity operation, charge conservation, time reversal invariance, CP violation and CPT theorem, the KO – KO doublet unitary symmetry SU(2), SU (3) and the quark model.

UNIT III

Weak Interaction: Classification of weak interactions, Fermi theory of beta decay, matrix element, classical experimental tests of Fermi theory, Parity non conservation in beta decay, lepton polarization in beta decay, the V-A interaction, parity violation in P-decay. Weak decays of strange-particles and Cabibbo's theory.

UNIT IV

Gauge theory and GUT: Gauge symmetry, field equations for scalar (spin 0), spinor (spin ½), vector (spin-1) and fields, global gauge invariance, local gauge invariance, Feynmann rules, introduction of neutral currents. Spontaneously broken symmetries in the field theory, standard model.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Subatomic Physics	H. Fraunfelder and E.M. Henley	N.J. Prentice Hall
2	Introduction to Elementary Particles	D. Griffiths	Wiley-VCH-2008
3	Introduction to High Energy Physics	D.H Perkins	Cambridge University Press, 2000

Course Code	**PHY604**
Course Title	**STATISTICAL MECHANICS**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B. Sc N.M
Course Objective (CO)	The objective of this course is to introduce the student to today's understanding of statistical physics and statistical mechanics.

Syllabus

UNIT I

Classical Stat. Mech. I: Foundation of statistical mechanics; specification of states in a system, contact between statistics and thermodynamics, the classical ideal state, the entropy of mixing and Gibbs paradox. The phase space of classical systems, Liouville's theorem and its consequences.

UNIT II

Classical Stat. Mech. II: The microcanonical ensemble with examples. The canonical ensemble and its thermodynamics, partition function, classical ideal gas in canonical ensemble theory, energy fluctuations in the canonical ensemble. A system of harmonic oscillators. The statistics of paramagnetism. The grand canononical ensemble, the physical significance of the statistical quantities, examples, fluctuation of energy and density. Cluster expansion of classical gas, the virial equation of state.

UNIT III

Quantum Stat. Mech.I : Quatum states and phase space, the density matrix, statistics of various ensembles. Example of electrons in a magnetic field, a free particle in a box and a linear harmonic oscillator. Significance of Boltzamann formula in classical and quantum statistical mechanics.

UNIT IV

Quantum Stat. Mech. II : An ideal gas in quantum mechanical microcanonical ensemble. Statistics of occupation numbers, concepts and thermodynamical behaviour of an ideal gas. Bose Einstein condensation, Discussion of a gas of photons and phonons, Thermodynamical behaviour of an ideal fermi gas, electron gas in metals, Pauli paramagnetism, statistical equilibrium of white dwarf stars.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Statistical Mechanics	R.K. Patharia	Butten Worth Heinemann, 1996
2	Statistical and Termal Physics	F. Reif	Mc-Graw Hill, 1965
3	Statistical Mechanics	Kerson Huang	Wiley, 1963

Course Code	**PHY608**
Course Title	**PHYSICS OF MATERIALS**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B Sc NM
Course Objective (CO)	• To engage the students in advanced education, research, and development in materials science • To develop critical reasoning to identify fundamental issues and establish directions for investigation • creative processes to define specific plans for problem solution

Syllabus

UNIT I

Vacuum Technology: Basic ideas about vacuum, Throughput, Conductance, Vacuum pumps : rotary pump, diffusion pump, ion pump, molecular pump, cryopump, Vacuum gauges : pirani gauge, penning gauge,ionization gauge (hot cathode ionization gauge, cold cathode ionization gauge).

UNIT II

Thin Film: Thin Film and growth process, Influence of nature of substrate and growth parameters (substrate temperature, thickness, deposition rate). Thin film deposition, techniques: thermal evaporation,chemical vapor deposition, spray pyrolysis, sputtering. Epitaxial growth, Thin film thickness measurement techniques: film resistance method, optical method, microbalance method.

UNIT III

Polymers, Ceramics, Liquid Crystals and Nanophase Materials: Characteristics, Application and Processing of polymers : Polymerization, Polymer types, Stress- Strain behaviour, melting and glass transition, thermosets and thermoplasts. Characteristics, Application and Processing of Ceramics, glasses and refrectories, Liquid Crystals : classification and applications, Nanophase materials: synthesis and applications.

UNIT IV

Characterization of Materials: Powder and single crystal X-ray diffraction, Transmission electron microscopy, Scanning electron microscopy, Low Energy Electron Diffraction (LEED), Auger electron microscopy, Atomic force microscopy.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Vacuum Technology	A. Roth	North Holland Pub. Co., 1976
2	Thin Film Phernomeon	K.L. Chopra	R E Kriegn Pub. Co., 1979
3	High Temperature Superconductors	E.S.R. Gopal & SV. Subramanyam-	Wiley, 1989
4	Material Scienceand Engg	W.D. Callister	Wiley, 1994

Course Code	**PHY610**
Course Title	**RADIATION PHYSICS**
Type of course	Practical
L T P	4 0 0
Credits	4
Course prerequisite	B. Sc N.M
Course Objective (CO)	Understand the basic physics of the electromagnetic and particulate forms of ionizing radiation. • Understand the distinctions between the units of radiation quantity, exposure and dose. • Be familiar with some of the methods used to measure radiation dose.

Syllabus

UNIT I

Ionizing Radiations and Radiation Quantities: Types and sources of ionizing radiation, fluence, energy fluence, kerma, exposure rate and its measurement - The free air chamber and air wall chamber, Absorbed dose and its measurement ; Bragg Gray Principle, Radiation dose units - rem, rad, Gray and sievert dose commitment, dose equivalent and quality factor.

UNIT II

Dosimeters: Pocket dosimeter, films, solid state dosimeters such as TLD, SSNTD, chemical detectors and neutron detectors. Simple numerical problems on dose estimation.

UNIT III

Radiation Effects and Protection: Biological effects of radiation at molecular level, acute and delayed effects, stochastic and non-stochastic effects, Relative Biological Effectiveness (RBE), Linear energy transformation (LET), Dose response characteristics. Permissible dose to occupational and non-occupational workers, maximum permissible concentration in air and water, safe handling of radioactive materials, The ALARA, ALI and MIRD concepts, single target, multitarget and multihit theories, Rad waste and its disposal, simple numerical problems.

UNIT IV

Radiation Shielding: Thermal and biological shields, shielding requirement for medical, industrial and accelerator facilities, shielding materials, radiation attenuation calculations-The point kernal technique, radiation attenuation from a uniform plane source. The exponential point-Kernal. Radiation attenuation from a line and plane source. Practical applications of some simple numerical problems.

Text and Reference Books

S. No	**Name**	**Author(S)**	**Publisher**
1	Nuclear Reactor Engineering	S. Glasstone and A. Sesonke	Van Nostrand Reinhold
2	Radiation Theory	Alison. P. Casart	
3	Radiation Biology	A. Edward Profio	Radiation Bio/Prentice Hall, 1968

Course Code	PHY612
Course Title	REACTOR PHYSICS
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B Sc NM
Course Objective	The aim of the subject is to provide the knowledge about nuclear reactors.

Syllabus

UNIT I

Interaction of Neutrons with Matter in Bulk: Thermal neutron diffusion, Transport and diffusion equations, transport mean free path, solution of diffusion equation for a point source in an infinite medium and for an infinite plane source in a finite medium, extrapolation length and diffusion length-the albedo concept.

UNIT II

Moderation of Neutron: Mechanics of elastic scattering, energy distribution of thermal neutrons, average logarithmic energy decrement, slowing down power and moderating ration of a medium. Slowing down density, slowing down time, Fast neutron diffusion and Fermi age theory, solution of age equation for a point source of fast neutrons in an infinite medium, slowing down length and Fermi age.

UNIT III

Theory of Homogeneous Bare Thermal and Heterogeneous Natural Uranium Reactors
Neutron cycle and multiplication factor, four factor formula, neutron leakage, typical calulations of critical size and composition in simple cases, The critical equation, material and geometrical bucklings, effect of reflector, Advantages and disadvantages of heterogeneous assemblies, various types of reactors with special reference to Indian reactors and a brief discussion of their design feature.

UNIT IV

Power Reactors Problems of Reactor Control: Breeding ratio, breading gain, doubling time, Fast breeder reactors, dual purpose reactors, concept of fusion reactors, Role of delayed neutrons and reactor period, In hour formula, excess reactivity, temperature effects, fission product poisoning, use of coolants and control rods.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	The elements of Nuclear reactor Theory	Glasstone & Edlund	Vam Nostrand, 1952
2	Introductions of Nuclear Engineering	Murray	Prentice Hall, 1961

Course Code	**PHY614**
Course Title	**PLASMA PHYSICS**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B Sc NM
Course Objective (CO)	To carry out basic research in theoretical and experimental Plasma Physics and the other is to use plasmas as a tool or technology for applications in other areas such as plasma based - material synthesis and development of propulsion systems.

Syllabus

UNIT I

Basics of Plasmas: Occurence of plasma in nature, definition of plasma, concept of temperature,Debye shielding and plasma parameter. Single particle motion in uniform E and B, non uniformmagnetic field, grid B and curvature drifts, invariance of magnetic moment and magnetic mirror.Simple application of plasmas.

UNIT II

Plasma Waves: Plasma oscillations electron plasma waves, ion waves, electrostatic electron and ion oscillations perpendicular to magnetic field upper hybrid waves, lower hybrid waves, ion cyclotron waves. Light waves in plasma.

UNIT III

Boltzmann and Vlasov Equations: The fokker plank equation, integral expression for collision lern zeroth and first order moments, the single equation relaxation model for collision lern. Application kinetic theory to electron plasma waves, the physics of landau damping, elementary magnetic and inertial fusion concepts.

UNIT IV

Non-linear Plasma Theories: Non-linear Electrostatic Waves, K dV Equations, Non-linear Schrodinger Equation, Solitons, Shocks, Non-linear Landou Damping.

Text and Reference Books:-

S. No	Name	Author(S)	Publisher
1	Introduction to Plasma Physics and Controlled Fusion	F. F. Chen	Springer, 1984
2	Plasma Physics	R. O. Dendy	Cfambridge University Press, 1995.
3	Ideal Magneto hydrodynamics	J. P. Friedberg	Springer edition, 1987
4	Fundamental of Plasma Physics	S. R. Seshadri	American Elsevier Pub. Co

Course Code	**616**
Course Title	**GEOPHYSICS**
Type of course	Practical
L T P	4 0 0
Credits	4
Course prerequisite	B. Sc N.M
Course Objective (CO)	To locate or detect the presence of subsurface structures or bodies and determine their configuration (i e size determine their configuration (i.e. size, shape, depth) and physical properties (i.e. physical parameters).

Syllabus

UNIT I

Seismology and Interior of the Earth: Origin of earth, shape, size, mass and density of the earth. Theory of seismic waves. The variation of P and S wave velocity, temperature, density, pressure and elastic parameters with depth. Mineralogical and chemical composition of crust, mental and core. Formation of core. Earthquake; effects, types, mechanism, source parameter, and hazard assessment.

UNIT II

Geochronology and Geodynamics: Geological Time Scale. Radioactive dating methods; U-Pb, Th-Pb, Pb-Pb, Rb-Sr, K-Ar, and C-14. Fission Track dating. Interpretation and discordant ages, age of earth. Heat flow: thermal and mechanical structure of the continental and oceanic lithosphere. Plate tectonics theory: kinematics, dynamics and evolution of plates; types of boundaries, processes. Geodynamics of Indian plate, formation of Himalya.

UNIT III

Radioactivity of Rocks: Magnetic differentiation, Browns reaction series. Radioactivity of rocks, soil, water and air. Uranium mineralization and its occurrences in India. Radiometric survey of rocks: ground and air borne surveys. Radiometer and emanometer. Role of radiometry in geophysical prospecting, gamma logging and gamma testing.

UNIT IV

Nuclear Techniques: Gamma-transmission method for determination of rock densities in Laboratory and in-situ.Gamma spectrometric analysis for U, Th and K in rock/soil. Neutron activation analysis: Equation for build up of induced activity.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	The Solid Earth	C.M.R. Fowler	
2	Interior of the earth	M.H.P. Bott	
3	The Earth's age and Geochronology	D.York and R.M. Fraquhar	

Course Code	**PHY618**
Course Title	**NANO TECHNOLOGY**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B Sc NM
Course Objective (CO)	The primary aim is to prepare students for a career in nanotechnology by providing them with a sound grounding in multidisciplinary area of nanoscale science.

Syllabus

UNIT I

Introduction and Synthesis of Nano Materials: Introduction, Basic idea of nanotechnology, nanoparticles, metal Nanoclusters, Semiconductor nanoparticles, Physical Techniques of Fabrication, inert gas condensation, Arc Discharge, RF plasma, Ball milling, Molecular Beam Epitaxy, Chemical Vapour deposition, Electrodeposition,
Chemical Methods-Metal nanocrystals by reduction, Photochemical synthesis, Electrochemical synthesis, Sol-gel, micelles and microemulsions, Cluster compounds. Lithographic Techniques-AFM based nanolithography and nanomanipulation, E-beam lithography and SEM based nanolithography, X ray based lithography.

UNIT II

Characterization Techniques: X-ray diffraction, data manipulation of diffracted X-rays for structure determination, Scanning Probe microscopy, Scanning Electron microscopy, Transmission Electron Microscopy, Scanning Tunneling Microscopy, Optical microscopy, FTIR Spectroscopy, Raman Spectroscopy, DTA, TGA and DSC measurements

UNIT III

Carbon Nanotubes and other Carbon based materials: Preparation of Carbon nano tubes, CVD and other methods pf preparation of CNT, Properties of CNT; Electrical, Optical, Mechanical, Vibrational properties etc. Application of CNT; Field emission, Fuel Cells, Display devices. Other important Carbon based materials; Preparation and Characterization of Fullerence and other associated carbon clusters/molecules, Graphenepreparation, characterization and properties, DLC and nano doamonds.

UNIT IV

Nanosemiconductors and Nano sensors: Semiconductor nanoparticles-applications; optical luminescence and fluorescence from direct band gap semiconductor nanoparticles, carrier injection, polymers-nanoparticles, LED and solar cells, electroluminescence. Micro and nanosensors; fundamentals of sensors, biosensor, microfluids, MEMS and NEMS, packaging and characterization of sensors.

Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Introduction to nanoscience and Nanotechnology	: K.K. Chattopadhyay and A.N. Banerjee	PHI Learning Pvt. Ltd. 2009
2	Nanotechnology Fundamentals and Applications	Manasi Karkare,	, I.K.- International Publishing House, 2008.
3	Nanostructures and Nanomaterials Synthesis, Properties and Applications	Guoahong Cao	Imperial College Press, 2004
4	Physical Properties of Carbon Nanotube	. Satio, G. Dresselhaus and M. S. Dresselhaus	Imperial College Press, 1998