PH1812-ELECTRODYNAMICS

Class : I M.Sc. **Credits: 4**

Semester : I **Hrs./week : 5**

Unit 1: ELECTROSTATICS-The Electric field-Point charge and continuous charge distributions-Divergence and curl of electric field-Application of Gauss's law-Electric potential-Poisson's and Laplace's equation-Potential of a localized charge distribution electrostatic boundary conditions-Work and energy in electrostatics-Energy of charge distribution. Conductors in electrostatics-Induced charge-force on a conductor Capacitors-Multipole expansion of potential-Electric field of a dipole-Electric fields inside matter-Non-polar and Polar dielectrics-Polarization-Electric field of a polarized object-Bound charges-Gauss's law in the presence of dielectric-Boundary conditions Linear dielectric-Susceptibility, Permittivity and Dielectric constant-Forces on dielectric

Unit 2: MAGNETOSTATIC-Lorentz force law-Force on current-Line, surface and Volume currents-Biot-Savart law and its applications-Divergence and Curl of magnetic field-Ampere's law and its applications-Magnetic vector potential-Magnetostatic boundary conditions-Multipole expansion of vector potential-Magnetic potential in matter-Dia, para and ferro magnets-Torques and force on magnetic dipoles -Magnetization-Field of magnetized object-Bound currents-Magnetic field inside matter Ampere's law in: magnetized materials-Boundary conditions-Linear media-Magnetic susceptibility and permeability-Ferromagnetism

Unit 3: ELECTRODYNAMICS-Ohm's law-electromotive force-Motional emf-Faraday's law of em induction-Induced electric field-Inductance-Neumann formula for mutual inductance-Energy in magnetic field-Maxwell' s equations in free space and in matter Displacement current-Boundary conditions-Potential formulation of electrodynamics Gauge transformations-Coulomb and Lorentz gauge-Momentum-Poynting theorem Maxwell's stress tensor-Conservation of momentum-Angular momentum.

Unit 4: ELECTROMAGNETIC WAVES: Wave equation for E and B-Monochromatic plane waves, Energy and momentum in electromagnetic waves-Propagation in linear media-Boundary conditions-Reflection and transmission at normal incidence-Reflection and transmission at oblique incidence Laws of geometrical optics-Fresnel's equationsBrewster's angle-Dispersion in dielectric media-Anomalous dispersion-Cauchy's formula-Electromagnetic waves in conductors-Skin depth-Boundary conditions-Reflection at the conducting surface.

Unit 5: ELECTROMAGNETIC RADIATION: Retarded scalar and vector potentialsLienard-Wiechert potentials for a moving point charge-Electric and magnetic fields of a moving point charge-Electric dipole radiation-Magnetic dipole radiation-Power radiated by a point charge Velocity and acceleration fields-Larmor formula-Lienard's generalization of the Larmor formula-radiation reaction-Abraham-Lorentz formula

BOOK FOR STUDY:

1. David J.Griffths, Introduction to Electrodynamics, Third Edition, Prentice-Hall of India.

BOOKS FOR REFERENCE:

2. John David Jackson, Classical Electrodynamics, Second Edition-(1975), Wiley Eastern Ltd
3. Gupta, Kumar and Singh, Electrodynamcs, Second Edition (2001), Pragati Prakashan
4. A.Z. Capri and P.V Panat, Introduction to Electrodynamics, 2002, Narosa Publishing House, New Delhi

PH1813-ELECTRONICS

Class : I M.Sc. **Credits: 5**

Semester : I **Hrs./week : 6**

Unit 1: Operational Amplifiers-Ideal Op-Amp-inverting, non-inverting, logarithmic, summing and difference amplifiers-integrator and differentiator-as a comparator-CMRR

Applications: Solving simultaneous and differential equations-weighted resistor and R-2R D/A converters-parallel, counter and successive approximation AID converters.

Unit 2: Intel 8085-Architecture-addressing modes for data-instruction set

Applications: Assembly language program involving-arithmetic and logical operations-use of subroutines-manipulating arrays-solving equations

Unit 3: Intel 8085-Timing of 8085-I/O devices-interfacing I/O devices

Applications: Assembly language programs involving keys and LEDs interface delays-using D/ A converter to generate waveforms-function generator simulation of counter and successive approximation AID converters

Unit 4: Intel 8085-Semiconductor memories-interfacing memory devices-interrupts

Applications: Assembly language programs involving-ISS-interrupt driven data acquisition systems

Unit 5: Zilog Z80-Architecture-addressing modes for data-instruction set-interrupt system.

Applications: Assembly language programs involving-arithmetic and logical operations-use of bit and string manipulating instructions

Books for study:

1. John D. Ryder, Electronic Fundamentals and Applications
2. Malvino and Leach, Digital Principles and Applications
3. Aditya P. Mathur, Introduction to Microprocessors

Books for reference:

1. Milman and Halkias, Electronic Devices and Circuits
2. Ramesh S. Gaonkar, Microprocessor-Architecture, Programming and Application with 8085/8080A
3. Lance A. Leventhal, 8085 Assembly Language Programming

PH1814-CLASSICAL MECHANICS

Class : I M.Sc. **Credits: 4**

Semester : I **Hrs./week : 5**

Unit 1: LAGRANGIAN FORMULATION-Mechanics of a system of particles-Constraints-D'Alembert' s principle-Lagrange equations-velocity dependent potentials-applications-Variational principle-Hamilton's principle-Non-holonomic systems-Conservation theorems and symmetry properties. Two-body central force problem-equations of motion-first integrals-classification of orbits-conditions for closed orbits-Kepler's problem-scattering in a central force field Lab frame-center of mass frame transformation.

Unit 2: RIGID BODY DYNAMICS-Kinematics-degrees of freedom-Euler angles-Euler's theorem on the motion of a rigid body-Rotations-finite and infinitesimal-Coriolis force. Angular momentum and kinetic energy-Inertia tensor-Principal axes-Euler's equations-Torque free motion of a rigid body-Symmetric top-Precession and nutation-applications.

Unit 3: HAMILTONIAN FORMULATION-Legendre transformation and Hamiltonian equations-Cyclic coordinates and conservation theorems-Hamiltonian equations from Variational principle-Canonical transformations-Poisson brackets-equations of motion-conservation theorems in Poisson bracket formulation-angular momentum Poisson brackets-generation of canonical transformations.

Unit 4: HAMILTON-JACOBI THEORY-Hamilton-Jacobi equation-Hamilton's principal function-free particle in Cartesian coordinates-central force in spherical polar coordinates-application to harmonic oscillator problem

Unit 5: ACTION-ANGLES-Action-angles-Kepler's problem-action-angle variables-simple harmonic oscillator. Oscillations-the eigenvalue equation-the principal axis transformation-free vibrations-normal coordinates-linear triatomic molecule.

BOOKS FOR STUDY:

1. Classical Mechanics by H.Goldstein, Charles Poole and John Sabko, 3rd edition, Pearson Education House, (2002)
2. Lagrangian and Hamiltonian mechanics, by M.G.Calkin, Allied Publishers Ltd.(2000)

BOOKS FOR REFERENCE:

1. Classical Mechanics by P.V.Panat, Narosa Publishers (2005)
2. Classical Mechanics by K.N.Srinivasa Rao, Universities Press (India) Pvt. Ltd, (2003)
3. Lagrangian dynamics, Schaum Series.
4. Problems and solutions on Mechanics,Ed. By Yung-Kuo Lim, Sarat Book House, (2001)

PH1815-STATISTICAL MECHANICS

Class : I M.Sc. **Credits: 5**
Semester : I **Hrs./week : 6**

Unit 1: INTRODUCTION-Phase Space-Ensemble-Ensemble average-Liouville Theorem-Equation of motion-Equal-apriori-probability-Statistical equilibrium-Micro canonical ensemble-Entropy of an ideal Boltzmann gas using micro canonical ensemble-Gibb's paradox. Quantisation of phase space-basic postulates-classical limit-Symmetry of wave functions-effect of symmetry on counting-MB, BE and FD statistics-various distributions using micro canonical ensemble.

Unit 2: CANONICAL AND GRAND CANONICAL ENSEMBLES-Entropy of a system in contact with a heat reservoir-Ideal gas in canonical ensemble-Maxwell velocity distribution-Equipartition of energy-photons. Grand canonical ensemble-Ideal gas in grand canonical ensemble-Canonical partition function-Translational partition function-Rotational partition function-Vibrational partition function-Electronic partition function.

Unit 3: BOSE-EINSTEIN STATISTICS-Bose-Einstein distribution-Bose-Einstein condensation-Thermodynamic properties of an ideal BE gas-Liquid Helium-Landau spectrum of Phonons and Rotons-Helium 4 and Helium 3 mixtures-Superfluid phases of Helium 3.

Unit 4: FERMI-DIRAC STATISTICS-Fermi-Dirac distribution-degeneracy-Thermionic emission-white dwarfs-Nuclear matterQuantum Hall effect-Specific heat of an electron gas-One-dimensional metal-Effect of Periodic structures.

Unit 5: FLUCTUATIONS-Introduction-mean square deviation-Fluctuations in ensembles-Concentration fluctuations in quantum statistics-One dimensional random walk-Brownian motion-Fourier analysis of a random function-Electrical noise-Nyquist theorem.

BOOKS FOR STUDY:

1. STATISTICAL MECHANICS by Agarwal.B.K. and Melvin Eisner, New Age International Limited,(2003) 2nd edition.
2. STATISTICAL MECHANICS by Bhattacharjee, Allied Publishers limited,(1996).

BOOKS FOR REFERENCE:

1. STATISTICAL MECHANICS by Donald A. McQuarrie, Viva Books Private limited,(2003).
2. INTRODUCTION TO STATISTICAL PHYSICS by Silvio R A Salinas, Springer,(2004).

PH1816-PRACTICAL I & PH2813 PRACTICAL II

Class : I M.Sc. **Credits : 5 each**

Semester : I & II **Hrs./week : 8 each**

1. Transistorised Amplifier-RC coupled
2. Deign of Gates-transistor (NOT, AND, OR, NAND)
3. A/D converter-Parallel conversion using LM339
4. 7 segment display-2 digit optically controlled counter
5. 555 Timer-Astable Multivibrator
6. 555 Timer-Temp. control (thermistor)
7. Op-Amp 741-Introduction (basic functionality)
8. Op-Amp 741-Solving Simultaneous Equations
9. Op-Amp 741-Second order filters
10. Op-Amp 741-Astable Multivibrator
11. Op-Amp 741-D/A converter (R-2R & Weighted)
12. Microprocessor 8085-Introduction I (arithmetic-immediate mode)
13. Microprocessor 8085-Introduction II (arithmetic and logical-all modes)
14. Microprocessor 8085-Introduction III (code conversions and arrays)
15. Microprocessor 8085-Solving equations
16. Microprocessor 8085-Subroutines
17. Microprocessor 8085-Subroutines (display results)
18. Microprocessor 8085-Interface I (LEDs)
19. Microprocessor 8085-Interface II (LEDs & switches)
20. Microprocessor 8085-Interface III (Freq. generation)
21. Microprocessor 8085-Interface IV (Waveform generation)
22. Microprocessor 8085-Interface V (Traffic lights simulation)
23. Microprocessor Z80-Introduction (use of advanced instructions w.r.t. 8085)
24. Microprocessor 8086-Introduction I (simple programs-all modes of addr.)
25. Microprocessor 8086-Introduction II (equations and arrays)
26. "C"-Language-Introduction I (simple programs)
27. "C"-Language-Introduction II (arrays & matrices)
28. "C"-Language-Introduction III (use of library functions)
29. "C"-Language-Introduction IV (Numerical methods)
30. MASM-Introduction I (using DOS interrupt 21h)
31. Turbo Debugger-Introduction I (simple programs-Trace mode)
32. Elastic constants of glass-Cornu's method
33. Iodine absorption spectrum-Spectroscopic constants
34. Arc Spectra-Hartman's Interpolation
35. Susceptibility-Quinke's method
36. Stefan's Constant-determination

The staff in-charge shall select any 28 from this list. The remaining 8 experiments can be chosen from this list or can be new experiments included by the staff in-charge with prior approval of the department.

PH 2810-MICROPROCESSOR AND MICROCONTROLLER

Class : I M.Sc. **Credits: 5**

Semester : II **Hrs./week : 6**

Objective : An in-depth understanding of the architecture and working of microprocessors and micro controllers has become a necessity for researchers, system developers, as well as programmers. This paper aims at providing the students with an exposure to the popular microprocessor Intel 8086 and the micro controller Intel 8051.

UNIT I : Intel 8086 Architecture and Instruction set

CPU architecture-addressing modes-instruction formats-instruction set-execution timing.

UNIT II : Introduction to Macro Assembler (MASM)

Assembler directives-assembler operators-assembly process-translation of assembler instructions-simple programs.

UNIT III : Modular Programming and Multiprogramming

Linking and relocation-access to external identifiers-procedures-interrupts and their routines-macros-process management and IRMX86-semaphore operations-common procedure sharing.

UNIT IV : I/O consideration, Interrupts and System bus structure

Programmed I/O-Interrupt I/O-block transfer and DMA-basic 8086 bus configuration-minimum and maximum modes-system bus timings-interrupt priority management-single and multiple 8259

UNIT V : Intel 8051 Micro controller

Introduction to micro controllers-internal architecture of 8051-addressing modes-instruction set-simple programs

BOOKS FOR STUDY:

1. Yu-cheng Liu, Glen A. Gibson, “Microcomputer Systems : 8086/8088 Family”, Prentice-Hall of India, 2006.
2. Douglas V. Hall, “Microprocessor interfacing, Programming and Hardware”, Tata McGraw-Hill, 2005.
3. Vijayendran V., “Fundamentals of Microprocessor-8086”, S.Visvanathan PVT.,LTD., 3rd Edition 2005.
4. Muhammad Ali Mazidi, Janice Gillipsie Mazidi, “The 8051 Microcontroller and Embedded Systems”, Pearson Prentice Hall, First Impression, 2006.

BOOKS FOR REFERENCES :

1. Barry B. Brey, “The Intel Microprocessors 8086/8088, 80186, 80286, 80386 and 80486, Prentice-Hall of India, New Delhi, 3rd Edition,1995.
2. Uffrenbeck J., “The 8086/8088 Family-Design, Programming and Interfacing, Software, Hardware and Applications”, Prentice-Hall of India, New Delhi.
3. Tribel W.A., Avtar Singh, “The 8086/8088 Microprocessors: Programming, Interfacing, Software, Hardware and Applications”, Prentice-Hall of India, New Delhi.

PH 2811-QUANTUM MECHANICS

Class : I M.Sc. **Credits: 5**

Semester : II **Hrs./week : 6**

1. **BASIC FORMALISM**:-The Schroedinger equation-Operator correspondence-Interpretation and Condition on wave function-Stationary states-Postulates of quantum mechanics-Linear operators and self-adjointness-Eigenvalue problem and degeneracy-Observables-Ehrenfest theorem-Completeness and normalization of eigenfunctions-Closure property-Physical interpretation of eigenvalues and eigenfunctions-Uncertainty relations and commuting observables.

2. **EXACTLY SOLUBLE EIGENVALUE PROBLEMS**:-Particle in a square-well potential (bound states)-Square potential barrier and tunnelling-Simple harmonic oscillator-Ladder operator method and-angular momentum operators-Spherical harmonics-Parity-rigid rotator-central potential-Hydrogen atom.

3. **GENERAL FORMALISM**:-State vectors-Hilbert space-Dirac notation-Dynamical variables and linear operators-Representation theory-Coordinate and momentum representation-Unitary transformation involving time-Schroedinger, Heisenberg and interaction pictures-Translation and rotation-Symmetries and conservation laws-Time reversal.

4. **ANGULAR MOMENTUM**:-Eigenvalue spectrum-Matrix representation-Spin angular momentum-Pauli matrices-Non-relativistic Hamiltonian including spin-Addition of angular momenta-Clebsch-Gordon coefficients-Two spin-1/2 particles-Addition of spin and orbital angular momenta-Fine structure of alkali atoms.

5. **APPROXIMATION METHODS**:

(a) **Perturbation theory**:-First and second order non-degenerate case-Degeneracy-Stark effect-Ground and first excited states of hydrogen atom-

(b) **The variation method**:-Upper bound on ground state energy-Trial function in variational parameters-Hydrogen molecule.

BOOKS FOR STUDY:

1) P.M.Mathews and Venkaresan K.: A Text Book of Quantum Mechanics-Tata McGraw-Hill, 2007.
2) B.K. Agarwal and Hari Prakash : Quantum Mechanics-Prentice-Hall of India, New Delhi, 2004.
3) Ghatak A., 2002, Introduction to Quantum Mechanics, MacMillan India Ltd., Madras.

BOOKS FOR REFERENCE:

1) Merzbacher E., Quantum Mechanics, 2nd Edition, Wiley International Edition, 1970.
2) Powell J.L. and Craseman B., Quantum Mechanics Narosa Publishing, Madras, 1995.
3) Landau and Lifshitz E.M., Quantum Mechanics, 1992.

PH 2812-MATHEMATICAL PHYSICS

Class : I M.Sc. **Credits: 5**
Semester : II **Hrs./week : 6**

Objective: To learn the advanced mathematical techniques with the purpose of their end use in physics.

UNIT 1: Complex analysis

Analytic functions-Cauchy-Riemann equations-Laplace's equation: harmonic functions-line integral in complex plane-Cauchy's theorem-Cauchy's theorem for multiply connected regions-Derivatives of analytic functions-Taylor's series-Maclaurin series-singularities-types of singularities-calculus of residues-cauchy's residue theorem.

Applications: Concept of equi-potential surfaces. Solution of two dimensional Laplace's equation as applicable to potential between (1) parallel plates (2) coaxial cylinders.(3) steady state heat flow equation (4) temperature distribution of a conducting wire surrounded by a thermally conducting cylinder

UNIT 2: Integral transforms

Laplace transform-inverse transform-shifting theorems-transform of derivatives and integrals-convolution theorem-partial fractions-differentiation and integration of transforms-transform of Dirac-Delta function.

Applications: Electrical network-damped and undamped forced vibrations of a mass spring system.

Fourier transform-inverse transform-cosine and sine transform-transform of derivatives-convolution theorem-transform of Gaussian function.

Applications: Solving partial differential equations like (1) heat flow equation (2) wave equation (3) damped and undamped forced vibrations of a harmonic oscillator.

UNIT 3: Partial differential equations

Homogeneous and non-homogeneous equations of first and second order partial differential equations-separation of variables technique-solution by Fourier series-use of double Fourier series.

Applications: (1) One dimensional wave equation (2) one dimensional heat flow equation (separation of variables and use of Fourier series) (3) two dimensional Laplace's equation in Cartesian coordinate (separation of variables and double Fourier series.)

UNIT 4: Special functions

Power series method for homogeneous linear differential equation with constant coeffeciants-solution of Legendre, Bessel, Hermite differential equation equations-Generating functions, Rodrigue's formula-orthonormality relations-Strum-Liouville problems-orthogonal functions.

Applications: (1)Multipole expansion in electrostatics (Legendre polynomials)

(2) partial wave analysis in plane wave expansion in quantum mechanics(Bessel function)-(3)orthogonal properties of the eigen functions of one dimensional harmonic oscillator using generating function.

UNIT 5: Group theory

Definition-subgroups-classes-Lagrange's theorem-homomophism and isomorphism-symmetry operations on an equilateral triangle and a square-group representation-irreducible and reducible represention-unitary transformation-Schur's lemmas-orthogonality theorem-character table.

Application: Predicting the number of rotational and vibrational modes of molecules (1) linear CO_2 molecule (2) non-linear H_2O molecule (3) predicting the number of rotational and vibrational modes of NH_3.

BOOKS FOR STUDY:

Units 1-4:

1. Erwin Kreyzig, Advanced engineering mathematics, 8^{th} edition, publishers-John Wiley & Sons, Inc, 2005.
2. S.Arumugam, A.Thangapandi Isaac and A.Somasundaram, Engineering mathematics, Vol I-III,first edition-publishers-Scitech publications (India) pvt.Ltd.

Unit 5:

(1) Michael Tinkham, Group theory and Quantum mechanics-publishers-Tata McGraw-Hill Co. Ltd,TMH edition,1974.

(2) A.W.Joshi , Group theory for physicistsWiley Eastern Limited, 2nd Esitin,1997.

BOOKS FOR REFERENCE:

(1) Pipes and Harvill-Applied mathematics for Engineers and physicists. Publishers-McGraw-Hill international book company, 3rd edition, 1984.

(2) Butkov ; Mathematical physics, 1968.

(3) Schaum's outline series, Theory and Problems of Fourier analysis, M.R.Spiegel, 2000.

(4) Murray R. Spiegel, Theory and Problems of Fourier Analysis with Applications to Boundary Value Problems, Mchraw Hill book company, 2000.

(5) Schaum's outline series, Theory and Problems of Laplace Transforms, Murray R. Spiegel, Mchraw Hill book company, 1989.

(6) Introduction to Partial Differential Equations, K. Sankara Rao, 2nd Edition, Prentice Hall of India, 2005.

(7) Greenberg M.D, Advanced engineering mathematics, publishers-pearson education (singapore) pvt. Ltd, 2nd edition, 2002.

(8) Bell: Special functions for scientists and Engineers, 1968.

PH 2953- ASTROPHYSICS

Class : I M.Sc. **Credits: 2**
Semester : II **Hrs./week : 4**

Unit 1: General Astronomy

System of Coordinates-Altazimuth, Equatorial (local and Universal), Ecliptic and Galactic systems. Magnitude scale and magnitude systems-correction for observed magnitudes. The proper motion-stellar parallax-Trignometric, cluster and secular parallaxes. Method of Luminosity distance.

Unit 2: Stellar temperatures and sizes

Colour and effective temperatures-defining stellar temperatures by matter laws-HR diagram-Spectral and luminosity classification of stars. Measurement of stellar radii-Relation of luminosity with mass, radii and surface temperature. Binary stars visual, spectroscopic and eclipsing binaries.

Unit 3: Stellar structure

Equations of stellar structure-Russel-vogt theorem-Ideas of polytropic model-stellar opacity-Free-Free transitions, Bound-Free transitions and electron scattering. Eddington's standard model. Homologous model for main sequence stars-Schwarzchild's model for real stars.

Unit 4: Stellar evolution

The virial theorem-application to an isothermal gas sphere-evolution of stars near the main sequence-effect of hydrogen depletion-Schoenberg-Chandrasekhar limit of an isothermal core-nuclear time scale-ages of clusters-Star formation-Jean's criterion.

Unit 5: Stellar energy sources

Thermonuclear fusion-CN cycle-pp chain-simple formulae for the energy generation rates-abundances for the elements in the stars structure of the sun from helioseismology-problems of nucleosynthesis.

BOOKS FOR STUDY:

1. Astrophysics-Stars and Galaxies, by K.D.Abhayankar, Tata McGraw Hill,1995.
2. Text Book of Astronomy and Astrophysics with elements of Cosmology by V.B.Bhatia, Narosa Publishing House.
3. Introduction to Astrophysics by Baidyanath Basu, Prentice Hall(India)

BOOKS FOR REFERENCES:

1. An Introduction to the Sun and the stars by Simon. F. Green and Mark.R.Jones, Cambridge University Press, (2004).
2. Compendium of Practical Astronomy, by Gunter Dectmar Roth, Vol. 1, Springer Verlag.
3. The Physics of stars by A.C.Phillips, John Wiley and sons(1999).

PH 2954-DATA COMMUNICATION AND COMPUTER NETWORKS

Class : I M.Sc. **Credits: 2**

Semester : II **Hrs./week : 4**

Objective : The advances in the information and communication technology during the last decade have left an indelible mark in all walks of life. This paper is aimed at exposing the students to the latest techniques in data communication and computer networks.

UNIT I : Data transmission and encoding

Concepts: Analog and Digital transmission, Transmission impairments-Transmission media-Synchronous / Asynchronous transmission-Line configurations-interfacing.

Digital data digital signals-Variations of NRZ and bi-phase-Digital data Analog signals-ASK, FSK, PSK, QPSK-Analog data digital signals-PCM, DM.

UNIT II : Data Link Control

Flow control, Error control-HDLC, Multiplexing.

UNIT III : Introduction to Computer Networks and the Physical Layer

Introduction: The uses of computer networks-Network hardware-Network software-Reference models-Example of networks-Network standardization.

The physical layer: The theoretical basis for data communication-Guided Transmission media-Wireless transmission.

UNIT IV : The Data Link and the Network Layers

The Data Link Layer: Data link layer design issues-Error detection and correction-Elementary data link protocols-Sliding window protocols-Example of data link protocols-ETHERNET.

The network layer: Network layer design issues-Routing algorithms-Congestion control algorithms.

UNIT V : The transport and the Application Layers

The transport layer: Transport layer design issues-Transport protocols-Simple transport protocol-Internet transport protocols UDP, TCP.

The application layer: Domain name system-Electronic mail-World Wide Web.

BOOKS FOR STUDY:

5. William Stallings, “Data and Computer Communication”, Prentice-Hall of India, 8th Edition, 2008.
6. Andrew S. Tanenbaum, “ Computer networks”, Prentice-Hall of India, New Delhi, 4th edition 2005.
7. Behrouz Forouzan, “Introduction to Data Communication and Networking”, Tata McGraw-Hill, 2000.

BOOKS FOR REFERENCES:

1. Douglas E. Comer, “Internet working with TCP/IP-Volume-I”, Prentice-Hall of India, 4th Edition, 2001.
2. Paub and Schilling, “Principles of Communication System”, MacGraw Hill, 1986.
3. James F. Kurose and Keith W. Ross, “Computer Networking-A top down Approach Featuring the Internet”, Pearson Education, Asia, 3rd Edition-2006.

PH3810-SOLID STATE PHYSICS-I

Class : II M.Sc. **Credits: 5**
Semester : III **Hrs./week : 6**

Objective: This paper aims to give an understanding of the structural aspects and some of the physical properties of condensed matter from a microscopic view point.

UNIT 1: States of matter: Crystalline and amorphous-unit cell-Bravais lattices-Miller indices-X-ray diffraction-Laue equations-interpretation of Bragg's equation-Ewald construction-reciprocal lattice (definition and properties)-reciprocal lattice of SC, BCC, FCC and HCP lattices-X-ray diffraction methods-neutron and electron diffraction methods-defects in solids (one, two and three dimensional).

UNIT 2: Dynamics of a chain of identical atoms-dynamics of a diatomic linear chain-anharmonicity and thermal expansion-thermal conductivity-phonon-phonon interaction-normal and Umklapp processes-heat capacity-density of phonon states-Debye's model of specific heat.

UNIT 3: Electron moving in a one-dimensional well-density of states in three dimension-Fermi-Dirac statistics-effect of temperature on Fermi distribution function-electronic heat capacity-electrical resistivity-Ohm's law-Widemann-Franz law-Hall effect.

UNIT 4: Bloch's theorem-Kronig-Penney model-construction of Brillouin zones-extended, reduced and periodic zone schemes-effective mass of an electron-nearly free electron model-conductors, semiconductors and insulators.

UNIT 5: Fermi surface and Brilloiun zones-Harrison's method of constructing Fermi surface in 2D-electron ,hole and open orbits-characteristics of Fermi surface-effects of electric field on the Fermi surface-effect of magnetic field on the Fermi surface-quantisation of electron orbits-experimental study of Fermi surface (dHVA method)

BOOKS FOR STUDY:

1. Solid state physics, Structure and properties of materials, **M.A.Wahab,** second edition, Narosa publishing house (2005)
2. Solid state physics, **Micea S.Rogalski and Stuart.B.Palmer**, Gordon and Breach science pub. (2001)
3. Solid state physics, **R.K.Puri and V.K.Babbar**, third edition, S.Chand and company Ltd.(2005)
4. Solid state physics, **P.K.Palanisamy**, Scitech publications (India). Ltd (2003)

BOOKS FOR REFERENCE:

1. Introduction to solid state physics **Charles Kittel**, Wiley eastern limited, 7^{th} edition.
2. Solid state physics, **Ajay Kumar Saxena**, MacMillan Publishers(2006)
3. Solid state physics, **J.S.Blackmore,** second edition-Cambridge university press (1974)
4. Solid state physics, **N.W.Ashcroft** and **N.D.Mermin**, CBS publishing Asia Ltd(1988)
5. Material science and engineering : A first course **V.Raghavan**, Prentice Hall of India private Ltd(1988)
6. Solid state physics, **H.C.Gupta**, Vikas publishing house private Ltd. (1995)
7. Principles of solid state, **H.V.Keer**, Wiley eastern Ltd. (1993)

PH3811-RELATIVITY AND QUANTUM MECHANICS

Class : II M.Sc. **Credits: 5**

Semester : III **Hrs./week : 6**

UNIT 1: **RELATIVISTIC MECHANICS**:-Postulates of special theory of relativity-Lorentz transformation equations-The structure of space-time-Contra-and covariant vectors-Proper time and proper velocity-Relativistic energy and momentum-momentum 4-vector-Compton scattering-Work-energy theorem.

UNIT 2: **RELATIVISTIC ELECTRODYNAMICS**:-Invariance of electric charge-covariant form of Lorentz force equation-The 4-current and the equation of continuity-The 4-vector potential and Lorentz condition-Anti symmetric field strength tensor-Dual field strength tensor-Covariant formulation of Maxwell's equation-Transformation of electromagnetic fields for simple situation.

UNIT 3: **SCATTERING THEORY**:-Kinematics of scattering process-Scattering amplitude-Green's function-Born approximation-Application to screened Coulomb potential-Partial wave analysis-Asymptotic behaviour of partial waves-Phase shifts-Scattering amplitude-Differential and total cross section-Optical theorem.

UNIT 4: **TIME EVOLUTION**:-Perturbative solution for transition amplitude-First and second order-Selection rule-First order transition with constant perturbation-Fermi's Golden rule-Harmonic perturbation-Transition amplitude-Interaction of an atom with electromagnetic radiation-dipole approximation-selection rule.

UNIT 5: **RELATIVISTIC QUANTUM MECHANICS**:-The Klein-Gordon equation-Plane wave solutions-Charge and current densities. The Dirac equation-Dirac's relativistic Hamiltonian-Dirac matrices-Plane wave solution-Energy spectrum-Spin of Dirac particle-Negative energy states-Dirac particle in electromagnetic field-Electron magnetic field-Energy spectrum-Spin magnetic moment

BOOKS FOR STUDY:

1) DAVID J. GRIIFFITHS: Introduction to Electrodynamics (Third edition)-Prentice Hall India
2) JOHN DAVID JACKSON: Classical Electrodynamics (Third edition)-Wiley Eastern Limited
3) P.M MATHEWS and K. VENKATESAN: Text book of Quantum Mechanics-Tata McGraw-Hill Publishing Limited
4) B.K. AGARWAL and HARI PRAKASH : QUANTUM MECHANICS-Prentice-Hall of India.

BOOKS FOR REFERENCE:

1) Reitz J.R., Milford F.J. and Christy R.W., Foundation of Electromagnetic Theory.
2) Bjorken J.D. and Drell S.D., Relativistic Quantum Mechanics.
3) Dirac P.A.M., The Principles of Quantum Mechanics.

PH3812-NUMERICAL METHODS AND C PROGRAMMING

Class : II M.Sc. **Credits: 5**
Semester : III **Hrs./week : 6**

OBJECTIVES: To familiarize the students with numerical methods and computer programming using C language.

UNIT I SOLUTIONS OF ALGEBRAIC SIMULTANEOUS EQUATIONS AND INTERPOLATION: Gauss elimination-Gauss Jordan-Gauss Seidal methods. Lagrange and Newton's formula-Curve fitting-Methods of least squares.

UNIT II NUMERICAL DIFFERENTATION AND INTEGRATION: Simpson's rule and Trapezoidal rule-Numerical solution to ordinary differential equations-Euler, Modified Euler and Runge-Kutta methods.

UNIT III FUNCTIONS ARRAYS AND POINTERS: Basic program structure-Simple data types, variables, constants, operators, comments-Control Flow; if, while, for, do-while, switch-Functions; Types, parameters, prototypes, recursion-Array usage Pointers, addresses and types, call by reference Pointer-array duality, Strings Arrays of pointers Arguments to main Pointers to functions

UNIT IV STRUCTURES AND DATA TYPES: Member accessing, pointers to structures-Structures and functions-Arrays of structures, linked lists, trees-Unions, enumerations and bit fields Usage, device accessing

UNIT V INPUT AND OUTPUT: Concepts Character and File I/O, Basic Curses, Simple File I/O, Standard I/O Routines

EXPERIMENTS:

1. Lagrange's Interpolation.
2. Numerical Integration by Trapezoidal
3. Numerical Integration by Simpson's rule
4. Eigen values and Eigen vectors of a real symmetric matrix.
5. Numerical Solution-Euler's method.
6. Numerical Solution-Runge-Kutta method.
7. Determination of roots-Newton Raphson method.
8. Curve fitting-Linear parameters
9. Curve fitting-Non-linear parameters

BOOKS FOR STUDY:

1. Computer Oriented Numerical Methods-V.Rajaraman, Prentice Hall, 1987.
2. Numerical Methods by Balachandra Rao S. and Shantha C.K., Universities Press Pvt Ltd., Revised Edition-2004.
3. Schaum's outline of programming with C by Byron Gottorfried.
4. Programming in Ansi 'C' by E. Balaguruswamy, Tata McGraw Hill.
5. Fundamental of computing c programming and MS office-Leon, Vijay Nicole imprints, Pvt, Chennai.

BOOKS FOR REFERENCE:

1. Numerical Methods in Science and Engineering-M.K.Venketaraman, National Publishing Co, 1989.
2. The C programming language by Kernigham & Richie, PHI Publication New Delhi-2007, 2nd Edition.
3. Let Us C by Kanetkar, BPB Publications.

PH3813-PRACTICAL III

Class : II M.Sc. **Credits: 5**
Semester : III **Hrs./week : 8**

1. Microprocessor 8085-Interface *(AID*-Counter)
2. Microprocessor 8085-Interface *(AID*-Successive approx.)
3. Microprocessor 8085-Interface (Calculator-16 switches)
4. Microprocessor 8085-Interface (Stepper motor control)
5. Microprocessor 8085-Interface (7 segment display multiplexing)
6. Microprocessor 8086-Interface (Stop clock-light operated)
7. Microprocessor 8086-Interface (7x5 LED dot matrix display)
8. Microprocessor 8086-Interface (Rolling display)
9. Micro controller 8051-Introduction I
10. Micro controller 8051-Introduction II
11. Inverter-Low D.C. to High A.C. converter
12. *A/D*-Binary counter-IC 7493
13. PLL-remote control applications
14. Dielectric constant of crystal
15. MASM-2 digits arithmetic operations
16. Turbo Debugger-Arrays manipulations
17. "C"-Language-Introduction to graphics
18. "C"-Language-Interface (Stepper motor control)

The staff in-charge shall select any 10 from this list. The remaining 8 experiments can be chosen from this list or can be new experiments included by the staff in-charge with prior approval of the department.

BOOKS FOR REFERENCE:

1. Ghosh P. K., Sridhar P. R., "Introduction to Microprocessors for Engineers and Scientists", Prentice-Hall of India, New Delhi, II Edition,2001.
2. Yu-Cheng Liu, Glenn A. Gibson, "Microcomputer Systems: 8086/8088 Family, Prentice-Hall of India, New Delhi, II Edition,1994.
3. Barry B. Brey, "The Intel Microprocessors 8086/8088, 80186, 80286, 80386 and 80486, Prentice-Hall of India, New' Delhi, III Edition,1995.
4. Brian W. Kernighan, Dennis M. Ritchie, "The C Programming Language", Prentice-Hall of India, New Delhi, 2nd Edition,1993.

PH3951-CRYSTAL PHYSICS

Class : II M.Sc. **Credits: 2**
Semester : III **Hrs./week : 4**

Objectives:
To provide a qualitative idea on the fundamentals of growing crystals and characterizing the grown samples. This paper will serve as an eye opener for students keen in research activities particularly in experimental physics.

UNIT-I : NUCLEATION

Introduction-kinds of nucleation-equilibrium stability and Meta stable state-classical theory of nucleation-effect of soluble impurities on nucleation-determination of solubility-methods of induction period measurements-desupersaturation-steady state nucleation rate-nucleation parameters.

UNIT-II : SOLUTION AND GEL GROWTH TECHNIQUES

Low temperature solution growth-slow cooling methods-temperature gradient method-criteria for optimizing solution growth parameters-basic apparatus for solution growth. Gel growth-structure of silica gel and gelling mechanism-nucleation control-merits of gel method-experimental methods-chemical reaction method-chemical reduction method-complex de complex method-solubility reduction method-sol gel method.

UNIT-III : HIGH TEMPERATURE AND OTHER TECHNIQUES OF GROWTH

Growth from melt-Bridgman, Czochralski, zone melting, Verneuil techniques-physical vapor deposition-flux growth-chemical vapor deposition chemical vapor transport-hydrothermal growth-epitaxial growth.

UNIT-IV : OPTICAL STUDIES

Atomic absorption spectroscopy-UV-Visible-NIR spectroscopy-Experimental set ups for Fourier Transform Infrared analysis, FT-Raman vibrational spectroscopy and NMR-Illustrations with selected crystals-Nonlinear optical phenomenon (qualitative)-Kurtz powder SHG method-photoconductivity and schematic set up for measurements-negative photoconductivity.

UNIT-V : CRYSTAL CHARACTERIZATION

Thermal analysis-methods of thermal analysis-thermogravimetric analysis (TGA)-Differential thermal analysis (DTA)-Differential Scanning Calorimetry (DSC)-Mechanical studies-methods of hardness testing (qualitative)-Vickers hardness testing-correlation of microhardness with other properties-estimation of hardness number and work hardening coefficient (n)-dielectric studies-dielectric constant and dielectric loss measurements.

BOOKS FOR REFERENCE:

1. Brice J. C. (1986), 'Crystal Growth Process', John Wiley and Sons, New York.
2. Brice J.C. (1973), 'The growth of crystals from liquids', North Holland publishing company, Amsterdam.
3. Buckley H.E. (1951), 'Crystal Growth', John Wiley and Sons, New York.
4. Pamplin B.R. (1980), 'Crystal Growth', Pergman Press, London.
5. Henisch H.K. (1988), 'Crystals in gels and Liesegang rings', Cambridge Univ. Press. USA
6. R.T. Sane and Jagdish K Ghadge 'Thermal Analysis Theory and applications' Quest Publications 1997
7. V G Dmitriev, G.G. Gurzadyan, D.N. Nikigosyan; 'Handbook of Nonlinear optical crystals' Springer-Verlag 1991
8. Joshi V.N. (1990), 'Photoconductivity', Marcel Dekker, New York.
9. Santhanaraghavan P. and Ramasamy P. Crystal growth Process and Methods, (2000) KRU Publications, Kumbakonam.

PH3952-GRAVITATION AND COSMOLOGY

Class : II M.Sc. **Credits: 2**
Semester : III **Hrs./week : 4**

OBJECTIVES:-

1. To introduce the students to the general theory of relativity with an emphasis on the physical aspects.
2. To discuss the observational inputs from astrophysics and cosmology.

Unit I: Theories of Gravitation-Conflict between Newtonian gravitation and special relativity-general theory of relativity-Mach's principle-Space-Time and co-ordinate systems-Tensors-Parallel transport-Covariant differentiation-The Riemannian Affine connection-The Lie derivative-Space-Time curvature.

Unit II: Geodesics-Geodesic deviation-Curvature Tensor-Scalar curvature-Energy Momentum Tensors-The action principle-Einstein equations of gravitation-a heuristic derivation-Newtonian approximation-the Schwarzschild solution-particle orbits-photon orbits.

Unit III: The experimental tests of the general theory of relativity-the gravitational red shift-Planetary motion-the bending of light-the radar echo delay-the precession of a gyroscope-Gravitational radiation.

Unit IV: Strong Gravitational Fields-equilibrium of massive spherical objects-binding energy-gravitational collapse of a homogeneous dust ball-Black holes-external Schwarzschild solution-the Kerr-Newmann solution-Black hole physics-Detection of Black holes.

Unit V : Cosmology-the observational background-the cosmological postulates-cosmological red shift-the Hubble law-the Olber's paradox-red shift-magnitude relation-counting of radio sources-angular diameters-age of the universe-the abundance of elements-the microwave background.

BOOKS FOR STUDY:

1. Lectures on Gravitation and cosmology, J.V.Narlikar, Macmillan co.1978.
2. An Introduction to General relativity, S.K.Bose, Wiley Eastern, 1980.

BOOKS FOR REFERENCE:

1. General Relativity, J.L.Martin, Prentice Hall, 1996.
2. Relativity and Gravitation, Philippe Tourrence, Cambridge University Press, 1997.
3. Introduction to the Theory of Relativity, P.G.Bergmann, Prentice Hall, 1992.

PH4806-SOLID STATE PHYSICS-II

Class : II M.Sc. **Credits: 5**
Semester : IV **Hrs./week : 6**

Objective: This paper aims to explore the theoretical understanding of various physical properties of condensed matter.

UNIT 1: Semi conducting properties:-Carrier concentration in semiconductors-Fermi level-mobility of charge carriers-effect of temperature on mobility-electrical conductivity of semi conductors-Hall effect in semi conductors-junction properties: metal-metal junction, metal-semiconductor junction, semiconductor-semiconductor junction.

UNIT 2: Dielectric properties:-dipole moment-polarisation-electric field of a dipole-polarisability-classical theory of electronic polarisation-polarisability, piezo, pyro and ferroelectric properties of crystals-anti Ferro electricity and ferri electricity

UNIT 3: Optical properties:-Absorption process-photo conductivity-photoelectric effect-photovoltaic effect-photo luminescence-colour centres (types and generation)-Maser and lasers

UNIT 4: Magnetic properties:-classification of magnetic materials-atomic theory of magnetism-Langevin's classical theory of diamagnetism and para magnetism-quantum theory of magnetism-ferromagnetism-Weiss molecular field theory-ferromagnetic domains-domain theory-anti ferromagnetism, ferrimagnetisms.

UNIT 5: Superconducting properties:-Sources of superconductivity-Meissner effect-thermodynamics of superconducting transition-isotope effect-London penetration depth-coherence length-band gap-elements of BCS theory-flux quantisation-Josephson effect-High T_c superconductivity.

BOOKS FOR STUDY:

1. Solid state physics, Structure and properties of materials, **M.A.Wahab,** second edition, Narosa publishing house (2005)
2. Solid state physics, **Micea S.Rogalski and Stuart.B.Palmer**, Gordon and Breach science pub. (2001)
3. Solid state physics, **R.K.Puri and V.K.Babbar**, third edition, S.Chand and company Ltd.(2005)
4. Solid state physics, **P.K.Palanisamy**, Scitech publications (India). Ltd (2003)

BOOKS FOR REFERENCE:

1. Introduction to solid state physics **Charles Kittel**, Wiley eastern limited, 7^{th} edition.
2. Solid state physics, **Ajay Kumar Saxena**, MacMillan Publishers(2006)
3. Solid state physics, **J.S.Blackmore,** second edition-Cambridge university press (1974)
4. Solid state physics, **N.W.Ashcroft** and **N.D.Mermin**, CBS publishing Asia Ltd(1988)
5. Material science and engineering : A first course **V.Raghavan**, Prentice Hall of India private Ltd(1988)
6. Solid state physics, **H.C.Gupta**, Vikas publishing house private Ltd. (1995)
7. Principles of solid state, **H.V.Keer**, Wiley eastern Ltd. (1993)

PH 4807-SPECTROSCOPY

Class : II M.Sc. **Credits: 5**
Semester : IV **Hrs./week : 6**

UNIT I: MICROWAVE SPECTROSCOPY: Rotation of molecules-Rotational spectra-Rigid and non-rigid diatomic rotator-Intensity of spectral lines-Isotopic substitution-Poly atomic molecules (Linear and symmetric top)-Hyperfine structure and quadrupole effects-Inversion spectrum of ammonia-Chemical analysis by microwave spectroscopy-Techniques and instrumentation

UNIT II: VIBRATIONAL SPECTROSCOPY: Infrared spectroscopy-Vibration of molecules-Diatomic vibrating rotator-vibrational rotational spectrum-Interactions of rotations and vibrations-Influence of rotation on the vibrational spectrum of linear and symmetric top and poly atomic molecules-Analysis by infrared techniques-Instrumentation-FTIR spectroscopy

Raman spectroscopy: Classical and quantum mechanical picture of Raman effect-Polarizability-Pure rotational Raman spectrum-Vibrational Raman Spectrum-Raman activity of vibrations of CO_2 and H_2O-Rule of mutual exclusion-Overtones and combination-Rotational fine structure-Depolarization ratio-Vibrations of spherical top molecule-structural determination from IR and Raman spectroscopy-techniques and instrumentation-FT Raman Spectroscopy

UNIT III: ELECTRONIC SPECTROSCOPY: Electronic spectra-Frank-Condon principle-Dissociation energy and dissociation products-Fortrat diagram-predissociation-shapes of some molecular orbits-Chemical analysis by electronic spectroscopy-Techniques and instrumentation-Mass spectroscopy-ESR spectroscopy-Introduction-techniques and instrumentation-Double resonance

UNIT IV: NUCLEAR SPECTROSCOPY: Nuclear magnetic resonance spectroscopy-Introduction-Interaction of spin and magnetic field-population of energy levels-Larmor precession-Relaxation times-Chemical shift and its measurement-Coupling constant-coupling between several nuclei-quadrupole effects-C^{13} NMR spectroscopy

Mossbauer spectroscopy: Principle-instrumentation-Effect of electric and magnetic fields

UNIT V: SURFACE SPECTROSCOPY Electron energy loss spectroscopy (EELS)-Reflection absorption spectroscopy (RAIRS)-Photoelectron spectroscopy (PES); XPES, UPES-Auger electron spectroscopy (AES) X-ray Fluorescence spectroscopy (XRF)-SIMS

BOOKS FOR STUDY:

1. Fundamentals of molecular spectroscopy : Colin Banwell and Mc Cash, TMH publishers-5th edition

PH 4808-NUCLEAR PHYSICS

Class : II M.Sc. **Credits: 5**
Semester : IV **Hrs./week : 6**

UNIT 1: Nuclear size, shapes and forces: Nuclear size determination by different methods-Electron scattering method-Electric-moments-magnetic moments. Nuclear forces: Two-nucleon potentials-Tensor forces-Ground state of the deuteron-Neutron Proton scattering at low energies-Singlet state-magnetic moment-Charge independence of nuclear forces-Iso-spin formalism-Meson theory of nuclear forces.

UNIT 2: Models of nuclei: Liquid drop model-Semi-empirical mass formulas and nuclear fission-Binding energy-Weizsacker mass formula-Levy's formula-Atomic masses and its significance-Shell model-Magic numbers-Barrier penetration-Basic ideas of reactors.

UNIT 3: Nuclear reactions: Nuclear reactions and cross-sections-Breit-Weigner single-level formula-Resonance scattering-The compound nucleus-Continuum theory-Optical model-Absorption cross-section at high energies.

UNIT 4: Radioactivity: Introduction-Gamow theory of alpha decay-Beta decay-Energy spectrum-Fermi theory-Fermi and Gamow-Teller selection rules-Non-conservation of parity-Pion condensation-Neutron stars.

UNIT 5: Classification of Elementary particles: Baryons-Mesons-General ideas of interactions-Strangeness-Basic ideas of quark model.

BOOKS FOR STUDY:

1. Nuclear Physics, Roy R.R and Nigam B.P., New Age International, Chennai, Edition 1 (2008).
2. Physics of the Nucleus, Preston M. A., (1962).
3. Theoretical Nuclear Physics, Blatt J.M. Weisskopf .V., (1952).
4. Introduction to Nuclear Physics, Harold Enge, (1969).
5. Nuclear Physics (VI and VII), Mermier, Shelton.

PH 4958-NANO SCIENCE

Class : II M.Sc. **Credits: 2**
Semester : IV **Hrs./week : 4**

Objectives: The course will introduce the students to the rapidly developing field of nanoscience and technology with special focus on the methods of synthesis, characterization techniques and applications of nanomaterials with physics emphasis. The course is expected to provide the necessary understanding in nanotechnology and the students must be able to perform their project works related to the synthesis and characterization of nanomaterials by direct experience.

Unit 1: Fundamentals of Nanoscale Science

Introduction-nano and nature-background to nanotechnology-scientific revolutions opportunities at the nanoscale-time and length scale in structures-energy landscapes basic intermolecular forces-interdynamic aspects of intermolecular forces-surfaces and dimensional space-evolution of band structures and Fermi surfaces-electronic structure of nanocrystals-bulk to nano transition-size and shapes-dimensionality and size dependent phenomena.

Unit 2: Classification of nanoparticles and its properties

Metal Nanoparticles: Size control of metal nanoparticles, Structural, Surface, electronic and optical properties.

Semiconductor Nanoparticles: solid state phase transformation, Excitons, Quantum confinement effect, Semiconductor quantum dots (SQDs), Correlation of properties with size, Quantum Well, Quantum Wires, Supper lattices band and Band offsets, Quantum dot lasers.

Semiconductor Nanocomposites: Types of Nanocomposites (Metal oxides, ceramic and Glass), Core-Shell nanoparticles-Types of systems-properties of nanocomposites.

Magnetic nanomaterials: Fundamentals of magnetic materials, Dia, Para, Ferro, Ferric, and Superpara magnetic materials, Nanostructured Magnetism.

Carbon Nanostructures: Introduction, Fullerenes, C60, CNT, mechanical, optical and properties.

Unit 3: Synthesis of Nanomaterials

Wet Chemical Synthesis for Nanomaterials: Chemical and co-precipitation, Sol fundamentals-sol-gel synthesis of metal oxides, Micro emulsions or reverse micelles, Solvothermal, Microwave heating synthesis, Sonochemical synthesis, Electrochemical synthesis, Photochemical synthesis, Langmuir-blodgett (LB) technique.

Other methods of Synthesis: Thermal evaporation, Spray pyrolysis, Molecular beam epitaxy (MBE), Chemical vapour deposition (CVD), Physical vapour deposition (PVD), Electric arc deposition, Ion implantation.

Unit 4: Characterization Techniques

Powder X-Ray Diffraction, Energy dispersive X-ray (EDX), X-ray photoelectron spectroscopy (XPS), Scanning electron microscope (SEM), Transmission electron microscope (TEM), Scanning tunnelling microscope (STM), Atomic force microscope (AFM), Scanning probe microscopy (SPM), UV-Visible absorption, Photoluminescence, Impedance measurement, IN characteristics, Vibrating sample magnetometer (VSM).

Unit 5: Applications of Nanomaterials and Nanocomposites

Nanosensors based on optical properties and quantum size effects: Sensors based on physical properties-Electrochemical sensors, Sensors for aerospace, defence and Biosensors. Energy: Solar cells, LEDs and Photovoltaic device applications. Nanophotonics and Devices: ID, 2D, 3D Photonic crystals, Couplers, Waveguides, Photonic crystal fibres, Optical data storage systems and Quantum computing. Photocatalytic applications: Air purification, Water purifications and Volatile organic pollution degradation. Medical applications: Imaging of cancer cells, Biological tags and Targeted nano drug delivery system. Carbon nanotubes: Field emission, Fuel cells and Display devices.

BOOKS FOR STUDY:

1. Structure and properties of solid state materials – B. Viswanathan, Oxford: Alpha Science International, II Edition (2006).
2. Nano the essentials by T.Pradeep, Tata McGraw-Hill publishing company limited (2007).

BOOKS FOR REFERENCES:

1. Nanocomposite Science and Technology- Pulickel M. Ajayan, Linda S. Schadler, Paul V. Braun, Copyright © 2003 Wiley-VCH Verlag GmbH & Co. KGaA.
2. Nanoparticles: from theory to application- G.Schmidt, Wiley Weinheim (2004).
3. Nanotechnology principle and practices by Sulabha K.Kulkarni, Capital publishing company (2007), India.
4. Encyclopedia of materials characterization-C.Rechard Brundle, Charles A.Evans, Butterworth-Heinemann publishers (1992).
5. Introduction to nanotechnology by Charles P.Poole, Frank J. Owens, John Wiley & Sons publication (2003).
6. Synthesis of inorganic materials by Ulrich Schubert, Nicola Husing, Wiley-VCH, 2nd Edition (2005).
7. Cluster Beam synthesis of nanotechnology by Milani and S.Lannota, Springer Verlang Berlin Heidelberg, New York (1999).

PH4959-PARTICLE PHYSICS

Class : II M.Sc. **Credits: 2**
Semester : IV **Hrs./week : 4**

OBJECTIVES:-

1) To provide a concise but accessible introduction to the standard model of particle physics.
2) To develop the theoretical concepts from the electromagnetic and weak interactions of leptons and quarks to the strong interactions of quarks.
3) To look at the experimental data supporting the model.

Unit I: The particle physicist's view of Nature: The construction of the standard model-leptons-quarks and systems of quarks-spectroscopy of systems of light quarks-more quarks-quark colour-electron scattering from nucleons-particle accelerators.

Lagrangian formulation of Lorentz covariant field theory-the Klein-Gordon equation-the energy – momentum tensor-complex scalar fields- A Lagrangian density for electromagnetism-the energy density of the electromagnetic field-massive vector fields.

Unit II: The Dirac equation and the Dirac field-spinors-free space solutions of the Dirac equation-the energy and momentum of the Dirac field- Dirac equation with an electromagnetic field – charge conjugation- electrodynamics of a charged scalar field- Boson and Fermion field quantization.

Unit III: SU(2), SU(3) symmetry – U(1) gauge symmetry – Non-Abelian (SU(2),SU(3)) gauge symmetry – Spontaneous symmetry breaking - Higgs-Kibble mechanism.

Unit IV:- V-A theory of weak interactions- Weinberg -Salam model for electro-weak theory-Lepton and quark doublets and their couplings to W, Z and γ – Experimental tests – Search for W^+, W^- and Z bosons.

Unit V: Quantum chromodynamics - The theory of strong interactions-A local SU(3) gauge theory-colour gauge transformations on quarks and gluons- asymptotic freedom-the quark-anti-quark interaction at short distances.

BOOKS FOR STUDY:

1. An introduction to the Standard model of particle physics, W.N.Cottingham and D.A.Greenwood, Cambridge University Press,1998.
2. Introduction to High Energy Physics, Donald H Perkins,Addison-Wesley Publishing Co. Inc.,3rd edition,1987.
3. Introduction to elementary particles, David Griffiths, John Wiley, !987.
4. Gauge theories in patrticle physics, Second Edition, Ian JR Aitchison and Anthony JG Hey, AdamHilger (IOP Publishing Ltd), 1989.

BOOKS FOR REFERENCES

1. The ideas of particle physics, G.D.Goughlan, James Edmund Dodd, Ben Gipaios, 3rd edition, Cambridge University Press,2006.
2. Experimental techniques in particle physics, Thomas Ferbel,Science,1991.
3. Particle Physics, Lev Borisovich Okun, CRC Press,1985.
4. Elementary particle physics,I.R.Kenyon,Science,1987.
5. Facts and mysteries in Elementary Particle Physics,Martinus Veltman, World Scientific,2007.
6. Introduction to Nuclear and Particle Physics, A.Das and T.Ferbel, 2nd edition,World Scientific,2007.
7. Techniques for Nuclear and Particle Physics , W.R.Leo, Springer Verlag,2008.