CMS COLLEGE KOTTAYAM

(AUTONOMOUS)

Affiliated to the Mahatma Gandhi University, Kottayam, Kerala

CURRICULUM FOR POSTGRADUTE PROGRAMME

MASTER OF SCIENCE IN APPLIED PHYSICS

UNDER CHOICE BASED CREDIT SYSTEM 2016
(With effect from 2016)

SEMESTER – I

PH21123 APPLIED MATHEMATICS – I

Unit I

Functions of a complex variable (18 hrs)

Functions of a complex variable - Analytic functions – Cauchy–Reimann equations - Laplaces equations - Cauchy's Integral Theorem - Cauchy's theorem for multiply connected domains - Cauchy's integral formula - Derivatives of analytic functions - Taylor & Laurent expansion - Singularities-poles and zeros - Residue theorem - Evaluation of definite integrals-Jordan's lemma - Cauchy principal value.

Text Book:

1. Mathematical method for physics, G. B. Arfken & H. J. Weber, Academic Press

Unit II

Linear Algebra: Matrices (12 hrs)

Linear system of equations-Gauss elimination method - Product theorem-Direct product -Diagonal matrices - Trace - Matrix inversion:Gauss-Jordan

matrix inversion - Orthogonal matrices - Euler angles-Complex matrices:Hermition, Skew-Hermition,Unitary - Pauli matrices - Symmetry properties & similarity transformation:Orthogonal & Unitary-Eigen vectors & eigen values - Cayley Hamilton theorem - Diagonalization of matrices:normalized eigen vectors - Normal modes of vibration.

Text Book:

1. Mathematical method for physics, G. B. Arfken & H. J. Weber, Academic Press

Probability (6 hrs)

Laws of probability – Random variables – Binomial - Poisson and Gauss's normal distributions.

Text Book:

1. Mathematical Physics, P.K Chattopadhyay, New Age International.

Unit III

Vector Calculus (18 hrs)

Differential Calculus: Gradient, Divergence, Curl - Successive applications of grad - Integral calculus: line, surface & volume integrals - Fundamental theorem for gradients, divergences and curls - Equation of continuity - Potential theory - Gauss's law and Poissons equation

Orthogonal curvilinear coordinates: Spherical & Cylindrical - Differential vector operators in orthogonal coordinates - Dirac delta function - its properties and integral forms

Linear vector spaces - Self adjoint, unitary & projection operators - Eigen values & Eigen vectors of self adjoint operators-inner product space-Schimdt orthogonalisation - Hilbert space -Schwartz inequality.

Text Book:

1. Mathematical method for physics, G. B. Arfken & H. J. Weber, Academic Press

Unit IV

Fourier Analysis: Fourier series, Integrals & Transforms (18 hrs)

Periodic functions - Fourier series:Functions of period 2π & functions for any period - Even and Odd functions - Half range expansions - Fourier integrals - Fourier transform - Cosine and Sine transform - Square wave – Gaussian - full wave rectifier - finite wave train - Linearity theorem -Fourier transform of derivatives - Convolution theorem - Parseval's theorem - Momentum representation - Harmonic oscillator - ground state of hydrogen atom.

Text Book:

1. Mathematical method for physics, G. B. Arfken & H. J. Weber, Academic Press

Laplace Transforms

Laplace transform - Inverse Laplace transform - Partial fraction expansion - Heavyside expansion formula - Linearity - first shifting theorem - Laplace transform of derivatives & integrals - applications to simple differential equations - Earth's nutation-LCR circuit - wave equation in a dispersive medium-second shifting theorem - Differentiation and integration of transforms - convolution theorem.

Text Book:

1. Mathematical method for physics, G. B. Arfken & H. J. Weber, Academic Press

References Books:

1. Advanced Engineering Mathematics, C.R. Wylie - Tata McGraw Hill.
2. Advanced Mathematics for Engineers & Scientists- Schaum's outline M.R. Spiegel Tata McGraw Hill.
3. Vector Analysis, Schaum's outline M.R. Spiegel Tata McGrawhill.
4. Complex variables - Schaum's outline M.$. Spiegel Tata McGraw Hill.
5. Introduction to Mathematical Physics, Charlie Harper, PHI.
6. Mathematical Physics, P.K. Chattopadhyay, New Age International.
7. Mathematical methods for Physics and Engineering, K.F. Riley, M.P. Hobson & S.J Bence, Cambridge University Press.
8. Advanced Engineering Mathematics, Eewin Kreyzing, John Wiley & Sons.
9. Matrices and Tensors, A.W. Joshi, Wiley
10. Probability-Schaum's outlinees-Seymour Lipschutz & Marc Lipson.

PH21124 THERMAL AND STATISTICAL PHYSICS

Unit I

Thermodynamics and Statistical Theory (18 hrs)

Basic ideas about heat, temperature, work done - Laws of thermodynamics & their consequences - T S diagrams & equations-Physical significance of entropy - Claussius Clapeyron equation - Thermodynamic potentials -

Maxwell's relations. Micro and Macrostates -Thermodynamic probability - Phase Space - Concept of Entropy and Thermodynamic probability - Microcanonical, Canonical & Grand Canonical ensembles.

Text Book:

1. Heat Thermodynamics, M.W. Zeemansky, Tata McGraw Hill (1997).
2. Thermodynamics & Statistical Mechanics-Brijlal and Subrahmanyam, S. Chand & Co.

Unit II

Classical and Quantum Statistical Mechanics (20 hrs)

Classical Statistical Mechanics: Classical Statistical Mechanics - Thermodynamics of an ideal monatomic gas - Gibb's Paradox - Partition function - Canonical and grand canonical partition function - Translational, rotational & vibrational partition functions - electronic & nuclear partitionfunctions - homonuclear molecules.

Quantum Statistical Mechanics: Need of quantum statistics - Symmetry of wave functions-Bosons - Fermions - Pauli's exclusion principle - BE & FD Distribution. Density matrix -Equation of motion of the density matrix - ensembles in quantum statistical mechanics -Calculation of Partition functions.

Text Book:

1. Statistical Mechanics, R. K. Pathria, Butterworth-Heinemann

Unit III

Ideal Bose and Fermi gases (16 hrs)

Ideal Fermi gas-Equation of state of an ideal Fermi gas - High & Low temperature limits - electron gas at absolute zero-degeneracy - free electron

model. Ideal Bose gas - Equation of state - Photons – Black body radiation & Planck's distribution law – Phonons - BE Condensation - Liquid Helium - Lambda transition

Text Book:

1. Statistical Mechanics, R. K. Pathria, Butterworth-Heinemann

Unit IV

Fluctuations & Phase transitions (18 hrs)

Energy fluctuations in canonical ensembles - Density fluctuations in grand canonical ensembles - Fluctuations in quantum statistics - One dimensional random walk problem-Brownian motion and random walk - Correlation function - Weiner-Khintchine theorem - Fokker Planck equation. First & second order phase transitions - Critical exponents - Scaling hypothesis - Ising model.

Text Book:

1. Statistical Mechanics, R. K. Pathria, Butterworth-Heinemann

References Books:

1. Statistical Mechanics, Kerson Huang, Wiley Eastern.
2. Introductory Statistical Mechanics,R. Bowley and M. Sanchez, Oxford University Press
3. Statistical Mechanics, B. K. Agarwal & M. Eisner, New Age Int.Pub.1998.
4. Fundamentals of Statistical Mechanics, B. B. Laud, New Age Int.Pub.1998.
5. Thermodynamics, M.W. Zeemansky, Tata McGraw Hill (1997).

6. Thermodynamics and Statistical Mechanics, W.G. Greiner, Neise and Stoker, Springer
7. Phase Transitions and Critical Phenomena, H. E. Stanley, Oxford Univ. Press.

PH21125 SOLID STATE PHYSICS

Unit I

Crystal Structure (8 hrs)

Crystal structure fundamentals - Bragg law - reciprocal lattice vectors Van Laue formulation of x-ray diffraction by crystals - Equivalence of the Bragg and von Laue formulations. Ewald construction – Brilliouin zones – reciprocal lattice to SC, BCC and FCC lattices - the geometrical structure factor-structure factor of BCC and FCC lattices - the atomic form factor.

Text Book:

1 Introduction to solid state physics, C. Kittel, Wiley India Pub.

Lattice Vibrations (10 hrs)

Vibrations of monoatomic lattices-lattice with two atoms per primitive cell-quantization of lattice vibrations - phonon momentum.

Lattice heat capacity - Einstein model - density of modes - Debye model - Anharmonic crystal interactions - thermal expansion - thermal conductivity - thermal resistivity - umklapp processes - second sound.

Text Book:

1 Introduction to solid state physics, C. Kittel, Wiley India Pub.

Unit II

Free Electron Theory (9 hrs)

Drude - Lorentz theory of metals (quantitative idea) - Fermi–Dirac distribution - Sommerfield theory – Free electron gas in one and three dimensions - Heat capacity of the electron gas – electrical conductivity and Ohm's law - experimental electrical resistivity of metals. Motion in magnetic fields. Hall Effect – thermal conductivity of metals - The Wiedmann-Franz law.

Text Book:

1 Introduction to solid state physics, C. Kittel, Wiley India Pub.

Energy Bands (11 hrs)

Nearly free electron model-origin of energy gap - Bloch functions - Kronig-Penny model - Wave equation of electron in a periodic potential - solution of the central equation – approximate solution near a zone boundary - number of orbitals in a band – Metal insulators and semiconductors. Brilliouin zone in one and two dimensions – extended - reduced and periodic zone schemes - representations

Text Book:

1 Introduction to solid state physics, C. Kittel, Wiley India Pub.

Unit III

Magnetic Properties (10 hrs)

Vibrations of monoatomic lattices-lattice with two atoms per primitive cell - quantization of lattice vibrations - phonon momentum.

Lattice heat capacity - Einstein model - density of modes - Debye model - Anharmonic crystal interactions - thermal expansion - thermal conductivity - thermal resistivity - umklapp processes - second sound.

Text Book:

1 Introduction to solid state physics, C. Kittel, Wiley India Pub.

Unit II

Free Electron Theory (9 hrs)

Drude - Lorentz theory of metals (quantitative idea) - Fermi–Dirac distribution - Sommerfield theory – Free electron gas in one and three dimensions - Heat capacity of the electron gas – electrical conductivity and Ohm's law - experimental electrical resistivity of metals. Motion in magnetic fields. Hall Effect – thermal conductivity of metals - The Wiedmann-Franz law.

Text Book:

1 Introduction to solid state physics, C. Kittel, Wiley India Pub.

Energy Bands (11 hrs)

Nearly free electron model-origin of energy gap - Bloch functions - Kronig-Penny model - Wave equation of electron in a periodic potential- solution of the central equation – approximate solution near a zone boundary - number of orbitals in a band – Metal insulators and semiconductors. Brilliouin zone in one and two dimensions – extended - reduced and periodic zone schemes - representations

Text Book:

1 Introduction to solid state physics, C. Kittel, Wiley India Pub.

Unit III

Magnetic Properties (10 hrs)

Langevin diamagnetism equation-quantum theory of paramagenetism - Hund rules - Cooling by adiabatic demagnetization of a paramagnetic salt.

Ferromagnetic order-Curie point and exchange integral. Antiferromagnetic order - Susceptibility below Neel temperature-Ferrimagnetisms and ferrites. Ferromagnetic domains.

Text Book:

1. Introduction to solid state physics, C. Kittel, Wiley India Pub.
2. Solid State Physics Structure and properties of materials, M.A. Wahab Narosa Pub. House (2010).

Dielectric Properties (8 hrs)

Dielectrics - Local electric field at an atom - dielectric constant and polarizability (Clausius-Mossotti relation) - electronic polarizability - Ferroeelctric crystals - Polarization catastrophe - Landau theory of phase transition - ferroelectric domains - antiferroelectricity.

Text Books:

1. Introduction to solid state physics, C. Kittel, Wiley India Pub.
2. Solid State Physics Structure and properties of materials, M. A. Wahab Narosa Pub. House (2010).

Unit IV

Superconductivity (16 hrs)

Superconductivity - Meissner effect - energy gap - isotope effect - type I, type II superconductors - thermodynamics of superconducting transition - London equation - BCS theory - dc and ac Josephson effects - Flux quantization – High Te superconductivity- applications.

Text Books:

1. Introduction to solid state physics, C. Kittel, Wiley India Pub.
2. Solid State Physics Structure and properties of materials, M. A. Wahab Narosa Pub. House (2010).

Reference Books:

1. Solid State Physics, N.W. Ashcroft and N D Mermin, Cengage Learning Pub(2011).
2. Solid State Physics, A.J. Dekker, Macmillan & Co Ltd.(1967).
3. Elementary Solid State Physics, M. Ali Omar, Pearson Edu. Pub.(2004).
4. Elements of Solid State Physics, J. P. Srivastava, PHI (2004).
5. Solid State Physics, S .O. Pillai, New Age Int. Publishers (2010).
6. Solid State Physics, C. M. Kachava, TMH (1990).
7. Solid State Physics, R. L. Singhal, Kedar Nath Ram Nath & Co. (1981).

PH21126 CLASSICAL MECHANICS AND NONLINEAR DYNAMICS

Unit I

Rigid Body Dynamics (12 hrs)

Independent coordinates - Orthogonal transformation - inertia tensor - Euler's equations, force free motion of a rigid body - cases of symmetrical top, heavy Symmetrical top, fast top, Sleeping top, Precession of charged bodies in magnetic field, Infinitesimal rotation, Coriolis force and its effects

Theory of Oscillations (6 hrs)

Formulation of the problem – Eigen value equation - Coupled Oscillators – Normal coordinates, Oscillations of linear triatomic molecules - monoatomic chain lattice – diatomic chain lattice

Text Books:

1. 1. Classical Mechanics, H. Goldstein, C.P. Poole & J.L. Safko, Pearson, 3rd Ed.
2. Classical Mechanics, J. C. Upadhyaya, Himalaya Pub. House.

Unit II

Hamiltonian Methods (18 hrs)

Critical review of Newtonian , Lagrangian and Hamiltonian approaches- application of Lagrange's equations to velocity dependent potentials - Hamiltonian equations of motion - Cyclic coordinates conservation theorems - Homogeneity of space and time –Action for an arbitrary motion, Physical significance of principal of least action, canonical transformations - Poisson brackets - Hamilonian's characteristic function, Hamilton-Jacobi theory -

Harmonic oscillator problem - Action Angle variables – Transition to wave mechanics

Text Books:

1. 1. Classical Mechanics, H. Goldstein, C.P. Poole & J.L. Safko, Pearson, 3rd Ed.
2. Classical Mechanics, J. C. Upadhyaya, Himalaya Pub. House.

Unit III

Lagrangian formulation for continuous systems – Sound variations in gas – Hamiltonian formulation for continuous systems- Description of fields

Principle of equivalence - Principle of General Covariance - Equation of motion of a particle in a weak gravitational field – Time dilation in gravitational field and gravitational red shift energy- momentum tensor and Einstein field equations.

Text Books:

1. 1. Classical Mechanics, H. Goldstein, C.P. Poole & J.L. Safko, Pearson, 3rd Ed.
2. Theory of relativity, R.K Pathria, Dover Pub. Inc. NY.

Unit IV

Classical Perturbation theory (10hrs)

Classical perturbation theory- Time dependent perturbation-Illustration-Case of simple pendulum with finite amplitudes-Kepler problem and precession of the equinoxes of satellite orbits-Time dependent perturbation First order with one degree of freedom

Text Book:

1. Classical Mechanics, H. Goldstein, C.P. Poole & J.L. Safko, Pearson, 3rd Ed.

Non-linear dynamical system (8 hrs)

Classification of dynamical systems-conservation systems- Integrable systems- Non-linear perturbation-KAM theorem(qualitative) Hamiltonian chaos –Dissipative systems –Continuous systems-Duffing oscillator discrete system logistic map intermittency –crisis –atractors limit cycles –chaotic attractors.

Text Books:

1. Deterministic Chaos, N. Kumar, University press 1996
2. Chaos and Integrebility in Nonlinear Dynamics, M. Tabor, John Wiley & Sons

Reference Books:

1. Classical Mechanics, N. C. Rana and P. S. Joag Tata McGraw Hill.
2. Classical Mechanics,A. K. Raychauduri, Oxford Uni. Press.
3. Dynamics, S. N. Rasband, John Wiley.
4. Introduction to Dynamics, I. Percival and D. Richard, Cambridge University Press.
5. Langrangian and Hamiltonian Mechanics, Calkin M. G. Allied Pub. Ltd.
6. Chaos in Classical and Quantum Mechanics, Gutzwiller, Springer
7. Chaotic Dynamics- an Introduction, G. L. Baker and J. P. Gollub, Cambridge University Press

8. Introduction to General Relativity, R. Addler, M. Bazim, M. Schiffer, MGH.
9. Gravitation and Cosmology: Principle and Applications of General Theory of Relativity, S. Weinberg, John Wiley & Sons

PH21127 GENERAL PHYSICS PRACTICALS

1. Y, n, σ – Cornu's method (i) Elliptical fringes (ii) Hyperbolic fringes
2. Absorption spectrum of KMnO4 solution and Iodine vapour
3. Arc spectra (i) iron (ii) copper (iii) brass
4. Arc spectrum – Identification of elements of an alloy
5. Hall effect (i) carrier concentration (ii) mobility (iii) Hall coefficient
6. Resistivity of (i) Ge (ii) Si at various temperatures by Four Probe Method and determination of band gap
7. Band gap energy of (i) Ge (ii) Si
8. Ultrasonics
9. Oscillating disc – Viscosity of a liquid
10. e/m – Thomson's method
11. Charge of electron – Millikan's experiment
12. Determination of e/k using diode
13. Study of absorption spectrum – Hartman's method

SEMESTER - II

PH22128 APPLIED MATHEMATICS – II

Unit I

Differential Equations & Special Functions (18 hrs)

Gamma and Beta functions-Different forms-evaluation of standard integrals

Bessel differential equation- series solution- the Bessel function of first kind and the second kind- generating function for Bessel functions- Recurrence relations, Legedre differential equation- series solution-Legendre polynomials- generating function for the Legendre polynomials- Recurrence formula- Orthogonality of Legendre polynomials- Rodrigues formula for Legendre polynomials- Spherical harmonics

Hermite differential equations – series solution- Hermite polynomial- Recurrence relation- generating function- orthogonality property of Hermite polynomial – Quantum mechanical harmonic oscillator-Leguerre differential equation- Associated Leguerre polynomials

Text Book:

1. Mathematical Physics, B. D. Gupta, Vikas Publishing House, New Delhi

Unit II

Tensor Analysis (18 hrs)

Tensors-co-ordinate transformations-contravariant,covariant and mixed tensors-Einstien summation convention-symmetric & skew-symmetric tensors-fundamental operation with tensors-contraction & Direct product-Quotient rule-Levi-civita symbol-Dual tensors-Christoffel symbols & their

transformation laws-covariant differentiation-tensor form of gradient,divergence curl & Laplacian-Geodesic equation.

Text Book:

1. Mathematical method for physics, G. B. Arfken & H. J. Weber.

Unit III

Group Theory (18 hrs)

Introduction to group theory-Definition of group-cyclic groups-point groups-homomorphism & isomorphism-classes-reducible & irreducible representations-Schru's lemma-great orthogonality theorem-Group character table-C2v & C3v groups-generators of continous groups-Rotation groups SO(2) & SO(3)-Lie group & Lie algebra-poincare-Lorentz group-SU(2) & SU(3)

Text Book:

1. Elements of Group Theory for physicists, A. W. Joshy, New Age India Pub.

Unit IV

Partial differential equations (18 hrs)

Introduction to partial differential equations-separation of variables: Cartesian coordinates, circular cylindrical coordinates, spherical polar coordinates

Examples of partial differential equations and boundary conditions-Heat equation-Wave equation-Laplace equation-Inhomogeneous partial differential equation:Poissons equation & Quantum mechanical scattering-Green's function.

Text Book:

1. Mathematical method for physics, G.B. Arfken & H. J. Weber.

Reference Books:

1. Mathematical method for physics, G. B. Arfken & H. J. Weber.
2. Mathematical Physics, B.D. Gupta, Vikas Pub. House Pvt Ltd, New Delhi,1997.
3. Advanced engineering mathematics, Cr Wylie, Tata McGraw Hill.
4. Advanced Mathematics for Engineers & Scientists, Schaum's outline M R Spiegel Tata McGraw Hill.
5. Matrices & Tensors in Physics, A.W Joshi, New Age India Pub.

PH22129 ELECTRONICS AND COMMUNICATIONS

Unit I

Linear Integrated Circuits (18 hours)

Differential amplifier- Frequency response of an OPAMP – Compensating networks – General linear applications – Instrumentation amplifier – Active filters – First and second order Butterworth filters – Phase shift and Wien bridge oscillators – Square - Traiangualr and Saw tooth wave generators – Comparators and Converters-D/A and A/D converter – Successive approximation – Dual slope integrator – 555 timer – Internal architecture – VCO - Phase locked loop – Voltage regulators.

Text Book:

1. OP-Amp and Linear integrated circuits, Ramakant Gayakwad, 4th Edition, TMH.

Unit II

Communication Systems (18 hours)

Modulation – Bandwidth requirements - Amplitude modulation – SSB technique – Frequency modulation – Frequency spectrum of FM wave – Phase modulation – Generation of FM – Pulse communications – Pulse modulation – Pulse width, pulse position, pulse code modulation – Digital communication – Digital codes – Error detection and correction – Modem classification – Modem interfacing.

Text Book:

1. Electronic communication system, George Kennedy, TMH.

Unit III

Microprocessors and Microcontrollers (18 hours)

Intel 8086 – Architecture – Addressing modes – Accessing and register data – Accessing memory and I/O ports – Addressing modes – Instruction set – Instruction format – Assembler dependent instructions – System design using 8086 – System concepts – Interfacing memory – Programmed I/O – 8086 based microcomputer – Basic ideas of 8088, 80186, 80286, 80386, 80486 and Pentium processors.

Evolution of microcontrollers – Comparison of microprocessors and microcontrollers – 8 bit microcontrollers – 8051 architecture – hardware – I/O pins, ports and circuits – External memory – Basic programming concepts – applications.

Text Books:

1. Microprocessor and Microcomputer based system design, M. Rafiquzzaman , Universal Book Stall, New Delhi.
2. The 8051 Microcontroller, Architecture, Programming and Applications, Kenneth J. Ayala Penram Int Pub, Mumbai.

Unit IV

Digital Signal Processing (18 hours)

Continuous time (CT) and Discrete time (DT) signals – Some elementary discrete time signals – Classification of discrete time signals – discrete time systems – classification of discre time systems – Convolution sum – Correlation of discrete time signal – Z transform- Analysis of CT signals – Fourier series and Fourier transforms – Analysis of DT signals – Fourier series and Fourier transforms - Discrete Fourier transform of DT signals – Fast Fourier transform –Digital filtering in time domain – FIR filters – IIR filters.

Text Books:

1. Signals and Systems, A.V. Oppenheim, A. S. Willsley and I. T. Young, PHI.
2. Digital Signal Processing, John G. Proakis, Dimitris G. Manolakis, 4th Edn. PHI.

Reference Books:

1. Op. Amps and Linear Circuits, R. A. Gayakwad, PHI (1997).
2. Microprocessor Architecture and Applications, R.S. Gaonkar, Wiley Eastern.
3. The Intel Microprocessors – 8086, 8088, 80186, 80286, 80386 and 80486,B.B. Bery, PHI.

4. Electronic fundamentals and applications, John Ryder.
5. Digital Signal Processing, John G. Proakis, Dimitris G. Manolakis,4th Edn. PHI.
6. Advance microprocessors and peripherals, A. K. Ray and K. M. Burchandi, TMH.

PH22130 SPECTROSCOPY

Unit I

Atomic Spectra (18 hrs)

Vector atom model-electron spin-Stern-Grelach experiment-LS and jj coupling schemes-spectroscopic terms-Pauli's exclusion principle-spin-orbit interaction-interaction energy-interaction energy in LS and jj coupling schemes-selection rule-Hund's rule-Lande interval rule- normal and anomalous Zeeman effect-Paschen-Back effect and Stark effect in one electron systems-hyperfine structure-width of spectral lines.

Text Books:

1. Introduction to atomic spectra, White H. E., McGraw Hill.
2. Spectroscopy Volume 1, Straughan and Walker, John Wiley & Sons.

Unit II

Resonance Spectroscopy (18 hrs)

ESR-theory-relaxation process-experimental setup-hyperfine structure-applications.

NMR-classical and quantum theories-relaxation process-experimental technique-chemical shift-spin-spin coupling-applications.

Mössbauer effect-theory-experimental technique-chemical isomer shift-magnetic hyperfine interactions-electric quadrapole interaction-applications

Text Books:

1. Spectroscopy volume 2 Straughan and Walker, John Wiley & Sons.
2. Molecular structure and spectroscopy, G. Aruldhas, PHI.

Unit III

Microwave and Infrared Spectroscopy (18 hrs)

Rotational spectra of rigid diatomic molecules-isotopic effect-intensity of rotational lines-non rigid rotator-linear polyatomic molecules-symmetric top molecules-microwave spectrometer-informations from rotational spectra.

Vibrating diatomic molecules as harmonic and anharmonic oscillators-diatomic vibrating rotator-breakdown of Born-Opeenheimer approximation-vibrational spectra of polyatomic molecules-overtones and combinations-influence of rotation on the spectra of linear and symmetric top molecules-IR spectroscopic analysis-FT-IR spectroscopy.

Text Books:

1. Molecular structure and spectroscopy, G. Aruldhas, PHI.
2. Fundamentals of molecular spectroscopy, C. N. Banwell and E. M. McCash, TMH.

Unit IV

Raman Spectroscopy (9 hrs)

Raman effect, theory, rotational Raman spectra-linear molecules-symmetric top molecules-vibrational Raman spectra-rotational fine structure-Raman activity-mutual exclusion principle-structure determination using Raman and IR spectroscopy-laser Raman spectrometer, basic idea of nonlinear Raman

effects, stimulated Raman effects, Hyper Raman effect, inverse Raman effect and CARS.

Electronic Spectroscopy (9 hrs)

Electronic spectra of diatomic molecules- progressions and sequences- Frank Condon principle- rotational fine structure of electronic vibration spectra-the Fortrat parabola-dissociation-pre dissociation-fluorescence and phosphorescence.

Text Books:

1. Molecular structure and spectroscopy, G. Aruldhas, PHI.
2. Fundamentals of molecular spectroscopy, C. N. Banwell and E. M. McCash, TMH.
3. Raman spectroscopy, D. A. Long, McGraw Hill Inc.

Reference Books:

1. Introduction to atomic spectra, H. E. White.
2. Introduction to molecular spectroscopy, G. M. Barrow McGraw Hill.
3. Elements of spectroscopy, Gupta, Kumar and Sharma, Prgathi Prakshan.
4. Molecular spectra and molecular structure, Vol. I, II & III, Hertzberg G., Van Nostrad, London.
5. The infrared spectra of complex molecules, Vol I and II, Bellamy L. J. Chapman and Hall.

PH22131 QUANTUM MECHANICS – I

Unit I

Applications of Schrodinger Equation (16 hrs)

Harmonic Oscillator-Three dimensional square well potential-Spherically symmetric potentials in three dimensions-Central force problems—the rigid rotor-Hydrogen atom

Text Book:

1. Quantum concepts and Applications, Nouredine Zettili, John Wiley & Sons.

Unit II

Mathematical Tools of Quantum Mechanics (18 hrs)

Hilbert space-Dimension and Basis of a vector space-Dirac notation-Ket space-Bra space-inner products-Operators-eigen values and eigen vectors of an operator-Hermition ,Unitary operators (eigen values & eigen vectors)-Projection operators-Compatible Obsevables-Uncertainity relation between two operators-Matrix representations of Kets,Bras & Operators-Change of Bases & Unitary transformations-Unitary equivalent observables-Position representation-Translation-Momentum as a generator of translation-Position-momentum uncertainity relation-Canonical commutation relations-Position space wave function-Momentum operator in the position basis-Momentum space function-Connection between position and momentum space function-Gaussian wave packets-Expectation value of x, x^2, p, p^2 for a Gaussian wave packet.

Text Book:

1. Modern Quantum Mechanics - J. J. Sakurai, Pearson Education.

Unit III

Quantum Dynamics (20 hrs)

Time evolution Operator-Schrodinger equation for the time evolution operator-Schrodinger picture & Heisenberg picture: Behaviour of state kets & Observables-Heisenberg equation of motion-Ehrenfest'stheorem-Energy eigenkets & eigenvalues of a simple Harmonic Oscillator using creation and annihilation operators.

Text Book:

1. Modern Quantum Mechanics, J. J. Sakurai, Pearson Education.

Time Independent Perturbations: Time independent perturbation theory-Nondegenerate case-Correction to wave function and energy to second order. anharmonic oscillator-Quadratic Stark effect-Degenerate case-Secular equation-linear Stark Effect & Zeeman effect in hydrogen.

Text Books:

1. Modern Quantum Mechanics - J J. Sakurai, Pearson Education.
2. Quantum concepts and Applications, Nouredine Zettili, John Wiley & Sons.

Unit IV

Scattering (18 hrs)

Scattering amplitude-Differential Scattering cross section & Total Scattering cross section-The Born approximation: The first Born approximation & its

validity-Application of Born approximation to square well, Yukawa & Screened Coulomb potential.

Method of Partial waves-Scattering by a perfectly rigid sphere & by a square well potential-Optical theorem-Ramsaur-Townsend effect-Resonance Scattering.

Text Books:

1. A modern approach to Quantum Mechanics, Townsend.
2. Introduction to Quantum Mechanics, David J. Griffiths.

References:

1. Modern Quantum Mechanics, J. J. Sakurai, Pearson Education.
2. Introduction to Quantum Mechanics, David J. Griffiths.
3. A Text book of Quantum Mechanics, P. M. Mathews & K. Venkatesan.
4. Quantum Mechanics, L. I. Schiff.
5. A modern approach to Quantum Mechanics-Townsend, Viva Books Pvt. Ltd. MGH
6. Quantum Mechanics, Ghatak and Loknathan.
7. Quantum Mechanics, G. Aruldas, PHI
8. Quantum Mechanics,V. K. Thankappan, New Age Int. Pub.
9. Quantum Mechanics, L. D. Landau and E. M. Lifshitz.
10. Quantum Mechanics, Messiah A. P. Q. Q. M - Vol I & II.
11. Quantum Mechanics- an Introduction, W. Greiner, Springer Verlag.

PH22132 ELECTRONICS PRACTICALS

1. Differential amplifier using Op amp.
2. Diiferential Amplifier using Transistors(With constant current source)
3. RC coupled CE Amplifier
4. First order lowpass & High pass filter
5. Second order lowpass & High pass filter
6. Square wave Generator
7. Triangular wave generator
8. Astable Multivibrator
9. Wein-Bridge Oscillator using Op.Amp.
10. Voltage regulator using Op.Amp.
11. Wave form generators using Op.Amp.
12. Voltage controlled Oscillator – IC 555
13. PLL and frequency multiplier
14. Frequency mixing, AM and demodulation
15. Frequency modulation and demodulation
16. DC and AC milli – voltmeter construction and calibration
17. Instrumentation amplifier using transducer
18. Amplified DC meter (FET Voltmeter)
19. Pulse width modulation

SEMESTER – III

PH23133 ELECTROMAGNETIC THEORY

Unit I

Electrostatics and Magnetostatics (18 hrs)

Electrostatics: Gauss's law & its applications- Laplace & Poisson's equations- electrostatic boundary conditions-Magnetostatics: Biot-Savart's law & application- Amperes law & application-magnetostatic boundary conditions.

Text Book:

1. Introduction to Electrodynamics, D. J. Griffiths-PHI.

Unit II

Electrostatic Fields in matter & Electrodynamics (18 hrs)

Electrostatic fields in matter: Polarization, Field of a polarized object, Gauss's law in dielectrics, Electric displacement, Linear dielectrics

Electrodynamics: Maxwell's equations in free space &linear isotropic media-Boundary conditions on field vectors D,E,B &H - Scalar & Vector Potentials-Coulomb and Lorentz guage - Lorentz force law in potential form. Energy & momentum in electrodynamics-Newton's third law-Poynting's Theorem-Maxwell's stress tensor.

Text Book:

1. Introduction to Electrodynamics, D. J. Griffiths-PHI.

Unit III

Electromagnetic Waves & Relativistic Electrodynamics (18 hrs)

Electromagnetic waves: Electromagnetic waves in free space, conductors & dielectrics-Energy & momentum of electromagnetic waves-Reflection & Transmission of EM waves in non-conducting media. Relativistic Electrodynamics: Lorentz transformation of EM field- EM field. Tensor-electrodynamics in tensor notation-Potential formulations of relativistic electrodynamics.

Text Book:

1. Introduction to Electrodynamics, D. J. Griffiths-PHI.

Unit IV

Electromagnetic Radiation & Waveguides (18 hrs)

Electromagnetic radiation:Radition from electric & magnetic dipoles-Lienard-Wiechert potential-Radiation from a moving point charge-TE & TM waves in rectangular waveguides-Impossibility of TEM wave in rectangular wave guide.

Text Book:

1. Antenna & waveguide propagation, K. D. Prasad.
2. Introduction to Electrodynamics, D. J. Griffiths-PHI.

Reference Books:

1. Introduction to Electrodynamics, D. J. Griffiths, PHI.
2. Electromagnetic waves & Radiating Systems, E.C Jordan & K. G. Balmain, PHI.
3. Classical Electrodynamics, J. D. Jackson, Wiley Eastern Ltd.

4. Elements of electromagnetic, Mathew N. O. Sadiku, Oxford University Press.
5. Electromagnetics-Schaum's outline series, Joseph A. Edminister.
6. Electromagnetic waves & radiating system, Jordan & Balmain.

PH23134 QUANTUM MECHANICS - II

Unit I

Theory of Angular Momentum (20 hrs)

Finite Versus Infinitesimal Rotations-Commutation relation between rotation operations about different axes-Infinitesimal Rotations in Quantum Mechanics-Fundamental commutation relations of angular momentum-Rotation operator for a spin ½ system-Pauli two component Formalism-Pauli Spin Matrices-2x2 matrix representation of rotation operator-Euler rotations-Commutation Relations and the Ladder Operators of Angular momentum-Eigen values of J^2 & J_z-Matrix elements of Angular-Momentum Operators-Representation of the rotation operator-Rotation matrix-Properties of the rotation matrix-Orbital angular momentum as a rotation generator-Spherical Harmonics-Spherical Harmonics as Rotation Matrices-Addition of angular momentum and spin angular momentum-addition of spin angular momenta of two spin ½ particles.(Mention Clebsch-Gordan coefficients)

Text Book:

1. Modern Quantum Mechanics, J. J. Sakurai, Pearson Education.

Unit II

Time dependent Perturbation Theory (16 hrs)

Interaction Picture-equation of motion for the state vectors & operators-Time dependent perturbation theory-Dyson series-Transition probability-Constant perturbation-Harmonic perturbation-Adiabatic & Sudden approximations-Interaction of atoms with classical radiation field-Electric dipole approximation.

Text Book:

1. Modern Quantum Mechanics, J. J. Sakurai, Pearson Education.

Unit III

Relativistic Quantum Mechanics (18 hrs)

Klein Gordan equation-Probability conservation-Dirac equation-Conserved current representation-large and small components-approximate Hamiltonian for an electrostatic problem-free particles at rest-Plane wave solutions-Dirac matrices-Positive and negative energy solutions-Physical interpretation-Non-relativistic limit of Dirac equation-Relativistic covariance of Dirac equation-Zitterbewegung.

Text Book:

1. Modern Quantum Mechanics, J. J. Sakurai, Pearson Education.

Unit IV

Second Quantization (18 hrs)

Lagrangian and Hamilton formalism of classical field theory-Canonical quantization-quantization of nonrelativistic Schrodinger equation-number

operator-creation and annihilation operators-Fock space representation-Concept of a vaccum state-Bosons and Fermions-Occupation number Formalism

Relativistic quantum field theory-Second quantization of free fields-scalar field-Dirac field-Electromagnetic fields quantization.

Text Books:

1. Field quantisation- W. Greiner, J. Reinhardt, Springer.
2. Quantum Mechanics-V. K. Thankappan, New Age Int. Pub.1996.

References

1. Modern Quantum Mechanics, J. J. Sakurai, Pearson Education.
2. Introduction to Quantum Mechanics, David J. Griffiths.
3. Quantum Mechanics, Nouredine Zettili.
4. A Text book of Quantum Mechanics, P. M. Mathews and K. Venkatesan.
5. Quantum Mechanics, L. I. Schiff.
6. Relativistic Quantum Mechanics, P. Strang.
7. Quantum Field Theory, L. Ryder, Academic Publishers,Calcutta,1989.
8. Quantum Field Theory, C. Itzykson and J. Zuber.
9. Advanced quantum mechanics, J. J. Sakurai, Pearson Education.
10. Quantum Mechanics, V. K. Thankappan, New Age Int. Pub., 1996.

PH23336 PHOTONICS – I

Unit I

Properties of Semiconductors (18 hrs)

Electronic properties of semiconductors – Carrier effective masses and band structure – Effect of temperature and pressure on band gap- PN junction – Conduction process in semi-conductor

Optical processes in semiconductors – Direct and indirect band gap semiconductors – Electron- Hole pair formation and recombination- Absorption in semiconductors –Effect of electric field on absorption- Absorption in quantum wells – Radiation in semiconductors

Text Book:

1. Semiconductor Optoelectronic Devices, Pallab Bhattacharya, PHI (1995).

Unit II

Display Devices (18 hrs)

Photo luminescence – Cathodo luminescence – Electro luminescence – LED – LED materials – Device configuration and efficiency – Hetero junction, surface emitting, edge emitting, stripe geometry LEDs – Drive circuitary – Performance and characteristics – Plasma display – Liquid crystal – Properties – Numeric displays

Text Book:

1. Optoelectronics an Introduction, J. Wilson and J.F.B. Hawkes, PHI (2000).

Unit III

Optoelectronic Modulators (18 hrs)

Modulation of light – Birefringence – Electro optic effect – Pockel's electro optic modulator – Kerr modulator – Magneto optic effect – Optical isolator – Acousto optic effect – Acousto optic modulator – Scanning and switching – Self electro optic device – Bipolar controlled modulator – Quantum well modulator.

Text Books:

1. Optoelectronics an Introduction: J. Wilson and J. F. B. Hawkes, PHI (2000).
2. Fibre Optics and Optoelectronics, R. P. Khare, Oxford University Press (2000).

Unit IV

Nanophotonics (18 hrs)

Photons and electrons: similarities and differences-free space propagation -Confinement of photons and electrons-propagation through a classically forbidden zone : Tunneling-Localizationunder periodic potential : Band gap-Cooperative effects for photons and electrons-nanoscale optical interactions-axial and lateral nanoscopic localization -quantum confined materials; quantum wells, quantum wires, quantum dots, quantum rings – quantum confined stark effect-dielectric confinement effect-super lattices - photonic crystals-features of photonic crystals-photonic crystal sensors-industrial nanophotonics-nanolithography (basic idea)-two photon lithography-sunscreen nanoparticles-self-cleaning glasses – fluorescent quantum dots-nanobarcodes-introduction to nanotoxicology.

Text Book:

1. Nano Photonics, P. N. Prasad, Wiley Interscience (2003).

Reference Books:

1. Optical fibre Communications, John M. Senior, PHI (1995).
2. Semiconductor Opto electronics, Jasprit Singh, TMH (1995).
3. Opto electronic Devices and Systems, S. C. Gupta, PHI (2005).
4. Light emitting Diodes, E. Fred Scheubert, Cambridge University Press (2003).
5. Principles of Nanophotonics, Lukas Novotny and Bert Hecht, CUP.
6. Nanophtonics, H. Rigneault, J.M. Lourtioz, C.D., J.A. Levenson, ISTE Pub. Co. (2006).
7. Optoelectronic Devices and Systems, S. C. Gupta, PHI (2005).

PH23337 LASER PHYSICS

Unit I

Lasers – Operating principles (20 hrs)

Thermal equilibrium– Absorption, spontaneous and stimulated emissions – Absorption and stimulated emission coefficients – Absorption and gain on homogeneously and inhomogeneously broadened radiative transitions – Gain coefficient and stimulated emission cross section for homogeneous and inhomogeneous broadening – Relationship of gain coefficient and stimulated emission cross section to absorption coefficient and absorption cross section– Population inversion and saturation intensity – exponential growth factor- Threshold requirements for laser with and without mirrors– Laser amplifiers – Pumping mechanism

Text Book:

1. Laser fundamental-W. T. Silfvast, Cambridge University Press (1996).

Unit II

Theory of Lasers -I (20 hrs)

Three and four level systems and rate equations –Laser spiking – Laser cavity modes- Longitudinal laser cavity modes- Fabry-Perot resonator- Longitudinal mode number- Transverse laser cavity modes- Development of transverse modes in a cavity with plane parallel mirrors- Properties of laser modes- Stable curved mirror cavities- Properties of Gaussian beams- Properties of real laser beams- Quality factor- The ultimate line width of the laser

Text Book:

1. Laser fundamental, W. T. Silfvast, Cambridge University Press (1996).
2. Lasers-Theory, and Applications, K. Thyagarajan and A. K. Ghatak, McMillian (2002).

Unit III

Theory of Lasers – II and Applications (16 hrs)

Q - Switching – Methods of Q – switching – Mode locking – Methods of mode locking –Ring lasers- Distributed feedback lasers- Properties of laser beams – Temporal coherence – Spatial coherence – Directionality

Applications of lasers (Qualitative idea)- Lasers in science, industry and medicine- Laser induced fusion- Lasers and holography- Laser cooling

Text Book:

1. Laser fundamental-W. T. Silfvast, Cambridge University Press (1996).
2. Lasers-Theory, and Applications –K. Thyagarajan and A. K. Ghatak, McMillian (2002).

Unit IV

Laser Systems (16 hrs)

Gas lasers – He-Ne laser, CO2 laser, Nitrogen laser, Argon ion laser – Solid state lasers- Ruby laser – Nd – YAG lser – Excimer lasers – Dye lasers – Fiber lasers- Generation of ultra-fast optical pulses– Femto second laser Semiconductor lasers – Junction laser operating principles – Hetero junction lasers – Quantum well lasers

Text Book:

1. Laser fundamental-W. T. Silfvast, Cambridge University Press (1996).
2. Lasers-Theory, and Applications –K. Thyagarajan and A. K. Ghatak, McMillian (2002).

Reference Books:

1. Laser Electronics, J. T. Vardeyan, PHI, 1989.
2. Solid State laser Engineering, W. Koechner, Springer Verlag, 2006.
3. Quantum Electronics, A. Yariv, John Wiley.
4. Laser Physics, Tarasov, MIR Pub, 1985.
5. Fiber optics and optoelectronics, R. P. Khare, Oxford University Press, 2004.
6. Optical Fiber Communications, John M. Senior,PHI(1994).

7. Dye laser, Schaffer, Springer Verlag,1977.
8. Lasers principles and applications, J. F. B. Hawkes and Wilson, PHI.

PH23135 COMPUTATIONAL PHYSICS PRACTICALS

(Programs are to be written in C++ language. Method, Algorithm and Flow chart are to be furnished)

1. Motion of a Spherical body in a viscous medium
2. Projectile motion
3. SHM – Damped and Forced
4. Formation of Standing waves
5. Electric field due to a point charge and equipotential surface
6. LCR circuits with AC and DC sources
7. Gauss elimination method for solving a system of linear equations
8. Finding the roots of a nonlinear equation by Bi section method
9. R.K Method
10. Euler Method
11. Integration by Monte Carlo method
12. Matlab – Matrix operations
13. Matlab – Digital signal processing
14. Matlab – Solving ordinary differential equations
15. Matlab –Plot unit impulse,step,ramp and random noise
16. Matlab-Generationof waveforms(Sinusoidal,square,triangular,exponential)
17. Matlab-Linear Convolution
18. Matlab-Circular Convolution

19. Matlab-Linear Convolution using Circular Convolution
20. Matlab-Random Sequence Generator
21. Matlab-Amplitude Modulation
22. Frequency Modulation using Matlab
23. Pulse width Modulation using Matlab
24. Inverse Discrete Fourier Transform using Matlab
25. Discrete Fourier Transform using Matlab

SEMESTER – IV

PH24138 NUCLEAR PHYSICS AND ASTROPHYSICS

Unit I

Nuclear Properties and Forces (4 hrs)

Nuclear Angular Momentum – Parity – Nuclear magnetic dipole moment – electric quadrupole moment – Simple theory of Deuteron – Properties of Nuclear forces –Spin dependence of nuclear force.

Nuclear Models (14 hrs)

Binding energy, semi-empirical mass formula, liquid drop model. Evidence of shell structure, single-particle shell model, its validity and limitations, Spin orbit coupling, Schmidt's lines and prediction of angular momentum and parity of nuclear ground states. Collective model of Bohr and Mottelson – rotational States and Vibrational levels.

Text Books:

1. Introductory Nuclear Physics, K. S. Krane, Wiley.
2. Nuclear Physics, D. C. Thayal, Himalaya Pub. House.

Unit II

Radioactivity, Fission and Fusion (18 hrs)

Radio activity, Units, alpha and beta decay, Gamow's theory, neutrino, Fermi's theory of beta decay, Radiation hazards. Nuclear fission, controlled fission reactions, fission reactors, nuclear fusion, controlled Fusion reactors.

Detectors, accelerators

Particle detectors - Ionization chamber, GM counter, bubble chamber, cloud chamber. Particle accelerators -Van de Graff generator, Cyclotron, Synchrotron.

Text Books:

1. Introductory Nuclear Physics, K. S. Krane, Wiley.
2. Nuclear Physics, D. C. Thayal, Himalaya Pub. House.

Unit III

Particle Physics (18 hrs)

Elementary particles and their quantum numbers (charge, spin, parity, isospin, strangeness, etc.). Gellmann-Nishijima formula. Quark model, confined quarks, coloured quarks, quark-gluon interaction, baryons and mesons. C, P, and T invariance. Application of symmetry arguments to particle reactions. Parity non-conservation in weak interaction. Relativistic kinematics, Grand unified theories.

Text Books:

1. Introductory Nuclear Physics, K. S. Krane, Wiley.
2. Nuclear Physics, D. C. Thayal, Himalaya Pub. House.

Unit IV

Astrophysics (18 hrs)

Sun

Solar structure - photosphere, chromosphere and corona. Activity in the sun-sunspots, flares, solar oscillations, helioseismology.

Expanding universe-red shift-Hubble's law. Fundamental assumptions - homogeneity and isotropy, the FRW metric, density evolution, critical density, cosmological constant. Conditions in the early universe – big bang nucleosynthesis.

Galaxies

Milky way galaxy-stellar population –spiral structure.

Compact Objects

Physical properties of black holes, white dwarfs, and neutron stars, formation of compact objects, pulsar phenomena, gravitational and neutrino radiation from supernova collapse and binary coalescence.

Text Books:

1. Introduction to Cosmology, J. V. Narlikar, Cambridge University Press.
2. Astrophysics: Stars and Galaxies, K.D.Abhyankar

Reference Books:

1. Introduction to High Energy Physics, D. H. Perkins.
2. Introduction to Elementary Particles, David Griffith, Harper and Row, N.Y, 1987.
3. B. L. Cohen, Concepts of Nuclear Physics, TMH, 1971.
4. R. R. Roy and B. P. Nigam, Nuclear Physics, New Age Int. ,1983.

5. Subatomic Particles, Frauenfelder and Henley, PHI.
6. The Ideas of Particle Physics, G. D. Coughlan and J. E. Dodd.
7. Introduction to Nuclear Physics, Herald A Enge, Addison, Wesley Pub, (1972).
8. Nuclear Physics, I. Kaplan, Narosa publishing House,(1962).
9. Nuclear Radiation detectors, Price.
10. Particle Hunters, Neeman, Y. Kirch ,Cambridge Univ. Press.
11. Elementary particles and symmetries, I. H. Ryder, Gordon and Breach, (1975) (Text).
12. The cosmic onion-Quarks and nature of Universe, Frank Close, AIP (1983).
13. Elements of Nuclear Physics, W. E. Burcham, Longmans (1981).
14. University Physics with Modern Physics, H. D. Young & R. A. Freedman, 11th Edn, (2004).
15. Elements of Nuclear Physics, M. L. Pandya & R. P. S. Yadav, 7th Edn, (2002).
16. The New Cosmology, Albrecht Unsold.
17. Astrophysics, B. Basu.
18. The Physical Universe, F. H. Shu.
19. Astrophysics: Stars and Galaxies. K. D. Abhyankar.
20. Black Holes, White Dwarfs and Neutron Stars, S.Shapiro & S. Teukolsky, Wiley, 1983.
21. Glendenning, Compact Stars: Nuclear Physics, Particle Physics and General Relativity, 2nd ed., Springer, 2000.

PH24139 COMPUTATIONAL PHYSICS

Unit I

Numerical Methods of Analysis (18 hrs)

Solution of algebraic and transcendental equations: Iterative, bisection and Newton-Raphson methods, Solution of simultaneous linear equations: Matrix inversion method, Interpolation: Newton and Lagrange formulas, Numerical differentiation, Numerical Integration, Trapezoidal, Simpson and Gaussian quadrature methods, Least-square curve fitting, Straight line and polynomial fits, Numerical solution of ordinary differential equations: Euler and Runge-Kutta methods.

Text Book:

1. Introductory Methods of Numerical Analysis, S. S. Sastry, Prentice Hall India.

Unit II

Fortran (18 hrs)

Flow charts, Algorithms, Integer and floating point arithmetic, Precision, Variable types, Arithmetic statements, Input and output statements, Control statements, Executable and non-executable statements, Arrays, Repetitive and logical structures, Subroutines and functions, Operation with files, Operating systems, Creation of executable programs.

Text Book:

1. Computer Programming in FORTRAN 77, Rajaraman.

Unit III

Object Oriented Analysis and C++ (18 hrs)

Principle of Object Oriented Programming, Software evaluation, OOP paradigm, Basic concept of OOP, Benefits of OOP, Application of OOP, Introduction to C++,Tokens, Keywords, Identifiers, Constants, Operators, Manipulators, Expressions and control structure, Pointers, Functions, Function prototyping, Parameters passing in functions, Values Return by functions, Inline functions – friend and virtual functions, Classes, objects, constructors and destructors, Operator overloading, Type conversions, Type of constructors , Function over loading

Text Books:

1. Object Oriented Programming with C++ , Balagurusamy, TMH.
2. Object Oriented Programming in Turbo C++ , Robert Lafore.

Unit IV

Matlab Programming (18 hrs)

Introduction-Matlab Features-Desktop Windows: Command, Workspace, Command History, Array Editor and Current Directory -Matlab Help and Demos- Matlab Functions, Characters, Operators and Commands. Basic Arithmetic in Matlab-Basic Operations with Scalars, Vectors and Arrays-Matrices and Matrix Operations-Complex Numbers- Matlab Built-In Functions-Illustrative Examples.

Control Flow Statements: *if, else, else if, switch* Statements-*for, while* Loop Structures-*break* Statement-Input/Output Commands-Function m Files-Script m Files-Controlling Output

Text Books:

1. Engineering and Scientific Computations Using Matlab, Sergey E. Lyshevski, Wiley
2. Matlab Programming-David Kuncicky, Prentice Hall.

Reference Books:

1. Numerical methods in Science and Engineering, M.K. Venkataraman, National Publishing Co. Madras.
2. Applied Numerical Analysis, Gerald, Person Educaton.
3. Numerical Methods for Engineers and Scientists, Joe D. Hoffman.
4. Numerical Methods For Scientific And Engineering Computation, M.K. Jain , New Age International.
5. Computational Methods in Physics and Engineering, Wong.
6. Computer Oriented Numerical Methods, Rajaraman.
7. Programming in C++, Schaum's Series.
8. A Guide to Matlab for Beginners & Experienced Users, B. Hunt, R. Lipsman, J. Rosenberg, Cambridge University Press.
9. Matlab Primer, T. A. Davis & K. Sigmon, Chapman & Hall CRC Press- London.
10. Getting Started With Matlab, Rudra Pratap, Oxford University Press, New Delhi.
11. An Introduction to Programming and Numerical Methods in MATLAB, S.R. Otto and J.P. Denier, Springer-Verlag-London.
12. Numerical Methods Using Matlab-John Mathews & Kurtis Fink, Prentice Hall-New Jersey.

PH24340 PHOTONICS – II

Unit I

Fiber Optic Communication (18 hrs)

Fibre optic communication system- Advantages of fiber optic system- System design considerations for point to point links- Digital systems- Link power budget- Rise time budget- Line coding- Analog systems- System architecture- Point to point links- Distribution networks- Local area networks

Text Book:

1. Fibre Optics and Optoelectronics, R. P. Khare, Oxford University Press (2004).

Unit II

Optical Amplifiers and Detectors (18 hrs)

Qualitative ideas of semiconductor optical amplifiers, Erbium doped fiber amplifiers and Raman amplifiers

Optical detection principle-Absorption coefficient- Quantum efficiency- Responsivity- Long wavelength cutoff- PN photo diode- PIN photo diode- Avalanche photo diode- Photo transistor-Photo conducting detectors- Photomultiplier- CCD- Photo voltaic effect and solar cells- Noise- Thermal noise- Dark current noise- Quantum noise

Text Books:

1. Fibre Optics and Optoelectronics, R. P. Khare, Oxford University Press (2004).
2. Optical fiber Communications, John M. Senior, PHI (1995).

Unit III

Fiber Cables and Connections (18 hrs)

Fiber material requirements- Fiber fabrication methods- Liquid – phase(Melting) Methods – Vapour-phase deposition methods- OVPO method- VAD method- MCVD method- PCVD method-Fiber optic cables- Fiber connections and related losses- Loss due to Fresnel reflection- fiber to fiber misalignment losses- loss due to other factors- Connection losses due to intrinsic parameters- Fiber splices- Fusion splices- Mechanical splices- Multiple splices- Fiber optic connectors- Butt-jointed connectors- Expanded beam connectors- multi fiber connectors

Text Book:

1. Fibre Optics and Optoelectronics, R. P. Khare, Oxford University Press (2004).

Unit IV

Frequency Multiplication and other Nonlinear Effects (18 hrs)

Wave propagation in an anisotropic crystal- Polarization response of materials to light- Second harmonic generation- Sum and difference frequency generation- Parametric oscillation- Third harmonic generation- Self focusing- Nonlinear optical materials- Phase matching- Acive phase matching- Saturable absorption- Optical bistability-Two photon absorption- Stimulated Raman scattering- Harmonic generation in gases.

Text Book:

1. Laser Fundamental, W.T. Silfvast, Cambridge University Press (1996).

Reference Books:

1. Fiber Optic Communication, D.C. Agarwal, Wheeler Publications (1993).
2. Optical Fiber Communication System, J. Gowar, PHI (1995).
3. Fiber Optic Communication, Joseph Palais, PHI (1998).
4. Understanding Fiber Optics, J. Hecht, Pearson Edu. Inc. (2006).
5. Optoelectronic Devices and Systems, S. C. Gupta, PHI (2005).

PH24341 FIBRE OPTICS

Unit I

Optical Waveguides (18 hrs)

Ray theory theory of transmission - Total internal reflection -Acceptance angle - Numerical aperture - Skew Rays. EM Theory for Optical propagation – Modes in a planar waveguide –Phase velocity and group velocity – Evanescent field - Optical fiber as a cylindrical waveguide- Modes – Mode coupling (elementary idea) – Classification of fibers – Step index fiber – Graded index fiber – Single mode fiber – Number of modes and cut off parameters – Mode field diameter and spot size

Text Book:

1. Optical Fiber Communications, John M. Senior,PHI (1994

Unit II

Transmission Characteristics of Optical Fibers (18 hrs)

Attenuation – Absorption losses – Linear scattering losses – Nonlinear scattering losses – Wavelengths for Communication – Fiber bend loss – Dispersion effects in fibers - Intra modal dispersion – Inter modal dispersion

– Over all fiber dispersion – Modal birefringence – Polarization maintaining fibers.

Text Book:

1. Optical Fiber Communications, John M. Senior, PHI (1994)

Unit III

Optical Fiber Measurements (18 hrs)

Attenuation measurements – Dispersion measurements – Refractive index profile measurements – Cut off wavelength measurements – Numerical aperture measurements – Diameter measurements – Field measurements – OTDR – Eye pattern technique

Text Book:

1. Optical Fiber Communications, John M. Senior, PHI (1994).

Unit IV

Optical Sensor Systems (18 hrs)

Intensity modulated sensors – Phase modulated sensors – Interferometric sensors – Sagnac effect and Fiber optic gyroscope – Polarization modulated sensors – Spectrally modulated sensors – Temperature, pressure, force and chemical sensors

Text Book:

1. Optical Fiber Communications, John M. Senior, PHI (1994).

Reference Books:

1. Fiber Optics and Optoelectronics, R.P. Khare, Oxford University Press (2004).
2. Fiber Optic Communication, D.C. Agarwal, Wheeler Publications (1993).

3. Optical Fiber Communication System, J. Gowar, PHI (1995).
4. Fiber Optic Communication, Joseph Palais, PHI (1998).
5. Understanding Fiber Optics, J. Hecht, Pearson Edu. Inc (2006).
6. Optoelectronic Devices and Systems, S.C. Gupta, PHI (2005).

PH24342 VI PHOTONICS PRACTICALS

1. Determination of Wavelength of laser beam using reflection and diffraction gratings
2. Beam profile of a laser
3. Bending laws of an optical fiber
4. Numerical aperture of an optical fiber
5. Data transmission and reception through optical fiber link
6. Coupling laws of an optical fiber
7. Michelson Interferometer
8. Comparison of resolving limit of optical instruments with human eye (A world view of Physics by Prof. D.P. Khandelwal et al – Page 300-301, South Asian Publishers Pvt. Ltd, New Delhi 1999)
9. Characteristics of photo diode, photo transistor, LDR, LED
10. Solar cell characteristics
11. Dispersion through a medium – C++
12. Young's double slit – Interference - C++
13. Diffraction due to a grating – C++
14. Polarization birefringence – C++