SEMESTER – III

AP3C09 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.

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:

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.

Unit IV

Electromagnet
ic 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:

Antenna & waveguide propagation, K. D. Prasad.

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

Reference Books:

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

Electromagnetic waves & Radiating Systems, E.C Jordan & K. G. Balmain, PHI.

Classical Electrodynamics, J. D. Jackson, Wiley Eastern Ltd.

4. Elements of electromagnetic, Mathew N. O. Sadiku, Oxford University Press.

Electromagnetics-Schaum's outline series,Joseph A. Edminister.

Electromagnetic waves & radiating system, Jordan & Balmain.

AP3C10 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:

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:

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:

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:

Field quantisation- W. Greiner, J. Reinhardt, Springer.

Quantum Mechanics-V. K. Thankappan, New Age Int. Pub.1996.

References

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

Introduction to Quantum Mechanics, David J. Griffiths.

Quantum Mechanics, Nouredine Zettili.

A Text book of Quantum Mechanics, P. M. Mathews and K. Venkatesan.

Quantum Mechanics, L. I. Schiff.

Relativistic Quantum Mechanics, P. Strang.

Quantum Field Theory, L. Ryder, Academic Publishers,Calcutta,1989.

Quantum Field Theory, C. Itzykson and J. Zuber.

Advanced quantum mechanics, J. J. Sakurai, Pearson Education.

Quantum Mechanics, V. K. Thankappan, New Age Int. Pub., 1996.

AP3E01 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:

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:

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:

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

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:

Optical fibre Communications,John M. Senior, PHI (1995).

Semiconductor Opto electronics, Jasprit Singh, TMH (1995).

Opto electronic Devices and Systems, S. C. Gupta, PHI (2005).

Light emitting Diodes, E. Fred Scheubert, Cambridge University Press (2003).

Principles of Nanophotonics, Lukas Novotny and Bert Hecht, CUP.

Nanophtonics, H. Rigneault, J.M. Lourtioz, C.D., J.A. Levenson, ISTE Pub. Co. (2006).

Optoelectronic Devices and Systems, S. C. Gupta, PHI (2005).

AP3E02 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:

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:

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

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:

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

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:

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

Lasers-Theory, and Applications –K. Thyagarajan and A. K. Ghatak, McMillian (2002).

Reference Books:

Laser Electronics, J. T. Vardeyan, PHI, 1989.

Solid State laser Engineering, W. Koechner, Springer Verlag, 2006.

Quantum Electronics, A. Yariv, John Wiley.

Laser Physics, Tarasov, MIR Pub, 1985.

Fiber optics and optoelectronics, R. P. Khare, Oxford University Press, 2004.

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

Dye laser, Schaffer, Springer Verlag,1977.

Lasers principles and applications, J. F. B. Hawkes and Wilson, PHI.

AP3P03 COMPUTATIONAL PHYSICS PRACTICALS

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

Motion of a Spherical body in a viscous medium

Projectile motion

SHM – Damped and Forced

Formation of Standing waves

Electric field due to a point charge and equipotential surface

LCR circuits with AC and DC sources

Gauss elimination method for solving a system of linear equations

Finding the roots of a nonlinear equation by Bi section method

R.K Method

Euler Method

Integration by Monte Carlo method

Matlab – Matrix operations

Matlab – Digital signal processing

Matlab – Solving ordinary differential equations

Matlab –Plot unit impulse,step,ramp and random noise

Matlab-Generationof

waveforms(Sinusoidal,square,triangular,exponential)

Matlab-Linear Convolution

Matlab-Circular Convolution

Matlab-Linear Convolution using Circular Convolution

Matlab-Random Sequence Generator

Matlab-Amplitude Modulation

Frequency Modulation using Matlab

Pulse width Modulation using Matlab

Inverse Discrete Fourier Transform using Matlab

Discrete Fourier Transform using Matlab