PERIYAR EVR COLLEGE (AUTONOMOUS & ACCREDITED)

PG AND RESEARCH DEPARTMENT OF PHYSICS

M.Sc., PHYSICS – COURSE PATTERN (2018 -19 ONWARDS)

S.No	Subject code	Course	Exam hrs	Hrs	Credits	Internal Exam	External Exam	Total
SEMESTER – I								
1	Core I	Classical Mechanics and Relativity	3	6	5	25	75	100
2	Core II	Mathematical Physics – I	3	6	5	25	75	100
3	Core III	Thermodynamics and Statistical Mechanics	3	6	4	25	75	100
4	Core IV	Advanced Electronics	3	6	4	25	75	100
5	Core V-P	Practical - I (General & Electronics)	4	6	4	40	60	100
		Total		**30**	**22**	**140**	**360**	**500**
SEMESTER – II								
6	Core VI	Mathematical Physics –II	3	6	5	25	75	100
7	Core VII	Electromagnetic Theory	3	6	5	25	75	100
8	Core VIII	Molecular Spectroscopy	3	6	5	25	75	100
9	Core IX	Nanoscience and Applications	3	6	4	25	75	100
10	Core X-P	Practical – II (General & Electronics)	4	6	4	40	60	100
		Total		**30**	**23**	**140**	**360**	**500**
SEMESTER – III								
11	Core XI	Quantum Mechanics	3	6	5	25	75	100
12	Core XII	Nuclear and Particle Physics	3	6	5	25	75	100
13	Core XIII-P	Practical – III (Advanced General Experiments & C Programming)	4	6	5	40	60	100
14	CBE I	Laser and Non – Linear Optics	3	6	4	25	75	100
15	CBE II	Communication Electronics	3	6	4	25	75	100
		Total		**30**	**23**	**140**	**360**	**500**
SEMESTER – IV								
16	Core XIV	Condensed Matter Physics	3	6	5	25	75	100
17	Core XV-P	Practical – IV (Microprocessor & Microcontrollers)	4	6	5	40	60	100
18	CBE III	Microprocessor and Microcontrollers	3	6	4	25	75	100
19	CBE IV	Crystal Growth and Thin Film Physics	3	6	4	25	75	100
20	Project*	Project		6	4	25	75*	100
		Total		**30**	**22**	**140**	**360**	**500**
		Grand Total		**120**	**90**	**500**	**1500**	**2000**

*** Viva-voce.**

SEMESTER I *Code: CC01*

CLASSICAL MECHANICS AND RELATIVITY

Unit I Fundamental Principles and Lagrangian Formulation

Mechanics of a particle and a system of particles – Constraints – Generalized coordinates – D'Alembert's principle and Deduction of Lagrangian equation – Hamilton's principle – Lagrange's equations of motion – Conservation theorems and symmetry properties – Applications to compound pendulum, linear harmonic oscillator and charged particles in an electromagnetic field and Atwood's machine.

Unit II Motion Under Central Force: Two-body problem

Tow-body central force problem – Stability of orbits – Kepler's problem – Kepler's Laws – Virial theorem – Rutherford Scattering – Artificial satellites – Geo stationary satellites.

Unit III Rigid Body Dynamics and Oscillatory Motion

Rigid body dynamics: Euler theorem– Euler angles – Angular momentum of a rigid body – Moment of inertia tensor -Euler's equations – Symmetrical top.

Oscillatory Motion: Theory of small oscillations– Two coupled oscillators– Normal modes and frequencies– Free vibrations of a linear tri atomic molecule – Parallel pendulum.

Unit IV Hamiltonian Canonical Formulation of Mechanics

Hamiltonian equations from Variational principle – Hamilton's canonical equations of motion –Physical significance of H– Advantages of Hamiltonian approach – Applications to linear harmonic oscillator and charged particles in an electromagnetic field - Principle of least action – Canonical transformations – Poisson bracket – Hamilton–Jacobi method – Action and angle variables.

Unit V Special Relativity in Classical Mechanics

Postulates of special theory of relativity – Lorentz transformation– Addition of velocities – Mass – energy and Mass – energy equivalence – Minkowski's four-dimensional space – Lorentz transformation as rotation in Minkowski's space – Lagrangian and Hamiltonian Formulation of relativistic mechanics.

Books for Study and Reference

1. H. Goldstein, C. P. Poole and J. L. Safko, *Classical Mechanics* (Pearson Education and Dorling Kindersley, New Delhi, 2007).
2. S. L. Gupta, V. Kumar and H.V. Sharma, *Classical Mechanics* (Pragati Prakashan, Meerut, 2012).
3. N.C. Rana and P.S. Joag, *Classical Mechanics* (Tata McGraw-Hill, New Delhi, 1991).
4. G. Aruldhas, *Classical Mechanics* (Prentice Hall of India 2001).
5. V. B. Bhatia, *Classical Mechanics* (Narosa, New Delhi, 1997).
6. T. L. Chow, *Classical Mechanics* (John-Wiley, New York, 1995).

SEMESTER I ***Code: CC02***

MATHEMATICAL PHYSICS – I

Unit I: Matrix Theory

Matrix - Rank of Matrix – Characteristic equation and roots - Cayley-Hamilton equation - Diagonalisation of matrices – Sylvester theorem – Hermitian and Skew Hermitian matrix and unitary matrix.

Vector space - Definitions and properties - Linear independence of vectors – Basis - Orthonormal basis - Schwartz inequality - Gram-Schmidt Orthogonolisation process.

Unit II: Vector field

Orthogonal curvilinear coordinates – Expression of gradient, divergent and curl functions – Laplacian in Cartesian, cylindrical and spherical co-ordinate system - Stoke's theorem - Gauss theorem - Green's theorem (only theorem).

Unit III: Special Functions

Gamma and Beta functions – Legendre, Hermite functions - Series solutions – Generating functions – Recurrence relations and orthogonal properties.

Unit IV: Complex Variables

Analytic function - Cauchy-Riemann equations – C-R in polar form –Harmonic function- Cauchy's integral theorem - Cauchy's integral formula for the derivative of an analytic function- Singular point-Residue-Cauchy's residue theorem - Evaluation of definite integrals by contour integration (Integration round the unit circle of the type).

Unit V: Group theory

Basic definitions – Multiplication table – Sub–groups, Co–sets and classes – Direct product groups – Point groups and space groups – Representation theory – Homomorphism and Isomorphism – Reducible and irreducible representations – Schur's lemma (no derivation) - The great orthogonality theorem – Character tables – C2v.

Books for Study and Reference

1. Mathematical Physics - H.K. Dass, S. Chand & Co, New Delhi. (Unit I, II, III and V)
2. Mathematical Physics – Sathya Prakash, S. Chand & Co, New Delhi. (Unit IV)
3. Mathematical Physics – B.D. Gupta, Vikas Publishing House, 2008.
4. Mathematical Physics – P.K. Chattopadhyay, New Age International PVT. Ltd. 2004. ((Unit II)
5. Elements of Group theory- A.W. Joshi

SEMESTER I ***Code: CC03***

THERMODYNAMICS AND STATISTICAL MECHANICS

Unit I: Laws of thermodynamics and their consequences

First law of thermodynamics – Definition - – Specific heat capacity of gases (C_p & C_v) – Second law of thermodynamics – Thermodynamic potentials – Gibb's – Helmholtz relation– Nernst's heat theorem or the third law – Consequences of the third law.

Unit II: Kinetic Theory of Gases

Mean free path and collision probability – Law of distribution of free path – Viscosity – Variation of viscosity with temperature – Boltzmann transport equation and its validity – Application to viscosity and electrical conductivity.

Unit III: Low Temperature Physics

Production of low temperature – Approach to absolute zero by adiabatic demagnetization – Measurement of low temperatures – Conversion of magnetic temperature to Kelvin temperature – Helium I and Helium II – Some peculiar properties of helium II.

UnitIV: General Principles of Statistical Mechanics

Phase Space – Macro and Microstates - Ensembles – Types of ensembles (Grand canonical ensembles and canonical ensembles) - Liouvilles theorem – Maxwell Boltzmann distribution law – Law of equipartition energy – Partition function – Thermodynamical quantities in terms of partition function.

Unit V: Quantum Statistical Mechanics

Quantum statistics of identical particles – Bose – Einstein gas – Bose – Einstein condensation – Fermi – Dirac gas – Degeneracy – Thermionic emission – Black body and Planck's radiation – Specific heat of solids: Einstein 's theory and Debye's theory.

Books for study and Reference

1. Statistical Mechanics, Gupta, Kumar and Pragathi Prakashan, Meerut.
2. Statistical Mechanics, Satya Prakash and J.P Agarwal, Kedarnath Ramnath &Co, Meerut.
3. Statistical Mechanics, R, Huang, Wiley Eastern Ltd., New Delhi, (1983)
4. Statistical and Thermal Physics, F. Reif, Mc Graw Hill, International Edition, Singapore (1979).

SEMESTER I ***Code: CC04***

ANALOG AND DIGITAL ELECTRONICS

Unit I: Special Semiconductor Device

FET - Theory of FET - Characteristics and parameters measurement – FET as an amplifier - MOSFET - Depletion and enhancement mode - Tunnel diode – Forward & Reverse bias characteristics – SCR, TRIAC, DIAC & UJT - construction, working and characteristics and applications- UJT relaxation oscillator- SCR- application in power control.

UNIT II: Operational Amplifier and its Applications

The basic operational amplifier – Characteristics of an ideal operational amplifier – Virtual ground – Open loop gain – Inverting and non Inverting amplifier – Summing amplifier – Differential amplifier – Instrumentation amplifier – DC characteristics – Input bias current – Input offset voltage – Input offset current – Measurement of op-amp parameters – Common Mode Rejection Ratio – Slew rate.

UNIT III: Waveform Generators

Op-Amp Multivibrators – Astable (square) – Monostable (pulse generators) – Schmitt trigger circuits – Triangular wave generators - Phase shift and Wien bridge sine wave oscillators – IC 555 timer – Astable, Monostable and trigger circuits.

UNIT IV: Digital Electronics

Arithmetic circuit – Half and Full adder – Half and Full subtractor – Parallel binary adder – 8421 adder – RS flip flop – Clocked RS flip flop – JK flip flop – Master Slave flip flop – Ripple counter – 4 bit ripple counter – Decade counter – Up and down counter – Ring counter – Serial and parallel registers

UNIT V: D/A AND A/D Converters

Digital to analog converter – Accuracy and resolution of DAC – Weighted register network – R-2R ladder network – Analog to digital converter – Simultaneous conversion – Successive approximation technique – Accuracy and resolution of ADC

Books for study:

1. Integrated Electronics – Millman – Halkias, Tata Mc Graw Hill.
2. Linear Integrated circuits – D. Ray Chaudhury, Shail Jain, New Age International Publishing.
3. Digital Principle and Application – Malvino and Leech, Tata Mc Graw Hill
4. Op-Amps & Linear Integrated Circuits - Ramakant A.Gayakwad
5. Principles of electronics – V.K.Metha – S.Chand and Co.

SEMESTER I *Code: CC05*

PRACTICAL - I (*GENERAL & ELECTRONICS*)

(Any 14 Experiments)

1. Determination of q, n, σ by elliptical fringes method
2. Determination of q, n, σ by hyperbolic fringes method
3. Determination of bulk modulus of a liquid by ultrasonic wave propagation
4. Spectrometer- wavelength of spectral lines of Hg spectrum- Hartmann's formula
5. Solar spectrum
6. Specific charge (e/m) of an electron – Magnetron Valve method
7. Thermionic work function of a diode
8. IC regulated power supply using IC 7805
9. OP-AMP –sine wave generation (Wein bridge Oscillator)
10. OP-AMP –square wave generation (Astable Multivibrator)
11. Characteristics of UJT.
12. Relaxation oscillator and waveform generation using UJT
13. Characteristics of SCR
14. FET – Common source amplifier
15. Determinations of wavelength of a laser source and thickness of a wire using Plane diffraction grating
16. Schmitt Trigger - Op. Amp
17. Op – Amp. Triangular wave generation.
18. FET amplifier (CS)
19. Characteristics of DIAC
20. BCD adder.

SEMESTER II ***Code: CC06***

MATHEMATICAL PHYSICS - II

Unit I: Integral transforms

Fourier series − Dirichilet's theorem − Fourier integral theorem − Fourier sine integrals-Fourier cosine integrals − Fourier sine and cosine transforms. Relation between Laplace and Fourier - Fourier transform of Gaussian function - Applications of Fourier transform- Solution of linear partial differential equation (Heat and Wave equation) .

Unit II: Laplace Transform

Convolution theorem - Laplace transform of the derivative of order n − Laplace transform of integral of tf(t), Laplace transform of f(t)/t – Inverse Laplace transform - Solution of differential equation by Laplace transform- Convolution theorem – Expression of current in LR and LC circuit using Laplace transform.

Unit III: Partial differential equations

Solution of equation by direct integration − Partial differential equation non-linear in p and q − Charpit's method − Linear homogenous partial differential equation of n^{th} order with constant co-efficient − Rules for finding complimentary function − Rules for finding the particular integral.

Unit IV: Numerical analysis - 1

Curve fitting by least square method (straight line and parabola) − - Newton interpolation formula (forward and backward) − Lagrange's interpolation -Numerical integration by Trapezoidal rule and Simpson rule 1/3 and 3/8 rules. C program for fitting data in straight line, Lagrange interpolation, Trapezoidal and Simpson's rules.

Unit V: Numerical analysis - 2

Solutions of linear equations – Iteration method-Newton Raphson method − Solution of first order differential equation − Euler's method - Runge Kutta II and IV order method. C program for Newton-Raphson method, Euler's method and Runge-Kutta II and IV order method.

Books for study

1. Mathematical Physics - H. K. Dass., Chand & Co., New Delhi.
2. Mathematical Physics - Sathya Prakash, Sultan Chand & Sons.
3. Numerical methods - M.K. Venkatraman, Sultan Chand & Sons, 2007.
4. Numerical methods and computer programming- Veerarajan and others.

SEMESTER II ***Code: CC07***

ELECTROMAGNETIC THEORY

Unit I: Electrostatics

Coulomb's law – Electric field – Continuous charge distributions – Div and Curl of E –Gauss law and its applications - Electric Potential - Poisson's equations - Laplace's equations: Cartesian, Cylindrical and spherical coordinates - Multipole expansion: potential at a large distance – Polarization: Gauss law in the presence of Dielectric, Boundary value problem, Energy in a dielectric system - Force on dielectrics.

Unit II: Magnetostatics

Biot - Savart law - Ampere's circuital law (Curl B) – Magnetic Scalar Potential Φ_m - Φ_m and B for a magnetic dipole, Φ_m and b for a circular coil - Magnetic vector Potential A - A and B for a magnetic dipole, A and B for a long current carrying wire – Multipole expansion of a current distribution – Magnetization – Susceptibility – Permeability (definitions and relations).

Unit III: Field equation and conservation laws

Faraday law of induction – Equation of Continuity - Displacement current - Maxwell equation (differential and integral) - Energy in Electromagnetic Fields (Poynting Theorem) – Electromagnetic potentials - Maxwell's equations in terms of electromagnetic potential – Coulomb Gauge - Lorentz Gauge.

Unit IV: Wave propagation

Plane wave equation – Propagation of E.M.W in Isotropic, Anisotropic dielectric medium - Plane waves in non-homogeneous non-conducting medium: poynting vector, power flow, energy density and significance - Partly conducting medium: skin effect, relative direction of E and H, pointing vector, energy density - propagation in ionized gases.

Unit V: Interaction of EM waves with matter and Wave guide

Reflection and refraction of E.M.W: Kinetic and Dynamic properties – Fresnel Formulae - Brewster law and degree of polarization – Total internal Reflection and Critical Angle - Wave Guide - Propagation of waves in a rectangular wave guide - Scattering and scattering parameters by a free electron (Thomson's scattering) and bound electron (Rayleigh scattering).

Books for study and reference

1. Introduction to Electrodynamics by David J. Griffith, Prentice Hall. (Unit I & II)

2. Electrodynamics - Chopra and Agarwal. (Unit III, IV & V)

3. Electromagnetic Theory - Sathya Prakash. (Unit IV)

4. Electromagnetic field Theory and Wave Propagation – Uma Mukherji

SEMESTER II *Code: CC08*

MOLECULAR SPECTROSCOPY

Unit-I Microwave spectroscopy

Rotation of diatomic molecules-Rigid and non-rigid rotator- Intensities of rotational spectral line- Rotations of Linear poly atomic molecules and symmetric top molecules-Stark effect in linear molecules –Instrumentation- applications: structural determination of simple molecules-Inversion spectra of ammonia-Measure of barrier heights.

Unit-II Infrared spectroscopy

Theory- Vibration spectra of diatomic molecule-diatomic vibrating rotator- Vibration-Rotation spectra of poly atomic molecules- Linear and symmetric top molecules – Vibrations of polyatomic molecules- Normal modes of molecular vibrations- Instrumentation of IR spectroscopy- Examination of an IR spectrum.

Unit- III Raman spectroscopy

Theory of Raman effect-classical and quantum theory- Pure rotational Raman spectra of diatomic molecules- Vibrational - Rotational Raman spectra- Rule of mutual exclusion principle- Moment of inertia of diatomic molecule and Raman spectroscopy- Raman spectrometer- Importance of Raman spectra- structure elucidation by Raman spectroscopy.

Unit- IV UV and Electronic spectra

Introduction-Absorption laws- Types of electronic transition- Transition probability-Chromophore - Auxochrome - Absorption spectra - Types of absorption bands-Instrumentation Woodward Fieser rules for calculating absorption maximum.

Introduction –Frank-Condon principle - vibrational coarse structure-rotational fine structure-Fortrat diagram-Applications.

Unit V NMR and ESR spectroscopy

NMR spectroscopy-Theory-width of absorption lines-chemical shift-single coil and double coil spectrometers-High resolution spectrometer-spin-spin interaction-chemical shift-coupling constant -sheilding - desheilding effect.

ESR spectroscopy-ESR spectrometer-Hyperfine splitting-Line width-Applications.

Books for study and reference

1. Spectroscopy (Atomic and molecular) - Gurdeep R. Chatwal,Shan k. Anand
2. Spectroscopy - H.Kaur (Pragati Prakashan publication)
3. Elementary Organic Spectroscopy - Y.R.Sharma
4. Elements of spectroscopy - Gupta.Kumar.Sharma
5. Fundamentals of Molecular Spectroscopy - C.N.Banwell
6. Organic spectroscopy – Jagmogan

SEMESTER II ***Code: CC09***

NANO SCIENCE AND APPLICATIONS

Unit I: Nanoscale System

Definition: Nanomaterials - Classification of Nanomaterials - Energy considerations and Quantum Confinement: 3D, 2D, 1D and zero dimensional DOS – Bulk Properties of Nano Materials – Electronic structure of nanomaterials and Fermi surface - Optical and magnetic properties of Nanomaterials.

Unit II: Synthesis of Nanomaterials

Bottom up approach: Sol – Gel synthesis – Hydrothermal Growth – Co-precipitation method – Polyol process - Thin film Growth: Pulsed Laser deposition - Chemical vapour deposition - Top Down Approach: Ball milling – Lithography – Photolithograpy - Electron beam lithography – X - ray lithography.

Unit III: Nanostructured Thin Film and Nanocomposites

Shape and structure of nanomaterials - Micro and Nanoscale Thin Film Fabrication Techniques – Optical, Electrical and Magnetic Properties of Nanostructured Thin Films – Nanocomposites – Physical and Optical Properties – Metal/Dielectric – Organic Nanocomposites.

Unit IV: Characterization Methods

X - ray diffraction – Debye Scherrer formula - Calculation of Lattice Parameters – Size/Strain analysis – Electrical Studies – Scanning Electron Microscopy (SEM) - Transmission Electron Microscopy (TEM) - Atomic Force microscopy (AFM) – Diffuse Reflectance Spectra – Vibration Sample Magnetometer .

Unit V: Applications : Nanodevices

Carbon Cluster – Carbon nanotubes and its Properties – Applications of carbon nanotubes - Drug Delivery System – Nanoelectronics: Single electron transistors, Molecular Machine - White LED - LASER - Microelectromechanical System (MEMS) - Nanoelectromechanical System (NEMS) : Fabrication, Nanodevices and Nanomachines.

Book for study and Reference:

1. Nano science and Nanotechnology – M.S. Ramachandra Rao and Shubra Singh.
2. Introduction Nanotechnology-Charles P. Poole, Jr., and Frank J. Owens, John Wiley and Sons, 2003.
3. Introduction to Nanoscience and Nanotechnology - K. K. Chattopadhyay and A. N. Bannerjee, PHI Learning Private Ltd.
4. Nanomaterials – B. Viswanathan, National Centre for Catalysis Research 2006.

SEMESTER II ***Code: CC10***

PRACTICAL - II (*GENERAL & *ELECTRONICS)

(Any 14 Experiments)

1. Determination of L and M of a coil by Anderson's method
2. Determination of Stefan's constant
3. Determination of Rydberg's constant- Hydrogen spectrum
4. Determination of viscosity of the liquid –Meyer's disc method.
5. Specific charge (e/m) of an electron – Thomson method.
6. Determination of Planck's constant
7. Determination of optical parameters using laser
8. Dual regulated power supply using IC 7809 and 7909
9. OP AMP – low pass, high pass and pass filter
10. OP-AMP D/A converter (weighted resistor method/R-2R ladder method).
11. Astable Multivibrator - 555 Timer
12. Half adder and Full adder using NAND.
13. Half subtractor and Full subtractor using NAND.
14. R-S & D Flip-flops using NAND gates.
15. J-K Flip flop using IC 7476.
16. Study of decade counter IC 7490, IC 7447 and FND507
17. UP/DOWN counter using IC (JK Flip-Flop)
18. Encoder using OR gates
19. Registers using D Flip flops.
20. Schmitt Trigger using 555 timer.

SEMESTER III ***Code: CC11***

QUANTUM MECHANICS

Unit I: The Schrödinger Equation and exactly solvable problems

The Schrödinger Equation – Physical interpretation and conditions on the wave function–postulates – Operators : Linear operator – Hamiltonian operators – Hermitian operators and properties – Expectation values and Ehrenfest's theorem – Particle in a square barrier potential (Tunnelling effect) – Linear harmonic oscillator — Three dimensional harmonic Oscillator.

Unit II: Time independent perturbation and time dependent perturbation

Time independent perturbation: Stationary perturbation theory (Non–degenerate case)– Zeeman effect–Stationary perturbation theory (Degenerate case) – Stark effect in hydrogen atom – WKB method – Electrons from a metal – Time dependent perturbation theory – First order perturbation – Constant perturbation – Transition probability – Fermi-golden rule – Harmonic Perturbation - Adiabatic approximation.

Unit III: Quantum Theory of Scattering

Scattering amplitude and cross section – Born approximation – Condition for validity of Born approximation – Scattering by a screened Coulomb potential – Rutherford's scattering formula – Partial wave analysis – Phase shifts.

Unit IV: Angular momentum

The total angular momentum operators – Commutation relations of total angular momentum with components - Eigen values of J^2 and Jz – Matrix representation of angular momenta (J_x, J_y, $J_x+ J_y$, $J_x- J_y$)– Pauli spin matrix – Addition of angular momentum – Clebsch – Gordon coefficients, CG for $J_1=1$, $J_2= ½$.

Unit V: Relativistic wave equation

The Klein Gordon equation – Dirac equation – Dirac matrices and their properties – Dirac free particle solution – probability density and current density - Negative energy states – Electromagnetic potentials: Magnetic moment of the electron – Existence of electron spin – Dirac equation of a central force field.

Books for study:

1. Quantum mechanics − G. Aruldhas Prentice Hall India Pvt., Limited
2. Quantum Mechanics – Sathya Prakash. Published by Kedarnath, Ramnath.

SEMESTER III *Code: CC12*

NUCLEAR AND PARTICLE PHYSICS

Unit I:Basic Nuclear properties and Nuclear models

Basic nuclear properties: size, shape charge distribution – spin and parity – determination of nuclear Mass – Binding Energy– Semi-empirical mass formula– Nuclear Stability – Mass parabolas.

Nuclear models: Liquid drop Model –Nuclear Shell model- Single particle model, its validity & limitation - Collective model

Unit II: Nuclear Forces

Nature and properties of Nuclear forces –Elements of two body problem –Properties of deuteron-Ground state of deuteron – Non-Central forces (Tensor forces) – Yukawa's meson theory – Yukawa potential – Spin independence – Charge symmetry of Nuclear forces.

Unit III: Radioactive decays

Elementary ideas of alpha, beta and gamma decays- Geiger-Nuttal law**-**Gamow's theory of α decay– Fermi theory of β decay – Selection rules – Non conservation of parity in beta decay – Gamma decay – Selection rules – internal conversion – Nuclear isomerism.

Unit IV: Nuclear fission and fusion

Nuclear fission: Nuclear fission-Mass & energy distribution of nuclear fragments – Bohr – Wheeler theory – Nuclear chain reactions – four factor formula – nuclear reactors

Nuclear Fusion–: Basic fusion processes – Solar fusion – Cold fusion – Controlled thermo nuclear reactions– Breeder reactor – Pinch effect.

Unit V: Elementary Particles

Classification of elementary particles – Types of interactions–conservation laws – strange particles– GellMann - Nishijima formula – Space inversion invariance (Parity) – Time reversal – CPT theorem –Parity non conservation in weak interaction– CP violation in neutral K-decay– Hyperons – Quark model.

Books for Reference:

1. Nuclear Physics - V. Devanathan Narosa Publishing house (2006).
2. Concepts of Nuclear Physics - B.L. Cohen, (Tata McGraw Hill, New Delhi, 1983)
3. Nuclear Physics – S.N. Ghosal, S. Chand Company Ltd (2010)
4. Nuclear Physics - Sathya prakash
5. Nuclear physics – An Introduction – S.B. Patel, Wiley Eastern.
6. Nuclear Physics - D.C. Tayal, Himalaya Publishing House.
7. Nuclear Physics - R.R.Roy and B.P Nigam, Wiley Eastern.

SEMESTER III ***Code: CC13***

PRACTICAL – III

Advanced General Experiments & C Programming

Any 14 Experiments:

1. Four probe method – Determination of Resistivity
2. Determination of carrier concentration and Hall coefficients in Semiconductor
3. Determination of magnetic susceptibility – Guoy's method
4. Determination of magnetic susceptibility of liquids by Quincke's method
5. Determination of separation of wavelength λ and dλ – Michelson's interferometer.
6. Determination of thickness of a thin film – Michelson interferometer.
7. Charge of an electron – Spectrometer.
8. Polarizability of liquids – Spectrometer.
9. Determination of wavelength of monochromatic source using bi – prism.
10. Determination of refractive index of liquids using bi – prism - telescope method.
11. Determination of specific rotator power of a liquid -Polarimeter.
12. "g" factor determination by using ESR spectrometer.
13. Laser grating – Determination of λ.

COMPUTER PRACTICALS

1. Roots of algebraic equations – Newton Raphson method.
2. Least square curve fitting – Straight line fit.
3. Interpolation – Lagrange method.

Numerical Integration

4. Trapezoidal rules.
5. Simpson's rules.

Solutions of ordinary differential equations

6 Runge – Kutta second and fourth order method.

7 Euler's method.

SEMESTER III ***Code: CBE1***

LASER AND NONLINEAR OPTICS

Unit I: Laser Fundamentals

Principle of Laser – Distinct Properties – Directionality – Intensity – Monochromaticity – Coherence – Population inversion – Methods of achieving population inversion – Einstein coefficients – Rate equations – Two level, three level and four level systems – Q factor – Resonating modes.

Unit II: Types of Lasers

Solid state lasers – Ruby laser – Nd: YAG laser – Excitation mechanism – Applications – Gas lasers: He-Ne laser and CO_2 laser – Structure – Two modes of excitation – Applications – Semiconductor lasers: Ga-As laser – Structural details – Excitation mechanism – Applications – Dye laser – Chemical lasers – Hydrogen Fluoride laser.

Unit III: Applications of Lasers

Scientific: Optical data storage – Detection of absolute rotation of the earth – Isotope separation – Laser Doppler Velocimetry (LDV) – Industrial: Laser Cutting and welding – Medical – Communication – Long distance transmission – Holography : Basics – Production of a hologram – Reconstruction of images – Applications.

Unit IV: Advances in Laser Physics and Laser Spectroscopy

Laser Physics: Q – switching – Mechanical, Acousto- Optic and Electro-optic Q switches – Spectroscopy: Rayleigh and Raman scattering – Stimulated Raman effect – Hyper – Raman Effect – Classical treatment – Coherent Anti-Stokes Raman Scattering (CARS) – Photo – Acoustic Raman Spectroscopy (PARS).

Unit V: Nonlinear Optics

Harmonic generation – Second harmonic generation – Polarization in a non-linear optical medium – Phase matching – Third harmonic generation – Optical mixing – Parametric generation of light – Self focusing of light.

Books for Study:

1. Laser and Nonlinear Optics – B.B. Laud, New Age International (P) Ltd. Publishers, New Delhi, 2000.
2. Laser – Theory and Applications – K. Thyagarajan and A. Ghatak, Tata Mc Graw Hill, Publishing Co., New Delhi.
3. Semiconductor Physics and Optoelectronics, P. K. Palanisamy, Scitech Publications (India) Pvt. Ltd., Chennai, 2003.

SEMESTER III ***Code: CBE2***

COMMUNICATION ELECTRONICS

Unit I: **Modulation and Demodulation**

Modulation - Types of modulation - Spectrum and power in AM signal – Generation of SSB Signal – VSB – Frequency and Phase modulation - FET Reactance – FM modulator – Armstrong method of FM generation – Frequency discriminator – Band width requirements – signal to noise ratio – Phase modulation, FM modulation and AM modulation Comparisons of AM, FM and PM – Pulse code modulation – Delta modulation – PCM reception – Advantages of PCM and DM - VSB Demodulator - Super heterodyne receiver –TRF receiver – straight receiver.

Unit II: Optical Fiber Communication - Fundamentals

Introduction to fibers: Introduction - Basic optical laws and definitions, optical fiber modes and configurations. Mode theory – overview of modes, key model concepts. Single and multi mode fibers – Step and Graded - index fiber structure - Advantages, disadvantages and applications of optical fiber communication.

Unit III: Optical Sources and Detectors

Optical Sources**:** Direct and Indirect band gaps. Light Emitting Diodes - LED Structures, Quantum efficiency and LED power. Laser Diodes – Laser diode modes and threshold conditions, Laser diode rate equations, external quantum efficiency.

Photo detectors: Pin Photo detector, Avalanche photodiodes, Photo detector noise, Detector response time.

Unit IV: Fascimile and Wireless Transmission

Fascimile: Fascimile transmitter – Fascimile receiver – Conversion of electrical signal to an optical image – Transmission of facsimile telegraph signal.

Wireless Transmission: Frequencies for radio transmission – Signals – Antennas – Signal propagation – Multiplexing (SDM, FDM, TDM & FDM) – Modulation (ASK, FSK, PSK, Advanced FSK, Advanced PSK).

Unit V: Mobile Communication

Cellular Concept – GSM - Mobile services – System Architecture – Network and Switching – Radio interface – Logical channels – Protocols – DECT (Digital Enhanced Cordless Telecommunication) – System and Protocol architecture.

Books for study and reference :

1. Principles of communication Engineering – Umesh Singh – Tech India Publication, New Delhi.
2. Communication Electronics – Deshpande N.D., Deshpande D.A, Rangole P.K., Tata Mc Graw Hill publishing company limited, New Delhi.
3. Electronics Communication – Dennis Roddy, John Coolen – Prentice – Hall of India Private Limited, New Delhi.
4. Mobile Communications – Jochen Schiller – Pearson Education (Singapore) Private Limited, Indian Branch – Patparganj – New Delhi.
5. Optical Fibre Communication, Gerd Keiser, Tata Mc Graw Hill, 1984.

Books for Reference:

1. Electronic Communication system – George Kennedy – Tata Mc Graw Hill, 3rd Edition.
2. Electronic Communications system – Wayne Tomasi – Addison Wesley Longman (Singapore) Private Limited, Patparganj – New Delhi.

SEMESTER IV ***Code: CC14***

CONDENSED MATTER PHYSICS

Unit I: Magnetic Materials

Introduction to Magnetic Materials – Different Types of Magnetic Materials – Weiss Theory of Ferromagnetism – Domain Theory of Ferromagnetism - Hysteresis – Hard and Soft Magnetic Materials – Ferrites (Ferri Magnetic Materials) – Structure and Properties of Ferrites – Application of Ferrites – Magnetic Recording (Storage) Materials – Magnetic Floppy Disks – Hard Disk Memory – Floppy Disk Drive.

Unit II: Super Conducting Materials

Introduction to Super Conductors – Properties of Super Conductors – Types of Super Conductors – High Temperature Super Conductors – Application of Super Conducting Materials – Cryotron – Josephson Device – SQUID – Magnetic Levitated Train (MagLev)

Unit III: Optical Material

Introduction – Optical Absorption in Metals, Semiconductors and Insulators – Traps, Recombination Centre And Excitons – Colour Centres – Luminescence – Fluorescence and Phosphorescence – LED – LCD – Dynamic scattering display – Difference between LED and LCD – Applications of Display devices.

Unit IV: Dielectric Materials

Dielectrics – Definition – Different Types of Dielectrics – Types of Electric Polarization – Frequency and Temperature – Effects on Polarization – Dielectric loss – Local Field or Internal Field – Clausius - Mosotti Relation – Dielectric Breakdown.

Unit V: Modern Engineering Materials

Introduction to Metallic Glasses – Properties and Applications – Shape Memory Alloys – Introduction – Classification – Working Principle of SMA – Basic Component of SMA system – Application of Thermoelectric SMAs – Advanced Ceramics – Introduction to Ceramics – Modern Application of Advanced Ceramics – Biomaterials.

Books for Study:

1. Material Science – Dr. M. Arumugam
2. Material Science – P. K. Palanisamy (SCITECH Publications)
3. Material Science – V. Ragahvan.

SEMESTER IV *Code: CBE3*

MICROPROCESSOR AND MICROCONTROLLER

Unit I: Microprocessor Architecture and Programming

Intel 8085- Microprocessor- Pin configuration - Registers - Stack Instruction word size - Instruction cycle - Instruction data flow- Addressing modes –Intel 8085 instructions – subroutines - Delay subroutines - Multi – byte addition/subtraction –finding the largest / smallest number in a data array - arranging an array of numbers in ascending /descending order-.

Unit II: Peripheral Devices and interfacing

Address space partitioning: Memory mapped I/O scheme-I/O mapped I/O scheme - Memory and I/O Interfacing: Memory Interfacing - I/O Interfacing - Data transfer schemes: Synchronous data transfer, Asynchronous data transfer, Interrupt driven data transfer, DMA data transfer scheme - Multiple interrupts-Interrupts of Intel 8085 - Hardware and software interrupts-interrupt call locations - Generation of control signals for Memory and I/O devices.

Unit III: Microprocessor Interfacing and Applications

Programmable peripheral interface Intel 8255 – Architecture - control groups - control word - Interfacing 7 segment LED display, Measurement of frequency, voltage and current - Measurement of temperature-Microprocessor based traffic control, Generate square wave or pulse using Microprocessor.

Unit IV: Microcontroller – 8051

Pin Description of 8051 – Architecture – Programming model -Special Function Register (SFR) – Stack-Addressing Modes – Classification of Instructions - Memory Organization - Assembly Language Programming –Arithmetic Operations.

Unit V: Serial data Communication and Interfacing

Serial data Communication – RS-232C Serial data –USART-(Intel 8251A) – Architecture - Pin Description - 8051 serial Communication – DAC(0800) - ADC(0809) - Pin description - block diagram - Interfacing with 8051.

Books for study and Reference

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1. B. Ram, Fundamentals of Microprocessors and Microcomputers, Dhanpat Rai Publications (P) LTD., New Delhi (2006).
2. A. Nagoor Kani, Microprocessor and Microcontrollers (second edition),RBA Publications, Chennai
3. A. P. Godse and D. A. Godse, Microprocessors and its Applications, Technical Publications, Pune, 2006.
4. R. Goankar, Microprocessor Architecture, Programming and Application (Wiley Eastern, New Delhi, 1985)
5. Muhammad Ali Mazidi, Janice Gillispie Mazidi – The 8051 Microcontroller and Embedded Systems, Pearson Education, Delhi, Seventh Indian Reprint 2004.

SEMESTER-IV **CODE: CC15**

PRACTICAL-IV

MICROPROCESSOR 8085 AND MICROCONTROLLER 8051

Any 14 Experiments

Microprocessor 8085

1. Program for multibyte hexadecimal addition/subtraction
2. Program for multibyte decimal addition/subtraction. .
3. 1's and 2's complements in an array
4. Shift left and right 8 bit number by one bit.
5. Find largest / smallest numbers in a list.
6. Arrange in ascending /descending order.
7. Code conversion ASCII to Decimal and vice versa, Decimal to Binary and Binary to Decimal.
8. Block of data transfer.
9. Rolling display.
10. Making an 8 bit DAC.
11. Making an 8-bit ADC (LED, RAM).
12. Wave form generation (sine, square, triangular) 8253.
13. Stepper motor interface.
14. Traffic light interface.
15. Digital clock.
16. Solid state relay interface.
17. Study of PPI 8255.

Microcontroller 8051

18. Program for addition and subtraction in 8 bits
19. Program for multiplication and division in 8 bits.
20. Sum of N numbers
21. Block of data transfer
22. Binary to decimal conversion vice –versa

SEMESTER IV ***Code: CBE4***

CRYSTAL GROWTH AND THIN FILM PHYSICS

Unit I: Nucleation and Growth

Nucleation – Different kinds of nucleation – Concept of formation of critical nucleus – Classical theory of nucleation – Spherical and cylindrical nucleus – Crystal system and symmetry.

Unit II: Solution Growth Technique

Low temperature solution growth: solution – Solubility and Supersolubility – Expression for supersaturation – Miers T- C diagram – Constant temperature bath and crystallizer – Seed preparation and mounting – Slow cooling and solvent evaporation method. Structures and importance of gel – Experimental procedure – chemical reaction method – Single and double diffusion method – Chemical reduction method – Complex and decomplexion method – Advantage of gel method.

Unit III: Melt Technique

Bridgman technique – Basic process – Various crucibles design – Thermal consideration Vertical Bridgman technique – Czochralski technique – Experimental arrangement – Growth process.

Vapour Technique*:*

Physical vapour deposition (PVD) – Chemical vapour deposition (CVD) – Chemical vapour transport.

Unit IV: Thin film Deposition Technique

Thin film – Growth kinetics of thin film – Deposition Techniques – Physical vapour Deposition – Resistance Heating – Flash evaporation – Laser gun Evaporation Sputtering – Reactive sputtering , Radio frequency sputtering – Chemical Vapour Deposition- Pyrolysis – Electrodeposition – electroless plating.

Unit V: Characterization Technique

High resolution X-ray Difractometer - Photoluminescence – Dispersive X- ray analysis (EDAX) - UV – VIS – NIR spectrometer – Etching – Vickers microhardness – Thermo gravimetric analysis, Differential thermal analysis and Differential scanning calorimetry .

Books for study and reference:

1. Crystal growth processes, J.C Brice, John Wiley Sons, New York (1986)
2. Crystal Growth Processes and Methods P. Santhanaragavan and P. Ramasamy, , KRU Publications, Kumbakonam.
3. Thin Film fundamentals, A. Goswami, New Age International (p) Limited, New Delhi (1996)
4. Instrumental Methods of Analysis, H.H. Willard, L.L Merit, J.A Dean and F.A. Settle, CBS Publishers and Distributors, New Delhi.