DEPARTMENT OF PHYSICS

M.Sc., PHYSICS SYLLABUS

(For the Candidates to be admitted from the year 2016-2017 onwards)

POOMPUHAR COLLEGE (AUTONOMOUS)

(Of the Tamil Nadu H. R. & C.E Admn. Dept)

(Accredited B+ By NAAC)

MELAIYUR - 609 107

DEPARTMENT OF PHYSICS

POOMPUHAR COLLEGE (AUTONOMOUS), MELAIYUR

COURSE STRUCTURE FOR UG COURSE UNDER CBSE

(Applicable to the candidates admitted form the academic year 2016 – 2017 onwards)

Sem	Course	Course Title	Ins. Hrs / Week	Credit	Exam Hrs	Marks		Total
						Int.	Ext	
I	Core Course – I (CC)	Mathematical Physics	5	5	3	25	75	100
	Core Course - II (CC)	Classicaldynamics and Relativity	5	5	3	25	75	100
	Core Course – III (CC)	Electronics	5	5	3	25	75	100
	Elective Course-I (EC)	Numerical Methods and C++ Programming	5	4	3	25	75	100
	Core Practical - IV(EC)	Physics Practical-I (General and Electronics)	10	5	4	40	60	100
	TOTAL		**30**	**24**				**500**
II	Core Course – V(CC)	Quantum Mechanics	5	5	3	25	75	100
	Core Course – VI (CC)	Atomic and Molecular Physics	5	5	3	25	75	100
	Core Course – VII(CC)	Statistical Mechanics	5	5	3	25	75	100
	Elective Course – II (EC)	Microprocessor and Microcontroller	5	4	3	25	75	100
	Core Practical-VIII(CP)	Physics Practical -II (General and Electronice)	10	5	4	40	60	100
	TOTAL		**30**	**24**				**500**
	Core Course – XI (CC)	Electromagnetic Theory	5	5	3	25	75	100
	Core Course – X (CC)	Nuclear and Particle Physics	5	5	3	25	75	100
	Core Course – XI (CC)	Solid State Physics	5	4	3	25	75	100
	Elective course - III (EC)	Crystal Growth and Thin Film Physics	5	4	3	25	75	100
	Core Practical -XII (CP)	Physics Practical -III (Electronics)	10	5	4	40	60	100
	TOTAL		**30**	**23**				**500**
IV	Core Course – XIII (CC)	Advanced Materials	5	5	3	25	75	100
	Elective Course – IV (EC)	Lasers and Nanotechnology	5	4	3	25	75	100
	Core Practical -XIV (CP)	Physics Practical -IV (Microprocessor and Programming)	10	5	4	40	60	100
	Core –XV	Project Work	10	5	-	-	-	100
	TOTAL		**30**	**19**				**400**
GRAND TOTAL			**120**	**90**				**1900**

Project : 100 Marks
Dissertation : 80 marks
Viva voice : 20 marks

Core Papers ---10

Core practical ---4

Elective Papers ---5

Project ---1

Note:

1. Theory	Internal	25 marks	External	75 marks
2. Practical	”	40 marks	”	60 marks

3. Separate passing minimum is prescribed for Internal and External

a) The passing minimum for CIA shall be 40% out of 25 marks (i.e. 10 marks)
b) The passing minimum for University Examinations shall be 40% out of 75 marks (i.e. 30 marks)
c) The passing minimum not less than 50% in the aggregate.

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C-I: MATHEMATICAL PHYSICS

Unit 1: Vector analysis

Gradient, divergence, curl and Laplacian – Line integral, surface integral and volume integral – Gauss theorem, Green's Theorem, Stoke's theorem and applications – Orthogonal curvilinear coordinates – Expression for gradient, divergence, curl and Laplacian in cylindrical and spherical co-ordinates .

Unit 2: Tensors and Matrix Theory

Tensors :Transformation of coordinates – Summation convention – Contravariant, covariant and mixed tensors – Rank of a tensor – Symmetric and antisymmetric tensors – contraction of tensor.

Matrix: Charateristic equation of a matrix – Eigenvalues and eigenvectors – Cayley – Hamilton theorem – Reduction of a matrix to diagonal form – Jacobi method - Sylvester's theorem.

Unit 3: Complex Analysis

Functions of complex variables – Differentiability – Cauchy-Riemann conditions – Complex integration – Cauchy's integral theorem and integral formula – Taylor's and Laurent's series - Residues and singularities – Cauchy's residue theorem – Evaluation of definite integrals.

Unit 4: Special Functions

Gamma and Beta functions – Sturm-Liouville problem – Legendre, Associated Legendre, Bessel, Laugerre and Hermite differential equations: series solution – Rodriguez formula – Generating functions – Orthogonality relations – Important recurrence relations.

Unit 5: Group Theory

Basic definitions – Multiplication table – Subgroups, Cosets and Classes – Direct Product groups – Point groups – Space groups – Representation theory – Homomorphism and isomorphism – Reducible and irreducible representation- Schur's lemma – The great Orthogonality theorem – Character table – C_{3v} and D_{3h} as examples – Elementary ideas of rotation groups.

Books for Study and Reference

1. Mathematical Physics – sathya Prakash.
2. Mathematical Physics – B.D. Gupta
3. Mathematical Physics – H.K. Dass
4. F.A. Cotton Chemical Applications of Group Theory.
5. Mathematical physics – Rajput
6. A.W. Joshi Elements of Group Therory for Physicists (Wiley Eastern, New Delhi 1971)

C- II: CLASSICAL DYNAMICS AND RELATIVITY

Unit 1 : Fundamental Principles and Lagrangian Formulation

Mechanics of a particle and system of particles – Conservation laws – constraints – Generalized coordinates –Principle of Virtual work- D'Alembert's principle and Lagrange's equation –Applications of Lagrange's equation-Atwood's Machine, simple pendulum, Linear Harmonic Oscillator- Hamilton's Principle – Lagrange's equation of motion – conservation theorems and symmetry properties – Motion under central force: General features – kepler's law- Kepler problem Scattering in a central force field-Virial theorem-Artificial Satellites-Geo stationary Satellites-Eccentricity of orbit of satellites-Escape Velocity.

Unit 2: Rigid body dynamics and theory of small oscillations

Rigid Body Dynamics

Euler angles – Moments and products of inertia – Euler's equations – Symmetrical top.

Oscillatory Motion

Theory of small oscillations – Normal modes and frequencies – Linear triatomic molecule, Wave motion – wave equation – Phase velocity – Group Velocity – dispersion.

Unit 3: Hamilton's Formulation

Hamilton's canonical equations of motion – Hamilton's equations from variational principle –Applications of Hamilton's equation- simple pendulum,compound pendulum,Linear Harmonic oscillator- principle of least action – Canonical transformations – Poisson brackets – Hamilton – Jacobi method – Action and angle variables – Kepler's problem in action – angle variables.

Unit 4: Nonlinear Dynamics

Linear and nonlinear oscillators – Phase trajectories – Period doubling phenomenon in Duffing oscillator. **Soliton:** Linear and nonlinear waves - Solitary Waves – KdV equation – Numerical experiments of Kruskal and Zabusky – Solitons.

Unit 5: Relativity

Basic ideas of special theory of relativity -energy momentum four vector – Minkowski's four dimensional space – Lorentz transformation as rotation in Minkowski's space – Compositions of L.T about two orthogonal directions – Thomas precession – Invariance of Maxwell's equations under Lorentz transformation – Elements of general theory of relativity.

Books for study and Reference:

Relevant Chapters in

1. H. Goldstein, Classical Mechanics, Narosa Book distributors, New Delhi (1980)
2. N.C Rana and P. S. Joag Classical Mechanics, Tata Mc: Graw Hill, New Delhi (1991)
3. S.L.Gupta, V.Kumar and H.V.Sharma, Classical Mechanics (Pragati Prakashan, Meerut,2001)

For unit 4

4. M. Lakshmanan and S.Rajasekar: Nonlinear Dynamics: Integrability, Chaos and Patterns, Springer – Verlag, Berlin (2003), Springer (India) 2004.
5. M. Lakshmanan and K.Murali: Chaos in Nonlinear Oscillators, world Scientific Co., Singapore (1996). Chapters 2-4.

Books for reference:

6. V.B.Bhatia, Classical Mechanics (Narosa, New Delhi,1997)
7. T.L.Chow, Classical Mechanics(John-Wiley, New York, 1995)

C– III: ELECTRONICS

Unit 1: Semi Conductor Diodes:

Principle,construction , charactertics ,working and uses of – Varactor diode – Schottky diode – Tunnel diode – Gunn diode – Optoelectronic diodes – LASER diode, LED and photo diode.-photo transistor, LDR and solar cell

Unit 2: Special Semiconductor Devices

JFET – Structure and working – V-I Characteristics – biasing circuits – CS amplifier design – ac analysis – MOSFET: Depletion and Enhancement type MOSFET – UJT characteristics – relaxation oscillator – SCR characteristics – application in power control DIAC, TRIAC.

Unit 3: Operational Amplifier:
Operational amplifier characteristics – inverting and non-inverting amplifier – instrumentation amplifier – voltage follower – integrating and differential circuits –log & antilog amplifiers – op-amp as comparator – Voltage to current and current to voltage conversions-active filters : low-pass, high pass, band pass & band rejection filter

Unit 4: Op-Amp as Oscillators and Convertors
Wien bridge, phase shift oscillator–triangular, saw-tooth and square wave generators-Schmitt's trigger – Voltage control oscillator – phase locked loops. Basic D to A conversion: weighted resistor DAC – Binary R-2R ladder DAC – successive approximation converter – dual slope ADC.

Unit 5: IC Fabrication and IC Timer:
Basic monolithic Ics – epitaxial growth – masking – etching impurity diffusion –fabricating monolithic resistors, diodes, transistors, capacitors – circuit layout – contacts and inter connections – 555 timer – description of the functional diagram – mono stable operation – applications of mono stable – astable operation – pulse generation.

References:

1. T.F. Schubert and E.M.Kim, "Active and Nonlinear Electronics", John Wiley Sons, New York (1996)
2. L.Floyd, Electronic Devices, "Pearson Education" New York (2004)
3. Dennis Le Crissitte, Transitors, Printice Hall India Pvt. Ltd. (1963)
4. J. Milmanan and C.C.Halkias, Integrated Electronics, Mcgraw Hill (1972)
5. R.A. Gayakwad, op – Amps & Linear integrated circuits, Printice Hall India Pvt Ltd. (1999)
6. M.Goodge, Semiconductor Device Technology Mc Millan (1983)
7. Ben.G.Streetman, Solid state electronic devices, Printice Hall, Englewood Cliffs, NJ (1999).
8. A. Mottershed, Semiconductor Devices and Applications, New Age Int Pub
9. Principle of Electronics-B.L.Theraja.

Elective- I : NUMERICAL METHODS AND C++ PROGRAMMING

Unit 1 : Numerical solution of algebraic and transcendental equations
The iteration method – The method of false position - Newton – Raphson method – Convergence and rate of convergence.

Simultaneous linear algebraic equations
Gauss elimination method – Jordon's modification – Gauss – Seidel method of iteration.

Unit 2: Curve Fitting and Interpolation
Curve fitting-method of least squares-straight line fit-Exponential fit.
Interpolation linear interpolation – Forward difference formula - Gregory – Newton forward and backward interpolation formula – Central difference formula – Gauss forward and backward interpolation formula – Divided differences – Properties – Lagaranges interpolation formula.

Unit 3 : Numerical differentiation and integration
Newton's forward and backward difference formula to compute derivaties – Two and Four point formula for First order derivatives-Three and Five point for second order derivatives-Numerical integration : the trapezoidal rule, Simpson's rule – 1/3 and 3/8 rule .

Unit 4: Numerical Solutions of ordinary differential equations
1^{st} and 2^{nd} order ordinary differential equations – Power series approximation – Pointwise method – Solutions of Taylor series – Euler's method – Improved Euler's method – Runge Kutta Method - second and fourth order – Runge – Kutta method for solving first order differential equations.

Unit 5 :Programming in C++
constants and variables-I/O operators and statements-Header files –main function-conditional statements-switch statement-void function-function program-for,while and do while statements-break,continue and go to statement-Arrays.

Books for study and Reference:

1. Introductory Methods of Numerical analysis – S.S. Sastry, Prentice – Hall of India, New Delhi (2003) 3^{rd} Edition.
2. Numerical methods is Science and Engineering M.K. Venkatraman.
3. Numerical Method – P. Kandasamy, K. Thilagavathi, and Guavathy.
4. Numerical Methods in C and C++, Veerarajan, S. Chand, New Delhi (2006).
5. Numerical Methods is Science and Engineering – The National Publishing Co. Madras. (2001).
6. Numerical Methods- Singaravelan.

CORE PRACTICAL - IV
PHYSICS PRACTICAL - I (GENERAL AND ELECTRONICS)

OBJECTIVE

- Experimental determination of certain physical constants and properties and verification of characteristics and applications of electronic components and devices.

Any twelve Experiments:

1. Determination of q, η, σ by elliptical fringes method.
2. Determination of q, η, σ by hyperbolic fringes method.
3. Determination of Stefan's constant.
4. Determination of e/m of an electron by Thomson's method.
5. Determination of L of a coil by Anderson's method.
6. Darlington pair Amplifier
7. Characteristics of JFET
8. Common source FET Amplifier
9. Common Drain FET Amplifier
10. Identification of prominent lines by spectrum photography- copper spectrum.
11. Study of a feedback amplifier- Determination of band width, input and output impedances.
12. Polarizability of liquids by finding the refractive indices at different wave lengths.
13. Verification of Hartmann's formula-using spectrometer
14. AND, OR, NOT, NAND and NOR logic gates.
15. Logic gates - Universality of NAND / NOR gates using IC.
16. Verification of Demorgan's, theorems and Boolean expressions.
17. Construction of dual regulated power supply using IC 741.

C - V: QUANTUM MECHANICS

Unit 1:schrodinger Equation and General Formulation
Schrödinger Equation -Physical meaning and properties of the wave function –basic postulates of quantum mechanics - Expectation values and Ehrenfest's theorem – Hermitian operators and their properties – Commutation relations – Uncertainty relation – Bra and ket vectors – Hilbert space – Schrödinger, Heisenberg and interaction pictures.

Unit 2: Exactly Solvable systems
Linear harmonic oscillator – Solving the one dimensional Schrodinger equation – Abstract operator method – Particle in a box – Square well potential – Rectangular barrier potential – Rigid rotator – Hydrogen atom.

Unit 3: Approximation Methods
Time independent perturbation theory: Non-degenerate and degenerate perturbation theories – Stark effect – WKB Approximation – Application to tunneling problem and quantization rules.
Time dependent perturbation theory: Harmonic Perturbation – Transition probability-sudden Approximation.

Unit 4: Scattering Theory and Angular Momentum
Scattering theory: Scattering amplitude and cross section -Green function approach– Born Approximation - Partial wave analysis.
Angular momentum: Matrix Representation of J-Spin angular momentum – Eigenvalues -- Addition of angular momenta – Clebsch- Gordan coefficients (basic ideas only)

Unit 5: Relativistic Quantum Mechanics
Klein –Gordon equation for a free particle and in an electromagnetic field – Dirac equation for a free particle – Charge and current densities – Dirac matrices – Plane wave solution – Negative energy states – Zitterbewegung –Spin angular momentum –Spin -orbit coupling.

Books for Study and Reference:
Relevant Chapters in

1. L. Schiff, Quantum Mechanics (Tata McGraw Hill, New Delhi, 1968).
2. V. Devanathan, Quantum Mechanics, Naroso Publishing House (2005)
3. P.M. Mathews and K. Venkatesan, A Text Book of Quantum Mechanics Tata McGraw Hill, New Delhi, 1987)
4. V.K. Thankappan, Quantum Mechanics (Wiley-Eastern, New Delhi, 1985)

C – VI: ATOMIC AND MOLECULAR PHYSICS

Unit 1: Atomic Spectra

Quantum States of electron in atoms – Hydrogen atom spectrum – Electron spin – Stern – Gerlach experiment – Spin – orbit interaction – Two electron systems – LS-JJ Coupling Schemes – Fine structure – spectroscopic terms and selection rules – Hyperfine structure – Exchange symmetry of wave functions – Pauli's exclusion principle – Periodic table – Alkali type spectra - Equivalent electrons – Hund's rule

Unit 2 :Quantum chemistry of Molecules

Covalent, ionic,metallic,hydrogen,dipolar bond and Vander waals interactions – Born – Oppenheimer approximation- Heitler – London and molecular orbital theories of H_2 - Bonding and anti-bonding MOs – Huckel's molecular approximation- Application to butadiene and benzene.

Unit 3: Microwave and IR Spectroscopy

Microwave spectroscopy

Rotational spectra of diatomic molecules – Effect of isotopic substitution – The non – rigid rotator – Rotational spectra of polyatomic molecules – Linear, symmetric top and asymmetric top molecules – Experimental techniques.

IR spectroscopy

Vibrating diatomic molecule – Diatomic vibrating rotator-Linear and symmetric top molecules – Analysis by infrared techniques – Characteristic and group frequencies

Unit 4: Raman Spectroscopy and Electronic Spectroscopy of Molecules

Raman spectroscopy: Raman effect – Quantum theory of Raman effect – Rotational and vibrational Raman shifts of diatomic molecules – Selection rules.

Electronic spectroscopy of molecules: Electronic spectra of diatomic molecules – The Franck condon principle – Dissociation energy and dissociation products – Rotational fine structure of electronic vibration transitions.

Unit 5: Resonance Spectroscopy

NMR: Basic principles – quantum mechanical description – Spin-spin and spin – lattice relaxation times – Chemical shift and coupling constant –NMR spectrometer.

ESR: Basic Principles – ESR Spectrometer – nuclear interaction and hyperfine structure relaxation effects-g-factor – Characteristics – Free radical studies and biological applications

Books for study and Reference:

1. C.N. Banwell, Fundamental of Molecular Spectroscopy (McGraw Hill, New York, 1981)
2. B.P. Straughan and S. Walker, Spectroscopy Vol.I. (Chapman and Hall, New York, 1976).
3. Manas Chanda, Atomic Stucture and Chemical Bond (Tata McGraw Hill, New Delhi, 1991).
4. Arthur Beiser, Concepts of Modern Physics (McGraw Hill, New York, 1995).
5. Spectroscopy – Gupta Kumar Sharma.
6. Introduction to Atomic Spectra – white McGraw Hill.
7. Introduction to spectroscopy – G.M- Burrow, Wiley.
8. Molecular spectroscopy-Gurdip chatwala
9. Molecular spectroscopy-Aruldoss

C - VII: STATISTICAL MECHANICS

Unit 1 : Thermodynamics

Laws of thermodynamics - some consequences of the laws of thermodynamics- Entropy – Calculation of entropy changes in reversible processes – The principle of increase of entropy – Thermodynamic potentials – Enthalpy, Helmholtz and the Gibbs functions – phase transitions – The Clausius - Clapeyron equation – van der waals equation of state.

Unit 2: Kinetic Theory

Distribution function and its evolution – Boltzmann transport equation and its validity – Boltzmann's H-theorem – Maxwell – Boltzmann distribution – Transport phenomena – Mean free path – Conservation laws.

Unit 3: Classical Statistical Mechanics

Review of probability theory – Macro – and micro states – phase space and ensembles – Density function – Liouville's theorem – Maxwell – Boltzmann distribution law – Micro canonical ensemble – Ideal gas – Entropy – Partition function – Principle of equipartition of energy – Canonical and grand canonical ensembles.

Unit 4: Quantum Statistical Mechanics

Basic concepts – Quantum ideal gas – Bose - Einstein and Fermi - Dirac statistics – Distribution laws–sackur-Tetrode equation – Equations of state – Bose – Einstein condensation.

Unit 5: Applications of Q.S.M

Ideal Bose gas : Photons – Black body and Planck radiation law – Photons – Einstien theory of solids – Liquid Helium.

Ideal Fermi gas : Properties – Degeneracy – Electron gas – Pauli paramagnetism.
Ferromagnetism : Isling and Heisenberg models.

Books for study and Reference :

1. K. Huang, Statistical Mechanics (Wiley Eastern Limited, New Delhi, 1963)
2. B.K Agarwal and M. Eisner, Statistical Mechanics (Wiley Eastern Limited, New Delhi, 1994).
3. Statistical mechanics – Gupta Kumar .
4. F. Reif, Fundamentals of Stat and Thermal physics (McGraw Hill, Singapore, 1985).
5. W.Greiner, L. Neise and H. Stocker, Thermodynamics and Statistical Mechanics (Springer, New York, 1995).
6. Statistical Mechanics-Agarwal
7. Statistical Mechanics-ESR Gopalan

Elective-II: MICROPROCESSOR AND MICROCONTROLLER

Unit 1: Microprocessor Architecture and Instruction set
8085,8086,6800- microprocessor architecture –Address Bus,Control Bus,Data Bus- Various registers – Central processing unit of micro computers – Timing and control unit – Instruction and data flow – System timings.

Unit 2:Instrution and programming (8085 only)
Instruction set-Data transfer group-Logical group-Branch group-Stack and I/o control instructions-Addressing modes.
Addition – Subtraction – Multiplication – Division – BCD arithmetic – Searching an array of a given number – Choosing the biggest and smallest numbers from a list – Ascending and descending orders – Square root of a number – Time delay – square wave generator.

Unit 3: Interfacing memory and I/O devices
Interfacing memory and devices – I/O and Memory mapped I/O – Type of interfacing devices – Data transfer schemes – Programmed and DMA data transfer schemes – Programmable Peripheral Interface (8255A) – 8253 Timer Interface – DMA controller – Programmable Interrupt controller (8259) – Programmable communication Interface (8251).

Unit 4 Microcontroller 8051
Features of 8051 – Architecture – Pin configuration – Memory organization -- External data and program memory -- Counters and timers – Serial data input/output – Interrupt structure – External interrupts – Addressing modes -- Comparison between microprocessor and microcontroller.

Unit 5 8051 Instruction Set and Programming
Instruction set – Data transfer, arithmetic and logical instructions – Boolean variable manipulation instructions – Program and machine control instructions – Simpleprograms – Addition and subtraction of two 8-bit and 16-bit numbers – Division –Multiplication -- Largest number in a set – Sum of a set of numbers.

References

1. R. Goankar, Micropressor Architecture, Programming and Applications (Wiley Eastern, New Delhi, 1985).
2. B. Ram, Fundamentals of Microprocessors and Microcomputers (Dhanapet Rai & Sons, New Delhi, 1995).
3. M. Schwarts, W.R. Bennet and S. Stein, Communication Systems and Techniques (McGraw Hill, New Delhi).
4. G. Kennedy, Elec Communication Systems (Tata McGraw Hill, New Delhi, 1995).
5. J. Millman and Halkias, Ele Devices and Ckts(McGraw Hill, Singapore, 1972).
6. satellite communication-Rody&coolan.

CORE PRACTICAL - VIII
PHYSICS PRACTICAL - II (GENERAL AND ELECTRONICS)

OBJECTIVE

- Experimental determination of certain physical constants and properties and verification of characteristics and applications of electronic components and devices.

Any twelve Experiments:

1. Photo electric effect (Planck's constant Determination).
2. Four probe Method – Determination of resistivities of powdered Samples.
3. Charge of an electron by spectrometer.
4. Determination of wave length of monochromatic source using biprism.
5. Determination of refractive index of liquids using biprism (by scale & telescope).
6. Rydberg's constant using spectrometer.
7. Identification of prominent lines by spectrum photography – Iron Spectrum.
8. Determination of specific rotatory power of a liquid using polarimeter.
9. Forbe's method of determining thermal conductivity.
10. Characteristics of UJT.
11. Half adder and full adder using IC.
12. Half subtractor and full subtractor using IC.
13. Op-amp wien bridge oscillator.
14. UJT Relaxation oscillator.
15. Characteristics of SCR.
16. 4-bit parallel Binary Adder.
17. Construction of Bistable Multivibrator.
18. Characteristics of LDR

CORE IX ELECTROMAGNETIC THEORY

UNIT I: Introduction to Electrostatics

Coulomb's law – Electric field – Gauss Law and its applications – Scalar potential – Surface distribution of charges and dipoles – Poisson and Laplace Equations – Green's theorem – Dirichlet and Neumann boundary conditions – Electrostatic boundary value problems : Solution using Green's function. Method of Images – Illustrations - Point charge in the presence of (i) a grounded conducting sphere, (ii) a charged, insulated and conducting sphere, (iii) near a conducting sphere at fixed potential and (iv) conducting sphere in a uniform electric field.

UNIT II: Electrostatics of Macroscopic media

Multipole expansion - Elementary treatment of electrostatics with ponderable media - Boundary value problems with dielectrics - Illustrations (i) a point charge embedded at a distance away from a dielectric interface (ii) dielectric sphere in a uniform electric field and (iii) spherical cavity in a dielectric medium with applied electric field - Molecular polarizability and electric susceptibility — Electrostatic energy in dielectric media.

UNIT III: Magnetostatics

Biot-Savart's law - Force between current carrying conductors - Differential equations of magnetostatics and Ampere's law — scalar and vector potentials — magnetic field of a localized current distribution, magnetic moment- force and torque and energy of a localized current distribution in an external magnetic induction- macroscopic equation-Boundary condition on B and H - Methods of solving boundary value problems in magnetostatics- Unifromly magnetized sphere.

UNIT IV: Electromagnetics

Faraday's laws of induction -Maxwell's displacement current - Maxwell's equations - Maxwell equations in terms of vector and scalar potentials — Gauge transformations - Lorentz gauge, Coulomb gauge — Poynting's theorem — Conservation of energy and momentum for a system of charged particles and electromagnetic fields.

UNIT V: Plane Electromagnetic Waves and wave Propagation

Plane waves in a non-conducting medium - Linear and circular polarization, Stoke's parameters - Reflection and refraction of electromagnetic waves at a plane interface between dielectrics - Fields at the surface and within a conductor- Propagation of electromagnetic waves in hollow metallic cylinders: Cylindrical and rectangular wave guides - TM and TE modesS.

Books for study and reference:

1. Electromagnetic theory -Chopra and Agarwal
2. Electromagnetic Theory and applications - Chatopadhyaya
3. Classical Electrodynamics - J.D. Jackson.
4. Electromagnetic theory- Sathya Prakash

CORE X - NUCLEAR AND PARTICLE PHYSICS

UNIT I: Nuclear Properties

Nuclear size, shape, mass — Nuclear stability, Binding energy, Mass defect and Packing fraction - Weiszacker's semi empirical mass formula - Mass parabolas for isobaric nuclei - nuclear magnetic moment - Determination of nuclear magnetic moment by magnetic resonance method — Electric Quadrupole moment - Ground state of Deutron - n-p scattering at low energies - spin dependence - scattering length, phase shift - effective range - exchange forces - meson theory.

UNIT II: Radioactive Decays

Alpha emission - Gamow's theory of Alpha decay - Geiger-Nuttal law - Beta decay - Neutrino hypothesis - Fermi theory of Beta decay - Curie point - Selection rules — Non conservation of parity - Gamma emission - Selection rules - Transition probability - Internal conversion – nuclear isomerism.

UNIT III: Nuclear Reactions and Nuclear Models

Q-values and kinematics of nuclear cross section — Energy and angular dependence - Reciprocity theorem - Compound nucleus - Briet-Wigner dispersion formula for resonance scattering and reactions - Resonance theory - Optical model— Shell model - Liquid drop model - Collective model.

UNIT IV: Accelerators, Fission and Fusion Reactors

Linear accelerators - Cyclotron - Synchrocyclotron - Betatron — Electron synchrotron - Proton Synchrotron - Nuclear fission — Mass distribution of fission fragments - spontaneous fission - Bohr-Wheeler theory - The nuclear chain reaction — Fission reactors - Homogeneous reactors - Heterogeneous reactors — Nuclear fusion — Thermonuclear reactions as source of stellar energy.

UNIT V: Particle Physics

Classification of elementary particles - General ideas of gravitational, strong, weak and electromagnetic interactions — conservation laws and their validity - The C-P-T theorem– Strangeness - Gellmann-Nishijima relation - SU(3) Symmetry - classification of Hadrons - Octets and Decuplets - Elementary ideas of quarks.

Books for study :

1. D.C. Tayal, Nuclear Physics
2. R. C. Sharma, Nuclear Physics
3. S.N.Ghoshal-Nuclear Physics

Books for reference:

1. K.S. Krane, Introductory Nuclear Physics (Tata McGraw Hill, New Delhi, 1987).
2. Pandya and Yadav, Nuclear Physics
3. S.B. Patel, Nuclear Physics: An Introduction (Wiley-Eastern, New Delhi, 1991).
4. B.L. Cohen Concepts of Nuclear Physics (Tata Mcgraw Hill, New Delhi, 1988).
5. Nuclear Physics - Roy Nigam
6. Nuclear Physics - S. K. Pandey

CORE XI - SOLID STATE PHYSICS

Unit I: Imperfection and optical properties

Classification of imperfection – point defect, interstitious defect, volume defect, schottky defect, Frenkel defect, vacancy defect, line defect – Screw & edge dislocation-Burger vector,colour centres and colouration.

Simple model of photoconductor – influence of traps – luminicense – Emission and absorption spectra – Efficiency of phosphor – Thermoluminance & glow curve.

Unit II: Vibrations of Solids

Vibration of monoatomic lattices - diatomic lattice vibration - Quantisation of lattice vibration Phonon momentum - N-Process and Umpklapp process - Local Phonon modes - Inelastic scattering of Photons by long wave phonons — The Einstein's theory of specific heats — Debye's model of lattice Specific heat- Thermal expansion - Lattice Thermal conductivity of Solids

Unit III: Electrical properties of solids

Free electron gas in three dimensions - Electrical conductivity and Ohm's law - Sommerfield theory of electrical conductivity - Hall effect - Thermal conductivity - Widemann Franz law - Bloch theorem - Kronig -Penney model - Velocity of electrons according to Band theory - Brillouin zones -Number of possible wave functions per band - Nearly free electron approximation - Density of states.

Unit IV: Magnetism

Quantum theory of paramagnetism - Paramagnetism of ionic crystals - Demagnetisation of paramagnetic salt -Ferromagnetism - Weiss theory - Molecular field - Heisenberg's exchange interaction — Hysteresis and Ferro magnetic domains - Domain structure - Origin of Domains - Bloch Walls — Anti ferromagnetism - Molecular field theory — Ferrimagnetism, Ferrites and magnetic properties of solids.

Unit V: Dielectrics and Super conductivity

Polarization - Dielectric constant and Polarisability - Clausius-Mossotti equation - Ferroelectric domains - Polarisation catastrophe.

Zero resistance — Behaviour in magnetic field - Meissner effect - Type I *&.* Type II superconductors - Thermodynamic of superconducting transition - London equation – Penetration depth - BCS theory (Qualitative study only) - Electron tunneling - AC and DC Josephson effects (basic idea only). High T_c superconductors.

Books for study :

1. Solid Slate Physics - S.O. Pillai
2. Gupta Kumar Sharma. Solid State Physics
3. Puri *&.* Babbar. Solid State Physics

Books for reference:

1. C. Kittel, Introduction to Solid State Physics
2. Blakemore, Solid Stale Physics
3. Dekker, Solid State Physics
4. Kakani *&* Hcmarajini. Solid State Physics
5. Saxena Gupta Saxena, Solid State Physics
6. Singhal, Solid State Physics
7. Crystal Growth - P.Ramasamy *&* P.Santhanaraghavan

Elective-III: CRYSTAL GROWTH AND THIN FILM PHYSICS

Unit 1: Nucleation and Growth

Nucleation - Different kinds of nucleation - Concept of formation of critical nucleus - Classical theory of nucleation - Spherical and cylindrical nucleus - Growth Kinetics of Thin Films - Thin Film Structure - Crystal System and Symmetry.

Unit 2: Solution and Gel

Low temperature solution growth: Miers T-C diagram - Constant temperature bath and crystallizer - Seed preparation and mounting - Slow cooling and solvent evaporation methods and temperature Gradient.

Principle - Various types - Structure of gel - Importance of gel - Experimental procedure - Chemical reaction method - Single and double diffusion method - Chemical' reduction method -Complex and decomplexion method - Advantages of gel method.

Unit 3 : Melt and Vapour Growth Techniques

Bridgman technique - Basic process - Thermal consideration -Vertical Bridgman technique - Czochralski technique - Experimental arrangement - Growth process.
Physical vapour deposition- Chemical vapour deposition

Unit 4 : Thin Film Deposition Techniques

Thin Films - Deposition Techniques - Physical Methods -Resistive Heating, Electron Beam Gun, Laser Gun Evaporation and Flash Evaporations - Sputtering -Reactive Sputtering. Chemical Methods - Spray Pyrolysis - Preparation of Transparent Conducting Oxides.

Unit 5: Characterization Technique

X - Ray Diffraction (XRD) - Powder and single crystal - Elemental analysis – EDAX – Atomic absorption spectroscopy – Thickness determination. Formation of fringes, Gravimetric method and Thermal characteristics. – Thermo Gravimetric Analysis (TGA) – Differential Thermal Analysis (DTA) – Differential Scanning Calorimetry (DSC).

Books for Study and Reference:

1. J.C. Brice, Crystal Growth Processes, John Wiley and Sons, New York (1986).
2. P. Santhana Ragavan and P. Ramasamy, Crystal Growth Processes and Methods, KRU Publications, Kurnbakonam (2001).
3. A. Goswami, Thin Film Fundamentals, New Age International (P) Limited, New Delhi (1996).
4. H.H. Willard, L.L. Merritt, J.A. Dean, F.A. Settle, CBS, Publishers and Distributors, New Delhi.

CORE PRACTICAL - III
PHYSICS PRACTICAL - III (ELECTRONICS)

OBJECTIVE:

• Verification of characteristics and applications of electronic components and devices

Any twelve Experiments:

1. DIAC, TRIAC characteristics.
2. Flip flops, D flip flop, JK flip flop, S-R / R - S flip flop.
3. Digital comparator using IC.
4. Study of counter using IC 7490.
5. Calibration of Thermocouple using B.G.
6. Calibration of Thermistor.
7. Decoder and encoder.
8. Multiplexer and demultiplexer.
9. BCD to seven segment display
10. 0 to 99 Counter
11. Shift Register – Left and Right.
12. Op-amp Characteristics.
13. Op-amp waveform generator.
14. Op-amp-Adder, Subtractor, Integrator & Differentiator.
15. Design and study of monostable multivibrator.\
16. Op-amp – D/A converter.
17. Op- amp Phase Shift oscillator.

CORE XIII - ADVANCED MATERIALS

UNIT – 1: Smart materials

Classification – Properties – SMA (Shape Memory Alloys) :- Fundamental characteristics – principle of shape memory effect – Hysterisis – Two way shape memory Alloy – Super elasticity – Thermo mechanical behaviour – Methods of processing – characterisation method – Chemical shape memory Alloys – Ni.Ti – Copper Alloy – Copper Aluminium Alloys – Applications

UNIT – 2: Semiconducting materials

Intrinsic semiconductor-Carrier concentrationin an intrinsic semiconductor-variation of carrier concentration with temperature-Determination of Band gap-Compound semiconductor-Hall Effect-Importance and applications of Hall effect – Extrinsic semiconductor – Extrinsic conductivity – Fermi level in extrinsic conductor.

UNIT-3: Nonlinear materials

Polarisation – second and third harmonic generation – Optical mixing – Optical rectification – Non linear material characteristics – Applications.

UNIT – 4: Magnetic materials

Hard and Soft magnetic materials – Energy product of magnetic material –magnetic recording materials – magnetic principle of Analog recording and reading – magnetic bubble memory – magnetic principle of computer data storage – magnetic tape – Floppy disk – magnetic hard disc – Computer Aided tomography.

UNIT – 5 : Bio materials

Classification – Structure of Ceramics – Ceramic Processing – Properties – Applications – Biomechanism – Classification – metal and Alloys – Bio active glasses and glass ceramics – polymers – Composites – Processing and properties – Applications.

Books for study

1. V. Rajendran and A. Marikani, Tata Mcgraw Hill
2. Dr.M. Arumugam – Anuradha Publications.

Elective-IV : NANO MATERIALS AND APPLICATIONS

UNIT I : Nano Materials

Classification of nano materials – Principle of Top –down and Bottom – up approaches – Chemistry of nano particles – Synthesis – nucleation and growth of nano particles- Fullerance variations – Properties- Quantum dot – Quantum well – Quantum wire

UNIT II : Synthesis and processing of Nanomaterials

Nucleation and growth of Nano particles – Synthesis of metallic and semiconductor nano particles – physical and chemical technique : Ball milling – Laser ablation – photo, e-beam, X-ray lithography – Molecular beam Epitaxy (MBE) – physical vapour Deposition (PVD) – Plasma arching – Chemical Vapour Deposition (CVD) – Sol Gel techniques – Electro chemical Etching technique.

UNIT III : Fabrication of Nano materials

Nano wires growth techniques : VLS and Electro Chemical Etching technique – Carbon Nanotubes : formation, growth, types and structure

UNIT IV : Characterization of Nano structured materials

Estimation of particles size : X –ray diffraction (XRD) powder method – Scanning Electron Microscope (SEM) – Scanning Probe Microscope (SPM) – Transmission Electron Microscope (TEM) – Block Diagram – working.

UNIT V : Applications of Nano Materials

Molecular electronics and Nano electronics-Nano Robots-Biological applications of Nano particles-Catalysis by Gold Nano particles-Bandgap Engineered Quantum devices-Nano mechanics-CNT emitters-photo electrochemical cells-Photonic crystals-Plasmon waveguides.

Books for Study

1. Dr. M.N. Ava Dhanulu - Laser and its application
2. Dr. Rakesh Rathi – Nano technology

Books for Reference

1. Govind. P. Agarwal, Fiber-Optics Communication Systems, 3rd Edn. John Wiley & Sons.
2. William T. Silvast, Laster Fundamentals, Cambridge University Press,
3. Cambridge 2003

CORE PRACTICAL - IV
PHYSICS PRACTICAL - IV (MICRPROCESSOR AND PROGRAMMING)

OBJECTIVE:

• To develop programming skills of microprocessor and C++ programming in solving some mathematical problems and their applications.

ANY TWELVE EXPERIMENTS - (Choosing of minimum of six experiments from each part)

A.MICROPROCESSOR & μ_c PRACTICALS

1. 8 bit addition, subtraction, multiplication and division.
2. 16 bit addition.
3. Conversion from decimal to octal and hexa decimal systems.
4. Conversion from Octal, hexa to decimal systems.
5. Traffic control system using microprocessor.
6. Control of stepper motor using microprocessor..
7. Largest and smallest of N digits.
8. Ascending and descending order.
9. Square and square root
10. Display of single character
11. Display of multi character
12. .Rolling display
13. Generation of wave forms: Sine, square, staircase, Triangular and saw tooth
14. 1's & 2's complements.

B. PRACTICALS (C++ Lab)

1. Roots of algebraic equation - Newton Raphson method.
2. Least square curve fitting - straight line fit.
3. Interpolation - Lagrange method.
4. Numerical integration - trapezoidal rule.
5. Numerical integration - Simpson's rule.
6. Ascending and Descending order.
7. Matrix, Addition, Subtraction and Multiplication.
8. Smallest and Largest of N digits.
9. Solving Quadratic equation.
10. Solution of ordinary differential equation - Runge - Kutta 4^{th} order method.