DEPARTMENT OF PHYSICS

M.Sc, PHYSICS SYLLABUS

(For the Candidates to be admitted from the year 2019-2020 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 PG COURSE UNDER CBSE
(Applicable to the candidates admitted form the academic year 2019 - 2020 onwards)

Sem	Course	Course Title	Ins. Hrs / Week	Credit	Exam Hrs	Marks		Total
						Int.	Ext	
I	Core Course -1 (CC)	Mathematical Physics	5	5	3	25	75	1O0
	Core Course - II (CC)	Classical dynamics 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
	TOT AL		**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 – Vll(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 Electronics)	10	5	4	40	60	100
	TOTAL		**30**	**24**				**500**
III	Core Course – IX (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 (General & Electronics)	10	5	4	40	60	too
	TOTAL		**30**	**23**				**500**
Iv	Core Course - XIII (CC)	Advanced Materials	5	5	3	25	75 J	100
	Elective Course - IV (EC)	Nanoscience	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	—4
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.

******

PG & Research Department of Physics

Learning Objectives, Course Outcome and Course Outcome Mapping are included in every subjects of PG and UG Physics syllabus.

- ✓ Learning Objective for units of Subject covers from LO1 to LO5.
- ✓ Course Outcome for units of Subject takes CO1 to CO5
- ✓ Course Outcome Mapping for each subject gives correlation between Programme Outcome versus Course Outcome.

Programme Outcomes (POs)

- **PO1: Disciplinary Knowledge:** Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of a Postgraduate programme of study.
- **PO2** - Analytical and Technical Skills: Ability to handle/use appropriate tools/techniques.
- **PO3** – Critical thinking and Problem Solving: Critically analyse problems and to arrive viable conclusions
- **PO4** – Environment and Society: Analyze the impact of scientific advances on the environment and society.
- **PO5** – Lifelong learning: Ability to engage in lifelong learning in the discipline.

Programme Specific Outcomes (PSOs):

- **PSO1: Knowledge:** Attain adequate knowledge in Physics concepts in subjects like Mathematical Physics, Classical Mechanics, and Quantum Mechanics etc. to gain the ability to understand and deal with abstract concepts.
- **PSO2: Entrepreneur:** Produce effective entrepreneurs by enhancing their critical thinking, problem solving, decision making, technical skill and leadership skill in order to facilitate start-ups and high potential organizations.
- **PSO3: Research and Development:** Design and implement HR systems and practices grounded in researches that comply with employment laws, leading the organization towards growth and development.
- **PSO4: Contribution to Business World:** To create employable, ethical and innovative professionals to sustain in the dynamic business world.
- **PSO5: Contribution to the Society:** To contribute the development of the society by collaborating with stakeholders for mutual benefit.

HOD **PRINCIPAL**

C-I: MATHEMATICAL PHYSICS

Learning Objectives

LO1	To create a basic knowledge in mathematical physics
LO2	To develop expertise in mathematical techniques required in physics.
LO3	To enhance problem solving skills.
LO4	To enable students to formulate, interpret and draw inferences from mathematical solutions
LO5	To understand the problems in complex variable

Unit I: 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 curvelinear coordinates - Expression for gradient, divergence, curl and Lapiacian in cylindrical and spherical co-ordinates.

Unit II: 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 III : 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 IV: Special Functions and Integral transforms ,

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.

Fourier transforms – Cosine and sine transforms – Linearity theorem – Parseval's theorem – solution of differential equation – Laplace transforms – Definition – Linearity, shifting and change of scale – properties – Inverse Laplace transformation – Definition – Problem – solution of differential equation.

Unit V: 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.

Course Outcomes

At the end of the course, student will be able to

CO1	create a basic knowledge in mathematical physics
CO2	develop expertise in mathematical techniques required in physics.
CO3	enhance problem solving skills.

CO4	enable students to formulate, interpret and draw inferences from mathematical solutions
CO5	understand the problems in complex variable

Books for Study and Reference

1. Mathematical Physics - sathya Prakash.
2. Mathematical Physics - B. D. Gupta
3. Mathematical Physics-H.K.Oass
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)

Course Outcome Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	2	2	3	2	3
CO2	2	2	3	2	2
CO3	2	2	3	2	2
CO4	2	2	2	2	2
CO5	3	2	3	3	3

C- II: CLASSICAL DYNAMICS AND RELATIVITY

Learning Objectives

LO1	To make learning of Classical Mechanics interesting and to teach the Lagrangian and Hamiltonian formalisms and their applications.
LO2	To study the kinematics of the rigid body through Euler's equations
LO3	To study the theory of Hamilton Jacobi theory and central force problem
LO4	To teach the theory of small oscillations and vibrational modes of molecules and to reate an understanding of the principles of Nonlinear dynamics and classical chaos.
LO5	To understand relativity and its consequences

Unit I : 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 fseld-Virial theorem-Artificial Satellites-Geo stationary Satellites-Eccentricity of orbit of satellites-Escape Velocity.

Unit II: Rigid body dynamics and theory of small oscillations

Rigid Body Dynamics

Euter 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 III: 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 IV: 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 V: 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. K 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.VSharma, Classical Mechanics (Pragati Prakashan, Meerut,2001)

For Unit IV

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.

Course Outcomes:

At the end of the course, student will be able to

CO1	have depth knowledge about Lagrangian and Hamiltonian formulations and solve problems using those formulations.
CO2	have knowledge about fundamentals of rigid body motion and explain Moment of inertia tensor and Euler's equations of motion and will also be able to solve problems on force free motion of a rigid body and symmetrical top.
CO3	apply Hamilton's characteristic function to solve problems. Understand Action Angle variables and solve one degree of freedom and Kepler's problem.
CO4	acquire knowledge about oscillatory motion and stability of oscillatory motion. understand the linear and nonlinear systems and basics of Chaos.
CO5	understand the applications relativistic mechanics and its consequences.

Books for reference:

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

Course Outcome Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	2	2	2	2	2
CO2	2	2	2	2	2
CO3	2	2	2	2	2
CO4	2	2	2	2	2
CO5	3	2	2	3	3

C- III: ELECTRONICS

Learning Objectives

LO1	To create a depth knowledge in power electronics
LO2	To develop expertise in techniques required in physics.
LO3	To enhance problem solving skills.
LO4	To enable students gained theoretical knowledge in classroom can be experimented in practicals
LO5	To deveplope knowage about fabrication of ics and logical applications

Unit I: Semi Conductor Diodes:

Principle.oonstruction , characteristics .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 II: 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 III: Operational Amplifier:

Operational amplifier characteristics - inverting and non-inverting amplifier - instrumentation amplifier - voltage follower - integrating and differentiating 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 IV: 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 OAC - Binary R-2R ladder DAC - successive approximation converter -dual slope ADC.

Unit V: IC Fabrication and IC Timer:

Basic monolithic tes - 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.

Course outcomes

At the end of the course, the student will be able to

CO1	understand the principles, working of semiconductor devices and diodes.
CO2	study the various classifications and applications of semiconductor memories
CO3	study the applications of operational amplifier.
CO4	highlight the concept of IC circuits and IC 555 timer.
CO5	understand basics idea about the IC’s

References:

1. T.F. Schubert and E.M.Kim, "Active and Nonlinear Electronics", John Wiley Sons, New York (1996)
2. L.FIoyd, Electronic Devices, "Pearson Education" New York (2004)
3. Dennis LeCrissitte, Transistors, Printice Hall India PvtLtd. (1963)
4. J. Milmanan and C.CHalkias, Integrated Electronics, Mcgraw Hill (1972)
5. RA.*Gayakwad, op - Amps & Linear integrated circuits, Printice Hall India Pvt Ltd. (1999)
6. M.Goodge, Semiconductor Device Technology Mc Millan (1983)
7. Ben.G.Streefman, 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.

Course Outcome Mapping:

	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	2	2
CO2	2	3	2	2	3
CO3	3	2	2	2	3
CO4	2	2	3	2	2
CO5	2	2	2	2	2

Elective- I: NUMERICAL METHODS AND C++ PROGRAMMING

LO1	To give strong foundation in errors and the measurements
LO2	To make learning of numerical solution of algebric solution
LO3	To study the sums on interpolation
LO4	To create an understanding on numerical solutions
LO5	To develop knowledge about C++ programming

Unit I : 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 II: 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 III : 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 IV: Numerical Solutions of ordinary differential equations

1^{sl} 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 V :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.

Course Outcomes:

At the end of the course, student will be able to

CO1	have depth knowledge about numerical solutions
CO2	have knowledge about fundamentals of curve fitting
CO3	apply .nueical differential equations
CO4	acquire knowledge about numerical problems

CO5	understand the applications of c++

Course Outcome Mapping:

	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	2	2
CO2	3	2	3	2	2
CO3	3	2	3	2	2
CO4	3	2	3	2	2
CO5	3	2	2	2	3

*****

Books for study and Reference:

1. Introductory Methods of Numerical analysis - S.S. Sastry, Prentice - Hall of India, New Delhi (2003) 3rd 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- Singaraveian.

CORE PRACTICAL IV

PHYSICS PRACTICAL I (GENERAL AND ELECTRONICS)

Learning Objectives

LO1	To make the students to understand experimental physics
LO2	To apply the theoretical knowledge for developing new devices
LO3	To study the aspects related to the application side of the experiments
LO4	To understand the usage of basic laws and theories to determine various properties of the materials given
LO5	To develop skills

Any TWELVE experiments (Six experiments from each part)

A. General Experiments

1. Determination of q, n, σ by elliptical fringes method
2. Determination of Stefan's constant
3. Determination of bulk modulus of a liquid by ultrasonic wave propagation
4. Determination of Rydberg's constant
5. Study of Hall effect in a semiconductor
6. Determination of dielectric constant at high frequency by Lecher wire
7. Michelson interferometer — Determination of wavelength of monochromatic source.
8. Determination of wavelength of monochromatic source using biprism
9. Charge of an electron by spectrometer
10. Dissociation energy of iodine molecule — Absorption spectrum
11. Spectrum photo — Cu/Fe arc spectrum
12. Polarization of light — Verification of Malus law and Brewster angle of glass
13. BH loop - Energy loss of a magnetic material - Anchor ring using B.G./CRO
14. Determination of e/m of an electron by magnetron method
15. Determination of dielectric loss using CRO

B. Electronics Experiments

1. Construction of dual regulated power supply
2. Astable and monostable multivibrators using IC555
3. Characteristics of UJT
4. Characteristics of SCR
5. Design and study of Wein bridge oscillator using op-amp
6. Design and study of square and triangular waves generators using op-amp
7. Solving ordinary differential equation using op-amp
8. V-I characteristics of a solar cell
9. Up/down counter using mod 10
10. Operation of shift register using serial-in serial-out, serial-in parallel-out and parallel-in serial-out

Course Outcome Mapping:

	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	2	2
CO2	3	3	3	2	3
CO3	2	3	3	2	2
CO4	3	3	3	2	3
CO5	2	3	3	2	2

C – V : QUANTUM MECHANICS

Learning Objectives

LO1	To introduce the basic postulates of quantum mechanics.
LO2	To make the student to understand exactly solvable systems.
LO3	To elucidate the aspects of time – independent and time-dependent perturbation theories.
LO4	To introduce the concepts of angular momentum and identical particles.
LO5	To make the students to understand relativistic quantum mechanics.

Unit I :Schrodinger Equation and General Formulation

Schrodinger 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 - Schrodinger, Heisenberg and interaction pictures.

Unit II: 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 III: 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 IV: 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 V: Reiativistic 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.

Course Outcome:

At the end of the course, student will be able to

CO1	Recognize the concept of quantum mechanical tool
CO2	Describe the application of Schrodinger's equation to exactly solvable problems
CO3	Analyse the approximations of quantum mechanical problems.
CO4	Represent various momentum tools
CO5	Understand and apply the Relativistic quantum field.

Course Outcome Mapping:

	PO1	PO2	PO3	PO4	PO5
CO1	2	2	2	2	2
CO2	2	2	2	2	2
CO3	2	2	2	2	2
CO4	2	2	2	2	2
CO5	3	2	2	3	3

*****

Books for Study and Reference:

Relevant Chapters in

1. L. Schiff, Quantum Mechanics (Tata McGraw Hill, New Oeibi, 1958).
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 (Wiiey-Eastern, New Delhi, 1985)

C - VI: ATOMIC AND MOLECULAR PHYSICS

Learning Objectives

LO1	To create a depth knowledge in atomic spectra
LO2	To develop expertise in quantum chemistry.
LO3	To enhance microwave spectroscopy
LO4	To enable students gained knowledge about raman spectroscopy
LO5	To deveplope knowage about resonance spectroscopy

Unit I: **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 II :Quantum chemistry of Molecules

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

Unit III: 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 IV: 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 V: 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

Course outcomes

At the end of the course, the student will be able to

CO1	understand the principles, working of quantum spectroscopy
CO2	study the various classifications and applications of microwave
CO3	study the applications of raman spectroscopy

CO4	highlight the concept of raman spectroscopy
CO5	understand basics idea about resonance

Course Outcome Mapping:

	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	2	2
CO2	2	3	2	2	3
CO3	3	2	2	2	3
CO4	2	2	3	2	2
CO5	2	2	2	2	2

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.l. (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 Sharrna.
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

Learning Objectives

LO1	To provide adequate introduction on the postulates of Thermodynamics
LO2	To understand the Transport properties and related equilibrium concepts
LO3	To learn the basics of classical statistical mechanics and to understand some of their Applications
LO4	To learn the basics of quantum statistical mechanics and to understand some of their Applications
LO5	To train to apply quantum mechanical statistics to various applications

Unit I : **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 II: Kinetic Theory

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

Unit III: 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 IV: 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 V: 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.

Course Outcomes

At the end of the course, student will be able to

CO1	have adequate knowledge on the basics of thermodynamics.
CO2	U understand the kinetic theory and transport properties.
CO3	know the Basic concepts of classical statistics and applications
CO4	know the Basic concepts of quantum statistics.
CO5	describe the role of quantum statistics to various real life problems.

Course Outcome Mapping:

	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	2	3
CO2	3	2	2	2	3
CO3	3	2	3	2	3
CO4	3	2	2	2	2
CO5	3	2	2	2	3

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 (MoGraw Hill, Singapore, 1985).
5. WGreiner, L. Neise and H. Stacker, Thermodynamics and Statistical Mechanics (Springer, New York, 1995).
6. Statistical Mechanics-Agarwal
7. Statistical Mechanics-ESRGopalan

Elective-II: MICROPROCESSOR AND MICROCONTROLLER

Learning Objectives

LO1	To learn the architecture of 8085 microprocessor, interrupts and timing diagrams
LO2	To write assembly language programmes to 8085 microprocessor
LO3	To study the architecture of 8086 microprocessor
LO4	To familiarize the architecture of 8051 microcontroller and its programming
LO5	To understand the principle of interfacing with peripheral devices and study the interfacing devices of 8085 and 8051

Unit I: MicroprocessorArchitecture 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 II:Instruction 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 III: 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 IV 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 V 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.

At the end of the course, student will be able to

CO1	Know various interrupts in 8085, timing diagrams for memory read/write cycle.
CO2	Write assembly language programs
CO3	Understand the hardware of 8086 and its modes of operations.
CO4	Understand the hardware of 8051 and to explain the instruction set, addressing modes and arithmetic operations
CO5	Know how to interface the peripheral devices with 8085 and 8051 and describe the different interfacing devices and can demonstrate the interfacing of DAC / ADC and stepper motor

Course Outcome Mapping:

	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	2	3
CO2	3	2	2	2	3
CO3	3	2	3	2	3
CO4	3	2	2	2	2
CO5	3	2	2	2	3

references

1. R. Goankar, Micropressor Architecture, Programming and Applications {Wiley Eastern, New Delhi, 1985).
2. B. Ram, Fundamentals of Microprocessors and Microcomputers (Ohanapet 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 Hfll, 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

(MICRPROCESSOR AND PROGRAMMING)

OBJECTIVE

Learning Objectives

LO1	To create basic skills in microprocessor practical
LO2	To develop the ideas about in microprocessor
LO3	To provide knowledge on assembly language programming in microprocessor
LO4	To cater basic idea of using interface with microprocessor.
LO5	To create skill on microcontroller applications.

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

Any **FIFTEEN** experiments (At least SIX experiments from each part)

A. Microprocessor (8085)

1. Finding the largest and smallest numbers in a data array
2. Arranging a set of numbers in ascending and descending orders
3. Study of multibyte decimal addition
4. Study of multibyte decimal subtraction
5. Interfacing hexa key board (IC 8212)
6. Study of seven segment display
7. Study of DAC interfacing (DAC 0900)
8. Study of ADC interfacing (ADC 0809)
9. Study of timer interfacing (IC 8253)
10. Study of programmable interrupt controller (IC 8259)
11. Traffic control system
12. Digital clock
13. Generation of square and sine waves using DAC 0800
14. Digital thermometer (temperature controller)
15. Control of stepper motor using microprocessor

B. C++ Programming

1. Least-squares curve fitting - Straight-line fit
2. Least-squares curve fitting - Exponential fit
3. Real roots of one-dimensional nonlinear equations — Newton Raphson method
4. Complex roots of one-dimensional nonlinear equations -- Newton—Raphson method
5. Interpolation - Lagrange method
6. Numerical integration - Composite trapezoidal rule
7. Numerical integration - Composite Simpson's 1/3 rule
8. Solution of a second-order ODE - Euler method
9. Solution of a first-order ODE - Fourth-order Runge—Kutta method
10. Uniform random number generation - Park and Miller method
11. Gaussian random number generation - Box and Muller method
12. Evaluation of definite integrals - Monte Carlo method
13. Calculation of mean and standard deviation of a set of uniform random

numbers

14. Computation of eigenvalues of linear harmonic oscillator by numerically solving Schrodinger equation
15. Monte Carlo simulation of electronic distribution of hydrogen atom

Course Outcome:

At the end of the course, student will be able to

CO1	know basic skills in microprocessor practical
CO2	understand the ideas about in microprocessor
CO3	get the knowledge on assembly language programming in microprocessor
CO4	know basic idea of using interface with microprocessor.
CO5	get skill on microcontroller applications.

Course Outcome Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	2	2	3
CO2	3	2	2	2	3
CO3	3	2	3	2	3
CO4	3	2	2	2	2
CO5	3	2	2	2	3

CORE IX ELECTROMAGNETIC THEORY

Learning Objectives

LO1	To develop a strong background in electromagnetic theory
LO2	To understand the nature of electric and magnetic force fields and the intricate connection between them
LO3	To provide a clear and logical presentation of Electrostatics and electrodynamics
LO4	To understand and use various mathematical tools to solve Maxwell equations in problems of wave propagation and radiation
LO5	To make the students understand the source of production and propagation of EM waves

UNIT I: Introduction to Electrostatics

Electric field - Coulomb's law - Gauss Law and its applications - Scalar potential - Surface distribution of charges and dipoles - Poisson and Laplace Equations - Green's theorem -Dirichiet 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, - 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.

Course Outcomes

At the end of the course, student will be able to

CO1	have a depth knowledge of electrostatics and clearly understand dielectric polarization.
CO2	Know the fundamental laws to find the magnetic field of a source. Apply the magnetic scalar and vector potentials to find the magnetic field due to localized source.

CO3	use Maxwell's equations for a system of charge and electromagnetic field.
CO4	know the propagation of electromagnetic waves in free space, dielectric medium and conducting medium.
CO5	Understand about the oscillating dipole. Know how the power radiated from a linear antenna. Understand clearly antenna arrays.

Course Outcome Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	2	2	3
CO2	3	2	2	2	3
CO3	3	2	3	2	3
CO4	3	2	2	2	2
CO5	3	2	2	2	3

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

Learning Objectives

LO1	Understand the fundamental principles and concepts governing nuclear and particle Physics.
LO2	Realize the nuclear structure and nuclear forces through various theories.
LO3	Analyze the theories involved in radioactive decays
LO4	Learn about nuclear fission and fusion reactions.
LO5	Gain knowledge in elementary particles based on theoretical models.

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 nuciear 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

Law of radioactive decay-Half life – mean life and successive radivactive transformation- 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

Types of reaction and conservative laws – energetic of nuclear reactions – isospin nuclei cross section - 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 : Elementary Particle

Classification of elementary particles – types of interaction between elementary particles – Hadrons and leptons – Symmetry and conservation laws – Strangeness and associate production- CPT theorem – classification of hadrons – Quark model – Isospin multiples – SU(2) – SU(3) multiplets – Gell-Mann – Okubo mass formula for octet and decuplet hadrons – Phenomenology of weak interaction hadrons and leptons – Universal Fermi interaction – Elementary concepts of weak interactions.

Course Outcomes:

At the end of the course, student will be able to

CO1	Summarize the nuclear interactions through nucleon scattering theories.
CO2	Gain knowledge in various types of nuclear reactions.
CO3	Discuss the theories involved in different types of radioactive decays.
CO4	Explain the nuclear fission and fusion reactions and their applications.
CO5	Describe elementary particles and discuss their classifications based on theoretical models.

Course Outcome Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	2	3	3	2	2
CO2	3	3	3	2	3
CO3	2	3	3	2	2
CO4	3	3	3	2	3
CO5	2	3	3	2	2

Books for study:

1. D.C. Tayal, Nuclear Fnysics
2. *R.* C. Sharma, Nuclear Physics
3. S.N.Ghoshal-Nuclear Physics
4. Introduction to Elementary Particles, d. Griffiths, 2nd Ed., Wiley-Vch, 2008.

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 Mograw+Hill, New Delhi, 1983).
5. Nuclear Physics - Roy Nigam
6. Nuclear Physics -S. K. Pandey

CORE XI - SOLID STATE PHYSICS

Learning Objectives

LO1	To understand the basic theory of imperfection and optical properties
LO2	To explain illustrate the vibratin of solids
LO3	To describe the electric properties of solids
LO4	To understand the Magnetism
LO5	To learn the di electrics

Unit I : Imperfection and opticatproperties

Classificaton of imperfection - point defect, interstitious defect, volume defect, schottky *defect, F*renkel defect, vacancy defect, line defect - Screw & edge Dislocation-Burger vector, colour centres and colouration.

Ordered phases of matter : Translational and orientation order – Kinds of liquid crystalline order – Quasi crystal – Super fluidity.

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.

Course Outcome:

At the end of the course, student will be able to

CO1	Explain the fundamental theory of imperfections
CO2	Brief out the various concepts of vibrations
CO3	Describe the elementary ideas of electrical properties of solids
CO4	Elaborate the utilization of magnetism
CO5	Illustrate the outline of application of di electrics

Course Outcome Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	2	3	3	2	2
CO2	3	3	3	2	3
CO3	2	3	3	2	2
CO4	3	3	3	2	3
CO5	2	3	3	2	2

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. Kiitel, 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

Learning Objectives

LO1	To give strong foundation in the conceptual understanding of the physical properties of Nucleation growth
LO2	To make learning of solution and gel
LO3	To study the Theory of melt and vapour growth techniques
LO4	To create an understanding on the thin films
LO5	To develop analytical thinking to characterisation technique

Unit I: 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 FHms - Thin Film Structure - Crystal System and Symmetry.

Unit II: 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 III : 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 IV : 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 V: Characterization Technique

X - Ray Diffraction (XRD) - Powder and single crystal – SEM - TEM – SPM – AFM – UV, FTIR – Photoluminisence - Elemental anacharacterisationlysis - EDX - 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),

Course Outcome:

At the end of the course, student will be able to

CO1	Give strong foundation in the conceptual understanding of the physical properties of crystals.
CO2	Have learning of Theory of Electrons and Dielectric Properties of Solids
CO3	Understand the Theory of Ferroelectrics and Piezo Electrics
CO4	Learn the principles of Magnetic Properties of Materials
CO5	Know about nano particles and their applications.

Course Outcome Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	2	2	3
CO2	2	3	2	3	2
CO3	2	2	2	3	2
CO4	2	2	2	3	2
CO5	3	3	2		

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. Witlard, L.L. Merritt, J A. Dean, F.A. Settle, CBS, Publishers and Distributors, New Delhi.

CORE PRACTICAL XII

PHYSICS PRACTICAL III

(GENERAL AND ELECTRONICS) OBJECTIVE

Learning Objectives

LO1	To make the students to understand experimental physics
LO2	To apply the theoretical knowledge for developing new devices
LO3	To study the aspects related to the application side of the experiments
LO4	To provide a hands-on learning experience and understand the basic concepts

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

Any **FIFTEEN** experiments (At least SIX experiments from each part)

A. General Experiments

1. Determination of q, n, σ by hyperbolic fringes method
2. Determination of thermal conductivity of a good conductor - Forbe's method
3. Determination of bulk modulus of a liquid using ultrasonic interferometer
4. Planck's constant- Photoelectric cell
5. Band gap energy of a semiconductor — Four-probe method
6. Determination of L of a coil by Anderson's method
7. Determination of e/m of an electron by Thomson's method
8. Determinations of wavelength of a laser source using plane diffraction grating and thickness of a wire
9. Polarizability of liquids by finding the refractive indices at different wavelengths
10. Study of a fiber optic cable — Numerical aperture and other parameters
11. Magnetic susceptibility of a paramagnetic solution using Quincke's tube method
12. Determination of specific rotator power of a liquid using polarimeter
13. Four-probe method - Determination of resistivities of powdered samples
14. Determinatipn of magnetic susceptibility of liquid by Guoy method
15. Determination of coefficient of coupling by AC bridge method

B. Electronics Experiments

1. Characteristics of LED and photo diodes
2. Characteristics of laser diode and tunnel diode
3. Digital to analog converters using op-amp
4. Study of phase-shift oscillator using op-amp
5. Design and study of Schmitt trigges using op-amp
6. Flip-flops — - RS, JK and D
7. Decoder and encoder
8. Temperature coefficient using 555 timer
9. Design of pre-emphasis and de-emphasis circuits
10. Pulse-width and pulse-position modulations

Course Outcome Mapping:

	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	2	2
CO2	3	3	3	2	3
CO3	2	3	3	2	2
CO4	3	3	3	2	3
CO5	2	3	3	2	2

*****

CORE XIII - ADVANCED MATERIALS

Learning Objectives

LO1	To create a basic knowledge smart materials.
LO2	To know the significance of semiconducting maerials
LO3	To enable the criteria about non linear maerials
LO4	To demonstrate the different regulatory as magnetic material
LO5	To Know the basic about Transport of bio materials

UNIT I: Smart materials

Classification - Properties - SMA (Shape Memory Alloys) :- Fundamental characteristics -principle of shape memory effect - Hysteresis - 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 II: Semiconducting materials

Intrinsic semiconductor-Carrier concentration in 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 III: Nonlinear materials

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

UNIT IV: 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 V : 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.

At the end of the course, student will be able to

CO1	Understand the characteristics of smart materials
CO2	Gain knowledge in semi conducting materials
CO3	Realize the role of non linear materials
CO4	Explain with the essentials of nonlinear mterials
CO5	Familiarize with bio materials

Course Outcome Mapping:

	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	2	2
CO2	3	3	3	2	3
CO3	2	3	3	2	2
CO4	3	3	3	2	3
CO5	2	3	3	2	2

Books for study

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

ELECTIVE COURSE IV
NANOSCIENCE

Learning Objectives

LO1	To create a basic knowledge in nano materials.
LO2	To know the significance of nanomaterials.
LO3	To enable the students to explore the field of nanomaterials.
LO4	To demonstrate the different tools for the characterization of synthesized materials.
LO5	To Know the basic about thin films

UNIT I : INTRODUCTION TO THE NANOWORLD

Introduction - Historical perspective on Nanomaterial - Classification of Nanomaterials -Quantum mechanics of low dimensional systems - Bound states and density of states: 3D,2D, ID and OD -Quantum confinement - Quantum wells, wires and dots - size dependent properties- Mossbauer effect - surface Plasmon resonance - single electron tunneling.

UNIT II: METALS, SEMICONDUCTORS AND CERAMICS NANOCRYSTALS

Reduction of size - Synthesis of metal nanoparticles and structures - Routes to arrangements -Background on Quantum Dot semiconductors - background on reverse Micellar solution -Synthesis of Semiconductors - Cadmium Telluride Nanocrystals - Cadmium sulfide Nanocrystals - Alloy Semiconductors - 2D and 3D Superlattices of Silver Sulfide Nanocrystals-Synthesis of Ceramics - Bondings and defects - Chemical, Physical and Mechanical properties of Ceramics.

UNIT III: NANOPARTICLES AND MAGNETISM

Magnetism in particles of reduced size and dimensions - Single domain particles and super paramagnetism - magnetism in clusters of nonmagnetic solids - magnetic behavior of small particles - diluted magnetic semiconductors (DMS) - Fe - DMS and II-VI Mn DMS and their applications - intermetallic compounds - binary and ternaries and their magnetic properties. Importance of nanoscale magnetism.

UNIT IV : CHEMICAL AND CATALYTIC ASPECTS OF NANOCRYSTALS

Nanomaterials in Catalysis - Nanostructured Adsorbents - Nanoparticles as new Chemical reagents - Specific Heat and Melting Points of Nanocrystalline Materials: Specific Heat of Nanocrystalline materials - melting points of Nanoparticle materials.

UNIT - V : APPLICATION OF NANOMATERIALS

Molecular Electronics and nano electronics, nanoboats, Biological applications, band gap engineered quantum devices - nanomechanics - carbon nanotube emitters, photoelectrochemical cells - photonic crystal and Plasmon wave guides - Structural and Mechanical materials - Colorants and Pigments.

At the end of the course, student will be able to

CO1	create a basic knowledge in nano materials.
CO2	know the significance of nanomaterials.
CO3	enable the students to explore the field of nanomaterials.
CO4	demonstrate the different tools for the characterization of synthesized materials.
CO5	Know the basic about thin films

Course Outcome Mapping:

	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	2	3
CO2	3	2	3	2	3
CO3	3	2	2	2	3
CO4	2	2	2	2	2
CO5	3	2	2	2	3

BOOKS FOR STUDY:

1. Nanoscale Materials in Chemistry - Kenneth J.Klabunde, A John Wiley & Sons, Inc..Publication, 2009.
2. Nanoscience and Nanotechnology: Fundamentals to Frontiers - M.S.Ramachandra Rao, Shubra Singh, Wiley, First Edition, 2013.

BOOKS FOR REFERENCE:

1. Introduction to Nanotechnology - Charles PPoole, Frank J. Owens, Wiley- India, 2009.
2. Xanostructures and Nanomaterials synthesis, properties and applications - Guozhong Gao, Imperial College Press, London, 2004.
3. Metal Oxides - V. Henrich, PA.Cox, Cambridge University Press, New York, 1994.
4. NATO ASI Series, Science and Technology of Nanostructured Magnetic Materials - Ed. George C. Hadjipanyis and Gary A.Prinz,, Plenum Press, New York, 1991.
5. Introduction to Magnetism and Magnetic Materials - DJiles, Chapman and Hall, London, 1991.
6. Physics and Chemistry of Metal Cluster Compounds - J.de Jongh, Kluwer Academic Publishers, Dordrecht, 1994.

CORE PRACTICAL XIV

PHYSICS PRACTICAL IV

(ELECTRONICS)

Learning Objectives

LO1	To make the students to understand experimental physics
LO2	To apply the theoretical knowledge for developing new devices
LO3	To study the aspects related to the application side of the experiments
LO4	To provide a hands-on learning experience and understand the basic concepts

.

Any **FIFTEEN** experiments

1. Characteristics of LVDT
2. Characteristics of LDR
3. Characteristics of strain guage
4. Characteristics of load cell
5. Characteristics of torque transducer
6. Calibration of thermistor
7. Digital to analog converter — R-2R and weighted method
8. Study of frequency multiplexer using PLL
9. Digital comparator using XOR and NAND gates
10. Study of Hall effect
11. Four bit binary up and down counter using IC 7473
12. BCD to 7 segment display
13. Study of RAM
14. Study of A/D converter — Counter ramp type method
15. Study of Arithmetic Logic Unit (ALU) - IC 74181
16. Construction and study of characteristics of Chua's diode
17. Study of nonlinear dynamics of Chua's circuit
18. Construction of memristor
19. Pulse code modulation and demodulation
20. Voltage controlled oscillator using IC 555
21. Microwave IC - Filter Characteristics
22. Characteristics of a voltage dependent resistor (VDR)
23. Transmission characteristics of optical fiber link
24. Design of AC/DC voltage regulator using SCR
25. Characteristics of Gunn diode oscillator

*****