POPE'SCOLLEGE

(Autonomous)

(Accredited by NAAC-II with 'A' Grade (CGPA: 3.28)

C.S.I.-THOOTHUKUDI-NAZARETH DIOCESE

SAWYERPURAM-62825

(AFFILIATED TO MANONMANIAM SUNDARANARUNIVERSITY)

PG & RESEARCH DEPARTMENT OF PHYSICS

M.Sc. PHYSICS - SYLLABUS

Learner Outcome Based Curriculum Framework (LOCF)

(2021 onwards)

LEARNING OUTCOME BASED CURRICULUM FRAMEWORK

VISION

To promote and celebrate excellence of the students in the field of new horizons of Physics by inculcating critical thinking, engaging them to work out in vast areas of research by means of its benefit to the society.

MISSION

- To impart quality education in Physics to the rural and economically weaker students.
- To develop logical thinking and skills among the students in supporting them for a better career.
- To promote effective teaching for getting content knowledge and to explore more new inventions.
- To provide an environment promoting the students for research in the needy fields.

ELIGIBILITY FOR ADMISSION:

Bachelor's degree with Physics, Electronics, Advanced Physics and Applied Physics approved by syndicate of Manonmaniam Sundaranar University / other recognized University by UGC.

PROGRAM OUTCOME (PO)

PO1	**Physics knowledge, Problem analysis and Design/development of solutions:** Create a comprehensive scientific knowledge, which will help to understand, explain, and to solve advanced scientific problems; identify, formulate and analyse ingenious complex problems in Physics.
PO2	D**evelopment of Practical Skill, Modern tool usage and Project management:** Use methodology and knowledge of Physics to design innovative experiments, analyse and interpret the data; Apply modern experimental and theoretical tools of Physics along with modern computation technology to predict and design advanced problems in Physics and to apply it for research and development activities.
PO3	**Ethics and Communication:** Apply and commit to professional ethics of Physics; Communicate the latest new inventions in Physics to the society through effective presentation, reports, projects and documentation.
PO4	**Physics and society:** Create an awareness of the impact of Physics on the society and apply the knowledge of Physics to critically assess and analyse the problems of society.
PO5	**Life-long learning:** Recognise the need to engage in independent and life-long learning in the context of scientific/ technological change.

PROGRAM SPECIFIC OUTCOME (PSO)

PSO1	Learn the major areas of classical mechanics, quantum mechanics, electromagnetism, electronics, microprocessors, structure of solid materials and their different physical properties along with metallurgy, material science and the fundamental theory of nature at small scale and levels of atom and subatomic particles.
PSO2	Develop proficiency in the analysis of complex physical problems and the use of mathematical or other appropriate techniques to solve them.
PSO3	Provide a systemic understanding of Physics concepts, principles and theories along with their applications.
PSO4	Identify and interpret data from a range of sources that include books, scientific reports, journals and the internet.
PSO5	Demonstrate engagement with current research and developments in the subject.

POPE'S COLLEGE (AUTONOMOUS) Sawyerpuram -628 251

Accredited by NAAC – II Cycle with 'A' Grade (CGPA:3.28)

Department of Physics and Research Centre

Post Graduate Programme

LOCF (Choice Based Credit System)

Course Structure of the Curriculum

(With effect from Academic Year 2021 - 2022 onwards)

Parts of the Curriculum	No. of Courses	Total No. of Credits	Total Marks
Core Theory (I – VI Semester)	12	60	1200
Core Practical	04	10	400
Core Project (IV Semester	01	05	100
Discipline Specific Elective (I – III Semester)	03	15	300
Self-Study Course (MOOCs) (I Semester)	–	02 *	–
Summer Training Programme (II Semester)	–	02 *	–
Self-Study Course (III Semester)	–	02 *	–
Total	**20**	**90 + 6 = 96**	**2000**

*** Not considered for Grand Total and CGPA**

POPE'S COLLEGE (AUTONOMOUS) Sawyerpuram -628 251

Accredited by NAAC – II Cycle with 'A' Grade (CGPA:3.28)

Department of Physics and Research Centre

Post Graduate Programme

LOCF (Choice Based Credit System)

Course Structure for M.Sc. Physics

(With effect from Academic Year 2021 - 2022 onwards)

Sem	Subject Code	Title of the Paper	Hours /Week	Credits
I	21PPHM11	Core –1 Mathematical Physics - I	6	5
	21PPHM12	Core -2 Classical Mechanics	6	5
	21PPHM13	Core – 3 Integrated Electronics	6	5
	21PPHE11	Discipline Specific Elective – 1 a) Non Linear Dynamics	6	5
	21PPHE12	b) Renewable Energy		
	21PPHMP1	Practical – 1 Advanced Physics Lab – I(General Physics - I)	3	-
	21PPHMP2	Practical – 2 Advanced Electronics	3	-
		Self Study Course (MOOCS)	-	2
		Total	**30**	**20 + 2**
II	21PPHM21	Core –4 Mathematical Physics - II	6	5
	21PPHM22	Core - 5 Solid State Physics	6	5
	21PPHM23	Core – 6 Statistical Mechanics	6	5
	21PPHE21	Discipline Specific Elective – 2 a) Numerical Methods and Programming in C^{++}	6	5
	21PPHE22	b) Microprocessor and Microcontroller		
	21PPHMP1	Practical – 1 Advanced Physics Lab – I (General Physics - I)	3	3
	21PPHMP2	Practical – 2 Advanced Electronics	3	2
		Summer Training Programme	-	2
		Total	**30**	**25 + 2**
III	21PPHM31	Core – 7 Quantum Mechanics – I	6	5
	21PPHM32	Core - 8 Electromagnetic Theory	6	5
	21PPHM33	Core – 9 Molecular Spectroscopy	6	5
	21PPHE31	Discipline Specific Elective – 3 a) Research Methodology	6	5
	21PPHE32	b) Nano Physics		
	21PPHMP3	Practical – 3 Advanced Physics Lab – II (General Physics- II)	3	-
	21PPHMP4	Practical – 4 Microprocessor and C^{++} Programming	3	-
		Life Skill Training (LST)	-	2
		Total	**30**	**20 + 2**
IV	21PPHM41	Core – 10 Quantum Mechanics - II	6	5
	21PPHM42	Core - 11 Materials Science	6	5
	21PPHM43	Core – 12 Nuclear and Particle Physics	6	5
	21PPHM4P	Discipline Specific Elective – 4 Project	6	5
	21PPHMP3	Practical – 3 Advanced Physics Lab – II (General Physics- II)	3	3
	21PPHMP4	Practical – 4 Microprocessor and C^{++} Programming	3	2
		Total	**30**	**25 + 2**
		Over all Total	**120**	**90 + 8**

PC/ 2021-2022 / PG / Physics / Semester – I

Core	Sub Code	MATHEMATICAL PHYSICS - I	Hrs./ Week	Credits:
01	21PPHM11		06	05

Objective	**:**	1. To solve the various differential equations 2. To study the Fourier transform and Laplace transform 3. To apply suitable mathematical methods to solve problems in physics
Unit I	**:**	**VECTOR ANALYSIS** Linear vector space - linear dependence - independence of vectors – Schimidts Ortho-normalisation - Classification of vector fields - Gauss divergence theorem - Deductions from Gauss divergence theorem -Stoke's theorem - Green's theorem - Green's theorem in a plane.
Unit II	**:**	**MATRICES** Square matrices - rank of a matrix – Properties - Hermitian matrix orthogonal, unitary. matrix – And its Theorems Eigen values; Eigen Vectors - Characteristic equation of matrix - Cayley Hamilton theorem – Square Matrix –Solving simultaneous equations- Gauss elimination method Power of matrices - Exponential of a matrix – Matrices in Physics.
Unit III	**:**	**SPECIAL FUNCTIONS I** Bessel differential equation and Bessel's function of I kind - Generating function - Recurrence relations – Orthogonality – Legendre Polynomial - Generating function - Recurrence relations – Orthogonality - Legaurre's differential equation and Legaurre polynomial - Generating function - Recurrence relations - Orthogonality – Rodriguez formula.
Unit IV	**:**	**FOURIER INTEGRAL TRANSFORMS** Fourier's transform (FT) - Properties of FT - FT of a derivative - Fourier sine and cosine transforms of derivatives - FT of functions of two or three variables - Finite FT - Simple applications of FT.
Unit V	**:**	**LAPLACE INTEGRAL TRANSFORMS** Laplace Transform (LT) - Properties of LT- t-shifting , s- shifting theorems- LT of derivation of a function - LT of periodic functions - Properties of inverse LT - Convolution theorem - Evaluation of inverse LT by convolution theorem - Application of LT.
Text Book	**:**	1. Mathematical Physics - Sathya Prakash, Sultan Chand & Sons. New Delhi. 2. Matrices and Tensors - A.W.Joshi, New Age International Publication ,New Delhi,2010. 3. Vector Analysis - Murray, R.Spiegel-II Edition, McGraw Hill,New Delhi,2009.

References	**:**	1. Applied Mathematics for Engineers and Physics - Louis A. Pipes Lawrence R. Harvill, Mc Graw Hill Ltd., 1970. 2. Mathematical Physicsists, Eugine Buthov, Addision Wesley, 1973. 3. Mathematical Physics - B. D. Gupta, Vikas Publication House, New Delhi,1994. 4. Engineering Mathematics – H.K. Dass, S. Chand, 2007.

COURSE OUTCOME

1. Understand Linear Vector Space and solve various vector problems using Gauss , Stoke's and Green's theorem
2. Determine Eigen values and vectors and solve simultaneous equations
3. Solve Legendre and Lagurre's differential equations
4. Apply Fourier transforms to solve problems in physics
5. Utilize LT and inverse LT to simplify complex and periodic differential equations

	PO1	PO2	PO3	PO4	PO4	PSO1	PSO2	PSO3	PSO4	PSO5
CO1										
CO2										
CO3										
CO4										
CO5										

PC/ 2021-2022 / PG / Physics / Semester – I

Core	Sub Code	CLASSICAL MECHANICS	Hrs./ Week	Credits:
02	21PPHM12		06	05

Objective	:	1. To acquire knowledge and understanding of Lagrangian and Hamiltonian formulation of mechanics 2. To solve the equations of motion for complicated mechanical systems using Lagrangian and Hamiltonian formulation of Classical Mechanics 3. To apply the methods of Lagrangian Dynamics to the study of small oscillations and the motion of rigid bodies
Unit I	:	**FUNDAMENTAL PRINCIPLES AND LAGRANGIAN FORMULATION** Variational Principles - Constraints - Generalised co-ordinates - Principle of Virtual work - D'Alembert's principle and Lagrange's equations - Applications of Lagrange's equations to simple pendulum, Atwood's machine and rolling mass inside a circular ring - Hamilton's principle - Lagrange's equation from Hamilton's principle.
Unit II	:	**MOTION UNDER A CENTRAL FORCE** Central force motion – Definition and characteristics - Reduction of two body problem to equivalent one body problem –Equation of the orbit and its stability - Motion under inverse square law - Kepler problem - Virial theorem –Scattering in a central force field - Rutherford scattering.
Unit III	:	**RIGID BODY DYNAMICS** Mechanics of a rigid body – Degrees of freedom of a rigid body - Orthogonal transformation – Coriolis effect– Eulerian angles - Kinematics of a rigid body, moments and products of inertia - K.E.of a rigid body - Euler's equation of motion - Torque free motion.
Unit IV	:	**MECHANICS OF SMALL OSCILLATIONS** Stable and unstable equillibrium - Formulation of the problem - Properties of T,V and ω - Normal Co-ordinates and normal frequencies of vibration - Free vibrations of linear triatomic molecule – Double pendulum.
Unit V	:	**HAMILTON'S FORMULATION** Hamilton's equation from variational principle - Principle of least action - Canonical transformations – Generating functions – Condition for a transformation to be canonical - Poisson brackets - Equation of motion and conservation theorems in Poisson's brackets - Hamilton Jacobi method - Application to Harmonic osciallator - Hamilton's characteristic function - Separation of variable - Action angle variables - Kepler problem in action angle variables.
Text Book	:	1. Classical Mechanics, Third Edition. Herbert Goldstein, Charles P. Poole John Safco, Pearson, Chennai.,3rd edition 2001.

		2. Classical Mechanics, Gupta Kumar, Sharma, Prakati Prakashan, Meerut, 2001. 3. Classical Mechanics, G. Aruldhas, PHI Learning Pvt. Ltd., New Delhi, 2008.
References	**:**	1. Classical Mechanics – J.C. Upadhyaya, I Edition, Himalaya Publishing House, Mumbai, 1999. 2. Classical Mechanics – N.C. Rana & P.S. Joag, Tata McGraw Hill, New Delhi, 1991. 3. Classical Electrodynamics – Jackson, II Edition. Willey Eastern Ltd, New Delhi, 1986.

COURSE OUTCOMES:

1. Apply Lagrangian formulation to solve problems in Classical Mechanics.
2. Derive Kepler's laws and scattering problem in central force field.
3. Discuss the rigid body motion and the origin of Coriolis and Centrifugal force terms in the equation of motion.
4. Utilize the theory of Small oscillations to find the normal frequencies and normal modes of vibrations.
5. Compare the motion of a mechanical system using Hamiltonian formulations and Hamilton Jacobi method.

	PO1	PO2	PO3	PO4	PO4	PSO1	PSO2	PSO3	PSO4	PSO5
CO1										
CO2										
CO3										
CO4										
CO5										

PC/ 2021-2022 / PG / Physics / Semester – I

Core	Sub Code	MATHEMATICAL PHYSICS - I	Hrs./ Week	Credits:
03	21PPHM13		06	05

Objective	**:**	1. To understand the principle and working of different Semiconductor devices. 2. To know the fundamentals of integrated circuits 3. To acquire knowledge about different types of sensors and transducers.
Unit I	**:**	**DEVICES, APPLICATIONS AND INTEGRATED CIRCUITS** FET – types of FET – characteristics and application of FET, MOSFET, SCR, DIAC, TRIAC – high frequency devices – Integrated circuits, IC fabrication technology – Integrated resistors and capacitors – VLSI technology.
Unit II	**:**	**DIGITAL ELECTRONICS** Flip flops – RS,T, D,JK and JK Master-slave- Asynchronous counter and synchronous counters - Registers – AD/DA Converter
Unit III	**:**	**OPERATIONAL AMPLIFIER AND APPLICATIONS** Characteristics and parameters – DC analysis of IC- Op-Amp-Instrumentation amplifier – sample and hold system – Analog multiplexer-Integrator – differentiator – Waveform generators -Design of analog circuits for the solution of simultaneous and differential equation- filters- low, high and band pass filters – Butterworth filter – II Order filter
Unit IV	**:**	**TIMER, VCO, PLL AND APPLICATIONS** Timer 555 IC, internal architecture and working – Modes of operation - monostable and astable operation applications – voltage controlled oscillator – IC 566 - PLL concept – PLL IC 565 Application – Frequency multiplexer - FSK modulation and Demodulation.
Unit V	**:**	**TRANSDUCERS** Transducers characteristics - selection of an instrumentation transducer - Types of transducers –Temperature transducers - Thermistors –Thermal radiation temperature measurements - low temperature thermometry – Photo conductive and Photo emissive detectors.
Text Book	**:**	1. Introduction to Semiconductor Devices - M. S. Tyagi, John Wiley and Sons, New Delhi, 2012. 2. Digital Electronics –V. K. Puri, Tata McGraw Hill, New Delhi, 1997.

References	**:**	1. Intergrated Electronics –Millman, Christos and Halkias, McGraw Hill Publication Singapore, 1987. 2. Linear Integrated Circuits – D. Roy Choudhury and B. Jain-New Age International Publication, New Delhi, 2010.

COURSE OUTCOME

1. Discuss the working of different Semiconductor devices
2. Understand the fundamental designing concepts of different types of Logics and IC fabrication technique
3. Utilize operational amplifier for different analog and digital applications
4. Design circuits using timer ICs
5. Explain the applications of transducers and sensors

	PO1	PO2		PO3	PO4	PO4	PSO1	PSO2	PSO3	PSO4	PSO5
CO1											
CO2											
CO3											
CO4											
CO5											

PC/ 2021-2022 / PG / Physics / Semester – I

DSE	Sub Code	NON LINEAR DYNAMICS	Hrs./ Week	Credits:
01	21PPHE11		06	05

Objective	**:**	1. To impart knowledge on linear and nonlinear dynamical systems. 2. To learn bifurcation processes and chaos in electronic circuits. 3. To describe qualitatively the behaviour of dynamical systems.
Unit I	**:**	**NONLINEARITY, LINEAR AND NONLINEAR OSCILLATORS** Dynamical systems - linear and nonlinear forces - Mathematical implications of nonlinearity- Working definition of nonlinearity - Effects of nonlinearity - Linear oscillators and predictability- Damped and driven nonlinear oscillators.
Unit II	**:**	**EQUILIBRIUM POINTS, BIFURCATIONS AND CHAOS** Equilibrium points-General criteria for stability-Classification-Some simple bifurcations -Saddle node, pitch fork, transcritical and Hopf bifurcations-Discrete dynamical systems - Logistic map -Equilibrium points and their stability - period doubling phenomenon - chaos.
Unit III	**:**	**CHAOS IN NONLINEAR ELECTRONIC CIRCUITS** Linear and nonlinear circuit elements - nonlinear circuits - Chua's diode-Autonomous case-Bifurcations and chaos - Chaotic dynamics of MLC circuit - Analog circuit simulation-Some other useful nonlinear circuit - Colpitt's oscillator.
Unit IV	**:**	**SOLITONS** Linear waves -Linear non dispersive wave propagation - Linear dispersive wave propagation-Nonlinear dispersive systems - Korteweg de vries equation- solitary and cnoidal waves - Numerical experiments of Zabusky and Kruskal-birth of solitons - Properties of solitons - applications of solitons.
Unit V	**:**	**FINITE DIMENSIONAL INTEGRABLE NONLINEAR DYNAMICAL SYSTEMS** Integrability – The notion of Integrability – Complete Integrability – Real time and complex time behavior – Partial Integrability and constrained Integrability – Integrability and separability – Painleve analysis – Classification of singular points – First order nonlinear ordinary differential equations and Kovalevskaya's rigid body problem – Second order nonlinear ordinary differential equations and Painleve's transcendental equations.
Text Book	**:**	Nonlinear Dynamics, Integrability, Chaos, Patterns by M. Lakshmanan and S. Rajasekar, Springer, Berlin, 2003.

References	**:**	1. Chaos in Nonlinear Oscillator, Controlling and Synchronization by M. Lakshmanan and K. Murali. (World Scientific, Singapore, 1997.) 2. Deterministic chaos by H.G. Schuster, (Verlag, Weinheim,1998.) 3. Non linear dynamics and Chaos – Steven H. Strgatz – 1st Edition, CRC press, 2000.

COURSE OUTCOME

1. Understand the fundamentals of linear and nonlinear dynamical systems.
2. Identify the types of bifurcation processes in nonlinear dynamical systems.
3. Discuss the chaotic behaviour of non linear electronic circuits
4. Explain the properties and applications of solitons.
5. Summarise the key aspects of integral systems.

	PO1	PO2	PO3	PO4	PO4	PSO1	PSO2	PSO3	PSO4	PSO5
CO1										
CO2										
CO3										
CO4										
CO5										

PC/ 2021-2022 / PG / Physics / Semester – I

DSE	Sub Code	RENEWABLE ENERGY	Hrs./ Week	Credits:
02	21PPHE12		06	05

Objective	:	1. To compare the Indian Energy scenario in relation to natural and human aspects of the environment. 2. To understand the various renewable energy sources 3. To acquire knowledge about different energy storage technologies.
Unit I	:	**INTRODUCTION** Primary and secondary energy – Commercial and non commercial energy – renewable and non – renewable resources and their importance – World energy use – reserves of energy resources–energy cycle of earth – Indian energy scenario – Long term energy scenario for India – environmental aspects of utilization.
Unit II	:	**SOLAR AND BIO ENERGIES** Introduction – extra - terrestrial solar radiation – radiation at ground level- collectors – Solar cells – application of solar energy – Biomass energy – biomass conversion – bio gas production – ethanol production – pyrolysis and gasification – direct combustion – application.
Unit III	:	**WIND ENERGY** Basic theory – types of turbines – applications geothermal energy – Introduction– geo thermal resources types – resource base – application for heating and electricity generation – Tidal energy–Introduction – origin of tides – Power generation scheme – wave energy – Introduction – basic theory – wave power devices.
Unit IV	:	**OTHER RENEWABLE ENERGY SOURCES** Open and closed OTEC cycles – bio-photolysis – ocean current - hydropower– introduction–basic concept–site selection–types of turbine–small scale hydropower – magneto hydrodynamics (MHD), Thermoelectric and Thermionic energy resources – basic principles – power generation – nuclear energy – basic principle – power generation (basic ideas only).
Unit V	:	**ENERGY STORAGE** Fuel cells – design and principle – classification – types – advantages and disadvantages – applications – Batteries – Introduction – Theory – Different types of batteries arrangements–classification of batteries–advantages of batteries for bulk storage– Hydrogen energy – production – electrolysis –thermochemical methods – solar energy method – hydrogen storage.
Text Book	:	1. Non-Conventional Energy Sources by G. D. Rai, Khanna Publishers, New Delhi, 1984 2. Alternate Energy Sources by T.N. Veziroglu, Vol.5 and 6, McGraw - Hill, 1978

References	**:**	1. Solar Energies of Thermal Processes by A. Duffieand W. A. Beckmann, John - Wiley, 1980 2. Principle of Solar Engineering by F. Kreith and J.F. Kreider, McGraw-Hill, 1978. 3. Solar energy–Principle of Thermal Collection and Storage by S.P. Sukhatme and K. Nayak, Tata Mc Graw Hill, 2008.

COURSE OUTCOME

1. Compare the Indian Energy scenario in relation to global energy scenario.
2. Distinguish the energy harvesting techniques of renewable energy sources
3. Analyze the energy crisis, the effective energy management, energy storage, and possible solutions.
4. Develop self-learning capability to establish renewable energy systems.
5. Explain about different energy storage technologies.

	PO1	PO2	PO3	PO4	PO4	PSO1	PSO2	PSO3	PSO4	PSO5
CO1										
CO2										
CO3										
CO4										
CO5										

PC/ 2021-2022 / PG / Physics / Semester – II

Core	Sub Code	MATHEMATICAL PHYSICS - II	Hrs./ Week	Credits:
04	21PPHM21		06	05

Objective	**:**	1. To acquire knowledge in complex variables and group theory. 2. To understand special functions applied to physics. 3. To know about partial differential equations and tensors.
Unit I	**:**	**COMPLEX ANALYSIS** Functions of complex variable - Analytic functions - Cauchy - Riemann differential equation - Harmonic functions - Cauchy's integral theorem - Cauchy's integral formula -Derivatives of analytic functions - Residues and their evaluations - Cauchy's residue theorem.
Unit II	**:**	**GROUP THEORY** Concept of a group - Abelian group - Cyclic group - Subgroup - Coset - Classes -Conjugate subgroups - Isomorphism and homomorphism - Reducible and irreducible representations - Some important theorems on representations - Orthogonality theorem – Enumeration of normal modes of H_2O molecule.
Unit III	**:**	**SPECIAL FUNCTIONS II** Hermite differential equation and Hermite polynomial - Generating function - Orthogonality - Recurrence relations – Gamma and Beta functions – Transformation of Gamma function - Transformation of Beta function – Relation between Gamma and Beta functions - Problems.
Unit IV	**:**	**PARTIAL DIFFERENTIAL EQUATIONS** Solution of heat flow equation (Method of separation of variables) – Linear flow in semi-infinite solid: Temperature on one face given as sinusoidal function of time – Variable linear flow in an infinite bar – two dimensional heat flow - three dimensional heat flow – Heat flow in circular plate (use of cylindrical co-ordinates) – Equation of motion for the vibrating string – Vibrations of a rectangular membrane - Vibrations of a circular membrane
Unit V	**:**	**TENSOR ANALYSIS** Scalar, contravarient and covarient vectors – Kronekar delta function - Tensor of higher ranks -Algebraic operations of tensors - Symmetric and anti-symmetric tensor - Fundamental tensor - Tensors in dynamic of a particle - Tensors in elasticity - Moment of inertia tensor.
Text Book	**:**	1. Mathematical Physics with Classical Mechanics by Sathya Pakash, Sultan Chand &Sons, New Delhi, 2014. 2. Elements of Group theory by A.W.Joshi,New Age International Publishers,New Delhi,2008.

References	**:**	1. Applied Mathematics for Engineers and Physicists by Louis A.Pipes, Lawrence R, Harvill, McGraw-Hill Ltd, 1970 2. Matrices and Tensors in Physics by A.W.Joshi, 3rd edition, New Age International Publishers, New Delhi, 1995.

COURSE OUTCOMES

1. Understand the elements of complex analysis and important integral theorems.
2. Analyse group theory for deeper understanding of various branches of physics
3. Apply special functions and their recurrence relations.
4. Solve the partial differential equations in physical problems.
5. Explain physical laws in terms of tensors and simplify using coordinate transformations.

	PO1	PO2	PO3	PO4	PO4	PSO1	PSO2	PSO3	PSO4	PSO5
CO1										
CO2										
CO3										
CO4										
CO5										

PC/ 2021-2022 / PG / Physics / Semester – II

Core	Sub Code	SOLID STATE PHYSICS	Hrs./ Week	Credits:
05	21PPHM22		06	05

Objective	:	1. To acquire knowledge about crystal systems and bondings. 2. To classify the properties of magnetic materials. 3. To learn about dielectrics, ferroelectrics and super conductivity.
Unit I	:	**CRYSTALLOGRAPHY AND CRYSTAL BINDING** Classification of crystals - Two dimensional Bravais lattices - Bravais lattices in 3 dimensional –Crystal systems- crystals of inert gases - ionic crystals - covalent crystals – metals - hydrogen bonds - atomic radii - analysis of elastic strains-elastic compliance and stiffness constants-elastic wave in cubic crystals.
Unit II	:	**LATTICE VIBRATIONS** Lattice waves - properties of Lattice waves - vibrational modes of a finite one dimensional lattice of identical atoms - diatomic linear lattice - quantization of lattice vibrations – phonons momentum - Inelastic scattering by phonons, by long wave length phonons- X rays by phonons- neutrons by phonons
Unit III	:	**FREE ELECTRON THEORY, ENERGY BANDS AND SEMICONDUCTOR CRYSTALS** Energy levels in one dimension-free electron gas in three dimensions-heat capacity of the electron gas-Electrical conductivity and Ohm's law-Hall effect-thermal conductivity of metals - Bloch functions – Kronig - Penney model.
Unit IV	:	**DIA, PARA, FERRO AND ANTIFERRO MAGNETISM** Langevin diamagnetism equation - quantum theory of diamagnetism - quantum theory of paramagnetism - Hunds rules - Paramagnetic susceptibility of conduction electrons-ferromagnetic order- magnons - antiferro magnetic order - ferromagnetic domains - origin of domains.
Unit V	:	**DIELECTRICS, FERROELECTRICS AND SUPER CONDUCTIVITY** Macroscopic electric field - Local field at an atom - Dielectric constant and polarizability - Structural phase transitions - Ferroelectric crystals - Ferroelectric domains - Piezoelectricity - occurrence of superconductivity - Meissner effect - thermodynamics of superconducting transition - London equation - coherence length - BCS theory of superconductivity - single particle tunnelling - DC Josephson and AC Josephson effects.

Text Book	**:**	1. Introduction to Solid State Physics by Charles Kittel, Seventh Edition Wiley- India Sixth reprint 2007. 2. Elementary Solid State Physics by Ali Omar. M, Darling Kingsly Pvt. Ltd, New Delhi,2009.
References	**:**	1. Solid State Physics by R. J. Singh, Pearson, First Impression, New Delhi, 2012 2. Solid State Physics by S. O. Pillai, New Age International Publishers, New Delhi, Jan 2015. 3. Introduction to Condensed Matter Physics by K.C. Barua, Narosa Publishing house (P) Ltd, New Delhi, 2009 4. Solid State Physics by H. Ibach and H. Luth – Springer International Edition, Springer India (P) Ltd, New Delhi, 2004.

COURSE OUTCOME

1. Understand the classification of crystals and types of bondings
2. Predict electrical and thermal properties of metals and semiconductors.
3. Discuss the concept of energy bands and electrical properties.
4. Classify the magnetic materials and its properties
5. Distinguish the concepts of dielectrics, ferroelectrics and super conductivity.

	PO1	PO2	PO3	PO4	PO4	PSO1	PSO2	PSO3	PSO4	PSO5
CO1										
CO2										
CO3										
CO4										
CO5										

PC/ 2021-2022 / PG / Physics / Semester – II

Core	Sub Code	STATISTICAL MECHANICS	Hrs./ Week	Credits:
06	21PPHM23		06	05

Objective	**:**	1. To develop the connection between statistical and thermodynamic quantities. 2. To understand the parameters of black body radiation and Planck radiation laws. 3. To define one dimensional Ising model.
Unit I	**:**	**BASIC CONCEPTS** Phase space – phase - space diagram of an oscillator-Volume in phase space – Ensembles - Micro canonical ensemble - Canonical ensemble - Grand canonical ensemble - Density of distribution in phase space - Liouville's theorem-Postulate of equal a priori probability - statistical, mechanical and thermal equilibrium - connection between statistical and thermo dynamical quantities.
Unit II	**:**	**M-B DISTRIBUTION LAW** Microstates and macro states - Stirling's approximation-Thermodynamic probability - General statistical distribution law - Classical Maxwell - Boltzmann distribution law - Evaluation of constants in the Maxwell Boltzmann distribution law - Maxwell's law of distribution of velocities - Principle of equipartition of energy - Boltzman entropy relation-Probability of magnetic moment distribution of independent atoms.
Unit III	**:**	**QUANTUM STATISTICS** Postulatory foundations of quantum mechanics-Transition from classical statistical mechanics to quantum statistical mechanics - Indistinguishability and quantum statistics - Exchange symmetry of wave functions – Bose - Einstein Statistics – Fermi - Dirac statistics - Maxwell-Boltzmann statistics - Results of three statistics - Thermodynamic interpretation of the parameters α and β-Black body radiation and the Planck radiation law.
Unit IV	**:**	**APPLICATIONS OF QUANTUM STATISTICS** Specific heat of solids - Dulong and Petit law-Einstein theory of specific heat of solids - Debye theory of specific heat of solids - Criticism of Debye's theory - Ideal Bose Einstein Gas - Energy and pressure of the Gas-Gas degeneracy - Bose-Einstein Condensation - Thermal properties of Bose Einstein Gas-Ideal Fermi Dirac gas - Energy and pressure of the Gas - Thermodynamic functions of degenerate Fermi-Dirac gas - Electron Gas

Unit V	**:**	**PHASE TRANSITIONS** Phase transition - Phase transitions of first and second kind - Critical exponent -Yang and Lee theory-Phase transitions of second kind: the Ising model – Braggs - Williams approximation - One dimensional Ising model.
Text Book	**:**	1. Elementary Statistical Mechanics, 22nd Edition - Dr. S. L. Gupta & Dr. V. Kumar, Pragati Prakasan, Meerut, 2008. 2. Statistical Mechanics - Sathya Prakash and V.P.Agarwal, Pragati Prakasan, Meerut, 2002.
References	**:**	1. Fundamentals of Statistical Mechanics- B.B Laud, New Age international Publishers, New Delhi, 2005. 2. An Introductory Course of Statistical Mechanics, First reprint - Palash B. Pal, Narosa, 2009. 3. Thermodynamics, Kinetic Theory and Statistical Thermodynamics, 3rd Edition- Sears Salinger Narosa, 2013. 4. Statistical Mechanics- Gupta and Kumar, Pragati Prakshan, Meerut, 2002.

COURSE OUTCOME.

1. Design phase-space diagram.
2. Illustrate the probability of magnetic moment distribution of independent atoms.
3. Distinguish classical and quantum statistical mechanics.
4. Explain energy and pressure of the gas using quantum statistics.
5. Discuss the phase transition of first and second kind.

	PO1	PO2	PO3	PO4	PO4	PSO1	PSO2	PSO3	PSO4	PSO5
CO1										
CO2										
CO3										
CO4										
CO5										

PC/ 2021-2022 / PG / Physics / Semester – II

DSE	Sub Code	NUMERICAL METHODS AND PROGRAMMING IN C^{++}	Hrs./ Week	Credits:
02	21PPHE21		06	05

Objective	:	1. To solve problems in the field of Applied Mathematics, Theoretical Physics and Engineering which requires computing of numerical results using certain raw data 2. Choose, develop and apply the appropriate numerical techniques for different problem, interpret the results, and assess accuracy. 3. It is designed to provide complete knowledge of Object Oriented Programming through C++ and apply it to solve bigger computing problems
Unit I	:	**ROOTS OF EQUATIONS AND EIGEN-VALUE PROBLEMS** Newton - Raphson method ,Secant Method. Muller's Method - Lin -Bairstow's Method. Linear Algebraic Equations: Gauss elimination - Gauss-Jordan - Gauss-Jacobi - Inverse of a matrix by Gauss Jordan elimination method.
Unit II	:	**CURVE FITTING / INTERPOLATION** Curve fitting: Linear Least square fitting - Nonlinear Fit- Fitting a polynomial function, Exponential function - Cubic spline fitting – Interpolation: Fundamental theorem of finite difference, Finite difference interpolation with equally spaced: Newton's forward and backward difference formulae - Unequally spaced: Lagrangian interpolation formula.
Unit III	:	**NUMERICAL DIFFERENTIATION AND INTEGRATION** Numerical Differentiation : Methods based on interpolation: non uniform and uniform nodal points - Methods based on finite differences: forward & backward difference formulae. Numerical Integration: Trapezoidal Rule, Simpson Rule - Monte-Carlo evaluation of integration. Methods based on undetermined coefficients: Gauss-Legendre, Gauss - Lagurre, Gauss - Hermite integration methods.
Unit IV	:	**SOLUTION TO ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS** Ordinary differential equations - Taylor's series method- Euler's method-Euler's modified method - Runge -Kutta 2nd and 4th order methods – Predictor - Corrector methods - solution to partial differential equations
Unit V	:	**C++ PROGRAMMING APPLICATIONS** Programme structure: header files, local, global and static variables, input and output statements; Euler's Method: Charging and discharging of a condenser; Runge-Kutta methods: Radioactive Decay; Newton-Raphson method: Solution van der Waals equation; Gauss elimination method: Currents in Wheatstone's bridge; Linear fitting. - least square method : Cauchy's constant; Simpson's and Monte-Carlo methods : Evaluation of (integral) area under the curve;Eigenvalues and eigenvectors of symmetry matrices; Numerical differentiation: Newton's Law of cooling.

Text Book	**:**	1. Numerical Methods for Scientific and Engineering Computation, M. K. Jain, S. R. K. Iyengar, R.K. Jain, 3rd Edition, New age international (P) Ltd, Chennai, 1998. 2. Object Oriented Programming with C++, E. Balgurusamy, Tata Mc Graw Hill, New Delhi, 2000.
References	**:**	1. Numerical Methods in Science and Engineering 2nd Ed., M .K. Venketraman, National Publishing Co, Chennai, 2010. 2. Computer Oriented Statistical and Numerical Methods, E. Balagurusamy, Macmillan India Ltd, New Delhi 2000.

COURSE OUTCOME

1. Understand Numerical analysis which has enormous application in the field of Science and some fields of Engineering.
2. Summarise numerical integration and differentiation and numerical solution of ordinary differential equations
3. Discuss numerical solution of nonlinear equations using Bisection, Newton – Raphson and fixed-point iteration methods.
4. Apply various problem solving techniques and become proficient in problem solving.
5. Familiar with programming using numerical packages like C++

	PO1	PO2	PO3	PO4	PO4	PSO1	PSO2	PSO3	PSO4	PSO5
CO1										
CO2										
CO3										
CO4										
CO5										

PC/ 2021-2022 / PG / Physics / Semester – II

DSE	Sub Code	MICROPROCESSOR AND MICROCONTROLLER	Hrs./ Week	Credits:
02	21PPHE22		06	05

Objective	**:**	1. To understand the architecture of μp8085 and Microcontroller 8051 2. To learn the instruction set of μp8085 and to develop simple programs. 3. To develop simple interfacing systems.
Unit I	**:**	**INTRODUCTION TO 8085 MICROPROCESSOR** Pin diagram and description - Bus System, Control Signals, Status Signals - Clock System - Latching of Address Bus - Interrupt System - Direct Memory Access- Internal architecture - ALU- Registers organization - Special purpose Registers and Counters - Flags - Program Status Word.
Unit II	**:**	**PROGRAMMING 8085** Assembly Language Programming - Assembler - Instruction Format of 8085- Instruction Set - Addressing Modes - Instruction cycle, Machine cycle and T-States - Timing Diagram of Read, Write machine cycles and some basic Instructions - 8 bit and 16 bit addition and subtraction- Loops and Branching - Multiplication and division in 8085-Searching and sorting - Finding smallest/biggest number in an array - Time delay calculation- Stack and Subroutines - Software Interrupts and ISR- Data Transfer Schemes.
Unit III	**:**	**INTERFACING AND PERIPHERAL DEVICES** Address Space of 8085- Address space partition- Memory Interfacing - Memory map and Address decoding- Interfacing of RAM (2K x 8 & 4K x 8) and ROM (2K x 8 & 4K x 8) - I/O mapped I/O and Memory Mapped I/O interfacing Schemes - Ports- Interfacing chips: Nonprogrammable Port 8212 - Programmable Peripheral Interface (PPI) 8255 architecture, Control Signals and operating Modes - Programmable Interval Timer (PIT) 8253.
Unit IV	**:**	**MICRO CONTROLLER 8051** Introduction - Comparison of Microcontroller & Microprocessor - Pin Diagram and description - Block Diagram of 8051 and Internal Architecture - Clocks - Registers- Flags-Internal Memory, SFR and I/O Ports - External Memory and decoding- Instruction Set and Addressing Modes of 8051- Features available in 8051: Timer and Counters, Timer Modes -Serial Port and Serial Data Transfer.
Unit V	**:**	**MICRO PROCESSOR BASED SYSTEM DESIGN AND A APPLICATIONS** Design considerations - Sensors and Transducers - Sample and Hold Circuits- -Interfacing Keyboard and multiplexed seven segment displays - DAC and ADC interfacing - Square, Rectangular and Ramp Wave Generation - Temperature measurement and control - Digital Clock - Stepper Motor Control.

Text Book	**:**	1. Fundamentals of Microprocessor and Microcontrollers by B. Ram-Dhanpat Rai Publications, 5th Edition, 2001. 2. Microprocessor and microcontroller system (First Edition) by Godse and Godse , Technical Publication Pune, 2007 – 2008.
References	**:**	1. Microprocessor Architecture, Programming and Applications with the 8085, Ramesh S. Gaonkar-4th Ed. Penram International. 2. The 8051 Microcontroller Architecture, Programming and Applications - Kenneth J. Ayala - Penram International Publishing, 1991. 3. The 8051 Microcontroller and Embedded Systems Using Assembly and C, 2nd Ed. Muhammad Ali Mazidi, Janice G. Mazidi, Rolin D. McKinlay, Pearson India, 2007.

COURSE OUTCOME

1. Describe the architecture, pin configuration and various functions of microprocessor 8085
2. Develop simple programs using 8085 instruction set
3. Recognize interfacing the memory and peripheral devices
4. Explain the architecture, pin configuration of microcontroller 8051
5. Apply interfacing techniques to understand DAC, ADC and other applications

	PO1	PO2	PO3	PO4	PO4	PSO1	PSO2	PSO3	PSO4	PSO5
CO1										
CO2										
CO3										
CO4										
CO5										

PC/ 2021-2022 / PG / Physics / Semester – II

Core Practical	Sub Code	GENERAL PHYSICS - I	Hrs./ Week	Credits:
01	21PPHMP1		03	03

COURSE OBJECTIVE

1. To apply the theoretical knowledge to carry out the experiments.
2. To get hands on experience on advance experiments prerequisite for research
3. To develop the skills to analyse the data

COURSE OUTCOME

1. Learn various experimental tools thereby developing analytical abilities to address real world problems.
2. Develop the skills related to research, education, and industry
3. Compare the experimental results with theoretical values.
4. Apply the theoretical principles of optics in experiments
5. Compare the solar absorption spectrum and Fraunhofer lines.

1. **Susceptibility** a. Determination of susceptibility of the given paramagnetic solution by Quinke's method for various normalities, b. Determination of Magnetic Moment and Bohr Magnetron from graph and by calculation for various normalities.
2. **Cauchy's Constant** a. Determination of Cauchy's Constant by spectrometer. b. Verification of the experimental result with graphically obtained value.
3. **Michelson's Interferometer** Determination of wavelength of a source and thickness of a thin transparent medium by forming interference pattern,
4. **Anderson's Bridge** Determination of self inductance of the given coil - (different turns/coil).
5. **Force Constants** Calculation of force constants of a molecule from the vibrational spectral data - At least 3 spectrum
6. **Solar Absorption Spectrum** Importance of Solar absorption spectrum and Fraunhofer lines Determination of wavelength of various absorptions.
7. **Thickness of a thin material/ diameter of a thread.** Determination of thickness of a very thin material or diameter of a thread using LASER diffraction and also by Airwedge method. Comparison of the results. Variation in thickness/diameter with Load.
8. **Hyperbolic fringes** Determination of Young's modulus, Bulk modulus, Rigidity modulus, Poisson's ratio and compressibility of the given material by forming hyperbolic fringes.
9. **Ultrasonic Interferometer** Determination of velocity of ultrasonic sound in the given liquid and compressibility of the liquid.
10. **Young's Double Slit** Determination of .wave length of the light source or width of the double slit using Laser source for a) standard kit b) lab/custom made double slit

11. **Mutual Inductance** Determination of mutual inductance between a pair of coils. Study of variation of mutual inductance for various distances and angles between the coils and determination of coefficient of coupling in each case. Graphical determination of break in coupling for distance and angle.
12. **XRD - Crystallographic Parameters** a) Braggs' Law of Diffraction - derivation, b) Definition of Crystallographic Parameters - d-Spacing and lattice parameters. c) Crystal systems and d-spacing in different crystal systems. d) Content of ICDD file (formerly known as JCPDS) e) Determination of unit cell dimensions f) Crystal parameter for the given XRD spectrum.
13. **Optical Fiber Characteristics** Determination of a. Numerical aperture and acceptance angle b. Attenuation in the fiber and c. Loss due to air gaps and coupling.

	PO1	PO2	PO3	PO4	PO4	PSO1	PSO2	PSO3	PSO4	PSO5
CO1										
CO2										
CO3										
CO4										
CO5										

PC/ 2021-2022 / PG / Physics / Semester – II

Core Practical	Sub Code	ADVANCED ELECTRONICS	Hrs./ Week	Credits:
02	21PPHMP2		03	02

COURSE OBJECTIVES

1. To design and construct electronic circuits for practical applications.
2. To handle various electronic measuring instruments for the measurement of various parameters.
3. To get hands-on experience in the working principles of electronic circuits and semiconductor devices.

COURSE OUTCOMES

1. Understand the basic operations in electronic circuit.
2. Perform experiments for studying the behavior of semiconductor devices.
3. Design Op amp based electronic Circuits.
4. Construct waveform generation circuits using Op amps, Comparators and ICs.
5. Develop skills to interpret the experimental data.

1. Series Voltage Regulator Construction of a series voltage regulator using transistor (as an error amplifier) - study the regulation factors (line regulation, load regulation) - to find out the percentage of regulation.

2. Schmitt Trigger Designing of a Schmitt trigger circuit using transistors - Trace the input and output waveforms - Draw Hysteresis curve and calculate hysteresis voltage both theoretically and experimentally.

3. Wave Form Generators Construction of a triangular and a ramp wave generator using OP Amp and construction of 555 timer based square wave generator.Theoretical calculation of the frequency of the output wave for various R and C values with experimental verification.

4. Counters and Decoders Construction and study of Modulus counters (2 to 9) using IC 7490 or any equivalent IC. Use a 7 segment decoder and a 7 segment display to show output.

5. Analog to Digital Conversion Construction of ADC converter using Comparator and an Encoder ICs - Measurement of the digital outputs for various input voltages - Resolution measurement.

6. Construction of Constant Current Source Construction of a constant current source using OP Amp and transistor/ FET(floating and grounded load). IR chareteristics.

7. FET Characteristics and Amplifier Drain and Transfer characteristics of FET - FET parameters from the characteristics. Designing of a voltage amplifier using FET - Frequency response and bandwidth of the amplifier.

8. Filters Design and construction of II order Active Filters (Low pass, High Pass and band pass) using 1C 741 for a particular frequency - Draw frequency response curve for each case.

9. UJT Characteristics and Relaxation Oscillator Characteristics study of UJT - construction of a relaxation Oscillator. using UJT to produce the saw tooth wave. Frequency response of the output for various R and C values.

10. Phase Shift and Phase Shift Circuit Design a Phase shifter circuit using Op-Amp - Measurement of the Phase shift of the input wave for various R and C combinations - Comparison of the experimental output with theoretical values.

11. Digital to Analog Conversion Construction of Weighted Resistor and R-2R Ladder Network D/A converters using IC 741- Graphing input and output voltages - Resolution Measurement.

12. SCR Characteristics and power control Characteristics study of SCR - Construction of a power controller device using SCR.

13. **Code Converters** Construction of Code converters using ICs - Tabulate input and output for various decimal numbers a. BCD to Excess-3 b. BCD to Gray c. Excess-3 to BCD d. Gray to Excess-3

14. Analog Computation. Solve the given 2 variable simultaneous equations by constructing the Analog computers using Op-Amps. Sample Eqns. a) X+2Y =4; 2X+Y = 5

b) 3P + 2Q = 18; P + Q =7.

	PO1	PO2	PO3	PO4	PO4	PSO1	PSO2	PSO3	PSO4	PSO5
CO1										
CO2										
CO3										
CO4										
CO5										

PC/ 2021-2022 / PG / Physics / Semester – III

Core	Sub Code	QUANTUM MECHANICS - I	Hrs./ Week	Credits:
07	21PPHM31		06	05

Objective	**:**	1. To understand Schrödinger equation for one dimension and Eigen values and Eigen Functions 2. To learn about the postulates/ theorems and Matrix formulation in quantum mechanics. 3. To explain the combination of angular momentum states and C-G coefficients.
Unit I	**:**	**THE SCHRODINGER WAVE EQUATION** Development of the wave equation – Travelling harmonic waves – The one dimensional wave equation – Interpretation of the wave equation – normalization – Probability current density – Expectation values – Ehrenfest's theorem Energy Eigen function – One dimensional square well potential.
Unit II	**:**	**EIGEN FUNCTIONS AND EIGEN VALUES** Interpretative postulates and energy Eigen functions – motion of a free wave packet in one dimension. Discrete Eigen values (bound states) – Linear Harmonic Oscillator – Spherically symmetric potential in three dimension.
Unit III	**:**	**CONTINUOUS EIGEN VALUES** One dimensional square potential barrier – Scattering coefficients – collisions in three dimensions – Scattering cross section – asymmetric behavior – Scattering by spherically symmetric potentials – Scattering by a perfect rigid sphere – scattering by a square well potential.
Unit IV	**:**	**MATRIX FORMULATION OF QUANTUM MECHANICS** Transformation theory – Transformation of Hamiltonian with W – Transformation of Hamiltonian with U, Transformation of Hamilton with V – Dirac's bra and ket notation Equations of Motion – Matrix theory of the linear harmonic oscillator.
Unit V	**:**	**SYMMETRY IN QUANTUM MECHANICS** Rotation, angular momentum and unitary groups – Proper rotation group – infinitesimal rotations – spin of vector particle – communication relation for the generators – Choice of representation – Angular momentum matrices – combinational of angular momentum states and tensor operation – Clebsch Gordan Coefficients.
Text Book	**:**	1. Quantum Mechanics, Third Edition - L. I. Schiff, Tata Mc-Graw Hill, New Delhi, 1968.

		2. Quantum Mechanics - Aruldhas, Prentice Hall of India, New Delhi, 2003.
References	**:**	1. Quantum Mechanics, III edition - Eugen Merzbacher, John Wiley, 2004. 2. Modern Quantum Mechanics - J. J. Sakurai, Addison - Wisley, 1994. 3. Quantum Mechanics - P. J. E.Peebles, Prentice-Hall of India, New Delhi, 2001. 4. Introductory Quantum Mechanics, IV edition- Richard L. Liboff, Pearson Education, 2003.

COURSE OUTCOMES

1. Explain the Schrödinger wave equation and square well potential.
2. Describe linear harmonic oscillator and spherically symmetric potential.
3. Understand scattering theory of quantum mechanics and symmetric potential.
4. Apply matrix theory of transformation to harmonic oscillator problem.
5. Derive Clebsch Gordan coefficients from angular momentum states.

	PO1	PO2	PO3	PO4	PO4	PSO1	PSO2	PSO3	PSO4	PSO5
CO1										
CO2										
CO3										
CO4										
CO5										

PC/ 2021-2022 / PG / Physics / Semester – III

Core	Sub Code	ELECTROMAGNETIC THEORY	Hrs./ Week	Credits:
08	21PPHM32		06	05

Objective	:	1. To impart knowledge of electrostatics and applications. 2. To understand the concepts of magneto statics and applications. 3. To learn electro dynamics and transmission of electromagnetic radiation.
Unit I	:	**ELECTROSTATICS** Coloumb's law – Gauss law – Poisson's equation and Laplace's equation – work done to move a point charge – energy of a point charge and continuous charge distribution – methods of images – electric field in dielectric materials – induced dipoles and polarizability – connection between polarizability and susceptibility – susceptibility, permeability and dielectric constant of linear dielectric.
Unit II	:	**MAGNETOSTATICS** Lorentz force law – Biot-savart's law and Ampere's law – magnetic vector potential multipole- Expansion of the vector potential – Effects of a magnetic field on atomic orbits – magnetic energy – Dia, Para, Ferro magnetism – magnetic susceptibility and permeability in linear and non linear media.
Unit III	:	**ELECTRODYNAMICS** Electromagnetic induction – Faraday's law – Maxwell's equation differential and integral form – Boundary conditions on field vectors D, E, B and H – Lorentz and coloumb gauge – pointing vector and pointing theorem – Maxwell's stress tensor – Conservation of momentum.
Unit IV	:	**ELECTROMAGNETIC WAVES** The wave equation for E and B – Monochromatic plane waves – energy and momentum in EM waves in linear media – Reflection and transmission at normal and oblique incidence – EM waves in conductors wave guides – TE waves in rectangular wave guides.
Unit V	:	**ELECTROMAGNETIC RADIATION** Retarded potential – Lenard – Wiechart potential – Electric dipole radiation – magnetic dipole radiation – power radiated by a point charge – Larmour formula – Abraham Lorentz formula for the radiation reaction - Scalar and vector potentials – Gauge transformations.
Text Book	:	1. Introduction to Electrodynamics, II Edition- David J Griffiths, Prentice Hall of India, 1989**.** 2. Classical Electrodynamics, Second edition- J.D.Jackson, Wiley Eastern Publication, 1975.

References	**:**	1. Foundation of Electromagnetic Theory, 4th edition- J.R. Reitz, E.J Milford and R.W Christy, Addion wiley,2008. 2. Electromagnetic Fields and Waves- P.Lorrain and D.Corson, CBS Publishers and distributors, 1986. 3. Electrodynamics- B.P Laud, New Age International Pvt. Ltd. New Delhi 1987.

COURSE OUTCOMES

1. Apply the principles of electrostatics to solve problems.
2. Understand the concepts of magnetostatics.
3. Explain electrodynamics based on Maxwell's equations
4. Discuss the propagation of electromagnetic waves in different media.
5. Summarise the concepts of electromagnetic radiation

	PO1	PO2	PO3	PO4	PO4	PSO1	PSO2	PSO3	PSO4	PSO5
CO1										
CO2										
CO3										
CO4										
CO5										

PC/ 2021-2022 / PG / Physics / Semester – III

Core	Sub Code	MOLECULAR SPECTROSCOPY	Hrs./ Week	Credits:
09	21PPHM33		06	05

Objective	**:**	1. To understand the basics of molecular spectroscopy. 2. To acquire knowledge on instrumentation in molecular spectrometers 3. To reveal the analysis and application of modern spectroscopy
Unit I	**:**	**MICROWAVE SPECTROSCOPY** Classification of molecules based on moment of inertia – rotational spectra of rigid and non-rigid diatomic molecules – Isotopic effect – intensities of spectral lines and information from them – linear polyatomic molecule - symmetric top molecule – chemical analysis –microwave spectrometer.
Unit II	**:**	**INFRARED SPECTROSCOPY** Vibrating diatomic and polyatomic molecules – Simple harmonic oscillator – anharmonicity – Hydrogen bonding – Fermi resonance – rotation vibration spectra of polyatomic molecule – information from IR spectra – IR spectrometer – FTIR.
Unit III	**:**	**RAMAN SPECTROSCOPY** Theory of Raman scattering – rotation vibration Raman spectra – mutual exclusion principle – Raman spectrometer – polarization of Raman scattered light – structure determination using IR and Raman spectrum – phase transition – Resonance Raman scattering.
Unit IV	**:**	**RESONANCE SPECTROSCOPY** Magnetic properties of nuclei – resonance condition – relaxation time – Chemical shift – application to molecular structure – Bloch equation – NMR instrumentation – NMR imaging – ESR theory and hyperfine structure - ESR spectra of hydrogen atom and anisotropic systems – triplet state analysis – crystal defects and biological studies – ESR spectrometer.
Unit V	**:**	**SURFACE SPECTROSCOPY** Electron Energy Loss Spectroscopy EELS – Reflection – Absorption IR spectroscopy RAIRS – Surface Enhanced Raman Scattering SERS – Inelastic Helium Scattering – X-Ray Photoelectron Spectroscopy XEPS – Ultraviolet PES – Auger Electron Spectroscopy AES – Extended X-ray absorption fine Structure EXAFS.
Text Book	**:**	1. Fundamentals of Molecular Spectroscopy- N. Banwell and E. M. Mc Cash, Tata McGraw Hill, 2017. 2. Molecular Structure and Spectroscopy- G. Aruldhas, Prentice Hall India, NewDelhi 2007.

References	**:**	1. Spectroscopy -B.P.Strughan and S.Walker, John Wiley,1976. 2. IR and Raman Spectroscopy Principle and Spectral Interpretation- Peter J.Larkin, Elsevier, 2011. 3. Introduction to Molecular Spectroscopy- Gordon M. Barrow, McGraw-Hill, 1972.

COURSE OUTCOME

1. Understand the types of spectrum and its basics.
2. Integrate the knowledge of instruments in advance research and employment.
3. Choose the type of spectroscopy for any given work.
4. Identify molecular structures and analyse the surface.
5. Apply the spectroscopic techniques to identify the pandemic infections.

	PO1	PO2	PO3	PO4	PO4	PSO1	PSO2	PSO3	PSO4	PSO5
CO1										
CO2										
CO3										
CO4										
CO5										

PC/ 2021-2022 / PG / Physics / Semester – III

DSE	Sub Code	RESEARCH METHODOLOGY	Hrs./ Week	Credits:
03	21PPHE3A		06	05

Objective	**:**	1. To identify the issues and concepts relevant to the research process. 2. To analyze the complex issues inherent in selecting a research problem, selecting an appropriate research design, and implementing a research project. 3. To develop the concepts and procedures of sampling, data collection, analysis and reporting.
Unit I	**:**	**FUNDAMENTALS OF RESEARCH** Definitions and characteristics of research - Research process and steps in it - Areas of research –Research methods vs methodology - Characteristics of scientific method - Motivation and objectives - Bias and Prejudice in research - Types of research – Descriptive vs. Analytical, Applied vs Fundamental, Quantitative vs Qualitative and Conceptual vs Empirical.
Unit II	**:**	**FORMULATION OF RESEARCH** Defining and formulating the research problem -Selecting the problem - Necessity of defining the problem - Importance of literature review in defining a problem – Literature review – Primary, secondary and tertiary sources – reviews, treatise, monographs-patents – web as a source – searching the web - Critical literature review – Identifying gap areas from literature review.
Unit III	**:**	**RESEARCH DESIGN** Basic Principles- Need of research design – Features of good design – Important concepts relating to research design – Observation and Facts, Laws and Theories, Prediction and explanation, Induction, Deduction and Development of Models. Developing a research plan - Exploration, Description, Diagnosis and Experimentation. Determining experimental and sample designs.
Unit IV	**:**	**EXECUTION AND REPORTING RESEARCH** Observation and Collection of theoretical and experimental data - Methods of data collection – Comparison of Data - Generalization and Interpretation. Structure and components of scientific reports - Types of report – Technical reports and thesis – Different steps in the preparation – Layout, structure and Language of thesis – Illustrations, figures and tables- Quotation and footnotes – Bibliography and referencing.
Unit V	**:**	**RESEARCH ETHICS AND PUBLICATION OF RESULTS** Environmental impacts - Ethical issues -Plagiarism – Research Journals – Impact Factor – Citation Index – Reporting to Journals - Commercialization

		– Copy right – royalty - Intellectual property rights and patent law – Trade Related aspects of Intellectual Property Rights – Reproduction of published material - Reproducibility and accountability.
Text Book	**:**	1. Research Methodoloy Methods and Techniques, 2nd Edn –C.K. Kotari, New Age International, New Delhi, 2004. 2. An introduction to Research Methodology- Garg, B.L., Kothari Karadia, R., Agarwal, F. and Agarwal, RBSA Publishers, U.K, 2002. 3. Research Methodology, vol – 2, Sinha, S.C. and Dhiman, A.K., Ess Ess Publications, New Delhi, 2002. 4. Research Methods: the concise knowledge base - Trochim, W.M.K., Atomic Dog Publishing, OH US, 2005. 5. Law relating to patents, Trademarks, Copyright Designs and Geographical Indications-Wadehra, B.L., Universal Law Publishing, New Delhi, 2000.
References	**:**	1. Research Methodology - S. Rajasekar, P. Philominathan and V. Chinnathambi, websource. 2. Research Methods: A Process of Inquiry- Anthony, M., Graziano, A.M. and Raulin, M.L., Allyn and Bacon, Boston,US, 2009. 3. How to Write and Publish a Scientific Paper- Day, R.A., Cambridge University Press. U.K, 1992. 4. Practical Research: Planning and Design, 10th Edition- Leedy, P.D. and Ormrod, J.E., Pearson New International Edn, USA, 2014.

COURSE OUTCOME

1. Understand some basic concepts of research and its methodologies
2. Identify appropriate research topics
3. Define appropriate research problem and parameters
4. Prepare a project proposal (to undertake a project)
5. Justify the overall process of designing a research study from its inception to its report.

	PO1	PO2	PO3	PO4	PO4	PSO1	PSO2	PSO3	PSO4	PSO5
CO1										
CO2										
CO3										
CO4										
CO5										

PC/ 2021-2022 / PG / Physics / Semester – III

DSE	Sub Code	NANO PHYSICS	Hrs./ Week	Credits:
03	21PPHE3B		06	05

Objective	**:**	1. To create the basic knowledge about nano materials and to know the scientific perspectives 2. To understand the fundamentals of nano scale systems and its properties. 3. To apply their knowledge in research.
Unit I	**:**	**NANOSTRUCTURES AND STRUCTURAL CHARACTERIZATION** History – background – nano scale in one dimension, two dimensions, three dimensions – Synthesis of oxide nanoparticles (Sol-gel processing), metallic nanoparticles: semiconductor nanoparticles, fabrication of core –shell nanostructures – aerosol synthesis – gas phase synthesis of nanoparticles – Structural characterization – X-ray diffraction – STM, Atomic force microscopy, properties of nano materials.
Unit II	**:**	**CARBON NANOTUBES** Carbon allotropes – types of carbon nano tubes – graphene sheet to single walled carbon nano tubes – electronic structure of carbon nano tubes – synthesis of carbon nano tubes: electric arc discharge method – laser method – electrolysis – pyrolysis of hydrocarbons – Fluidised bed CVD method – solar production of CNT – purification methods – properties – filling of CNT – fullerene – purification – properties – application of CNT
Unit III	**:**	**QUANTUM HETEROSTRUCTURES** Introduction – hetero structure – growth of hetero structure - molecular beam epitaxy – metal organic chemical vapour deposition – hetero junction band alignment – quantum well – super lattice – low dimensional system –doped hetero structures modulation doping –optical confinement – application of hetero structures
Unit IV	**:**	**QUANTUM WIRES AND QUANTUM DOTS** Introduction – size effects - preparation of quantum nano structures – Fermi gas and density of states – Calculation of density of states – infra red detector – quantum well lasers – quantum cascade laser – nano wires – production, structure and uses of nano wires – quantum dots: fabrication techniques – electronic properties - application of quantum dots: information storage – infrared photo detector –quantum dot lasers
Unit V	**:**	**MAGNETO ELECTRONICS AND APPLICATIONS OF NANO TECHNOLOGY** Magnetism in nano crystals – Nano crystalline soft magnetic materials – Coloumb blockade –single electron transistor – quantum cellular automata – fabrication – Spintronics – giant magneto resistance – Quantum Hall effect – Quantum spin Hall effect – fractional quantum Hall effect – application of nanotechnology – medical application of molecular nanotechnology

Text Book	**:**	1. Nanophysics - Dr. Sr. Gerardin, Jayam, publishers, 2010. 2. Nano: The Essentials- T. Pradeep, Tata McGraw Hill, 2007. 3. Optical Properties of Semiconductor Quantum Dots - U. Woggon Springer Verlog, 1997.
References	**:**	1. The Physics of low Dimensional Semiconductors an introduction- John H. Davis, Cambridge University Press, 2006 2. Transport in Semiconductor nanostructure- D. Ferry and S. Goodnick, Cambridge University Press, 1997. 3. Nanotechnology in Carbon Materials - M. S. Dresselhaus and R. Salio 4. Advanced Magnetic nanostructures - K. P. Awasthi, Cyber Tech Publications, 2008 5. Introduction to Nanotechnology - Charles P. Poole Jr, Frank.J.Owens, Wiley India Pvt. Ltd, 2008.

COURSE OUTCOMES:

1. Understand the nanometer scale materials and characterization techniques
2. Explain the aspects of nano technology and synthesis of nano materials
3. Describe the principle of quantum hetero structures, production and application.
4. Analyse the two dimensional and three dimensional nanostructures.
5. Interpret Magneto electronics and its novel applications.

	PO1	PO2	PO3	PO4	PO4	PSO1	PSO2	PSO3	PSO4	PSO5
CO1										
CO2										
CO3										
CO4										
CO5										

PC/ 2021-2022 / PG / Physics / Semester – IV

Core	Sub Code	QUANTUM MECHANICS - II	Hrs./ Week	Credits:
10	21PPHM41		06	05

Objective	**:**	1. To impart knowledge on perturbation theory. 2. To learn approximation methods in quantum mechanics. 3. To understand semi classical theory and relativistic quantum mechanics.
Unit I	**:**	**APPROXIMATION METHODS FOR BOUND STATES** Stationary Perturbation theory – Non degenerate case – degenerate case – Zeeman effect without electron spin – first order Stark effect in hydrogen – Variation method – Ground state of Helium – Vander Waals interaction – Perturbation calculation – variation calculation.
Unit II	**:**	**THE WKB APPROXIMATION** Classical limits – Tunneling through a barrier – Time dependent perturbation theory – Transition probability theory – adiabatic approximation – sudden approximation – disturbance of an Oscillator.
Unit III	**:**	**IDENTICAL PARTICLE AND SPIN** Identical particles - symmetric and anti - symmetric wave functions – Construction from unsymmetrized function – Distinguishability of identical particle - The exclusion principle – Connection with statistical mechanics – Collisions of identical particles – Spin angular momentum – electron spin functions.
Unit IV	**:**	**SEMICLASSICAL THEORY** Absorption and induced emission – Maxwell's equations – Transition probability – Electric dipole transitions – Forbidden transition – Spontaneous emission – Asymptotic form – angular momentum – Plank distribution formula.
Unit V	**:**	**RELATIVISTIC WAVE EQUATION** Schrodinger relativistic equation **-** Electromagnetic potentials – energy levels in a Coulomb field – Dirac's relativistic equation – Free particle solution – Charge and current densities – Electromagnetic potentials – Spin and angular momentum – Negative energy states.
Text Book	**:**	1. Quantum Mechanics, Third Edition- L. Schiff, Tata McGraw Hill, New Delhi, 1968. 2. A Text Book of Quantum Mechanics- P. M. Mathews and K. Venkatesan, Tata McGraw Hill, New Delhi, 1987.

References	**:**	1. Quantum Mechanics the Fundamentals- S. Rajasekar and R. Velusamy, CRC Press, Taylor and Francis group, Boca Raton, London, 2014. 2. Advanced Quantum Mechanics- J. Sakurai, Pearson Education, New Delhi, 2009. 3. Quantum Physics, II Edition- S. Gasiorowicz, John Wiley, 1996.. 4. Quantum Mechanics, III Edition- Eugen Merzbacher, John Wiley, 2004. 5. Quantum Mechanics- J.L. Powell and B. Crasemann, Addison Wiley Publications, 1961.

COURSE OUTCOMES.

1. Understand different perturbation theory in quantum mechanics.
2. Apply approximation methods to perturbation theory
3. Explain spin of identical particles and angular momentum.
4. Discuss the application of semi classical theory to radiation.
5. Develop knowledge on relativistic wave equation.

	PO1	PO2	PO3	PO4	PO4	PSO1	PSO2	PSO3	PSO4	PSO5
CO1										
CO2										
CO3										
CO4										
CO5										

PC/ 2021-2022 / PG / Physics / Semester – IV

Core	Sub Code	MATERIAL SCIENCE	Hrs./ Week	Credits:
11	21PPHM42		06	05

Objective	**:**	1. To understand the phase transformation in materials. 2. To familiarize the properties, defects and applications of materials. 3. To customize material properties and manufacturing processes to develop new materials.
Unit I	**:**	**PHASE DIAGRAM SAND PHASE TRANSFORMATION** Phase rule- Single component systems- Binary Phase diagrams- Micro structural Changes during cooling- The lever rule- Applications of phase diagrams. Phase transformations- Time scale for phase changes- The growth and the overall transformation kinetics of nucleation– Applications.
Unit II	**:**	**ELASTIC BEHAVIOUR** Atomic model of elastic behavior - The modulus as a parameter in design-Rubber - like elasticity - Inelastic behavior: Relaxation Processes - Viscoelastic behavior: Spring-Dashpot models.
Unit III	**:**	**IMPERFECTIONS** Crystal imperfections-Point imperfections- The geometry of dislocations-other properties of dislocations- surface imperfections.
Unit IV	**:**	**OXIDATION, CORROSION AND OTHER DEFORMATION** Mechanisms of oxidation-oxidation resistant materials- the principles of corrosion- protection against corrosion- plastic deformation- the tensile stress- stress-strain curve- plastic deformation by slip -Creep- mechanisms of creep-creep resistant materials- Ductile fracture-Brittle fracture- Methods of protection against fracture.
Unit V	**:**	**COMPOSITES** Introduction - Classification of Composites - Particle-reinforced composites-Cermets- dispersion-strengthened composites- fiber-reinforced composites-influence of fiber length- influence of fiber orientation and concentration-Processing of fiber-reinforced composites: Prepreg production processes-Application of composites.
Text Book	**:**	1. Materials Science and Engineering. (5^{th} ed.), Raghavan. V., New Delhi: Prentice-Hall of India Limited, 2007. 2. Materials Science and Engineering: An Introduction, (7^{th} ed.), William D. Callister, Jr., John Wiley & Sons, 2007.

References	**:**	1. An Introduction to Materials Engineering and Science for Chemical and Materials Engineers, B.S. Mitchell, (1st ed.), Wiley, 2003. 2. Solid State Physics- Structure and Properties of Materials. (3rd ed.), Wahab, M.A., New Delhi: Narosa Publishing House Pvt. Ltd, 2015. 3. Advanced Solid State Physics. (2nd ed.), Philip Philips, UK: Cambridge University Press, 2014. 4. Rudiments of Materials Science, S.O. Pillai Sivagami Pillai, New Age International Publishers, 2005. 5. Materials Science, V. Rajendran, Tata McGraw Hill Pub. Company Ltd, New Delhi, 2011. 6. Structure and Properties of Engineering Alloys, (2nd ed.), William F. Smith, Mc-Graw-Hill Inc., U.S.A, 1993.

COURSE OUTCOME

1. Explain the effect of heat treatment on phase transformation.
2. Analyze the elastic behavior of materials.
3. Identify the nature of dislocations in materials.
4. Describe the mechanisms involved in oxidation and corrosion of materials.
5. Discuss the types of composite materials.

	PO1	PO2	PO3	PO4	PO4	PSO1	PSO2	PSO3	PSO4	PSO5
CO1										
CO2										
CO3										
CO4										
CO5										

PC/ 2021-2022 / PG / Physics / Semester – IV

Core	Sub Code	NUCLEAR AND PARTICLE PHYSICS	Hrs./ Week	Credits:
12	21PPHM43		06	05

Objective	:	1. To impart knowledge in nuclear physics and nuclear models 2. To provide theoretical knowledge about nuclear reactors and nuclear reactions. 3. To learn about fundamental particles and interactions.
Unit I	:	**NUCLEAR FORCES** Ground and excited states of deuteron – magnetic dipole and electric quadrupole moments of deuteron – n-p scattering at low energies – scattering length – phase shift analysis – shape independent effective range theory of np scattering – pp scattering at low energies – exchange forces –meson theory of nuclear force.
Unit II	:	**NUCLEAR DECAYS** Gamow's theory of alpha decay – line and continuous spectrum of β decay - Fermi theory of beta decay – Fermi and Gamow-Teller selection rules – parity violation – detection and properties of neutrino – Gamma decay – multipole transitions in nuclei – selection rules – internal conversion – nuclear isomerism.
Unit III	:	**NUCLEAR MODELS** Liquid drop model – Weizsackers mass formula – mass parabola – nuclear stability – Bohr Wheeler theory of nuclear fission -magic numbers -evidence for magic numbers – shell model – spin orbit coupling – angular momenta and parities of nuclear ground states – magnetic moments -schmidt line - collective model.
Unit IV	:	**NUCLEAR REACTIONS AND NUCLEAR REACTORS** Types of nuclear reactions – Q-equation – solution of the equation – compound nuclear theory – reciprocity theorem – nuclear cross section – resonance scattering– Breit -Wigner dispersion formula – nuclear chain reaction – four factor formula – critical size of a reactor – reactor buckling – classification of nuclear reactor based on fuel and moderator.
Unit V	:	**ELEMENTARY PARTICLES** Classification of elementary particles - fundamental interactions conservations laws – CPT theorem - SU(3) multiplet – meson octet – baryon octet and baryon decouplet – Gellmann-Okubo mass formula - Quark theory.
Text Book	:	1. Nuclear Physics and Particle Physics- D. C. Tayal, Wiley Publications, 2016. 2. Elements of Nuclear Physics- M. C. Pandia and R. P. S. Yadav Kedarnath, Publications, 2004.

References	**:**	1. Concepts of Nuclear Physics- Bernard L Cohen, Tata Mc Graw Hill, 2012. 2. Nuclear Physics: An Introduction- S. B. Patel, Wiley Eastern Ltd, 2009. 3. Nuclear Physics- R. R. Roy and B. P. Nigam, New Age International Ltd, 4. Introduction to Nuclear & Particle Physics- Mittal Varma & Gupta, PHI, Delhi, 2013.

COURSE OUTCOME

1. Acquire basic knowledge on properties of nucleus and nuclear forces.
2. Summarize the theories of radioactive decays.
3. Illustrate the different nuclear models that expose the structure of nucleus.
4. Examine the nuclear reactions for nuclear energy production with different reactors
5. Develop an insight into the elementary particles with fundamental interactions in nature.

	PO1	PO2	PO3	PO4	PO4	PSO1	PSO2	PSO3	PSO4	PSO5
CO1										
CO2										
CO3										
CO4										
CO5										

PC/ 2021-2022 / PG / Physics / Semester – IV

Core Practicals	Sub Code	GENERAL PHYSICS PRACTICAL - II	Hrs./ Week	Credits:
03	21PPHMP3		03	03

COURSE OBJECTIVE

1. To make the students perceive some of the fundamental Principles and laws of Physics through experiments.
2. To apply their theoretical knowledge to carry out experiments in basic as well as certain advanced areas of Physics.

COURSE OUTCOME

1. Have a clear understanding of subject related concepts and of contemporary issues.
2. Gain hands on experience in handling sophisticated instruments to work in applied fields.
3. Perform experiments like Young's modulus, thermistor, ultrasonic diffractometer, and Hall effectfor studying mechanical , thermal, optical and magnetic parameters of materials.

1. Guoy's Balance

Determination of Magnetic Susceptibility (Volume and Mass) of the given sample. (use a specimen in the form of a long rod or tube filled with power or liquid)

2. Elliptical Fringes

Determination of Young's modulus, Bulk modulus, Rigidity modulus,Poisson's ratio and compressibility of the given material by forming Elliptical fringes.

3. Temperature co-efficient and Band Gap

Determination of Temperature co-efficient and band gap of a given Semiconductor Thermistor using Carey-Foster Bridge.

4. Hall Effect

a. Definition of Hall Effect and its application

Determination of

b. Hall voltage

c. Hall coefficient

d. Carrier density

e. Mobility of charge carriers

f. Resistivity

5. Four Probe

a) Four Probe principle

b) Measurement of Resistivity and Energy band gap of a given semiconductor material

c) Measurement of Resistivity of a large sample using Four Probe mapping.

6. Equipotential lines

a) Formation of equipotential lines for

a) Parallel plates b) circular plates c) plates of irregular shape.

b) Determination of Electric field between the equipotential lines.

c) Mapping of Electric field vector between the plates.

7. Ultrasonic Diffraction –Determination of Velocity and Compressibility in liquids.

8. **Temperature co-efficient of a forward biased diode** Measure the resistance of a forward biased diode at three different temperature and hence find the temperature co-efficient. Also plot variation of I with respect to T.

9. **Phototransistor characteristics** characteristic study of Phototransistor using a) light sources of different wave length b) light sources of different intensities Plots for a) Spectral response b) Sensitivity c) Linearity

10. **LCR circuit**

a) **Determination of dielectric constant** of a liquid using LCR circuit

b) **Determination of dielectric constant** of a given crystal using LCR meter.

11. **Hysteresis Formation and tracing of magnetic hysteresis loop** for the given specimen to determine

a) Coercivity

b) Retentivity and

c) Energy loss per unit volume per cycle of the specimen

12. **Two Probe Determination of resistivity** of the given samples.

13. **Calibration of Hall Probe** into Gauss meter

a) Calibration of Hall probe into Gauss meter using a Search coil and

b) Determination of calibration curve for a two axis Hall probe in radial mode

14. **Chua's Diode -** Characteristic of non-linearity.

15. **Bi –Prism**, determination of wavelength of monochromatic source.

	PO1	PO2	PO3	PO4	PO4	PSO1	PSO2	PSO3	PSO4	PSO5
CO1										
CO2										
CO3										
CO4										
CO5										

PC/ 2021-2022 / PG / Physics / Semester – IV

Core Practicals	Sub Code	MICROPROCESSOR AND C++ PROGRAMMING	Hrs./ Week	Credits:
04	21PPHMP4		03	02

(*Any 12 programs with a minimum of 5 from each PART. For practical examination, questions will be either from* Microprocessor or from C++ Programming)

COURSE OBJECTIVES

1. Study the Architecture of 8085 microprocessor and to study 8086 microprocessor based ALP using arithmetic, logical and shift operations.
2. To learn the fundamental programming concepts and methodologies which are essential to building good C++ programs.
3. To practice the fundamental programming methodologies in the C++ programming language via laboratory experiences.

COURSE OUTCOMES

1. Fundamentals of microprocessor 8085
2. Write simple programs using 8085 instructions for arithmetic operations and counters
3. Manipulate a set of data in ascending and descending order
4. Familiarize themselves with C++ programming
5. Write C++ program to evaluate numerical integration, differentiation, matrix addition and multiplication

PART A: Microprocessor Programming

(All programs must have Algorithm and Flow chart)

1. Arithmetic Operations

a) Addition of two 8 bit and two 16 bit numbers

b) Subtraction of two 8 bit and 16 bit numbers

c) Multiplication of two 8 bit numbers – 16 bit result.

d) Division of 16 bit by an 8 bit number.

2. Data Manipulation

a) Arrange the given data items in Ascending or Descending order

b) Finding the Minimum and Maximum value in the given data set.

c) Search of a given character/number in the given data set.

3. System Call and Counters

a) Display a character/number on the 7 segment display of the Kit using Monitor Call.

b) Calculation of Time delay for a given interval.

c) Up-Counter to count from 00 up to ‘nn’ with 1 sec time interval.

d) Down counter to count from ‘nn’ to 00 with specified counting interval.

4. Block Move and Series Generation

a) Moving a block of data from memory xxxx to yyyy.

b) Fibonacci series generation

c) Tribonacci series generation

5. System Call and Rolling character

a) Calculation of time delay for a given interval.

b) Display a Character on the 7 segment display of the Kit using Monitor Call.

c) Roll a given character from Left to Right / Right to Left on the 7 segment displays with the specified time interval.

6. ADC and DAC conversion

a) Interfacing ADC with 8085 – ADC chip Block diagram – 8085- ADC interfacing diagram

b) Conversion of analog input to digital – Resolution – Graph between input and output.

c) Interfacing DAC with 8085 –DAC chip Block diagram – 8085 DAC interfacing diagram.

d) Conversion of digital input to analog – Resolution – Graph between input and output.

7. DAC interfacing and Wave form generation. Interfacing DAC with 8085 – DDC Chip Block diagram – 8085- DAC-8085 interfacing diagram and Wave Form generation using DAC

a) Square wave with the specified period

b) Rectangular wave with the specified period

c) Ramp Wave with the specified period

d) Triangular Wave

PART B: C++ programming

(All programs must have Algorithm and Flow chart)

1. Curve Fitting – Fitting a straight line.

a) Principle of least Square and fitting a straight line.

b) Principle of linear interpolation

c) C++ program to fit a straight line using the data obtained from Cauchy's Constant Experiment and Interpolation using the fitted equation

2. Solution of simultaneous equations - Gauss Elimination method.

a) Procedure to solve Simultaneous equations using Gauss Elimination Method

b) Solving unknown branch currents in Whetstone's bridge using GE method manually.

c) C++ program to solve the equations.

3. Numerical Differentiation.

a) Derivation of Exponential law of Radioactive decay.

b) RK 4th order method of solving a given 1st order differential equation.

c) Analytical computation of the mass of the given radioactive sample after a specified period (Given: activity or half life period).

d) C++ program using RK method to solve radioactive problem – Compare output with the analytical result.

4. Area under the Curve

a) Numerical integration – derivation of Simpson's rule

b) C++ programs for Simpson 1/3rd rule, Simpson 3/8 rule and Monte -carlo integration.

c) Comparison of the program output with direct integration.

5. Eigen Value and Eigen Vector.

a) Explanation of Eigen Values and Eigen Vectors.

b) Calculation of Eigen Values and Eigen Vectors using analytical method.

c) C++ program to calculate Eigen values and Eigen vectors of a give matrix – Comparison with analytical result.

6. Matrix Multiplication

a) Multiplication of given matrices

b) Rotation matrix definition.

c) C++ program to rotate the given point about the origin using rotation matrix by the given angle.

7. Numerical Differentiation

a) Numerical differentiation – related to any physical problem

b) Derivation of Newton's law of cooling – equation

c) C++ program to verify the Newton's law of cooling from the given experimental data.

8. Solution of Algebraic and Transcendental equations.

a) Solution of the given equations using Newton Raphson Method – manual calculation.

b) C++ program to find the solution using N-R method and verification.

	PO1	PO2	PO3	PO4	PO4	PSO1	PSO2	PSO3	PSO4	PSO5
CO1										
CO2										
CO3										
CO4										
CO5										

PC/ 2021-2022 / PG / Physics / Semester – IV

Project	Sub Code	MAJOR PROJECT	Hrs./ Week	Credits:
01	21PPHM4P		06	05

Group Project can be allotted for students (four maximum)

Must be subject oriented or applied or interdisciplinary or can be carried out in research institutes/Universities/facilitated colleges/in collaboration with leading institutes.

COURSE OBJECTIVE

1. This course work makes the student to select a suitable problem to work as a project for his relevance.
2. Make the group to solve with a sharing to overcome complicated things
3. In theoretical work make them to acquainting deep knowledge with computer programming and soft wares
4. In experimental work to attain knowledge of designing instruments and devices of their need
5. Confidence over facing any challenge in the respective field

COURSE OUTCOME

1. Define problems and to analyse, interpret and draw conclusions from data
2. Makes them to face complications in work and to solve in group
3. Gives confidence to use any software / instruments and to approach knowledgeable appropriate people for projects.
4. Gives confidence to present any work in seminars/conferences and to update in their relevant field of interest.

	PO1	PO2	PO3	PO4	PO4	PSO1	PSO2	PSO3	PSO4	PSO5
CO1										
CO2										
CO3										
CO4										
CO5										