SRI RAMAKRISHNA MISSION VIDYALAYA COLLEGE OF ARTSAND SCIENCE
COIMBATORE - 641 020
For the Students admitted in the year 2020 -2021
M.Sc PHYSICS

PROGRAMME OUTCOMES (PO)

PO1: Demonstrate the advanced theories, theorems and coherent understanding variety of field of Science, its different branches, diversified thinking and its linkage with other disciplinary areas related to specific professional subject area of physical sciences, including professional engagement in advanced research and developments.

PO2: Analyze and interpret the scientific truths /information using appropriate methods, including the specific programming skill with the use of appropriate software, and report the findings accurately with experimental results.

PO3: Demonstrate the relevant generic skills and global competencies such as problem solving, investigative skills, analytical skills, communication skills, and ICT skills.

PO4: Develop Entrepreneurship interest with ability to work individually and in a group.

PO5: Assimilate the skills and cognitive developments in explicit areas associated to current and emerging technology concerned with societal, national and global requirements. Validate the professional behavior such as being unbiased and truthful in all aspects.

PROGRAMME SPECIFIC OUTCOMES (PSO)

At the end of this programme, a post graduate will be able to

PSO1: establish the intensive knowledge through the better understanding of advanced theories and principles to identify, analyze and solving the problems in various domains of Physics.

PSO2: promote research interest in Physics and foster a spirit of inquisitiveness; improve the professional, life and social skills to gratify the requirements of the industry, society and global scientific community.

PSO3: instigate the employability and entrepreneurship skills to enhance the experiential exposure through versatile core concepts learnt from Physics.

PSO4: empowering the youth by inculcating core knowledge and understanding the physics concepts, accomplish projects in multidisciplinary environment.

PSO5: imparting character-building education, which increase the strength of minds and expand the intellectual ability to meet the challenges in Physics evolution.

M. Sc PHYSICS
Under Choice Based Credit System (CBCS) 2020 - 21 Onwards

SCHEME OF EXAMINATION

SEMESTER – I

S. No.	Course Code	COURSE TITLE	Hrs / wk	Credits	Exam Hrs	MAX. MARKS		
						INT	EXT	TOT
01	20PPH1C01	**Core - 1** Classical, Statistical and Relativistic Mechanics	5	4	3	25	75	100
02	20PPH1C02	**Core - 2** Mathematical Physics	5	4	3	25	75	100
03	20PPH1C03	**Core - 3** Electronics	5	4	3	25	75	100
04	20PPH1EL1	**Elective- 1** Programming In C++ And MATLAB	5	4	3	25	75	100
05	20PPH2CP1	**Core Practical - I** General Experiments	3	- -		- -	- -	- -
06	20PPH2CP2	**Core Practical-II** Electronics	3	- -		- -	- -	- -
07	20PPH2EP1	**Elective Practical - I** Simulation in Physics - C++ Programming	4	- -		- -	- -	- -
		TOTAL - I	30	16		100	300	400

SEMESTER – II

S. No.	Course Code	COURSE TITLE	Hrs/ wk	Credits	Exam Hrs	MAX. MARKS		
						INT	EXT	TOT
01	20PPH2C04	**Core - 4** Electromagnetic Theory and Electrodynamics	5	4	3	25	75	100
02	20PPH2C05	**Core - 5** Modern Optics	5	4	3	25	75	100
03	20PPH2C06	**Core - 6** Quantum Mechanics - I	5	4	3	25	75	100
04	20PPH2C07	**Core - 7** Digital system design and Microprocessor	5	4	3	25	75	100
05	20PPH2CP1	**Core Practical - I** General Experiments	3	3	4	40	60	100
06	20PPH2CP2	**Core Practical - II** Electronics	3	3	4	40	60	100
07	20PPH2EP1	**Elective Practical - I** Simulation in Physics - C++ Programming	4	4	4	40	60	100
		TOTAL - II	30	26		220	480	700

SEMESTER – III

S. No.	Course Code	COURSE TITLE	Hrs/ wk	Cre dits	Ex am Hr s	MAX. MARKS		
						INT	EXT	TOT
01	20PPH3C08	**Core - 8** Quantum Mechanics - II	5	5	3	25	75	100
02	20PPH3C09	**Core - 9** Solid State Physics	5	5	3	25	75	100
03	20PPH3EL2	**Elective – 2** Advanced Materials and Characterization	5	4	3	25	75	100
04	20PPH3EL3	**Elective (IDE) - 3** Numerical Analysis	5	4	3	25	75	100
05	20PPH4CP3	**Core Practical - III** Advanced Experiments	3	- -		- -	- -	- -
06	20PPH4CP4	**Core Practical - IV** Special Electronics	3	- -		- -	- -	- -
07	20PPH4EP2	**Elective Practical - II** Simulation In Physics - MATLAB Programming	4	- -		- -	- -	- -
		TOTAL - III	30	18		100	300	400

SEMESTER – IV

S. No.	Course Code	COURSE TITLE	Hrs/ wk	Cr edi ts	Ex am Hr s	MAX. MARKS		
						INT	EXT	TOT
01	20PPH4C10	**Core - 10** Condensed Matter Physics and Nano Science	5	5	3	25	75	100
02	20PPH4C11	**Core - 11** Nuclear Physics	5	5	3	25	75	100
03	20PPH4C12	**Core - 12** Spectroscopy	5	5	3	25	75	100
04	20PPH4CP3	**Core Practical – III** Advanced Experiments	3	3		40	60	100
05	20PPH4CP4	**Core Practical - IV** Special Electronics	3	3		40	60	100
06	20PPH4EP2	**Elective Practical - II** Simulation In Physics - MATLAB Programming	4	4		40	60	100
07	20PPH4CPR	**Project Work**	5	5	-	40	60	100
		TOTAL - IV	30	30		235	465	700
		Total I + II + III + IV	120	90		655	1545	2200

INTER DEPARTMENTAL ELECTIVE - IDE*

For MATHEMATICS: SEMESTER - III

S.No.	COURSE CODE	PAPER	COURSE TITLE	HOURS PER WEEK	CRE DITS	Exam Hrs	MAX. MARKS		
							INT	EXT	TOTAL
01	20PMA3EL3	Elective III	Elective (IDE):Relativity and wave mechanics	5	4	--	25	75	100

***IDE-Elective III** - Offered by Physics Department to Mathematics Department
Programme: M.Sc Physics Subject Code: 20PPH1C01
Course Title : **CLASSICAL, STATISTICAL AND RELATIVISTIC MECHANICS**
Core : 1
Year : I Semester : I
Hours/Week : 5 Credits : 4

COURSE OBJECTIVES

To enable the students to know about the

- Lagrangian and hamiltonian formulations
- canonical equations and transformations for mechanical systems
- statistical theories and relativistic mechanics in space time continuum.
- distinguish classical and quantum statistics
- understand relativistic mechanics in space-time continuum.

COURSE OUTCOMES (CO)

By the end of the course, the students will be able to

CO1	apply Lagrangian and hamiltonian methods for devoloping equations of motion	K3
CO2	solve the canonical equations and transformations for mechanical systems	K3
CO3	learn the statistical theories and relativistic mechanics in space time continuum.	K4
CO4	explain the Bosons and Fermions and compare three statistics	K2 & K3
CO5	express the relativistic Lagrangian and Hamiltonian of a Charged Particle in an E.M. field.	K2

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze;

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	L	M		S	S	S	M	L
CO2	S	S	S	M	S		S	S	M	M	S
CO3	S	M	L	M	S		S	S	M	S	M
CO4	S	M	S	S	M		S	S	S	S	S
CO5	S	S	M	M	S		S	S	M	S	M

S - Strong; M - Medium; L - Low

UNIT – I: LAGRANGIAN AND HAMILTONIAN FORMULATIONS
Generalized Coordinates – Mechanics of a Particle and System of Particles (Momentum and Energy) D'Alemberts Principle – Lagrange's Equations – Applications (Linear Harmonic Oscillator, Simple pendulum, Isotropic oscillator and Electric circuit) – Hamilton's Equations – Applications (Simple Pendulum, Compound Pendulum and 2D Harmonic Oscillator) – Deduction of Hamilton's Principle – Hamilton's Variational Principle – Principle of Least Action.

UNIT – II: CANONICAL TRANSFORMATIONS

Equation of Canonical Transformations – Infinitesimal Contact Transformations – Lagrange and Poisson Brackets as Canonical Invariants – Equations of Motion in Poisson Bracket form – Jacobi's Identity – Relation between Lagrange and Poisson Brackets – Action Angle Variables – Euler's Angles – Angular Velocity of a Rigid Body – Euler's Equation of Motion.

UNIT – III: CLASSICAL STATISTICS

Basic Elements of Statistical Mechanics – Concept of Ensemble – Gibb's Canonical Ensemble – Grand Canonical Ensemble – Phase Space Entropy – Partition Function – Thermo dynamical Potentials – Internal Energy – Helmholtz Function – Gibb's Function – Free Energy – Maxwell Boltzmann Distribution – Evaluations of Multipliers of Alpha and Beta – Doppler Broadening – Applications of MB Distribution Law - Total Internal Energy and Specific heat at Constant Volume of an Ideal Gas – MB Speed Distribution Law – Most Probable, Average and Root Mean Square Speeds – Entropy of an Ideal Gas.

UNIT – IV: QUANTUM STATISTICS

Bose Einstein Distribution – Determination of e^{α} – Planck's Law of Radiation – Rayleigh – Jeans Law – Wien's Displacement Law – BE Condensation - Fermi Dirac Distribution –Fermi Energy – Fermi Temperature – Fermi Velocity – Mean K.E. – Thermionic Emission – Pauli's Spin Paramagnetism – Comparison of MB, BE and FD Statistics.

UNIT – V: RELATIVISTIC MECHANICS

Einstein's Mass Energy Relation – Relation between Momentum and Energy – Four Vectors – Four Velocity – Energy – Momentum Four Vectors – Four Force – Relativistic Classification of Particles – Relativistic Lagrangian, Hamiltonian function – Relativistic Lagrangian and Hamiltonian of a Charged Particle in an E.M. field.

TEXT BOOK:

1. Gupta and Satyaprakash, Classical Mechanics, Kedar Nath Ramnath,Year:1974-1975, Edition:2^{nd}.
2. Miss Kamal Singh & S. P. Singh, Elements of Statistical Mechanics, S.Chand & Co,1988, 2nd edition.

REFERENCE BOOK:

1. H. Goldstein, Addison,Classical Mechanics,Wesley Publishers,1982 : Edition: 2^{nd} .
2. A.J.Poyinton, Introduction To Statistical Physics, Longmans, green & Co Ltd, London,1967,Edition: 1^{st} .
3. Satyaprakash,Relativistic Mechanics,Pragati Prakasam,1974-76,3^{rd} edition.
4. Brijal and Subramanyam, Thermal and Statistical PhysicsS. Chand & company Year:1989,Edition:1^{st}.

Programme : M. Sc Physics Subject Code: 20PPH1C02
Course Title : **MATHEMATICAL PHYSICS**
Core : 2
Year : I Semester : I
Hours/Week : 5 Credits : 4

COURSE OBJECTIVES

To enable the students to know about the mathematical foundation in

- differential equations
- Fourier integrals and transforms
- complex variables
- tensors and beta & gamma functions
- group theory for the discription of the physicsl phenomena

COURSE OUTCOMES (CO)

By the end of the course, the students will be able to solve the problems in Physics through

CO1	differential equations	K3
CO2	Fourier integrals and transforms	K3
CO3	complex variables	K3
CO4	tensors and beta & gamma functions	K3 & K4
CO5	group theory	K3 & K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze;

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	L	M		S	M	M	M	M
CO2	S	M	S	M	M		S	M	M	M	S
CO3	M	S	S	M	M		S	S	M	M	S
CO4	S	S	S	M	M		S	M	S	M	S
CO5	M	S	S	M	L		M	S	S	M	M

S - Strong; M - Medium; L - Low

UNIT – I: DIFFERENTIAL EQUATIONS
Bessel's differential equation - Recurrence formulae for J_n (x) - Generating function for $J_n(x)$ - Hermite differential equation - Hermite's polynomials - Generating function of Hermite polynomials - Recurrence formulae for Hermite polynomials - Rodrigue's formula - Orthogonality Theorem.

UNIT – II: FOURIER INTEGRALS AND TRANSFORMS

Fourier Integrals - Fourier Integral - Even and odd functions - Complex form of Fourier integral - Examples - Inverse Laplace theorem - Fourier's Transform - Infinite Fourier sine and cosine transforms - Properties of Fourier Transform - Examples.

UNIT – III: COMPLEX VARIABLES

Analytic function - Cauchy Riemann differential equations - CR equations in polar form - Laplace's equation - Examples - Cauchy's integral theorem - Cauchy's integral formula - Taylor's series - Laurent's Series - Singularities of an analysis function - Residues and their evaluation - Cauchy residue theorem - Evaluation of definite integrals (Trigonometric functions of cos θ and sin θ only).

UNIT - IV: TENSORS AND BETA GAMMA FUNCTIONS

Scalars - Contravariant and covariant vectors - Tensors of higher rank - Algebric operation of tensors - Mixed tensor - Symmetric and anti symmetric tensors- Quotient law - Beta and Gamma functions - Definitions - Symmetry property of Beta function - Other forms of Beta function - Evaluation of Gamma function - Other forms of Gamma function - Relation between Beta and Gamma functions – Examples.

UNIT – V: GROUP THEORY

Concept of a group - Abelian group - Generators of finite group - Cyclic groups - Group Multiplication table - Rearrangement theorem - Sub groups - Lagrange's theorem for finite group - Conjugate elements and classes - Group of symmetry of an equilateral triangle - Group of symmetry of square - Representation of a group - Reducible and irreducible representation - Schur's lemmas – The Great Orthogonality theorem.

TEXT BOOK:

1. Satya Prakash,Mathematical Physics with Classical mechanics, Sultan Chand & sons, Reprint 2007.

REFERENCE BOOK:

1. B.D.Gupta,Mathematical Physics, Vikas Publishing house P. ltd.1997.2nd edition.

Programme : M.Sc Physics Subject Code: 20PPH1C03
Course Title : **ELECTRONICS**
CORE : 3
Year : I Semester: I Hours/Week : 5 Credits : 4

COURSE OBJECTIVES

To understand the basic knowledge of

- analog electrical device and field effect transistors
- utilize negative resistance for circuit analysis
- fabrication technology
- OP-AMPs and its applications
- digital electronics and fundamentals

COURSE OUTCOMES (CO)

By the end of the course, the students will be able to

CO1	recognize a variety of exciting high tech products and systems enabled by electronics	K1
CO2	manipulate voltages, currents and resistance in negative resistance and devices	K3
CO3	fabrication technology	K3
CO4	understand the working of OP-AMPs and its applications	K2 &K3
CO5	use a mathematical and problem solving approach for digital electronics fundamentals	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze;

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	S	L		S	M	S	M	S
CO2	S	M	M	M	M		S	S	M	M	S
CO3	M	M	S	S	L		S	M	S	M	M
CO4	S	M	M	S	M		S	S	M	S	M
CO5	M	S	S	S	M		S	S	M	S	S

S - Strong; M - Medium; L - Low

UNIT - I : FIELD EFFECT TRANSISTOR (FET) :

FET – JFET – V-I characteristics – Biasing - FET as Voltage Variable Resistor – Small signal model of FET - Common source Amplifier and Common Drain Amplifier at low and high Frequencies – FET Differential Amplifier – MOSFET Depletion – Enhancement MOSFETs – Characteristics – Logic gates using MOSFETs – Complementary MOSFET.

UNIT - II : NEGATIVE RESISTANCE AND DEVICES :

UJT and its characteristics – UJT Relaxation Oscillator – UJT Applications – Tunnel Diode Characteristics and applications – Gunn Diode Mechanism, Characteristics and Applications – PNPN Diode – SCR – Characteristics and Applications – Silicon Controlled Switch (SCS) – IMPATT- TRAPATT- Diodes and applications.

UNIT - III : IC - FABRICATION TECHNOLOGY :

Monolithic IC process – Refining and growth of silicon crystals- Silicon wafer preparation-Diffusion of dopant impurity systems-Ion implantation –Thermal oxidation –Photolithography-Fine line lithography-Plasma etching Chemical Vapour Deposition (CVD) –Silicon insulators -Metallization – Monolithic components-ResistorsCapacitors – Diodes –Transistor.

UNIT - IV: OPERATIONAL AMPLIFIER :

Characteristics of Ideal and Practical OP AMP – Analysis of 741 – Parameters of OP AMP – Theory of Inverting Amplifier – Virtual Ground – Theory of Non Inverting Amplifier –Solutions of Simultaneous Equations – Solutions of Differential Equations - Sinusoidal oscillators – Phase shift oscillator – Wien Bridge Oscillator-Multi vibrator- Schmitt Trigger- Square wave and Triangular wave generators.

UNIT- V: DIGITAL ELECTRONICS FUNDAMENTALS :

Number Systems- Binary codes – 8421 Code-Excess 3 code – Grey code- ASCII code – Logic circuits - Sum of Product and Product of Sum - Boolean Algebra-De Morgan's Theorems – Arithmetic Circuits (Half and Full adder – Half and Full subtractor)– Simplification using Karnaugh's Map (2,3 and 4 variables).

TEXT BOOK:

1. Millman and Halkias, Integrated Circuits, Tata McGraw Hill Year: 1991 Edition:8th.

2. Malvino and Leech, Digital principles and applications,Tata McGraw Hill, 1981, Edition: 4th

REFERENCE BOOK:

1. S.M. Szee, Physics of Semiconductor devices, John Wiley & Sons limited, 2007, Edition: 2 nd

Programme : M.Sc Physics Course Code: 20PPH1EL1
Course Title : **PROGRAMMING** IN **C++ AND MATLAB**
Elective : 1 Year:I
Semester : I Hours/Week : 5
4 Credits

COURSE OBJECTIVES

To enable the students, to know the

- basic functions of C++ programming
- different classes and objects
- Introduction of Mat lab functions, branching statements,
- Program design, user defined functions
- Features of Mat lab Programs and how they may applied for our day to day life.

COURSE OUTCOMES (CO)

By the end of the course, the students will be able to

CO1	understand the functions of C++ programming	K1
CO2	using the different classes and objects in C++ programming	K4
CO3	understand the introduction of Mat lab functions, branching statements,	K3
CO4	Program design, user defined functions	K1& K2
CO5	write the Mat lab Programs and how they may applied for physics concepts	K3

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze;

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	S	S		S	S	S	M	S
CO2	S	M	S	M	S		S	M	S	L	S
CO3	S	M	M	S	S		S	M	S	L	S
CO4	M	M	M	M	S		S	S	M	M	S
CO5	M	S	S	S	S		S	S	S	M	S

S - Strong; M - Medium; L - Low

UNIT - I :BEGINNING WITH C ++

Basic Concepts of OOP - Structure of C++ Programme - Tokens, Expressions and Control structures - Basic data types - Symbolic Constants - Operators in C++ - Manipulators - Type Casting - Expressions and their Types - Control structure: if, else, nested if, switch case, while, do while, for, nested for- break - continue and goto statement – Types Functions - Function Prototyping - Call by reference - Return by Reference - Inline Functions - Default Arguments.

UNIT - II :CLASSES AND OBJECTS

Specifying a Class - Defining Member Functions - Static Data Members - Static Member Functions - Arrays of Objects - Objects as Function Arguments - Friend Functions - Returning Objects - Constant Member Functions - Pointers to Members. **Constructors and Destructors:** Constructors - Parameterized Constructors - Copy Constructor - Dynamic Constructor - Constant Objects - Destructors.

UNIT - III :POLYMORPHISM AND FILES

Operator Overloading - Function Overloading - Single Inheritance - Multiple Inheritance - Hierarchical Inheritance - Multi Level Inheritance - Hybrid Inheritance.Classes for File Stream Operations - Opening and Closing a File - Text File Operations - Binary File Operations - Function Templates - Class Templates - Member Function Templates.

UNIT- IV : INTRODUCTION TO MATLAB:

Basics of MATLAB - MATLAB windows - On-line help - Input - Output - File types – Interactive Computation: Matrices and vectors - Input - Indexing - Matrix manipulation - Creating vectors - Matrix array operations - Arithmetic operations - Relational operations - Logical operations - Elementary math function - Matrix function - Character strings - Manipulating character strings - Eval function - Array operations - Command line functions - Inline function - Anonymous function - Plotting simple graphs.

UNIT - V : PROGRAMMING ON MATLAB

Scripts and functions - Script files - Function files - Executing a function - Sub functions - Nested functions - Language specific features - Use on comments to create online help - Continuation - Global variables - Loops branches and control flow - Interactive input- Application: Linear algebra - Solving a linear system - Gaussian elimination - Eigen values and Eigen vectors - Matrix factorization

TEXT BOOK:

1. E. Balagurusamy,Object - Oriented Programming with C++,Tata Mc- Graw Hill Publishing Ltd, 2001 : Edition:2nd.
2. Rudra Pratap, Getting started with MATLAB - A quick introduction for Scientists and Engineers,Oxford University Press,2005.

REFERENCE BOOK:

1. Herbert Schildt, C++:The Complete Reference,McGraw- Hill,1998,Edition: 3.
2. Stephen J. Chapman , Thomson, MATLAB Programming For Engineers,Learning publishing company, 2004, Edition:3rd.
3. Bjarne Stroustrup, The C++ Programming Language,Addison Wesley, 2nd edition.

Programme : M.Sc Physics Subject Code: 20PPH2C04
Course Title : **ELECTROMAGNETIC THEORY AND ELECTRODYNAMICS**
CORE : 4
Year : I Semester : II
Hours/Week : 5 Credits : 4

COURSE OBJECTIVES

To understand the basics of

- electrostatics and magnetostatics
- field equation and conservation law
- propagation of electromagnetic waves and radiating systems
- interaction of emw with matter on macroscopic scale
- relativistic electrodynamics

COURSE OUTCOMES (CO)

By the end of the course, the students will be able to

CO1	summarise the fundamentals of electrostatics and magnetostatics	K2
CO2	integrate the field equation and conservation law	K3
CO3	understand the propagation of electromagnetic waves and radiating systems	K2,K3&K4
CO4	understand the interaction of emw with matter on macroscopic scale	K4
CO5	implied the relativistic principle to relativistic electrodynamics	K2& K3

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze;

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	M	M		S	S	M	S	S
CO2	S	M	M	M	L		S	S	S	M	M
CO3	S	S	S	M	M		M	M	M	S	M
CO4	S	M	S	M	L		S	M	S	M	S
CO5	S	S	S	M	M		M	S	M	S	M

S - Strong; M - Medium; L - Low

UNIT – I : ELECTROSTATICS AND MAGNETOSTATICS

Dielectrics and its Polarization – External Field of a Dielectric Medium – Electric Field inside a Dielectric – Dielectric Constant and Displacement Vector – Relation Between D, P and E – Polarization of Non-Polar Molecules (Clausius-Mossotti Relation) – Polarization of Polar Molecules.

Ampere's Law of Force – Biot- Savart Law - Ampere's Circuital Law – Magnetic Scalar Potential – Magnetic Vector Potential – Magnetisation and Magnetisation Current – Magnetic Intensity – Magnetic Susceptibility and Permeability.

UNIT – II: FIELD EQUATION AND CONSERVATION LAW

Equation of Continuity – Displacement Current – Maxwell's Equations – Derivations and Physical Significance – Energy in Electromagnetic Fields (Poynting's Theorem) – Poynting Vector – Electromagnetic Potentials – Concept of Guage – Lorentz Guage.

UNIT – III: PROPAGATION OF ELECTROMAGNETIC WAVES AND RADIATING SYSTEMS

Propagation of Electromagnetic Waves in Free Space – Isotropic Dielectrics – Anisotropic Dielectric –Conducting Media – Ionized Gases.

Oscillating Electric Dipole - Radiation from an Oscillating Dipole - Vector Potential – Scalar Potential – Magnetic Induction – Electric Intensity.

UNIT – IV: INTERACTION OF EMW WITH MATTER ON MACROSCOPIC SCALE

Scattering and Scattering Parameters – Scattering by a Free Electron (Thomson Scattering) – Scattering by a Bound Electron (Rayleigh Scattering) – Dispersion - Normal and Anomalous – Dispersion in Gases (Lorentz Theory) – Dispersion in Liquids and Solids.

UNIT – V: RELATIVISTIC ELECTRODYNAMICS

Four Vectors and Tensors – Transformation Equation for Charge - Current Densities – Electromagnetic Potentials – Electromagnetic Field Tensor – Transformation Equations for Electric Field Vectors – Covariance of Maxwell Equations - Four Vector – Four Tensor.

TEXT BOOK:

Dr. K. K. Chopra and G. C. Agarwal, Electromagnetic Theory, K. Nath & Co (Sixth Edition)

REFERENCE BOOK:

Paul Lorrain and Dale R. Corson, Electromagnetic Field and Waves, CBS Pub, 2nd Edition,

Programme : M.Sc Physics Subject Code: 20PPH2C05
Course Title : **MODERN OPTICS**
Core : 5
Year : I Semester : II
Hours/Week : 5 Credits : 4

COURSE OBJECTIVES

To enable the students to understand the

- analytical methods of theories of nature of light
- concept of laser theories and energy level transaction of laser
- theoretical and experimental concepts of non linear optics and fiber communication
- compare the theoretical and experimental concepts of non linear optics.
- gain knowledge on propagation of light through variety of fibers, fiber material and importance of fiber communication

COURSE OUTCOMES (CO)

By the end of the course, the students will be able to

CO1	explain the various theories associated with the propagation of light energy in various medium	K2 & K3
CO2	discriminate various laser activities and devices	K3
CO3	analyse the different properties related to non linear optics and fiber communication	K1 & K2
CO4	categorize the different theories related to non linear optics and its applications	K4
CO5	apply the knowledge of light propagation in variety of fiber materials	K3 & K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze;

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	M	S		S	S	M	S	M
CO2	S	M	M	M	S		S	S	S	S	S
CO3	S	M	M	S	M		S	S	M	M	S
CO4	S	M	S	L	M		S	S	S	S	S
CO5	S	M	S	S	M		S	S	S	M	S

S - Strong; M - Medium; L - Low

UNIT - I : PROPAGATION AND NATURE OF LIGHT
Phase velocity – Group velocity – Doppler effect – Energy flow – Liner polarization – Matrix representation of polarization (Jones calculus) – Reflection and refraction at a plane boundary – Amplitudes of reflected and refracted waves – Brewster angle – Phase changes in total internal reflection.

UNIT - II : COHERENCE AND INTERFERENCE

Theory of partial coherent light - Visibility of fringes - Coherent time and Coherent length - Spatial coherence - Fourier Transform spectroscopy - Interference with Multiple beam - Theory of multilayer films.

UNIT - III : LASER OPTICS

Laser rate equations – Three level system – Four level system – Population inversion – Optical resonators – Ruby laser – Helium-Neon Laser – Carbon dioxide laser – Four Level Solid Laser – Semiconductor laser –Holography- Theory of holography – Applications in Communication and Medicine.

UNIT - IV : NON LINEAR OPTICS

Nonlinear response – Nonlinear phenomenon and harmonic generation – Phase matching – Susceptibility Tensors – Parametric amplifications –Monley –Row relations – Self focusing – Theory of self focusing – Theory of laser Raman spectroscopy.

UNIT - V : FIBER OPTICS

Basic optical laws and definitions – Optical fiber modes and configuration – Step index and Graded index fiber structure – Fiber materials – Fiber fabrication – Mechanical properties of Fibers – Fiber optic communication – Wavelength Division Multiplexing (WDM) – Local Area Network (LAN) – Optical fiber Bus – Nonlinear optical Effects.

TEXT BOOK

1. Grant R.Fowles, Introduction to Modern Optics, Halt,Rineharand Winston Inc, Reprint 2007, Edition:2nd.
2. Thyagarajan and Ghatak, Lasers theory and applications, Macmillan.
3. G.D. Barugh, Essentials of Laser and Nonlinear optics, Pragati Prakashan Meerut, 2000, Edition:1ST.
4. Gerd Keiser, Optical Fiber communications, Mc GrawHill

REFERENCE BOOK

1. Born and wolf, Principles of Optics, Pergman Press, Reprint, 1997, Edition: 2nd

2. Cherin, Introduction to Optical fibers, Mc Graw Hill, Reprint, 1997, Edition: 2nd

Programme : M.Sc Physics Subject Code: 20PPH2C06
Course Title : **QUANTUM MECHANICS - I**
Core : 6
Year : I Semester : II
Hours/Week : 5 Credits : 4

COURSE OBJECTIVES

To enable the students to understand the

- basics of quantum mechanics and importance of schrodinger equations
- gain knowledge on wave functions, observables, and operators
- wave functions, observables, operatros matrix methods involved in the formation of quantum mechanical equation of motion
- problems associated with the subatomic systems
- need for the approximate methods to obtain the solution of the complex problems

COURSE OUTCOMES (CO)

By the end of the course, the students will be able to

CO1	discuss the nessecity for the study of quantum mechanics	K1 & K2
CO2	wave functions, observables, operatros matrix methods involved in the formation of quantum mechanical equation of motion	K2
CO3	interpret the equation of motion in three representations	K4
CO4	solve the subatomic problems	K3
CO5	evaluate the ground state energy of atoms using time independent perturbation theory	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze;

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	M	M		S	S	S	M	M
CO2	S	M	S	M	L		S	M	M	L	M
CO3	S	M	M	S	S		S	S	M	M	S
CO4	S	M	M	S	L		S	M	S	M	M
CO5	S	S	S	S	S		S	S	S	S	S

S - Strong; M - Medium; L - Low

UNIT - I : GENERAL FORMALISM OF QUANTUM MECHANICS
Wave packet- Time dependent and Time independent Schrödinger equation –Interpretation of wave function-Probability interpretation- Probability current density-Expectation value-Ehrenfest's theorem-Linear Vector Space –Linear Operator- Eigen function and Eigen values –Hermitian Operator – Postulates of Quantum Mechanics – Simultaneous Measurability of Observables – General Uncertainty Relation – Dirac's Notation.

UNIT - II : EQUATION OF MOTION AND HEISENBERG METHOD

Equation of motion – Schrödinger, Heisenberg and Interaction representation – Heisenberg method – Matrix representation of Wave Function and operator –Properties of Matrix elements – Schrödinger equation in Matrix form – Eigen value problem –Unitary transformations – Linear harmonic oscillator - Matrix method.

UNIT - III : APPLICATION TO ONE AND THREE DIMENSIONAL PROBLEMS

Square well potential with rigid walls and finite walls – Square potential barrier – Alpha emission – Bloch waves in a periodic potential – Kronig – Penney square well periodic potential – Linear harmonic oscillator - Schrödinger method - Operator method – Delta function- Particle moving in a spherically symmetric potential - System of two interacting particles – Rigid rotator – Hydrogen atom - Hydrogenic orbitals.

UNIT - IV: ANGULAR MOMENTUM

Angular momentum operators – Angular momentum commutation relations – Eigen values and Eigen functions of $L^2$and L_z - General angular momentum - Eigen values of J^2 and J_z – Angular momentum matrices – Spin angular momentum – Spin vectors for spin 1/2 system – Addition of angular momenta.

UNIT - V : TIME INDEPENDENT PERTURBATION THEORY

Time independent perturbation theory - Basic concepts – Non degenerate energy levels – Anharmonic oscillator - First order correction – Ground state of helium – Effect of electric field on the ground state of hydrogen – Degenerate energy levels - Ground state theory of deuteron.

TEXT BOOK

G. Aruldhas, Quantum Mechanics, Prentice- Hall of India Pvt, Delhi, 2004.

REFERENCE BOOK

1. P. M. Mathews, T. K. Venkatesan, A Text Book for Quantum Mechanics, McGraw- Hill Publishers,
2. L. I Shiff, Quantum Mechanics, McGraw- Hill Publishers New York, 1955.

Programme : M.Sc Physics Subject Code: 20PPH2C07
Course Title : **DIGITAL SYSTEM DESIGN AND MICROPROCESSOR**
Core : 7
Year : I Semester : II
Hours/Week : 5 Credits : 4

COURSE OBJECTIVES

To understand the basics of

- timer circuits and shift registers, methods of analog to digital conversion
- microprocessor 8085 and its interfacing
- to familiarize the instruction format
- instruction set used in second generation microprocessor
- to develop the programming skill in advanced microprocessor

COURSE OUTCOMES (CO)

By the end of the course, the students will be able to

CO1	design the timer circuits and shift registers	K2
CO2	understand the concepts of instruction format	K2 & K3
CO3	instruction set used in second generation microprocessor	K3 & K4
CO4	know the applications of 8085	K4
CO5	develop the programming skill in advanced microprocessor	K3

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze;

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	M	L		S	M	M	L	S
CO2	S	S	S	S	S		S	S	M	M	S
CO3	S	S	M	M	M		S	M	S	L	S
CO4	S	S	M	S	S		S	M	S	L	S
CO5	S	S	M	S	S		S	S	S	M	S

S - Strong; M - Medium; L - Low

UNIT - I: DIGITAL CIRCUITS

555 Timer internal Structure - 555 Timer as schmitt Trigger - Flip- Flops - NAND Latch - SR, JK, JK Master Slave - Counters - Scale of two to ten counter - Shift Registers - Serial and Parallel - Shift left and Shift right operations - Up Down counters - Multiplexers and Demultiplexers - Decoders and Encoders.

UNIT - II: DIGITAL SYSTEM DESIGN

D/A Conversion - Binary weighted resistor D/A converter - R- 2R resistive adder D/A converter- Counter type D/A converter successive approximation A/D converter- Dual slope A/D converter- Parallel comparator A/D converter, Sample and hold circuits, Multiplexing displays - Digital frequency counter - Digital Multimeter.

UNIT - III: MICROPROCESSOR FUNDAMENTALS AND APPLICATIONS

Introduction to microprocessor - 8085 Architecture - Pin configuration - Addressing modes - - Instruction classification - Instruction set - Data transfer instructions - Arithmetic instructions - Logical and branch instructions- Programmable Peripheral interface (8255A) - Programmable interrupt controller (8259) - Seven segment LED display

UNIT - IV: ADVANCED MICROPROCESSORS 8086

Introduction to microprocessor 8086 - Pin functions of 8086 - 8086 Architecture - Address space and data organization - Hardware organization of the memory address space - Memory read and write bus cycle - Input and output instructions - Input/output port interface minimum mode - Input and output maximum mode signals - Interrupt and 8086 response.

UNIT – V: PROGRAMS AND APPLICATIONS OF 8086 MICROPROCESSOR

General program structure – Addition of two 16 bit numbers – multiplication of two 16 bit numbers – Division of a 32 bit number by a 16 bit number - Multibyte addition - Ascending order-bubble start – Display character string - Programmable Interrupt controller(PIC)8259A – Interrupt applications – Stepper motor interface.

TEXT BOOK

1. Malvino and Leech, Digital Principles & Application, McGraw Hill Company
2. V. Vijayendran, Introduction to Integrated Electronics Digital and Analog, 2007, Reprint 2007, 1st Edition.
3. B. Ram, Fundamentals of Microprocessors and microcomputers, Dhaputrai Publications New Delhi, 2005, 6th Edition.
4. S. Gonkar, Microprocessor Architecture, Programmming and applications with the 8085, Penram International publishing Privt, Ltd, 1996, 5th Edition.
5. A. K. Roy Malvino and K.M. Bhurchandi, Advanced Microprocessors And Peripherals, Tata McGraw- Hill, 2005, 16th Reprint.
6. V. Vijayendran, Fundamentals of Microprocessor 8086, S.Viswanathan Publishers, 2007.

REFERENCE BOOK

Albert Paul Malvino, Digital Computer Electronics, Tata McGraw- Hill, 1992, 18th Reprint edition.

Programme : M.Sc Physics Subject Code: 20PPH2CP1
Course Title : **GENERAL EXPERIMENTS**
Core Practical : I
Year : I Semester: II
Hours/Week : 3 Credits : 3

COURSE OBJECTIVES

This course helps the students to

- realize the interaction of electric and magnetic fields on charged particles
- find the difference in wavelength between the neighboring spectral lines
- measure the thermal response of the negative TCR of the thermistor
- realize the quantized energy level in the hydrogen atom
- study the magnetic properties of the materials

COURSE OUTCOMES (CO)

By the end of the course, the students will be able to

CO1	Understand the basics of experimental physics	K1&K2
CO2	acquire strong laboratory skills	K3
CO3	implied the knowledge of theory involved in physics	K2& K4
CO4	know quantized energy level in the hydrogen atom	K3
CO5	understand the magnetic properties of the materials	K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze;

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	M	S		S	S	S	S	S
CO2	S	S	M	M	S		S	M	M	M	S
CO3	S	S	M	S	S		M	S	M	S	S
CO4	S	M	M	M	S		S	M	S	M	S
CO5	S	M	S	M	S		S	M	S	S	S

S - Strong; M - Medium; L - Low

Any TWELVE of the following Experiments:

1. Young′s modulus - Cornu′s method - Elliptical fringes
2. Polarizability of liquids - Spectrometer
3. Compressibility of liquids - Ultrasonic diffraction
4. Michelson′s interferometer

5. Fabry - Perot interferometer
6. Planck′s constant - Photoelectric emission
7. Thermistor- Temp. coefficient of resistance and band gap energy
8. Stefan′s constant - Vacuum Diode/Stefan′s apparatus
9. Thermal conductivity - Forbe′s method
10. e/m- Thomson′s method
11. e/m - Helical method
12. e/m - Magnetron method
13. Electronic charge - Millikan′s oil drop method
14. Rydberg′s constant - Hydrogen spectrum
15. Boltzmann′s constant - Boltzmann′s apparatus
16. Hysteresis curve of Ferromagnetic materials - CRO method

Programme : M. Sc Physics Subject Code: 20PPH2CP2
Course Title : **ELECTRONICS EXPERIMENTS**
Core Practical : II
Year : I Semester : II
Hours/Week : 3 Credits : 3

COURSE OBJECTIVES

To gain the basics of practical knowledge in electronics experiments.

- realize the characteristics of the higher order active devices
- recognize the feedback concept of oscillators
- understand the performance of the Op-Amps in oscillator domain
- realize thermal performance of a semiconductor using Four probe setup
- design and study the performance of adder and subtractor circuits

COURSE OUTCOMES (CO)

By the end of the course, the students will be able to

CO1	understand working of OP-AMPs and its applications.	K3
CO2	construct oscillator circuits using OP-AMP.	K2
CO3	construct digital circuits using ICs.	K2
CO4	enhance present day devices requirements in industries and research fields	K4
CO5	know the performance of adder and subtractor circuits	K1 & K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze;

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	S	S		S	M	M	S	S
CO2	S	M	M	L	S		S	M	S	S	S
CO3	S	S	M	L	S		S	S	M	M	S
CO4	S	M	M	S	S		S	S	M	M	S
CO5	S	S	M	S	S		S	S	M	M	S

S - Strong; M - Medium; L – Low

Any TWELVE of the following Experiments:

1. IC regulated power supply - 5, 9, 12 - 0 - 12 V, 1 amp
2. FET Characteristics
3. UJT Characteristics
4. SCR Characteristics

5. MOSFET Characteristics
6. DIAC Characteristics
7. TRIAC Characteristics
8. Photo Diode and Photo Transistor
9. UJT relaxation oscillator
10. Astable multivibrator - 555 IC
11. Phase shift oscillator - 741 IC
12. Wien bridge oscillator - 741 IC
13. Wave form generators - 741 IC (Sine, Square and Triangular)
14. Band gap energy and Carrier concentration - Ge - Four Probe method
15. Half adder, Full adder and 4 - Bit binary adder
16. Half subtractor, Full subtractor and 4 - Bit binary subtractor

Programme : M.Sc Physics Subject Code: 20PPH2EP1
Course Title : **SIMULATION IN PHYSICS - C++ PROGRAMMING**
Elective Practical : I
Year : I Semester : II
Hours/Week : 4 Credits : 4

COURSE OBJECTIVES

This course offers the students to

- gain the practical knowledge in C++ programming.
- inculcate laboratory practice and to develop programming skills
- have hands on experience on using advanced computers
- find ease method to solve equations
- develop skills on performing iteration

COURSE OUTCOMES (CO)

By the end of the course, the students will be able to

CO1	analysis practical knowledge in C++ programming.	K3
CO2	laboratory practice and to develop programming skills	K2
CO3	have hands on experience on using advanced computers	K3
CO4	analyze various problems related to have an analytical structure of experiments	K4
CO5	develop problem solving skills and to solve more problems based on physical concepts	K3

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze;

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S		S	M	S	S	S
CO2	S	M	S	S	M		S	M	M	S	S
CO3	S	M	S	S	S		S	S	S	S	S
CO4	S	S	S	S	S		S	S	M	M	S
CO5	S	S	S	M	S		S	M	S	S	S

S - Strong; M - Medium; L - Low

Any Fifteen of the following Experiments:

1. Moment of inertia of Circular disc and Solid sphere.
2. Moment of inertia of Spherical sphere and Solid cylinder.
3. Temperature conversion from F to C and C to F.
4. Plank’s law of radiation - Determination of energy density.

5. Resolving and dispersive power of grating
6. Solar spectrum- Determination of photon energy.
7. Rayleigh Jean's Law - Determination of energy density
8. SCR power control - Determination of power output.
9. AND, OR and NOT gates.
10. NAND and NOR gates.
11. Radioactive decay of the element
12. Mosley's law- Determination of frequency and wavelength
13. Radius, orbital wavelength and energy levels of atoms - Bohr model.
14. Lyman, Balmer and Paschen series - Wave number.
15. Brackett and Pfund series - Wave number.
16. Determination of the diameter of molecules.
17. Determination of Molecular weight of compounds.
18. Band gap energy of thin films.
19. Solution of differential equation by Runge - Kutta method.
20. Integration by Simpsons 1/3 rule.

Programme : M.Sc Physics Subject Code: 20PPH3C08
Course Title : **QUANTUM MECHANICS- II**
Core : 8
Year : II Semester : III
Hours/Week : 5 Credits : 4

COURSE OBJECTIVES

To enable the students to understand the

- techniques involved in various approximate methos
- methods involved in framing of schrodinger equations time dependent
- methods involved in framing of schrodinger equations independent systems
- many electron problems using Thomas-Fermi and Hartree-Fock equations
- scattering theories, relativistic quantum mechanics and quantum fields
-

COURSE OUTCOMES (CO)

By the end of the course, the students will be able to

CO1	utilise the various approximate methos on subatomic problems	K3
CO2	frame of schrodinger equations for time dependent and independent systems	K4
CO3	many electron problems using Thomas-Fermi and Hartree-Fock equations	K4
CO4	apply the scattering and Dirac theories on potential well problems	K3& K4
CO5	relativistic quantum mechanics repectively	K3

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze;

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	M	S		S	S	S	S	S
CO2	S	M	S	M	M		S	M	S	M	S
CO3	S	M	S	M	S		S	M	S	M	M
CO4	S	S	M	L	M		S	M	S	M	M
CO5	S	S	S	S	S		S	S	S	S	S

S - Strong; M - Medium; L - Low

UNIT - I : APPROXIMATION METHODS

Variational principle-Rayleigh-Ritz method – Variation method for exited states – Ground state of helium – Hydrogen molecule ion- Ground state of deuteron – WKB Method – Connection formulas –Validity – Barrier penetration – Alpha Emission – Bound states in a potential well.

UNIT - II : TIME DEPENDENT PERTURBATION THEORY
Introduction – First order perturbation – Harmonic perturbation – Transitions to continuum states – Absorption and emission of radiation – Einstein's A and B coefficients - Selection rules.

UNIT - III : MANY ELECTRON ATOMS
Indistinguishable particles – Pauli principle – Inclusion of spin – Spin functions for two-electrons – Spin functions for three-electrons – Helium atom – Central field approximation – Thomas-Fermi model of the atom – Hartree equation – Hartree-Fock equation.

UNIT - IV : THEORY OF SCATTERING
Scattering cross- section - Scattering amplitude partial waves - Scattering by a central potential - Partial wave analysis - Significant number of partial waves - Scattering by an attractive square well potential - Breit- Wiger formula - Scattering length - Expression for phase shifts - Integral equation - Born approximation - Scattering by screened coulomb potential - Validity of born approximation - Laboratory and centre of mass coordinate system.

UNIT - V : RELATIVISTIC WAVE EQUATIONS AND QUANTIZATION OF WAVEFIELDS
Klein-Gordon equation – Interpretation of the Klein-Gordon equation - Dirac's equation for a free particle – Dirac matrices – Covariant form of Dirac equation - Probability density – Plane wave solution – Negative energy states – Spin of the Dirac particle – Radial equation for an electron in a central potential – Hydrogen atom – Lamb shift – Coordinates of the field – Quantum equation for the field – Creation, destriction and number operators – Quantized field energy.

TEXT BOOK

G. Aruldhas, Quantum Mechanics, Prentice- Hall of India Pvt, Delhi, 2004.

REFERENCE BOOK

1. P. M. Mathews, T. K. Venkatesan, A Text Book for Quantum Mechanics, McGraw- Hill Publishers,
2. L. I Shiff, Quantum Mechanics, McGraw- Hill Publishers New York, 1955.

Programme : M.Sc Physics Subject Code: 20PPH3C09
Course Title : **SOLID STATE PHYSICS**
Core : 9
Year : II Semester : III
Hours/Week : 5 Credits : 4

COURSE OBJECTIVES

To understand the basics of

- crystallography and defects in solids
- phonons through lattice vibration
- specific heat
- elastic and optical properties of solids
- magnetic and dielectric properties

COURSE OUTCOMES (CO)

By the end of the course, the students will be able to

CO1	understand the elements of x - ray crystallography and defects in solids	K1 & K2
CO2	know about the phonons and the specific heat capacity of the materials at low temperature	K3
CO3	understand about the elastic behaviour of the crystaline solids and photoconductivity	K1 & K4
CO4	know about the types of magnetic materials	K4
CO5	understand the polarisisation of dipoles in dielectrics and ferro electricity	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze;

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	M	S		S	S	S	S	S
CO2	S	S	M	M	S		S	M	S	S	S
CO3	S	M	S	M	S		S	M	S	M	L
CO4	S	S	M	L	S		S	S	S	M	S
CO5	S	S	M	L	S		S	S	M	S	S

S - Strong; M - Medium; L - Low

UNIT - I : ELEMENTS OF X - RAY CRYSTALLOGRAPHY AND DEFECTS IN SOLIDS

Miller Indices - Point groups - Space group - Reciprocal lattice - Bragg's law interpretation - Structure factor - fcc and bcc structures - Electron density distribution experimental techniques for crystal structure studies (Powder, Laue and Rotation crystal method) - Electron and neutron diffraction methods - Point defects - Colour centres - Line defects - Edge dislocation - Screw dislocation - Dislocation motion.

UNIT - II : LATTICE VIBRATION AND THERMAL CONDUCTIVITY

Phonons in solids - One dimensional atomic chain - (Mono atomic and diatomic) - Momentum of phonons- Optical properties in the infrared - Inelastic scattering of neutrons by phonons - Local phonon model- Umklapp and normal process - Theory of specific heat (Classical, Einstein and Debye Model) - Thermal expansion and thermal conductivity - Boltzmann transport equation .

UNIT - III : ELASTIC AND OPTICAL PROPERTIES OF SOLIDS

Elastic stress components - Analysis of elastic strains - Elastic energy density - Elastic stiffness constants of cubic crystals - Elastic waves in cubic crystals - Experimental determination of elastic constants for cubic crystals - Photo conductivity - Excitation across a gap - Simple model of photo conductor trapping capture - Recombination - Excitons - Luminescence - Activators - Absorption spectra - Emission spectra.

UNIT- IV: **MAGNETIC PROPPERTIES**

Magnetic permeability - Theory of diamagnetism - Langevin's theory of para magnetism - Weiss theory - Paramagnetic susceptibility of a solid - Calculation of susceptibility - Quantum theory of para magnetism - Determination of susceptibility- Para and diamagnetic materials - Ferromagnetism - Spontaneous magnetism in ferromagnetism - Curie-Weiss law - Ferromagnetic domains - Domain theory- Antiferromagnetism - Structure of ferrites.

UNIT- V : DIELECTRIC PROPERTIES

Microscopic concepts of polarization - Langevin's theory of polarization in polar dielectrics - Local field in liquids and solids - Evaluation of local fields for cubic structure- Computation of E_n- Clausius-Mossotti Relation - Lorentz formula - Ferroelectricity - Dipole theory of ferroelectricity - Classification of ferroelectric materials - Anti ferro electricity - Piezoelectricity - Complex dielectric constant and dielectric loss - Effects of dielectrics.

TEXT BOOK

1. B.S. Saxena, R.C.Gupta & P.N. Saxena, Fundamentals of Solid state Physics, Pragathi Prakashan, 2003, 13th edition.
2. S. O Pillai, Solid State Physics, New age international, 1997, 4th edition.

REFERENCE BOOK

S. L. Gupta, Solid state Physics, Nath &Co,Meerut, 1983- 84, 4th edition.

Programme: **M. Sc Physics**
Course Title : **Advanced Materials and Characterization** Course Code: 20PPH3EL2
Year : **II** Semester: **III**
Hours/Week : **5** Credits: **4**

COURSE OBJECTIVES

This course offers to

- understand techniques involved in various approximate methods
- study the methods involved in setting up of Schrödinger equations for time dependent and independent systems
- calculate central field potential of many electron problems using Thomas-Fermi and Hartree-Fock equations
- elucidate scattering theories
- acquire knowledge on relativistic quantum mechanics and quantum field theory

COURSE OUTCOMES (CO)

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

CO1	use the various approximate methods to solve subatomic problems	K2, K3 & K4
CO2	deduce the Schrödinger equations for time dependent and independent systems	K3
CO3	calculate field potential for many electron problems using Thomas-Fermi and Hartree-Fock equations	K4
CO4	distinguish the relativistic and non-relativistic quantum mechanics	K2
CO5	apply the scattering techniques, Dirac theories and methods of quantization of field energy to solve specific problems in Quantum mechanics	K2 & K3

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze;

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	S	S		S	S	M	S	S
CO2	S	L	M	S	S		S	S	M	S	S
CO3	S	S	S	S	S		S	S	S	M	S
CO4	S	M	M	L	S		S	S	S	S	S
CO5	S	M	M	M	S		S	S	S	S	S

S - Strong; M - Medium; L - Low

UNIT - I: THIN FILMS:

Thin Film and growth process - Distribution of deposits - Deposition Techniques: Thermal evaporation - Cathodic sputtering – Glow discharge sputtering - RF sputtering – Chemical and Physical vapor deposition – Spray pyrolysis – Spin coating.
THICKNESS MEASUREMENTS: Mass methods – Optical method - photometry, ellipsometry, interferometry - Microbalance technique.
UNIT - II POLYMERIC MATERIALS:

Introduction and types - Photoconductive polymers - Composition and structure of polymers – Polymerization techniques – Chemical oxidative and Electrochemical polymerization - Applications.
SOLAR CELLS: Introduction - History and types of solar cell - Thin film and Dye sensitized solar cell - Minority carrier diffusion - IV characteristics - Solar cell output parameters.

UNIT - III X-RAY ANALYSIS:

Powder X-ray diffraction - Debye-Scherrer technique - Indexing the powder pattern - Calculation of particle size using Scherer method - Lattice constant calculations.
MICROSCOPY ANALYSIS: Scanning Electron Microscope (SEM) - EDAX analysis - Principle and working of Atomic Force Microscopy (AFM) and - Principle of Transmission Electron Microscopy (TEM)

UNIT - IV OPTICAL ANALYSIS:
UV-Vis spectroscopy studies - Band gap calculation - Determination of refractive index and optical conductivity - Fluorescence and Photoluminescence studies - Determination of direct band gap energy - Electroluminescence - FTIR spectroscopy - determination of different vibrational modes.

UNIT – V ELECTRICAL AND THERMAL ANALYSIS:
Two probe and four probe methods - Hall effect setup measurement - Thermal Analysis: Introduction - Thermogravimetric analysis (TGA) - instrumentation - Determination of weight loss and decomposition products - Differential thermal analysis (DTA) - Cooling curves - Differential scanning calorimetry (DSC) - Instrumentation - Specific heat capacity measurements.

TEXT BOOK:

1. A.Goswam, Thin film fundamentals, New age international (P) Ltd, New Delhi (1986)
2. C.P. Poole, F.J. Ownes, Introduction to Nano technology, Wiley, India (2007),
3. L.D. Partain , Solar Cells and their applications, John Wiley and Sons, New York (1995)
4. Lawrence E. Murr, Electron and Ion microscopy and Microanalysis principles and Applications Marcel Dekker Inc., New York (1991).

Reference Books

1. K.L. Chopra, Thin film phenomena, McGraw-Hill Book companies, New york (1969).
2. G.Timp, Nanotechnology, A.P. Press, Springer (1999)
3. R.H. Bube, Photovoltaic Materials, Imperial (1998).
4. Nanoscale characterization of surfaces & interfaces, N John Dinardo, Weinheim Cambridge: Wiley-VCH, 2nd ed., 2000.

Programme : M.Sc Physics Subject Code: 20PPH4C10
Course Title : **CONDENSED MATTER PHYSICS AND NANO SCIENCE**
Core : 10
Year : II Semester : IV
Hours/Week : 5 Credits : 4

COURSE OBJECTIVES

This course exposes the students to

- providethe basics of crystallography and defects in solids
- learn aboutthe lattice vibration and specific heat capacity of materials
- calculate elastic constants for cubic crystals and excitons of solids
- distinguish the different types of magnetic materials
- acquirebasic concept of polarization and dielectric properties

COURSE OUTCOMES (CO)

By the end of the course, the students will be able to learn the

CO1	electrons in the periodic lattice, effective mass and fermi surfaces	K2
CO2	types of semiconductors, mobility and conductivity	K4
CO3	thermodynamics of superconductors, new superconductors and applications	K3
CO4	categories the types of magnetic materials	K2 & K4
CO5	analyze the polarization of dipoles in dielectrics	K3

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze;

1.	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	L	S		S	S	S	S	S
CO2	S	S	S	M	S		S	S	S	M	S
CO3	S	S	M	S	S		S	S	S	M	M
CO4	S	S	M	S	S		S	M	S	M	M
CO5	S	S	M	S	S		S	M	M	S	S

S - Strong; M - Medium; L - Low

UNIT - I: BAND THEORY OF SOLIDS

Free electron model - Wave equation in a periodic table and bloch theorem - Kronig-Penney theory - Acceleration of electron in the periodic lattice and effective mass of the electron - Free electron approximation - Tight binding approximation - Brillouin zones - Construction of fermi surfaces - Experimental methods in fermi surface studies.

UNIT- II: SEMICONDUCTORS

Intrinsic Semiconductor - Carrier Concentration in Intrinsic Semiconductor – Calculation of density of holes and electrons – Fermi level and its variation with temperatures – Mobility and conductivity – Determination of band gap - Extrinsic Semiconductor – Expression for carrier concentration in n-type and p-type semiconductors – Variation of Fermi level with temperature and impurity concentration – Hall effect - Determination of Hall coefficient.

UNIT- III: SUPERCONDUCTORS

Superconductivity phenomena - Thermodynamics of superconductivity transition - London equations - Type I and Type II superconductors - BCS theory - Josephson's tunneling - DC and AC Josephson's Effect - New superconductors - Applications - High temperature superconductors - SQUIDS.

UNIT - IV: NANOMATERIALS AND CHARACTERISATION

Classification of Nanostructured materials - Quantum well, quantum wires and quantum dots - Lithography - (Photoresist spinner, positive and negative photoresists) - Fabrication methods - Top down process - Bottom up approach - Plasma assisted deposition process - Deposition by epitaxy - Liquid phase methods - Techniques for synthesis of nanophase materials - Mechanical alloying - Inert gas condensation - Sol-gel techniques - Properties of nanomaterials - Methods for templating the growth of nanomaterials - Ordering of nanosystems.

UNIT - V: NANODEVICES AND THEIR APPLICATIONS

Energies associated with ferromagnetic material - Effect of physical dimensions on magnetic properties of materials - Nanomagnetic materials - Geometric Nanomagnets - Layered Nanomagnets - Carbon nanotubes - Organic field effect transistor (OFET) - Organic light emitting diode (OLED) - Organic photovoltaic - Bilayer organic solar cell using CuPc and PTC - Injection laser - Quantum well lasers - Quantum cascade laser - Single electron tunneling and coulomb blockade behavior - Optical memories - Quantum dot laser.

TEXT BOOK

1. B.S. Saxena, R.C.Gupta & P.N. Saxena, Fundamentals of Solid state Physics, Pragathi Prakashan, 2003, 13th edition.
2. Dr. S. Jayakumar, Materials Science, R.K. Publishers, 2008.

REFERENCE BOOK

1. S. L. Gupta, Solid state Physics, Nath &Co,Meerut, 1983- 84, 4th edition.
2. S. O Pillai, Solid State Physics, New age international, 1997, 4th edition.

Programme : M.Sc Physics Subject Code: 20PPH4C11
Course Title : **NUCLEAR PHYSICS**
Core : 11
Year : II Semester : IV
Hours/Week : 5 Credits : 4

COURSE OBJECTIVES

To understand the concept and theory of

- radioacivity
- structure of nucleus
- different nuclear models
- various types of Nuclear reaction
- elementary particles

COURSE OUTCOMES (CO)

By the end of the course, the students will be able to

CO1	understand the three modes of decay	K3
CO2	study the theories of nuclear composition	K2
CO3	understand the various nuclear models	K4
CO4	know about the role of elementary particles	K2
CO5	know the interactions with matter.	K2& K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze;

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	L	M	S	S		S	M	M	S	S
CO2	S	S	M	S	S		S	M	S	S	S
CO3	S	M	S	M	S		S	S	M	M	S
CO4	S	S	M	L	S		S	S	M	S	M
CO5	S	M	M	M	M		S	S	S	M	L

S - Strong; M - Medium; L - Low

UNIT - I : NUCLEAR DISINTEGRATION STUDIES

Alpha Decay: Properties of alpha particles – Velocity and energy of alpha particles - Geiger-Nuttal law – Gamow's theory of alpha decay.

Beta Decay: Properties and beta particles - Fermi's theory of beta decay – Kurie plot - Forms of interaction and selection rules – Electron capture.

Gamma Transitions: Absorption of gamma rays by matter – Interaction of gamma rays with matter – Measurement of gamma rays energies – Dumond bent crystal spectrometer - Internal conversion.

UNIT - II : ELEMENTS OF NUCLEAR STRUCTURE
Theories of nuclear composition (Proton- electron theory, proton neutron theory) – Mass spectroscopy – Bainbridge and Jordan mass spectrograph – Nier's mass spectrometer– Deuteron - Magnetic and quadra pole moment of deuteron – Ground state of deuteron – Excited state of deuteron –Meson theory of nuclear forces - Yukawa potential.

UNIT - III : NUCLEI MODELS
Liquid drop model- Semi-empirical mass formula – merits and demerits – Shell models –Basic assumption of shell models – Square well potential - The harmonic oscillator - Magic numbers – Spin orbit coupling- prediction of the Shell model- merits and demerits – Fermi gas model- Collective model.

UNIT - IV: NUCLEAR REACTION STUDIES
Types of Nuclear reaction - Conservation laws for nuclear reactions – Kinematics of Nuclear reactions – Exothermic and endothermic reactions – threshold energy- compound nucleus- Nuclear fission- Energy released in fission- Nuclear fusion- hydrogen burning and solar energy.

UNIT - V : ELEMENTARY PARTICLES
Classification of elementary particles – Fundamental interactions – Electromagnetic, strong, weak and gravitational interactions – Quantum numbers - – Conservation laws – The CPT Theorem - Particle symmetries – SU (2) Symmetry - SU (3) symmetry – Quarks theory.

TEXT BOOK

1. Pandiya and Yadav, Elements of Nuclear Physics, Kedar Nath, Ram Nath, Meerut, 1997, 7^{th} edition.

REFERENCE BOOKS

1. D. C. Tayal, Nuclear Physics, Himalaya Publishing, 2003, Edition: 9^{th}
2. B L Cohen, Concept of Nuclear Physics, Tata McGraw - Hill, Publisher, New Delhi, Year: 1989 Edition: 9^{th} Reprint.

Programme : M.Sc Physics Subject Code: 20PPH4C12
Course Title : **SPECTROSCOPY**
Core : 12
Year : II Semester : IV
Hours/Week : 5 Credits : 4

COURSE OBJECTIVES

This course expose the students to

- gain knowledge on theories of atomic and microwave spectroscopy
- distinguish between rotational and molecular vibrations in IR and Raman spectra
- analyze vibrational band systems in electronic spectra
- acquire knowledge on components of NMR, NQR, ESR and Mossbauer
- learn various experimental methods like Raman, IR, NMR etc.,

COURSE OUTCOMES (CO)

By the end of the course, the students will be able to learn the

CO1	concepts of Atomic and molecular spectroscopy	K1
CO2	analtical techniques of electronic rotational	K4
CO3	vibrational spectra	K3& K4
CO4	formation of Deslanders table	K2
CO5	explicate different electronic transitions	K2,K3

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze;

MAPPING

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	L	M		S	S	M	M	M
CO2	S	S	M	L	L		M	S	S	S	M
CO3	S	S	M	S	M		S	S	M	M	M
CO4	S	M	S	M	M		S	M	S	S	S
CO5	S	M	S	S	M		S	S	S	M	M

S - Strong; M - Medium; L - Low

UNIT - I: ATOMIC AND MICROWAVE SPECTROSCOPY
Introduction to atomic spectroscopy – spectra of the alkali metal vapours – Normal Zeeman effect - Lande's 'g' formula - Paschen back effect - Stark effect – Linear molecules- Spherical top molecules- Symmetric top molecules- Study of hindered internal rotation and inversions (elementary ideas only).

UNIT - II: IR AND RAMAN SPECTROSCOPY

Radiation sources - Pure rotational spectra of gaseous diatomic molecules - Molecular vibration - IR rotation vibration spectra of gaseous diatomic molecules – Classical theory of Raman effect and the selection rule for Raman scattering – Quantum theory of the Raman effect - Pure rotational Raman spectra of diatomic and polyatomic molecules - Raman vibration studies of diatomic molecules.

UNIT - III: UV AND ELECTRONIC SPECTROSCOPY

Born-oppenheimer approximation – vibrational coarse structure:progressions – Deslanders table formation – Intensity of vibrational electronic spectra: The Franck-Condon principle – Molecular orbital theory – chemical analysis by electronic spectroscopy – Effect of solvents of electronic spectra Electronic spectra of transition metal complexes: Selection rules only – Jablonski diagram – Resonance fluorescence – normal florescence – Ultraviolet photo electron spectroscopy.

UNIT – IV: NMR AND NQR SPECTROSCOPY

NMR Quantum mechanical description - Classical description - Bloch equations - Relaxation process - Mechanisms of spin lattice relaxation – chemical shift - Mechanisms of spin-spin relaxation - Experimental technique: The spectrometer: Basic requirements only – Fourier transform spectrometer.

NQR: Fundamental requirements - General principles - Integral spins –Experimental detection of NQR frequencies – the Super regenerative oscillator - Continuous wave oscillator – Chemical application (main uses only).

UNIT – V: ESR AND MOSSBAUER SPECTROSCOPY

The ESR experiment - Thermal equilibrium and relaxation - ESR spectrometer - Reflection cavity and microwave bridge - Magnetic field modulation - Characteristics of the g-factor - Hyper fine structure - Energy levels for a radical with S=1/2 and I=1/2 - Mossbauer effect – Recoilness emission and absorption - Mossbauer spectrum - Experimental methods – Chemical isomer shift.

TEXT BOOK

1. B.P. Straughan and S. Walker, Spectroscopy: Volume (I, II & III), John wiley and sons, New York, 1976.
2. Benwell, Fundamental of Molecular Spectroscopy, McGraw Hill Edu.Pvt.Ltd. Edition Year: 2013

REFERENCE BOOK:

G.Aruldhas, Molecular Structure and Spectroscopy, Prentice Hall of India pvt Ltd, 2004,

Programme : M.Sc Physics Subject Code: 20PPH4CP3
Course Title : **ADVANCED EXPERIMENTS**
Core Practical : III
Year : II Semester : IV
Hours/Week : 3 Credits : 3

COURSE OBJECTIVES

- inculcate laboratory practice and to reinforce the concepts and methods presented in theory
- predict the magnetic properties of liquid with advanced instruments
- calculate the absorption coefficient of nuclear radiation
- measure the dipole moments and dielectric constants ,conductivity band gap energy, charge carriers, refractive index, selective coating absorptivity and particle size using advanced equipments
- gain hands on experience on using advanced instrumentation

COURSE OUTCOMES (CO)

By the end of the course, the students will be able to

CO1	Understand the properties materials	K3
CO2	know about the handling radioactive materials	K2
CO3	develop thinfilm coatings	K1 & K3
CO4	acquire strong laboratory skills in handling advanced instruments	K4
CO5	gain hands on experience on using advanced instrumentation	K2

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze;

MAPPING

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S		S	S	M	S	S
CO2	S	S	M	M	S		S	S	S	S	S
CO3	S	S	M	M	S		S	M	S	M	S
CO4	S	S	S	M	S		S	S	M	S	S
CO5	S	S	M	S	S		S	M	S	S	S

S - Strong; M - Medium; L - Low

Any Fifteen of the following Experiments:

1. Determination of Dipole moment of liquids and solids.
2. Susceptibility of liquids - Quincke's method.
3. Susceptibility of liquids - Gouy's method.

4. Geiger Muller counter - Characteristics of GM tube and absorption coefficient of Aluminium- Beta & Gamma rays.
5. Determination of Band gap energy - Michelson interferometer.
6. Study of Hall Effect in semiconductors.
7. Synthesis and study of conductivity of electro- deposited conducting polymers.
8. X - ray powder photograph - Debye - Scherrer formula.
9. Deposition and Study of conductivity and activation energy of spray pyrolysis coated SnO_2 films.
10. Study of transmission of light through optic fiber - Numerical Aperture and Bending loss.
11. Elastic constants in solids - ultrasonic method.
12. Ferroelectric materials - Curie Temperature.
13. Study of Zeeman Effect.
14. Laser- Determination of refractive index of given liquids.
15. Determination of thickness of wire using laser
16. Determination of absorbitivity of CoO selective coating.
17. Determination of dielectric constant : Non – Polar liquids
18. Deposition of Black Cobalt selective surface by spray pyrolysis method and deposition of Carbon by Direct method-Temperature measurements.
19. Solar cells- I-V characteristics.
20. Solar cells- variable temperature characteristics.

Programme : M.Sc Physics Subject Code : 20PPH4CP4
Course Title : **SPECIAL ELECTRONICS**
Core Practical : IV
Year : II Semester : IV Hours/Week : 3
Credits : 3

COURSE OBJECTIVES

This course exposes the students to

- inculcate laboratory practice and to reinforce the concepts and methods presented in theory
- practice systematic method to handle the electronic laboratory equipments
- design converter circuits, flip-flop, counter and timer circuits
- construct and verify the performance of the electronic circuits
- have a hands -on training on microprocessor interfacing devices

COURSE OUTCOMES (CO)

By the end of the course, the students will be able to

CO1	construct and understand about the working of digital circuits and its applications	K3
CO2	develop microprocessor programming skill	K4
CO3	develop C++ programming skill	K1 & K2
CO4	acquire knowledge to create the digital circuits with respect to day-to-day need	K3
CO5	have a hands -on training on microprocessor interfacing devices	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze;

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S		S	S	M	S	S
CO2	S	S	M	M	S		S	S	L	S	S
CO3	S	S	S	S	S		S	S	M	L	S
CO4	S	S	S	S	S		S	S	M	M	S
CO5	M	S	M	S	S		S	S	L	M	S

S - Strong; M - Medium; L - Low

Any Fifteen of the following Experiments:

1. Gray code converter.
2. A/D Converter using 741 IC.
3. Flip flops- RS, JK and MS.
4. Wave form generator – 8038.
5. D/A Converter using 741 IC.
6. Study of Multiplexers and Demultiplexers.
7. Decade counter.
8. Digital timers and Frequency Dividers.
9. Counters-MOD-2 to MOD-10.
10. Microprocessor - Musical Tone generator.
11. Microprocessor - Seven segment Running display.
12. Microprocessor - Stepper motor controller
13. Microprocessor - Traffic light interface.
14. Microprocessor - A/D and D/A converters.
15. C++ Program - Evaluating polynomial by Lagrange's interpolation method.
16. C++ Program - Computing area under a curve.
17. C++ Program - Evaluating Sine, Cosine and Exponential series.
18. C++ Program - Solving differential equation by Runge - Kutta method.
19. C++ Program - Evaluating integral by Simpson's 1/3 rule .
20. C++ Program-. Roots of the equation by Newton- Raphson method.

Programme : M.Sc Physics Subject Code: 20PPH4EP2
Course Title : **SIMULATION IN PHYSICS THROUGH MATLAB PROGRMMING**
Elective- Practical: II
Year : II Semester : IV
Hours/Week : 4 Credits : 4

COURSE OBJECTIVES

This course offers the students to

- gain the practical knowledge in matlab programming.
- inculcate laboratory practice and to develop programming skills
- have hands on experience on using advanced computers
- find ease method to solve equations
- develop skills on verifying various physical parameters

COURSE OUTCOMES (CO)

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

CO1	develop MATLABprogrmming skill	K3
CO2	manipulate the programme through MATLABprogrmming	K3
CO3	analyze the physics based conceptsthroughMATLABprogramme	K4
CO4	solve various problems related to simulation methods	K3
CO5	show problem solving skills and to compute more problems based on physical concepts	K2 & K3

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	S		S	M	S	S	S
CO2	S	S	S	S	M		S	M	S	S	S
CO3	S	S	S	S	S		S	S	M	M	S
CO4	S	S	M	S	S		S	S	S	M	S
CO5	S	S	S	M	S		S	M	S	S	S

S - Strong; M - Medium; L - Low

Any Fifteen of the following Experiments

1. Projectile on a horizontal surface (g).
2. Moment of inertia of circular disc, Solid sphere, Spherical sphere and Solid cylinder.

3. Simple harmonic motion- Lissajous Figures (g).
4. Temperature conversion from F to C and C to F (g).
5. Plank’s law of radiation and Rayleigh Jeans law- Verification (g).
6. Resolving and dispersive powers of grating.
7. Solar spectrum- Determination of photon energy.
8. Determination of currents through resistors- Maxwell’s mesh method.
9. SCR power control (g).
10. 8421 code conversion and AND, OR, NOT, NAND, NOR, gates.
11. Radioactive decay (g).
12. Mosley’s law- Verification (g).
13. Radius, orbital wavelength and energy levels of atoms- Bhor model.
14. Lyman, Balmer, Paschen, Brackett and Pfund series- Wave number.
15. Determination of the diameters of molecules.
16. Molecular weight of compounds.
17. Particle in a box and Hydrogen atom wave function probability (g).
18. Band gap energy of thin films.
19. Solution of differential equation by Runge- Kutta method.
20. Integration by Simpsons 1/3 rule.

Note: (g) refers Graphical output.

Programme : M.Sc Mathematics Subject Code: 20PMA3EL3
Course Title : Elective (IDE): **RELATIVITY AND WAVE MECHANICS**
Year : II Semester : III
Hours/Week : 5 Credits : 4

COURSE OBJECTIVES

This course intends students to

- understand the fundamental theories of relativistic mechanics
- distinguish dual nature of matter waves
- calculate Eigen values and Eigen functions
- learn commutation algebra
- use the quantum approximation method to approach problems

COURSE OUTCOMES (CO)

By the end of the course, the students will be able to

CO1	understand the theories of relativistic mechanics	K4
CO2	origin of wave mechanics	K1, K2 &K3
CO3	formalism of wave mechanics and simple applications	K3
CO4	connect equation of motion for various physical system using Schrödinger wave equation	K3 &K4
CO5	express the ground state energy of hydrogen atom using various approximation methods	K3 & K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze;

	PO1	PO2	PO3	PO4	PO5		PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	M	M		S	S	S	M	M
CO2	S	S	M	L	M		S	M	S	L	M
CO3	S	S	S	M	S		S	M	M	S	S
CO4	S	S	S	M	M		S	S	S	M	S
CO5	S	S	S	S	S		S	S	M	S	S

S - Strong; M - Medium; L - Low

UNIT - I : RELATIVISTIC MECHANICS

Einstein's mass-energy relation - Relation between momentum and energy - Four vectors - Four velocity - Energy - Momentum four vectors - Four force - Relativistic classification of particles -

Relativistic Lagrangian, Hamiltonian function - Relativistic Lagrangian and Hamiltonian of a charged particle in an EM field.

UNIT - II : ORIGIN OF WAVE MECHANICS

Failure of classical mechanics - De Broglie's Theory - Davisson and Germer experiment - G.P Thomson experiment - Uncertainity principle - Illustration of Heisenberg's uncertainity principle - Electron microscope - Advantages over ordinary optical microscope - Applications.

UNIT - III : FORMALISM OF WAVE MECHANICS

Postulates of Quantum Mechanics - Equation of motion of matter waves - Time Independent Schrödinger equation - Schrödinger equation for a free particle - Time Dependent Schrödinger's Equation - Physical Interpretation of the Wave Function - Normalized and orthogonal wave functions - Solution of the Schrödinger Equation - Values of dynamical quantities - Probability current density - Particle flux - Ehrenfest theorem - Eigen value and Eigen function.

UNIT - IV : SIMPLE APPLICATIONS: (1D PROBLEMS)

Solution of Schrödinger's equation for a particle in a box - Linear harmonic oscillator - One dimensional square well potential - Step potential - Rigid rotator.
Operators - Operator formalism in Quantum Mechanics - Dynamical variables as operators - Hamiltonian operator - Commutation relation between position and momentum - Commutation rules for the components of orbital angular momentum - Ladder operators.

UNIT - V : PERTURBATION THEORY

First order Time independent perturbation theory - Perturbed harmonic oscillator - Zeeman effect (without electron spin) - First order Stark effect in hydrogen atom - Helium atom.

TEXT BOOKS

1. Satya prakash and C.K. Singh, Quantum mechanics

2. Murugesan, Modern physics, R, S. Chand & Company, 1995, 5th edition

3. Satya Prakash, Relativistic Mechanics, Pragati Prakashan, 5th edition