ANDHRA KESARI UNIVERSITY

DEPARTMENT OF PHYSICS

Syllabus approved in the PG Board of Studies meeting held on 05-8-2023

(w.e.f. Academic Year 2022-23 Amended as per NEP - 2020)

M.Sc. Physics

ANDHRA KESARI UNIVERSITY : ONGOLE

DEPARTMENT OF PHYSICS

TWO YEAR M.Sc. COURSE IN PHYSICS (2023-2024)

Semester -I

S.No	Components of Study	Title of the Course	Title of the Paper	No. of Credits	Internal Assessment Marks	Semester end Examinations Marks	Total Marks
1.	**Core-I**	PHY 1.1	1. Classical Mechanics	4	30	70	100
2.	**Core-II**	PHY 1.2	1. Introductory Quantum Mechanics	4	30	70	100
3.	**Compulsory Foundation**	PHY 1.3	1. Mathematical Physics	4	30	70	100
4.	**Elective Foundation**	PHY 1.4 (A)	1. Analog and Digital Electronics	4	30	70	100
		PHY 1.4 (B)	2. Electronic Devices & Applications				
		PHY 1.4 (C)	3. Fibre Optics				
5.	**Practical -I**		General Physics (Electricity & Optics)	4	30	70	100
6.	**Practical-II**		Electronics	4	30	70	100
	Total			24	180	420	600

- Elective Foundation – Choose one paper.

Semester –II

S.No	Components of Study	Title of the Course	Title of the Paper	No. of Credits	Internal Assessment Marks	Semester end Examinations Marks	Total Marks
1.	**Core-I**	PHY 2.1	1.Statistical Mechanics	4	30	70	100
2.	**Core-II**	PHY 2.2	1.Solid State Physics	4	30	70	100
3.	**Compulsory Foundation**	PHY 2.3	1.Quantum dynamics and Scattering theory	4	30	70	100
4.	**Elective Foundation**	PHY 2.4 (A)	1.Computational methods and Programming	4	30	70	100
		PHY 2.4 (B)	2.MATLAB &Basic Python programming				
		PHY 2.4 (C)	3.Non-Linear Optics				
5.	**Practical -I**		General Physics (Spectroscopy)	4	30	70	100
6.	**Practical-II**		Electronics	4	30	70	100
7.	**Skill Development Course**			4	00		
	Total			28	180	420	600

- Elective Foundation – Choose one paper.

Semester –III

S.No	Components of Study	Title of the Course	Title of the Paper	No. of Credits	Internal Assessment Marks	Semester end Examinations Marks	Total Marks
1.	**Core-I**	PHY 3.1	1.Nuclea and particle Physics	4	30	70	100
2.	**Core-II**	PHY 3.2	2. Advanced Quantum Mechanics	4	30	70	100
3.	**Elective-I**	PHY 3.3 (A)	1. Condensed Matter Physics-I	4	30	70	100
		PHY 3.3 (B)	2.Nano Materials and Devices				
		PHY 3.3 (C)	3. Applied Spectroscopy				
4.	**Elective-II**	PHY 3.4 (A)	1. Condensed Matter Physics-II	4	30	70	100
		PHY 3.4 (B)	2.Sensors and Transducers				
		PHY 3.4 (C)	3. Medical Physics				
5.	**Practical -I**		Microprocessor & C Programming	4	30	70	100
6.	**Practical-II**		Condensed Matter Physics	4	30	70	100
7.	**Skill Enhancment Course**			4	00	00	
	Total			28	180	420	600

- Elective I– Choose one paper
- Elective II– Choose one paper.

--

Semester- IV

S.No	Components of Study	Title of the Course	Title of the Paper	No. of Credits	Internal Assessment Marks	Semester end Examinations Marks	Total Marks
1.	**Core-I**	PHY 4.1	1.Electromagnetic theory, Lasers and Modern Optics	4	30	70	100
2.	**Core-II**	PHY 4.2	2. Atomic, Molecular and Resonance Spectroscopy	4	30	70	100
3.	**Elective-I**	PHY 4.3 (A)	1. Advances in Materials Science	4	30	70	100
		PHY 4.3 (B)	2.Crystal growth and thin films				
		PHY 4.3 (C)	3.Solar Energy-Thermal and Photovoltaic Properties				
4.	**Elective-II**	PHY 4.4 (A)	1. Advanced Condensed Matter Physics	4	30	70	100
		PHY 4.4 (B)	2. Advanced Spectro scopy				
		PHY 4.4 (C)	3. Photonics				
5.	**Practical -I**		Advanced Electronics	4	30	70	100
6.	**Practical-II**		Advanced Condensed Matter Physics	4	30	70	100
7.	**Project work**			4	00	100	100
	Total			28	180	420	700

- Elective I– Choose one paper
- Elective II– Choose one paper

PHY 1.1

DEPARTMENT OF PHYSICS, ANDHRA KESARI UNIVERSITY::ONGOLE

Syllabus approved in the PG Board of Studies meeting held on 05-8-2023

(w.e.f. Academic Year 2023-24 Amended as per NEP - 2020)

M.Sc. Physics (I Semester)

Core I : CLASSICAL MECHANICS

Course Objectives:

- Introduction to basic ideas about Newtonian mechanics
- Initiation of mechanical system through derivative and problematic approaches
- Study of motion of the body in different systems of equation

Unit-I (Lagrangian mechanics)

Newtonian mechanics of one and many particle systems, Conservation laws, Constraints and their classification, principle of virtual work, D'Alembert's principle and Lagrange's equation of motion, Applications: linear harmonic oscillator, simple pendulum, compound pendulum, L-C Circuit, Lagrangian for a Charged Particle Moving in an Electromagnetic field.

Learning Outcomes:

- Learning concepts of mechanics of the systems for problematic analysis of the objects
- Lagrangian systems are useful to examination of the motion of the objects
- In view of Competitive exams problematic and derivational tactics in equation of motion in Lagrangian from D'Alembert's principle.

Unit-II (Hamilton's mechanics)

Deduction of Hamilton's principle from D'Alemberts principle, modified Hamilton's principle, Hamilton's principle and Lagrange's equations, generalized momentum and cyclic coordinates, Hamilton function H and conservation of energy, Hamilton's equation (Hamilton's canonical equations of motion), Simple application of the Hamilton principle- linear harmonic oscillator, simple pendulum, Δ-variation, principle of least action. Equations of canonical transformation, (Generating functions), examples of canonical transformations for a harmonic oscillator.

Learning Outcomes:

- To study the Hamilton's principle from D'Alemberts principle.
- To learn about oscillator mechanics and canonical transformations.

Unit-III (Poisson's bracket and Hamilton –Jacobi method)

Introduction to Poisson's bracket notation, equations of motion in Poisson bracket form, fundamentals of Poisson's bracket notation, angular momentum and Poisson brackets, Jacobi's identity.

Hamilton – Jacobi equation of Hamilton's principal function, The Harmonic oscillator problem as an example of the Hamilton – Jacobi Method, Hamilton –Jacobi equation for Hamilton's characteristic function, Action – angle variables.

Learning Outcomes:

- To study the equation of motion in Poisson bracket form
- In view of theory exams theory learning for Hamilton's-Jacobi equations.
- Learn about Hamilton –Jacobi equation for Hamilton's characteristic function.

Unit-IV (Dynamics of a rigid body)
The Euler angles-first rotation, second rotation and third rotation, angular momentum and inertia tensor, principal axes and principal moments of inertia, rotational kinetic energy of a rigid body, Euler's equations of motion of a rigid body, torque-free motion of a rigid body.

Learning Outcomes:
- Gained knowledge of The Euler angles-first rotation, second rotation and third rotation.
- Learn about motion and indication of rigid body through tensor, Euler equation of motion.

Unit-V (Special theory of relativity)
Introduction to special theory of relativity, Galilean transformations, principle of relativity, transformation of force from one inertial system to another, covariance of the physical laws, principle of relativity and speed of light, Lorentz transformations, consequences of Lorentz transformations, aberration of light from stars, relativistic Doppler's effect.

Learning Outcomes:
- Galilean transformations of relativistic mechanics.
- Covariance of the physical laws
- Relativistic Doppler's effect.

Course Outcomes:
- Students get knowledge on mechanics of the macroscopic things where Newton laws are applicable, can learn constrained motion of rigid bodies in one, two and three dimensions.
- Students can understand the motion of bodies similar to Hamilton and Lagrangian systems and resolve with practical approach.
- The students will know the concept of special theory of relativity.

Text and Reference Books
1.Classical Mechanics by H.Goldstein
2. Fundamentals of Classical Mechanics by J.C. Upadhyaya,
3. Classical Mechanics by Charles P.Poole, John Safko 3rd Edition, Parson Publications
4.Classical Mechanics by G. Aruldhas, PHI Publishers
5. Introduction to special relativity- Robert Resnick.

NOTE: Question paper contains **FIVE** questions with internal choice have to be set from each unit. Each question carries 14 marks.

DEPARTMENT OF PHYSICS, ANDHRA KESARI UNIVERSITY::ONGOLE

Syllabus approved in the PG Board of Studies meeting held on 05-8-2023

(w.e.f. Academic Year 2023-24 Amended as per NEP - 2020)

M.Sc. Physics (I Semester)

Core II: INTRODUCTORY QUANTUM MECHANICS

Course Objectives:

- Introduction of Quantum Mechanics and the Schrodinger equation
- To acquire mathematical skills require to develop theory of quantum mechanics
- To develop understanding of postulates of quantum mechanics and to learn to apply them to solve some quantum mechanical systems
- To offer systematic methodology for the application of approximation methods to solve complicated quantum mechanical systems

UNIT-I (Schrodinger wave equation and one dimensional problems)

Why QM? Revision; Inadequacy of classical mechanics; Schrodinger equation; continuity equation; Ehrenfest theorem; admissible wave functions; Stationary states. One-dimensional problems, wells and barriers. Harmonic oscillator by Schrodinger equation.

Learning Outcomes:

- Students will learn the difference between classical mechanics and quantum mechanics.

UNIT-II (Linear vector spaces and operators)

Linear Vector Spaces in Quantum Mechanics: Vectors and operators, change of basis, Dirac's bra and ket notations. Eigen value problem for operators. The continuous spectrum. Application to wave mechanics in one dimension. Hermitian, unitary, projection operators. Positive operators. Change of orthonormal basis, Orthogonalization procedure, uncertainty relation.

Learning Outcomes:

- Students will learn the mathematical formalism of eigen values, eigen states of wells and barriers and unitary operators, hermitian operators, which form the fundamental basis of quantum theory.

UNIT III (Orbital angular momentum)

Angular momentum: commutation relations for angular momentum operator, Angular Momentum in spherical polar coordinates, Eigen value problem for L^2 and L_z, L_+ and L_- operators Eigen values and eigen functions of rigid rotator and Hydrogen atom

Learning Outcomes:

- Learn commutations relations for angular momentum operator and its applications in daily life
- Application to rigid rotator, hydrogen-like atoms and angular momentum operators will teach the students how to obtain eigen values and eigen states for such systems elegantly.

UNIT IV (Time-independent perturbation theory)

Time-independent perturbation theory; Non-degenerate and degenerate cases; applications to (a)normal helium atom (b) Stark effect in Hydrogen atom. Variation method. Application to ground state of Helium atom, WKB method.

Learning Outcomes:

- To understand the concepts of time-independent perturbation theory and their applications to physical situations.
- Studying the applications of Non-degenerate and degenerate cases in perturbation theory
- Learning the variation and WKB methods

UNIT V (Time dependent perturbation theory)

Time dependent perturbation: General perturbations, variation of constants, transition into closely spaced levels –Fermi's Golden rule. Einstein transition probabilities, Interaction of an atom with the electromagnetic radiation. Sudden and adiabatic approximation.

Learning Outcomes:

- Students will learn how to use perturbation theory to obtain corrections to energy eigen-states and eigen-values when an external electric or magnetic field is applied to a system
- Learning the significances of Fermi's Golden rule.
- To teach the students various approximation methods in quantum mechanics.

Course Outcomes:

- Understand historical aspects of development of quantum mechanics.
- Understand and explain the differences between classical and quantum mechanics.
- Understand the central concepts and principles in quantum mechanics, such as the Schrodinger equation, the wave function and its statistical interpretation, the uncertainty principle, stationary and non-stationary states, wells and barriers, harmonic oscillator, as well as the relation between quantum mechanics and linear algebra including understanding of linear vector spaces. They will master the concepts of angular momentum and spin, as well as the rules for quantization and addition of these. Hence they will be able to solve the complex systems by approximation method.

Text and Reference books

1. Eugen Merzbacher, Quantum Mechanics, Wiley
2. L I Schiff, Quantum Mechanics (Mc Graw-Hill)
3. B Crasemann and J D Powell, Quantum Mechanics (Addison Wesley)
4. A P Messiah, Quantum Mechanics
5. J J Sakural, Modem Quantum Mechanics
6. Mathews and Venkatesan Quantum Mechanics
7. Quantum Mechanics" by R.D. Ratna Raju
8. Fundamentals of quantum Mechanics, Statistical Mechanics & Solid State Physics by S.P.Kuila, Books and Allied, Kolkata

NOTE : Question paper contains **FIVE** questions with internal choice have to be set from each unit. Each question carries 14 marks.

DEPARTMENT OF PHYSICS, ANDHRA KESARI UNIVERSITY::ONGOLE

Syllabus approved in the PG Board of Studies meeting held on 05-8-2023

(w.e.f. Academic Year 2023-24 Amended as per NEP - 2020)

M.Sc. Physics (I Semester)

Compulsory Foundation: MATHEMATICAL PHYSICS

Learning Objectives:

- Student should be able to understand basic theory of Complex Analysis, Special functions, Fourier series and integral transforms.
- To learn mathematical tools required to solve physical problem.
- To understand mathematical concepts related to physics
- To understand the relevance of higher mathematics and concepts of physics.

Unit-I

Beta & Gamma functions -definition, relation between them- properties.

Legendre's Differential equation: The Power series Solution–Legendre Functions of the first and second kind –Generating Function- Rodrigue's formula– Orthogonal Properties – Recurrence Relations-Physical applications.

Associated Legendre equation, Orthogonal properties of Associated Legendre's function.

Bessel's Differential Equation: Power series Solution –Bessel Functions of First and Second kind- Generating Function –Orthogonal Properties –Recurrence Relations- Physical applications.

Learning Outcomes:

- To learn about basic theory of polynomials
- To acquire knowledge about Legendre's, Associated Legendre's and Bessel equations.
- To learn the physical applications and properties in order to solve quantitative problems in the study of physics.

Unit-II

Hermite Differential Equation : Power series Solution–Hermite polynomials – Generating Function- Orthogonality –Recurrence relations -Rodrigues formula- Physical applications.

Laguerre Differential equations: The Power series Solution–Generating Function- Rodrigue's formula– Recurrence Relations, Orthogonal Properties- - Physical applications.

Learning Outcomes:

- To learn about basic theory of polynomials
- To acquire knowledge about Hermite Differential and Laguerre Differential Equation.
- To learn the physical applications and properties in order to solve quantitative problems in the study of physics.

Unit-III

Integral Transforms: Laplace transforms – definition- properties-Derivative of Laplace transform– Laplace transform of a derivative –Laplace transform of periodic function– evaluation of Laplace transforms–Inverse Laplace transforms-properties- evaluation of Inverse Laplace transforms– elementary function method– Partial fraction method– Solution of ordinary differential equation by using Laplace transformation method–Fourier series– evaluation of Fourier coefficients– problems–Fourier Transforms- infinite Fourier Transforms-Finite Fourier Transforms-Properties– problems.

Learning Outcomes:

- This will enable students to apply integral transform to solve mathematical problems and used to understand the analysis of Fourier series.
- The students will be able to use Fourier transforms as an aid for analyzing different types of waves.

Unit-IV

Complex Variables: Function of complex number- definition-properties, analytic function-Cauchy – Riemann conditions-polar form-problems, Cauchy's integral theorem, Cauchy's integral formula- problems ,Taylor's Series-Laurent's expansion-Problems, Calculus of Residues, Cauchy's Residue theorem, Evaluation of Residues, Evaluation of contour integrals.

Learning Outcomes:

- To learn about complex algebra and Cauchy's integral theorems.
- To learn evaluation of contour integrals.

Unit-V

Tensor Analysis: Introduction– Contravariant, Covariant and mixed tensors – Rank of a tensor – symmetric and anti-symmetric tensors - Invariant tensors, Addition and multiplication of tensors, Outer and inner products- contraction of tensors and quotient law.

Learning Outcomes:

- The students should be able to formulate and express a physical law in terms of tensors.
- To know how to simplify tensors by using coordinate transforms.
- To understand what extent tensors used to explain theory of relativity

Course Outcomes:

After successfully completing the course, student will be able to:

- Understand the basic elements of complex analysis, including the important integral theorems.
- Understand the applications special functions that are used in quantum mechanics.
- Learned how to expand a function in a Fourier series and able to solve mathematical problems relevant to the physical sciences.

Text and reference books:

1. Mathematical Methods for Physics. By G.Arfken
2. Laplace and Fourier Transforms-by Goyal and Gupta. PragatiPrakashan, Meerut
3. Matrices and Tensors for Physicists by A W.Joshi
4. Mathematical Physics byB.D.Gupta, Vikas Publishing House, New Delhi
5. Complex Variables, Schaum Series
6. Vector and Tensor Analysis, Schaum Series
7. Fundamentals of Mathematical Physics, 6th Edition by A.B.Gupta, Books and Allied, Kolkata.
8. Mathematical Physics - B.S. Rajput
9. Mathematical Physics - Satya Prakash

NOTE : Question paper contains **FIVE** questions with internal choice have to be set from each unit. Each question carries 14 marks.

PHY 1.4 (A)

DEPARTMENT OF PHYSICS, ANDHRA KESARI UNIVERSITY::ONGOLE

Syllabus approved in the PG Board of Studies meeting held on 05-8-2023

(w.e.f. Academic Year 2023-24 Amended as per NEP - 2020)

M.Sc. Physics (I Semester)

Elective Foundation: ANALOG AND DIGITAL ELECTRONICS

Course Objectives:

- Introduction of Semiconductor Devices and the Opto-electronic devices and their analysis.
- Operational Amplifiers, Construction and working DC and AC analysis, Effect of Feedback.
- Acquiring the Knowledge in Communication Electronics and then the Digital electronics.
- Architecture of 8085 Microprocessor, Instruction set, Addressing modes and some illustrative programmes.
- Introduction to 8051 Microcontroller.

UNIT-I

Semiconductor Devices

Diodes, Junction diode, Tunnel diode, Photo diode, transistors, Silicon controlled rectifier, Uni junction transistor, Field effect transistor, JFET & MOSFET, CMOS,

Opto-electronic devices: Solar cells, Photo detectors, LEDs.

Learning Outcomes:

- Construction and working of Tunnel diode, photo diode, Silicon Controlled Rectifier, Uni-junction Transistor.
- Know the Characteristics of FET, MOSFET and CMOS.
- Construction, working and applications of Solar Cells and LED's.

UNIT II

Operational Amplifiers

Differential Amplifier –circuit configurations - dual input, balanced output differential amplifier – DC analysis – Ac analysis, inverting and non inverting inputs CMRR. Block diagram of a typical Op-Amp-analysis. Open loop configuration inverting and non-inverting amplifiers. Op-amp with negative feedback- voltage series feedback – effect of feedback on closed loop gain input resistance output resistance bandwidth and output offset voltage- voltage follower.

Practical Op-amps

Input offset voltage- input bias current-input offset current, total output offset voltage, CMRR frequency response. Summing amplifier, Scaling and Averaging amplifiers, integrator and
differentiator.

Oscillators principles, – oscillator types – frequency stability – response The phase shift oscillator, Wein bridge oscillator –Multivibrators- Monostable and astable –comparators- Square wave and triangular wave generators- voltage regulators.

Learning Outcomes:

- To learn about the Differential amplifier and then the Operational amplifier, AC and DC analysis, Characteristics, Effect of Feedback.
- Oscillators Principles, Construction and working of different types of Oscillators. Clear picture of Multivibrators and then the Comparators using Operational amplifiers.

UNIT III

Communication Electronics

Amplitude modulation – Generation of AM waves – Demodulation of AM waves – DSBSC modulation. Generation of DSBSC waves. Coherent detection of DSBSC waves, SSB modulation, Generation and detection of SSB waves. Vestigial side band modulation, Frequency Division Multiplexing (FDM).

Learning Outcomes:

- Acquiring knowledge in Communication electronics AM &FM, modulation and Demodulation

UNIT IV
Digital Electronics
Simplification of Boolean expressions: Algebraic method, Karnaugh method, EX-OR, EX-NOR gates, Combinational Logic gates- Decoder- encoders- Multiplexer(data selectors)-application of multiplexer - De multiplexer(data distributors), Sequential Logic- Flip-Flops: A 1- bit memory – the R-S Flip – Flop, JK Flip-Flop – JK master slave Flip-Flop – T- Flip – Flop – D Flip – Flop – Shift registers – Synchronous and Asynchronous counters – cascade counters - A/D to D/A converters.
Learning Outcomes:
- Expressing the Boolean expressions in a simple way, Karnaugh method.
- Learning the Combinational Logic Circuits, Multiplexer and Demultiplexer
- Learning about the Sequential Logic circuits- Flip-Flops, Registers and Counters

UNIT V
Microprocessors
Introduction to microcomputers – memory – input/output –interfacing devices 8085 CPU -Architecture – BUS timings – Demultiplexing the address bus – generating control signals – instruction set – addressing modes – illustrative programmes – writing assembly language programmes –looping, counting and indexing – counters and timing delays – stack and subroutine. Introduction to micro controllers-8051 micro controllers-architecture & pin description.
Data interpretation and analysis-Precision and accuracy- Error analysis, propagation of errors. Least squares fitting.
Learning Outcomes:
- Knowledge about the Microprocessor and its Architecture
- Learning the Instruction Set, Addressing modes
- Writing the programmes using 8085 instructions
- Little knowledge about 8051 Microcontroller

Course Outcomes:
At the end of the course the student is expected to assimilate the following and possesses basic knowledge of the following.
- The design and functional performance of various semiconductor and optoelectronic devices such as Diodes, transistors, Solar Cells, Photo detectors and LEDs.
- To learn about the Differential amplifier and then the Operational amplifier, AC and DC Analysis, Characteristics, Effect of Feedback.
- Acquiring knowledge in Communication electronics AM &FM, modulation and Demodulation
- Learning the Combinational Logic Circuits, Multiplexer and Demultiplexer
- Learning about the Sequential Logic circuits- Flip-Flops, Registers and Counters
- Knowledge about the Microprocessor and its Architecture

Text and Reference Books

1. Electronic devices and circuits-G.K.Mithal(Khanna)
2. Integrated Electronics- Jacob millman & C.C. Halkies(TMH)
3. Op-Amps & Linear integrated circuits- Ramakanth A.Gayakwad
4. Op.Amps & Linear integrated circuits- D. Mahesh Kumar(MacMillan)
5. Digital principles and applications by A.P.Malvino and Donald P.Leech TMH 1993
6. Microprocessor Architecture, Programming and Applications with 8085/8086 by Ramesh S. Gaonkar, Wiely-Eastern 1987.
7. Digital Electronics: An Introduction to theory and Practical – William.H.Gotnman.

NOTE : Question paper contains **FIVE** questions with internal choice have to be set from each unit. Each question carries 14 marks.

PHY 1.4 (B)

DEPARTMENT OF PHYSICS, ANDHRA KESARI UNIVERSITY::ONGOLE
Syllabus approved in the PG Board of Studies meeting held on 05-8-2023
(w.e.f. Academic Year 2023-24 Amended as per NEP - 2020)
M.Sc. Physics (I Semester)

Elective Foundation: ELECTRONIC DEVICES AND APPLICATIONS

UNIT-I: Fabrication of IC and logic families

Fabrication of IC - Monolithic integrated circuit fabrication - IC pressure transducers - Monolithic RMS - Voltage measuring device - Monolithic voltage regulators - Integrated circuit multipliers - Integrated circuit logic - Schottky TTL - ECL - I^2L - P and N-MOS Logic - CMOS Logic - Tristate logic circuits – PLA, PLC and PLD.

UNIT-II: Opto electronic devices

Light sources and Displays - Light emitting diodes - Surface emitting LED - Edge Emitting LED - Seven segment display - LDR - Diode lasers - Photo detectors - Basic parameters - Photo diodes - p-i-n Photo diode - Solar cells - Photo transistors - IR and UV detectors.

UNIT-III: 555 Timer and applications

555 Timer - Description - Monostable operation - Frequency divider - Astable operation -Schmitt trigger - Phase Locked Loops - Basic principles - Analog phase detector - Voltage Controlled Oscillator - Voltage to Frequency conversion - PLL IC 565 - Description - Lock-in range - Capture range - Application - Frequency multiplication.

UNIT-IV: Op-amp applications

Instrumentation amplifier - V to I and I to V converter - Op-amp circuits using diodes - Sample and Hold circuits - Log and Antilog amplifiers - Multiplier and Divider - Electronic analog Computation solving simultaneous and differential equation- Schmitt Trigger - Astable, Monostable Multivibrator – Triangular wave generator - Sine wave generator - Active filters – Low, High and Band pass first and second order Butterworth filters – wide and narrow band reject filters.

UNIT-V: Pulse and digital Communication

Pulse communications - Introduction - Types - Pulse-Amplitude Modulation (PAM) - Pulse Time Modulation - Pulse Width Modulation (PWM) - Pulse Position Modulation (PPM) - Pulse Code Modulation (PCM) - Principles of PCM - Quantizing noise - Generation and Demodulation of PCM - Effects of Noise - Advantages and applications of PCM - Pulse systems - Frequency-Shift keying - Digital communication - Modem classification - Modes of modem operation -Modem interconnection - Modem interfacing.

Books for Study:

1. S.M. Sze, 1985, Semiconductor Devices - Physics and Technology, Wiley, New York.
2. Millman and Halkias, Integrated Electronics, McGraw-Hill, New Delhi.
3. R.A. Gaekwad, 1994, Op-Amps and integrated circuits EEE.
4. Taub and Shilling, 1983, Digital Integrated Electronics, McGraw-Hill, New Delhi.

5. J. Millman, 1979, Digital and Analog Circuits and Systems, McGraw-Hill, London.
6. George Kennedy, 1987, Electronic communication systems 3rd Edition, McGraw-Hill, London.

Text and Reference Books

1. R.F. Coughlin and F.F, Driscol, 1996, Op-Amp and linear integrated circuits, Prentice Hall of India, New Delhi.
2. M.S.Tyagi, Introduction to Semiconductor Devices, Wiley, New York.
3. P. Bhattacharya, 2002, Semiconductor Optoelectronic Devices, 2nd Edition, Prentice-Hall of India, New Delhi.
4. Deboo/ Burrous, 1985, Integrated circuits and semiconductor Devices – Theory and application, McGraw-Hill, New Delhi.
5. D. Roy Choudhury, 1991, Linear integrated circuits, Wiley Eastern, New Delhi.
6. Ramakant Gaekwad, 1981, Operational amplifiers, Wiley Eastern, New Delhi

NOTE : Question paper contains **FIVE** questions with internal choice have to be set from each unit. Each question carries 14 marks.

DEPARTMENT OF PHYSICS, ANDHRA KESARI UNIVERSITY::ONGOLE

Syllabus approved in the PG Board of Studies meeting held on 05-8-2023

(w.e.f. Academic Year 2023-24 Amended as per NEP - 2020)

M.Sc. Physics (I Semester)

Elective Foundation: FIBRE OPTICS

Unit I: Linear, nonlinear waves and Maxwell's equations

Simple pendulum – small and large oscillations – Duffing oscillator – Linear and nonlinear medium - Maxwell's equations – Electromagnetic waves phase and group velocity, modes in a planar and cylindrical wave guides – polarization - dielectric susceptibility – first and higher order susceptibilities.

Unit II: Optical fiber waveguides and sources

Ray theory transmission: Total internal reflection, acceptance angle, numerical aperture and skew rays –- evanescent field and Goos-Haechen shift – step index and graded index fibers – single and multi-mode fibers.

Sources: LED - Lasers – mode locked Lasers - modulation capability- transient response - semiconductor losses - diode structure and threshold conditions – modulation – temperature effects – source linearity and reliability – Photo detectors – PIN Photo detector – avalanche photodiode.

Unit III: Transmission characteristics of optical fibers

Attenuation – material absorption losses in silica fibers – linear and nonlinear scattering losses – fiber bend loss – mid-infrared and far-infrared transmission – intramodal and intermodal dispersion – overall fiber dispersion in multimode and single-mode fibers – modal birefringence.

Unit IV: Fabrication and connection of optical fibers

Glass fibers - Preparation of optical fibers – Liquid-phase (melting) and Vapour-phase deposition techniques – characteristics of single-mode, multimode, plastic-clad and all-plastic fibers - Stability of the Fiber Transmission Characteristics: Micro bending and hydrogen absorption – fiber alignment and joint loss – fiber splices – Fiber connectors: cylindrical ferrule expanded beam connectors - Fiber couplers: Three and four port couplers - star couplers.

Unit V: Nonlinear effects in fiber and solitons in optical fiber communication

Refractive index – frequency and intensity dependent refractive index – group velocity dispersion – self-phase modulation - Kerr effect – chirping - stimulated Raman scattering – stimulated Brillouin scattering – self-steepening – self-focusing – self-defocusing – concept of solitons – formation of solitons – kdV equation - Nonlinear Schrödinger equation for solitons – soliton switching – soliton laser- advantages of soliton based communication.

Books for study:

1. Introduction to fiber optics, Ajoy Ghatak and K. Thyagarajan, Cambridge University press, 6th ed., 2006.
2. Optical fiber communications: Principles and practice, John M. Senior, PHI, 2nd edition.
3. Fiber-Optic communication systems, Govind P. Agrawal, John Wiley, 2003.
4. Waves called solitons: concepts and experiments, Springer Verlag, 1992.
5. Optical fiber communications, Gerd Keiser, McGra-Hill, 2nd edition.
6. Lasers and Non-Linear optics, B.B. Laud, New Age International, New Delhi.
7. Solitons in optical communications, Akira Hasegawa and Yujiodama,, Oxford Press,1995.
8. Nonlinear fiber optics – Robert W Boyd, Elsevier, 2nd ed., 2006.

NOTE : Question paper contains **FIVE** questions with internal choice have to be set from each unit. Each question carries 14 marks.

DEPARTMENT OF PHYSICS, ANDHRA KESARI UNIVERSITY::ONGOLE

Syllabus approved in the PG Board of Studies meeting held on 05-8-2023

(w.e.f. Academic Year 2023-24 Amended as per NEP - 2020)

M.Sc. Physics (II Semester)

Core I : STATISTICAL MECHANICS

Course Objectives:

- This course in statistical mechanics provides the basic idea of probability and calculating probability for various statistical systems of particles.
- To apply the principles of probability in distribution of particles in various systems
- To learn the different types of statistics distribution and particles.

UNIT I (Fundamentals of classical statistical mechanics)

Relation between statistical mechanics and thermodynamics, Phase space, Ensembles-micro canonical, canonical and grand canonical ensemble, density distribution in the phase space, Liouville's theorem, equipartition of energy theorem, microstates and macrostates.

Learning Outcomes:

- To learn postulates of classical statistical mechanics and Ensembles.
- To study density of states Liouville's theorem and paradox.

UNIT-II (Ideal gas in various ensembles)

Classical ideal gas in micro canonical ensemble, partition function for micro canonical ensemble, Gibb's paradox, partition function for Canonical ensemble, thermo dynamical function for Canonical ensemble, partition function for Grand canonical ensemble, thermo dynamical function for Grand canonical ensemble.

Learning Outcomes:

- To know about partition function in different ensembles.
- To study the Gibb's paradox.

UNIT III (Energy fluctuation and distribution function)

Energy fluctuation in micro canonical ensemble, energy fluctuation in canonical ensemble, density fluctuation in Grand canonical ensemble, energy fluctuation in Grand canonical ensemble. Maxwell-Boltzmann distribution, Bose-Einstein distribution, Fermi- Dirac distribution, Darwin-Fowler method.

Learning Outcomes:

- To study the features of Maxwell-Boltzmann statistics.
- To derive the Bose-Einstein distribution.

UNIT IV (Molecular partition function)

Molecular partition function- Translational partition function, Rotational partition function, Vibrational partition function, Electronic and Nuclear partition function, application of rotational partition function, application of vibrational partition function in solids.

Learning Outcomes:

- To learn electronic and nuclear partition function.
- To acquire knowledge about vibrational partition function in solids

UNIT V (Ideal Fermi and Bose Gas)

Equation of state of an ideal Fermi gas, theory of White dwarf stars, Landau diamagnetism, Photons, Phonons in solids, Bose-Einstein condensation, thermionic emission, magnetic susceptibility of free electrons, Brownian motion of a molecule.

Learning Outcomes:

- To learn about Ideal Fermi gas and to derive equations.
- To acquire knowledge about Bose- Einstein condensation.

Course Outcomes:

- After taking this course student are able to determine the probability of any type of events.
- Students have understood the concept of phase space and its volume.
- They can easily distinguish between different types of particles and statistics and can easily distribute bosons, fermions and classical particles among energy levels.
- After studying Fermi Dirac statistics, students have learnt to deal with much electron system.

Text and Reference Books:

1. Statistical and Thermal Physics by S. Lokanadhan and R.S. Gambhir (PHI).
2. Statistical Mechanics by K. Huang (Wiley Eastern)
3. Statistical Mechanics: Theory and applications by S.K. Sinha
4. Fundamentals of Statistical and Thermal Physics by F. Reif
5. Statistical Mechanics by Gupta and Kumar, Pragati Prakashan Pub. Meerut.
6. Statistical Mechanics by Satya Prakash.

NOTE : Question paper contains **FIVE** questions with internal choice have to be set from each unit. Each question carries 14 marks.

DEPARTMENT OF PHYSICS, ANDHRA KESARI UNIVERSITY::ONGOLE

Syllabus approved in the PG Board of Studies meeting held on 05-8-2023

(w.e.f. Academic Year 2023-24 Amended as per NEP - 2020)

M.Sc. Physics (II Semester)

Core II: SOLID STATE PHYSICS

Course Objectives:

- The present syllabus sequence of articles in each unit enables the student to understand the gradual development of the subject regarding solid state matter.
- Solid-state physics is provided an understanding of structure concerned with their association and regular, periodic arrangement in crystals.
- Understand the physics of insulators, semiconductor and conductors with special emphasis on the elementary band theory of semiconductors.

UNIT I

CRYSTAL STRUCTURE: Periodic array of atoms—Lattice translation vectors and lattices, symmetry operations, The Basis and the Crystal Structure, Primitive Lattice cell, Fundamental types of lattices—Two-Dimensional lattice types, three-Dimensional lattice types, Index system for crystal planes, Packing density: SC, BCC and FCC, simple crystal structures-- sodium chloride, cesium chloride, diamond structures and Zinc Sulfide.

Learning Outcomes:

- To understand the arrangement of atoms and the possible arrangements in solid state materials.
- To know about different parameters regarding the structure of the materials and crystal planes.
- Discussing structures of some familiar materials NaCl, CsCl , diamond and ZnS..

UNIT II

CRYSTAL DIFFRACTION AND RECIPROCAL LATTICE: Bragg's law, Experimental diffraction methods- Laue method and powder method, Derivation of scattered wave amplitude, Geometrical Structure Factor, Reciprocal lattice, Reciprocal lattice to SC lattice, BCC lattice and FCC Lattice, Properties of reciprocal lattice, Brillouin Zone, Neutron diffraction, Electron diffraction.

Learning Outcomes:

- Clear understanding of X-ray diffraction techniques like Laue, powder methods using Bragg's law.
- To know some useful parameters about cubic and non-cubic crystal systems.
- Understanding of positions of the atoms in a unit cell further useful to obtain knowledge on reciprocal lattice for different systems.

UNIT III

Lattice Vibrations and Thermal Properties: Elastic waves in one dimensional array of identical atoms. Vibrational modes of a diatomic linear lattice and dispersion relations. Acoustic and optical modes. Infrared absorption in ionic crystals. Phonons and verification of dispersion relation in crystal lattices. Lattice heat capacity– Einstein and Vibrational modes of continuous medium-Debye theory. Origin of thermal expansion and Gruneisen relation.

Learning Outcomes:

- To obtain expressions for one dimensional linear lattice and diatomic lattice.
- Distinguish between acoustical and optical modes.
- Understand the importance of Einstein's theory and Debye's theory.

UNIT IV

FREE ELECTRON FERMI GAS: Failures of free electron theory of metals (Qualitative only) Energy levels and density of orbits in one dimension, Free electron gas in 3 dimensions-Fermi-Dirac distribution function and variation of Fermi function with temperature (Qualitative only)-Density of states-Heat capacity of the electron gas, Experimental heat capacity of metals-Electrical conductivity and Ohm's law-Thermal conductivity of metals-Wiedemann-Franz law-Motion of magnetic field-Hall effect.

Learning Outcomes:

- Understanding the classical free electron theory - their failure and quantum free electron theory.
- Understanding about electrical and thermal conductivity.

UNIT V

THE BAND THEORY OF SOLIDS: Nearly free electron model, Origin of the energy gap, The Block Theorem, Kronig-Penny Model, wave equation of electron in a periodic potential, Approximate solution near a zone boundary, Effective mass of electron**,** The distinction between metals, insulators and semiconductors.

Learning Outcomes:

- Understanding the conduction, valance bands and reasons for energy band gap.
- Understanding about the band theory of solids and must be able to differentiate insulators, conductors and semiconductors.

Course Outcome:

- ➢ A brief idea about crystalline and amorphous substances, about lattice, unit cell, miller indices, reciprocal lattice, concept of Brillouin zones.
- ➢ The students should be able to elucidate the important features of solid state physics by covering structural aspects like lattice cell parameters which are studied by diffraction techniques.
- ➢ A detailed understanding on band theory of solids helps to distinguish metals, insulators and semiconductors.

Text and Reference books:

1. Introduction to Solid State Physics, C. Kittel, 5th Edition,
2. Solid State Physics, A.J. Dekker.
3. Solid State Physics, S.O. Pillai 7th Edition
4. Solid State Physics H.C. Gupta, Vikas Publisher, Noida, 2nd Edition
5. Fundamentals of quantum Mechanics, Statistical Mechanics & Solid State Physics by S.P.Kuila, Books and Allied, Kolkata
6. Solid State Physics, M.A. Wahab, Narosa publishing house.

NOTE : Question paper contains **FIVE** questions with internal choice have to be set from each unit. Each question carries 14 marks.

DEPARTMENT OF PHYSICS, ANDHRA KESARI UNIVERSITY::ONGOLE

Syllabus approved in the PG Board of Studies meeting held on 05-8-2023

(w.e.f. Academic Year 2023-24 Amended as per NEP - 2020)

M.Sc. Physics (II Semester)

Compulsory Foundation: QUANTUM DYNAMICS AND SCATTERING THEORY

Course Objectives:

- Introduction of Spin and Total angular momentum
- To acquire mathematical skills require developing theory of different pictures.
- To develop understanding of scattering theory
- To offer systematic methodology for the application of molecular quantum mechanical systems

UNIT-I (Spin and Total angular momentum)

Introduction to spin and total angular momentum, spin angular momentum and Pauli's spin matrices, total angular momentum J. explicit matrices for J^2, J_x, J_y & J_z, combination of two angular moment and tensor operator, Clebsch-Gordan coefficients for j_1=1/2, j_2 =1/2 and j_1=1, j_2 =1/2, Wigner-Eckart theorem.

Learning Outcomes:

- The students will be able to grasp the concepts of spin and angular momentum, as well as their quantization and addition rules.
- Students will learn the mathematical formalism of Clebsch-Gordan coefficients quantum theory.

UNIT II (Quantum dynamics)

Introduction to quantum dynamics, equation of motion in Schrödinger picture and Heisenberg picture, correspondence between the two, correspondence with classical mechanics, application of Heisenberg picture to harmonic oscillator, interaction picture.

Learning Outcomes:

- Learn mathematical expressions for Schrödinger picture and their applications.
- Students will learn the application of Heisenberg picture.

UNIT III (Identical particles)

The indistinguishability of identical particles – the state vector space for a system of identical particles – creation and annihilation operators- continuous one particle system- dynamical variables – the quantum dynamics of identical particle systems

Learning Outcomes:

- Students will learn the physical significance of identical particles.
- The students will be able to grasp the concepts of quantum dynamics of identical particle systems

UNIT IV (Scattering Theory)

Introduction of scattering – notion of cross section – scattering of a wave packet- scattering in continuous stream model – Green's function in scattering theory – Born approximation – first order approximation – criteria for the validity of Born approximation, form factor scattering- scattering from a square well potential – partial wave analysis – expansion of a plane wave – optimal theorem –scattering from a square well potential.

Learning Outcomes:

- Acquiring knowledge in sscattering theory
- Studying the applications of Green's function and Born approximation in Scattering Theory

UNIT V (Molecular Quantum Mechanics)

Introduction to molecular quantum mechanics**,** the Born-Oppenheimer approximation – the hydrogen molecule ion – the valance bond method – the molecular orbital method- Comparison of the methods – Heitler-London method (Ref : Atkins, Chapter-9, 279-294).

Learning Outcomes:

- Students will gain the knowledge about the Born-Oppenheimer Approximation
- Learning the significances of Heitler-London method
- Knowing the importance of different methods involved in Molecular Quantum Mechanics

Course Outcomes:

- ➢ Understand the Spin, Total angular momentum and Clebsch-Gordan coefficients concepts.
- ➢ Understand historical aspects of identical particles in quantum mechanics
- ➢ Scattering theory will teach them how to use projectiles to infer details about target quantum system.

Text and Reference Books

1. Merzbacher, Quantum Mechanics
2. L I Schiff, Quantum Mechanics (Mc Graw-Hill)
3. B Crasemann and J D Powell, Quantum Mechanics (Addison Wesley)
4. A P Messiah, Quantum Mechanics
5. J J Sakural, Modem Quantum Mechanics
6. Mathews and Venkatesan Quantum Mechanics
7. Quantum Mechanics, R.D. Ratna Raju
8. Quantum mechanics by Kakani and Chandaliya
9. Atkins P, Molecular Quantum Mechanics, Oup 1996(T)

NOTE : Question paper contains **FIVE** questions with internal choice have to be set from each unit. Each question carries 14 marks.

PHY 2.4 (A)

DEPARTMENT OF PHYSICS, ANDHRA KESARI UNIVERSITY::ONGOLE

Syllabus approved in the PG Board of Studies meeting held on 05-8-2023

(w.e.f. Academic Year 2023-24 Amended as per NEP - 2020)

M.Sc. Physics (II Semester)

Elective Foundation: COMPUTATIONAL METHODS AND PROGRAMMING

Course objective:

- Finding the solutions for Linear and Non-linear equations and simultaneous equations
- Introduction to interpolations, numerical differentiation and integration
- The basics of C-language, C- character set, arithmetic expressions and some simple programs
- Acquiring knowledge about control statements, arrays and user defined functions
- Understanding the basic concepts of MATLAB and its applications

UNIT-I Linear, Nonlinear Equations and Simultaneous Equations

Linear and Nonlinear Equations: Solutions of Algebraic and transcendental equations- Bisection, False position and Newton-Raphson methods-Basic principles-Formulae- Algorithms **Simultaneous Equations:** Solutions of simultaneous linear equations - Gauss elimination method, Jacobi and Gauss Seidel iterative methods-Basic principles-Formulae-Algorithms

Learning outcomes:

- Learning the solutions to the linear equations , Algorithms
- Learning the solutions to the Non-linear equations, Algorithms
- Solutions to the simultaneous equations and Algorithms
- Learning Iterative methods for solutions and the Algorithms

UNIT-II Interpolations, Numerical differentiation and integration

Interpolations: Concept of linear interpolation-Finite differences-Forward, Backwards and central differences-Newton's and Lagrange's interpolation formulae-principles and Algorithms

Numerical differentiation and integration: Numerical differentiation-algorithm for evaluation of first order derivatives using formulae based on Taylor's series-Numerical integration-Trapezoidal and Simpson's 1/3 rule-Formulae-Algorithms, Solution of first order differential equation using Runge - Kutta method.

Learning outcomes:

- Learning various concepts of interpolations along with their principals and algorithms.
- Learning Taylor's series formulae and algorithm for evaluating first order derivatives
- Learning Trapezoidal and Simpson's 1/3 rule-Formulae, Algorithms for numerical integration.
- Learning Runge - Kutta method for solutions to first order differential equation

UNIT-III Fundamentals of C Language and Operators

Fundamentals of C Language:

C Character set -Identifiers and Keywords-Constants-Variables-Data types-Declarations of variables –Declaration of storage class-Defining symbolic constants –Assignment statement.

Operators - Arithmetic operators-Relational Operators-Logic Operators-Assignment operators- Increment and decrement operators –Conditional operators- Bitwise operators.

Arithmetic expressions – Precedence of arithmetic operators – Type converters in expressions – Mathematical (Library) functions – data input and output – The getchar and putchar functions-Scanf – Printf -simple programs.

Learning outcomes:

- Acquiring knowledge about C character set.
- Understanding different types of operators.
- Acquiring knowledge about arithmetic operators, mathematical functions, data input and output functions
- Writing the programmes using C character functions.

UNIT-IV Control statements, Arrays and User Defined functions

Control statements and Arrays: If-Else statements –Switch statement-The operator –GO TO –While, Do-While, FOR statements-BREAK and CONTINUE statements.

Arrays: One dimensional and two dimensional arrays –Initialization –Type declaration-Inputting and outputting of data for arrays –Programs of matrices addition, subtraction and multiplication

User Defined functions: The form of C functions –Return values and their types –calling a function – Category of functions. Nesting of functions- Recursion- ANSI C functions-Function declaration. Scope and life time of variables in functions.

Learning outcomes:

- Learning different types of control statements and arrays.
- Little knowledge about Initialization, Type declaration, Inputting and outputting of data for arrays.
- Acquiring knowledge on various user defined functions.
- Learning about function declarations and lifetime of variables in functions.

UNIT V-MATLAB and Applications:

Basics of Mat lab- Mat lab windows – On-line help- Input-Output-File types-Platform Dependence-Creating and working with Arrays of Numbers – Creating, saving, plots printing Matrices and Vectors – Input – Indexing – matrix Manipulation-Creating Vectors Matrix and Array Operations Arithmetic operations-Relational operations – Logical Operations – Elementary math functions, Matrix functions – Character Strings Applications- Linear Algebra,-solving a linear system, Gaussian elimination, Finding Eigen values and eigenvectors, Matrix factorizations, Curve Fitting and Interpolation – Polynomial curve fitting on the fly, Least squares curve fitting, General nonlinear fits, Interpolations.

Learning outcome:

- Learning basic knowledge of MATLAB
- Understanding various operations and functions in MATLAB
- Acquiring knowledge about curve fittings using MATLAB

Course outcome:

At the end of the course the student is expected to assimilate the following and possesses basic knowledge of the following.

- ➢ The principals and algorithms of various concepts of interpolation, numerical differentiation and integration
- ➢ The C character set, arithmetic operators, mathematical functions, data input and output functions, Program writing using C character functions
- ➢ To write programs of matrices addition, subtraction and multiplication using arrays
- ➢ Application of MATLAB

Text and Reference Books

1. Numerical methods, V.N.Vedamurthy, N.Ch.S.N.Iyengar, FirstEdition(VPH)
2. Computer Oriented Numerical Methods-V. Raja Raman-fourth edition(PHI)
3. Y. Kirani Singh and B. B.Chaudhuri, MATLAB Programming, Prentice-Hall India, 2007
4. Rudra Pratap, Getting Started with Matlab 7, Oxford, Indian University Edition, 2006
5. Stormy Attaway: A Practical introduction to programming and problem solving, Elsevier 2012
6. Numerical Methods, E. Balaguruswamy, Tata McGraw Hill

NOTE : Question paper contains **FIVE** questions with internal choice have to be set from each unit. Each question carries 14 marks.

DEPARTMENT OF PHYSICS, ANDHRA KESARI UNIVERSITY::ONGOLE
Syllabus approved in the PG Board of Studies meeting held on 05-8-2023
(w.e.f. Academic Year 2023-24 Amended as per NEP - 2020)
M.Sc. Physics (II Semester)
Elective Foundation: MATLAB AND BASIC PYTHON PROGRAMMING

Course objectives:
• Understanding the basic concepts of MATLAB and its application- Learning basic knowledge of MATLAB
• Understanding various operations and functions in MATLAB
• Acquiring knowledge about curve fittings using MATLAB Python course is aimed at offering the fundamental concepts of Python scripting language to the students. It starts with the basics of Python programming and deals with lists, dictionaries, functions, exceptions and files. The objective of this course is to enable the students to develop the applications using the concepts of Python.

UNIT I-MATLAB and Applications: Basics of Mat lab- Mat lab windows – On-line help- Input-Output-File types-Platform Dependence Creating and working with Arrays of Numbers – Creating, saving, plots printing Matrices and Vectors – Input – Indexing – matrix Manipulation-Creating Vectors Matrix and Array Operations Arithmetic operations-Relational operations – Logical Operations – Elementary math functions, Matrix functions – Character Strings Applications- Linear Algebra,-solving a linear system, Gaussian elimination, Finding Eigen values and eigenvectors, Matrix factorizations, Curve Fitting and Interpolation – Polynomial curve fitting on the fly, Least squares curve fitting, General nonlinear fits, Interpolations.
Learning outcome:

- Learning basic knowledge on MATLAB and its applications.
- Understanding the creating, saving, plots printing matrices and rectors.
- Acquiring knowledge about curve Filling and Interpolation.

Unit II:Python INTRODUCTION: History of Python, Features of Python, Python Installation on Windows & LINUX, installing python packages via PIP, running python commands using the REPL(Shell), Running Python Scripts, Variables, Assignment, Keywords, Input-Output, Indentation; Basic data types - integers, Booleans etc. **OPERATORS AND EXPRESSIONS**: Operators- Arithmetic Operators, Comparison (Relational) Operators, Assignment Operators, Logical Operators, Bitwise Operators, Membership Operators, Identity Operators; Expressions and order of evaluations.
Learning outcome:

- Learning the history of python and its features, installation on windows.
- Acquiring the knowledge on operators and expressions.
- Writing the programs using PHYTON Functions.

UNIT - IIICONTROL STRUCTURES-CONDITIONAL CONTROL STRUCTURES: if, elif, else; Loop control structures: for, while, for... else, while, else, nested lo ops, break, continue, pass. Python Data Structures: Lists, Tuples, Dictionary: Creation, Accessing, Basic operators and methods.
OTHER DATA STRUCTURES: Strings- creation, accessing, operators, methods; Sets- creation, accessing, operators, methods; List Comprehensions. Functions - Defining functions, Calling functions, Passing arguments, Keyword arguments, Default arguments, Variable-length arguments, Anonymous functions (lambda), fruitful Functions (Function Returning Values), Scope of the variables in a function - global and local Variables.
Learning outcome:

- Understanding the loop control structures, python Data structures and other data structures.
- Learning the Basic knowledge about functions, arguments, variables.
- Writing the programs using Data structures.
- Understanding the scope of variables in a function.

UNIT - IV MODULES: Creating modules, import statement, from. Import statement, name spacing. Error and Exceptions Difference between an error and Exception, Handling Exception, Try except block, Raising Exceptions, User defined exceptions. File processing: Reading and Writing Files- Creating a New File- Writing to a File- Reading Files as Text, Opening and Closing files, Reading and writing, tell (), seek(), rename ().

Learning outcome:

- Understanding the creating modules, name spacing, Error and Exceptions.
- Learning the Difference between an error and exceptions and also how to Handling.
- Creating New file, reading files as text, opening and closing files.

UNIT - V OBJECT ORIENTED PROGRAMMING IN PYTHON: Classes, selfvariable, Methods, Constructor Method, Inheritance, Overriding Methods, Datahiding

Learning outcome:

- Develop the knowledge about Design structured and object-oriented programming solutions.
- Learning the methods for Data hiding, overriding.
- Understanding the object oriented programming in Python.

Course outcomes:

Learning basic knowledge of MATLAB

- Understanding various operations and functions in MATLAB
- Acquiring knowledge about curve fittings using MATLAB

At the end of the course the student is expected to assimilate the following and possesses basic knowledge of the following. ¬ To understand the basic concepts of Matlab-To write programs of matrices addition, subtraction and multiplication using arrays ¬ Application of MATLAB.

Python: Understand different python programming concepts and apply them to develop programs. -Analyze the usage of different data structures for practical and contemporary applications for solving a given problem. -Develop functional, reliable and user-friendly Python programs for a given problem application. -Design solutions using the concepts of object-oriented programming paradigm. - Develop programs to solve data stored in files. -Upon completion of the course, the student will be able to achieve the following outcomes: -Identify suitable data types and data structures required for an application -Design structured and Object-oriented programming solutions -Design reliable applications for a given problem

Text and Reference Books

1. Y. Kirani Singh and B. B.Chaudhuri, MATLAB Programming, Prentice-Hall India, 2007
2. Rudra Pratap, Getting Started with Matlab 7, Oxford, Indian University Edition, 2006
3. Stormy Attaway: A Practical introduction to programming and problem solving, Elsevier 2012.
4. Vamsi Kurama, Python Programming: A Modern Approach, 1st edition, Pearson Publishers, 2018.
5. Mark Lutz, Learning Python, 2nd edition, O'Reilly Media, 2003.
6. Allen Downey,Think Python, 2nd edition, Green Tea Press, 2016.
7. Ashok NamdevKamthane, Amith Ashok Kamthane, Programming and Problem Solving with Python", 1st Edition, McGraw Hill Education, 2016.
8. W.J.Chun, "Core Python Programming", 3rd Edition, Pearson Publisher, 2013

NOTE: Question paper contains FIVE questions with internal choice have to be set from each unit. Each question carries 14 marks.

…..

PHY 2.4 (C)

DEPARTMENT OF PHYSICS, ANDHRA KESARI UNIVERSITY::ONGOLE
Syllabus approved in the PG Board of Studies meeting held on 05-8-2023
(w.e.f. Academic Year 2023-24 Amended as per NEP - 2020)
M.Sc. Physics (II Semester)

Elective Foundation NON LINEAR OPTICS

Unit I: Lasers

Gas lasers – He-Ne, Az + ion lasers – Solid state lasers – Ruby – Nd: YAG, Ti Sapphire –Organic dye laser – Rhodamine – Semiconductor lasers – Diode laser, p-n-junction laser, GaAs Laser

Unit II: Introduction to Nonlinear Optics

Refractive index – frequency dependent and intensity dependent refractive index - Wave propagation in an anisotropic crystal – Polarization response of materials to light – Second harmonic generation – Sum and difference frequency generation – Phase matching –four wave mixing - Third harmonic generation – self focusing – Parametric amplification - bistability

Unit III: Multiphoton Processes

Two photon process – Theory and experiment – Three photon process parametric generation of light – Oscillator – Amplifier – Stimulated Raman scattering – Intensity dependent refractive index optical Kerr effect – photorefractive, electron optic effects

Unit IV: Nonlinear Optical Materials

Basic requirements – Inorganics – Borates – Organics – Urea, Nitro aniline – Semi organics – Thiourea complex – X-ray diffraction, FTIR and FT-NMR qualitative study – Kurtz test – Laser induced surface damage threshold

Unit V: Fiber Optics

Step – Graded index fibers – wave propagation – Fiber modes – Single and multimode fibres – Numerical aperture – Dispersion – Fiber bandwidth – Fiber loss – Attenuation coefficient – Material absorption

Text and Reference Books

1. B.B. Laud, Lasers and Nonlinear Optics, 2nd Edn. New Age International (P) Ltd., New Delhi, 1991
2. Robert W. Boyd, Nonlinear Optics, 2nd Edn., Academic Press, New York, 2003
3. Govind P. Agarwal, Fiber-Optics Communication Systems, 3rd Edn. John Wiley & Sons,Singapore 2003

4. William T. Silvast, Laser Fundamentals, Cambridge University Press, Cambridge 2003

5. Nonlinear Optics – Basic Concepts D.L. Mills, Springer, Berlin 1998.

NOTE : Question paper contains **FIVE** questions with internal choice have to be set from each unit. Each question carries 14 marks.

PHY 3.1

M.Sc. Physics (III Semester)

Core I : NUCLEAR AND PARTICLE PHYSICS

Course Objectives:

- Utilizing the basic concepts of Nuclear and Particle physics, the forces, models and decay theory Nucleus of lattice.
- Elementary particle physics and applications of Nuclear physics would be extensively discussed in this course.
- The detailed theory of accelerators
- The primary objective is to teach the concepts of Nuclear and particle physical and important applications in nuclear physics.

UNIT-I (Nuclear Forces)

Mass defect, Binding energy, nuclear magnetic dipole moment, electric quadrupole moment, characteristics of Nuclear Forces, ground state of deuteron, qualitative discussion of neutron-proton scattering at low energies, proton-proton scattering at low energies, saturation of nuclear forces, Meson theory of nuclear forces(Yukawa's Potential).

Learning Outcomes:

To study the primary concepts in Nuclear physics and domains, instability, Energy levels, mirror nuclei.

- Characteristics of Nuclear Force and Ground state of deuteron.
- Discussions on scattering cross-sections, neutron-proton and proton- proton scattering at low energies.
- Knowledge about charge independence, spin dependence of nuclear forces.
- Meson theory of nuclear forces.

UNIT-II (Nuclear Models and Nuclear Decay)

Weizsacker semi-empirical mass formula, Liquid drop model, Bohr –Wheeler theory of nuclear fission, Nuclear shell model-square well of infinite depth, harmonic oscillator potential, spin-orbit potential. Gamow's theory of Alpha decay process, Fermi's theory of β - decay.

Learning Outcomes:

- Complete knowledge on concepts in Nuclear Models**.**
- Alpha decay process, Energy release in Beta-decay, Fermi's theory of β - decay, selection rules and parity violation in β -decay.

UNIT-III (Nuclear Reactions and Nuclear Energy)

Types of nuclear reactions, conservation laws of nuclear reactions, Nuclear reaction kinematics - the Q – equation, threshold energy- Nuclear cross section.

Nuclear fission, types of fission, nuclear fusion and thermonuclear reactions, general aspect of reactor design, classification of reactors-research reactors and power reactors.

Learning Outcomes:

- Knowledge on various kinds of nuclear reactions and conservation laws.
- Detailed information on nuclear kinematics, the Q – equation, threshold energy.
- Explanations on various concepts of nuclear Fission.
- Types of nuclear reactors and subject on nuclear chain reaction.

UNIT-IV (Particle Accelerators)

Introduction, Classification of accelerators, Electrostatic accelerators – Cockcroft-Walton accelerator, Van de Graff accelerator, Linear accelerators – Drift tube accelerators , Wave guide accelerators – Low energy circular accelerators – Cyclotron (fixed frequency)and Betatron accelerator.

Learning Outcomes:

- Knowledge on Classification of accelerators.
- Types of Linear accelerators and Low energy circular accelerators.
-

UNIT-V (Elementary Particle Physics)

Classification of elementary particles, particle interactions, conservation laws (linear momentum, angular momentum, energy, charge, baryon number, lepton number, isospin, hyper charge, strangeness quantum number), Elementary ideas of CP and CPT invariance, SU(2), SU(3) multiplets, Quark model.

Learning Outcomes:

- Classification - Particle interactions and families, symmetries and conservation laws
- Elementary ideas of CP and CPT invariance, SU(2), SU(3) multiplets and Quark model.
- Knowledge on dissimilar applications in nuclear physics.

Course Outcomes:

- Describe and understand the differential nuclear reactions and nuclear forces.
- Understand the applications of nuclear physics.
- Students have understood the concept of nuclear fission and nuclear fusion.

Text and Reference books

1. Nuclear Physics by D.C. Tayal, Himalaya publishing Co.,
2. Introductory Nuclear Physics by Kenneth S. Krane
3. Introduction to Nuclear Physics by Harald A. Enge
4. Concepts of Nuclear Physics by Bernard L. Cohen.
5. Elementary particle physics- M.J. Longo
6. Introduction to Elementary Particles by D. Griffiths
7. Nuclear Physics by S.B. Patel, Wiley Eastern Ltd.,

NOTE : Question paper contains **FIVE** questions with internal choice have to be set from each unit. Each question carries 14 marks.

DEPARTMENT OF PHYSICS, ANDHRA KESARI UNIVERSITY::ONGOLE

Syllabus approved in the PG Board of Studies meeting held on 05-8-2023

(w.e.f. Academic Year 2023-24 Amended as per NEP - 2020)

M.Sc. Physics (III Semester)

Core II: ADVANCED QUANTUM MECHANICS

Course Objectives:

- Understanding of relativistic quantum mechanics with different aspects in the presence of electromagnetic fields
- Representation Dirac equation, different notations for covariance and invariance under Lorentz transformations, getting knowledge on charge conjugation
- Introduction on field quantization and effect of quantization on different fields, second quantization.

Unit – I (Klein –Gordon and Dirac equation)

Klein –Gordon equation –continuity equation (probability and Current density) - Klein –Gordon equation in presence of electromagnetic field – Dirac equation (for a free particle) - probability and Current density – constants of motion - Dirac equation in presence of electromagnetic fields

Learning Outcomes

- Derivation of Klein –Gordon equation for a free particle and in the presence of electromagnetic fields
- Variation of Dirac equationin case of a free particle and electromagnetic field.
- Continuity equation in the absence (free particle) and presence of e.m.field

Unit – II (Applications of Dirac's equation)

Hydrogen atom – covariant notation – covariance of Dirac equation- invariance of Dirac equation under Lorenz transformation – pure rotation and Lorentz transformation. Charge conjugation – hole theory and charge conjugation – projection operators for energy and spin- bilinear covariant – Dirac equation for zero mass and spin ½ particles.

Learning Outcomes

- To learn about Hydrogen atom under the quantum effects and Dirac equation,
- Knowing information on Lorentz transformation, charge conjugation

Unit – III (Quantization of classical field)

Introduction for quantization of fields – concept of field Hamiltonian formulation of classical field – real scalar field Schrodinger field – Dirac field – Maxwell's field – quantum equation of the field – quantization of real scalar field and second quantization – quantization of complex scalar field – quantization of Schrödinger field - quantization of Dirac field.

Learning Outcomes

- Basic concepts of quantization of fields, derivation and problematic approaches to Dirac and Maxwell's fields.
- Concept of Second quantization and scalar fields.

Unit – IV (Quantum theory of radiation)

Classical radiation field, creation, annihilation and number operators, quantized radiation field. Emission and absorption of photons by atoms, Rayleigh scattering, Thomson scattering, and the Raman effect, radiation damping and resonance fluorescence, dispersion relations and causality, the self-energy of a bound electron: the Lamb shift.

Learning Outcomes

- Students should be able to understand radiation fields representation in semi classical approaches.
- To know the representation and analysis of the self-energy of a bound electron.
- To understand the various scattering methods such as Thomson Scatterings.

Unit – V (Relativistic quantum mechanics)

Probability conservation in relativistic quantum mechanics, the Dirac equation, simple solutions, non relativistic approximation, plane waves. Relativistic covariant, bilinear covariants, Dirac operators in the Heisenberg representation, Zitterbewegung and negative-energy solutions, central force problem., the hydrogen atom, hole theory and charge conjugation, quantization of the Dirac filed, weak interaction and parity non conservation., the two-component neutrino.

Learning Outcomes

- Students should be able to understand Relativistic covariant
- To know the representation and analysis of Zitterbewegung solutions
- To understand the Dirac filed.

Course Outcomes

- ➢ Relativistic quantum mechanics will provide an exposure to how special relativity in quantum theory works on free particles and in the electromagnetic field.
- ➢ The basics of scattering theory are understood.

Text and Reference books

1. Advanced Quantum Mechanics by J.J. Sakurai
2. Relativistic Quantum Fields. Vols. I & II by Bjorken and Drell
3. Quantum Field Theory by Mandl
4. Particles and Fields by Lurie
5. Quantum Theory of Fields. Vols. I & II by Weinberg

NOTE : Question paper contains **FIVE** questions with internal choice have to be set from each unit. Each question carries 14 marks.

PHY 3.3 (A)

DEPARTMENT OF PHYSICS, ANDHRA KESARI UNIVERSITY::ONGOLE

Syllabus approved in the PG Board of Studies meeting held on 05-8-2023

(w.e.f. Academic Year 2023-24 Amended as per NEP - 2020)

M.Sc. Physics (III Semester)

Elective –I CONDENSED MATTER PHYSICS -I

Course Objectives:

- Utilizing the basic concepts of solid state physics, the quantum theory of lattice dynamics and thermal neutron scattering would be extensively discussed in this course.
- Properties of metallic lattices, simple alloys and estimation of concentration of defects in ionic crystals.
- The ultraviolet spectrum of the alkali halides, excitons, Illustration of electron-hole interaction in single ions and Lattice defect in ionic crystals and estimation of concentration of defects in ionic crystals. Thallium-activated alkali halides, The sulfide phosphors, Electroluminescence.
- Vibrational modes of a diatomic linear lattice and dispersion relations and Lattice thermal conductivity-Phonon mean free path.
- Quantum theory of Para magnetism, Crystal Field Splitting, Quenching of the orbital Angular Momentum.
- Saturation Magnetization at Absolute Zero and Magnons, Bloch's $T^{3/2}$ law.

UNIT-I

Defects: Properties of metallic lattices and simple alloys: The structure of metals –classification of lattice defects. Configurational -entropy –The number of vacancies and interstitial as function of temperature –The formation of lattice defects in metals. Lattice defect in ionic crystals and estimation of concentration of defects in ionic crystals. Edge and screw dislocation The Frank read mechanism of dislocation multiplication.

Learning Outcomes:

- Properties, structure and classification of metal alloys and their defects.
- Estimation of lattice defects in ionic crystals.
- To know how to form lattice defects in metals.
- To learn about the Frank read mechanism of dislocation multiplication.

UNIT-II

Optical Properties: Optical and thermal electronic excitation in ionic crystals, The ultraviolet spectrum of the alkali halides; excitons, Illustration of electron-hole interaction in single ions, Qualitative discussion of the influence of lattice defects on the electronic levels, Non stoichiometric crystals containing excess metal, The transformation of F centers into F_1 centers and vice versa, Coagulation of F centers and colloids, Color centers resulting from excess halogen, Color centers produced by irradiation with X-rays.

Learning Outcomes:

- Optical and thermal electronic excitation of ionic crystals and Illustrate the electron-hole interaction in single ions.
- The transformation of F centers into F_1 centers and learn about Photoconductivity in crystals containing excess metal.

- General remarks about Luminescence Excitation and emission, Decay mechanisms.
- To know about Thallium-activated alkali halides, sulfide phosphors and Electroluminescence.
- Learning the Non stoichiometric crystals containing excess metals.

UNIT-III Photoconductivity and Luminescence

Excitons: Weakly bound and tightly bound – Photoconductivity – Simple model – Influence of traps – Space charge effects – Determination of photoconductivity. Luminescence – Various types– Thermoluminescence, Electroluminescence, Photoluminescence, Cathodoluminescence and Chemiluminescence - Excitation and emission – Decay mechanisms – Applications.

Learning Outcomes:

- To know about photoconductivity and various traps and their effects.
- General remarks about Luminescence Excitation and emission, Decay mechanisms.
- Learning the applications of decay mechanisms..

UNIT IV: Semiconductor Physics

Intrinsic and extrinsic semiconductors –Fermi level, Expressions for electron and hole concentrations in intrinsic and extrinsic semiconductors– Variation of Fermi level with temperature – np product – Carrier mobility, conductivity and their variation with temperature – Direct and indirect band gap semiconductors – Differences and examples – Continuity equation – Drift and Diffusion – Einstein relation –Recombination of electron -hole pairs - various recombination mechanisms.

.**Learning Outcomes:**

- Knowledge about the importance of semiconductors.
- To know about the variation of Fermi level with temperature.
- To know about the direct and indirect band gap semiconductors
- Learning with various recombination mechanisms.

UNIT V

Magnetic Properties of Solids: Quantum theory of Para magnetism, Crystal Field Splitting, Quenching of the orbital Angular Momentum, Ferromagnetism Curie point and the Exchange integral, Saturation Magnetization at Absolute Zero, Magnons, Bloch's $T^{3/2}$ law. Ferromagnetic Domains. Antiferromagnetism, The two-sublattice model, Superexchage interaction Ferrimagnetism, The structure of ferrites, The saturation magnetization, Elements of Neel's theory. (Solid State Physics by C. Kittel Chapters 14 and 15)

Learning Outcomes:

- Ferromagnetism Curie point and the Exchange integral, Saturation Magnetization at Absolute Zero,
- To learn about the Ferromagnetic Domains. Antiferromagnetism,
- To study the saturation magnetization and Elements of Neel's theory.

Course Outcomes:

- ➢ A student of this course is expected to understand thoroughly the concepts of lattice dynamics and Luminescence Excitation and emission, Decay mechanisms spectroscopy.
- ➢ In addition, the students would be able to perform various analytical as well as numerical calculations needed for understanding the quantum theory of solids.

Text and Reference Books

1. Madelng: Introduction to Solid State theory
2. Callaway: Quantum theory of solid state
3. A.J. Dekker: Solid state physics
4. C. Kittel: Solid State Physics
5. Introduction to Semiconductor materials and devices –MS .Tyagi , Wiley
6. Solid State Physics S.O. Pillai New Age International

NOTE : Question paper contains **FIVE** questions with internal choice have to be set from each unit. Each question carries 14 marks.

. PHY 3.3 (B)

DEPARTMENT OF PHYSICS, ANDHRA KESARI UNIVERSITY::ONGOLE
Syllabus approved in the PG Board of Studies meeting held on 05-8-2023
(w.e.f. Academic Year 2023-24 Amended as per NEP - 2020)
M.Sc. Physics (III Semester)

Elective –I NANO MATERIALS AND DEVICES

UNIT-1: Introduction to Nanomaterials

Introduction to Nanomaterials -Zero, One and Two Dimensional Nanomaterials Quantum confinement, Density of states, Dependence of dimensionality – Physical and chemical properties.

UNIT –II: Synthesis of Nanomaterials

Introduction to Bottom –up and Top- down approaches

Ball milling –Inert Gas condensation – Physical vapour deposition -, Molecular Beam Epitaxy – Sputtering – Pulsed laser Deposition –Chemical vapour deposition - Sol Gel – Hydrothermal Synthesis

UNIT- III: Nano –Carbon

Carbon molecules: Nature of the carbon bond –New Carbon structure –carbon clusters –Small carbon clusters –Discovery of C_{60} –Structure of C_{60} and its properties –Synthesis of buckyballs and Applications.

Carbon Nanotubes: Fabrication –Structure - Electrical Properties – Applications of carbon Nanotubes

Graphene: Fabrication – Structure – Electrical Properties – Applications.

UNIT –IV: Nano Devices

Introduction – Nanofabrication –Photo- Lithography – Pattern transfer – Introduction to MEMS –Single Electron Transistor – Solar Cells – Light Emitting diodes –Gas Sensors- Microbatteries – Field emission display devices –Fuel Cells.

UNIT –V: QUANTUM DOTS

Quantum confinement - Excitons and excitonic Bohr radius – difference between nanoparticles and quantum dots - Preparation through colloidal methods - Epitaxial methods- MOCVD and MBE growth of quantum dots - current-voltage characteristics - magneto tunneling measurements

Books for Study

1. Nanomaterials: Synthesis, Properties and Applications – Edited by A.S. Edelstein and R.C. Cammarata, Institute of Physics Publishing, 2002.
2. Introudction to Nanotechnology – Charles P. Poole Jr and Frant J. Owens, Wiley

Interscience, 2003.
3. Nanopracticles from Theroy to Applications edited by Gunter Schmid, Wiley VCH, 2004.
4. Nanoelectronics and Nanosystems by K. Glosekotter and J. Dienstuthi (Springer), 2004.
5. Nanoscale Materials in Chemistry, Kenneth J. Klabunde, 2001 Wiley & Sons, Publcn.
6. Nanotechnology: Principles and Practices, Sulabha K.Kulkarni, Capital Publishing company

NOTE: Question paper contains **FIVE** questions with internal choice have to be set from each unit. Each question carries 14 marks.

PHY 3.3 (C)

DEPARTMENT OF PHYSICS, ANDHRA KESARI UNIVERSITY::ONGOLE

Syllabus approved in the PG Board of Studies meeting held on 05-8-2023

(w.e.f. Academic Year 2023-24 Amended as per NEP - 2020)

M.Sc. Physics (III Semester)

Elective –I APPLIED SPECTROSCOPY

Course Objectives -This course enables the students

A. To become familiar with Beer's law and working of Spectrophotometer.
B. To learn about the IR spectrophotometry and Fourier Transform Infrared Spectrometer used for the study of molecular structure.
C. To familier with the principles of Fluorescence and Phosphorescence spectroscopy and their applications.
D. To learn the theory of Raman scattering and application of Raman Spectroscopy.
E. To learn the technique of structure determination using IR and Raman spectroscopy.
F. To learn non-linear Raman phenomenon and photo-acoustic Raman scattering and multi photon spectroscopy.

Course Outcomes - After the completion of this course, students will be

1. Able to learn absorption principle and spectrophotometrs working in different spectral regions.
2. Able to undertake molecular structure elucidation.
3. Able to use effectively the Fluorescence and Phosphorescence spectroscopic techniques for various analytical purposes.
4. Able to determine the structure of molecules using IR and Raman spectroscopy.
5. Able to acquire knowledge about the non-linear Raman phenomenon and photo-acoustic Raman scattering and multi photon spectroscopy.

UNIT- I: Molecular Spectroscopy

Introduction – Rotational and vibrational structure of electronic bands of diatomic molecules – Fortrat diagram – General relations – Combination relations for 1Σ - 1Σ and 1Σ – 1π bands – Evaluation of rotational constants with reference to above transitions. Isotope effect in electronic spectra of diatomic molecules – Vibrational effect and rotational effect. Potential energy curves - Dissociation energy and pre-dissociation energy.

UNIT II – Spectrophotometry

Introduction- Beer's law – Absorptivity – UV and visible absorption- Instrumentation- Essential parts of spectrophotometer- Gratings and prisms – Radiant energy sources – filters – Photosensitive detectors- Barrier layer cells – Photo emissive cells –Relationship between absorption in the visible and UV region and molecular structure – IR spectrophotometry - Fourier Transform Infrared (FTIR) Spectrometer – Molecular structure.

UNIT III - Fluorescence and Phosphorescence Spectroscopy

Introduction – Flourescence- Resonance Flouorescence- Normal Fluorescence-Intensities of Transitions – Non-radiative decay of fluorescent molecules – Phosphorescence and the nature of the triplet state-Population of the triplet state – Delayed fluorescence- Excitation spectra - Experimental methods – Emission lifetime measurements – Time resolved emission spectroscopy – Applications of Fluorescence and Phosphorescence

UNIT IV- Raman Spectroscopy

Introduction- Theory of Raman Scattering – Rotational Raman Spectra- Vibrational Raman Spectra – Mutual Exclusion principle – Raman Spectroscopy/ Sample Handling Techniques- polarization of Raman Scattered Light – Single Crystal Raman Spectra – Raman Investigation of Phase Transitions – Resonance Raman Scattering – Structure Determination using IR and Raman Spectroscopy.Difference between Raman spectra and Infrared spectra.

UNIT V - Non-linear spectroscopic phenomena

Non-linear Raman phenomenon - Hyper Raman spectroscopy – Stimulated Raman spectroscopy – Inverse Raman effect – Coherent Anti-stokes Raman scattering – Photo-acoustic Raman scattering – Multi Photon Spectroscopy

Text and Reference Books

1. Molecular spectra and Molecular structure Volume I, **G. Herzberg** (2^{nd} Edition, Van. Nostrand London)
2. Fundamentals of Molecular Spectroscopy,**C.N. Banwell**(Tata Mcgraw- Hill Publishing Company Ltd, 1983)
3. Spectroscopy,**Straughan and Walker** (volume 2 and volume3, John wiley and Sons, 1976)
4. Molecular Structure and Spectroscopy,**G. Aruldhas**(Printice- Hall of India, Pvt. Ltd. 2001)
5. Instrumental Methods of Analysis,**Willard, Merritt, Dean and Settle** (CBS Publishers and Distributor, New Delhi, 200)

NOTE : Question paper contains **FIVE** questions with internal choice have to be set from each unit. Each question carries 14 marks.

PHY 3.4 (A)

DEPARTMENT OF PHYSICS, ANDHRA KESARI UNIVERSITY::ONGOLE
Syllabus approved in the PG Board of Studies meeting held on 05-8-2023
(w.e.f. Academic Year 2023-24 Amended as per NEP - 2020)
M.Sc. Physics (III Semester)

Elective –II CONDENSED MATTER PHYSICS -II

Course Objectives:
- Continuation to Condensed Matter Physics-I for depth of the core subject.
- Initiation of theoretical conceptual ideas about elementary mechanics of molecules.
- Energy level representation through different conceptual and pictorial representations.
- Adoption of mixture of concepts from statically mechanics, classical mechanics and quantum mechanics for Dielectric studies.
- Expansion of those concepts for ferroelectrics.

UNIT- I
Elements of group theory: Introduction to crystallographic point groups, the five platonic solids, procedure for symmetry classification of molecules, class, matrix notation for geometrical transformations, matrix representation of point groups, reducible and irreducible representations, great orthogonality theorem and its consequences, Character tables for C_{2V} and C_{3V} point groups, Mullikan symbolism, Symmetry species.
Learning Outcomes:
- Learning concepts of mechanics crystallography via point groups
- Study the classification of point groups and matrix and notation representations.
- In view of Competitive exams problematic and derivational tactics through characteristics tables and symmetry species.

Unit II
Elements of Ligand field theory& Electronic spectra: Concept of ligand field and crystal field. Free ion configurations-terms and states. Derivation of free ion terms for d^1 and d^2 configuration. Energy ordering of terms- Hund's rules.
Learning Outcomes:
- Learning theories of Elements of Ligand field theory & Electronic spectra with ligand field and crystal field.

Unit III Crystal fields parameters
Strength of crystal fields, Crystal field potentials for O_h and T_d fields. Meaning of Dq. Construction of ligand field energy level diagrams- effect of weak crystal fields on terms. Splitting due to lower symmetries Electronic spectra of d^1 and d^9 systems.T-S Diagrams with specific examples.
Learning Outcomes:

- Creating interest toward research via theory, calculation and pictorial presentation T-S diagrams and crystal field theory.

Unit-IV
Dielectrics: Macroscopic description of the static dielectric constant, The static electronic and ionic polarizabilities of molecules, Orientational Polarization, The static dielectric constant of gases. The internal field according to Lorentz, The static dielectric constant of solids, Classius-Mosetti equation, The complex dielectric constant and dielectric losses, Dielectric losses, relaxation time and Debye's relations, Cole-Cole diagrams. The classical theory of electronic polarization and optical absorption.

Learning Outcomes:

- Learning concepts of Dielectrics and polarization
- Study the fields through Lorentz field and pictorial representation to understand Cole-Cole diagrams.

Unit V

Ferroelectrics: General properties of ferroelectric materials. Classification and properties of representative ferroelectrics, the dipole theory of ferroelectricity, objections against the dipole theory, Ionic displacements and the behaviour of $BaTiO_3$ above the curie temperature, the theory of spontaneous polarization of $BaTiO_3$. Thermodynamics of ferroelectric transitions, Ferroelectric domains.

Learning Outcomes:

- Learning concepts of ferroelectric materials.
- Creating interest toward research via theory and thermodynamics of ferro electric transitions.

Course Outcomes:

- ➢ Students will get knowledge on Elements of group theory and point groups.
- ➢ Students will be able to do Crystal field theory, crystal field potentials and T-S diagrams.
- ➢ Students will know what a polarization and Clasius- Mosseti equation is.
- ➢ Understating of Ferroelectrics and theories, classifications and domains can also be done.

Text and Reference Books

1. Chemical applications of group theory by F.A. Cotton
2. Spectroscopy of molecules by Veera Reddy
3. Solid State Physics by A.J.Dekker (Macmillan)
4. Solid State Physics by C.Kittel
5. Advanced inorganic chemistry by F.A. Cotton & G. Wilkinson

NOTE : Question paper contains **FIVE** questions with internal choice have to be set from each unit. Each question carries 14 marks.

.

PHY 3.4 (B)

DEPARTMENT OF PHYSICS, ANDHRA KESARI UNIVERSITY::ONGOLE
Syllabus approved in the PG Board of Studies meeting held on 05-8-2023
(w.e.f. Academic Year 2023-24 Amended as per NEP - 2020)
M.Sc. Physics (III Semester)

Elective –II SENSORS AND TRANSDUCERS

Course Objectives - This course enables the students:

A. To understand the fundamentals of sensors and transducers and opto-electronic devices.
B. To learn the principles of transducers, gauges, LEDs, FETs, filters and amplifiers.
C. To learn the characteristics of LVDT, phtodiode, couplers, detectors and amplifiers.

Course Outcomes - After the completion of this course, students will be:

1. The students able to construct transistor, FET..
2. The students will able to understand the concepts of optoelectronic devices.
3. They can understand the device structure and characteristics of photovoltaic cell, LED, LCD and photodiode.
4. In depth understanding of filters, detectors and amplifiers.

UNIT – I: General Introduction to sensors/transducers

Definition of a transducer/sensor. Role of a transducer in a generalized measurement system. Classification of transducers. Classification of transducers. Significant parameters of transducer. Temperature scales. Mechanical temperature sensors. Platinum resistance thermometer. Thermistors. Thermocouples.

UNIT –II: Displacement and strain transducers

Displacement transducers - Variable resistance, inductance and capacitance. Linear voltage differential Transformer (LVDT) Strain - Definition, Principal of working of strain gauges. Gauge factor. Types of strain gauges. Materials for strain gauges. Temperature compensation. Application

UNIT –III: Opto - electronic transducers

Photoemission tube. Photomultiplier cell. Photoconductive cell. Photovoltaic cell (solar cell). Photodiode, Photo – transistor, Photo FET, Light emitting diode. Liquid crystal display. Optoelectronic couplers. Laser diode.

UNIT –IV: Single conditioners (Filters, Detectors & Amplifiers)

Filters – Integrators, Differentiators and active filters. Detectors Peak Detectors sample and _ hold circuits. Phase sensitive detector and precision rectifiers, Amplifiers – chopper stabilized DC amplifiers. Instrumentation amplifiers. Logarithmic and anti-logarithmic amplifiers Isolation amplifiers, Lock in amplifiers.

UNIT V: ADVANCED SENSORS

MEMS: Introduction – Sensor Materials - Surface processing techniques - R&D on MEMS - Current and Future Technology - The NANO/MEMS Program.

Text and Reference Books

1. Instrumentation Measurement Analysis, Nakra and Chaudary, 4th Edition, Tata Mc Graw-Hill,1985.
2. Instrumentation - Devices and Systems, Rangan, Mani and Sharma, 2nd Edition, Tata Mc GrawHill, 1983.
3. A course in Electrical and Electronic Measurements and Instrumentation, AK Sawhney, 4th Edition,Dhanpat Rai & Company, 2016.
4. Instrumental Methods of Analysis, Willard, Meritt, Dean and Seattle, 7th Edition, Van Nostrand,1981.
5. Hand Book of Biomedical Instrumentation, RS Khandpur, 3rd Edition, Tata Mc Graw-Hill, 1987.
6. Fundamentals of Electronic Devices, David A. Bell, 5th Edition, Oxford University Press, 2008.
7. An introduction to Operational amplifiers, SV Subramanyam, 2nd Edition, Macmillan India,1980.
8. Sensors Handbook - Sabrie Soloman, McGraw-Hill (Second ed.,)

NOTE : Question paper contains **FIVE** questions with internal choice have to be set from each unit. Each question carries 14 marks.

.

PHY 3.4 (C)

DEPARTMENT OF PHYSICS, ANDHRA KESARI UNIVERSITY::ONGOLE

Syllabus approved in the PG Board of Studies meeting held on 05-8-2023

(w.e.f. Academic Year 2023-24 Amended as per NEP - 2020)

M.Sc. Physics (III Semester)

Elective –II MEDICAL PHYSICS

Course Objectives:

- To understand the general concepts in radiation and its interaction and dose measurement.
- To apply the physics concepts in clinical trials.
- To emphasize the significance of various medical techniques and therapy

UNIT – I: Ionising Radiation and Dosimetry

Generation of radiation, Interaction of charged particles with matter, interaction of high energy photons with matter, radiation depth of interaction, range, attenuation curves, dose and exposure measurement, maximum permissible levels, overview of measurement methods: film dosimeters, thermos luminescent dosimetry (TLD), dose measurement during radiography.

UNIT – II: Radioisotopes and Nuclear Medicine

Diagnosis with radioisotopes, isotopes, half-life, nuclear radiations, energy of nuclear radiations, units of activity, isotope generators, principles of measurement: counting statistics, sample counting, liquid scintillation counting, non-imaging investigations examples: haematological measurements, Glomerular filtration rate, radionuclide imaging, bone imaging, dynamic renal function.

UNIT – II: Image Production-I

Radionuclide imaging: the gamma camera, energy discrimination, collimation, image display, single-photon emission tomography (SPET), positron emission tomography (PET), ultrasonic imaging: pulse–echo techniques, tissue interaction with ultrasound, transducer arrays, applications: Doppler imaging, CT imaging: absorption of X-rays, data collection, image reconstruction, beam hardening, spiral CT.

UNIT – IV: Image Production-Ii

Electrical impedance tomography (EIT): image reconstruction, data collection, multi-frequency and 3D imaging, magnetic resonance imaging (MRI): the nuclear magnetic moment, precession in the presence of a magnetic field, T1 and T2 relaxations, the saturation recovery pulse sequence, the spin–echo pulse sequence, localization: gradients and slice selection, frequency and phase encoding, the FID and resolution, imaging and multiple slicing.

UNIT – V: Electrophysiology

Sources of biological potentials, the nervous system, neural communication, the interface between ionic conductors: Nernst equation, membranes and nerve conduction, muscle action potentials, volume conductor effects, the ECG/EKG and its detection and analysis, characteristics of the ECG/EKG, the electrocardiographic planes, recording the ECG/EKG, ambulatory ECG/EKG monitoring.

Learning Outcomes:

- Acquire the major aspects of nature and subject of medical physics and the application of physics to medicine
- Outline the principles of physics of different medical radiation devices and their modern advances
- Recognize the nature, properties, dosimetery of radiation and basics of radiation protection and also medical effects

Text and Reference Books

1. B.H. Brown, R.H. Smallwood, D.C. Barber, P.V. Lawford, and D.R. Hose, Medical Physics and Biomedical Engineering, Institute of Physics Publishing, 1999.
2. S.A. Kane, Introduction to Physics in Modern Medicine, CRC Press, 2009.
3. F.M. Khan, and J.P. Gibbons, Khan's the physics of radiation therapy. Lippincott Williams and Wilkins, 2014.
4. P. Suetens, Fundamentals of Medical Imaging. Cambridge university press, 2017.
5. W.J. Meredith, and J.B. Massey, Fundamental Physics of Radiology. Butterworth-Heinemann, 2013.
6. F.A. Smith, A Primer in Applied Radiation Physics, World Scientific Publishing Co. Inc, 2000.

NOTE : Question paper contains **FIVE** questions with internal choice have to be set from each unit. Each question carries 14 marks.

.

PHY 4.1

M.Sc. Physics (IV Semester)

Core I: ELECTROMAGNETIC THEORY, LASERS AND MODERN OPTICS

Course Objectives:

- Introduction to Electromagnetic waves
- To gain mathematical skills to develop theory of Electromagnetic laws
- To understanding of concept of basic laws in wave propagation
- To analyse the waves and antennas for signal propagation
- To understand the importance of lasers in diversified fields.
- To analyse various optical devices for day to day life
- To understand linear optics and non-linear optical devices

UNIT–I Electromagnetic Waves

Electromagnetic Theory: Maxwell's equations –General wave equation-Propagation of light in isotropic dielectric medium–Propagation of light in conducting medium –Skin depth –Laws of reflection and refraction at the boundary of a dielectric interface–Fresenel's equations–Poynting's theorem–Non-Uniqueness' of electromagnetic potentials and Gauge transformations (Coulomb and Lorentz gauge).

Learning Outcomes:

- The students will be able to grasp the concepts of electro magnetic theory, as well as its aims.
- Students will learn concepts of radiation, potentials, signal, and propagation of electromagnetic waves in media.
- Students will acquire the knowledge on different types of equations derived from Maxwell's equations.

UNIT–II Electromagnetic Radiation

Electromagnetic Radiation –Retarded Potentials –Radiation from an Oscillating dipole –Electric quadrupole–radiation-Linear Antenna –Lienard-Wiechert Potentials–Electromagnetic fields of a uniformly moving point charge-Radiation from an accelerated charge at low velocity-Larmor's formula.

Learning Outcomes:

- The students will be able to grasp the production of electro magnetic radiation from different accelerated charges, as well as its aims.
- Students will learn concepts of potentials, signal , Antenna theory.

UNIT-III Lasers

Lasers: Introduction – directionality- brightness- monochromaticity- coherence – relation between the coherence of the field and the size of the source – The Einstein coefficients – Population inversion-Pumping schemes – attainment of population inversion - two level – three level and four level pumping . Optical feedback: the optical resonator-Quality factor– laser power and threshold condition confinement of beam within the resonator.-line broadening mechanisms – natural, collision and Doppler broadening–Types of Lasers:, He-Ne Laser, Semiconductor GaAs laser, CO_2 Laser, Nd-YAG Laser– applications of lasers.

Learning Outcomes:

- Learn the principles behind working of laser
- Students will learn the importance of absorption and emission processes in lasers.
- Students will acquire the knowledge about applications of lasers in different fields

UNIT –IV Non linear Optics and Holography

Basic Principles- Harmonic generation – Second harmonic generation–Phase matching –Third Harmonic generation-Optical mixing –Parametric generation of light –Parametric light oscillator– Frequency up conversion–Self focusing of light-Introduction to Holography– Recording and reconstruction of Hologram–Basic theory of Holography–Diffuse object illumination-Speckle pattern –-Applications of Holography.

Learning Outcomes:

- Acquiring knowledge on Non linear optical devices and Holographic materials
- Students will acquire mathematical skills require to develop the harmonic generation
- Students will acquire the knowledge importance of hologram after invention of lasers
- Students will understand recording of hologram by basic laws

UNIT–V Fiber Optics

Introduction – total internal refraction –optical fiber modes and configurations– fiber types – Step index fiber structures – single mode fibers-Graded index fiber structure – Fiber materials and fabrication– Wave guide equation–wave equations for step indexed fibers – modal equation – attenuation – Signal distortion on optical wave guides – Block diagram of fiber optic communication system – Applications of optical fibers.

Learning Outcomes:

- Students will learn the principle of optical fiber for communication
- Learning the physical significances of different types of fibers
- Knowing the Preparation of different techniques used for making optical fibers

Course Outcomes:

- At the completion of this course students will be able to
- Understand application of lasers in day to day life
- Understand communication of signals from one point to other
- Student will understand the information on common basics involved in the non-linear optics and fibre optics
- Acquire knowledge various scientific phenomena and their relevance in day to day life
- Teacher will teach the importance of Electromagnetic theory and Modern Optics

Text and Reference Books

1. Introduction to Electrodynamics by D.J.Griffiths, Prentice-Hall, India
2. Electromagnetics by B.B. Laud, Wiley –Eastern, New Delhi.
3. Modern Optics by Fowels
4. Laser and their applications by M.J. Beesly, Taylor and Francis, 1976.
5. Laser and Non-Linear Optics by B.B. Laud, Wiley Eastern Ltd.,1983.
6. Optics by E. Hecht, Addison Wiley, 1974.
7. Optical fibers communications by Gerel Keiser, McGraw Hill Book, 2000.

NOTE : Question paper contains **FIVE** questions with internal choice have to be set from each unit. Each question carries 14 marks.

PHY 4.2

DEPARTMENT OF PHYSICS, ANDHRA KESARI UNIVERSITY::ONGOLE
Syllabus approved in the PG Board of Studies meeting held on 05-8-2023
(w.e.f. Academic Year 2023-24 Amended as per NEP - 2020)
M.Sc. Physics (IV Semester)

Core II: ATOMIC, MOLECULAR AND RESONANCE SPECTROSCOPY

Learning Objectives:

- The subject of Molecular and Solid State Spectroscopy has reached a significant advancement in high–precision experimental measurement techniques.
- The main objective is to teach the students the basic atomic and molecular (diatomic) structures with quantum mechanical approach leading to their fundamental spectroscopies.

UNIT I: Atomic Absorption Spectroscopy
Introduction – Principle – Differences between Atomic Absorption Spectroscopy and Flame Emission Spectroscopy–Advantages of Atomic Absorption Spectroscopy over Flame Emission Spectroscopy–Disadvantages of Atomic Absorption Spectroscopy–Applications of Atomic Absorption Spectroscopy.
Learning Outcomes:

- To know about atomic structure and how they absorb the energy.
- To learn about different absorption techniques.

UNIT-II
Unit-II: Absorption spectrophotometer
Introduction-Beer's law-Absorptivity-UV and Visible absorption-Instrumentation-Block diagram of spectrophotometer-gratings and prisms-radient energy sources-filters-photosensitive detectors-barrier layer cells-photo emissive cells-photomultiplier tubes. Relation between absorption in the visible and UV region and molecular structure.

Learning Outcomes:

- To know about absorption techniques.
- To acquire knowledge about absorption process and instrumentation.

Unit-III: Raman spectroscopy- Introduction-Theory of Raman scattering-Rotational Raman spectra-Vibrational Raman Spectra-Laser Raman Spectroscopy – Sample Handling techniques-Polarisation of Raman Scattered light-Fourier Transform (FT) Raman Spectroscopy and its additional advantages over the conventional Raman Spectroscopy.

FTIR spectrometer-Principle-working-block diagram-molecular structure-qualitative and quantitative analysis-applications-difference between FTIR and IR spectrometer.

Learning Outcomes:

- To learn about the molecular spectroscopy and its techniques.
- To know about the instrumentation of FTIR.

UNIT-IV
NMR Theory, Basic Principles, Nuclear spin and Magnetic moment, Relaxation mechanism, spin lattice and spin-spin relaxation (12) times by pulse methods, Bloch's equations and solutions of Bloch's equations – Experimental

methods, CW NMR Spectrometer. Electron Spin Resonance – The ESR spectrometer, experimental methods, thermal equilibrium and Relaxation methods, characteristics of g and A values, Unpaired electron, fine structure and Hyperfine structure.

Learning Outcomes:

- To learn the Basic principles of NMR theory and Experimental methods.
- To study what is ESR and ESR spectrometer.

UNIT-V

Nuclear quadrupole resonance (NQR) spectroscopy, The fundamental requirements of NQR spectroscopy, General principles, Integral spins and Half Integral Spin., experimental detection of NQR frequencies, block diagram of NQR spectrometer, Experimental methods of SR oscillator, CW oscillator, pulse methods. Mossbauer spectroscopy: The Mossbauer Effect, Recoil less Emission and Absorption, The Mossbauer spectrometer, Experimental Methods, Chemical shift, Magnetic Hyperfine interactions. Photo Electron Spectroscopy, its theory, instrumentation and Applications.

Learning Outcomes:

- To know about NQR and experimental detection of NQ frequencies.
- To study Mossbauer spectroscopy.
- To learn Photo electron spectroscopy and its applications.

Course Outcomes:

After the completion of the course, students will be able to:

- Describe theories explaining the structure of atoms and the origin of the observed spectra.
- Knows the different types of atomic spectra.
- Explain the observed dependence of molecular, atomic and electron spectral lines on externally applied electric and magnetic fields.
- The student would be equipped with an in-depth knowledge of spectroscopic techniques that can be applied in solving problems.

Text and Reference Books:

1. Atomic and Molecular Spectroscopy, Gurdeep Chatwal, Sharma Anand, Himalaya Publishing House.
2. Fundamentals of Molecular Spectroscopy, C.N. Banwell, Tata Mc Graw-Hill,1983.
3. Instrumental methods of Analysis by Willard, Merritt and Dean
4. Molecular spectra and Molecular Structure (van Nostrand) by G. Herzberg
5. Introduction to atomic spectra by H.E. White (T)
6. Fundamentals of molecular spectroscopy by C.B. Banwell (T)
7. Nuclear Magnetic Resonance By E.R. Andrew, Cambridge University Press 1955
8. Spectroscopy by B.P. Stranghon and S.Walker Volume -1 John Wiley and Sons Inc., New York, 1976
9. Pulse and Fourier transform NMR by TC farrar and ED Becker, Academic Press 1971
10. Mossbauer Spectroscopy by M.B. Bhide.

NOTE : Question paper contains **FIVE** questions with internal choice have to be set from each unit. Each question carries 14 marks.

DEPARTMENT OF PHYSICS, ANDHRA KESARI UNIVERSITY::ONGOLE

Syllabus approved in the PG Board of Studies meeting held on 05-8-2023

(w.e.f. Academic Year 2023-24 Amended as per NEP - 2020)

M.Sc. Physics (IV Semester)

Elective –I ADVANCES IN MATERIALS SCIENCE

Course Objective:

- Acquiring the knowledge on material types and then introduction to glasses, glass forming systems, glass transition temperatures and applications of glasses
- Introduction to liquid crystals
- To acquire knowledge on hexagonal, cubic and lamellar phases of amphiphilic molecular systems
- Obtain fundamental concepts and current knowledge of biomaterials and their biomedical applications
- To demonstrate nanocrystalline materials types and their properties and also to understand various approaches of nanomaterial synthesis and characterization

Unit-I

Introduction: Classification of Materials: Types of materials, Metals, Ceramics (glasses), polymers, composites, semiconductors.

Glasses: The glass transition - theories for the glass transition, Factors that determine the glass-transition temperature. Glass forming systems and ease of glass formation, preparation of glass materials.

Applications of Glasses: electronic applications, electrochemical applications, optical applications, magnetic applications.

Learning outcomes:

- Classification of materials
- The basic knowledge about glass, glass preparation, characteristics of glass formation, factors of glass transition, applications of Glasses

Unit-II

Biomaterials: Implant materials: Stainless steels and its alloys, Ti and Ti based alloys, Ceramic implant materials; Hydroxyapatite glass ceramics, Carbon Implant materials, Polymeric Implant materials, Soft tissue replacement implants, Sutures, Surgical tapes and adhesives, heart valve implants, Artificial organs, Hard Tissue replacement Implants, Internal Fracture Fixation Devices, Wires, Pins, and Screws, Fracture Plates.

Learning outcomes:

- The fundamentals of biomaterials
- To acquire knowledge about types of implant materials and their biomedical usage

Unit-III

Liquid Crystals: Mesomorphism of anisotropic systems, different liquid crystalline phases and phase transitions, Elastic continuum theory of liquid crystals, liquid crystals in electric and magnetic fields, few applications of liquid crystals.

Learning outcomes:

- To learn about types of liquid crystals and theory of liquid crystals
- To acquire knowledge about defects and dynamics in liquid crystals

Unit-IV

Nanomaterials:

Origin of Nano materials-Zero, one and two dimensional Nano materials quantum confinement, density of states, physical and chemical properties, synthesis of Nano materials-Bottom-up and Top-down approaches, Chemical methods: Sol-Gel process-Spray Pyrolysis- Solvothermal synthesis-Chemical vapor deposition (CVD), Physical methods: Ball milling-Inert gas condensation technique-Thermal evaporation-Pulsed Laser Deposition (PLD)-Sputtering-Laser ablation method.

Learning outcomes:

- To understand various types of nano crystalline materials
- To describe several synthesis methods for fabrication of nanomaterials
- To analyze and characterize the properties of nanomaterials using various characterization techniques
-

Unit-V: **Carbon based nanomaterials:**

Carbon based molecules and carbon bond - C60: Discovery, Synthesis and structure of C60 - Superconductivity in C60 - Carbon nanotubes: Fabrication – Structure – Electrical properties – Vibrational properties – Mechanical properties – Applications (fuel cells, chemical sensors, catalysts).

Learning outcomes:

- To understand various types of Carbon nanotubes.
- To describe electrical properties
- Applications of nanomaterials

Course Outcome:

At the end of the course the student is expected to assimilate the following and possesses basic knowledge of the following.

- ➢ The fundamental knowledge about material classification, glass, glass preparation, characteristics of glass formation, factors of glass transition, applications of Glasses
- ➢ The knowledge about types of biomaterials used in various implants

Text and Reference Books:

1 Inorganic solids D. M. Adams (John-Wiley)

2 Physics of Amorphous Materials by S.R. Elliott.

3 Fundamentals of thermotropic liquid crystals, deJen and Vertoghen

4 Nanocrystalline materials- H. Gleiter

5 . Biomaterials Science and Engg. J.B. Park

6. Introduction to Material science for Engineers by James. F. Shackelford (Newyork. 1985)

7.Charles P Poole Jr., Frank J. Ownes, Introduction to Nanotechnology, John Wiley Sons,

8. Science of Engineering Materials and Carbon Nanotubes, C.M. SRIVASTAVA and C. SRINIVASAN (New Age Int).

NOTE : Question paper contains **FIVE** questions with internal choice have to be set from each unit. Each question carries 14 marks.

PHY 4.3 (B)

DEPARTMENT OF PHYSICS, ANDHRA KESARI UNIVERSITY::ONGOLE

Syllabus approved in the PG Board of Studies meeting held on 05-8-2023

(w.e.f. Academic Year 2023-24 Amended as per NEP - 2020)

M.Sc. Physics (IV Semester)

Elective –I CRYSTAL GROWTH AND THIN FILMS

UNIT I: Nucleation and Growth

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

UNIT II: Growth Techniques

Solution Growth Technique: Low temperature solution growth: Solution - Solubility and super solubility – Expression of super saturation – Miers T-C diagram - Constant temperature bath and crystallizer – Seed preparation and mounting - Slow cooling and solvent evaporation methods.
Gel Growth Technique: Principle – Various types – Structure of gel – Importance of gel – Experimental procedure –Chemical reaction method – Single and double diffusion method – Chemical reduction method –Complex and decomplexion method – Advantages of gel method.

UNIT III: Melt Growth Techniques

Melt technique: Bridgman technique - Basic process – Various crucibles design - Thermal consideration –Vertical Bridgman technique –Crystal Pulling technique - Czochralski technique – Experimental arrangement – Growth process –Zone melting technique –Skull melting process – Verneuil Process

UNIT IV: Thin Film Deposition Techniques

Thin Films – Introduction to Vacuum Technology - Deposition Techniques - Physical Methods – Resistive Heating, Electron Beam Gun, Laser Gun Evaporation and Flash Evaporations, Sputtering - Reactive Sputtering, Radio-Frequency Sputtering - Chemical Methods – Spray Pyrolysis - Chemical vapour deposition (CVD)– Preparation of Transparent Conducting Oxides.

UNIT V: Characterization Technique

X – Ray Diffraction (XRD) – Powder and single crystal - Fourier transform Infrared analysis (FT-IR) – Elemental analysis – Elemental dispersive X-ray analysis (EDAX) - Scanning Electron Microscopy (SEM) – UV-Vis-NIR Spectrometer – Etching (Chemical) – Vickers Micro hardness –Dielectric studies – Second harmonic generation test.

Text and Reference Books:

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

NOTE : Question paper contains **FIVE** questions with internal choice have to be set from each unit. Each question carries 14 marks

DEPARTMENT OF PHYSICS, ANDHRA KESARI UNIVERSITY::ONGOLE

Syllabus approved in the PG Board of Studies meeting held on 05-8-2023

(w.e.f. Academic Year 2023-24 Amended as per NEP - 2020)

M.Sc. Physics (IV Semester)

Elective –I SOLAR ENERGY – THERMAL AND PHOTOVOLTAIC PROPERTIES

UNIT - I: Basic Concepts of Solar Energy

Introduction - Distribution of solar radiation – Solar Constant, Zenith Angle, Air Mass, Standard Time, Local Apparent Time, Equation of Time, Declination, Hour Angle, Azimuth Angles (all definitions only). Radiation Measurement using Pyranometer and Pyrheliometer – Principle and working.

Kirchoff's law – Solar transmittance, absorptance, emittance and reflectance – Their relation. Selective coatings - Methods of Preparation of coatings - Measurement of solar absorptance and emittance of a selective surface.

UNIT - II: Solar Thermal Collectors

Introduction, Collector types - Flat plate collector (FPC), Evacuated tube collector – Energy balance equation and efficiency, Definitions of collector overall heat loss coefficient, collector efficiency factor, collector heat-removal factor and collector flow factor, Temperature distribution in FPC - Testing of FPC, solar water heating - natural and forced circulation type; Concentrating collectors, types, single axis and two-axis tracking – Performance of Linear parabolic trough concentrator.

UNIT – III: Solar Cells

Photovoltaic effect – Equivalent circuit of solar cell - Definitions of cell parameters, Type of cells, Crystalline silicon (c-Si), Float zone and Czochrolski methods - Wafer to cell formation steps, Poly-Si wafer growth methods – EFG, Web, Heat exchange method, Amorphous Si cells. Thin film cells – Advantages and limitations

UNIT – IV: Solar Cell Fabrication

CdTe/CdS, CuInGaSe2/CdS and GaAs cells – Configurations and structures

– Fabrication of these cells - I-V characteristics and spectral response - Multijunction cells - Quantum dot, Dye sensitized and Perovskite cells.

UNIT – V: Solar Photovoltaic Systems

Photovoltaic (PV) Module assembly - Description of steps involved in the fabrication of solar module - Performance of module – I-V Characteristics, Modules design for different current and voltages - Module protection - Use of bypass and blocking diodes, Solar PV system - Components – PV Array, battery, invertor and load. Bifacial solar modules – Advantages over mono-facial cells; Applications of solar PV systems – Stand-alone system – Design methodologies, Hybrid system – Types and issues, Grid connected systems.

Books for Study

1. Solar Energy Utilization, G. D. Rai, Khanna Publishers, 1987.
2. Solar Energy - Fundamentals, Design, Modelling and Applications, G.N. Tiwari, Narosa Publications, 2005.
3. Solar Energy-Principles of Thermal Energy Collection & Storage, S.P. Sukhatme, Tata Mc-Graw Hill Publishers, 1999.
4. Science and Technology of Photovoltaics, P. Jayarama Reddy, CRC Press (Taylor & Francis Group, Leiden, Netherlands) & BS Publications, 2009.
5. Solar Photovoltaics- Fundamentals, Technologies and Applications, Chetan Singh Solanki, PHI Learning Pvt. Ltd., 2015.

NOTE : Question paper contains **FIVE** questions with internal choice have to be set from each unit. Each question carries 14 marks

DEPARTMENT OF PHYSICS, ANDHRA KESARI UNIVERSITY::ONGOLE

Syllabus approved in the PG Board of Studies meeting held on 05-8-2023

(w.e.f. Academic Year 2023-24 Amended as per NEP - 2020)

M.Sc. Physics (IV Semester)

Elective –II ADVANCED CONDENSED MATTER PHYSICS

Course Objective:

- The lattice dynamics of the solids are discussed briefly to understand the influence of interatomic forces on crystals of different bonding nature and studied thermal properties of the solids including the interaction of electron, photon and phonons.
- Understanding of the crystal growth techniques with different states of the matter.
- Interaction of the electrons with phonons and polaron.
- Properties and practical applications of superconductors.

UNIT I

Lattice Dynamics and Optical properties of Solids: Inter atomic forces and lattice dynamics of simple metals, ionic and covalent crystals. Optical phonons and dielectric constants. Inelastic neutron scattering. Anhormonicity, thermal expansion and thermal conductivity. Interaction of electrons and phonons with photons., Direct and indirect transitions.

Learning outcome:

- To know how interatomic forces acting on crystal lattice, thermal properties of the solid state matter.
- Optical properties of the matter are understood with the help of electron, phonon, photon interaction.

UNIT II

Crystal growth techniques: Bridgeman-Czochralski-liquid encapsulated czochralski (LEC) growth technique-zone refining and floating zone growth-chemical vapour deposition (CVD)-Molecular beam epitaxy (MOVPE)-vapour phase epitaxy-hydrothermal growth-Growth from melt solutions-Flame fusion method.

Learning outcome:

- To know how to grow crystals using different preparation techniques.
- Understanding the advantages and difficulties in the process of growing crystals.

UNIT III

Absorption in insulators, Polaritons, One – phonon absorption, optical properties of metals, skin effect and anomalous skin effect. Interaction of electrons with acoustic and optical phonons, polarons.

Learning outcome:

- Students can understand the absorption process in insulators then optical properties are observed.
- To know the basic understanding of normal and anomalous skin effect, penetration depth etc.

UNIT IV

Superconductivity: The Meissner effect – Isotope effect- specific heat-thermal conductivity and manifestation of energy gap. Quantum tunneling-Cooper pairing due to phonons, BCS theory of superconductivity, Ginzsburg-Landau theory and application to Josephson effect: d-c Josephson effect, a-c Josephson effect, macroscopic quantum interference. Vortices and type I and type II superconductors, applications of superconductivity-high temperature superconductivity (elementary).

Learning outcome:

- Understand the basic theory of superconductors and their Type I and II classifications.
- Comprehend the physical concept of BCS theory through formation of cooper pairs.
- Advantages of Josephson effect of superconductors and practical applications of superconductors in various fields.

UNIT V

Characterization Techniques:

X-ray diffraction, data manipulation of diffracted X-rays for structure determination, Scanning Probe microscopy, Scanning Electron microscopy, Transmission Electron Microscopy, Scanning Tunneling Microscopy, Optical microscopy, DTA, TGA and DSC measurements.

Learning outcome:

- Understand the basic Instrumentation and working principle of advanced instruments.
- To know the applications of materials using the various techniques.

Course outcome:

- ➢ The students should be able to elucidate the important features of condensed matter physics by covering lattice dynamics, preparation of crystals under different conditions.
- ➢ Students learned the interaction of electrons with phonons, polarons and the absorption phenomenon in insulators and metals.
- ➢ The origin of superconductivity is understood and the classification and different practical applications are explained.
- ➢ Student can understand the various characterization techniques used for materials characterization.

Text and Reference Books

1. Madelung: Introduction to Solid State Theory.
2. Callaway: Quantum theory of Solid State.
3. Huang: Theoretical Solid State Physics
4. Kittel: Quantum theory of Solids
5. Solid state Physics by Guptha Kumar and Sarma
6. Solid State Physics S.O. Pillai New Age International
7. Science of Engineering Materials: C.M. Srivastva and C. Srinivasan-New Age International, 2005.
8. The Principles and Practice of electron Microcopy: Ian. M. Watt-Cambridge University Press, 1997.

NOTE : Question paper contains **FIVE** questions with internal choice have to be set from each unit. Each question carries 14 marks.

PHY4.4 (B)

DEPARTMENT OF PHYSICS, ANDHRA KESARI UNIVERSITY::ONGOLE

Syllabus approved in the PG Board of Studies meeting held on 05-8-2023

(w.e.f. Academic Year 2023-24 Amended as per NEP - 2020)

M.Sc. Physics (IV Semester)

Elective –II ADVANCED SPECTROSCOPY

UNIT I: UV Spectroscopy

Energy levels, Molecular orbitals – Theory of UV spectra – Franck Condon Principle – transition Probability, measurement of spectrum – Types of transition in Organic molecules – Types of absorption bands – transition in metal complexes – Selection rules – Electronic spectra in poly atomic molecules – Chromophore concept – Application of UV Spectroscopy.

UNIT II: Atomic absorption and Emission Spectroscopy

Principle of AAS, measurement of atomic absorption – Instrumentation – single beam Spectrophotometer –Applications of AAS - Atomic emission Spectroscopy – Principle of AES, Advantages - Instrumentation- laser beam – applications of AES –Difference between AAS and AES.

UNIT III: Surface Enhanced Raman Scattering (SERS)

Surfaces for SERS study – Enhancement mechanism – Instrumentation and sampling techniques - Surface selection rules – SERS microprobe – SERS study of bio molecules – SERS in medicine – Use of Laser FT Raman spectrometer – measurement of depolarization ratio – sample handling methods

UNIT IV: Surface Spectroscopy

Electron energy loss spectroscopy (EELS) – Reflectance Absorbance – IR spectroscopy (RAIRS) – Inelastic helium scattering – Photo electron spectroscopy (PES) – X ray photo electron spectroscopy (XPES) – Ultraviolet PES – Auger electron spectroscopy (AES).

UNIT V: Nonlinear Spectroscopic Phenomena

Nonlinear Raman phenomena – Hyper Raman effect – Experimental Technique – Stimulated Raman scattering – Inverse Raman effect – Coherent antistokes Raman scattering(CARS) – Photo acoustic Raman scattering – Multiphoton spectroscopy.

Text and Reference Books

1. C. N. Banwell and E. M. McCash, 1994, Fundamentals of Molecular Spectroscopy, 4thEdition, Tata Mc Graw-Hill, New Delhi.
2. G. Aruldhas, 2001, Molecular structure and spectroscopy, Prentice Hall of India Pvt.Ltd., New Delhi
3. H.Kaur, 2009, Spectroscopy, 5th Edition, A Pragati Prakashan
4. P. S. Sindhu, 1990, Molecular Spectroscopy, Tata Mc Graw-Hill, New Delhi.
5. D.N. Sathyanarayana, Vibrational Spectroscopy, New age International Publishers.
6. G. W. King, 1964, Spectroscopy and molecular structure, Hoit Rinchart and WinstenInc, London
7. T. A. Carlson, 1975, Photo electron and Auger spectroscopy, Plenum Press
8. J . Loder, 1970, Basic Laser Raman spectroscopy, Hezdan and Son Ltd.
9. T. P. Das and E. L. Hehn, 1958, NQR Spectroscopy, Academic Press
10. Raymond Chang, 1980, Basic Principles of Spectroscopy Mc Graw-Hill Kogakusha

NOTE : Question paper contains **FIVE** questions with internal choice have to be set from each unit. Each question carries 14 marks

DEPARTMENT OF PHYSICS, ANDHRA KESARI UNIVERSITY::ONGOLE

Syllabus approved in the PG Board of Studies meeting held on 05-8-2023

(w.e.f. Academic Year 2023-24 Amended as per NEP - 2020)

M.Sc. Physics (IV Semester)

Elective –II PHOTONICS

Course Objectives - This course enables the students:

A. To understand the light propagation phenomenon through fiber optic cable
B. To understand various loss mechanism of signal while travelling through an optical fiber.
C. To understand the basic working principle of waveguides and its design parameters.
D. To identify waveguides for applications in fiber optics communication systems
E. To understand the principle of working of fiber based sensors for various application purposes.

Course Outcomes - After the completion of this course, students will be:

1. Able to illustrate the principle of fiber optics communications.
2. Able to distinguish between various loss mechanism in fiber optics communication system.
3. Able to utilize the idea of waveguide for different application purpose.
4. Able to categorise different waveguides for the utilization in optics communication system
5. Able to interpret different fiber sensors and their respective application and can recommend this technique for other new application.

UNIT - I: Fibre Optic Components

Connector principles, Fibre end preparation, Splices, Connectors, Source coupling, Distribution networks, Directional couplers, Star couplers, Switches, Fiber optical isolator, Wavelength division multiplexing, Time division multiplexing, Fiber Bragg gratings. Advantage of fiber optic sensors, Intensity modulated sensors.

UNIT - II: Fibre Optic Sensors

Mach-Zehnder interferometer sensors, Current sensors, Chemical sensors –Fiber optic rotation sensors. Optical biosensors: Fluorescence and energy transfer sensing, molecular beacons and optical geometries of bio-sensing, Bio-imaging, Biosensing.

UNIT - III: Integrated Optics

Introduction – Planar wave guide – Channel wave guide – Y-junction beam splitters and couplers - FTIR beam splitters – Prism and grating couplers – Lens wave guide – Fabrication of integrated optical devices - Integrated photodiodes – Edge and surface emitting laser – Distributed Bragg reflection and Distributed feed back lasers - Wave guide array laser.

UNIT - IV: Optical Signal Processing

Introduction, Effect of lens on a wavefront, Fourier transform properties of a single lens, Optical transfer function, Vanderlugt filter, Image spatial filtering, Phase-contrast microscopy, Pattern recognition, Image de-blurring, Photonic switches, Optical transistor, Optical Gates- Bistable systems, Principle of optical Bistability, Bistable optical devices, Self electro-optic effect device.

UNIT - V: Photonic Crystals

Basics concepts, Theoretical modeling of photonic crystals, Features of photonic crystals, Methods of fabrication, Photonic crystal optical circuitry, Nonlinear photonic crystals, Photonic crystal fibers, Photonic crystals and optical communications, Photonic crystal sensors.

Text and Reference Books

1. Fibre Optic Communication, Joseph C. Palais, Pearson Education Asia, India, 2001
2. Introduction To Fibre Optics, A.Ghatak And K.Thyagarajan, Cambridge University Press, New Delhi, 1999
3. Optical Guided Wave Signal Devices, R.SymsAndJ.Cozens. Mcgraw Hill, 1993.
4. Optical Electronics, A Ghatak and K. Thyagarajan, Cambridge University Press, New Delhi.
5. Fundamentals of Photonics, B.E.A. Saleh and M.C. Teich, John Willy and Sons,1991
6. Introduction to Fourier Optics, Joseph W. Goodman, McGraw-Hill, 1996.
7. Nanophotonics, P.N.Prasad, Wiley Interscience, 2003.
8. Biophotonics, P.N.Prasad, Wiley Publications, 2004.

NOTE : Question paper contains **FIVE** questions with internal choice have to be set from each unit. Each question carries 14 marks

DEPARTMENT OF PHYSICS, ANDHRA KESARI UNIVERSITY::ONGOLE
Syllabus approved in the PG Board of Studies meeting held on 05-8-2023
(w.e.f. Academic Year 2023-24 Amended as per NEP - 2020)

List of I Semester Practical's

PRACTICAL-I: GENERAL PHYSICS

1. Planck's Constant:

AIM: To study the characteristics of Photo cell and to determine the value of Planck's constant.

2. Thermister:

AIM: To study the characteristics of the Thermister.

3. Newton Rings:

AIM: To determine the wavelength of sodium vapor lamp and the radius of curvature of the given plano convex lens.

4. Twin-T-Filter:

AIM: To study frequency response characteristics of a Twin-T-Filter circuit to find its cutoff frequency.

5. Mesh method Analysis:

AIM: To identify theoretical and practical values of Mesh method analysis.

6. Maximum Power transfer theorem:

AIM: To verify the maximum power transform theory in the case of simple T-network.

7. Diffraction grating – Normal Incidence method:

AIM: To determine the wavelength of a given light source by diffraction grating normal incidence method.

List of II Semester Practical's

PRACTICAL-II: GENERAL PHYSICS

1. Ultrasonic Interferometer:

AIM: To determine the velocity of ultrasonic waves in different liquids by using ultrasonic interferometer.

2. Elastic Constant:

AIM: To determine Young's modulus (Y), Rigidity modulus (ŋ), Bulk modulus (K) and Poisson's ratio (□□□ of a given glass plate by forming newton's rings.

3. Cauchy's constants:

AIM: To determine the Cauchy's constants in the Cauchy's relation using Spectrometer and prism

4. LC High pass and Low pass Filter:

AIM: To construct the LC high pass and low pass filter circuits. Draw its frequency response characteristics.

5. RC High pass and Low pass Filter:

AIM: To construct LC high pass and low pass filter circuits. Draw its frequency response characteristics.

6. Network- Theorem:

AIM: To prove super position theorem is Reciprocity theorem in a simple network.

7. Diode-Laser:

AIM: To determine the wavelength of solid state diode laser from diffraction pattern

List of III Semester Practical's

PRACTICAL –III : CONDENSED MATTER PHYSICS

- Specific heat of Graphite.
- IV characteristics of solar cells.
- Internal series Resistance of Solar cells.
- Dielectric constant of Ferro electric material.
- Series and parallel combination of solar cell.
- Coefficient of thermal expansion.

List of III Semester Practical's

PRACTICAL –IV : MICROPROCESSOR & C PROGRAMMING

- Multiplication by repetitive addition
- Multibyte addition.
- Decoding the number in ASCII.
- Interchanging the digits in a two-digit number.
- Addition of two matrices.
- Surface Area, volume of sphere and cone.
- Trace of a matrix
- Distance between the two points.
- Given number is a prime or not.
- Transpose of a given matrix.

(PHY1.1)

M.Sc. DEGREE EXAMINATION (2023 – 2024)
First Semester
Physics
Core-I, CLASSICAL MECHANICS

Time: Three Hours Maximum: 70 marks

Answer the following

1) a) State and explain D'Alembert's principle and derive the Lagrangian equation.

b) Find the solution of compound pendulum using Lagrange's equation of motion.

Or

c) Explain different types of constraints with examples.

d) Derive the law of conservation of linear momentum and conservation of energy for a system of particles in the Lagrangian framework.

2) a) State and explain Hamilton's principle

b) Define Hamilton's principle and obtain Lagrange's equation form it.

Or

c) Mention the four generating functions and obtain the transfer motion equations for F_2 and F_4 generating functions.

d) Solve the Harmonic oscillator problem using canonical transformations.

3) a) Define Poisson brackets and mention their properties.

b) Obtain the Poisson bracket relations for angular momentum.

Or

c) Obtain Hamilton Jacobi equation for Hamilton characteristic function.

d) What are action angle variables? Explain how they can be used to obtain the frequencies of periodic motion.

4) a) Obtain Euler angles which would completely specify the orientation of a rigid body.

b) Define inertia tensor and explain the principal moments of inertia.

Or

c) Obtain Euler's equation of motion for rotating rigid body with a fixed body.

d) Explain the torque free motion of rigid body.

5) a) Enunciate the principle the special theory of relativity and derive Lorentz transformations.

b) What due you understand by time dilation, what is proper interval of time?. Briefly discuss one experiment in support of time dilation in special relativity.

Or

c) Derive the expression for Galilean transformations.

d) Obtain the expression for relativistic Doppler's effect.

(PHY1.1)

M.Sc. DEGREE EXAMINATION (2023 – 2024)
First Semester
Physics
Core-I, CLASSICAL MECHANICS

Time: Three Hours   Maximum: 70 marks

Answer the following

1) a) State and explain D'Alembert's principle and derive the Lagrangian equation.

b) Find the solution of compound pendulum using Lagrange's equation of motion.

Or

c) Explain different types of constraints with examples.

d) Derive the law of conservation of linear momentum and conservation of energy for a system of particles in the Lagrangian framework.

2) a) State and explain Hamilton's principle

b) Define Hamilton's principle and obtain Lagrange's equation form it.

Or

c) Mention the four generating functions and obtain the transfer motion equations for F_2 and F_4 generating functions.

d) Solve the Harmonic oscillator problem using canonical transformations.

3) a) Define Poisson brackets and mention their properties.

b) Obtain the Poisson bracket relations for angular momentum.

Or

c) Obtain Hamilton Jacobi equation for Hamilton characteristic function.

d) What are action angle variables? Explain how they can be used to obtain the frequencies of periodic motion.

4) a) Obtain Euler angles which would completely specify the orientation of a rigid body.

b) Define inertia tensor and explain the principal moments of inertia.

Or

c) Obtain Euler's equation of motion for rotating rigid body with a fixed body.

d) Explain the torque free motion of rigid body.

5) a) Enunciate the principle the special theory of relativity and derive Lorentz transformations.

b) What due you understand by time dilation, what is proper interval of time?. Briefly discuss one experiment in support of time dilation in special relativity.

Or

c) Derive the expression for Galilean transformations.

d) Obtain the expression for relativistic Doppler's effect.

(PHY 1.2)

M.Sc. DEGREE EXAMINATION (2023 – 2024)
First Semester
Physics
Core-II INTRODUCTORY QUANTUM MECHANICS

Time: Three Hours   Maximum: 70 marks

Answer the following

1) a) Write the significance of Schrodinger wave equation.

b) State and explain the Ehrenfest theorem.

Or

c) What are stationary states? In stationary states, show that the probability current density is constant in time.

d) Obtain the expression for Harmonic oscillator by Schrodinger wave equation.

2) **a**) Discuss Dirac's bra and ket notation in linear complex vector spaces.

b) Define unitary and Hermitian operators and discuss its properties.

Or

c) Write short note on Positive operators.

d) Derive the expression for orthogonalization procedure in operators.

3) **a**) Define various angular momentum operators and write their property.

b) Obtain the Eigen values and Eigen functions of rigid rotator.

Or

c) Discuss the concept of hydrogen atom in rigid rotator.

d) Explain the commutation relations for angular momentum operator

.

4) **a**) Explain time-independent perturbation theory for non-degenerate systems.

b) Discuss Stark effect in hydrogen atom.

Or

c) Discuss variation method.

d) Discuss the WKB method.

5) **a**) Explain what you understand by time dependent perturbation theory.

b) Obtain an expression for probability of transition into a set of closely spaced level. What is Fermi's golden rule?

Or

c) Using perturbation theory, find the energy values of normal helium atom.

d) Write a note on Einstein transition probabilities.

(PHY 1.3)

M.Sc. DEGREE EXAMINATION (2023 – 2024)
First Semester
Physics
Compulsory Foundation-MATHEMATICAL PHYSICS

Time: Three Hours | Maximum: 70 marks

Answer the following

1. (a) Obtain the power series solution for Legendre's differential equation.
   (b) Derive the relation between Beta & Gamma functions

   Or

   (c) State and prove orthogonormal property of Associated legendre's Polynomial.
   (d) Evaluate $J_{-1/2}(x) = \sqrt{2/\pi x}$ Cosx, b) $J_{3/2}(x) = \sqrt{2/\pi x}\left[1/x \sin x - \cos x\right]$

2. (a) State and prove generating function of laguerre's polynomial.
   (b) Prove that (i) $H_n^1(x) = 2n\, H_{n-1}(x)$ (ii) $2x\, H_n(x) = 2n\, H_{n-1}(x) + H_{n+1}(x)$

   Or

   (a) Obtain one fundamental recurrence relation of Lagurre polynomial
   (b) State and prove orthogonal property of Hermite's Polynomial

3. State and prove first and second shifting properties of Laplace transform.
   (b) Find the inverse Laplace transform of $\frac{5S+3}{(S-1)(S^2+2S+5)}$

   Or

   (c) Obtain the Fourier coefficients of Fourier series.
   (d) Find the Fourier Sine transform of e^{-ax} for x>0.

4. (a) State and prove Cauchy's integral formula.
   (b) Expand $f(z) = z^3 - 3z^2 + 4z - 2$ about z=2 by Taylor's series

   Or

   (c) State and prove necessary and sufficient condition for a function to be analytic in a region R.

   (d) Using calculus of residue prove that $\int_0^{2\pi} \frac{d\theta}{2+\cos\theta} = \frac{2\pi}{3}$

5. (a) Define tensor. Distinguish between contravariant and covariant tensors.
   (b) Explain the quotient law of tensor.

   Or

   (c) Explain the addition and multiplication of tensors.
   (d) Give the transformation law of tensor of 3^{rd} order.

(PHY 1.4 A)

M.Sc. DEGREE EXAMINATION (2023 – 2024)
First Semester
Physics
Elective Foundation - ANALOG AND DIGITAL ELECTRONICS

Time: Three Hours Maximum: 70 marks

Answer the following

Q1 (a) Describe the principle and working of Tunnel diode with a neat block diagram.
(b)Explain the characteristics of CMOS.
Or
(c) Describe the construction and working of Solar Cell.
(d) Explain the applications of LED’s.

Q2 (a) Draw the block diagram of a typical Op-Amp and explain the characteristics of a Op-Amp.
(b)Write a note on non-inverting amplifier with Op-Amp.
Or
(c) Describe the construction and working of Wein bridge oscillator with a neat block diagram.
(d) Write a note on Mono stable multivibrator.

Q3 (a) Explain the generation of AM waver.
(b)Write a note on DSBSC modulation.
Or
(c) Explain about the EX-OR and EX-NOR and discuss the working of multiplexer as data selector.
(d) What are Flip-Flops? Explain the R-S Flip-Flop.

Q4 (a) Explain the BUS timings in 8085 and discuss the demultplexing the address bus.
(b)Explain the addressing modes of 8085 microprocessor.
Or
(c) Write an ALP for addition of two 8-bit numbers.
(d) Describe the architecture of 8051 micro controller.

Q5 (a) Draw the architecture of 8051.
(b)Explain the addressing modes of 8051 micro controller
OR
(c) How the data Interpretation takes place and how the analysis is being done.
(d) Explain the Error analysis..

(PHY 1.4 B)

M.Sc. DEGREE EXAMINATION (2023 – 2024)
First Semester
Physics
Elective Foundation – Electronic Device & Applications

Time: Three Hours Maximum: 70 marks

Answer the following

Q1 (a) Describe the principle and working of Tunnel diode with a neat block diagram.
(b)Explain the characteristics of CMOS.
Or
(c) Describe the construction and working of Solar Cell.
(d) Explain the applications of LED's.

Q2 (a) Draw the block diagram of a typical Op-Amp and explain the characteristics of a Op-Amp.
(b)Write a note on non-inverting amplifier with Op-Amp.
Or
(c) Describe the construction and working of Wein bridge oscillator with a neat block diagram.
(d) Write a note on Mono stable multivibrator.

Q3 (a) Explain the generation of AM waver.
(b)Write a note on DSBSC modulation.
Or
(c) Explain about the EX-OR and EX-NOR and discuss the working of multiplexer as data selector.
(d) What are Flip-Flops? Explain the R-S Flip-Flop.

Q4 (a) Explain the BUS timings in 8085 and discuss the demultplexing the address bus.
(b)Explain the addressing modes of 8085 microprocessor.
Or
(c) Write an ALP for addition of two 8-bit numbers.
(d) Describe the architecture of 8051 micro controller.

Q5 (a) Draw the architecture of 8051.
(b)Explain the addressing modes of 8051 micro controller
OR
(c) How the data Interpretation takes place and how the analysis is being done.
(d) Explain the Error analysis..

(PHY 1.4 C)

M.Sc. DEGREE EXAMINATION (2023 – 2024)
First Semester
Physics
Elective Foundation – Fibre Optics

Time: Three Hours Maximum: 70 marks

Answer the following

Q1 (a) Describe the principle and working of Tunnel diode with a neat block diagram.
(b)Explain the characteristics of CMOS.
Or
(c) Describe the construction and working of Solar Cell.
(d) Explain the applications of LED's.

Q2 (a) Draw the block diagram of a typical Op-Amp and explain the characteristics of a Op-Amp.
(b)Write a note on non-inverting amplifier with Op-Amp.
Or
(c) Describe the construction and working of Wein bridge oscillator with a neat block diagram.
(d) Write a note on Mono stable multivibrator.

Q3 (a) Explain the generation of AM waver.
(b)Write a note on DSBSC modulation.
Or
(c) Explain about the EX-OR and EX-NOR and discuss the working of multiplexer as data selector.
(d) What are Flip-Flops? Explain the R-S Flip-Flop.

Q4 (a) Explain the BUS timings in 8085 and discuss the demultplexing the address bus.
(b)Explain the addressing modes of 8085 microprocessor.
Or
(c) Write an ALP for addition of two 8-bit numbers.
(d) Describe the architecture of 8051 micro controller.

Q5 (a) Draw the architecture of 8051.
(b)Explain the addressing modes of 8051 micro controller
OR
(c) How the data Interpretation takes place and how the analysis is being done.
(d) Explain the Error analysis..

(PHY 2.1)

M.Sc. DEGREE EXAMINATION (2023 – 2024)
Second Semester
Physics

Core-I, STATISTICAL MECHANICS

Time: Three Hours Maximum: 70 marks

Answer the following

Q1) a) Explain the relation between statistical mechanics and thermodynamics

b) Explain different ensembles in statistical mechanics.

Or

c) State and prove Liouville's theorem.

d) Obtain the solution for equipartition energy theorem.

Q2) a) Obtain partition function for classical ideal gas in micro canonical ensemble.

b) Obtain the thermodynamic qualities for ideal monatomic gas.

Or

c) Explain about Gibb's paradox

d) How is it resolved?

Q3) a) Obtain Bose-Einstein distribution.

b) Discuss energy fluctuation in canonical ensemble.

Or

c) Obtain Fermi-Dirac distribution.

d) Derive partition function using Darwin-Fowler method.

Q4) a) Derive the expression for molecular partition function.

b) Derive the expression for translational partition function.

Or

c) Write notes on applications of vibrational partition function in solids.

d) Derive the expression for nuclear partition function.

Q5) a) Explain Landau diamagnetism.

b) Explain Brownian motion of a molecule.

Or

c) Write notes on white dwarf stars.

d) Obtain the expression for state of an ideal Fermi gas.

(PHY 2.2)

M.Sc. DEGREE EXAMINATION (2023 – 2024)
Second Semester
Physics
Core-II- Solid State Physics

Time: Three Hours Maximum: 70 marks

Answer the following

1) a) Explain different symmetry operations in crystal lattices.
b) Describe the fundamental type of three dimensional lattices.
Or
c) Derive the packing density of BCC and FCC structures.
d) Describe the structure of Diamond cubic structure.

2) a) State and explain Bragg's law.
b) Explain the powder method in the determination of crystal structure.
Or
c) Derive the equation for scattered wave amplitude.
b) Show that the reciprocal of bcc is fcc.

3) a) Discus vibrational modes of diatomic linear lattice.
b) Explain infrared absorption in ionic crystals.
Or
c) Derive the expression for Debye's theory of specific heat.
d) Explain origin of thermal expansion and obtain Gruneisen relation.

4) a) Describe the free electron gas in 3 dimensions.
b) Write a note on Fermi-Dirac distribution function and variation of Fermi function with temperature.
Or
c) Obtain the ratio of thermal to electrical conductivity.
d) State and explain Hall effect.

5) a) Discuss the origin of energy gap.
b) Explain motion of electron in periodic potential using Kronig-Penney method.
Or
c) Discuss the effective mass of an electron
d) Distinguish between metals, insulators and semiconductors basing on the band theory of solids.

(PHY 2.3)

M.Sc. DEGREE EXAMINATION (2023 – 2024)

Second Semester

Physics

CompulsoryFoundation –Quantum Dynamics and Scattering Theory

Time: Three Hours | Maximum: 70 marks

Answer the following

1. (a) State and explain Pauli's spin matrices.
   (b) Explain Clebsch-Gordan coefficients for $j_1 = \frac{1}{2}, j_2 = \frac{1}{2}$ and $j_1 = 1 , j_2 = \frac{1}{2}$

(Or)

   (c) Write Wigner –Eckart theorem.
   (d) Explain combination of two angular moment and tensor operator.

2. (a) Explain the application of Heisenberg picture to harmonic oscillator.
   (b) Discuss the correspondence between Heisenberg picture andSchrodinger picture.

(Or)

(c) Write the equation of motion in Schrodinger picture.
(d) Define various angular momentum operators and write their properties.

3. (a) Explain the indistinguishability of identical particles.
   (b) Discuss the quantum dynamics of identical particle systems.

(Or)

   (c) State and explain creation and annihilation operators.
   (d) Explain the state vector space for a system of identical particles.

4. (a) Discuss the scattering of wave packets.
   (b) Write Green's function in scattering theory.

(Or)

   (c) Discuss the criteria for the validity of Born approximation.
   (d) Explain the scattering from a square well potential.

5. (a) Explain the Born-Oppenheimer approximation.
(b) Discuss the Heitler-London method.

(Or)

(c) Briefly explain the valance band method.
(d) Write the introduction to molecular quantum mechanics.

(PHY 2.4 A)

M.Sc. DEGREE EXAMINATION (2023 – 2024)
Second Semester
Physics
Elective Foundation - COMPUTATIONAL METHODS AND PREOGRAMMING

Time: Three Hours   Maximum: 70 marks

Answer the following

1. (a) Explain Newton-Raphson Method for finding the roots of an equation.

   (b) Using Bisection Method find the root of the equation $x^3 - x^2 - 1 = 0$.

OR

   (c) Discuss the Gauss Elimination Method for solving a system of simultaneous linear equation.

   (d) Write algorithm for Gauss-Seidal Method.

2. (a) Explain Langrange's Interpolation Formula.

OR

   (b) Using Newton's Forward Interpolation Formula, find the value of y at x = 170.

x	100	150	200	250	300
y	10.63	13.03	15.04	16.81	18.42

   (c) Derive Trapezoidal rule.

3. (a) Discuss Assignment Statements in 'C' language.

   (b) Explain various data types.

OR

   (c) Explain different types of Operators in detail with examples.

4. (a) Explain IF-ELSE, WHILE, DO-WHILE, FOR, BREAK and CONTINUE with examples.

OR

   (b) Explain the form of user defined functions in 'C' languages.

   (c) Write a 'C' program for addition of tw3o matrices.

5. (a) Explain creating vectors matrix and array operations in MATLAB.

(b) Discuss about elementary mathematical functions with proper commands.

OR

(c) Perform the finding of eigen value and eigen vectors with the help of MATLAB.

(PHY 2.4 B)

M.Sc. DEGREE EXAMINATION (2023 – 2024)

Second Semester

Physics

Elective Foundation – MATLAB & Basic Python Programming

Time: Three Hours Maximum: 70 marks

Answer the following

1. (a) Explain Newton-Raphson Method for finding the roots of an equation.

(b) Using Bisection Method find the root of the equation $x^3 - x^2 - 1 = 0$.

OR

(c) Discuss the Gauss Elimination Method for solving a system of simultaneous linear equation.

(d) Write algorithm for Gauss-Seidal Method.

2. (a) Explain Langrange's Interpolation Formula.

OR

(b) Using Newton's Forward Interpolation Formula, find the value of y at x = 170.

x	100	150	200	250	300
y	10.63	13.03	15.04	16.81	18.42

(c) Derive Trapezoidal rule.

3. (a) Discuss Assignment Statements in 'C' language.

(b) Explain various data types.

OR

(c) Explain different types of Operators in detail with examples.

4. (a) Explain IF-ELSE, WHILE, DO-WHILE, FOR, BREAK and CONTINUE with examples.

OR

(b) Explain the form of user defined functions in 'C' languages.

(c) Write a 'C' program for addition of tw3o matrices.

5. (a) Explain creating vectors matrix and array operations in MATLAB.

(b) Discuss about elementary mathematical functions with proper commands.

OR

(c) Perform the finding of eigen value and eigen vectors with the help of MATLAB.

(PHY 2.4 C)

M.Sc. DEGREE EXAMINATION (2023 – 2024)
Second Semester
Physics
Elective Foundation – Non – Linear Optics

Time: Three Hours Maximum: 70 marks

Answer the following

1. (a) Explain Newton-Raphson Method for finding the roots of an equation.

   (b) Using Bisection Method find the root of the equation $x^3 - x^2 - 1 = 0$.

OR

   (c) Discuss the Gauss Elimination Method for solving a system of simultaneous linear equation.

   (d) Write algorithm for Gauss-Seidal Method.

2. (a) Explain Langrange's Interpolation Formula.

OR

   (b) Using Newton's Forward Interpolation Formula, find the value of y at x = 170.

x	100	150	200	250	300
y	10.63	13.03	15.04	16.81	18.42

   (c) Derive Trapezoidal rule.

3. (a) Discuss Assignment Statements in 'C' language.

   (b) Explain various data types.

OR

   (c) Explain different types of Operators in detail with examples.

4. (a) Explain IF-ELSE, WHILE, DO-WHILE, FOR, BREAK and CONTINUE with examples.

OR

   (b) Explain the form of user defined functions in 'C' languages.

   (c) Write a 'C' program for addition of tw3o matrices.

5. (a) Explain creating vectors matrix and array operations in MATLAB.

(b) Discuss about elementary mathematical functions with proper commands.

OR

(c) Perform the finding of eigen value and eigen vectors with the help of MATLAB.

(PHY 3.1)

M.Sc. DEGREE EXAMINATION (2023 – 2024)
Third Semester
Physics
Core-I, NUCLEAR AND PARTICLE PHYSICS

Time: Three Hours Maximum: 70 marks

Answer the following

Q1) a) Write the significance of magnetic dipole moment and electric quadrupole moment.

b) Explain the mass defect and binding energy of the nucleus.

Or

c) Discuss how the study of ground state of deuteron gives information on the strength of nuclear force.

d) Describe the characteristics of the nuclear force.

Q2) a) State and explain Weizsacker's semi-empirical mass formula.

b) Obtain the expression for Bohr- Wheeler theory of nuclear fission.

Or

c) Discuss how Fermi's theory can account for the β - decay.

d) Give an account of how parity violation in β - decay was accounted for.

Q3) a) Discuss the conservation laws of nuclear reactions and explain about nuclear kinematics.

b) Explain the Nuclear cross section

Or

c) What is nuclear reactor and explain types of reactors.

d) Explain the process of nuclear fusion and thermonuclear reactions.

Q4) a) With a neat diagram describe the working of a Cockcroft –Walton accelerator.

b) Explain the working of Van de Graff accelerator.

Or

c) Write about the Betatron accelerator.

d) Explain the working of Cyclotron accelerator.

Q5) a) Write about different particle interactions.

b) Discuss symmetries and conservation laws in particle physics.

Or

c) Explain the elementary ideas of CP and CPT invariance.

d) Explain the discovery of K-mesons and hyperons and write note on μ and π mesons.

(PHY 3.2)

M.Sc. DEGREE EXAMINATION (2023 – 2024)
Third Semester
Physics
Core-II, ADVANCED QUANTUM MECHANICS

Time: Three Hours | Maximum: 70 marks

Answer the following

1. (a) Explain the drawbacks of Klein-Gordon relativistic equation.
(b) Obtain Klein-Gordon equation in the presence of an electromagnetic field.
(Or)
(c) Explain what are theconstants of motion.
(d) Derive the relativistic Dirac equation for a free particle.

2. (a) Explain the spin of a Dirac's particle.
(b)What are Lorentz transformation and explain invariance of Dirac's equationunder Lorentz transformation
(Or)
(c) Describe the projection operators for energy and spin.
(d) Discuss the covariance of Dirac's equation.

3. (a) Obtain quantum equation of the field.
(b) Explain the Hamiltonian formulation of classical field.
(Or)
(c) Describe what is meant by second quantization.
(d) Explain what is meant by Schrodinger field.

4. (a) Discuss the Bethe's treatment of Lamb shift.
(b) Write the quantization of radiation field.
(Or)
(c) Explain briefly Thomson scattering.
(d) Discuss the quantization of radiation field.

5. (a) Explain Probability conservation in relativistic quantum mechanics.
(b) Write about the Zitterbewegung and negative-energy solutions.
(Or)
(c) Give an account of weak interaction and parity non conservation.
(d) Discuss the quantization of Dirac field.

(PHY 3.3 A)

M.Sc. DEGREE EXAMINATION (2023 – 2024)
Third Semester
Physics
Elective-I, CONDENSED MATTER PHYSICS-I

Time: Three Hours | Maximum: 70 marks

Answer the following

1. (a) Explain the formation and different lattice defects
   (b) Explain the formation of lattice defects in metals?
   Or
   (c) Discuss the Edge and screw dislocation?
   (d) Explain the Frank read mechanism in discolations?

2. (a) Explain optical and thermal electronic excitation in ionic crystals?
   (b) Explain the Ultraviolet spectrum of the alkali halides?
   Or
   (c) Explain the transformation of F centers into F_1 centers?
   (d) Explain the photoelectric effect in alkali halides?

3. (a) Explain about the Excitons?
   (b) Explain about photoconductivity with a simple model?
   Or
   (c) Explain about Luminescence and its types?
   (d) Explain about excitation and emission?

4. (a) What is a Semiconductor? Explain about the Intrinsic and Extrinsic semiconductors?
   (b) Explain the variation of Fermi level with respect to the temperature?
   Or
   (c) Explain about direct and indirect semiconductors?
   (d) Explain about the recombination of electron-hole pairs? Write about various recombination mechanisms?

5. (a) Discuss the Quantum theory of Para magnetism?
   (b) Write about Curie point and the exchange integral?
   Or
   (c) Explain about the Two-sub lattice model?
   (d) Explain super exchange interaction associated with Ferrimagnetism?

(PHY 3.3 B)

M.Sc. DEGREE EXAMINATION (2023 – 2024)
Third Semester
Physics
Elective-I, Nano Materials & Devices

Time: Three Hours Maximum: 70 marks

Answer the following

1. (a) Explain the formation and different lattice defects
   (b) Explain the formation of lattice defects in metals?
   Or
   (c) Discuss the Edge and screw dislocation?
   (d) Explain the Frank read mechanism in discolations?

2. (a) Explain optical and thermal electronic excitation in ionic crystals?
   (b) Explain the Ultraviolet spectrum of the alkali halides?
   Or
   (c) Explain the transformation of F centers into F_1 centers?
   (d) Explain the photoelectric effect in alkali halides?

3. (a) Explain about the Excitons?
   (b) Explain about photoconductivity with a simple model?
   Or
   (c) Explain about Luminescence and its types?
   (d) Explain about excitation and emission?

4. (a) What is a Semiconductor? Explain about the Intrinsic and Extrinsic semiconductors?
   (b) Explain the variation of Fermi level with respect to the temperature?
   Or
   (c) Explain about direct and indirect semiconductors?
   (d) Explain about the recombination of electron-hole pairs? Write about various recombination mechanisms?

5. (a) Discuss the Quantum theory of Para magnetism?
   (b) Write about Curie point and the exchange integral?
   Or
   (c) Explain about the Two-sub lattice model?
   (d) Explain super exchange interaction associated with Ferrimagnetism?

(PHY 3.3 C)

M.Sc. DEGREE EXAMINATION (2023 – 2024)
Third Semester
Physics
Elective-I, Applied Spectroscopy

Time: Three Hours | Maximum: 70 marks

Answer the following

1. (a) Explain the formation and different lattice defects
   (b) Explain the formation of lattice defects in metals?
   Or
   (c) Discuss the Edge and screw dislocation?
   (d) Explain the Frank read mechanism in discolations?

2. (a) Explain optical and thermal electronic excitation in ionic crystals?
   (b) Explain the Ultraviolet spectrum of the alkali halides?
   Or
   (c) Explain the transformation of F centers into F_1 centers?
   (d) Explain the photoelectric effect in alkali halides?

3. (a) Explain about the Excitons?
   (b) Explain about photoconductivity with a simple model?
   Or
   (c) Explain about Luminescence and its types?
   (d) Explain about excitation and emission?

4. (a) What is a Semiconductor? Explain about the Intrinsic and Extrinsic semiconductors?
   (b) Explain the variation of Fermi level with respect to the temperature?
   Or
   (c) Explain about direct and indirect semiconductors?
   (d) Explain about the recombination of electron-hole pairs? Write about various recombination mechanisms?

5. (a) Discuss the Quantum theory of Para magnetism?
   (b) Write about Curie point and the exchange integral?
   Or
   (c) Explain about the Two-sub lattice model?
   (d) Explain super exchange interaction associated with Ferrimagnetism?

M.Sc. DEGREE EXAMINATION (2023 – 2024)
Third Semester
Physics
Elective-II, CONDENSED MATTER PHYSICS-II

Time: Three Hours Maximum: 70 marks

Answer the following

1. (a) Explain the matrix representation of point groups?
(b) What are reducible and irreducible representations? Explain.

Or

(c) Write procedure for symmetry classification of molecules?
(d) Explain the great orthogonality theorem?

2. (a) Explain the concept of Crystal field theory?
(b) Explain the Free ion configurations?

Or

(c) Derive the free ion terms for d^1 configuration?
(d) Explain the Hund's rules?

3. (a)Write the crystal field potential for O_h field?
(b) Explain the construction of ligand field energy level diagram?

Or

(c) Write the electronic spectra for d^9 system?
(d) Explain the T-S diagram with example?

4. (a) Give macroscopic description of static dielectric constant?
(b) Explain about ion polarizabilities of molecules?

Or

(c) Derive the Classius-Mosetti equation?
(d) Briefly explain the complex dielectric constant and dielectric losses?

5. (a) What are Ferroelectric materials? Explain its properties?
(b)Write the dipole theory of ferroelectricity?

Or

(c) Explain the theory of spontaneous polarization of $BaTiO_3$?
(d) Write about the thermodynamics of ferroelectric transitions?

(PHY 3.4 B)

M.Sc. DEGREE EXAMINATION (2023 – 2024)
Third Semester
Physics
Elective-II, Sensors & Transducers

Time: Three Hours | Maximum: 70 marks

Answer the following

1. (a) Explain the matrix representation of point groups?
(b) What are reducible and irreducible representations? Explain.

Or

(c) Write procedure for symmetry classification of molecules?
(d) Explain the great orthogonality theorem?

2. (a) Explain the concept of Crystal field theory?
(b) Explain the Free ion configurations?

Or

(c) Derive the free ion terms for d^1 configuration?
(d) Explain the Hund's rules?

3. (a)Write the crystal field potential for O_h field?
(b) Explain the construction of ligand field energy level diagram?

Or

(c) Write the electronic spectra for d^9 system?
(d) Explain the T-S diagram with example?

4. (a) Give macroscopic description of static dielectric constant?
(b) Explain about ion polarizabilities of molecules?

Or

(c) Derive the Classius-Mosetti equation?
(d) Briefly explain the complex dielectric constant and dielectric losses?

5. (a) What are Ferroelectric materials? Explain its properties?
(b)Write the dipole theory of ferroelectricity?

Or

(c) Explain the theory of spontaneous polarization of $BaTiO_3$?
(d) Write about the thermodynamics of ferroelectric transitions?

M.Sc. DEGREE EXAMINATION (2023 – 2024)
Third Semester
Physics
Elective-II, Medical Physics

Time: Three Hours Maximum: 70 marks

Answer the following

1. (a) Explain the matrix representation of point groups?
(b) What are reducible and irreducible representations? Explain.

Or

(c) Write procedure for symmetry classification of molecules?
(d) Explain the great orthogonality theorem?

2. (a) Explain the concept of Crystal field theory?
(b) Explain the Free ion configurations?

Or

(c) Derive the free ion terms for d^1 configuration?
(d) Explain the Hund's rules?

3. (a)Write the crystal field potential for O_h field?
(b) Explain the construction of ligand field energy level diagram?

Or

(c) Write the electronic spectra for d^9 system?
(d) Explain the T-S diagram with example?

4. (a) Give macroscopic description of static dielectric constant?
(b) Explain about ion polarizabilities of molecules?

Or

(c) Derive the Classius-Mosetti equation?
(d) Briefly explain the complex dielectric constant and dielectric losses?

5. (a) What are Ferroelectric materials? Explain its properties?
(b)Write the dipole theory of ferroelectricity?

Or

(c) Explain the theory of spontaneous polarization of $BaTiO_3$?
(d) Write about the thermodynamics of ferroelectric transitions?

(PHY 4.1)

M.Sc. DEGREE EXAMINATION (2023 – 2024)
Fourth Semester
Physics
Core-I, Electromagnetic theory, Lasers and Modern Optics

Time: Three Hours Maximum: 70 marks

Answer the following

1) a) Obtain Maxwell's equations and derive Poynting's theorem

Or

b) Define skin depth and explain the reflection and refraction at the boundary of a dielectric interface.

2) a) Define retarded potential and obtain expression for radiation power from an oscillating electric dipole

Or

b) Write a note on Electric quadrupole and Derive Larmor's formula.

3) a) Explain the properties of lasers.
b) Obtain the relation between the coherence of the field and the size of the source.

Or

c) Explain the attainment of population inversion in three level lasers
d) Discuss the threshold condition of confinement of beam with in the resonator

4) a) What is harmonic generation? Explain second and third harmonic generation in non-linear optics.
b) What is optical mixing? Explain.

Or

c) Explain basic theory of Holography.
d) Discuss recording and reconstruction of Hologram.

5) a) Explain the concept of total internal reflection and explain fiber types.
b) Obtain modal equation.

Or

c) Derive wave equation for step indexed fibers
d) Explain Applications of optical fibers.

(PHY 4.2)

M.Sc. DEGREE EXAMINATION (2023 – 2024)
Fourth Semester
Physics
Core II, ATOMIC, MOLECULAR AND RESONANCE SPECTROSCOPY

Time: Three Hours Maximum: 70 marks

Answer the following

1. (a) Write the principle and working of atomic absorption spectroscopy?
   (b) Write the advantages of atomic absorption spectroscopy?

   Or

   (c) Write differences between Atomic absorption spectroscopy and Flame Emission spectroscopy?
   (d) Write the applications of atomic absorption spectroscopy?

2. (a) State and explain Beer's law? Explain the UV-VIS absorption?
   (b) With a neat block diagram, explain the working of UV-VIS spectrophotometer?

   Or

   (c) Explain the photomultiplier tubes and photosensitive detectors?
   (d) Write the relation between molecular structure and absorption spectrum?

3. (a) Write the principle and theory of Raman scattering?
   (b) Explain the Rotational Raman Spectra?

   Or

   (c) Write the principle and working of FTIR spectrometer?
   (d) Write the advantages of Fourier Transform Infrared over Infrared spectroscopy?

4. (a) Write the principle and working of NMR spectrometer?
   (b) Derive the solution for Bloch's equations?

   Or

   (c) What is EPR? Write the principle and conditions of EPR spectrometer?
   (d) Write the characteristics of g and A?

5. (a) What is NQR spectroscopy? Draw the block diagram of NQR spectrometer?
   (b) Give a brief account on Pulse method?

   Or

   (c) Explain the instrumentation of Photoelectron spectroscopy with block diagram?
   (d) Give a brief note on Chemical shift and Magnetic hyperfine interactions?

(PHY 4.3 A)

M.Sc. DEGREE EXAMINATION (2023 – 2024)
Fourth Semester
Physics
Elective-I, ADVANCES IN MATERIALS SCIENCE

Time: Three Hours Maximum: 70 marks

Answer the following

1) a) Explain in detail the classification of materials.

Or

b)Define glass transition and discuss the factors that determine glass transition temperature.

2) a)What are Implant materials? Explain the use of Ti and Ti based alloys in Implant materials.

Or

b)Discuss about the Soft tissue replacement Implants and Hard tissue replacement Implants.

3) a) What is meant by Liquid Crystal? Discuss different liquid crystalline phases and phase transitions.

Or

b) Discuss the Elastic Continuum theory. Mention few applications of liquid crystals.

4) a)Explainzero,one and two dimensional Nano materials. Discuss Quantum Confinement.

Or

b) Discuss some Chemical methods for the preparation of Nano materials.

5) a)Describe the synthesis and structure of C60.

Or

b) What are Carbon Nano tubes? Explain the Vibrational and Mechanical properties of CNTs.

(PHY 4.3 B)

M.Sc. DEGREE EXAMINATION (2023 – 2024)

Fourth Semester

Physics

Elective-I, Crystal growth and thin films

Time: Three Hours Maximum: 70 marks

Answer the following

1) a) Explain in detail the classification of materials.

Or

b)Define glass transition and discuss the factors that determine glass transition temperature.

2) a)What are Implant materials? Explain the use of Ti and Ti based alloys in Implant materials.

Or

b)Discuss about the Soft tissue replacement Implants and Hard tissue replacement Implants.

3) a) What is meant by Liquid Crystal? Discuss different liquid crystalline phases and phase transitions.

Or

b) Discuss the Elastic Continuum theory. Mention few applications of liquid crystals.

4) a)Explainzero,one and two dimensional Nano materials. Discuss Quantum Confinement.

Or

b) Discuss some Chemical methods for the preparation of Nano materials.

5) a)Describe the synthesis and structure of C60.

Or

b) What are Carbon Nano tubes? Explain the Vibrational and Mechanical properties of CNTs.

(PHY 4.3 C)

M.Sc. DEGREE EXAMINATION (2023 – 2024)
Fourth Semester
Physics
Elective-I, Solar Energy – Thermal and Photovoltaic Properties

Time: Three Hours | Maximum: 70 marks

Answer the following

1) a) Explain in detail the classification of materials.

Or

b)Define glass transition and discuss the factors that determine glass transition temperature.

2) a)What are Implant materials? Explain the use of Ti and Ti based alloys in Implant materials.

Or

b)Discuss about the Soft tissue replacement Implants and Hard tissue replacement Implants.

3) a) What is meant by Liquid Crystal? Discuss different liquid crystalline phases and phase transitions.

Or

b) Discuss the Elastic Continuum theory. Mention few applications of liquid crystals.

4) a)Explainzero,one and two dimensional Nano materials. Discuss Quantum Confinement.

Or

b) Discuss some Chemical methods for the preparation of Nano materials.

5) a)Describe the synthesis and structure of C60.

Or

b) What are Carbon Nano tubes? Explain the Vibrational and Mechanical properties of CNTs.

(PHY 4.4 A)

M.Sc. DEGREE EXAMINATION (2023 – 2024)
Fourth Semester
Physics
Elective-II, Advanced Condensed Matter Physics

Time: Three Hours Maximum: 70 marks

Answer the following

1. (a) Explain inelastic neutron scattering.
(b) Discuss lattice dynamics and optical properties of solids.
(Or)
(c) Discuss Inter atomic forces of lattice in nature.
(d) Write direct and indirect transitions.

2. (a) Briefly explain the crystal growth techniques.
(b) Discuss zone refining and and floating zone growth.
(Or)
(c) Describe the chemical vapour deposition method.
(d) Explain the molecular beam epitaxy (MOVPE) method.

3. (a) Write the optical properties of metals.
(b) Discuss the skin and anomalous skin effect.
(Or)
(c) Briefly explain the interaction of electrons with acoustic and optical phonons.
(d) Write about absorption in insulators.

4.(a) Discuss BCS theory of superconductivity.
(b) Briefly explain AC and DC Josephson effect.
(Or)
(c) Explain briefly Quantum tunneling.
(d) Write about type-I and type-II super conductors.

5. (a) Briefly explainthe data manipulation of diffracted X-rays.
(b) Discuss Scanning probe Microscopy.
(Or)
(c) Write about DSC measurements.
(d) Briefly explain Transmission Electron Microscopy.

(PHY 4.4 B)

M.Sc. DEGREE EXAMINATION (2023 – 2024)
Fourth Semester
Physics
Elective-II, Advanced Spectroscopy

Time: Three Hours   Maximum: 70 marks

Answer the following

1. (a) Explain inelastic neutron scattering.
(b) Discuss lattice dynamics and optical properties of solids.

(Or)

(c) Discuss Inter atomic forces of lattice in nature.
(d) Write direct and indirect transitions.

2. (a) Briefly explain the crystal growth techniques.
(b) Discuss zone refining and and floating zone growth.

(Or)

(c) Describe the chemical vapour deposition method.
(d) Explain the molecular beam epitaxy (MOVPE) method.

3. (a) Write the optical properties of metals.
(b) Discuss the skin and anomalous skin effect.

(Or)

(c) Briefly explain the interaction of electrons with acoustic and optical phonons.
(d) Write about absorption in insulators.

4.(a) Discuss BCS theory of superconductivity.
(b) Briefly explain AC and DC Josephson effect.

(Or)

(c) Explain briefly Quantum tunneling.
(d) Write about type-I and type-II super conductors.

5. (a) Briefly explainthe data manipulation of diffracted X-rays.
(b) Discuss Scanning probe Microscopy.

(Or)

(c) Write about DSC measurements.
(d) Briefly explain Transmission Electron Microscopy.

(PHY 4.4 C)

M.Sc. DEGREE EXAMINATION (2023 – 2024)
Fourth Semester
Physics
Elective-II, Photonics

Time: Three Hours | Maximum: 70 marks

Answer the following

1. (a) Explain inelastic neutron scattering.
(b) Discuss lattice dynamics and optical properties of solids.
(Or)
(c) Discuss Inter atomic forces of lattice in nature.
(d) Write direct and indirect transitions.

2. (a) Briefly explain the crystal growth techniques.
(b) Discuss zone refining and and floating zone growth.
(Or)
(c) Describe the chemical vapour deposition method.
(d) Explain the molecular beam epitaxy (MOVPE) method.

3. (a) Write the optical properties of metals.
(b) Discuss the skin and anomalous skin effect.
(Or)
(c) Briefly explain the interaction of electrons with acoustic and optical phonons.
(d) Write about absorption in insulators.

4.(a) Discuss BCS theory of superconductivity.
(b) Briefly explain AC and DC Josephson effect.
(Or)
(c) Explain briefly Quantum tunneling.
(d) Write about type-I and type-II super conductors.

5. (a) Briefly explainthe data manipulation of diffracted X-rays.
(b) Discuss Scanning probe Microscopy.
(Or)
(c) Write about DSC measurements.
(d) Briefly explain Transmission Electron Microscopy.