Anekant Education Society's

TULJARAM CHATURCHAND COLLEGE OF ARTS, SCIENCE AND COMMERCE, BARAMATI

(Autonomous Status)

(Affiliated to Savitribai Phule Pune University, Pune)

Faculty of Science

Department of Physics

Proposed Syllabus

For

M.Sc. in Physics

Semester-II

2019 PATTERN

From Academic Year 2019-2020

Anekant Education Society's

TULJARAM CHATURCHAND COLLEGE OF ARTS, SCIENCE AND COMMERCE, BARAMATI

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M. Sc. I

2019 Pattern

Semester-II Course Structure

Course Number	Course Code	Course Name	Credit
7	PHY4201	Physics of Semiconductor Devices	4
8	PHY4202	Atoms, Molecules & Laser	4
9	PHY4203	Quantum Mechanics-II	4
10	PHY4204	Electrodynamics	4
11	PHY4205	Electronics Laboratory-II	4
12	PHY4206	Basic Physics Laboratory-II	4
Total Credit			**24**

Programme Outcomes (POs)

PO1	**Disciplinary Knowledge:** Demonstrate comprehensive knowledge of the discipline that forms a part of a postgraduate Programme. Execute strong theoretical and practical understanding generated from the specific Programme in the area of work.
PO2	**Critical Thinking and Problem solving:** Exhibit the skill of critical thinking and understand scientific texts and place scientific statements and themes in contexts and also evaluate them in terms of generic conventions. Identify the problem by observing the situation closely, take actions and apply lateral thinking and analytical skills to design the solutions.
PO3	**Social competence:** Exhibit thoughts and ideas effectively in writing and orally; communicate with others using appropriate media, build effective interactive and presenting skills to meet global competencies. Elicit views of others, present complex information in a clear and concise way and help reach conclusions in group settings.
PO4	**Research-related skills and Scientific temper :** Infer scientific literature, build a sense of enquiry and able to formulate, test, Analyse, interpret and establish hypothesis and research questions; and to identify and consult relevant sources to find answers. Plan and write a research paper/project while emphasizing on academics and research ethics, scientific conduct and creating awareness about intellectual property rights and issues of plagiarism.
PO5	**Trans-disciplinary knowledge:** Create new conceptual, theoretical and methodological understanding that integrates and transcends beyond discipline-specific approaches to address a common problem.
PO6	**Personal and professional competence:** Perform independently and also collaboratively as a part of a team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self-motivation and adaptability skills and commit to professional ethics.
PO7	**Effective Citizenship and Ethics:** Demonstrate empathetic social concern and equity centered national development, and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.
PO8	**Environment and Sustainability:** Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
PO9	**Self-directed and Life-long learning:** Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

M. Sc-I (Physics) Semester-II

PHY4201: PHYSICS OF SEMICONDUCTOR DEVICES

Credit: 04 **No. of Lectures: 60**

Course outcomes:

Course outcomes: On successful completion of this course students will be able to do the following:

CO1: Utilize semiconductor models to analyze carrier densities and carrier transport.

CO2: The students should be able to understand and utilize the basic governing equations to analyze semiconductor devices.

CO3: The students should be able to understand and analyze the inner working of semiconductor p-n diodes, Schottky barrier diodes and new semiconductor devices.

CO4: The students should be able to explain how the metal-semiconductor contacts will occur.

CO5: The students should be able to discuss conduction in semiconductors – charge carriers, intrinsic/extrinsic, p-type, n-type.

CO6: The students should be able to know the physics of semiconductor junctions, metal-Semiconductor junctions and metal-insulator-semiconductor junctions.

CO7: Stay informed about recent advancements in semiconductor device technology.

Unit 1: Properties of Semiconductors **(15L)**

An introduction to semiconductors, their crystal structure and their band structure, Intrinsic and extrinsic semiconductors, Charge carriers and their effective masses. Carrier concentration at thermal equilibrium for intrinsic and doped semiconductors, Carrier energy distribution, applications of Fermi factor to semiconductors, Density of available states, Excess carriers, carrier transport phenomena, Recombination Process, Basic equation for semiconductor device operation.

Unit 2: PN Junction **(15L)**

Basic device technology, Depletion region and depletion capacitance, Current Voltage Characteristics: Ideal case, Shockley Equation, Generation recombination process. High injection condition, Diffusion capacitance, Narrow base diode, Junction breakdown.

Unit 3: Junction Transistor & Field Effect Devices **(15L)**

Formation of transistor, Basic current Voltage relationship, Current gain in transistor, Injection efficiency, base transport factor, Depletion layer and surface recombination, Static characteristics common base and common emitter configurations, Power transistor, General consideration, second breakdown switching transistor, Schottky diode, Semiconductor controlled rectifier, Basic characteristics static characteristics, Dynamic characteristics, Current limiter.

Unit 4: Metal Semiconductor & Metal Insulator Semiconductor Devices **(15L)**

Schottky effect, Energy Band relation at metal semiconductor contact, Ideal condition and surface states depletion Layer, General expression for barrier height Current, Transport Theory in Schottky barrier, Thermionic Emission Theory, Diffusion theory, Measurement of Schottky barrier height current voltage measurement, Forward characteristics, Reverse characteristics.

Reference Books:

1. Physics of Semiconductor Devices – S.M. Sze
2. Physics Solid State Devices – Streetman B.B.
3. Semiconductor Physics – Smith
4. Fundamentals of Semiconductor Devices – J. Lindmayer and C.Y. Wrigley
5. Physics of Semiconductor Devices – Michael shur
6. Introduction to Semiconductor devices – K.J.M. Rao

Mapping of Program Outcomes with Course Outcomes

Course Outcomes	Programme Outcomes								
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO9
CO 1	3			3					2
CO 2	3								
CO 3		3		2					
CO 4		3							
CO 5									
CO 6		3							
CO7				3					

Justification

PO1: Disciplinary Knowledge

CO1: Utilizing semiconductor models to analyze carrier densities and transport directly contributes to disciplinary knowledge in semiconductor physics. Weightage: 3

CO2: Understanding and utilizing basic governing equations to analyze semiconductor devices aligns with disciplinary knowledge. Weightage: 3

PO2: Critical Thinking and Problem Solving

CO3: Understanding and analysing the inner workings of semiconductor diodes and new devices involves critical thinking and problem-solving. Weightage 3

CO4: Explaining how metal-semiconductor contacts occur requires critical thinking and problem-solving skills. Weightage 3

CO6: Discussing conduction in semiconductors involves critical thinking and understanding of charge carriers. Weightage 3

PO4: Research-related Skills and Scientific Temper

CO1: Utilizing semiconductor models involves research-related skills. Weightage 3

CO3: Understanding and analysing the inner workings of semiconductor devices involves research-related skills. Weightage 2

CO7: Knowing the physics of semiconductor junctions involves research-related skills and scientific temper. Weightage 3

PO9: Self-directed and Life-long Learning

CO1: Utilizing semiconductor models contributes to the ability for self-directed and life-long learning. Weightage 2

M. Sc-I (Physics) Semester-II

PHY4202: ATOMS, MOLECULES & LASER

Credit: 04 **No. of Lectures: 60**

Course Outcomes: After completion of the course, the student should be able to:

CO1: Understand the concept of atomic spectra and their origin, spectral line, fine and hyperfine structure, Zeeman, Paschen and Stark effect.
CO2: To understand different types of coupling schemes, metastable state, types of pumping and different applications of laser.
CO3: Understand the principle of ESR, NMR and concept of Frank Condon principle.
CO4: Understand the working principle and applications of different types of lasers.
CO5: Study the basic principles of lasers, including population inversion, stimulated emission, and the concept of gain.
CO6: Understand different types of lasers and their applications in various fields.
CO7: Demonstrate qualitative problem – solving skills in all the topics covered.

Unit 1: Atoms **(15L)**

Introduction, Atomic structure and spectra, quantum states of an electron in an atom, [Exclusion principle and electronic configuration, electron spin, Hund's rule, Maximum multiplicity], Coupling scheme, origin of spectral lines, spectrum of He and alkali atoms, fine and hyperfine structure, isotropic shift, Zeeman and Paschen effect, Stark effect, Selection rule, Problem solving.

Unit 2: Molecules and Resonance Spectroscopy **(15L)**

Introduction, Origin of molecule spectra, Rotational and vibrational spectra for diatomic molecule, vibrational course structure, frank-condon principle, Born–Oppenheimer approximation, electron spectrum and Raman spectrum in diatomic molecule, Electron Spin Resonance (ESR) and Nuclear Magnetic Resonance (NMR) chemical shift , Problem solving.

Unit 3: Lasers. **(15L)**

Introduction, Basic of LASERs (Absorption, spontaneous & Stimulated emission, population inversion), metastable state, Types of Pumping, Gain, Einstein's coefficient, threshold condition, Rate equations for Two level, Three level and Four level laser, rate equation, Problem solving.

Unit 4: Lasers and its applications. **(15L)**

Introduction, Different types of lasers, He-Ne laser, CO_2 laser, Nd-YAG, Ruby, Excimer laser, Dye laser, semiconductor laser, Applications of Lasers , Industrial applications-Cutting, molding, melting, welding, drilling, Medical applications-Skin therapy, Laser eye surgery, Holography- principle & construction.

Reference Books

1. Molecular structure and spectroscopy, G. Aruldas
2. Fundamentals of molecular spectroscopy, Collin N, Banwell & Elaine M.
3. Atomic and molecular Physics, J. B. Rajam
4. Principles of Laser and their applications, Rhods
5. An introduction to laser theory and application, M. N. Avdhanulu-S. Chand Publication
6. Lasers, A. G. Sigman-Oxfaord University Press 1986.

Mapping of Program Outcomes with Course Outcomes

Course Outcomes	Programme Outcomes								
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO9
CO 1	3			2					2
CO 2	3								
CO 3	3			2					
CO 4									
CO 5									
CO 6		3							
CO7		3							

Justification

PO1: Disciplinary Knowledge

CO1: Understanding the concept of atomic spectra, origin of spectral lines, and various effects directly contributes to disciplinary knowledge in atomic and molecular physics. Weightage: 3

CO2: Describing the coupling scheme, metastable states, and applications of lasers directly aligns with disciplinary knowledge in laser physics. Weightage: 3

CO3: Understanding the concept of Frank Condon principle, ESR, NMR, etc., contributes to disciplinary knowledge in spectroscopy and magnetic resonance. Weightage: 3

PO2: Critical Thinking and Problem Solving

CO6: Demonstrating quantitative problem-solving skills in all the topics covered involves critical thinking and problem-solving. Weightage: 3

CO7: Problem-solving ability is a direct manifestation of critical thinking and problem-solving skills. Weightage: 3

PO4: Research-related Skills and Scientific Temper

CO1: Understanding atomic spectra and spectral effects involves research-related skills and scientific temper. Weightage: 2

CO3: Understanding principles in spectroscopy and magnetic resonance involves research-related skills and scientific temper. Weightage: 2

PO9: Self-directed and Life-long Learning

CO1: Understanding the concept of atomic spectra and spectral effects contributes to the ability for self-directed and life-long learning. Weightage: 2

M. Sc-I (Physics) Semester-II

PHY4203: QUANTUM MECHANICS II

Credit: 04 **Total No. of Lectures: 60**

Course outcomes:

After completion of the course, the student should be able to:
CO1.Understand the drawbacks of Classical Mechanics and necessity of Quantum Mechanics
CO2. Understand the behaviour of particles under Classical and Quantum conditions.
CO3. Understand the Operators in Quantum Mechanics.
CO4. Learn about Approximation Methods to solve problems.
CO5. Understand scattering of particle and symmetric and antisymmetric functions.
CO6. Perform calculations using angular momentum techniques.
CO7. Manipulate expressions using Dirac's notation.

Revision and general formalism:

Time-independent Perturbation theory: Non degenerate, degenerate, Introduction to Time-dependent Perturbation theory.

Unit 1: Approximation Methods II **(15 L)**

Introduction, Time dependent Perturbation theory: Transition amplitude, 1st and 2nd order, selection rules, Fermi's golden rule, Harmonic perturbation, dipole approximation, Einstein coefficient for spontaneous emission.

Variational method: Basic principles and application to hydrogen atom, helium atom, deuteron problem, Vander walls interaction.

WKB approximation: General formalism, Bound states for potential wells – with no rigid walls, with one rigid wall, with two rigid walls. Bohr's quantization condition, Application to tunneling, field emission

Unit 2: Theory of Scattering **(15 L)**

Introduction, Collisions in 3-D and scattering: Laboratory and CM reference frames; scattering amplitude, differential scattering cross section and total scattering cross section: scattering by spherically symmetric potentials, Method of partial waves, Phase shift, Ramsauer-Townsend effect, scattering by a perfectly rigid sphere and by square well potential, Yukawa potential. The Born approximation, Lippman-Schwinger equation, applications and validity of the Born approximation.

Unit 3: Symmetries in quantum mechanics and Identical Particles **(15 L)**

Conservation laws and degeneracy associated with symmetries; Continuous symmetries, space and time translations, rotations; Rotation group, homomorphism between SO (3) and SU (2); Explicit matrix representation of generators for j = $\frac{1}{2}$ and j = 1; Rotation matrices; Irreducible spherical tensor operators, Wigner-Eckart theorem; Discrete symmetries, parity and time reversal.

Identical Particles:

Meaning of identity and consequences, Symmetric and antisymmetric wave functions, Slater determinant, Symmetric and antisymmetric spin wave functions of two identical particles, Collisions of identical particles, Pauli's exclusion principle and Slater determent.

Unit 4: Relativistic Quantum Mechanics **(15 L)**

Klein-Gordon equation, Feynman-Stuckelberg interpretation of negative energy states and concept of antiparticles, Dirac equation, covariant form, adjoint equation, Plane wave solution and momentum space spinors, Spin and magnetic moment of the electron, Non relativistic reduction, Helicity and chirality, Properties of γ matrices, Charge conjugation, Normalisation and completeness of spinors.

What NEXT with Quantum Mechanics? : Anti communication numbers, Quantisation of electromagnetic field, 'reverse time' using algorithm on a computer, past and future.

Reference Books:

1. Quantum Mechanics by Nouredine Zettili, A John Wiley and Sons, Ltd.
2. Modern Quantum Mechanics by J. J. Sakurai.
3. A Text-book of Quantum Mechanics by P. M. Mathews and K. Venkatesan.
4. Quantum mechanics by A. Ghatak and S. Lokanathan.
5. Quantum Mechanics by L. I. Schiff.
6. Quantum Physics by R. Eisberg and R. Resnick.
7. Introduction to Quantum Mechanics by by David J. Griffiths.
8. Introductory Quantum mechanics by Granier, Springer Publication.
9. Introductory Quantum Mechanics by Li boff, 4th Edition, Pearson Education Ltd.
10. Principles of Quantum Mechanics by Shankar R. IInd Edition (Plenum, 1994).

Mapping of Program Outcomes with Course Outcomes

Course Outcomes	Programme Outcomes								
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO9
CO 1	3				2				2
CO 2		3							
CO 3			3	3					
CO 4			3	3					
CO 5									
CO 6		3							
CO7		3							

Justification

PO1: Disciplinary Knowledge

CO1: Applying non-relativistic quantum mechanics for further studies in theoretical physics and nanotechnology directly contributes to disciplinary knowledge in quantum mechanics and its applications. Weightage: 3

PO2: Critical Thinking and Problem Solving

CO2: Applying variational methods, time-independent perturbation theory, and time-dependent perturbation theory to solve problems involves critical thinking and problem-solving skills. Weightage: 3

CO6: Problem-solving ability directly aligns with critical thinking and problem-solving skills. Weightage: 3

CO7: Critical thinking is explicitly mentioned as a course outcome. Weightage: 3

PO4: Research-related Skills and Scientific Temper

CO3: Understanding and learning theoretical aspects at the quantum level involves research-related skills and scientific temper. Weightage: 3

CO4: Knowing more about the insight of the microscopic world involves research-related skills and scientific temper. Weightage: 3

PO5: Trans-disciplinary Knowledge

CO1: Applying non-relativistic quantum mechanics for further studies in nanotechnology contributes to trans-disciplinary knowledge. Weightage: 2

PO9: Self-directed and Life-long Learning

CO1: Applying general experience with non-relativistic quantum mechanics for further studies contributes to the ability for self-directed and life-long learning. Weightage: 2

M. Sc-I (Physics) Semester-II

PHY4204: ELECTRODYNAMICS

Credit: 04 **No. of Lectures: 60**

Course Outcomes:

On successful completion of this course students will be able to do the following

CO1: Understand the concept of multipole expansions and deeper meaning of Maxwell's equations.

CO2: Understand the technique of deriving formulae for the electromagnetic waves in stationary and conducting medium.

CO3: Calculate the electromagnetic radiations from moving charges, considering retardation effects and make a detailed account for Gauge transformations.

CO4: Embracing the concepts of special relativity as emerged through the laws of electrodynamics.

CO5: To formulate and solve the electromagnetic problems skills In all the topics covered. CO6**:** Explain classical electrodynamics based on Maxwell's equations including its formulation in covariant form.

CO7**:** Solve problems involving the calculation of fields, the motion of charged particles and the production of electromagnetic waves; and

CO8**:** Analyse the solution of these problems in the context of a range of applications.

CO9**:** Problem Solving Ability

Unit 1: Multiple Expansions and Time Varying Fields (15 L)

Multiple expansions for a localized charge distribution in free space, linear quadrapole potential and field, static electric and magnetic fields in material media, boundary conditions, Time dependent fields, Faraday's law for stationary and moving media, Maxwell's displacement current, differential and integral forms of Maxwell's equations, Maxwell's equations for moving medium.

Unit 2: Energy, Force, Momentum Relations and Electromagnetic Wave Equations (20 L)

Energy relations in quasi-stationary current systems, Magnetic interaction between two current loops, Energy stored in electric and magnetic fields, Poynting's theorem, General expression for electromagnetic energy, Electromagnetic wave equations, Electromagnetic plane waves in stationary medium, Reflection and refraction of electromagnetic waves at plane boundaries (Oblique incidence), Electromagnetic waves in conducting medium, Skin effect and skin depth, wave guides , Dispersion relations(solid, liquid, gas)

Unit 3: Inhomogeneous Wave Equations (15 L)

Inhomogeneous wave equations, Lorentz's and Coulomb's gauges, Gauge transformations, Wave equations in terms of electromagnetic potentials, D'Alembertian operator, Hertz potential and its use in computation of radiation fields. Radiation from moving charges, radiation from a dipole.

Unit 4: Relativistic Mechanics and Covariance (10 L)

Galilean Transformation, Lorentz transformations, Relativistic velocity addition, Minkowski's space-time diagram, Four vector potential, electromagnetic field tensor, Lorentz force on a charged particle.

References:

1) Introduction to Electrodynamics, (3rd Edition) by David J. Griffith Publication: Prentice-Hall of India, New Delhi.
2) Introduction to Electrodynamics, by A.Z. Capri and P.V. Panat Narosa Publishing House.
3) Foundations of Electromagnetic theory by Reitz & Milford, World student series Edition.
4) Classical Electrodynamics, by J.D. Jackson, 3rd Edition John Wiley.
5) Electromagnetic theory and Electrodynamics by Satya Prakash, Kedar Nath and Co- Meerut.
6) Electromagnetics by B.B. Laud, Willey Eastern.
7) Matrices and Tensors in Physics by A. W. Joshi, 3rd Edition, New Age International.
8) Electrodynamics by Kumar Gupta and Singh.
9) Electromagnetic Theory by Umesh Sinha, Satya prakashan tech. India Publication.

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Course Outcomes	Programme Outcomes								
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO9
CO 1	3			2					2
CO 2		3							
CO 3				3					
CO 4					3				
CO 5		3							
CO 6		3							
CO7									

Justification

PO1: Disciplinary Knowledge

CO1: Understanding the concept of multipole expansions and the deeper meaning of Maxwell's equations directly contributes to disciplinary knowledge in electromagnetism and theoretical physics. Weightage: 3

PO2: Critical Thinking and Problem Solving

CO2: Understanding the technique of deriving formulae for electromagnetic waves involves critical thinking and problem-solving skills. Weightage: 3

CO5: Solving problems involving the calculation of fields, the motion of charged particles, and the production of electromagnetic waves directly aligns with critical thinking and problem-solving skills. Weightage: 3

CO6: Analysing the solution of problems in the context of a range of applications involves critical thinking and problem-solving. Weightage: 3

PO4: Research-related Skills and Scientific Temper

CO1: Understanding the concept of multipole expansions involves research-related skills and scientific temper. Weightage: 2

CO3: Calculating electromagnetic radiations from moving charges, taking into account retardation effects, and accounting for Gauge transformations involves research-related skills and scientific temper. Weightage: 3

PO5: Trans-disciplinary Knowledge

CO4: Embracing the concepts of special relativity as emerged through the laws of electrodynamics contributes to trans-disciplinary knowledge in physics and relativity. Weightage: 3

PO9: Self-directed and Life-long Learning

CO1: Understanding the concept of multipole expansions contributes to the ability for self-directed and life-long learning. Weightage: 2.

M. Sc-I (Physics) Semester-II

PHY4205: ELECTRONICS LABORATORY-II

Credits: 04

Course outcomes: After completion of the course, the student should be able to:
CO1: Understand mathematical description and representation of continuous and discrete time signals and systems.
CO2: Understand and resolve the signals in frequency domain using Fourier series and Fourier transforms.
CO3: Understand the limitations of Fourier transform and need for Laplace transform and develop the ability to analyze the system in s-domain.
CO4: Understand the basic concept of probability, random variables & random signals and develop the ability to find correlation, CDF, PDF and probability of a given event.
CO5: Comply and verify parameters after exciting devices by any stated method.
CO6: Implement circuit and test the performance.
CO7: Design and analyze circuits.
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(Students must perform Any 10 Experiments)

1. Precision rectifier.
2. Frequency to voltage converter using OP-AMP.
3. Sample and hold circuits.
4. Shift Register using 7495.
5. Class-B push pull amplifier using Dual power supply and OP-AMP.
6. Fold back power supply.
7. Design, built and test oscillator-phase shift oscillator.
8. Study of voltage controlled oscillator using IC-566.
9. Frequency multiplier using PLL-565.
10. CVCC using OP-AMP.
11. Study of multiplexer and Demultiplexer.
12. Frequency modulation and demodulation.
13. Pulse code modulation and demodulation.
14. FSK modulation and demodulation.
15. 8-bit ADC.
16. Design, built and test oscillator – LC oscillator

Mapping of Program Outcomes with Course Outcomes

Course Outcomes	Programme Outcomes								
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO9
CO 1	3								
CO 2		3							
CO 3									
CO 4				3					2
CO 5				3					
CO 6		3							
CO7		3							

Justification

PO1: Disciplinary Knowledge

CO1: Analyzing the characteristics of electronic devices aligns directly with disciplinary knowledge in electronics and electrical engineering. Weightage: 3

PO2: Critical Thinking and Problem Solving

CO2: Learning about operation amplifiers and their applications involves critical thinking and problem-solving skills. Weightage: 3

CO6: Problem-solving ability directly aligns with critical thinking and problem-solving skills. Weightage: 3

CO7: Critical analysis involves critical thinking and aligns with problem-solving skills. Weightage: 3

PO4: Research-related Skills and Scientific Temper

CO4: Designing experiments using hardware and software involves research-related skills and scientific temper. Weightage: 3

CO5: Implementing circuits and testing performance requires research-related skills and scientific temper. Weightage: 3

PO9: Self-directed and Life-long Learning

CO4: Designing experiments using hardware and software contributes to the ability for self-directed and life-long learning. Weightage: 2

M. Sc-I (Physics) Semester-II

PHY4206: BASIC PHYSICS LABORATORY-II

Credits: 04

Course outcomes: After completion of the course, the student should be able to:
CO1: The students would be able to have strong foundation knowledge and comprehend the basic concepts and principles in Physics.
CO2: The students would be able to experience a well-resourced environment for learning Physics
CO3: To motivate and inspire the students to create deep interest in Physics, to develop broad and balanced knowledge and understanding of physical concepts, principles and theories of Physics.
CO4: Learn, design and perform experiments in the labs to demonstrate the concepts, principles and theories learned in the classrooms.
CO5: Develop the ability to apply the knowledge acquired in the classroom and laboratories to specific problems in theoretical and experimental Physics.
CO6: Emphasize the discipline of Physics to be the most important branch of science for
CO7: Problem Solving

(Students have to perform Any 10 Experiments)

1. Skin depth in Al using electromagnetic radiation.
2. Franck – Hertz Experiment.
3. Thermionic Emission.
4. Electron Spin Resonance (ESR).
5. Study of Hysteresis (B-H curve)
6. Ionic Conductivity of NaCl.
7. Zeeman Effect.
8. Study of electromagnetic damping
9. Study of the characteristics of a laser beam (Beam Divergence).
10. Determination of wavelength of He-Ne LASER by Reflection grating
11. Energy gap of semiconductor.
12. e/m by Thomson’s method
13. Measurement of the focal length of a given convex lens using a laser.
14. Determination of wavelength of He-Ne LASER by transmission grating
15. Determination of Polarisation
16. G.M. counter: Determination of dead time of GM tube by Double source method

Mapping of Program Outcomes with Course Outcomes

Course Outcomes	Programme Outcomes								
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO9
CO 1	3								
CO 2		3							
CO 3			3	3					
CO 4				3					2
CO 5				3					
CO 6		3							
CO7		3							

Justification

PO1: Disciplinary Knowledge

CO1: Deciding which data to collect and which variables to vary is an essential part of acquiring disciplinary knowledge in experimental design and data analysis. Weightage: 3

PO2: Critical Thinking and Problem Solving

CO2: Analysing data using computational methods involves critical thinking and problem-solving skills. Weightage: 3

CO6: Problem-solving ability directly aligns with critical thinking and problem-solving skills. Weightage: 3

CO7: Critical analysis involves critical thinking and aligns with problem-solving skills. Weightage: 3

PO3: Social Competence

CO3: Demonstrating skills and competencies to conduct a wide range of scientific experiments contributes to social competence through collaborative and hands-on learning. Weightage: 3

PO4: Research-related Skills and Scientific Temper

CO3: Conducting a wide range of scientific experiments involves research-related skills and scientific temper. Weightage: 3

CO4: Learning, designing, and performing experiments in the labs to demonstrate concepts involve research-related skills and scientific temper. Weightage: 3

CO5: Developing the ability to apply knowledge to specific problems in theoretical and experimental physics involves research-related skills and scientific temper. Weightage: 3

PO9: Self-directed and Life-long Learning

CO4: Learning, designing, and performing experiments in the labs contributes to the ability for self-directed and life-long learning. Weightage: 2