

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 Submitted to BoS

For

M.Sc. in Physics

Semester-II

From Academic Year

2022-2023

Anekant Education Society's
TULJARAM CHATURCHAND COLLEGE OF ARTS, SCIENCE AND COMMERCE, BARAMATI
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M.Sc.-I

Semester-II

Course Structure

Course Number	Course Code	Course Name	Credit
7	PSPH 121	Physics of Semiconductor Devices	4
8	PSPH 122	Atoms, Molecules & Laser	4
9	PSPH 123	Quantum Mechanics-II	4
10	PSPH 124	Classical Electrodynamics	4
11	PSPH 125	Electronics Laboratory-II	4
12	PSPH 126	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.

SYLLABUS (CBCS) FOR M.Sc. PHYSICS (W.E.F. June 2022)

Academic Year 2022-2023

M. Sc-I (Physics) Semester-II

PSPH 121: Physics of Semiconductor Devices

Credit: 04

Total No. of Lectures: 60

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

(1 Credit)

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

(1 Credit)

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: Metal–Semiconductor and Semiconductor Heterojunctions Devices

(1 Credit)

The Schottky Barrier Diode, Qualitative Characteristics, Ideal Junction Properties, Nonideal Effects on the Barrier Height, Current–Voltage Relationship, Comparison of the Schottky Barrier Diode and the P-N Junction Diode, Metal–Semiconductor Ohmic Contacts, Ideal Nonrectifying Barrier, Tunneling Barrier, Specific Contact Resistance, Heterojunctions Heterojunction Materials, Energy-Band Diagrams, Current–Voltage Characteristics

Unit 4: Metal Insulator Semiconductor Devices**(1 Credit)**

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

Reference Books:

1. Physics of Semiconductor Devices – S.M. Sze
2. Physics Solid State Devices – Streetman B.B.
3. Semiconductor Physics and Devices- Donald A Neamen 4e
4. Semiconductor Physics – Smith
5. Fundamentals of Semiconductor Devices – J. Lindmayer and C.Y. Wrigley
6. Physics of Semiconductor Devices – Michael shur
7. 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
PSPH 122: Atoms, Molecules & Laser

Credit: 04

Total 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

(1 Credit)

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

(1 Credit)

Bonding mechanism in molecules, Molecular orbital methods, Valence band method, Molecular Spectra – Rotational and vibrational spectra for diatomic molecules, Electronics spectra of diatomic molecules, vibration course structure, vibrational analysis of band system, Frank – Condon principle, Dissociation energy and dissociation products, rotational fine structure of electronic vibration transitions, electronic angular momentum in diatomic molecules, Problem solving.

Unit 3: Resonance Spectroscopy

(1 Credit)

(a)ESR- Principles of ESR, ESR spectrometer, total Hamiltonian, hyperfine structure.

(b)NMR-Magnetic properties of nucleus, resonance condition, NMR instrumentation, relaxation process, chemical shift, applications of NMR.

Unit 4: Lasers and its applications.**(1 Credit)**

Introduction, Basic of LASERs (Absorption, spontaneous & Stimulated emission, population inversion), metastable state, Types of Pumping, Gain, Einstein's coefficient, threshold condition, Different types of lasers, He-Ne laser, CO₂ laser, Nd-YAG, Ruby, Excimer laser, Dye laser, semiconductor laser, Applications of Lasers: 1. Industrial applications- Cutting, molding, melting, welding, drilling, 2. Medical applications-Skin therapy, Laser eye surgery, 3. Holography- principle & construction, Problem solving.

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-Oxford University Press 1986.
7. An Introduction to Lasers Theory and Applications, M N Avadhanulu

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
PSPH 123: 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.

Unit 1: Approximation Methods **(1 Credit)**

Revision: Time-independent Perturbation theory: Nondegenerate, degenerate.

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.

Unit 2: Variational method and WKB approximation: **(1 Credit)**

Basic principles and application to hydrogen atom, helium atom.

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, Tunnelling through a potential barrier, Problems.

Unit 3: Theory of Scattering **(1 Credit)**

Introduction, Introduction to 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, applications, and validity of the Born approximation.

Unit 4: Symmetry in Quantum Mechanics **(1 Credit)**

Symmetry Parity, Identical particles, 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 determinant.

Introduction to DFT (Density Functional Theory)

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	PO 8	PO 9
CO 1	3				2				2
CO 2		3							
CO 3			3	3					
CO 4			3	3					
CO 5									
CO 6		3							
CO 7		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
PSPH 124: Classical Electrodynamics

Credit: 04

Total 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 : Electromagnetic Theory

(1 Credit)

Coulomb's law, like and unlike charges, resolution of vectors, buoyance force, combination of forces, system of charges in equilibrium, coulomb's force and SHM, Regular polygon on n side, continuous charge distribution, problems

Unit 2 : Electric field

(1 Credit)

Electric field, Circular ring, thin rod, circular disc, cylinder, electric field by coulomb's force, simple pendulum, electric field by coulomb's law, discrete charges and combination of charges, electric field by circular ring, circular disc, gauss law, hollow sphere, circular sphere, solid sphere, solid cylinder, nonuniform charges distribution, problems.

Unit 3 : Electric potential and method of images (1 Credit)

Electric potential, point charges, circular ring, circular disc, electric potential due to hollow sphere, solid sphere non uniform charge distribution, spherical charge distribution, conducting plane, conducting sphere, application, work done, work energy theorem, problems.

Unit 4 : Poisson, Laplace equation and magneto statistic (1 Credit)

Poisson equation, Laplace equation, electric field due to conductor, Cartesian, cylindrical, spherical, single variable, application of Laplace, problems. Biot-savart law, magnetic field due to straight current carrying wire, straight wire, infinite wire at one end, direction of magnitude, due to segment of circular wire, applications, closed polygon, hexagon, n side polygon, amperes law

problems.

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.

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					
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
PSPH 125: Electronics Laboratory-II

Credits: 04

No of Practicals:10

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.

(Students must perform Any 8 Experiments)

1. Op-amp as a 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. Crystal oscillator- Millar type.
11. Study of multiplexer and Demultiplexer.
12. Analog to Digital Converter (8-bit).
13. Instrumental amplifier using three op-amps
14. Diode pump using UJT.
15. Digital to Analog Converter (Binary Weighted Type)

Additional Activity (Any one Activity equivalent to two experiments)

Students must perform at least one additional activity out of two activities in addition to eight experiments mentioned above. Total Laboratory work with additional activities should be equivalent to ten experiments.

1. Simulation/Demonstration/Mini Project

2. Industrial Visit / Study Tour / Field visit

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

PSPH-126: Basic Physics Laboratory-II

Credits: 04

No of Practicals:10

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 must perform Any 8 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. Determination of Rydberg constant.
9. Study of electromagnetic damping
10. Study of the characteristics of a laser beam (Beam Divergence).
11. Determination of wavelength of He-Ne LASER by Reflection grating
12. Energy gap of semiconductor.
13. e/m by Thomson's method
14. Optical activity of Sugar solution using Polarimeter.
15. G.M. counter: Determination of dead time of GM tube by Double source method

Additional Activity (Any one Activity equivalent to two experiments)

Students must perform at least one additional activity out of two activities in addition to eight experiments mentioned above. Total Laboratory work with additional activities should be equivalent to ten experiments.

1. **Simulation/Demonstration/Mini Project**
2. **Industrial Visit / Study Tour / Field visit**

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	PO 8	PO 9
CO 1	3								
CO 2		3							
CO 3			3	3					
CO 4				3					2
CO 5				3					
CO 6		3							
CO 7		3							

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