SYLLABUS

for

Semester II

Program: M. Sc.

Course: Physics

Effective from

Academic Year

2026-27

M. Sc. (Physics) SEMESTER II

COURSE NAME: Classical Electrodynamics

COURSE CODE: PHYMSC-S2P4-4CR26 [CREDITS - 04]

CC IV	Course Code: PHYMSC-S2P4-4CR26	
Course Learning Outcomes		
After the successful completion of the course, the learner will be able to • perform multipole expansion of potential due to localized charge distributions • solve the problems of scalar and vector potential under different gauges • analyse the behaviour of electromagnetic wave to different waveguides • apply the concepts of electromagnetic waves to real life problems • explain power radiated by a point charge, electric dipole radiation, magnetic dipole radiation • design different antenna using the theory of radiations.		
Unit I	**Multipole Expansion, Potentials and Fields**	**[15L]**
Learning Objective This unit is intended to • establish the method of multipole expansions of scalar potential • develop the theoretical backgrounds of gauge transformation, retarded potential and Lienard-Wiechert potentials.		
Learning Outcomes: At the end of this unit, the learner will be able to • analyse the physical effects due to localized charge distributions • implement the methods of different gauges.		
1.1	Multipole expansions for a localised charge distribution in free space, linear quadrupole potential and field, static electric and magnetic fields in material media, Boundary conditions.	**[9L]**
1.2	Scalar and vector potentials, Gauge transformations, Coulomb and Lorentz gauge, Retarded potentials and Lienard-Wiechert potentials.	**[6L]**
Unit II	**Electromagnetic Waves 1**	**[15L]**
Learning Objective This unit is intended to • develop the basic knowledge of waves • familiarize the students with the basic terms associated an electromagnetic wave, such as velocity, energy and momentum etc.		
Learning Outcomes: At the end of this unit, the learner will be able to • apply the wave theory to longitudinal and transverse waves		

• implement wave theory to electromagnetic waves.		
2.1	Waves in one dimension: the wave equation, sinusoidal waves, boundary conditions: reflection and transmission, polarization.	**[8L]**
2.2	electromagnetic waves in vacuum: the wave equation for E and B, monochromatic plane waves, energy and momentum in electromagnetic waves.	**[7L]**
Unit III	**Electromagnetic Waves 2**	**[15L]**
Learning Objective This unit is intended to • explain the nature of electromagnetic field travelling in different media.		
Learning Outcomes: At the end of this unit, the learner will be able to • investigate the nature of electromagnetic field travelling in different media in terms of various physical aspects • apply the concepts of electromagnetic wave to different waveguides.		
3.1	Electromagnetic waves in matter: propagation in linear media, reflection and transmission at normal incidence, reflection and transmission at oblique incidence.	**[7lL**
3.2	Absorption and dispersion: electromagnetic waves in conductors, reflection at a conducting surface, the frequency dependence of permittivity, wave guides: waves in a rectangular wave guide.	**[8L]**
Unit IV	**Radiation**	**[15L]**
Learning Objective This unit is intended to • give the students the basics of radiation theory.		
Learning Outcomes: At the end of this unit, the learners will be able to 3. explain power radiated by a point charge, electric dipole radiation, magnetic dipole radiation. 4. design different antenna using the theory of radiations.		
4.1	What is radiation? electric dipole radiation, magnetic dipole radiation, radiation from an arbitrary source, power radiated by a point charge, radiation reaction.	**[6L]**
4.2	Radiation from external sources, electric dipole radiations, magnetic dipole and electrical quadrupole radiation, center-fed linear antenna, Hertzian dipole antenna, Rayleigh scattering at long wavelength and blueness of sky, scalar diffraction theory.	**[9L]**
References:		

- Classical electrodynamics by J. D. Jackson, 3rd Ed., Wiley Student Ed., 2009.
- Introduction to Electrodynamics by David J. Griffiths, 4th Ed., PHI, 2017.
- Electromagnetics by B. B. Laud, 2nd Ed., New Age International Publication, 2006.
- Electrodynamics by Gupta, Kumar and Singh, Pragati Prakashan, 14th Ed., 2019.
- Classical Electrodynamics by Griener, 1st Ed., Springer Verlag, New York, 1998.

Note: Each unit carries equal weightage of total marks of the course.

Question Paper Template

Unit	Remembering/ Knowledge (1)	Understanding (2)	Applying (3)	Analysing (4)	Evaluating (5)	Creating (6)	Total marks
I	40%	40%	10%	10%	-	-	100 %
II	40%	40%	10%	10%	-	-	100 %
III	40%	40%	10%	10%	-	-	100 %
IV	40%	40%	10%	10%	-	-	100 %

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
• perform multipole expansion of potential due to localized charge distributions	√	√		√		
• solve the problems of scalar and vector potential under different gauges	√	√		√		
• analyse the behaviour of electromagnetic wave to different waveguides	√					
• apply the concepts of electromagnetic waves to real life problems	√	√		√		
• explain power radiated by a point charge, electric dipole radiation, magnetic dipole radiation	√					
• design different antenna using the theory of radiations	√	√		√	√	

M. Sc. (Physics) SEMESTER II

COURSE NAME: Quantum Mechanics-I

COURSE CODE: PHYMSC-S2P5-4CR26 [CREDITS - 04]

CC V	Course Code: PHYMSC-S2P5-4CR26

Course Learning Outcomes

At the end of this course, learners will be able to

- implement basics postulates of quantum mechanics to quantum systems
- estimate the expectation value of physical observables
- connect the quantum mechanics to classical mechanics
- solve one dimensional problems in quantum mechanics
- solve three dimensional problems in quantum mechanics
- represent the orbital angular momentum operator in matrix form
- determine the eigen values and eigen functions of L_z and L^2.

Unit I	Postulates of Quantum Mechanics	[15L]

Learning Objective:

This unit is intended to

- introduce basic postulates of quantum mechanics to students
- make students familiarize the terms used in quantum mechanics such as probability density, superposition principle, observables, expectation value, stationary states etc.
- build bridge between quantum mechanics and classical mechanics.

Learning Outcomes:

At the end of this unit, the learner will be able to

- apply basics postulates of quantum mechanics to quantum systems
- determine the eigen value and eigen function of an observable and estimate its expectation value
- relate the quantum mechanical solution to classical solution of a physical system.

1.1	Basic postulates of quantum mechanics, the state of a system: probability density, the superposition principle, observables and operators, measurement in quantum mechanics: how measurements disturb systems, expectation values, Complete Sets of Commuting Operators (CSCO), measurement and the uncertainty relations, time evolution of the system's state: time evolution operator, stationary states: time-independent potentials, Schrodinger equation and wave packets, the conservation of probability, time evolution of expectation values, symmetries and conservation laws: infinitesimal unitary transformations, finite unitary transformations, symmetries and conservation laws,	**[11L]**

1.2	Connecting Quantum to Classical Mechanics: Poisson brackets and commutators, Ehrenfest theorem, Quantum Mechanics and Classical Mechanics.	**[4L]**
Unit II	**One-dimensional Problems**	**[15L]**
Learning Objective: This unit is intended to • illustrate methods to solve one dimensional problems using Schrodinger equation. • familiarize students with the concepts of quantization of energy.		
Learning Outcomes: At the end of this unit, the learner will be able to • solve one dimensional problems using Schrodinger equation. • analyse the quantum solution and compare the solution to classical solution.		
2.1	Properties of one-dimensional motion: discrete spectrum, continuous spectrum (unbound states), mixed spectrum, symmetric potentials and parity, the free particle: continuous states, the potential step, the potential barrier and well: the case $E > V_o$, the case $E < V_o$, the tunnelling effect.	**[9L]**
2.2	The harmonic oscillator: energy eigen values, energy eigen states, energy eigen states in position space, the matrix representation of various operators, expectation values of various operators.	**[6L]**
Unit III	**Three Dimensional Problems**	**[15L]**
Learning Objective: This unit is intended to • illustrate methods to solve three dimensional problems using Schrodinger equation. • familiarize students the concepts of quantization of energy in 3-D problems.		
Learning Outcomes: At the end of this unit, the learner will be able to • solve three dimensional problems using Schrodinger equation. • analyse quantum solution and compare the solution to classical solution for 3-D problems.		
3.1	3-D problems in cartesian coordinates: general treatment; separation of variables, the free particle, the box potential, harmonic oscillators.	**[7L]**
3.2	3-D problems in spherical coordinates: central potential: general treatment, the free particle in spherical coordinates, the hydrogen atom.	**[8L]**
Unit IV	**Angular Momentum**	**[15L]**
Learning Objective: This unit is intended to • introduce the concepts of angular momentum to students.		

<table>
<tr><td colspan="3">Learning Outcomes:
At the end of this unit, the learner will be able to
• represent the orbital angular momentum operator in matrix form
• evaluate the eigen values of L_z and L^2 and determine their eigen functions.</td></tr>
<tr><td>4.1</td><td>Orbital angular momentum, general formalism of angular momentum, matrix representation of angular momentum, geometrical representation of angular momentum, spin angular momentum: experimental evidence of the spin, general theory of spin, spin 1/2 and the Pauli matrices, eigen functions of orbital angular momentum: eigen functions and eigen values of L_z, eigen functions of L^2.</td><td>[15L]</td></tr>
<tr><td colspan="3">Reference Books:
• Quantum Mechanics: Concepts and Applications: Nouredine Zettili, 2nd Ed., John Wiley and Sons Ltd., 2004.
• A text book of Quantum Mechanics: P. M. Mathews and K. Venkatesan, 2nd Ed., Tata McGraw Hill Education Private Limited, 2011
• Introduction to Quantum Mechanics: David Griffiths, 2nd Ed., Pearson Education; 2015.
• Quantum Mechanics: Claude Cohen-Tannoudji, Bernard Diu, Franck Laloe Vol. I & II, 2nd Ed., Wiley-CH, 2019.</td></tr>
</table>

Question Paper Template

Unit	Remembering/ Knowledge (1)	Understanding (2)	Applying (3)	Analysing (4)	Evaluating (5)	Creating (6)	Total marks
I	30%	30%	15%	15%	5%	5%	100 %
II	30%	30%	15%	15%	5%	5%	100 %
III	30%	30%	15%	15%	5%	5%	100 %
IV	30%	30%	15%	15%	5%	5%	100 %

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
• implement basics postulates of quantum mechanics to quantum systems	√					
• estimate the expectation value of physical observables	√	√				√
• connect the quantum mechanics to classical mechanics	√					
• solve one dimensional problems in quantum mechanics	√	√				√
• solve three dimensional problems in quantum mechanics	√	√				√
• represent the orbital angular momentum operator in matrix form	√	√				
• determine the eigen values and eigen functions of L_z and L^2	√	√				√

M. Sc. (Physics) SEMESTER II

COURSE NAME: Statistical Physics

COURSE CODE: PHYMSC-S2P6-4CR26 [CREDITS - 04]

CC VI	Course Code: PHYMSC-S2P6-4CR26	
Course Learning Outcomes		
At the end of this course, learners will be able to • implement fundamental principles and concepts of statistical mechanics to Fermi-Dirac and Bose-Einstein systems. • gain practical skills in solving problems related to statistical physics using mathematical and computational methods. • analyze and interpret the behaviour of complex systems using statistical mechanics principles. • apply statistical physics in various fields such as condensed matter physics, astrophysics, biophysics, and materials science. • explain phase transitions and critical phenomena using statistical mechanics.		
Unit I	**Formulation of Quantum Statistics**	**[15L]**
Learning Objective: This unit is intended to • learn the quantum-mechanical ensemble theory and their application to statistical systems • explore the fundamental concepts of indistinguishability and symmetry of quantum particles • familiarize density matrix and partition function of a system of free particles.		
Learning Outcomes: At the end of this unit, the learner will be able to • grasp the principles of quantum mechanics and their relevance to statistical systems • apply statistical methods to quantum systems to understand the statistical behavior of particles • distinguish between bosons and fermions and their statistics • analyze experimental data and interpret results using the concepts and methods of quantum statistics • solve theoretical and practical problems using quantum statistical methods.		
1.1	Quantum-mechanical ensemble theory: the density matrix, statistics of the various ensembles, examples, systems composed of indistinguishable particles, the density matrix and the partition function of a system of free particles.	**[15L]**
Unit II	**Ideal Bose Systems**	**[15L]**
Learning Objective:		

This unit is intended to

- learn the fundamental principles of Bose-Einstein statistics
- familiarize oneself with the concept of Bose-Einstein condensation and its significance in the context of quantum gases
- explore the thermodynamic properties of ideal Bose systems, including the calculation of partition functions, energy, entropy, and specific heat
- develop the ability to analyze and interpret experimental data related to ideal Bose systems.

Learning Outcomes:

At the end of this unit, the learner will be able to

- apply the fundamental principles of Bose-Einstein statistics to ideal Bose gases.
- analyze the behaviour of ideal Bose gases at different temperature regimes
- explain the thermodynamic properties of ideal Bose systems, such as energy, entropy, and specific heat, using statistical mechanics principles.
- recognize the experimental techniques used to study Bose-Einstein condensation and interpret experimental data related to ideal Bose systems.
- apply mathematical formalisms, including partition functions and Bose-Einstein distribution functions, to describe ideal Bose systems.

2.1	Thermodynamic behaviour of an ideal Bose gas, Bose–Einstein condensation in ultracold atomic gases, thermodynamics of the blackbody radiation, the field of sound waves, elementary excitations in liquid helium II.	**[15L]**
Unit III	**Ideal Fermi Systems**	**[15L]**

Learning Objective:

This unit is intended to

- understand the principles of quantum mechanics and statistical mechanics relevant to fermionic particles
- learn about the behaviour of fermionic particles at low temperatures, including the Pauli exclusion principle and Fermi energy
- investigate the properties of Fermi gases, such as degeneracy pressure and heat capacity.

Learning Outcomes:

At the end of this unit, the learner will be able to

- interpret the distinct behaviour of fermions governed by the Pauli exclusion principle and Fermi-Dirac statistics.
- apply the Fermi-Dirac Statistics to Fermi systems.
- analyze the properties of Fermi gases, including degeneracy pressure, specific heat, and behaviour at low temperatures.
- solve Fermi system-related problems.

3.1	Thermodynamic behaviour of an ideal Fermi gas, magnetic behaviour of an ideal Fermi gas, the electron gas in metals, ultracold atomic Fermi gases, statistical equilibrium of white dwarf stars, statistical model of the atom	**[15L]**
Unit IV	**Phase Transitions: Criticality, Universality, and Scaling**	**[15L]**

Learning Objective:
This unit is intended to

- provide a foundation of phase transitions
- explore Ising model in zeroth approximation and first approximation.

Learning Outcomes:
At the end of this unit, the learner will be able to

- apply the theory of phase transition to Ising model
- analyse the thermodynamic properties near critical points
- solve the research problems related to phase transition in lattice gases and binary alloys.

4.1	General remarks on the problem of condensation, condensation of a Van der Waals gas, a dynamical model of phase transitions, the lattice gas and the binary alloy, Ising model in the zeroth approximation, Ising model in the first approximation.	**[15L]**

Reference Books:

- Statistical Mechanics by R. K. Pathria and P. D. Beale, 3rd Ed., Elsevier 2011.
- Greiner, Neise and Stocker, Thermodynamics and Statistical Mechanics, 2nd Ed., Springer 1997.
- Fundamentals of Statistical and Thermal Physics by F. Reif, Waveland Press, Reprint, 2009.
- Statistical Physics Vol. 5 by F. Reif, 8th Ed. Reprint, 2017.
- Statistical Mechanics by Kerson Huang, 2nd Ed., Wiley 1987.
- Statistical Physics Vol. 5 by Landau and Lifshitz, 3rd Ed., Butterworth-Heinemann 1996.

Question Paper Template

Unit	Remembering/ Knowledge (1)	Understanding (2)	Applying (3)	Analysing (4)	Evaluating (5)	Creating (6)	Total marks
I	30%	30%	15%	15%	5%	5%	100 %
II	30%	30%	15%	15%	5%	5%	100 %
III	30%	30%	15%	15%	5%	5%	100 %
IV	30%	30%	15%	15%	5%	5%	100 %

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
• implement fundamental principles and concepts of statistical mechanics to Fermi-Dirac and Bose-Einstein systems.	√		√			
• gain practical skills in solving problems related to statistical physics using mathematical and computational methods.	√	√	√			√
• analyze and interpret the behaviour of complex systems using statistical mechanics principles.	√	√	√			√
• apply statistical physics in various fields such as condensed matter physics, astrophysics, biophysics, and materials science.	√	√	√			√
• explain phase transitions and critical phenomena using statistical mechanics	√					

M. Sc. (Physics) SEMESTER II

COURSE NAME: Introduction to Arduino

COURSE CODE: PHYMSC-S2VOC1-4CR26 [CREDITS - 04]

VOC-1	**Course Code: PHYMSC-S2VOC-4CR26**	
Course Learning Outcomes		
At the end of this course, learners will be able to • use combination of input and output devices to work in programmed manner • differentiate various sensors based on touch, sound, temperature and humidity • design a minimum level of automation system using sensors and display devices to perform a task.		
Unit I	**Embedded Systems and Arduino**	**[15L]**
Learning Objective: After completing this course, students will be able to: • Explain the architecture and differences between microcontrollers and microprocessors and describe the role of embedded systems and open-source platforms. • Develop simple Embedded C programs using Arduino IDE by applying variables, functions, and conditional statements. • Implement digital input and output operations using GPIO pins of ATmega328-based Arduino board.		
Learning Outcomes: After successful completion of the course, students will be able to: • Explain the architecture and differences between microcontrollers and microprocessors and describe the role of embedded systems and open-source platforms like Arduino. • Develop simple Embedded C programs using Arduino IDE by applying programming concepts such as variables, functions, and conditional statements. • Implement digital input and output operations using GPIO pins of ATmega328-based Arduino board.		
1.1	Introduction to microcontroller and microprocessors, role of embedded systems, open-source embedded platforms, Introduction to Arduino IDE-features, IDE overview, fundamentals of embedded C Programming concepts: variables, functions, conditional statements, Concept of GPIO in ATmega 328 based Arduino board, digital input and output.	**[15L]**
Unit II	**Peripheral Interface and Programming:**	**[15L]**
Learning Objective: After completing this course, students will be able to: • Explain the principles of peripheral interfacing, serial communication, and ADC operation in ATmega328-based Arduino systems. • Interface and program output devices (LED, LCD) and implement waveform generation using Arduino IDE. • Integrate sensors (LM35, LVDT, strain gauge) and actuators (stepper motor) with ATmega328-based Arduino board to develop basic embedded applications.		
Learning Outcomes:		

At the end of this unit, the learner will be able to

- Interface and control basic output devices such as LED and LCD using ATmega328-based Arduino board.
- Implement serial communication and ADC operations in ATmega328-based Arduino board for data acquisition and signal processing.
- Design and develop embedded applications by interfacing sensors (LM35, LVDT, strain gauge) and actuators (stepper motor), and generate different waveform outputs.

2.1	Peripheral Interface and Programming: Interfacing of Atmega328 based Arduino board with LED and LCD, serial communication using Arduino IDE, Concept of ADC in ATmega328 based Arduino board and different wave shape generation, interfacing of ATmega328 based Arduino board with temperature sensor (LM35), LVDT, strain gauge, Stepper motor.	**[15L]**

Reference Books:

- Barret Steven : Arduino Microcontroller processing for everyone" Morgan
- and Claypool Publishers.
- Massimo Banzi : "Getting started with Arduino" Maker Media INC.
- Brad Kendall : " Getting started with Arduino : Beginers Guide
- Arduino for Dummies, John Nussey, 2nd Ed., John Wiley & Sons,
- Arduino Essentials, Francis Perea, Packt Publishing
- Arduino for Beginners: Essential Skills Every Maker Needs, John Baichtal, Que Publishing
- https://www.tutorialspoint.com/arduino/index.htm

NOTE:

- The subject is to be taught using hands-on methodology. The students will be "learning by doing" and shall be using the computer from day 1 to learn the various topics mentioned above. The extensive use of online resources is recommended and students should be able to search on internet and verify interfacing technique of the device to be connected to Arduino board. There shall be only laboratory work for the subject and students will be examined for the same.
- The students are to design a minor project using Arduino UNO R3 and interface (at least) one sensor as input and one output device. The students will make a presentation about their project and submit a written project report.
- The students will be marked for their performance at the presentation and project work.
- The candidates will have to appear for a viva voce while submitting the project.
- The examiner will mark the candidates based on their performance. The suggested marking scheme is given below.

Suggested hands-on experiments during practical sessions. **[30L]**

1. Introduction to Arduino IDE by installing IDE, configuring boards with ports and communicating on serial monitor.
2. Interfacing an LED using digitalWrite() and blinking it using variable rate.
3. Varying brightness of RGB led using pwm and write a function to glow and fade the led.

4. Interfacing a microswitch and a buzzer. Change buzzer beeps and duration.
5. Interface a DHT 11 for sensing temperature and humidity.
6. Interface a joystick sensor and glow led as per joystick position.
7. Interfacing 16x2 LCD display via IIC interface. Display data from a sensor on LCD.
8. Interface a LDR, IR sensor and hall effect switch.
9. Interface HC-SR04 ultrasonic sensor module.
10. Interface a sound sensor, rotary encoder and relay
11. Project work (equivalent to 5 Experiment)

Note:

1. The subject is to be taught using hands-on methodology. The students will be "learning by doing" and shall be using the computer from day 1 to learn the various topics mentioned above. The extensive use of online resources is recommended and students should be able to search on internet and verify interfacing technique of the device to be connected to Arduino board. There shall be only laboratory work for the subject and students will be examined for the same.
2. Students are assumed to be familiar with Arduino boards so interfacing experiments may be speeded up so as to allot more time to project design and assembling.
3. The students are to design a project using any embedded system board and interface (at least) two sensors as input and one output device. The components required for the project are to be procured by the students themselves.
4. The students are required to make a presentation about their project and submit a written project report.
5. The project has to be made / assembled in the institute laboratory under the supervision of guide allotted.
6. Ready-made projects are strictly not to be encouraged.
7. The students will be marked for their performance at the presentation and project work.
8. The candidates will have to appear for a viva voce while submitting the project.

Question Paper Template (Theory)

Unit	Remembering/ Knowledge (1)	Understanding (2)	Applying (3)	Analysing (4)	Evaluating (5)	Creating (6)	Total marks
I	10%	30%	30%	30%	-		100 %
II	10%	30%	30%	30%	-		100 %

Question Paper Template (Practical)

Evaluation Criterion	Examination	% Marks
Attendance	CIE	10%
Performance during hands on sessions	CIE	20%
Project	SEE	40%
Viva Voce	SEE	30%
	Total	**100%**

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
Explain the architecture and differences between microcontrollers and microprocessors and describe the role of embedded systems and open-source platforms like Arduino.	√	√			√	
Develop simple Embedded C programs using Arduino IDE by applying programming concepts such as variables, functions, and conditional statements.	√	√			√	
Implement digital input and output operations using GPIO pins of ATmega328-based Arduino board.	√	√			√	√
Interface and control basic output devices such as LED and LCD using ATmega328-based Arduino board.	√	√			√	
Implement serial communication and ADC operations in ATmega328-based Arduino board for data acquisition and signal processing.	√	√			√	√
Design and develop embedded applications by interfacing sensors (LM35, LVDT, strain gauge) and actuators (stepper motor) and generate different waveform outputs.	√	√			√	√

M. Sc. (Physics) SEMESTER II

COURSE NAME: Physics Practical-4

COURSE CODE: PHYMSC-S2PR4-6CR26 [CREDITS - 02]

Practical VI	Course Code: PHYMSC-S1PR4-2CR26
Course Learning Outcomes	
After the successful completion of the course, learners will be able to • demonstrate practical skills • correlate the Physics theory concepts through practical	
Practical	

1	To study Hall effect.
2	To study Electron Spin Resonance (ESR).
3	To determine energy band-gap of different semiconducting materials.
4	To determine charge of electron using Millikan's oil drop method.
5	To determine e/m using Helical method.
6	To determine electrical conductivity of graphite.
7	To study Frank-Hertz experiment.

Reference Books:

- Classical electrodynamics by J. D. Jackson, 3rd Ed., Wiley Student Ed., 2009.
- Introduction to Electrodynamics by David J. Griffiths, 4th Ed., PHI, 2017.
- Electromagnetics by B. B. Laud, 2nd Ed., New Age International Publication, 2006.
- Advanced Practical Physics by B. L. Worsnop and H. T. Flint, 3rd Ed., Asia Publishing House, New Delhi, 2021
- University Practical Physics by D. C. Tayal, Edited by Ila Agarwal, 1st Ed., Himalayan Publishing House, 2000.
- Experimental Physics: Modern Methods by R. A. Dunlap, Oxford University Press, New Delhi 1988.
- Methods of Experimental Physics: Series of Volumes by D. Malacara, Academic Press Inc. 1988.

Note:

- The duration of each experiment is of 4 hours.
- In the external exam, a student will have to perform one experiment of 4-hours duration.

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
• demonstrate practical skills	√	√	√	√	√	√
• correlate the Physics theory concepts with appropriate practical	√	√			√	

M. Sc. (Physics) SEMESTER II

COURSE NAME: Physics Practical-5

COURSE CODE: PHYMSC-S2PR5-2CR26 [CREDITS - 02]

Practical V	Course Code: PHYMSC-S1PR5-2CR26
Course Learning Outcomes	
After the successful completion of the course, learners will be able to • demonstrate practical skills • correlate the Physics theory concepts through practical	
Practical	

1	To determine characteristics of GM tube.
2	To study counting statistics using GM tube.
3	To study Ultrasonic interferometer.
4	To determine magnetic susceptibility of the given material.
5	To study Co-60 spectrum and calculation of resolution of detector in terms of energy.
6	To determine linear and mass absorption coefficients using Scintillation detector.
7	To study energy calibration of gamma ray spectrometer (study of linearity).

Reference Books:

- Introductory Nuclear Physics by Kenneth S. Krane. John Wiley & Sons Inc., 1987
- Nuclear Physics by S.N. Ghoshal S Chand Publishing, 2019
- Introduction to Nuclear and Particle Physics by V.K. Mittal, R.C. Verma, and S.C. Gupta. PHI Learning 2018
- Advanced Practical Physics by B. L. Worsnop and H. T. Flint, 3rd Ed., Asia Publishing House, New Delhi, 2021
- University Practical Physics by D. C. Tayal, Edited by Ila Agarwal, 1st Ed., Himalayan Publishing House, 2000.
- Experimental Physics: Modern Methods by R. A. Dunlap, Oxford University Press, New Delhi 1988.
- Methods of Experimental Physics: Series of Volumes by D. Malacara, Academic Press Inc. 1988.

Note:

- The duration of each experiment is of 4 hours.
- In the external exam, a student will have to perform one experiment of 4-hours duration.

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
• demonstrate practical skills	√	√	√	√	√	√
• correlate the Physics theory concepts with appropriate practical	√	√			√	

M. Sc. (Physics) SEMESTER II

COURSE NAME: Physics Practical-6

COURSE CODE: PHYMSC-S2PR6-2CR26 [CREDITS - 02]

Practical VI	Course Code: PHYMSC-S1PR6-2CR26

Course Learning Outcomes

After the successful completion of the course, learners will be able to

- demonstrate practical skills
- correlate the Physics theory concepts through practical

Practical

1	Study the hermiticity of given operator/commutator/matrix.
2	Evaluate the given commutators.
3	Solve time independent Schrödinger Equation for a given potential in one dimensional.
4	Find the matrices representing the operators J^2, J_x, J_y and J_z for a given value of j.
5	Minor Project

Reference Books:

- Quantum Mechanics: Concepts and Applications: Nouredine Zettili, 2nd Ed., John Wiley and Sons Ltd., 2004.
- A text book of Quantum Mechanics: P. M. Mathews and K. Venkatesan, 2nd Ed., Tata McGraw Hill Education Private Limited, 2011
- Introduction to Quantum Mechanics: David Griffiths, 2nd Ed., Pearson Education; 2015.
- Advanced Practical Physics by B. L. Worsnop and H. T. Flint, 3rd Ed., Asia Publishing House, New Delhi, 2021
- University Practical Physics by D. C. Tayal, Edited by Ila Agarwal, 1st Ed., Himalayan Publishing House, 2000.
- Experimental Physics: Modern Methods by R. A. Dunlap, Oxford University Press, New Delhi 1988.
- Methods of Experimental Physics: Series of Volumes by D. Malacara, Academic Press Inc. 1988.

Note:

- The duration of each experiment is of 4 hours.
- In the external exam, a student will have to perform one experiment of 4-hours duration.

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
• demonstrate practical skills	√	√	√	√	√	√
• correlate the Physics theory concepts with appropriate practical	√	√			√	