



**Sir P. T. Sarvajani College of Science (Autonomous)
Athwalines, Surat-395001**

SYLLABUS
for
Semester I and II
Program: M. Sc.
Course: Physics

Effective from
Academic Year
2024-25



Board of Studies in Physics
Undergraduate and Post graduate

	Name	Designation	Institute/Industry
Head of the Department			
1	Prof. Sadanand Sutar	Chairperson	Sir P. T. Sarvajani College of Science
All Faculty Members of the Department			
1	Prof. Vireshkumar Thakkar	Associate Professor	Sir P. T. Sarvajani College of Science
2	Dr. Nisha Patel	Assistant Professor	Sir P. T. Sarvajani College of Science
3	Dr. Dhiraj Shah	Assistant Professor	Sir P. T. Sarvajani College of Science
4	Prof. Kileen Mahajan	Associate Professor	Sir P. T. Sarvajani College of Science
5	Prof. Bhupesh Lad	Associate Professor	Sir P. T. Sarvajani College of Science
6	Dr. Naveen Kumar Singh	Adhyapak Sahayak	Sir P. T. Sarvajani College of Science
7	Dr. Jenishkumar Patel	Adhyapak Sahayak	Sir P. T. Sarvajani College of Science
8	Prof. Pradipkumar Dholakia	Assistant Professor	Sir P. T. Sarvajani College of Science
Subject Expert nominated by Vice-Chancellor			
1	Dr. Arvind Bajaj	Nominated Member	V. S. Patel College of Arts & Science, College Campus, Morarji Desai Marg, Bilimora
Subject experts			
1	Prof. Smita L. Survase	Nominated Member	K. J. Somaiya College of Commerce and Science (Autonomous), Mumbai
2	Prof. Mahesh Shetti	Nominated Member	Wilson College (Autonomous), Mumbai
Representative from Industry/corporate sector/allied area			



1	Mr. Gopal Singh Panwar	Nominated Member	Officer, Human Resources, L & T Defence IC, Hazira, Surat
Meritorious Alumnus			
1	Mr. Darshankumar Jagdishbhai Gabani	Nominated Member	R & D Division, Lucan Techno, Katargam, Surat
Expert from other than the parent University			
1	Prof. Chetan Limbachia	Nominated Member	Head, Department of Applied Physics, M. S. University, Vadodara

Acknowledgement

At the outset, I would like to thank our, Principal Dr. Pruthul Desai for his guidance and support during the curriculum restructuring process. I am also grateful to all the esteemed members of the Board of Studies, for their constructive suggestions and contributions.

Above all, I am deeply indebted to all the young and vibrant colleagues in the Department of Physics for the long and arduous work they have put in during the compiling of the restructured syllabus.

Prof. S. A. Sutar

(Chairperson, Board of Studies in Physics)



Graduate Attributes:

After the successful completion of units in different courses of M. Sc. PHYSICS, the learner will be able to:

- GA 1:** Capacity to conduct the experiments and evaluate the findings based on the knowledge gained in the scientific domain.
- GA 2:** Ability to organize, carry out and document theoretical and/or experimental Physics problems using scientific methods in their future endeavours.
- GA 3:** Ability to generate, process, analyse, model and visualise data by using a variety of tools such as programming, sophisticated instrumentation and other resources.
- GA 4:** Exhibiting creativity and problem-solving skills through appropriate planning and organizational skills to work as a team.
- GA 5:** Honouring and adhering to professional ethics and standards.
- GA 6:** Capacity to engage in the technical domain via written and oral communication effectively.

Programme Specific Outcomes:

- PO 1:** Apply knowledge of Physics to analyze problems; evaluate and validate experimental results and draw logical conclusions thereof.
- PO 2:** Utilize technical and analytical skills through experiential learning.
- PO 3:** Recognize the need for continuous learning and knowledge updation throughout their professional career.
- PO 4:** Demonstrate and maintain the highest standard on ethical issues in the professional career.
- PO 5:** Exhibit the ability to work both, as an individual and as a team member in a variety of situations and disciplines.
- PO 6:** Communicate effectively with the scientific community and the general public using written and spoken language as well as the electronic media.



Content

Sr. No	Semester	Course number	Course Code	Course title
1	MSc- Sem I	CC I	PHYMSC-S1P1-4CR24	Mathematical Methods in Physics
2		CC II	PHYMSC-S1P2-4CR24	Classical Mechanics
3		CC III	PHYMSC-S1P3-4CR24	General Electronics
4		EC I	PHYMSC-S1E1-4CR24	Physics of Semiconductor Devices
5		EC II	PHYMSC-S1E2-4CR24	Crystal Growth and Characterization
6		EC III	PHYMSC-S1E3-4CR24	Numerical Methods
7		EC IV	PHYMSC-S1E4-4CR24	Nuclear Radiation
8		SEC I	PHYMSC-S1SEC1-2CR24	Introduction to Arduino
9		PRACTICAL I	PHYMSC-S1PR1-6CR24	MSc Sem I Lab Course
1	MSc- Sem II	CC IV	PHYMSC-S2P4-4CR24	Classical Electrodynamics
2		CC V	PHYMSC-S2P5-4CR24	Quantum Mechanics- I
3		CC VI	PHYMSC-S2P6-4CR24	Statistical Physics
4		EC V	PHYMSC-S2E5-4CR24	Electronic Communication
5		EC VI	PHYMSC-S2E6-4CR24	Nanotechnology and Its Applications
6		EC VII	PHYMSC-S2E7-4CR24	Numerical Techniques and FORTRAN programming
7		EC VIII	PHYMSC-S2E8-4CR24	Particle Accelerators and Detectors
8		SEC II	PHYMSC-S2SEC2-2CR24	Advanced Arduino and IoT
9		PRACTICAL II	PHYMSC-S2PR1-6CR24	MSc Sem II Lab Course



Sir P. T. Sarvajani College of Science (Autonomous)
Athwalines, Surat-395001

SEM-1



M. Sc. (Physics) SEMESTER I

COURSE TITLE: Mathematical Methods in Physics

COURSE CODE: PHYMSC-S1P1-4CR24 [CREDITS - 04]

CCI	Course Code: PHYMSC-S1P1-4CR24
Course Learning Outcomes	
<p>After the successful completion of the course, the learner will be able to</p> <ul style="list-style-type: none"> • apply the eigenvalues and eigenvectors for solving various problems in Physics • categorize various special functions and their properties • apply the Fourier transform and Laplace transform for solving complex problems • apply the Binomial, Poisson and Gaussian distribution functions and Group theory for statistical analysis 	
Unit I	Matrices, Vector Spaces and Tensors [15L]
<p>Learning Objective This unit is intended to</p> <ul style="list-style-type: none"> • familiarize the students with the concepts of operators, vector spaces and their properties • study the eigenvalues and eigenvectors and their relevance in Physics • infer the types of tensors and their properties 	
<p>Learning Outcomes: At the end of this unit, the learner will be able to</p> <ul style="list-style-type: none"> • apply the concepts of operators and vector spaces in solving problems • apply the eigenvalues and eigenvectors for solving various problems in Physics • classify the tensors and their properties 	
1.1	Review of matrices - vector spaces, basis vectors, linear operators, linear dependence and independence, inverse [4L]
1.2	Eigenvalues and eigenvectors, diagonalising matrices – hermitian matrices, anti-hermitian matrices, orthogonal matrices, applications. Commutator, change of basis, similarity transformations, Jacobi method. [7L]
1.3	Tensors – introduction, tensors of rank zero, one and two, covariant and contravariant tensors, symmetry, contraction, direct product, inverse transformation, quotient rule [4L]
Unit II	Special Functions [15L]
<p>Learning Objective This unit is intended to</p> <ul style="list-style-type: none"> • study special functions such as Legendre function, Bessel function, etc. and their properties relevant in Physics 	
<p>Learning Outcomes: At the end of this unit, the learner will be able to</p> <ul style="list-style-type: none"> • categorize various special functions and their properties 	



2.1	Legendre's equation, Legendre polynomials, Rodrigues' formula, Generating function, recursion relations, orthogonality and normalization properties of the Legendre polynomial, extended power series method, Euler-Cauchy equation and its solution, Associated Legendre functions, orthogonality and normalization properties of the Associated Legendre polynomial, Spherical Harmonics, Bessel's equation, Bessel functions, Bessel Functions: Generating function, recursion relations, orthogonality and normalization properties of the Bessel functions, integral and half integral orders, Bessel functions of second kind, Hankel functions, Hermite functions – recurrence relations, Rodrigue's formula, orthogonality	[15L]
Unit III	Integral Transforms	[15L]
Learning Objective		
This unit is intended to		
<ul style="list-style-type: none"> • infer the concepts of Fourier transform and its applications • familiarize students with Laplace transform and relevant theorems. 		
Learning Outcomes:		
At the end of this unit, the learner will be able to		
<ul style="list-style-type: none"> • apply the Fourier transform and Laplace transform for solving complex problems. 		
3.1	Fourier integral, Fourier cosine and sine integral, Fourier cosine and sine transform, Fourier complex integral, Fourier transform, properties of Fourier transform, application of Fourier transforms - uncertainty principle and Fraunhofer diffraction, Dirac delta function, Fourier transform of derivatives, Discrete Fourier Transform, Fast Fourier Transform	[8L]
3.2	Laplace transform, linearity, first shifting theorem (s-shifting), Laplace transform of derivatives, Laplace transform of integral, Laplace transform for solving differential equations, initial value problems, Heaviside function and its relevance, second shifting theorem (t-shifting), short impulses, Dirac delta function	[7L]
Unit IV	Probability and Group theory	[15L]
Learning Objective		
This unit is intended to		
<ul style="list-style-type: none"> • study probability distributions • infer the concepts of group theory and its relevance. 		
Learning Outcomes:		
At the end of this unit, the learners will be able to		
<ol style="list-style-type: none"> 1. apply the Binomial, Poisson and Gaussian distribution functions for statistical analysis 2. interpret the concepts of group theory. 		
4.1	Data representation – average and spread, mean, standard deviation, variance, experiments, outcomes, events, probability, permutations,	[9L]



	combinations, probability distributions, discrete random variables, mean and variance of a distributions, binomial distributions, poisson distributions, gaussian distributions.	
4.2	Group Theory: Introduction and definitions – Group, finite group, order of group, Abelian group, symmetric group, Subgroup and classes, Group representations.	[6L]

References:

1. Mathematical Methods for Physics and Engineering by Riley, Hobson and Bence, 2nd Ed. Cambridge University Press 2006.
2. Mathematical Methods for Physicists: G. Arfken and H. J. Weber, 7th Edition, Academic Press, 2013.
3. Mathematical Methods in the Physical Sciences by M L Boas, 3rd Ed. Wiley 2006.
4. Advanced Engineering Mathematics, 10th Edition, Erwin Kreyszig Wiley 2011.
5. Mathematical Methods of Physics: Mathews and Walker, 2nd Edition, Pearson Education, 2004.
6. Matrix Methods and Vector Spaces in Physics by Vinod Sharma, Kindle Ed. PHI Learning Pvt. Ltd. 2009.

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	20%	30%	30%	20%	-	-	100 %
II	10%	20%	30%	20%	10%	10%	100 %
III	10%	20%	30%	20%	10%	10%	100 %
IV	20%	20%	30%	20%	10%	-	100 %

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
<ul style="list-style-type: none"> apply the eigenvalues and eigenvectors for solving various problems in Physics 		√				
<ul style="list-style-type: none"> categorize various special functions and their properties 	√					
<ul style="list-style-type: none"> Apply the Fourier transform and Laplace transform for solving complex problems 	√	√				
<ul style="list-style-type: none"> apply the Binomial, Poisson and Gaussian distribution functions and Group theory for statistical analysis 	√		√			



M. Sc. (Physics) SEMESTER I

COURSE TITLE: Classical Mechanics

COURSE CODE: PHYMSC-S1P2-4CR24 [CREDITS - 04]

CC II	Course Code: PHYMSC-S1P2-4CR24
Course Learning Outcomes	
<p>At the end of this course, learners will be able to</p> <ul style="list-style-type: none"> • understand and apply the Lagrangian approach and Hamiltonian approach in classical mechanics • use mathematical tools necessary to analyse and solve a wide range of physical problems • apply principles of Classical Mechanics to analyse various system • investigate the normal modes of vibration for linearized systems • understand the concept of rigid body and small oscillations and appraise their significance in the dynamics of physical systems • explain and use canonical transformations. 	
Unit I	Central Force Problem [15L]
<p>Learning Objective: This unit is intended to</p> <ul style="list-style-type: none"> • explain the motion under the influence of central force • introduce the properties and characteristics of central force potentials • explain the use of mathematical methods to solve central force problems. 	
<p>Learning Outcomes: At the end of this unit, the learner will be able to</p> <ul style="list-style-type: none"> • analyze the motion of a particle under the influence of a central force using the principles of classical mechanics • apply angular momentum and energy conservation principles to central force problems and analyze the implications for the trajectory of the particle • investigate the properties and characteristics of central force potentials, including Keplerian orbits • apply mathematical methods to solve central force problems • understand and apply the principles of Coulomb's law and classical mechanics to predict the scattering pattern of alpha particles by a nucleus. 	
1.1	<p>Reduction of two body problem to one body problem; equation of motion and first integrals; equivalent one-dimensional problem; classification of orbits; differential equation for the orbit; power law potentials; Bertrand's theorem; the Kepler's problem; scattering in a central force field; Rutherford scattering cross section. [15L]</p>
Unit II	Rigid Body Motion and Small Oscillations [15L]
<p>Learning Objective:</p>	



This unit is intended to

- introduce rigid body dynamics
- explain the concept of small oscillations and their significance
- introduce use of mathematical techniques (vector calculus, differential equations, and matrix algebra, etc) to solve complex problems of rigid body dynamics and small oscillations.

Learning Outcomes:

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

- understand the principles and techniques of rigid body dynamics
- apply mathematical techniques, including vector calculus, differential equations, and matrix algebra, to solve complex problems in rigid body dynamics
- examine the dynamics of rigid bodies subject to external forces and torques, including the effects of moments of inertia and external constraints
- investigate the normal modes of vibration for linearized systems
- explore the concept of eigenvalues and eigenvectors in the context of small oscillations and understand their role in determining the frequencies and modes of vibration
- apply mathematical techniques to solve for the normal modes and frequencies of small oscillation systems.

2.1	Eigen-values of the inertia tensor and the principal axis transformation; Euler's and Lagrangian's treatment for rigid body motion; force free motion of a symmetrical top; motion of a heavy symmetrical top with one point fixed.	[7L]
2.2	Formulation of the problem; the eigenvalue equation and the principal axis transformation; normal modes and normal coordinates for small oscillations; examples: free vibrations of a linear tri-atomic molecule, coupled pendulums, double pendulum.	[8L]
Unit III	Hamiltonian Dynamics and Canonical Transformations	[15L]

Learning Objective:

This unit is intended to

- introduce Hamiltonian formulation
- make students familiarize with Hamiltonian equations of motion
- introduce the concept of canonical transformations.

Learning Outcomes:

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

- derive the Hamiltonian function for a given system using the Lagrangian formulation and Legendre transformation.
- apply the Hamiltonian formulation to a variety of physical systems, including simple mechanical systems, electromagnetic systems, and quantum mechanical systems.
- establish connection between ignorable coordinates and laws of conservations.



<ul style="list-style-type: none"> understand the concept of canonical transformations and their significance in classical mechanics for describing the evolution of dynamical systems. demonstrate proficiency in applying canonical transformations to analyze and solve problems in various areas of Physics. 		
3.1	Hamilton's equations of motion: Legendre transformation and Hamiltonian function; canonical equations of Hamilton; cyclic coordinates and conservation theorems; Routh's procedure.	[7L]
3.2	Generators of canonical transformations, equations of canonical transformations; examples; the harmonic oscillator; Poisson brackets; equation of motion in Poisson bracket; infinitesimal canonical transformation.	[8L]
Unit IV	Hamilton-Jacobi Theory	[15L]
<p>Learning Objective: This unit is intended to</p> <ul style="list-style-type: none"> introduce Hamilton-Jacobi theory explain the method of separation of variables and its application introduce concept of action-angle variables and their significance. 		
<p>Learning Outcomes: At the end of this unit, the learner will be able to</p> <ul style="list-style-type: none"> examine the concept of canonical transformations and their role in simplifying the Hamilton-Jacobi equation and generating solutions investigate the method of separation of variables and its application to solve the Hamilton-Jacobi equation for specific dynamical systems understand the concept of action-angle variables and their significance in integrable Hamiltonian systems. 		
4.1	Hamilton-Jacobi Theory: Hamilton-Jacobi equation; Hamilton's principle and characteristic function; examples; separation of variables in Hamilton-Jacobi equation; orbit equation for central force problem; periodicity and action angle variables, frequencies of periodic motion.	[15L]
<p>Reference Books:</p> <ul style="list-style-type: none"> Classical Mechanics by H. Goldstein, 3rd Ed., Pearson education, 2002. Classical Mechanics by Tai L. Chaw, 2nd Ed., CRC Press, 2013. Introduction to Classical Mechanics by Kleppner and Kolenkow, 2nd Ed., Cambridge University Press, 2021. Classical Dynamics of Particles and Systems by J. B. Marion and S. T. Thronton, 5th Ed., Saunders College Publishing, 1995 Classical Mechanics by N. C. Rana and P. S. Joag, 1st Ed. (42nd reprint, 2016), TMH, 1991. 		



- Introduction to Classical Mechanics by R. G. Takwale and P. S. Puranik, 1st Ed. (37th reprint, 2008), Tata McGraw-Hill, 1990.
- Mechanics: Course of Theoretical Physics Vol. 1 by L D Landau and E M Lifshitz, 3rd Ed., Butterworth-Heinemann Publishing co., 2010.
- Fundamental Principles of Classical Mechanics: A Geometrical Perspective by Kai S Lam, 1st Ed., World Scientific Publishing Company, 2014.
- Solved Problems in Classical Mechanics: Analytical and Numerical Solutions with Comments by Owen de Lange and John Pierrus, 1st Ed., Oxford University Press, 2010.

Question Paper Template

Unit	Remembering/ Knowledge (1)	Understanding (2)	Applying (3)	Analysing (4)	Evaluating (5)	Creating (6)	Total marks
I	20%	40%	20%	20%	-	-	100 %
II	-	20%	40%	20%	20%	-	100 %
III	-	20%	40%	20%	20%	-	100 %
IV	20%	20%	40%	20%	-	-	100 %

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
• Understand and apply the Lagrangian approach and Hamiltonian approach in Classical Mechanics.	√		√		√	
• To use mathematical tools necessary to analyze and solve a wide range of physical problems.	√	√	√		√	
• Apply principles of Classical Mechanics to analyse various system.	√	√	√			
• Investigate the normal modes of vibration for linearized systems.	√	√	√			
• Understand the concept of rigid body and small oscillations and appraise their significance in the dynamics of physical systems.	√	√	√			
• Explain and use canonical transformations.	√	√	√			



M. Sc. (Physics) SEMESTER I
COURSE TITLE: General Electronics

COURSE CODE: PHYMSC-S1P3-4CR24 [CREDITS - 04]

CC III	Course Code: PHYMSC-S1P3-4CR24	
Course Learning Outcomes		
<p>At the end of this course, learners will be able to</p> <ul style="list-style-type: none"> understand the fundamentals of analog circuits and working of digital electronics learn applications of the operational amplifier study the signal conversion of analog to digital and digital to analog. learn the design of SMPS (Switch Mode Power Supply). 		
Unit I	Registers and Counters [15L]	
<p>Learning Objective: This unit is intended to</p> <ul style="list-style-type: none"> understand different kinds of registers and learn their uses introduce asynchronous and synchronous counters and their features. 		
<p>Learning Outcomes: At the end of this unit, the learner will be able to</p> <ul style="list-style-type: none"> classify and understand different types of registers and counters use digital counters and registers for various applications. 		
1.1	<p>Registers: Types of Registers, Serial In-Serial Out, Serial In-Parallel Out, Parallel In-Serial Out, Parallel In-Parallel Out, universal shift register, applications of shift registers, applications of register, delay line, serial to parallel data convertor.</p>	[6L]
1.2	<p>Display Systems: seven segment display, alpha numeric display, dot matrix display and multiplexed display system.</p>	[3L]
1.3	<p>Counters: asynchronous counters, decoding gates, synchronous counters, changing the counter modulus, decade counters, presetable counters, asynchronous counters, ring counter, applications of counter, digital clock.</p>	[6L]
Unit II	Operational Amplifier Applications [15L]	
<p>Learning Objective: This unit is intended to</p> <ul style="list-style-type: none"> introduce active filters of different types understand the application of operational amplifiers in designing multivibrators, PLL and phase detector. 		
Learning Outcomes:		



<p>At the end of this unit, the learner will be able to</p> <ul style="list-style-type: none"> design Butterworth's first order filters use op-amp in designing various multivibrators apply the PLL and Phase detector circuits. 		
2.1	<p>Operational amplifier: Active filter - 1st order only of butterworth low pass, high pass, band-pass filter, band-reject filters.</p>	[8L]
2.2	<p>Applications of operational amplifier: Designing multivibrators, phase lock loop (PLL), phase detector, voltage-to-current convertor, current-to-voltage convertor, Voltage Controlled Oscillator (VCO)</p>	[7L]
Unit III	Signal Conversion (A/D & D/A)	[15L]
<p>Learning Objective: This unit is intended to</p> <ul style="list-style-type: none"> introduce the students with A/D and D/A convertors. 		
<p>Learning Outcomes: At the end of this unit, the learner will be able to</p> <ul style="list-style-type: none"> design various A/D and D/A convertors. 		
3.1	<p>D/A Convertors: Digital to analogue convertor, D/A convertor with binary weighted resistors, D/A convertor with R-2R resistors, Monolithic / hybrid D/A convertor</p>	[7L]
3.2	<p>A/D convertor: Sample-and-hold circuit, successive-approximation A/D Convertor, Monolithic / hybrid A/D convertor</p>	[8L]
Unit IV	SMPS (Switch Mode Power Supply)	[15L]
<p>Learning Objective: This unit is intended to</p> <ul style="list-style-type: none"> infer the concepts of fixed/adjustable and positive/ negative voltage supply introduce the Switch Mode Power Supply (SMPS). 		
<p>Learning Outcomes: At the end of this unit, the learner will be able to</p> <ul style="list-style-type: none"> design and troubleshoot the power supply circuits using three-terminal voltage regulators. 		
4.1	<p>Power supply design using three terminal regulator, fixed voltage Regulator, positive voltage regulator series with seven voltage options, negative voltage regulator series with nine voltage options, adjustable voltage regulators, adjustable positive voltage regulators, adjustable negative voltage regulators, DC to DC convertor, switching regulated power supply.</p>	[15L]



Reference Books:

- Digital Principles and Applications, Donald P. Leach, Albert Paul Malvino, Goutam Shah, 8th Ed., Tata McGraw Hill Edu. Pvt. Ltd. 2013
- Op-amps and Linear Integrated Circuits, Ramakant A Gayakwad, 4th Ed., Pearson
- Electronic Principles, Albert Malvino and David Bates 7th Ed., Tata McGraw Hill Edu. Pvt. Ltd. 2017
- Digital Fundamentals Floyd and Jain 8th Ed., Pearson Education 2005

Question Paper Template

Unit	Remembering/ Knowledge (1)	Understanding (2)	Applying (3)	Analysing (4)	Evaluating (5)	Creating (6)	Total marks
I	10%	40%	20%	20%	-	10%	100 %
II	10%	20%	30%	30%	-	10%	100 %
III	40%	40%	10%	10%	-	-	100 %
IV	20%	30%	20%	20%	-	10%	100 %

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
• understand the fundamentals of analog circuits and working of digital electronics	√	√	√		√	
• learn applications of the operational amplifier	√	√	√		√	
• study the signal conversion of analog to digital and digital to analog.	√	√	√		√	
• learn the design of SMPS (Switch mode power supply)	√	√	√		√	



M. Sc. (Physics) SEMESTER I

COURSE TITLE: Physics of Semiconductor Devices

COURSE CODE: PHYMSC-S1E1-4CR24 [CREDITS - 04]

EC I	Course Code: PHYMSC-S1E1-4CR24	
Course Learning Outcomes		
<p>At the end of this course, learners will be able to</p> <ul style="list-style-type: none"> • acquire knowledge of core concepts of basic semiconductor devices • explain the physical mechanism of charge carriers in semiconductor devices • get acquainted with formation of depletion region and depletion capacitance while preparing p-n junction diode and associated phenomena • apply different optical devices as per the need. 		
Unit I	Carrier Transport Phenomena	[15L]
<p>Learning Objective: This unit is intended to</p> <ul style="list-style-type: none"> • introduce carrier transport phenomena in various semiconductor devices and discuss their effects. 		
<p>Learning Outcomes: At the end of this unit, the learner will be able to</p> <ul style="list-style-type: none"> • acquire knowledge of core concepts of basic semiconductor devices • explain the physical mechanism of charge carriers in semiconductor devices. 		
1.1	Carrier transport phenomena: mobility, resistivity and Hall Effect, recombination process, phonon spectra, optical thermal and high field properties of semiconductor, basic equation for semiconductor device operation.	[15L]
Unit II	Junction Diodes	[15L]
<p>Learning Objective: This unit is intended to</p> <ul style="list-style-type: none"> • introduce students to the Physics of various p-n junction diodes and their characteristics • make them aware of the different phenomena that take place during their working. 		
<p>Learning Outcomes: At the end of this unit, the learner will be able to</p> <ul style="list-style-type: none"> • gain knowledge on formation of depletion region and depletion capacitance while preparing p-n junction diode and associated phenomena • study Physics of I-V characteristics of a diode 		



<ul style="list-style-type: none"> understand the functioning of present-day devices through the knowledge of the physics of semiconductor materials and devices. 		
2.1	Depletion region and depletion capacitance, abrupt and linearly graded junctions, current-voltage characteristics, ideal case- Shockley equation, generation and recombination, diffusion capacitance, junction breakdown, thermal instability, tunnelling effect, avalanche multiplication, terminal function. metal-semiconductor contact, energy band relation, Schottky effect, ohmic contact, heterojunction.	[15L]
Unit III	Bipolar Transistors	[15L]
<p>Learning Objective: This unit is intended to</p> <ul style="list-style-type: none"> introduce the students to different types of transistors and their performance characteristics. 		
<p>Learning Outcomes: At the end of this unit, the learner will be able to</p> <ul style="list-style-type: none"> understand the construction and performance characteristics of different types of transistors. 		
3.1	Bipolar transistors, static characteristics, microwave transistors, cut-off frequency, microwave characterization, device geometry and performance, power transistors, switching transistor, basic static performance parameters, non-ideal effect, hetro-bipolar junction transistor.	[15L]
Unit IV	Optical Devices	[15L]
<p>Learning Objective: This unit is intended to</p> <ul style="list-style-type: none"> make the students aware of the concepts of different optical devices and their performance characteristics. 		
<p>Learning Outcomes: At the end of this unit, the learner will be able to</p> <ul style="list-style-type: none"> use different optical devices as per their characteristics and specifications. 		
4.1	Optical absorption: photon absorption coefficient, electron-hole pair generation.	[4L]
4.2	Solar cell: p-n junction solar cell, conversion efficiency and solar concentration, heterojunction solar cell, amorphous silicon solar cell.	[7L]
4.3	Photo-detectors, PIN photodiode, light emitting diode (LED), laser diode.	[4L]
<p>Reference Books:</p> <ul style="list-style-type: none"> Semiconductor Physics and Devices by D. A. Neamen, 4th Ed., Tata McGraw-Hill Publishing Company Limited, 2002 Physics of Semiconductor Devices by S. M. Sze, 3rd Ed., Wiley-Interscience, 1981 		



- Solid State Electronic Devices by B. G. Streetman, 3rd Ed., Prentice-Hall of India Private Limited, 1994.
- Semiconductor Devices by Jasprit Singh, 1st Ed., McGraw-Hill Publishing Company Limited, 1994.

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	30%	30%	20%	20%	-	-	100 %

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
• acquire knowledge of core concepts of basic semiconductor devices	√					
• explain the physical mechanism of charge carriers in semiconductor devices	√	√				
• get acquainted with formation of depletion region and depletion capacitance while preparing p-n junction diode and associated phenomena	√					
• apply different optical devices as per the need	√	√	√		√	



M. Sc. (Physics) SEMESTER I

COURSE TITLE: Crystal Growth and Characterization

COURSE CODE: PHYMSC-S1E2-4CR24 [CREDITS - 04]

EC II		Course Code: PHYMSC-S1E2-4CR24
Course Learning Outcomes		
<p>At the end of this course, learners will be able to</p> <ul style="list-style-type: none"> develop crystals of variety through different growth techniques gain knowledge of the construction and performance characteristics of different spectroscopy and microscopy techniques and their applications gain knowledge on formation of nucleus during growth of crystals apply various methods for analysing thermal properties. 		
Unit I	Crystal Growth Techniques	[15L]
<p>Learning Objective: This unit is intended to</p> <ul style="list-style-type: none"> introduce various crystal growth techniques and their comparative aspects to the students. 		
<p>Learning Outcomes: At the end of this unit, the learner will be able to</p> <ul style="list-style-type: none"> develop crystals of variety through different growth techniques. 		
1.1	Crystal growth, crystal growth techniques, the chemical physics of crystal growth, crystal growth from solution techniques, vapour growth techniques, how to start crystal growth, advantages and disadvantages of crystal growth methods.	[15L]
Unit II	Theory of Crystal Growth	[15L]
<p>Learning Objective: This unit is intended to</p> <ul style="list-style-type: none"> introduce students to the Physics of crystal growth techniques make them aware of the nucleation and energy of formation during crystal growth. 		
<p>Learning Outcomes: At the end of this unit, the learner will be able to</p> <ul style="list-style-type: none"> gain knowledge on formation of nucleus during growth of crystals classify nuclei obtained during growth of crystals. 		
2.1	Nucleation, classical theory of nucleation, Gibbs Thomson equation for vapour, modified Thompson's equation for melt, Gibbs Thomson equation for solution, energy of formation of a nucleus, spherical and cylindrical nucleus, cap shaped and disc shaped nucleus.	[15L]



Unit III	Characterization Tools-I	[15L]
<p>Learning Objective: This unit is intended to</p> <ul style="list-style-type: none"> • introduce the students to different types of spectroscopy techniques. 		
<p>Learning Outcomes: At the end of this unit, the learner will be able to</p> <ul style="list-style-type: none"> • gain knowledge of the construction and performance characteristics of different spectroscopy techniques and their applications. 		
3.1	Ultraviolet and visible absorption spectroscopy, Infrared Spectroscopy, basic components of infrared spectrophotometers, Fourier Transform Infrared Spectroscopy (FTIR), Fluorescence spectroscopy, principle and measurement Raman spectrometer, pH meters, principle of pH measurement.	[15L]
Unit IV	Characterization Tools-II	[15L]
<p>Learning Objective: This unit is intended to</p> <ul style="list-style-type: none"> • make the students aware of the concepts of microscopy techniques • introduce different methods of thermal analysis. 		
<p>Learning Outcomes: At the end of this unit, the learner will be able to</p> <ul style="list-style-type: none"> • use different microscopy techniques as per their characteristics and specifications. • apply various methods for analysing thermal properties. 		
4.1	Optical microscopy and morphological studies of surfaces, Electron Spin Resonance (ESR) spectrometers, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM).	[8L]
4.2	Thermo-Analytical methods, Thermo-Gravimetric Analysis (TGA), Differential Thermal Analysis (DTA), Simultaneous Thermal Analysis (STA), Mass Spectrometer.	[7L]
<p>Reference Books:</p> <ul style="list-style-type: none"> • Crystal Growth: P. Ramaswamy and Santhan Raghavan, 1st Ed., Kru Publications–Chennai, 2000. • Hand book of Analytical Instruments: R. S. Khandpur, 1st Ed. (6th Reprint), Tata McGraw Hill Professional, Electrical Engineering Series, 2010. • Crystal Growth Principles and Progress: A. W. Vere, 1st Ed., Springer, 1988. • Nucleation and Crystal Growth: Metastability of Solution and Melts, Keshra Sangwal, 1st Ed., Wiley, 2018. 		



- Crystal Growth Concepts, Mechanisms and Applications: J. Li, Jianwei Li and Yanhui Chy, 1st Ed., Nova Science Publishers Inc., 2017.
- Crystal Growth: B. D. Pamplin, 2nd Ed., Pergamon Publication, 2013.
- Crystals and Crystal Growing: Alan Holder and Phylis Morrison, 1st Ed., MIT Press, 1982.
- Introduction to Crystal Growth: Principles and Practice, H. L. Bhatt, 1st Ed., CRC Press, 2014.
- Crystal Growth for Beginners Fundamentals of Nucleation, Crystal Growth and Epitaxy: Ivan V. Markov, 2nd Ed., World Scientific Publishing Co. 2003.

Question Paper Template

Unit	Remembering/ Knowledge (1)	Understanding (2)	Applying (3)	Analysing (4)	Evaluating (5)	Creating (6)	Total marks
I	20%	30%	20%	20%	-	10%	100 %
II	20%	20%	30%	30%	-	-	100 %
III	20%	40%	20%	20%	-	-	100 %
IV	20%	40%	20%	20%	-	-	100 %

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
• develop crystals of variety through different growth techniques	√	√				√
• gain knowledge of the construction and performance characteristics of different spectroscopy and microscopy techniques and their applications	√	√	√			√
• gain knowledge on formation of nucleus during growth of crystals	√	√				
• apply various methods for analysing thermal properties	√	√	√			√



M. Sc. (Physics) SEMESTER I

COURSE TITLE: Numerical Methods

COURSE CODE: PHYMSC-S1E3-4CR24 [CREDITS - 04]

EC III		Course Code: PHYMSC-S1E3-4CR24	
Course Learning Outcomes			
<p>At the end of this course, learners will be able to</p> <ul style="list-style-type: none"> • apply spline functions to curve fitting • use LU decomposition methods for various problems in Physics • solve ordinary and partial differential equation by using different numerical methods. 			
Unit I	Spline Functions		[15L]
<p>Learning Objective: This unit is intended to</p> <ul style="list-style-type: none"> • introduce the spline functions and its properties to the students. 			
<p>Learning Outcomes: At the end of this unit, the learner will be able to</p> <ul style="list-style-type: none"> • apply spline functions to curve fitting. 			
1.1	Linear splines, quadratic splines, cubic splines, minimizing property of cubic splines, error in the cubic splines and its derivatives, surface fitting by cubic splines, cubic B-splines representation of B-splines, least squares, solution application of B-splines.		[15L]
Unit II	Numerical Linear Algebra		[15L]
<p>Learning Objective: This unit is intended to</p> <ul style="list-style-type: none"> • introduce students to the method of LU decomposition for solving different equations. 			
<p>Learning Outcomes: At the end of this unit, the learner will be able to</p> <ul style="list-style-type: none"> • apply LU decomposition methods for various problems in Physics. 			
2.1	Introduction, triangular matrices, LU Decomposition of matrix, vector and matrix norms, solution of linear systems - direct methods, Gauss elimination, necessity for pivoting, Gauss-Jordan method, modification of the Gauss method to compute the inverse, number of arithmetic operations, LU decomposition method, computational procedure for LU decomposition method, LU decomposition from Gauss elimination, solution of tridiagonal systems, III-conditioned linear systems, method for III-conditioned systems, solution of linear systems - Iterative methods, matrix eigen value problem, eigen values of a symmetric tridiagonal matrix, Householder's method, QR method, singular value decomposition.		[15L]



Unit III	Numerical Solution of Ordinary Differential Equation	[15L]
<p>Learning Objective: This unit is intended to</p> <ul style="list-style-type: none"> introduce the students to different numerical methods to solve ordinary differential equations. 		
<p>Learning Outcomes: At the end of this unit, the learner will be able to</p> <ul style="list-style-type: none"> solve ordinary differential equation by using different numerical methods. 		
3.1	Introduction, solution by Taylor's Series, Picard's method of successive approximations, Euler's method, error estimates for the Euler Method, modified Euler's method, Runge-Kutta methods, predictor-corrector methods, Adams-Moulton method, Milne's method, cubic spline method, simultaneous and higher-order equations, some general remarks, boundary-value problems, Finite-difference method, Cubic Spline method, Galerkin's Method.	[15L]
Unit IV	Numerical Solution of Partial Differential Equation	[15L]
<p>Learning Objective: This unit is intended to</p> <ul style="list-style-type: none"> introduce the students to different numerical methods to solve partial differential equations. 		
<p>Learning Outcomes: At the end of this unit, the learner will be able to</p> <ul style="list-style-type: none"> solve partial differential equation by using different numerical methods. 		
4.1	Introduction, Laplace's equation, Finite-difference approximations to derivatives, solution of Laplace's equation, Jacobi's method, Gauss-Seidel method, Successive Over-Relaxation (SOR) method, ADI method, heat equation in one dimension, Finite-difference approximations, Iterative methods for the solution of equations, application of Cubic spline, wave equation, software for partial differential equations.	[8L]
<p>Reference Books:</p> <ul style="list-style-type: none"> Introductory Methods of Numerical Analysis: S. S. Sastry, 5th Ed., PHI, 2012 Numerical Methods for Scientists and Engineers: K. S. Rao, 4th Ed., PHI, 2001 Numerical Mathematical Analysis: J. B. Scarborough, Oxford Books Co., 6th Ed., 1962 Numerical methods for Engineers: S. C. Chapra, R. P. Canale, 5th Ed., McGraw Hill, 2006. Numerical Analysis for Scientists and Engineers: Theory and C Programs, Madhumangal Pal, 1st Ed., Alpha Science International Ltd., 2007. 		



Question Paper Template

Unit	Remembering/ Knowledge (1)	Understanding (2)	Applying (3)	Analysing (4)	Evaluating (5)	Creating (6)	Total marks
I	20%	20%	30%	20%	10%	-	100 %
II	20%	20%	30%	30%	10%	-	100 %
III	10%	30%	30%	20%	10%	-	100 %
IV	10%	30%	30%	20%	10%	-	100 %

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
• apply spline functions to curve fitting	√	√				
• use LU decomposition methods for various problems in Physics	√	√			√	√
• solve ordinary and partial differential equation by using different numerical methods	√	√			√	√



M. Sc. (Physics) SEMESTER I

COURSE TITLE: Basic Nuclear Properties and Radioactivity

COURSE CODE: PHYMSC-S1E4-4CR24 [CREDITS - 04]

EC IV	Course Code: PHYMSC-S1E4-4CR24	
Course Learning Outcomes		
<p>At the end of this course, learners will be able to</p> <ul style="list-style-type: none"> • illustrate the concepts of radioactive decay and its applications • understand basic properties of α-particle • solve various problems related to energy and range of the α-particle • understand the concepts of β-decay and solve problems related to β- decay • understand the concepts of γ -decay and Mossbauer effect. 		
Unit I	Radioactivity	[15L]
<p>Learning Objective: This unit is intended to</p> <ul style="list-style-type: none"> • familiarize the students with the concepts of radioactive disintegration and growth and decay of radioactive substance. • study the mean life and half-life of radioactive substances and understanding the age of minerals and rocks. 		
<p>Learning Outcomes: At the end of this unit, the learner will be able to</p> <ul style="list-style-type: none"> • illustrate the concepts of radioactive decay. • understand the mean life and half-life of radioactive substance. • review various applications of radioactivity. 		
1.1	Radioactive disintegration and displacement law, growth and decay of radioactivity, successive disintegration, radioactive equilibrium, discovery of radium, radioactive series, branching, radon gas, mean life of a radioactive substance, measurement of decay constant, half-lives for complex decays, age of minerals and rocks, applications of radioactivity.	[15L]
Unit II	Alpha Particles and Alpha Radioactivity	[15L]
<p>Learning Objective: This unit is intended to</p> <ul style="list-style-type: none"> • study various properties of α-particles • elaborate range energy relation and theory of α disintegration. 		
<p>Learning Outcomes: At the end of this unit, the learner will be able to</p> <ul style="list-style-type: none"> • understand basic properties of α-particle. 		



<ul style="list-style-type: none"> • solve various problems related to energy and range of the α-particle. 		
2.1	Determination of q/M of α -particles, determination of the charge and mass of the α -particles, identification of α particle by spectroscopic method, determination of the velocity of the α -particle, alpha disintegration energy, range of the α -particle, range energy relationship for α -particles, Geiger-Nuttal law, theory of α disintegration.	[15L]
Unit III	Beta Particles and Beta Activity	[15L]
<p>Learning Objective: This unit is intended to</p> <ul style="list-style-type: none"> • infer the concepts of β-decay. • familiarize with the concept of continuous β energy spectrum and the Neutrino hypothesis. 		
<p>Learning Outcomes: At the end of this unit, the learner will be able to</p> <ul style="list-style-type: none"> • understand the concepts of β-decay and solve problems related to β- decay. • relate the β- decay and α – decay scheme. 		
3.1	Determination of the specific charge of the beta particles, Bucherer's experiment, determination of the β energy, focusing a charged particle by a magnetic field, energetics of β - decay, origin of continuous β -spectrum: neutrino hypothesis, Fermi's theory of allowed β -decay, allowed and forbidden β -transitions, selection rules in β -decay, Sargent diagram.	[15L]
Unit IV	Gamma Rays	[15L]
<p>Learning Objective: This unit is intended to</p> <ul style="list-style-type: none"> • infer the concepts of γ -decay. 		
<p>Learning Outcomes: At the end of this unit, the learner will be able to</p> <ul style="list-style-type: none"> • understand the concepts of γ -decay and Mossbauer effect. 		
4.1	Nature of γ -rays, passing a γ -rays through matter, photoelectric absorption of γ -rays, Compton scattering of γ -rays, electron-positron pair production by γ -rays, electron-positron pair annihilation, determination of γ -ray energy, γ -ray spectra and nuclear energy levels.	[15L]
<p>Reference Books:</p> <ul style="list-style-type: none"> • Introductory Nuclear Physics by K. Krane, 3rd Ed., Wiley India Pvt. Ltd. • Nuclear Physics by S. N. Ghoshal, S. Chand & Co. Pvt. Ltd., Revised enlarged Edition, 2014. • Nuclear Physics by D. C. Tayal, Revised enlarged Edition, Himalaya Publishing House, 2017. 		



- Nuclear Physics by Roy and Nigam, 2nd Ed., Wiley Eastern Ltd., 1979.
- Atomic and Nuclear Physics by S. N. Ghoshal, Revised Edition, S. Chand & Company, 2019.
- Nuclear Models by W. Greiner and J.A. Maruhn, 1st Ed., Springer, 1996.

Question Paper Template

Unit	Remembering/ Knowledge (1)	Understanding (2)	Applying (3)	Analysing (4)	Evaluating (5)	Creating (6)	Total marks
I	30%	30%	20%	20%	-	-	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
• illustrate the concepts of radioactive decay and its applications	√	√			√	
• understand basic properties of α -particle	√	√				
• solve various problems related to energy and range of the α -particle	√	√			√	
• understand the concepts of β -decay and solve problems related to β - decay	√	√			√	



M. Sc. (Physics) SEMESTER I

COURSE TITLE: Introduction to Arduino

COURSE CODE: PHYMSC-S1SEC1-2CR24 [CREDITS - 02]

SEC I	Course Code: PHYMSC-S1SEC1-2CR24	
Course Learning Outcomes		
<p>At the end of this course, learners will be able to</p> <ul style="list-style-type: none"> 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]
<p>Learning Objective: This unit is intended to</p> <ul style="list-style-type: none"> introduce the students to programming using Arduino UNO board. 		
<p>Learning Outcomes: At the end of this unit, the learner will be able to</p> <ul style="list-style-type: none"> use combination of input and output devices to work in programmed manner. 		
1.1	<p>Main Components of Embedded Systems, Constraints of Embedded Systems, Concepts of microprocessor and microcontroller and other Elements of Embedded Systems. What is a Program/Software/Simulator/Compiler and its applications within Embedded Systems. Microcontrollers, Programming Microcontrollers, Arduino Platform, The Boards, The Anatomy of an Arduino Board, The Development Environment (IDE).</p>	[7L]
1.2	<p>Learning about Analog, Digital, Power, Other Pins, External/USB power supply, reset button, and other components of Arduino Board. Learning about the standard library of Arduino, adding libraries from external sources. Writing Arduino Sketches, working with examples, interfacing some components like LED, switch and buzzer with Arduino, Serial Monitor of Arduino IDE.</p>	[8L]
Unit II	Sensor Fundamentals	[15L]
<p>Learning Objective: This unit is intended to</p> <ul style="list-style-type: none"> familiarize the students with interfacing of sensors and transducers introduce programming to control various LEDs, displays and sensor modules. 		
<p>Learning Outcomes: At the end of this unit, the learner will be able to</p>		



	<ul style="list-style-type: none"> • 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. 	
2.1	<p>How sensors work, analog and digital sensors, pull-up/down resistors and examples of sensors, connecting different sensors such as: humidity, heat/temperature, proximity, IR motion, accelerometer, sound, light, distance, pressure, thermal, infrared, LDR, ultrasonic transducer pair etc. to Arduino board, interfacing 16x2 LCD, reading various sensor data and displaying on serial monitor and LCD.</p>	[15L]
Reference Books:		
<ul style="list-style-type: none"> • 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:		
<ul style="list-style-type: none"> ➤ 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.		
<ol style="list-style-type: none"> 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

Question Paper Template

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

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 %

Mapping of CLOs and PSOs

Course Learning Outcomes	Programme Outcomes					
	1	2	3	4	5	6
<ul style="list-style-type: none"> • use combination of input and output devices to work in programmed manner 	√	√			√	
<ul style="list-style-type: none"> • differentiate various sensors based on touch, sound, temperature and humidity 	√	√			√	
<ul style="list-style-type: none"> • design a minimum level of automation system using sensors and display devices to perform a task 	√	√			√	√



M. Sc. (Physics) SEMESTER I

COURSE TITLE: MSc Sem I Lab Course

COURSE CODE: PHYMSC-S1PR1-6CR24 [CREDITS - 06]

Practical I	Course Code: PHYMSC-S1PR1-6CR24														
Course Learning Outcomes															
<p>After the successful completion of the course, learners will be able to</p> <ul style="list-style-type: none"> • demonstrate practical skills • correlate the Physics theory concepts through practical 															
Group-A Practicals															
➤	<table border="1" style="width: 100%; border-collapse: collapse;"> <tbody> <tr><td style="width: 5%; text-align: center;">1</td><td>To obtain the Fourier transforms of given function.</td></tr> <tr><td style="text-align: center;">2</td><td>To obtain the Laplace transforms of given function.</td></tr> <tr><td style="text-align: center;">3</td><td>To obtain spherical harmonics for different values of l.</td></tr> <tr><td style="text-align: center;">4</td><td>To evaluate the given data by applying Binomial distribution function.</td></tr> <tr><td style="text-align: center;">5</td><td>To evaluate the given data by applying Poisson distribution function.</td></tr> <tr><td style="text-align: center;">6</td><td>To evaluate the given data by applying Gaussian distribution function.</td></tr> <tr><td style="text-align: center;">7</td><td>To determine the eigenvalues and eigenvectors of the given matrix.</td></tr> </tbody> </table>	1	To obtain the Fourier transforms of given function.	2	To obtain the Laplace transforms of given function.	3	To obtain spherical harmonics for different values of l .	4	To evaluate the given data by applying Binomial distribution function.	5	To evaluate the given data by applying Poisson distribution function.	6	To evaluate the given data by applying Gaussian distribution function.	7	To determine the eigenvalues and eigenvectors of the given matrix.
1	To obtain the Fourier transforms of given function.														
2	To obtain the Laplace transforms of given function.														
3	To obtain spherical harmonics for different values of l .														
4	To evaluate the given data by applying Binomial distribution function.														
5	To evaluate the given data by applying Poisson distribution function.														
6	To evaluate the given data by applying Gaussian distribution function.														
7	To determine the eigenvalues and eigenvectors of the given matrix.														
Group-B Practicals															
➤	<table border="1" style="width: 100%; border-collapse: collapse;"> <tbody> <tr><td style="width: 5%; text-align: center;">1</td><td>To measure the period of oscillation of the given pendulum by changing (i) angle of inclination and (ii) length using variable 'g' pendulum setup.</td></tr> <tr><td style="text-align: center;">2</td><td>To determine the resistivity of the material by using Four-probe method.</td></tr> <tr><td style="text-align: center;">3</td><td>To identify the crystal structure by X- ray diffraction pattern.</td></tr> <tr><td style="text-align: center;">4</td><td>To study Linear Variable Differential Transducer (LVDT).</td></tr> <tr><td style="text-align: center;">5</td><td>To determine the range of projectile as a function the angle of inclination using Projectile Motion experiment setup.</td></tr> <tr><td style="text-align: center;">6</td><td>To determine the wavelength of monochromatic light by using Michealson Interferometer.</td></tr> <tr><td style="text-align: center;">7</td><td>To study absorption spectrum of Iodine molecule.</td></tr> </tbody> </table>	1	To measure the period of oscillation of the given pendulum by changing (i) angle of inclination and (ii) length using variable 'g' pendulum setup.	2	To determine the resistivity of the material by using Four-probe method.	3	To identify the crystal structure by X- ray diffraction pattern.	4	To study Linear Variable Differential Transducer (LVDT).	5	To determine the range of projectile as a function the angle of inclination using Projectile Motion experiment setup.	6	To determine the wavelength of monochromatic light by using Michealson Interferometer.	7	To study absorption spectrum of Iodine molecule.
1	To measure the period of oscillation of the given pendulum by changing (i) angle of inclination and (ii) length using variable 'g' pendulum setup.														
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7	To study absorption spectrum of Iodine molecule.														
Group-C Practicals															
➤	<table border="1" style="width: 100%; border-collapse: collapse;"> <tbody> <tr><td style="width: 5%; text-align: center;">1</td><td>To design, build and test 4-bit Up/Down counter using IC 7493.</td></tr> <tr><td style="text-align: center;">2</td><td>To design, build and test triangular wave generator.</td></tr> <tr><td style="text-align: center;">3</td><td>To study Voltage-Controlled Oscillator using IC 566.</td></tr> <tr><td style="text-align: center;">4</td><td>To design, build and test active low pass and high pass filter.</td></tr> <tr><td style="text-align: center;">5</td><td>To design, build and test active band pass and notch filter.</td></tr> </tbody> </table>	1	To design, build and test 4-bit Up/Down counter using IC 7493.	2	To design, build and test triangular wave generator.	3	To study Voltage-Controlled Oscillator using IC 566.	4	To design, build and test active low pass and high pass filter.	5	To design, build and test active band pass and notch filter.				
1	To design, build and test 4-bit Up/Down counter using IC 7493.														
2	To design, build and test triangular wave generator.														
3	To study Voltage-Controlled Oscillator using IC 566.														
4	To design, build and test active low pass and high pass filter.														
5	To design, build and test active band pass and notch filter.														



6	To design, build and test universal shift register.
7	To design, build and test adjustable voltage regulator using LM 317.

Reference Books:

- 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. Three such experiments are to be performed by each student per week.
- In the external exam, a student will have to perform three experiments, one from each group. The experiment will be of 4-hour duration.
- There should be three examiners, one for each group, in the external examination.

Question Paper Template

Unit	Remembering/ Knowledge (1)	Understanding (2)	Applying (3)	Analysing (4)	Evaluating (5)	Creating (6)	Total marks
Practical I	10%	30%	20%	20%	10%	10%	100 %

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	√	√			√	