Chaudhary Bansi Lal University

(A State University established under Haryana Act No. 25 of 2014)

Scheme of Examination
For
Postgraduate Programme

M.Sc. PHYSICS

as per NEP 2020
Curriculum and Credit Framework for Undergraduate Programmes
(Multiple Entry-Exit, Internships and Choice Based Credit System LOCF)

With effect from the session 2025-26 (in phased manner)

DEPARTMENT OF PHYSICS

Chaudhary Bansi Lal University, Prem Nagar-127031
Bhiwani
HARYANA, INDIA

Programme Learning Outcomes (PLOs) for PG Programmes as per NEP-2020

PLOs		Master Degree in Physics
		After the completion of Master degree in Physics the student will be able to:
PLO-1	Knowledge and Understanding	Demonstrate the fundamental and advanced knowledge of the subject and understanding of recent developments and issues, including methods and techniques, related to the Physics.
PLO-2	General Skills	Acquire the general skills required for performing and accomplishing the tasks as expected to be done by a skilled professional in the fields of Physics.
PLO-3	Technical/ Professional Skills	Demonstrate the learning of advanced cognitive technical/professional skills required for completing the specialized tasks related to the profession and for conducting and analyzing the relevant research tasks indifferent domains of the Physics.
PLO-4	Communication Skills	Effectively communicate the attained skills of the Physics in well-structured and productive manner to the society at large.
PLO-5	Application of Knowledge and Skills	Apply the acquired knowledge and skills to the problems in the subject area, and to identify and analyze the issues where the attained knowledge and skills can be applied by carrying out research investigations to formulate evidence-based solutions to complex and unpredictable problems associated with the field of Physics or otherwise.
PLO-6	Critical thinking and Research Aptitude	Attain the capability of critical thinking in intra/inter-disciplinary areas of the Physics enabling to formulate, synthesize, and articulate issues for designing of research proposals, testing hypotheses, and drawing inferences based on the analysis.
PLO-7	Traditional knowledge, Values and Ethics	Demonstrate awareness of traditional astronomical tools and methodologies and compare them with modern instruments. Understand the historical, cultural, and philosophical foundations of Indian science and its global relevance.
PLO-8	Capabilities/qualities and mindset	To exercise personal responsibility for the outputs of own work as well as of group/team and for managing complex and challenging work(s) that requires new/strategic approaches.
PLO-9	Employability and job-ready skills	Attain the knowledge and skills required for increasing employment potential, adapting to the future work and responding to the rapidly changing demands of the employers/industry/society with time.

Chaudhary Bansi Lal University Bhiwani

Scheme of Examination for the Post Graduate Programmes (M.Sc. Physics)
as per NEP 2020 Curriculum and Credit Frame work for Postgraduate Programmes
(Choice Based Credit System LOCF) with effect from the session 2025-26 (in a phased manner)

2-year PG Programme

Semester I

Course Type	Course Code	Nomenclature of course	Theory (T)/ Practical (P)	Credits		Contact hours per week L: Lecture P: Practical T: Tutorial				Internal Assessment Marks	End Term Examination Marks	Total Marks	Examination hours
					Total	L	T	P	Total				
CC-1	25PN-PHY-101	Mathematical Physics	T	4		4	0	0	4	30	70	100	3
CC-2	25PN-PHY-102	Classical Mechanics	T	4		4	0	0	4	30	70	100	3
CC-3	25PN-PHY-103	Quantum Mechanics -I	T	4		4	0	0	4	30	70	100	3
DEC-I	25PN-PHY-105E	Electronic Devices and Circuits- I	T	4	24	4	0	0	4	30	70	100	3
	25PN-PHY-105M	Material Science -I											
CC-4	25PN-PHY-104	General Electronics-I	P	4		0	0	8	8	30	70	100	3
PC-1	25PN-PHY-106	Physics Lab- I	P	4		0	0	8	8	30	70	100	3

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Physics		
Semester	1^{st}		
Name of the Course	Mathematical Physics		
Course Code	25PN-PHY-101		
Course Type	CC-I		
Level of the course	500-599		
Pre-requisite for the course (if any)	--		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	**CLO 101.1:** Understand basics of group theory, preparation of group multiplication tables and construction of character table of symmetry groups. **CLO 101.2:** Find the Fourier series expansion, Fourier integrals, Fourier and Laplace transforms of functions and derivatives. **CLO 101.3:** Obtain explicit expressions of Hermite, Laguerre, Bessel and Legendre polynomials and to establish their recurrence relations and other properties. **CLO 101.4**: Derive Cauchy integral theorem, Cauchy integral formula, Taylor and Laurent series expansion of functions of complex variable and to evaluate some typical definite integral using the method of contour integration.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B-Contents of the Course

Instructions for Paper-Setter

1. The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration.
2. The compulsory question (Question No. 1) will consist of at least 4 parts covering entire syllabus.
3. The question paper is expected to contain problems to the extent of 20% of total marks.
4. The examinee will be required to attempt 5 questions; selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Matrices and Group Theory:** Matrices: Orthogonal, Unitary and Hermitian matrices, Eigenvalues and eigenvectors of matrices, Matrix diagonalization. Fundamentals of Group theory: Definition of a group and illustrative examples, Group multiplication table, rearrangement theorem, cyclic groups, sub-groups and cosets, permutation groups, conjugate elements and class	15

	structure, normal devisors and factor groups, isomorphism and homomorphism, class multiplication. Group representation: Reducible and irreducible representations, great orthogonality theorem (without proof) and its geometric interpretation.	
II	**Differential Equation:** Solution of linear differential equation of first and second order with constant coefficients, ordinary point, singular point (Regular and Irregular), series solution around an ordinary point, series solution around a regular singular point by Frobenius method, Solution of Legendre's differential equation, Solution of Bessel's differential equation, Solution of Laguerre and Hermite's differential equations, Fourier transform, Fourier cosine and sine transform , Laplace transform, Properties of Laplace transforms, Inverse Laplace transformation.	15
III	**Special Functions**: Bessel Functions: Bessel functions of the first kind $J_n(x)$, Generating function, Recurrence relations, Expansion of $J_n(x)$ when n is half an odd integer, Integral representation; Legendre Polynomials $P_n(x)$: Generating function, Recurrence relations and special properties, Rodrigues' formula, Orthogonality of $P_n(x)$; Associated Legendre polynomials, Hermite and Laguerre Polynomials: generating function & recurrence relations only.	15
IV	**Functions of a complex variable and calculus of residues:** Complex algebra, Functions of a complex variable, Cauchy's integral theorem, Cauchy's integral formula; Taylor and Laurent expansions; Singularities; Cauchy's residue theorem, Cauchy principle value, Singular points and evaluation of residues, Jordan's Lemma; Evaluation of definite integrals of the type: $\int_0^{2\pi} f(\sin\theta, \cos\theta)\, d\theta$; $\int_{-\infty}^{\infty} f(x)dx$; $\int_{-\infty}^{\infty} f(x)e^{iax}dx$ using Cauchy's residue theorem.	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		End Term Examination: 70	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Group Theory and Quantum Mechanics by M. Tinkam.
2. Mathematical Methods for Physicists (4^{th} edition) by G. Arfken.
3. Mathematical Methods for Physicists (6^{th} edition) by Arfken and Weber.
4. Mathematical Physics for Physicists and Engineers by L. Pipes.
5. Introduction to Mathematical Physics by C. Harper.

Session: 2025-26			
Part A - Introduction			
Name of Programme	M.Sc. Physics		
Semester	1^{st}		
Name of the Course	Classical Mechanics		
Course Code	25PN-PHY-102		
Course Type	CC-2		
Level of the course	500-599		
Pre-requisite for the course (if any)	--		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	**CLO 102.1:** Demonstrate a basic and advanced knowledge of Lagrangian and Hamiltonian Formulations and solve related problems. Identify the cyclic coordinates and understand their importance in Hamiltonian formulation. **CLO102.2:** Acquire knowledge of canonical Transformation and various generating functions for this transformation. Develop a deep understanding to tackle the problems of classical mechanics under small oscillations. **CLO 102.3:** Demonstrate the concept of motion of a particle under central force and apply advanced methods to deal with central force problems. Use Hamilton-Jacobi theory for finding the solutions of various Classical systems. **CLO 102.4:** Understand the foundations of nonlinear dynamics in general and chaotic motion and fractals, in particular. Perform stability analysis of cubic an harmonic oscillator and undamped pendulum, and find chaotic trajectories.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B-Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist of at least 4 parts covering entire syllabus. The question paper is expected to contain problems to the extent of 20% of total marks. The examinee will be required to attempt 5 questions; selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Lagrangian and Hamiltonian formulations:** Hamilton's principle,	15

	Derivation of Lagrange's equations from Hamilton's principle, Principle of Least Action and its applications, Canonical Transformation; The Hamiltonian Formalism: Canonical formalism, Hamiltonian equations of motion, The physical significance of the Hamiltonian, Cyclic coordinates, Rauthian procedure and equations, Derivation of Generating functions, examples, properties, Derivation of Hamiltonian equations from variational principle.	
II	**Poisson bracket and theory of small oscillations**: Poisson bracket, special cases of Poisson bracket, Poisson theorem, Poisson bracket and canonical transformation, Jacobi identity and its derivation, Lagrange bracket and its properties, the relationship between Poisson and Lagrange brackets and its derivation, the angular momenta and Poisson bracket, Liouville's theorem and its applications; Theory of small oscillations: Formulation of the problem, Eigenvalue equation and the principle axis transformation, frequencies of free vibrations and normal coordinates, free vibrations of a linear triatomic molecule.	15
III	**Two-body central force problem and H-J theory:** Two body central force problem: Reduction to the equivalent one body problem, the equation of motion and first integrals, classification of orbits, the Virial theorem, the differential equation for the orbit, integrable power law in time in the Kepler's problem, scattering in central force field; H-J Theory: H-J equation and their solutions, use of H-J method for the solution of harmonic oscillator problem, Hamilton's principle function, Hamilton's characteristic function and their properties.	15
IV	**Introductory non-linear dynamics:** Classical Chaos: Linear and nonlinear systems, periodic motion, Perturbation and KAM theorem, dynamics in phase space, phase portraits for conservative systems, attractors, classification and stability of equilibrium points, stability analysis of cubic an harmonic oscillator and un damped pendulum, chaotic trajectories and Liapunov exponent, Poincare Map, Henon-Hiels Hamiltonian, bifurcation, driven-damped harmonic oscillator, the logistic equation, Fractals and dimensionality.	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		End Term Examination: 70	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Classical Mechanics (3rd ed., 2002) by H. Goldstein, C. Poole and J. Safko, Pearson Edition
2. Classical Mechanics by John R Taylor.
3. Chaos and Integrability in nonlinear dynamics: An introduction (1989) by Michael Tabor.
4. Nonlinear dynamics: Integrability, Chaos and patterns (2003) by M. Lakshmanan and S. Rajasekar.
5. Classical Mechanics, J.C. Upadhyaya, Himalaya Publishing House.

Session: 2025-26			
Part A– Introduction			
Name of Programme	M. Sc. Physics		
Semester	1st		
Name of the Course	Quantum Mechanics-I		
Course Code	25PN-PHY-103		
Course Type	CC-3		
Level of the course	500-599		
Pre-requisite for the course (if any)	--		
Course Learning Outcomes (CLOs) After completing this course, the learner will be able to:	**CLO 103.1:** Realize basic quantum-mechanical view point, learn its wave mechanical & matrix formulations, and solve the Schrödinger equation for simple potentials, including harmonic and central potentials. **CLO 103.2:** Construct matrices for observables and wave functions in different representations, apply matrix theory to linear harmonic oscillator, and describe the time-development of a quantum system in Schrödinger, Heisenberg and Interaction pictures. **CLO 103.3:** Calculate the eigenvalues and eigen functions for the orbital and general angular momenta, learn the matrix representation of angular momentum, and perform addition of two angular momenta. **CLO 103.4:** Grasp the concepts of identity & indistinguishability, understand symmetric and anti-symmetric wave functions, construct spin and total wave functions for a system of two spin ½ particles, and comprehend connection among spin, symmetry & statistics.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		
Part B-Contents of the Course			

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist of at least 4 parts covering entire syllabus. The question paper is expected to contain problems to the extent of 20% of total marks. The examinee will be required to attempt 5 questions; selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact

		Hours
I	**Schrodinger formulation of Quantum Mechanics:** Recapitulation of basic concepts: Two-slit experiment with *em* radiation and matter particles, Quantum-mechanical view point, The Schrödinger wave equation, Expectation values, Ehrenfest theorem; Interpretative postulates of quantum mechanics: Dynamical variables as Hermitian operators, Eigenvalues and eigen functions, Expansion in eigen functions; Illustration of postulates for energy and momentum: Ortho normality of eigen functions, Reality of eigenvalues, Closure property, Probability function and expectation value, Co-ordinate and momentum representations of wave function, Uncertainty principle for two arbitrary observables; Problems: A charged particle in a uniform static magnetic field (eigen functions and Landau levels); The Hydrogen atom (reduced mass, radial wave functions and energy eigenvalues).	15
II	**Matrix formulation of Quantum Mechanics:** Preliminaries: Hermitian and unitary matrices, Transformation and diagonalization of matrices, Matrices of infinite rank; Representation of observables and wave functions as matrices, Transformation theory, choice of basis, change of basis, unitary transformations, Hilbert space representation; Dirac's ket and bra notation; Time-development of quantum system: Schrödinger, Heisenberg and Interaction pictures, Link with classical equations of motion, Quantization of a classical system; Application to motion of a particle in an *em* field; Matrix theory of the harmonic oscillator: Spectrum of eigenvalues and eigen functions, Matrices for position, momentum and energy operators (energy representation).	15
III	**Quantum theory of Angular Momentum:** Orbital angular momentum operator **L**, Cartesian and spherical polar co-ordinate representation, Commutation relations, Orbital angular momentum and spatial rotations, Eigenvalues and eigen functions of $\mathbf{L}^2$ and L_z, Spherical harmonics; General angular momentum **J**: Eigenvalues and eigen functions of $\mathbf{J}^2$ and J_z, Matrix representation of angular momentum operators, Spin angular momentum, Wave function including spin (Spinor); Spin one-half: Spin eigen functions, Pauli spin matrices; Addition of two angular momenta, Clebsch-Gordan coefficients and their calculation for $j_1= j_2 =1/2$, $j_1=1$, $j_2 =1/2$ and $j_1= j_2 =1$; The Wigner-Eckart theorem.	15
IV	**Many-particle systems and identical particles:** Many-particle Schrödinger wave equation, Stationary-state solutions; Systems of identical particles, Physical meaning of identity, Principle of indistinguishability, Exchange and transposition operators, Totally symmetric and anti-symmetric wave functions, Time-invariance of symmetry, Construction of symmetric and anti-symmetric wave functions, Connection among spin, symmetry and statistics of identical particles, Fermions and bosons; Spin and total wave functions for a system of two spin ½ particles, Pauli exclusion principle and Slater determinant; Application to the electronic system of the helium atom (*para*- and *ortho*-	15

	helium); Limit of distinguishability of identical particles; Basic idea of quantum entanglement.	
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Quantum Mechanics (3rd edition) by L. I. Schiff
2. Quantum Mechanics (2nd edition) by B. H. Bransden and Joachain
3. Quantum Mechanics (3rd edition) by S. Gasiorowicz
4. Quantum Mechanics (3rd edition) by E. Merzbacher
5. Quantum Mechanics by John L. Powell and B. Crasemann
6. Quantum Mechanics by A. K. Ghatak and S. Loknathan
7. Introductory Quantum Mechanics (4rd edition) by Richard L. Liboff
8. Quantum Mechanics: Concepts and Applications (2nd edition) by N. Zettili
9. Quantum Mechanics by Y. B. Band and Y. Avishai

Part A - Introduction			
Name of Programme	M.Sc. Physics		
Semester	1^{st}		
Name of the Course	Electronic Devices and Circuits-I		
Course Code	25PN-PHY-105E		
Course Type	DEC-I		
Level of the course	500-599		
Pre-requisite for the course (if any)	--		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	**CLO 104.1:** Be aware of the general characteristics of important semiconductor materials. Develop a deep understanding of the basic design, operation and characteristics of a pn-junction and a BJT along with knowledge of the basic network theorems and their applications in electronic circuit analysis. **CLO 104.2:** Learn to devise and analyze various transistor amplifier models. Understand the concept of negative feedback and its importance in amplifiers. **CLO 104.3:** Perform a load-line analysis and design of various biasing schemes in amplifiers. Acquaint with the frequency response of variously coupled amplifiers and sources of noise in electronic devices. **CLO 104.4:** Gain knowledge of classification, sources of distortions and their estimation, operation and determination of efficiency of power amplifiers. Clearly understand the need of regulation, operation and circuit analysis of different voltage and current regulators.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B-Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist of at least 4 parts covering entire syllabus. The question paper is expected to contain problems to the extent of 20% of total marks. The examinee will be required to attempt 5 questions; selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Basics of pn-junction, BJT and Network Theorems:** Semiconductors: intrinsic and extrinsic semiconductors, charge densities in p and n type semiconductors, conduction by charge drift and diffusion, the pn-junction, energy level diagrams of	15

	pn-junction under forward and reverse bias conditions, derivation of pn-diode equation, Zener diode, Zener and avalanche breakdowns, clipping and clamping circuits; The bipolar junction transistor: basic working principle, configurations and characteristics, voltage breakdowns, Network theorems: node, mesh, superposition, Miller's, Thevenin's and Norton's theorems.	
II	**Amplifier Models, Feedback and Biasing**: Two port network analysis: active circuit models, gain in decibels, equivalent circuit for BJT, the trans conductance model for BJT, analysis of CE, CB, and CC amplifiers; An amplifier with feedback, effect of negative feedback on gain and its stability, distortions, input and output impedances of amplifiers, Location of quiescent (Q) point, biasing circuits for amplifiers: fixed bias, emitter feedback bias & voltage feedback bias, bias compensation, bias techniques for linear integrated circuits, thermal runaway and thermal stability.	15
III	**Frequency Response of Amplifiers:** The amplifier pass band, mid frequency range response of a direct coupled CE cascade, the high frequency equivalent circuit (Miller effect), the high frequency response of a direct coupled CE cascade, the frequency response of RC and transformer coupled CE amplifiers, gain-frequency plots of amplifier response (Bode plots), bandwidth of cascaded amplifiers, bandwidth criterion for the transistor, the gain-bandwidth product, composite amplifier designs, bootstrapping in amplifiers, noise in amplifiers, noise figure.	15
IV	**Power Amplifiers and Regulators:** Power amplifiers: class A large signal amplifier, second and higher order harmonic distortions, the transformer coupled power amplifier, impedance matching, efficiency, push-pull amplifiers, class-B amplifiers, complementary stages, cross over distortions, class-AB operation, heat sinks, derating curve; Electronic voltage regulators: basic operation and analysis of Zener diode voltage regulator, single BJT shunt and series regulators, feedback series BJT regulator and current regulator, overload and short circuit protection circuits.	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		End Term Examination: 70	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Electronic fundamentals and applications (5th Ed.) by J. D. Ryder.
2. Integrated Electronics by J. Millman and C. C. Halkias.
3. Circuits and Networks: Analysis and Synthesis by A.Sudhakar and S.M.S. Palli
4. Electronic devices and circuits by Y. N. Bapat.
5. Pulse, digital and switching waveforms by J. Millman and H. Taub.
6. Millman's Electronic Devices and Circuits by J. Millman, C. C. Halkias&SatyabrataJit
7. Electronic Devices and Circuit Theory by Robert L Boylestadand Louis Nashelsky.
8. Solid state Electronic Devices by B.G. Streetman and S.K. Banerjee.

Session: 2025-26

Part A–Introduction

Name of Programme	M. Sc. Physics		
Semester	1^{st}		
Name of the Course	Material Science-I		
Course Code	25PN-PHY-105M		
Course Type	DEC-I		
Level of the course	500-599		
Pre-requisite for the course (if any)	--		
Course Learning Outcomes (CLOs) After completing this course, the learner will be able to:	**CLO 308.1:** Understand the basic concepts and properties of Materials and describe how and why defects (point, line and planar) in materials greatly affect engineering properties and limit their use in service **CLO 308.2:** Understand strengthening and grasp the importance of various strengthening mechanisms and describe various parameters involved in elastic deformation, plastic deformation, an elastic deformation etc. **CLO 308.3:** Grasp the concept of phase diagrams and be able to predict microstructures and understand transformation mechanisms (nucleation and growth, martensitic) and comprehend Iron-Carbon system and ceramics. .**CLO 308.4:** Elucidate the kinematics of elastic collisions and have in depth understanding energetic ion beam based techniques (given in the syllabus) for analysis of materials and perform computations of depth profiles and concentration analysis using these techniques, Choose the most appropriate technique for characterization.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B-Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist of at least 4 parts covering entire syllabus. The question paper is expected to contain problems to the extent of 20% of total marks. The examinee will be required to attempt 5 questions; selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Imperfections in Solids:** Point Defects: vacancy, substitutional, interstitial, Frenkel and Schottky defects, equilibrium concentration of Frenkel and Schottky defects; Line Defects: slip planes and slip directions, edge and screw dislocations, Burger's vector, cross-slip, glide and climb, jogs, dislocation	15

	energy, super & partial dislocations, dislocation multiplication, Frank Read sources; Planar Defects: grain boundaries and twin interfaces; Dislocation Theory – experimental observation of dislocation, dislocations in FCC, HCP and BCC lattice.	
II	**Mechanical Properties:** Stress Strain Curve; Elastic Deformation: atomic mechanism of elastic deformation and anisotropy of Young's modulus, elastic deformation of an isotropic material; Anelastic and Viscous deformation; Plastic Deformation: Schmid's law, critically resolved shear stress; Strengthening Mechanisms: work hardening, recovery, recrystallization, strengthening from grain boundaries, low angle grain boundaries. Yield point. Strain aging, solid solution strengthening, two phase aggregates, strengthening from fine particles; Fracture: ideal fracture stress, brittle fracture-Griffith's theory, ductile fracture.	15
III	**Microstructure:** Solid Solutions and Intermediate Phases: phase rule, unitary & binary phase diagrams, Lever rule, Hume-Rothery rule; Free Energy and Equilibrium Phase Diagrams: complete solid miscibility, partial solid miscibility-eutectic, peritectic and eutectoid reactions, eutectaid mixture; Nucleation, Growth and Overall Transformation Kinetics; Martenstic Transformation; The Iron-Carbon System: various phases, phase diagram, phase transformations, microstructure and property changes in iron-carbon system; Ceramics: glass transition temperature, glassformers, commercial ceramics, mechanical properties, high temperature properties.	15
IV	**Materials Processing and Characterization:** Ion Implantation: introduction, ion implantation process, depth profile, radiation damage and annealing effects of trace-impurities, implantation induced alloying and structural phase transformation; Rutherford Backscattering Spectrometry (RBS): principle, kinematics of elastic collision, shape of the backscattering spectrum, depth profiles and concentration analysis, applications; Elastic Recoil Detection Analysis (ERDA): basic principle, kinematics, concentration analysis, depth profiling, depth resolution, applications; Secondary Ion Mass Spectroscopy (SIMS): basic principle, working, yield of secondary ions and applications.	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Material Science by J. C. Anderson, K. D. Leaver, J. M. Alexander and R. D. Rawlings
2. Mechanical Metallurgy by G. E. Dieter
3. Ion Implantation by G. Dearnally
4. Fundamentals of Surface and Thin Film Analysis by L. C. Feldman and J. W. Mayer
5. Surface Analysis Methods in Material Science by D. J. O'Connor, B. A. Sexton and R. St. C. Smart (Eds), Springer Series in Surface Sciences 2023.

Part A- Introduction			
Name of the Programme	M.Sc. Physics		
Semester	1st		
Name of the Course	General Electronics-I		
Course Code	25PN-PHY-104		
Course Type	CC-4		
Level of the course	500-599		
Pre-requisite for the course (if any)	--		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	**CLO 105.1:** Draw and understand the frequency response of different Filter circuits and a RC-coupled amplifier in its three configurations. Also measure important parameters of rectifier, filter, voltage regulator and pn-junction circuits. **CLO 105.2**: Design and draw load characteristics of a push-pull amplifier **CLO 105.3:** Design and understand the operations of clipping, clamping circuits, differentiating and integrating circuits. **CLO 105.4:** Measure the sensitivities of X and Y plates of a CRO and determine frequency and phase-difference using a CRO.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time	0	4 hours	

Part B – Contents of the Course	
Practicals	**Contact Hours**
Note: Student will perform at least eight experiments. The examiner will allot one practical at the time of end term examination. 1. To determine various parameters of a pn-junction diode. 2. To study the frequency response of low-pass, high-pass and band-pass filters. 3. To study the rectifier circuits and to measure the ripple factors of C, L and π-section filters. Also study the stabilization characteristics of a voltage regulator consisting of IC-741. 4. To study the load characteristics of a Class-B push-pull amplifier. 5. To draw frequency response characteristics of a RC-coupled single stage BJT amplifier in all the three configurations. 6. To measure (a) phase difference, (b) deflection sensitivities and (c) frequency of an unknown ac signal using CRO. 7. To study the clipping and the clamping circuits. 8. To study the differentiating and integrating circuits. 9. To simplify a complex circuit into a simpler equivalent circuit consisting of a voltage source in series with a resistance or by Thevenin's circuit. 10. To simplify a complex circuit into a single current source in	120

	parallel with a resistance or by Norton's circuit. 11. To analyze circuits with multiple independent voltage or current sources by considering the effect of each source individually or by Superposition circuit. 12. To study the characteristics of CB and CE Transistor configuration.	

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practicum**	**30**	➢ **Practicum**	**70**
• Class Participation:	5	Lab record, Viva-Voce, write-up and execution of the practical	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	25		

Part C - Learning Resources

Recommended Books/e-resources/LMS:

1. Integrated Electronics by J. Millman and C. C. Halkias
2. Pulse, digital and switching waveforms by J. Millman and H. Taub
3. Electronic devices and circuits by Y. N. Bapat
4. Microwave devices and circuits by Samuel Y. Liao
5. Physics of semiconductor Devices by S. M. Sze
6. Electronic instrumentation and measurement techniques by W. D. Cooper and A. D. Helfrick
7. OPAMPs and linear IC circuits by Ramakant A. Gayakwad
8. Electronics for Scientists and Engineers: Devices, Circuits and Systems by TV Viswanathan, GK Mehta and V Rajaraman

<table>
<tr><th colspan="4">Session: 2025-26</th></tr>
<tr><th colspan="4">Part A - Introduction</th></tr>
<tr><td>Name of the Programme</td><td colspan="3">M.Sc. Physics</td></tr>
<tr><td>Semester</td><td colspan="3">1st</td></tr>
<tr><td>Name of the Course</td><td colspan="3">Physics Lab-I</td></tr>
<tr><td>Course Code</td><td colspan="3">25PN-PHY-106</td></tr>
<tr><td>Course Type</td><td colspan="3">PC-2</td></tr>
<tr><td>Level of the course</td><td colspan="3">500-599</td></tr>
<tr><td>Pre-requisite for the course (if any)</td><td colspan="3">--</td></tr>
<tr><td>Course Learning Outcomes (CLO)
After completing this course, the learner will be able to:</td><td colspan="3">CLO 106.1: Determine the ionization potential of mercury. Measure the width of a narrow slit using diffraction phenomenon. Calculate the Planck’s constant using a suitable light source.
CLO 106.2: Set Fabry-Parot interferometers for various practical measurements. Verify the energy quantization using the Frank-Hertz Experiment.
CLO 106.3: Demonstrate different harmonics present in complex signals using Fourier Analysis.Verify the inverse square law of radiation flux.
CLO 106.4: Measure the band gap of a semiconductor material. Understand the underlying dynamics mimicked by the Chua’ and Feigenbaum circuits.</td></tr>
<tr><td rowspan="2">Credits</td><td>Theory</td><td>Practical</td><td>Total</td></tr>
<tr><td>0</td><td>4</td><td>4</td></tr>
<tr><td>Teaching Hours per week</td><td>0</td><td>8</td><td>8</td></tr>
<tr><td>Internal Assessment Marks</td><td>0</td><td>30</td><td>30</td></tr>
<tr><td>End Term Exam Marks</td><td>0</td><td>70</td><td>70</td></tr>
<tr><td>Max. Marks</td><td>0</td><td>100</td><td>100</td></tr>
<tr><td>Examination Time</td><td>0</td><td colspan="2">4 hours</td></tr>
<tr><th colspan="4">Part B-Contents of the Course</th></tr>
<tr><th colspan="3">Practicals</th><th>Contact Hours</th></tr>
<tr><td colspan="3">Note: Student will perform at least eight experiments. The examiner will allot one practical at the time of end term examination.
1. To determine the ionization potential of mercury.
2. To measure the width of a narrow slit using the diffraction phenomenon.
3. To determine the value of Planck’s constant using photocell/LED.
4. Fabry-Parot interferometer experiment.
5. Demonstration of energy quantization using the Frank-Hertz Experiment.
6. Fourier analysis of complex signals
7. To determine band-gap of a semiconductor material.
8. To verify the inverse square law of radiation flux.
9. To study nonlinear dynamics using Chua’ circuit.
10. To study nonlinear dynamics using Feigenbaum circuit.
11. To study B-H curve of a given ferrite sample and find energy loss in case of ferrite Core.</td><td>120</td></tr>
</table>

	12. To determine the capacitance of a parallel plate Capacitor using Capacitance and permittivity kit. 13. To determine the value of e/m i.e. specific charge for an electron by Helical Method. 14. To determine the wavelength of an given source using the double-slit experiment	

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practicum**	**30**	➢ **Practicum**	**70**
• Class Participation:	5	Lab record, Viva-Voce, write-up and execution of the practical	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	25		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Integrated Electronics by J. Millman and C. C. Halkias
2. Nonlinear dynamics: Integrability, Chaos and patterns (2003) by M. Lakshmanan and S. Rajasekar
3. Introduction to Solid State Physics (7th edition) by Charles Kittel
4. Modern Physics by Arthur Beiser
5. Elements of Nuclear Physics by W. E. Meyerhof.
6. Nuclear Radiation Detectors by S. S. Kapoor and V. S. Ramamurthy.