



SARDAR PATEL UNIVERSITY

Vallabh Vidyanagar

NAAC 'A' Grade (10-01-2023 To 09-01-2028)

NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

[M.Sc. Applied Physics] Semester-II

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2T02NCAPH01	Classical Mechanics and Quantum Mechanics	4-0-1	120	04

• Course Learning Outcomes (CLOs)

On completion of this course, students will be able to:

CLO1:

Critically analyze the motion of mechanical systems using Lagrangian and Hamiltonian approaches, including constraints and symmetry theorems.

CLO2:

Evaluate canonical transformations, Poisson brackets, and Hamilton-Jacobi theory to solve complex dynamical problems like the harmonic oscillator.

CLO3:

Formulate and solve the secular equation for small oscillations in coupled systems, determining eigenvectors and normal coordinates for linear triatomic molecules

CLO4:

Apply Dirac notation and commutator algebra within Hilbert space to determine eigenvalues, eigenvectors, and uncertainty relations for quantum operators

CLO5:

Demonstrate advanced knowledge of angular momentum spectra, Clebsch-Gordan coefficients, and Pauli matrices to describe non-relativistic Hamiltonian systems involving spin.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	Constrained Motion: Constraints, Classification of constraints, Principle of virtual work, D'Alembert's principle and its application. Lagrangian formulation: - limitations of Newtonian formulation, degrees of freedom, generalised coordinates and velocities, Derivation of Lagrange's equation, derivation of Lagrange's equation from Hamilton's principle, simple application of Lagrange's equation, Cyclic coordinates, Symmetry and conservation theorems. Phase Space and the motion of the system Hamiltonian, Canonical transformations, Equations of Canonical transformations, Canonical transformations for the Harmonic Oscillator.	CL, RP, SDL	CLO1
II	Poisson brackets and canonical invariants, equations of motion, Infinitesimal CT and conservation theorems in the Poisson bracket formulation, Hamilton Jacobi theory, Application to harmonic oscillator problem. Types of equilibrium, Theory of Small Oscillations, Secular equation, eigenvectors and eigen-frequencies, Orthogonality of	CL, PBL, CBL	CLO2, CLO3



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	eigenvectors; Normal coordinates; coupled Oscillation, Linear triatomic molecule, Small oscillations of particles on string, Introduction to nonlinear oscillations.		
III	The Hilbert Space and Wave Functions, Dirac Notation, Operators: Hermitian Adjoint, Projection Operators, Commutator Algebra, Uncertainty Relation between Two Operators, Inverse and Unitary Operators, Eigenvalues and Eigenvectors of an Operator, Matrix Representation of Kets, Bras and Operators, Change of Bases and Unitary Transformations, Representation in Continuous Bases, Parity Operator.	CL, ICT, SDL	CLO4
IV	Quantum theory of angular momentum and its eigenvalue spectrum. Matrix representation of angular momentum operators, spin angular momentum, Pauli matrices and their properties, total wave function, non-relativistic Hamiltonian including spin. Addition of angular momenta, definition of Clebsch-Gordan coefficients, Phase convention, spin-wave function for a system of two spin-1/2 particles, Identical particles with spin, addition of spin and orbital angular momenta.	CL, ICT, PBL	CLO5

• (*) Learning Pedagogies/Methods

Notes:

(1) The following list is suggestive. Any other learning pedagogies relevant to discipline-specific requirements can be added.

(2) Acronyms/abbreviations of the terms can be placed in the above table.

(a) Classroom Lecture (CL)

(b) Seminars (Student-led and Faculty-moderated)

(c) Case-Based Learning (CBL)

(d) Micro-Projects/Mini Research Tasks

(e) Industrial Visit/Field Visit/Institutional Visit

(f) Problem-Based Learning (PBL)

(g) Research-Oriented Learning (Literature Review, Tool Construction, Data Analysis Exercises)

(h) Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)

(i) Experiential Learning (Community Engagement, Internship-linked Activities, Practice-based Tasks)

(j) Simulation and Role-Play (Academic, Professional, or Policy-based Scenarios)

(k) ICT-Enabled Learning (LMS-based Tasks, Digital Resources, Virtual Labs/Webinars)

(l) Reflective Practices (Learning Journals, Reflective Notes, Concept Mapping)

(m) Inquiry-Based Learning

(n) Self-Directed Learning (Guided Readings, Concept Exploration Tasks)

• Assessment Methodologies

(A) Internal Assessment

a. Internal Formative assessment [30Marks]

(a) Assignment, Self-learning and Terms work

(b) Seminar/Presentation

(c) Quiz

(d) Attendance



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b. Internal Summative Assessment [20Marks]

- (a) Mid-term tests
- (b) End of Term Examination
- (c) Laboratory performance
- (d) Viva-voce

(B) Weightage of Learning Efforts for External Assessment

Unit	Aligned COs	Total Learning Hours	Approximate weightage(Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse & above (A)	
I	CLO1	30	3	3	6	12
II	CLO2, CLO3	30	3	4	7	14
III	CLO4	30	3	3	6	12
IV	CLO5	30	3	3	6	12
		120	12	13	25	50

• Assessment and Evaluation

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Seminars, Assignments, Quizzes, Class Regularity,	50%
2	End-Semester Examination	Written Exam	50%

(C) CLOs – PLOs Matrix

CLO	PLO									
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3	3	1	2	2	1	1	-	-	2
CLO2	3	3	1	2	3	2	1	-	-	2
CLO3	3	3	2	2	3	2	1	-	1	2
CLO4	3	3	1	3	2	1	1	-	-	2
CLO5	3	3	1	3	2	2	1	-	-	2

Values to CLO-PLO matrix are assigned by judging the importance of the particular CLO in relation to the PLOs.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-



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[M.Sc. Applied Physics] Semester-II

• Suggested Learning Materials Books:

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Classical Mechanics – System of particles and Hamiltonian Dynamics	Greiner	2006	Springer International Ed.
2	Classical Mechanics	Goldstein, Pole & Safko	3rd Ed / 2002	Pearson Education, Pte. Ltd
3	Classical Mechanics	V. B. Bhatia	-	Narosa
4	Introduction to Classical Mechanics	R. G. Takwale and P. S. Puranik	-	TMH
5	A text book of Quantum Mechanics	P.M. Mathews and K. Venkatesan	-	TMH
6	Introduction to Quantum Mechanics	David J. Griffiths	-	-
7	Quantum Mechanics	Ghatak & Loknathan	-	McMillan India Publication
8	Quantum Mechanics	G. Aruldas	-	Prentice-Hall India, Pvt., 9Ltd.
9	Quantum Mechanics Concepts and Applications	Nouredine Zettili	-	John Wiley and Sons, Ltd.

• Online Resources (Open Source)

Sr. No.	Description of Resource(s)	Weblink
1	NPTEL Course: Classical Mechanics	https://nptel.ac.in/courses/115/106/115106123/
2	NPTEL Course: Quantum Mechanics I	https://nptel.ac.in/courses/115/105/115105098/
3	NPTEL Course: Classical Mechanics (Advanced)	https://nptel.ac.in/courses/115/103/115103115/
4	NPTEL Course: Engineering Physics (Classical & Quantum)	https://nptel.ac.in/courses/122/106/122106034/
5	NPTEL Course: Quantum Mechanics II	https://nptel.ac.in/courses/115/101/115101107/



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[M.Sc. Applied Physics] Semester-II

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2T02NCAPH02	Electrodynamics	4-0-1	120	04

• Course Learning Outcomes (CLOs)

On completion of this course, students will be able to:

CLO1:

Evaluate complex electric and magnetic fields, forces, and potentials using Gauss's Law, Ampère's Law, and Faraday's Law in various charge distributions.

CLO2:

Analyze Maxwell's equations to describe the propagation of electromagnetic waves in vacuum and linear media, including reflection, refraction, and skin depth.

CLO3:

Demonstrate a critical understanding of wave propagation in rectangular, cylindrical, and dielectric waveguides (optical fibers) and transmission lines using Smith charts.

CLO4:

Formulate scalar and vector potentials using Lorentz and Coulomb gauges and evaluate radiation from electric/magnetic dipoles and antennas.

CLO5:

Analyze radiation from moving point charges using Lienard-Wiechert potentials and understand Larmor's generalization for relativistic cases like Synchrotron radiation.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	Applications of Electrostatics: Gauss' law of electrostatics, field due to linear, spherical and cylindrical charge distribution, Curl of electrostatic field and Electrostatic potential, Gauss's Law in Magnetism, Applications Involving Charged Particles Moving in a Magnetic Field, The Hall Effect, The Biot-Savart Law, The Magnetic Force Between two Parallel Conductors, Ampère's Law, Faraday's Law of Induction-Induced emf and Electric Fields-Generators and Motors-Eddy Currents. Displacement Current and General Form of Ampère's Law.	CL, RP, SDL	CLO1
II	Maxwell's equations in matter, Continuity equation, Poynting theorem – Momentum conservation, Electromagnetic Waves in Vacuum: Wave equation for E and B fields, Monochromatic plane waves – Energy & momentum in electromagnetic waves, Polarization of electromagnetic waves: linear and circular polarization. Application of Brewster's law, Electromagnetic waves in matter: Propagation in linear media- Boundary conditions Reflection and Refraction – Snell's law. Total internal reflections, EM waves in isotropic linear conducting media – skin depth.	CL, ICT, CBL	CLO2



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III	Wave Guides: Bounded waves, TE, TM and TEM waves, Rectangular and cylindrical wave guides, Resonant cavities. Dielectric wave guides (Optical fibers)-Propagation mechanism, angle of acceptance, Numerical aperture, Modes of propagation, Types of optical fibers, Attenuation and Mention of expression for attenuation coefficient. Optical fiber sensors- Intensity based displacement sensor and Temperature sensor based on phase modulation Transmission Lines: Distributed line parameters, transmission line equations, Input Impedance, SWR and Power, Smith chart, some applications of transmission lines, microstrip transmission line	CL, PBL, ICT	CLO3
IV	Electromagnetic Radiation: Electromagnetic potentials Scalar and vector potentials Gauge transformations Gauge conditions (Lorentz and Coulomb gauges). Retarded Potentials Radiations from extended sources: Electric and Magnetic dipole radiation, Center-fed linear antenna- Hertzian dipole antenna – Small loop antenna. Radiation from Moving point charges: Lienard-Wiechert potentials- Fields of a moving point charge- Power radiated by a point charge (Larmor formula), Radiation from a slowly moving charges, Radiation from relativistically moving charges, Larmor's generalization to relativistic case – Synchrotron radiation – Bremsstrahlung radiation	CL, ICT, SDL	CLO4, CLO5

• (*) Learning Pedagogies/Methods

Notes:

(3) The following list is suggestive. Any other learning pedagogies relevant to discipline-specific requirements can be added.

(4) Acronyms/abbreviations of the terms can be placed in the above table.

(o) Classroom Lecture (CL)

(p) Seminars (Student-led and Faculty-moderated)

(q) Case-Based Learning (CBL)

(r) Micro-Projects/Mini Research Tasks

(s) Industrial Visit/Field Visit/Institutional Visit

(t) Problem-Based Learning (PBL)

(u) Research-Oriented Learning (Literature Review, Tool Construction, Data Analysis Exercises)

(v) Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)

(w) Experiential Learning (Community Engagement, Internship-linked Activities, Practice-based Tasks)

(x) Simulation and Role-Play (Academic, Professional, or Policy-based Scenarios)

(y) ICT-Enabled Learning (LMS-based Tasks, Digital Resources, Virtual Labs/Webinars)

(z) Reflective Practices (Learning Journals, Reflective Notes, Concept Mapping)

(aa) Inquiry-Based Learning

(bb) Self-Directed Learning (Guided Readings, Concept Exploration Tasks)



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[M.Sc. Applied Physics] Semester-II

• Assessment Methodologies

(D) Internal Assessment

a. Internal Formative assessment [30Marks]

- (e) Assignment, Self-learning and Terms work
- (f) Seminar/Presentation
- (g) Quiz
- (h) Attendance

b. Internal Summative Assessment [20Marks]

- (e) Mid-term tests
- (f) End of Term Examination
- (g) Laboratory performance
- (h) Viva-voce

(E) Weightage of Learning Efforts for External Assessment

Unit	Aligned COs	Total Learning Hours	Approximate weightage(Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse & above (A)	
I	CLO1	30	3	3	6	14
II	CLO2	30	3	3	6	12
III	CLO3	30	3	3	6	12
IV	CLO4, CLO5	30	3	4	7	14
		120	12	13	25	50

• Assessment and Evaluation

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Seminars, Assignments, Quizzes, Class Regularity,	50%
2	End-Semester Examination	Written Exam	50%

(F) CLOs – PLOs Matrix

CLO	PLO									
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CLO1	3	3	1	2	2	1	1	1	1	2
CLO2	3	3	1	2	3	2	-	1	-	2
CLO3	3	3	2	2	3	3	1	-	-	2
CLO4	3	3	1	3	2	2	1	1	1	2
CLO5	3	3	1	3	2	2	-	1	-	2



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[M.Sc. Applied Physics] Semester-II

Values to CLO-PLO matrix are assigned by judging the importance of the particular CLO in relation to the PLOs.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

• Suggested Learning Materials Books:

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Classical Electrodynamics	J. D. Jackson	2nd Ed / 1975	Wiley Eastern Ltd.
2	Introduction to Electrodynamics	David J. Griffiths	3rd Ed / 2002	Prentice Hall, India
3	Classical Electromagnetic Theory	Jack Vanderlinde	1993	John Wiley & Sons, Inc.
4	Elements of Electromagnetics	Sadiku	2nd Ed / 1995	Oxford Univ. Press, Inc.
5	Classical Electrodynamics	Griener	1998	Springer Verlag, New York, Inc.

• Online Resources (Open Source)

Sr. No.	Description of Resource(s)	Weblink
1	NPTEL Course: Electrodynamics	https://nptel.ac.in/courses/115/104/115104088/
2	NPTEL Course: Electromagnetic Theory	https://nptel.ac.in/courses/115/106/115106122/
3	NPTEL Course: Electromagnetics I	https://nptel.ac.in/courses/115/101/115101004/
4	NPTEL Course: Electromagnetics II	https://nptel.ac.in/courses/115/101/115101005/
5	NPTEL Course: Transmission Lines and EM Waves	https://nptel.ac.in/courses/117/101/117101056/



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[M.Sc. Applied Physics] Semester-II

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2T02NCAPH03	Elements of Applied Physics	4-0-1	120	04

• Course Learning Outcomes (CLOs)

On completion of this course, students will be able to:

CLO1:

Critically analyze the mechanisms and characteristics of various vacuum system components, including pumps and gauges, to evaluate their performance in research and industrial applications.

CLO2:

Evaluate the production, scattering, and diffraction of X-rays, electrons, and neutrons to interpret the structural evolution of materials.

CLO3:

Demonstrate a theoretical and experimental basis for the practical application of Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM) in material characterization.

CLO4:

Formulate the principles and instrumentation for thermal analytical methods (TGA, DTA, DSC) and spectroscopic techniques (XPS, XRF, UV-Vis) for qualitative and quantitative analysis.

CLO5:

Analyze the working principles, energy resolution, and applications of various radiation counters and semiconductor detectors.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	Introduction of vacuum, Applications for Vacuum Pumps, Classification of vacuum pumps, Rotary pump, Diffusion pump, Molecular drag pump, Gettering and ion pumping, Sputter ion pump, measurement of pumping speed: constant pressure method, constant volume method. Classification of vacuum gauges: McLeod gauge, Thermal conductivity gauge, Thermocouple gauge, Hot cathode ionization gauge, Bayard-Alpert gauge, Cold cathode ionization gauge, Penning gauge, Magnetron gauge.	CL, RP, SDL	CLO1
II	X-ray Diffraction: X-ray sources, Production of X-rays, continuous X-rays, characteristics X-rays, X-ray filters, X-ray absorbers, scattering by electrons, atom and unit cell, Electron Diffraction: Introduction to electron diffraction, Transmission Electron microscopes, Neutron Scattering: Slow neutron scattering in solid, Elastic Scattering, Cross – section, Coherent Scattering.	CL, ICT, CBL	CLO2, CLO3



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[M.Sc. Applied Physics] Semester-II

III	Thermal Analysis and its applications: Thermo gravimetric analysis, Differential thermal analysis and Differential scanning calorimetry, X-Ray Photoelectron Spectroscopy Surface Analysis Technique, X-ray fluorescence spectroscopy, UV-Visible spectroscopy, atomic absorption spectroscopy.	CL, PBL, ICT	CLO4
IV	Ionization Chamber, Proportional Counter, Geiger-Mueller Counter, Scintillation detector: organic scintillator, Inorganic scintillator, Light guides, Photomultiplier tubes, Scintillation Spectrometer, Energy resolution of a scintillation spectrometer, Semiconductor detectors: Diode detector, Diffused junction detector, Surface barrier detector, Ion implanted layer detectors, Fully depleted detectors, Lithium doped germanium detector [Ge (Li)], High purity germanium detector (HPGe), Cherenkov Detector, Photographic emulsion, Cloud Chamber, Bubble Chamber, Spark Chamber.	CL, ICT, SDL	CLO5

- **(*) Learning Pedagogies/Methods**

Notes:

(5) The following list is suggestive. Any other learning pedagogies relevant to discipline-specific requirements can be added.

(6) Acronyms/abbreviations of the terms can be placed in the above table.

- (cc) Classroom Lecture (CL)
- (dd) Seminars (Student-led and Faculty-moderated)
- (ee) Case-Based Learning (CBL)
- (ff) Micro-Projects/Mini Research Tasks
- (gg) Industrial Visit/Field Visit/Institutional Visit
- (hh) Problem-Based Learning (PBL)
- (ii) Research-Oriented Learning (Literature Review, Tool Construction, Data Analysis Exercises)
- (jj) Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)
- (kk) Experiential Learning (Community Engagement, Internship-linked Activities, Practice-based Tasks)
- (ll) Simulation and Role-Play (Academic, Professional, or Policy-based Scenarios)
- (mm) ICT-Enabled Learning (LMS-based Tasks, Digital Resources, Virtual Labs/Webinars)
- (nn) Reflective Practices (Learning Journals, Reflective Notes, Concept Mapping)
- (oo) Inquiry-Based Learning
- (pp) Self-Directed Learning (Guided Readings, Concept Exploration Tasks)

- **Assessment Methodologies**

- (G) Internal Assessment**

- a. Internal Formative assessment [30Marks]**

- (i) Assignment, Self-learning and Terms work
 - (j) Seminar/Presentation
 - (k) Quiz
 - (l) Attendance



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[M.Sc. Applied Physics] Semester-II

b. Internal Summative Assessment [20Marks]

- (i) Mid-term tests
- (j) End of Term Examination
- (k) Laboratory performance
- (l) Viva-voce

(H) Weightage of Learning Efforts for External Assessment

Unit	Aligned COs	Total Learning Hours	Approximate weightage(Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse & above (A)	
I	CLO1	30	2	3	7	12
II	CLO2, CLO3	32	2	3	9	14
III	CLO4	28	2	3	7	12
IV	CLO5	30	2	3	7	12
		120	8	12	30	50

• Assessment and Evaluation

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Seminars, Assignments, Quizzes, Class Regularity,	50%
2	End-Semester Examination	Written Exam	50%

(I) CLOs – PLOs Matrix

CLO	PLO									
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3	3	2	2	2	3	1	-	-	2
CLO2	3	3	1	2	3	2	1	-	-	2
CLO3	3	3	3	3	3	3	1	-	1	1
CLO4	3	3	3	3	2	2	1	-	-	2
CLO5	3	3	2	2	2	2	1	-	-	2

Values to CLO-PLO matrix are assigned by judging the importance of the particular CLO in relation to the PLOs.

CLO – PLO correlation	Value
Strong	3
Moderate	2
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[M.Sc. Applied Physics] Semester-II

• Suggested Learning Materials Books:

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Vacuum Science and Technology	V.V. Rao, T.B. Ghosh and K.L. Chopra	-	Allied Publishers Limited (India)
2	Elements of X-ray diffraction	Cullity and Stock	-	-
3	An introduction to lattice dynamic	L.S Kothari	-	-
4	Biomedical instrumentation & measurements	L. Cromwell	-	-
5	Instrumental method of analysis	Willard	-	-
6	Fundamentals of Nuclear Physics	Jagdish Varma, Roop Chand Bhandary, D.R.S. Somayajulu	-	-
7	Device Materials and Fabrication Techniques	-	-	-

• Online Resources (Open Source)

Sr. No	Description of Resource(s)	Weblink
1	NPTEL - Vacuum Technology (Lecture Notes)	https://nptel.ac.in/content/storage2/courses/112101004/downloads/(38-8-3)%20NPTEL%20-%20Vacuum%20Technology.pdf
2	NPTEL - X-ray Crystallography	https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-mm06/
3	NPTEL - Material Characterization Techniques	https://onlinecourses.nptel.ac.in/noc20_mm14/preview
4	IITK - TGA-DSC Reading Material	https://www.iitk.ac.in/che/pdf/resources/TGA-DSC-reading-material.pdf
5	NPTEL - Nuclear Physics: Fundamentals and Applications	https://nptel.ac.in/courses/115/103/115103030/
6	NPTEL - Introduction to SEM/TEM (Lecture Notes)	https://nptel.ac.in/content/storage2/courses/112101007/downloads/Lecturenotes/Lecture37.pdf



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[M.Sc. Applied Physics] Semester-II

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2T02NCAPH04	Practical based on P2T02NCAPH01 & P2T02NCAPH02	0-4-0	120	04

• Course Learning Outcomes (CLOs)

On completion of this course, students will be able to:

CLO1:

Analyze the transport properties of semiconductors by determining the Hall Coefficient and assessing magneto-resistance effects.

CLO2:

Evaluate the performance and efficiency of solar panels by analyzing I-V characteristics in various combinations and identifying the maximum power point.

CLO3:

Investigate phase transitions in materials by measuring the Curie temperature of ferroelectric substances.

CLO4:

Analyze the physical properties of nanomaterials by determining the compressibility of nanofluids with varying concentrations and temperatures.

CLO5:

Characterize the response and sensitivity of different photo-sensors and apply analytical techniques to interpret experimental data.

Unit	Course Content	Learning Pedagogies*	CLO(s)
	1. Determine Hall Coefficient using Hall Effect 2. Solar Cell I-V Characteristic in Series and Parallel combination on Solar Panel 3. Determination of maximum power point and solar cell efficiency 4. Determination of semiconductor magneto-resistance 5. Measurement of Curie temperature of ferroelectric materials 6. Determination of compressibility of nanofluids with variation of nanoparticles at different temperature 7. Characteristics of Photo-sensors.	Experiential Learning, Collaborative Learning, IBL, PBL, SDL, ICT	CLO1, CLO2, CLO3, CLO4, CLO5

• (*) Learning Pedagogies/Methods

Notes:

(7) The following list is suggestive. Any other learning pedagogies relevant to discipline-specific requirements can be added.

(8) Acronyms/abbreviations of the terms can be placed in the above table.

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[M.Sc. Applied Physics] Semester-II

- (ss) Case-Based Learning (CBL)
- (tt) Micro-Projects/Mini Research Tasks
- (uu) Industrial Visit/Field Visit/Institutional Visit
- (vv) Problem-Based Learning (PBL)
- (ww) Research-Oriented Learning (Literature Review, Tool Construction, Data Analysis Exercises)
- (xx) Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)
- (yy) Experiential Learning (Community Engagement, Internship-linked Activities, Practice-based Tasks)
- (zz) Simulation and Role-Play (Academic, Professional, or Policy-based Scenarios)
- (aaa) ICT-Enabled Learning (LMS-based Tasks, Digital Resources, Virtual Labs/Webinars)
- (bbb) Reflective Practices (Learning Journals, Reflective Notes, Concept Mapping)
- (ccc) Inquiry-Based Learning
- (ddd) Self-Directed Learning (Guided Readings, Concept Exploration Tasks)

• Assessment Methodologies

(J) Internal Assessment

a. Internal Formative assessment [30Marks]

- (m) Practical performance
- (n) Journal preparation
- (o) Viva voce
- (p) Attendance

b. Internal Summative Assessment [20Marks]

- (m) Mid-term tests [20Marks]
- (n) End of Term Examination
- (o) Laboratory performance
- (p) Viva-voce

(K) Weightage of Learning Efforts for External Assessment

Unit	Aligned COs	Total Learning Hours	Approximate weightage(Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse & above (A)	
Practical 01 to 07	CLO1, CLO2, CLO3, CLO4, CLO5	120	5	10	35	50

• Assessment and Evaluation

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Practical performance, Journal preparation, Viva voce, Attendance	50%
2	End-Semester Examination	University Practical Examination	50%



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(L) CLOs – PLOs Matrix

CLO	PLO									
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3	3	3	1	2	2	-	-	1	2
CLO2	3	2	3	1	2	3	2	1	2	2
CLO3	3	2	3	-	3	2	1	-	1	2
CLO4	3	3	3	2	2	-	2	-	2	3
CLO5	2	2	3	-	2	3	-	1	1	2

Values to CLO-PLO matrix are assigned by judging the importance of the particular CLO in relation to the PLOs.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

• Suggested Learning Materials Books:

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Introduction to Nanotechnology	C.P. Poole, F.J. Owens	1st Edition / 2003	Wiley
2	Solid State Physics	N.W. Ashcroft, N.D. Mermin	1st Edition / 1976	Cengage
3	Solar Cells: Operating Principles, Technology, and System Applications	Martin A. Green	1982	Prentice Hall

• Online Resources (Open Source)

Sr. No.	Description of Resource(s)	Weblink
1	NPTEL: Experimental Physics I	https://nptel.ac.in/courses/115105110
2	Virtual Labs (MHRD):	https://vlab.amrita.edu/?sub=1&brch=282&sim=1512&cnt=1



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Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2T02NCAPH05	Practical based on P2T02NCAPH03 & P2T02NCAPH06	0-4-0	120	04

• Course Learning Outcomes (CLOs)

On completion of this course, students will be able to:

CLO1:

Analyze the performance characteristics of Op-Amps, IC-555 Timers, and UJT's to design functional analog circuits

CLO2:

Evaluate the wave properties and diffraction patterns of He-Ne LASERS and characterize the transmission efficiency of optical fibers.

CLO3:

Apply advanced statistical techniques, including error estimation and least-square fitting, to validate experimental results.

CLO4:

Investigate the thermal and electrical transport properties of metals to determine the Lorentz number.

CLO5:

Demonstrate proficiency in using sophisticated analytical instruments while correlating experimental observations with theoretical physics.

CLO6:

Evaluate the mechanical properties of engineering materials by performing Rockwell Hardness and Impact Testing (Charpy/Izod), and analyze the relationship between material microstructure and fracture toughness.

Unit	Course Content	Learning Pedagogies*	CLO(s)
	8. Measurement of Op-Amp characteristics 9. IC-555 Timer circuit 10. Uni-junction Transistor characteristic 11. He-Ne LASER diffraction studies 12. Error estimation and least-square fitting 13. To study thermal and electrical conductivity of metals at constant temperature gradient and determination of Lorentz number. 14. Optical Fiber characterization and Transmission 15. Rockwell Hardness Testing 16. Izod Impact testing	Experiential Learning, Collaborative Learning, IBL, PBL, SDL, ICT	CLO1, CLO2, CLO3, CLO4, CLO5



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• (*) Learning Pedagogies/Methods

Notes:

(9) The following list is suggestive. Any other learning pedagogies relevant to discipline-specific requirements can be added.

(10) Acronyms/abbreviations of the terms can be placed in the above table.

(eee) Classroom Lecture (CL)

(fff) Seminars (Student-led and Faculty-moderated)

(ggg) Case-Based Learning (CBL)

(hhh) Micro-Projects/Mini Research Tasks

(iii) Industrial Visit/Field Visit/Institutional Visit

(jjj) Problem-Based Learning (PBL)

(kkk) Research-Oriented Learning (Literature Review, Tool Construction, Data Analysis Exercises)

(lll) Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)

(mmm) Experiential Learning (Community Engagement, Internship-linked Activities, Practice-based Tasks)

(nnn) Simulation and Role-Play (Academic, Professional, or Policy-based Scenarios)

(ooo) ICT-Enabled Learning (LMS-based Tasks, Digital Resources, Virtual Labs/Webinars)

(ppp) Reflective Practices (Learning Journals, Reflective Notes, Concept Mapping)

(qqq) Inquiry-Based Learning

(rrr) Self-Directed Learning (Guided Readings, Concept Exploration Tasks)

• Assessment Methodologies

(M) Internal Assessment

a. Internal Formative assessment [30Marks]

(q) Practical performance

(r) Journal preparation

(s) Viva voce

(t) Attendance

b. Internal Summative Assessment [20Marks]

(q) Mid-term tests [20Marks]

(r) End of Term Examination

(s) Laboratory performance

(t) Viva-voce

(N) Weightage of Learning Efforts for External Assessment

Unit	Aligned COs	Total Learning Hours	Approximate weightage(Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse & above (A)	
Practical 01 to 09	CLO1, CLO2, CLO3, CLO4, CLO5, CLO6	120	5	10	35	50



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• Assessment and Evaluation

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Practical performance, Journal preparation, Viva voce, Attendance	50%
2	End-Semester Examination	University Practical Examination	50%

(O)CLOs – PLOs Matrix

CLO	PLO									
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3	2	3	-	2	3	1	-	2	2
CLO2	3	-	3	2	2	3	1	1	1	2
CLO3	2	3	2	2	3	-	2	2	-	2
CLO4	3	2	3	2	2	2	-	-	1	2
CLO5	3	2	3	3	3	2	3	2	2	3
CLO6	3	2	3	2	3	3	2	-	2	2

Values to CLO-PLO matrix are assigned by judging the importance of the particular CLO in relation to the PLOs.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

• Suggested Learning Materials Books:

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Op-Amps and Linear Integrated Circuits	Ramakant A. Gayakwad	4th Ed / 2015	Pearson
2	Optical Fiber Communications: Principles and Practice	John M. Senior	3rd Ed / 2009	Pearson
3	Advanced Practical Physics for Students	B.L. Worsnop & H.T. Flint	9th Ed / 1951	Methuen
4	Materials Science and Engineering: An Introduction	William D. Callister	10th Ed / 2018	Wiley

• Online Resources (Open Source)

Sr. No.	Description of Resource(s)	Weblink
1	NPTEL: Experimental Physics I	https://nptel.ac.in/courses/115105110
2	Virtual Labs (MHRD):	https://vlab.amrita.edu/?sub=1
3	PhET: Geometric Optics and	https://phet.colorado.edu/en/simulations/filter?subjects=physics



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	Laser interference visualizations.	
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Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2T02NCAPH06	Fundamentals of Materials Science	2-0-1	60	02

• Course Learning Outcomes (CLOs)

On completion of this course, students will be able to:

CLO 1:

Explain and classify different types of engineering materials and interpret their structure at various levels (atomic, crystal, microstructure) to understand their mechanical behaviour.

CLO 2:

Analyze the relationship between processing, structure, and properties of materials and predict material performance under different service conditions.

CLO 3:

Evaluate mechanical properties using stress-strain behaviour and determine strength, modulus, hardness, toughness, and impact resistance for engineering applications.

CLO 4:

Apply knowledge of material processing techniques (casting, forming, heat treatment, etc.) to modify and improve material properties.

CLO 5:

Interpret the Fe-Fe₃C phase diagram and analyze phase transformations (pearlite, bainite, martensite) to solve problems related to steels with different heat treatment processes.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	Introduction to Materials & Materials Science, types of materials, levels of structure, structure- property – processing relationship, properties of materials (Mechanical properties stress-strain curves, strength and modulus under various modes of deformation, flexural strength, hardness, impact strength etc.) processing of materials, environmental effect on materials behavior, Materials selection criteria.	CL, Seminar, ICT	CLO1, CLO2, CLO3
II	Fe-Fe ₃ C phase diagram, pearlite, bainite, martensite, cementite, heat treatments processes, classification of steels and their applications. Metallurgy in ancient India e.g. Wootz Steel & Damascus Blades etc. Aluminium alloys, magnesium alloys, copper alloys, nickel, cobalt, zinc alloys, titanium alloys, refractory metals.	CL, ICT, SDL	CLO4, CLO5



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• (*) Learning Pedagogies/Methods

Notes:

- (11) The following list is suggestive. Any other learning pedagogies relevant to discipline-specific requirements can be added.
- (12) Acronyms/abbreviations of the terms can be placed in the above table.
- (sss) Classroom Lecture (CL)
- (ttt) Seminars (Student-led and Faculty-moderated)
- (uuu) Case-Based Learning (CBL)
- (vvv) Micro-Projects/Mini Research Tasks
- (www) Industrial Visit/Field Visit/Institutional Visit
- (xxx) Problem-Based Learning (PBL)
- (yyy) Research-Oriented Learning (Literature Review, Tool Construction, Data Analysis Exercises)
- (zzz) Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)
- (aaaa) Experiential Learning (Community Engagement, Internship-linked Activities, Practice-based Tasks)
- (bbbb) Simulation and Role-Play (Academic, Professional, or Policy-based Scenarios)
- (cccc) ICT-Enabled Learning (LMS-based Tasks, Digital Resources, Virtual Labs/Webinars)
- (dddd) Reflective Practices (Learning Journals, Reflective Notes, Concept Mapping)
- (eeee) Inquiry-Based Learning
- (ffff) Self-Directed Learning (Guided Readings, Concept Exploration Tasks)

• Assessment Methodologies

(P) Internal Assessment

a. Internal Formative assessment [30Marks]

- (u) Assignment, Self-learning and Terms work
- (v) Seminar/Presentation
- (w) Quiz
- (x) Attendance

b. Internal Summative Assessment [20Marks]

- (u) Mid-term tests
- (v) End of Term Examination
- (w) Laboratory performance
- (x) Viva-voce

(Q) Weightage of Learning Efforts for External Assessment

Unit	Aligned COs	Total Learning Hours	Approximate weightage(Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse & above (A)	
I	CLO1, CLO2, CLO3	30	1	4	8	13
II	CLO4, CLO5	30	1	3	8	12



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		60	2	7	16	25
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• Assessment and Evaluation

Sr.No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Seminars, Assignments, Quizzes, Class Regularity,	50%
2	End-Semester Examination	Written Exam	50%

(R) CLOs – PLOs Matrix

CLO	PLO									
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3	3	2	2	2	3	1	1	1	2
CLO2	3	3	1	2	3	2	-	1	1	2
CLO3	3	3	3	3	3	3	1	-	-	2
CLO4	3	3	3	3	2	2	-	1	1	2
CLO5	3	3	2	2	2	2	1	1	-	2

Values to CLO-PLO matrix are assigned by judging the importance of the particular CLO in relation to the PLOs.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

• Suggested Learning Materials Books:

Sr.No.	Title	Author(s)	Edition/Year	Publisher
1	The Science and Engineering of Materials	Donald R. Askeland	-	PWS-Kent Publishing
2	Callister's Materials Science and Engineering	William D. Callister, Jr, R. Balasubramanian	-	-
3	Physical Metallurgy: Principles and Practice	V. Raghavan	-	PHI Learning Publishers
4	Science of Engineering Materials	Manas Chanda	-	Macmillan Publishers
5	Ceramic Hardness	Ian McColm	-	Springer Publications
6	Physics of Polymers	Strobl, Gert R.	-	Springer Publications

• Online Resources (Open Source)

Sr. No.	Description of Resource(s)	Weblink
1	NPTEL Course: Fundamentals of Material Processing	https://nptel.ac.in/courses/112/104/112104203/
2	NPTEL Course: Materials Science and Engineering	https://nptel.ac.in/courses/113/104/113104096/
3	NPTEL Course: Advanced Materials and	https://nptel.ac.in/courses/112/108/112108150/



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	Processes	
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