



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-I

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2T01NCAPH01	Basic Mathematical Tools	4-0-1	120	04

• Course Learning Outcomes (CLOs)

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

CLO1:

Critically analyze analytic functions and contour integrals to evaluate complex definite integrals and solve boundary-value problems using the Residue theorem.

CLO2:

Apply Fourier and Laplace transform techniques to model and solve advanced physical systems, including damped oscillators and RLC analogies, demonstrating a critical understanding of convolution and momentum representation.

CLO3:

Evaluate the stability and behavior of classical and mechanical systems by constructing and interpreting phase diagrams for autonomous and conservative systems, including population models.

CLO4:

Formulate and solve physical laws using tensor algebra and covariant derivatives, applying Christoffel symbols and the geodesic equation to describe curved spaces or specialized physical frames.

CLO5:

Apply the principles of group theory and matrix representations (reducible and irreducible) to identify symmetries and solve problems in various branches of physics, such as molecular or crystal structures.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	Introduction, Analytic functions, Contour integrals, Cauchy-Riemann equations and their implications, Singularity, Pole, Laurent series, The Residue theorem, Methods of finding residues, Evaluation of definite integrals by use of the residue theorem, Mapping. Special functions: Hermite, Bessel, Laguerre and Legendre functions	CL, Seminar, RP	CLO1
II	Integral transforms, Fourier transform and its properties as well as applications such as Gaussian function, finite wave train, etc., Convolution theorem, momentum representation, Laplace transform and its properties, Laplace transforms of some elementary functions and derivatives including some applications in the problems of physics e.g. step function, simple harmonic oscillator, damped oscillator- RLC analogy etc.	CL, ICT, PBL	CLO2



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-I

III	Phase plane: Pendulum equation and its phase diagram, Autonomous equations in the phase plane, Phase diagram for the simple harmonic oscillator – weak and critical damping, Conservative systems, Damped linear oscillator, Nonlinear damping – dry friction, the brake, the pendulum clock, General phase plane for first-order system, Applications of Population Models – predator-prey problem, general epidemic, recurrent epidemic, Linear approximation at equilibrium points.	CL, SDL	CLO3, CLO4
IV	Tensors: Types of tensors and their algebra, Contraction and inner product, Metric tensors, Quotient rule, Dual and irreducible tensors, Christoffel symbols, covariant derivative, Geodesic equation. Introduction to group theory: Definition and examples, group multiplication table, homomorphism and isomorphism, matrix representations – reducible and irreducible, classes and character, subgroups and cosets, Dihedral group, orthogonal groups and special unitary group, Illustrations of the group concept in various branches of physics.	CL, ICT, RP	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.

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

• Assessment Methodologies

(A) Internal Assessment

a. Internal Formative assessment [30Marks]

- Assignment, Self-learning and Terms work
- Seminar/Presentation
- Quiz
- Attendance



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-I

b. Internal Summative Assessment [20Marks]

- (a) Mid-term tests [20Marks]
- (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	2	3	7	12
II	CLO2	30	2	3	7	12
III	CLO3, CLO4	30	2	3	9	14
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%

(C) CLOs – PLOs Matrix

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



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-I

• Suggested Learning Materials Books:

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Mathematical Methods for Physicists	G. Arfken and Weber	6th Ed (2005)	Academic Press
2	Mathematical Physics	P. K. Chattopadhyay	1990	Wiley Eastern Limited
3	Vector Analysis	Murray Spiegel	-	Schuam Series
4	Mathematical Methods in Physical Sciences	M. L. Boas	Second Edition, 1996	John Wiley & Sons
5	Mathematical Methods of Physics	Mathews & Walker	2nd Ed., 2004	Pearson Education
6	Elements of Group Theory for Physicists	A. W. Joshi	1997	New Age Int. Pub
7	Nonlinear Ordinary Differential Equations	D. W. Jordan & P. Smith	1976	Clarendon Press, Oxford
8	Matrices and Tensors in Physics	A. W. Joshi	3rd Ed.	New Age International (P) Ltd.

• Online Resources (Open Source)

Sr. No.	Description of Resource(s)	Weblink
1	NPTEL Course: Complex Analysis	https://nptel.ac.in/courses/111/103/111103070/
2	NPTEL Course: Mathematical Methods	https://nptel.ac.in/courses/111/102/111102129/
3	Classical Physics Study Material (PDF)	https://nptel.ac.in/content/storage2/courses/122106027/classicalphysics.pdf
4	NPTEL Course: Nonlinear Systems	https://nptel.ac.in/courses/112/103/112103167/
5	NPTEL Course: Linear Algebra/Matrix Theory	https://nptel.ac.in/courses/111/106/111106113/



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-I

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2T01NCAPH02	Physics of Atomic-Molecular Spectroscopy and Statistical Mechanics	4-0-1	120	04

• Course Learning Outcomes (CLOs)

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

CLO1:

Critically analyze the Schrödinger equation for one and two-electron atoms to evaluate fine structures, Lamb shifts, and auto-ionization phenomena in hydrogenic and helium systems.

CLO2:

Evaluate the electronic structure of diatomic molecules using Born-Oppenheimer and LCAO approximations, and interpret rotational-vibrational spectra.

CLO3:

Demonstrate an advanced understanding of laser operational principles (NH₃, He-Ne, CO₂, Semiconductor) and distinguish between various Raman scattering effects using classical and quantum treatments.

CLO4:

Formulate density matrices and partition functions for various ensembles to determine the physical significance of statistical quantities in ideal quantum gases.

CLO5:

Analyze phase transitions using Landau theory and the Ising model, and apply transport equations to solve problems involving Brownian motion and diffusion.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	Atoms and Molecules: Schrödinger equation for one-electron atoms – H-atom, the dipole selection rules. Fine structure of hydrogenic atoms, The Lamb shift and its determination, Hyperfine structure and isotopic shifts. Schrödinger equation for Two-electron atoms, the role of Pauli Exclusion Principle, Energy levels of He atom, Doubly excited states, Auto-ionization in Helium. Thomas-Fermi model for many-electron atoms. The Born-Oppenheimer approximation for molecule, electronic structure of diatomic molecules, LCAO approximation for H ₂ ⁺ ion.	CL, RP, SDL	CLO1, CLO2
II	Laser & Spectroscopy: Emission and absorption spectroscopy: UV-visible-IR absorption (introduction), Classical view of Einstein coefficients; two-level system, Three-level Laser system, Variation of Laser power around threshold. NH ₃ maser, He-Ne Laser (energy level diagram), CO ₂ Laser, Semiconductor Lasers, Rayleigh and Raman scattering, Stimulated Raman effect, Hyper-Raman effect: Classical treatment, Quantum mechanical treatment, Coherent anti-stokes Raman scattering (CARS), Spin-flip Raman Laser, Free-electron Laser	CL, ICT, PBL, Seminar	CLO3



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-I

III	Classical Statistical Mechanics: Canonical ensemble: Physical significance of various statistical quantities, energy fluctuations, the equipartition and the virial theorems, a system of harmonic oscillators Grand-canonical ensemble: Physical significance of various statistical quantities, density and energy fluctuations, classical ideal gas, a system of independent, localized particles Quantum Statistical Mechanics: Formulation: Quantum microstate and microstate, density matrix and its properties, density matrices and partition functions for microcanonical, canonical and grand-canonical ensembles. Ideal quantum gases: Hilbert space of identical particles, canonical formulation, degenerate Fermi gas, degenerate Bose gas	CL, PBL, SDL	CLO4
IV	Non-equilibrium Statistical Mechanics: Classification of phase transitions, Landau theory of second order phase transition, Examples of phase transitions, Ising model in one and two dimensions, Critical indices, Scaling laws, Boltzmann Transport Equation, Boltzmann H – theorem, Theory of Brownian motion, Diffusion equation.	CL, ICT, SDL	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) (SDL)

• Assessment Methodologies

(D) Internal Assessment

a. Internal Formative assessment [30Marks]

(e) Assignment, Self-learning and Terms work

(f) Seminar/Presentation

(g) Quiz

(h) Attendance



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-I

b. Internal Summative Assessment [20Marks]

- (e) Mid-term tests [20Marks]
- (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, CLO2	30	2	3	9	14
II	CLO3	30	2	3	7	12
III	CLO4	30	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%

(F) CLOs – PLOs Matrix

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

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	-



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-I

• Suggested Learning Materials Books:

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Physics of Atoms and Molecules	B. Bransden & C. J. Joachain	-	Pearson Education
2	LASERS Theory and Applications	K. Thyagarajan & A. K. Ghatak	2008	Macmillan India
3	Statistical Mechanics	R. K. Pathria	2nd Ed, 1996	Butterworth-Heinemann
4	Statistical Mechanics	Kerson Huang	1987	John Wiley & Sons

• Online Resources (Open Source)

Sr. No.	Description of Resource(s)	Weblink
1	Atomic and Molecular Physics	https://nptel.ac.in/courses/115/101/115101003/
2	Molecular Spectroscopy	https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-cy13/
3	Statistical Mechanics	https://nptel.ac.in/courses/115/103/115103113/



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-I

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2T01NCAPH03	Applied Electronics	4-0-1	120	04

• Course Learning Outcomes (CLOs)

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

CLO1:

Analyze the physics of PN junction-based devices, including I-V characteristics and switching speeds, to evaluate their performance in clippers, clampers, and optoelectronic applications.

CLO2:

Design and troubleshoot non-linear integrated circuits using Op-Amps and 555 Timers for applications such as Schmitt triggers, multivibrators, and voltage-controlled oscillators.

CLO3:

Implement Boolean functions and BCD codes using Karnaugh mapping and tri-state logic to optimize digital arithmetic circuits.

CLO4:

Formulate complex combinational and sequential digital systems, including decoders, multiplexers, registers, and counters.

CLO5:

Evaluate the architecture of digital-to-analog and analog-to-digital converters alongside various semiconductor memory technologies for integrated system design.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	PN Junction Based Devices: Introduction to P-N Junction-Barrier Potential and I-V Characteristics, Applications of P-N junctions- Diode as clipper, Diode as a clamper circuit, Diode as a switch, Reverse Recovery time of diode, optoelectronic devices, light emitting diode, photodiode and phototransistor, solar cells, Uni-junction Transistor, Silicon control rectifier, DIAC and TRIAC, Applications of some solid-state devices.	CL, ICT, SDL	CLO1
II	Non-linear Integrated Circuits Block diagram of Operational Amplifier IC 741, Characteristics and parameters of Op-Amp, Op-Amp- comparator, Schmitt Trigger, UTP and LTP determination, Timer IC 555 block diagram and working, Timing waveform generators using IC 555- monostable and Astablemultivibrator, more applications of IC 555 Timer – delay timers, sequential timer, pulsed-tone oscillator, voltage-controlled oscillator	CL, PBL, Seminar,	CLO2
III	BCD Codes and Digital Circuits Review of Binary Coded Decimal codes, Boolean functions, Min-terms and Max-terms. Karnaugh Mapping, Tri-state logic, positive and negative logic,	CL, PBL, RP	CLO3, CLO4



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-I

	signed binary numbers. Arithmetic logic circuits: Adders- Half adder and Full adder, Subtractors, comparators, Combinational and Sequential Circuits- Decoders, De-multiplexers, Encoders, Multiplexers, Registers and Counters and its applications.		
IV	Applications of Digital Circuits Memories: Read Only Memory, Programmable Read Only Memory, Erasable Programmable Read Only Memory & Random-Access Memory, expanding memory size. Digital to Analog and Analog to Digital Convertors: Resistive divider, Binary ladder, Digital to Analog Convertor using OPAMP, specifications, parallel comparators, counter method & approximation methods.	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

b. Internal Summative Assessment [20Marks]

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



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-I

(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	30	2	3	7	12
III	CLO3, CLO4	30	2	3	9	14
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	1	2	2	1	-	1	2
CLO2	3	3	3	2	3	3	1	-	-	2
CLO3	3	3	1	1	2	2	1	1	1	-
CLO4	3	3	3	2	3	3	1	-	1	2
CLO5	3	3	2	1	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	-



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-I

- Suggested Learning Materials Books:**

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Solid State Pulse Circuits	David A. Bell	-	Prentice Hall of India, New Delhi
2	Digital Electronics	Malvino & Leech	-	-
3	Microelectronics: Digital and Analog	K. R. Botkar	-	-
4	Integrated Electronics	K. R. Botkar	-	-
5	Electronic Devices & Components	J. Seymour	-	-
6	Operational Amplifier	Ramakant Gaekwad	-	-

- Online Resources (Open Source)**

Sr. No.	Description of Resource(s)	Weblink
1	NPTEL Course: Digital Electronics	https://nptel.ac.in/courses/117/107/117107095/
2	NPTEL Course: Digital Systems	https://nptel.ac.in/courses/108/108/108108122/
3	NPTEL Course: Operational Amplifiers	https://nptel.ac.in/courses/117/106/117106086/
4	Study Material: Digital Electronics & Logic (PDF)	https://nptel.ac.in/content/storage2/courses/112103174/pdf/mod3.pdf



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-I

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2T01NCAPH04	Practical based on P2T01NCAPH01 & P2T01NCAPH02	0-4-0	120	04

• Course Learning Outcomes (CLOs)

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

CLO1:

Demonstrate advanced practical knowledge of semiconductor physics and frequency response by applying experimental methods to validate theoretical models.

CLO2:

Design and execute complex experiments using Four-Probe methods and LCR circuits while adhering to precision and safety standards

CLO3:

Apply electronic devices and combinational logic circuits to solve computational and signal-processing problems.

CLO4:

Evaluate experimental data using graphical analysis and analytical instruments to determine physical constants like e/k .

CLO5:

Communicate technical findings through structured laboratory reports and viva-voce interactions.

Unit	Course Content	Learning Pedagogies*	CLO(s)
	1. Frequency response of LDR using different filters 2. Determination of Resistivity of a semiconductor using Four Probe method 3. Arithmetic operations through combinational Logic Circuits 4. LCR Damped Harmonic Oscillator 5. Wave shaping circuits (using R, C and D) 6. Determination of e/k using a power transistor 7. Analog to Digital Converter	Experiential Learning, Collaborative Learning, PBL, SDL	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.

(qq) Classroom Lecture (CL)

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

(ss) Case-Based Learning (CBL)



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-I

- (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%



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-I

(L) CLOs – PLOs Matrix

CLO	PLO									
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3	2	2	1	-	2	-	-	-	1
CLO2	2	-	3	2	2	2	-	2	1	-
CLO3	3	3	2	-	1	3	-	-	-	1
CLO4	2	3	2	2	3	-	1	2	-	-
CLO5	-	-	-	1	-	-	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	Practical Physics	C.L. Arora	2024	S. Chand
2	Digital Principles and Applications	Leach & Malvino	9th Ed.	McGraw Hill
3	Advanced Practical Physics for Students	Worsnop & Flint	Recent	Littlehampton



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-I

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2T01NCAPH05	Practical based on P2T01NCAPH03 & P2T01NCAPH06	4-0-1	120	04

• Course Learning Outcomes (CLOs)

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

CLO1:

Analyze the temperature-dependent behavior of semiconductors to determine fundamental properties like energy band gap using thermistor characteristics.

CLO2:

Evaluate the dielectric properties of solid materials using resonance methods and determine fundamental physical constants through optoelectronic measurements (e.g., Planck's constant via LED).

CLO3:

Investigate nuclear radiation phenomena by determining the dead time of a Geiger-Muller Counter and applying statistical analysis to experimental data.

CLO4:

Interpret complex spectroscopic and nonlinear data, including solar absorption spectra using the Hartmann formula and the study of chaos through logistic mapping.

CLO5:

Demonstrate proficiency in advanced spectroscopic techniques by analyzing the Zeeman Effect and correlating experimental observations with quantum mechanical theories.

Unit	Course Content	Learning Pedagogies*	CLO(s)
	1. Thermistor characteristics and estimation of the band gap of the semiconducting material 2. Measurement of dielectric constant of solid materials by resonance method 3. Determination of the Planck's Constant using LED 4. Dead time determination of a Geiger-Muller Counter 5. Analysis of solar absorption spectra using Hart-Mann formula 6. Study of chaos through the logistic map of a population growth 7. Zeeman Effect	Experiential Learning, Collaborative Learning, IBL, PBL, SDL	CLO1, CLO2, CLO3, CLO4, CLO5

• (*) 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)



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-I

- (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 07	CLO1, CLO2, CLO3, CLO4, CLO5	120	5	10	35	50



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-I

• 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	1	2	2	2	1	1	2
CLO2	3	2	3	-	2	2	-	1	1	-
CLO3	3	3	3	2	3	1	2	2	-	2
CLO4	2	3	2	2	-	-	2	1	1	3
CLO5	3	2	-	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 Solid State Physics	C. Kittel	8th Edition / 2004	Wiley
2	Advanced Practical Physics for Students	B.L. Worsnop and H.T. Flint	9th Edition / 1951	Methuen
3	Experiments in Modern Physics	A. Melissinos and J. Napolitano	2nd Edition / 2003	Academic Press

• Online Resources (Open Source)

Sr. No.	Description of Resource(s)	Weblink
1	NPTEL: Experimental Physics I, II & III	NPTEL - Experimental Physics, https://bop-iitk.vlabs.ac.in/exp/
2	Virtual Labs (MHRD): Photoelectric Effect	https://mp-amrt.vlabs.ac.in/exp/photoelectric-effect/simulation.html



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-I

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2T01NCAPH06	Nanoscience & Applied Materials	2-0-1	60	02

• Course Learning Outcomes (CLOs)

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

CLO1:

Critically analyze the fundamental principles of dimensionality and quantum confinement to evaluate size-dependent properties in various nanostructured materials.

CLO2:

Evaluate and differentiate between top-down and bottom-up approaches for the synthesis and deposition of nanomaterials.

CLO3:

Demonstrate advanced knowledge of chemical synthesis methods, including Sol-Gel, hydrothermal, and sonochemical processes for creating core-shell structures and quantum dots.

CLO4:

Formulate strategies for the fabrication of carbon nanotubes and other nanostructured materials based on specific industrial requirements.

CLO5:

Assess the emerging applications of nanotechnology in industrial and environmental sectors.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	Nanoscience& Nanotechnology- Definition, Concepts: Top down and Bottom up, Fundamentals of Nano-science and Nanotechnology, Classification of Nanostructure, Dimensionality & Quantum Confinement, Carbon Nanomaterials other Nanostructured materials, size dependant properties of nanomaterials. Nanotechnology in ancient Bharat e.g. Gold nanoparticles in Gold Bhashma, CNTs in Kiladi Artefacts coatings etc..	CL, RP, SDL	CLO1, CLO2
II	Chemical processes: Chemical precipitation and co-precipitation, polyol, and borohydrate reduction methods, Sol-Gel synthesis; Microemulsions synthesis, Hydrothermal, Solvothermal synthesis methods, Microwave assisted synthesis; Sonochemical assisted synthesis, Core-Shell nanostructure, Quantum dot (QDs) synthesis, fabrication of carbon nanotubes etc.	CL, ICT, PBL	CLO3, CLO4, CLO5



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-I

• (*) 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 [15Marks]

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

b. Internal Summative Assessment [10Marks]

- (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	30	1	3	8	12
II	CLO3, CLO4, CLO5	30	1	4	8	13
		60	02	07	16	25



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-I

• 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	1	2	2	2	1	1	-	2
CLO2	3	3	2	2	2	3	1	-	-	2
CLO3	3	3	3	3	2	3	1	-	1	1
CLO4	3	3	3	3	2	3	1	-	1	2
CLO5	3	3	2	2	3	3	1	1	-	1

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	Charles P. Poole, Jr., Frank J. Owens	-	Wiley-India
2	Nanotechnology: Principles and practices	Sulabha K. Kulkarani	-	Springer
3	Bio nanotechnology- lessons from nature	David S. Goodsell	-	Wiley-India
4	Carbon Nanomaterials	Yuri Gogotsi, Volker Presser	-	CRC Press

• Online Resources (Open Source)

Sr. No.	Description of Resource(s)	Weblink
1	NPTEL Course: Nanostructures and Nanomaterials	https://nptel.ac.in/courses/113/106/113106093/
2	NPTEL Course: Introduction to Nanotechnology	https://nptel.ac.in/courses/118/104/118104008/
3	NPTEL Course: Nanotechnology: Science and Applications	https://nptel.ac.in/courses/118/102/118102003/
4	NPTEL Course: Properties of Nanomaterials	https://nptel.ac.in/courses/118/107/118107015/
5	NPTEL Course: Nanostructures and Nanomaterials	https://nptel.ac.in/courses/113/106/113106093/



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-I
