Vidya Prasarak Mandal's

B. N. Bandodkar College of Science (Autonomous), Thane

Syllabus for

Programme: Master of Science

Specific Programme: BPPH

Programme: Master of Science Specific Programme: Physics

[**M.Sc. Physics I (Semester I and II)**]

Level 6.0

CHOICE BASED GRADING SYSTEM

Revised under NEP

From academic year 2023-24

Preamble

The systematic and planned curricula of the M.Sc. Physics degree is a unique and multidisciplinary program me that provides theoretical and applied knowledge in a range of subjects, including physics, electronics, optics, mathematics, classical and quantum.

The curriculum for the M. Sc. (Physics) programme is designed to cater to the requirement of NEP 2020 Based Credit System following the University Grants Commission (UGC)guidelines. In the proposed structure, due consideration is given to Elective Courses (Discipline specific – Physics).

Furthermore, continuous assessment is an integral part of the CBCS, which will facilitate systematic and thorough learning towards better understanding of the subject. The systematic and planned curricula divided into one years (comprised of two semesters)

Dr. Sangita S. Meshram
Chairperson, BOS Physics
VPM's B. N. Bandodkar College of Science (Autonomous), Thane

PROGRAMME OUTCOMES (POs) OF MASTER OF SCIENCE (M.Sc.)

The Postgraduate Programmes of Science are intended to cater quality education and attain holistic development of learners through the following programme outcomes:

- **PO1 – Domain Knowledge**

  Comprehend and demonstrate domain knowledge in specialized branch of science. Instil ability to apply it in upgrading professional, social and personal life.

- **PO2 – Development of Research Competence**

  Imbibe skills related to identification of research problem, formulating hypothesis, execution of research process, analysing data, interpreting the data, drawing conclusion and presenting research work. Encourage learners for doctoral studies.

- **PO3 - Digital Literacy**

  Enhance ability to access, select and use a variety of relevant information e-resources for creating new knowledge resources.

- **PO4 - Sensitization towards Environment**

  Build cohesive bond with nature by respecting natural resources, encouraging eco-friendly practices and creating awareness about sustainable development.

- **PO5 - Individuality and Team work**

  Encourage learner to work independently or in collaboration for achieving effective results through practical experiments, project work and research activities.

- **PO6 – Competence for Employment**

  Promote field work, internships, industrial training, research projects, research paper presentations and publications to develop competence for adapting towards dynamic socio-economic changes and make learner employable.

Eligibility: B.Sc. Physics Pass
Duration: 2 years (Syllabus for M.Sc. First year semester I & II)
Mode of Conduct: Offline lectures/ Online lectures
Discipline/Subject: Physics
Specific Programme: M.Sc. PHYSICS
Level: 6.0
Qualification Title: PG Diploma

Discipline/Subject: PHYSICS

Program Specific Outcomes-Physics

1.	**PSO1 – Remember & Understand** Demonstrate in-depth understanding of **fundamental and advanced concepts of physics**.	L1

2.	**PSO2 – Apply** Apply theoretical and experimental physics principles to **solve physical problems and perform laboratory experiments**.	L2
3.	**PSO3 – Analyze** Analyze experimental and theoretical data using **mathematical, computational, and statistical tools**.	L3
4.	**PSO4 – Evaluate** Evaluate physical models, experimental results, and research literature **critically and scientifically**.	L4
5.	**PSO5 – Create** Design and execute **independent research projects**, including experimental design and scientific reporting.	L5
6.	**PSO6 – Professional & Ethical Practice** Demonstrate **ethical conduct, laboratory safety, teamwork, and effective scientific communication**.	L6
Specific Programme: M. Sc. (PHYSICS)		

Assessment: Weightage for assessments (in percentage) For Major

Type of Course	Formative Assessment / IA	Summative Assessment
Theory	40%	60%

B. N. Bandodlar College of Science, (AUTONOMOUS)-Thane									
Master program in Physics									
Year (2 Yrs)	LEVEL	SEMESTER	Major			Research Methodology	On Job Training / Field project	Research project	Cum Credits	Degrees
			Mandatory		Electives anyone					
I	**6.0**	SEM-I	3*4 + 2 = 14		Credits 4	Credits 4	NA	NA	22	PG Diploma in Chemistry (After 3 Yrs. degree UG)
			Course 1	Credits 4	Course 1= Credits 4					
			Course 2	Credits 4	**OR**					
			Course 3	Credits 4	Course 2 = Credits 4					
			Course 4	Credits 2	**OR**					
		SEM-II	Course 1	Credits 4	Course 1 = Credits 4	NA	**Credits 4**	NA	**22**	
			Course 2	Credits 4	**OR**					
			Course 3	Credits 4	Course 2 = Credits 4					
			Course 4	Credits 2	**OR**					
Cum Cr. for 1 Yr. PG Diploma			**28**		8	4	4		44	
II	**6.5**	SEM- III	Course 1	Credits 4	Course 1	Credits 4	NA	NA	**Credits 4**	22	Master program in Chemistry (After 3 Yrs. degree UG)
			Course 2	Credits 4	**OR**					
			Course 3	Credits 4	Course 2	Credits 4				
			Course 4	Credits 2	**OR**					
		SEM IV	Course 1	Credits 4	Course 1	Credits 4	NA	NA	**Credits 6**	22	
			Course 2	Credits 4	**OR**					
			Course 3	Credits 4	Course 2	Credits 4				
					OR					
Cum Cr. for integrated 1 Yr. PG Degree			**26**		**8**			**10**	**44**	
Cum Cr. for 2 Yr. PG Degree			**44**		**16**	**4**	**4**	**10**	**88**	

Sr. No	Heading	Particulars
1	Title of the Course	**M.Sc. Physics**
2	Eligibility for Admission	B.Sc. **Physics** or equivalent qualification from other universities as may have been allowed by the relevant ordinances of this university
3	Passing Marks	40%
4	No. of Years /Semesters	Two
5	Level	PG
6	Level	PG
7	Pattern	Semester
	Date:	**Signature**

PROGRAMME
OUTLINE

YEAR	COURSE TYPE	COURSE CODE	COURSE TITLE	CREDITS
M.Sc. I Sem-I (Level-6.0)	Mandatory Course-I	23BPPH1T01	Mathematical Methods	04
	Mandatory Course-II	23 BPPH1T02	Classical Mechanics	04
	Mandatory Course-III	23BPPH1T03	Quantum Mechanics-I	04
	Mandatory Course Practical	23BPPH1P01	Practical LAB-I based on 23BPPH1T01, 23BPPH1T02 and 23BPPH1T03	02
	Elective1	23BPPH1T04	Electronic Structures of Solids	02
		23BPPH1P02	Practical LAB-EI-1 based on 23BPPH1T04	02
	OR			
	Elective2	23BPPH1T05	Solid State Physics	02
		23BPPH1P03	Practical LAB-EI-2 based on 23BPPH1T05	02
	RM	23BPRM1T02	Research Methodology in Physics	04
	TOTAL			**22**
M.Sc. I Sem-II	Mandatory Course-I	23BPPH2T01	Advanced Electronics	04
	Mandatory Course-II	23BPPH2T02	Electrodynamics	04
	Mandatory Course-III	23BPPH2T03	Quantum Mechanics-II	04
	Mandatory Course Practical	23BPPH2P01	Practical LAB-II based on 23BPPH2T01, 23BPPH2T02 and 23BPPH2T03	02
	Elective 1	23BPPH2T04	Applied Thermodynamics	02
		23BPPH2P02	Practical LAB-EI-1 based on 23BPPH2T04	**02**
	OR			

	Elective2	23BPPH2T05	Solid State Devices	02
		23BPPH2P03	Practical LAB-EI-2 based on 23BPPH2T05	02
	OJT/FP	23BPPH2P04	On Job Training in Physics / Field Project in Physics	04
	TOTAL			**22**

Semester I

Course Code 23BPPH1T01	Course Title: Mathematical Methods	Credits 4	No. of lectures 60

Course Outcomes:

CO1	solve complex variable problems involving Cauchy-Riemann equations, analytic functions, series expansions, contour and improper integrals using the residue theorem.	L3
CO2	Apply matrix theory and its applications in physics, along with basic tensor analysis, including operations, summation conventions, and the Levi-Civita symbol.	L3
CO3	solve second-order linear differential equations, work with special functions, and use Green's functions and Sturm-Liouville theory.	L3
CO4	Apply Fourier and Laplace transform techniques to solve ordinary and partial differential equations.	L4

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	0	0	0	0	0
CO2	3	0	0	0	0	0
CO3	3	0	0	0	0	0
CO4	3	0	0	0	0	0

Unit-I	Complex Variables, Limits, Continuity, Derivatives, Cauchy-Riemann Equations, Analytic functions, Harmonic functions, Elementary functions: Exponential and Trigonometric, Taylor and Laurent series, Residues, Residue theorem, Principal part of the functions, Residues at poles, zeroes and poles of order m, Contour Integrals, Evaluation of improper real integrals, improper integral involving Sines and Cosines, Definite integral sin involving sine and cosine functions.	**15**
Unit-II	Matrices, Eigenvalues and Eigenvectors, orthogonal, unitary and Hermitian matrices, Diagonalization of Matrices, Applications to Physics problems. Introduction to Tensor Analysis, Addition and Subtraction of Tensors, summation convention, Contraction, Direct Product, Levi-Civita Symbol	**15**
Unit-III	General treatment of second order linear differential equations with non- constant coefficients, Power series solutions, Frobenius method, Legendre, Hermite and Laguerre polynomials, Bessel equations, Nonhomogeneous equation – Green's function, Sturm-Liouville theory.	**15**

Unit-IV	Integral transforms: three dimensional Fourier transforms and its applications to PDEs (Green function of Poisson's PDE), convolution theorem, Parseval's relation, Laplace trans forms, Laplace transform of derivatives, Inverse Laplace transform and Convolution theorem, use of Laplace's transform in solving differential equations.	**15**

Main references:

1. S.D. Joglekar, Mathematical Physics: The Basics, UniversitiesPress2005
2. S.D. Joglekar, Mathematical Physics: Advanced Topics, CRCPress2007
3. M.L. Boas, Mathematical methods in the Physical Sciences, WileyIndia2006
4. G.Arfken and H.J.Weber: Mathematical Methods for Physicists, Academic Press 2005

Additional references:

1. A.K.Ghatak, I.C.Goyaland S.J.Chua, Mathematical Physics, McMillan
2. A.C.Bajpai, L.R.Mustoe and D.Walker, Advanced Engineering Mathematics, John Wiley
3. E. Butkov, Mathematical Methods, Addison-Wesley
4. J. Mathews and R.L.Walker, Mathematical Methods of physics
5. P.Dennery and A.Krzywicki, Mathematics for physicists
6. T. Das and S.K. Sharma, Mathematical methods in Classical and Quantum Mechanics
7. R.V.Churchill and J W. Brown , Complex variables and applications, VEd. McGraw. Hill
8. A.W.Joshi,Matrices and Tensors in Physics,Wiley India

Course Code 23BPPH1T02	Course Title: Classical Mechanics	Credits 4	No. of lectures 60

Course Outcomes:

CO1	Apply the Lagrange & Hamilton's formulation to solve the different problems.	L3
CO2	Summarize the two body Central force field problems.	L2
CO3	Extend the terms Small Oscillations and Legendre Transformations.	L2
CO4	Apply the canonical transformation and Poisson's Bracket to solve the problems.	L3

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	0	0	0	0	0
CO2	1	0	0	0	0	0
CO3	3	0	0	0	0	0
CO4	3	0	0	0	0	0

Unit I	Mechanics of a particle, Mechanics of a system of particles, Frames of references, rotating frames, Centrifugal and Coriolis force, Constraints, D'Alembert's principle and Lagrange's equations, Velocity-dependent potentials and the dissipation function, Simple applications of the Lagrange formulation. Hamilton's principle, Calculus of variations, Derivation of Lagrange's equations from Hamilton's principle ,Lagrange Multipliers and constrain text ruminations problems, Extension of Hamilton's principle to nonholonomic systems, Advantages of a variational principle formulation.	15
Unit II	Conservation theorems and symmetry properties, Energy Function and he conservation of energy. The Two-Body Central Force Problem: Reduction to the equivalent one body problem, The equations of motion and first integrals, The equivalent one-dimensional problem and classification of orbits, The virial theorem, The differential equation for the orbit and integrable power-law potentials, The Kepler problem : Inverse square law of force, The motion in time in the Kepler problem, Scattering in a central force field, Transformation of the scattering problem to laboratory coordinates.	15
Unit III	Small Oscillations: Formulation of the problem, the eigenvalue equation and the principal axis transformation, Frequencies of free vibration and normal coordinates, Forced and damped oscillations, Resonance and beats. Legendre transformations and the Hamilton equations of motion, Cyclic coordinates and conservation theorems, Derivation of Hamilton's equations from a variational principle.	15

Unit IV	Canonical Transformations, Examples of canonical transformations, The simplistic approach to canonical transformations, Poisson brackets and other canonical invariants, Equations of motion, infinitesimal canonical transformations and conservation theorems in the Poisson bracket formulation, The angular momentum Poisson bracket relations.	**15**

Main Reference:

1. Classical Mechanics, H. Goldstein, PooleandSafko,3rd Edition, Narosa Publication (2001)

Additional References:

1.   Classical Mechanics, N.C. Rana and P.S. Joag. Tata McGraw Hill Publication.

2.   Classical Mechanics, S.N. Biswas, Allied Publishers (Calcutta).
3.   Classical Mechanics, V. B. Bhatia, Nervosa Publishing (1997).
4.   Mechanics, Landau and Lifshitz, Butterworth, Heinemann.
5.   The Action Principle in Physics, R.V. Kamat, New Age Intel. (1995).
6.   Classical   Mechanics,   VolI   and   II, E.A.   Decalogue, John Wiley (1982).

7.   Theory and Problems of Lagrange Dynamics, Schaum Series, McGraw (1967).

8.   Classical Mechanics of Particles and Rigid Bodies, K.C. Gupta, Wiley Eastern (2001)

Course Code 23BPPH1T03	Course Title Quantum Mechanics-I		Credits 4	No. of lectures 60

Course Outcomes:

CO1	Explain the concepts of general Formalism of Wave Mechanics.	L2
CO2	Summarize the term Wave packet and Schrodinger equation and its different applications.	L2
CO3	Make use of the solution of Schrodinger equation in Three dimensional problems.	L3
CO4	Apply the angular momentum operator to solve its problems	L3

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	0	0	0
CO2	2	0	0	0	0	0
CO3	1	0	0	0	0	0
CO4	2	0	0	0	0	0

UNIT-1		15
	Review of concepts: Postulates of quantum mechanics, observables and operators, measurements, state function and expectation values, the time-dependent Schrodinger equation, time development of state functions, solution to the initial value problem. The Superposition principle, commutator relations, their connection to the uncertainty principle, complete set of commuting observables. Time development of expectation values, conservation theorems and parity. Formalism: Linear Vector Spaces and operators, Dirac notation, Hilbert space, Hermitian operator sand their properties, Matrix mechanics: Basis and representations, unitary transformations, the energy representation. Schrodinger, Heisenberg and interaction picture.	

		15
UNIT-II	**Wave packet:** Gaussian wave packet, Fourier transform. Schrodinger equation solutions: one dimensional problem: General properties of one-dimensional Schrodinger equation, Particle in a box, Harmonic oscillator by raising and lowering operators and Frobenius method, unbound states, one dimensional barrier problems, finite potential well	
UNIT-III	Schrodinger equation solutions: Three dimensional problems: Orbital angular momentum operators in cartesian and spherical polar coordinates, commutation and uncertainty relations, spherical harmonics, two particle problem- coordinates relative to center of mass, radial equation for a spherically symmetric central potential, hydrogen atom, eigenvalues and radial eigenfunctions, degeneracy, probability distribution.	15
UNIT-IV	**Angular momentum** Ladder operators, eigenvalues and eigenfunctions of L^2 and L_u using spherical harmonics, angular momentum and rotations. Total angular momentum J; LS coupling; eigenvalues of J^2 and Jz. Addition of angular momentum, coupled and uncoupled representation of eigenfunctions, Clebsch Gordan coefficient for $j_1= j_2= ½$ and $j_1=1$ and $j_2= ½$. Angular momentum matrices, Pauli spin matrices, spin eigen functions, free particle wave function including spin, addition of two spins.	15

Main references:

1. Richard Liboff, Introductory Quantum Mechanics,4thedition, Pearson.
2. D J Griffiths, Introduction to Quantum Mechanics4thedition
3. A Ghatak and S Lokanathan, Quantum Mechanics: Theory and Applications,5thedition.
4. N Zettili, Quantum Mechanics: Concepts and Applications,2ndedition, Wiley.

Additional References

1. W Greiner, Quantum Mechanics: An introduction, Springer,2004
2. R Shankar, Principles of Quantum Mechanics, Springer,1994
3. P.M.Mathews and K.Venkatesan,ATextbookof Quantum Mechanics ,Tata McGraw Hill (1977).
4. J. J. Sakurai Modern Quantum Mechanics, Addison-Wesley (1994).

Course Code 23BPPH1P01	Course Title Practical LAB-I based on 23BPPH1T01, 23BPPH1T02 and 23BPPH1T03	Credits 2	No. of lectures 60

Course Outcomes:

CO1	Apply fundamental principles of physics to measure surface tension and torsional constants using standard experimental techniques.	L3
CO2	Design, assemble, and test regulated power supply and constant current circuits using operational amplifiers and linear ICs.	L4
CO3	Analyse and implement timing and waveform generation circuits using ICs for practical electronic applications.	L4
CO4	Design and evaluate second-order active filters and instrumentation amplifiers for signal conditioning and noise rejection applications.	L4

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	0	0	2	0
CO2	2	1	0	0	2	0
CO3	2	1	0	0	2	0
CO4	2	1	0	0	2	0

Lab-1	Surface Tension by Quince's method
	Measurement of Torsional constant using oscillator
	Delayed linear weepusingIC555
	Regulator positive power supply using IC LM317-
	Regulator Negative power supply using IC LM 337
	Dual power supply using ICLM317 and LM 337
	Constant current supply using IC741and LM317
	Active filter second order. High Pass
	Active filter second order. Low Pass
	Active filter second order. Band Pass
	Active filter second order. Band Reject
	Waveform generator using ICS
	Instrumentation amplifier

References
Advanced Practical Physics-Worsnop and Flint
Atomic spectra-H.E. White
Experiments in modern physics– ellissinos
A course of experiments with Laser- Sirohi
Elementary experiments with Laser- G.White
HBCSE Selection camp 2007Manual
Solid state devices-W.D.Cooper
Electronic text lab manual-P.B.Zbar
Electronic Principles-A.P.Malvino
Opeational amplifiers and linear Integrated circuits-Coughlin & Driscoll
Practical analysis of electronic circuits through experimentation-L.MacDonald
Integrated Circuits- K.R.Botkar
Op-amps and linear integrated circuit technology- R.Gayakwad
Digital Electronics –RogerT okheim
Digitaltheoryandexperimentationusingintegratedcircuits-MorrisE.Levine(PrenticeHall)
Practical analysis of electronic circuits through experimentation-Lome Macronaid (Technical Education Press)
Logicdesignprojectsusingstandardintegratedcircuits-JohnF.Waker(JohnWiley&sons)
Practical applications circuits handbook – Anne Fischer Lent & Stan Miastkowski (Academic Press)
Digital logic design,a text lab manual- Anala Pandit(Nandu printers and publishers Pvt.Ltd.)

Course Code 23BPPH1T04		Course Title Electronic structure of Solids	Credits 2	No. of lectures
Course Outcomes:				
CO1	Explain the free electron gas model and Sommerfeld theory of metals by analysing electron behaviour in an infinite square well potential.			L2
CO2	Construct the electron energy band formation in solids using periodic potential models, including nearly-free electron approximation and tight-binding method.			L3
CO3	Understand electronic band structure methods such as APW, KKR, OPW, and pseudopotentials.			L2
CO4	Apply band structure concepts to interpret Fermi surfaces and experimental probe techniques.			L3

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	0	0	0
CO2	1	0	0	0	0	0
CO3	2	0	0	0	0	0
CO4	1	0	0	0	0	0

UNIT-1	Prototype Electronic Structure Free electron gas in Infinite Square well potential– Sommerfeld theory of metals. Electron energy levels in a periodic potential. Nearly-free electron approximation. The tight-binding method.	**15**
UNIT-2	Electronic Band Structure Methods Cellular method; Augmented plane-wave (APW) method; Green's function (KKR) method; Orthogonalized plane wave (OPW) method; Pseudopotentials. Band structure / Fermi surface of selected metals – alkali and noble metals, simple multivalent metals, transition metals, rare- earths, semi-metals, semiconductors Si and Ge. Fermi surface probes: Electrons in a magnetic field - the de Haas-van Alfen effect. Magneto- acoustic effect, cyclotron resonance.	**15**

Main References: -

- H Ibach and H Luth, Solid State Physics, 3rd ed.; Springer, 2003. Chpts. 6,7,9.
- Neil W Ashcroft and N David Mermin, Solid State Physics. Holt, Rinehart and Winston, 1976.Chapters2, 8-17.
- MichaelPMarder,Condensed MatterPhysics, 2nded.;John Wiley and Sons, 2010.
- AdditionalReferences:

- BrianTanner,IntroductiontothePhysicsofElectronsin Solids, CUP, 1995.
- MA Wahab, Solid State Physics, Narosa,2005.
- G Grosso and G Paravicini, Solid State Physics, Academic Press, 2000.

Course Code 23BPPH1P02	Course Title Practical LAB-EI -1 based on 23BPPH1T04	Credits 2	No. of lectures 60

Course Outcomes:

CO1	Understand diffraction phenomena and determine wavelength using wave optics principles.	L2
CO2	Apply interferometric techniques to determine light sources and spectral characteristics.	L3
CO3	Analyse quantum effects through photoelectric experiments to determine fundamental constants.	L4
CO4	Built and test basic electronic control circuits for practical applications.	L3

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	0	0	2	0
CO2	2	1	0	0	2	0
CO3	2	1	0	0	2	0
CO4	2	1	0	0	2	0

23BPPH1P02	Diffraction at Cylindrical object
	Wavelength of monochromatic light by diffraction at straight edge.
	Michaelson's interferometer (Na Light)
	Michaelson's interferometer (He-Ne laser)
	Analysis of sodium spectrum
	Determination h/e using vacuum photo cell
	Diac-Triac phase control
	ON/OFF temperature controller using ICS

Course Code 23BPPH1T05	Course Title Solid State Physics	Credits 2	No.of lectures 30

Course Outcomes:

CO1	Understand diffraction and reciprocal lattice concepts including Bragg law, Brillouin zones, and diffraction conditions for crystal structures.	L2
CO2	Illustrate the interference, structure factor, and experimental diffraction techniques for scattering from crystalline and amorphous solids.	L2
CO3	Understand lattice vibrations, phonon concepts, and dispersion relations in monoatomic and diatomic crystals.	L2
CO4	Apply phonon and anharmonic interaction concepts for thermal conductivity, neutron scattering, and lattice imperfections.	L3

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	0	0	0
CO2	2	0	0	0	0	0
CO3	2	0	0	0	0	0
CO4	1	0	0	0	0	0

UNIT-I	**Diffraction of Waves by Crystals and Reciprocal Lattice** Bragg law, Scattered Wave Amplitude–Fourier analysis, Reciprocal Lattice Vectors, Diffraction Conditions, Brillouin Zones, Reciprocal Lattice to SC, BCC and FCC lattice. Interference of Waves, Atomic Form Factor, Elastic Scattering by crystal, Ewald Construction, Structure Factor, Temperature Dependence of the Reflection Lines, Experimental Techniques (Laue Method, Rotating Crystal Method, Powder Method) Scattering from Surfaces, Elastic Scattering by amorphous solids.	
UNIT-II	Lattice Vibrations and thermal properties Vibrations of Monoatomic Lattice, normal mode frequencies, dispersion relation. Lattice with two atoms per unit cell, normal mode frequencies, dispersion relation., Quantization of lattice vibrations, phonon momentum, Inelastic scattering of neutrons by phonons, Surface vibrations, Inelastic Neutron scattering. Anharmonic Crystal Interaction. Thermal conductivity – Lattice Thermal Resistivity, Umklapp Process, Imperfections	

Main References: -

1. Charles Kittel "Introduction to Solid State Physics", 7th edition John Wiley & sons.
2. J. Richard Christman "Fundamentals of Solid- State Physics" John Wiley & sons
3. M.A. Wahab "Solid State Physics –Structure and properties of Materials" Narosa Publications1999.
4. M. Ali Omar "Elementary Solid-State Physics" Addison Wesley (LPE)
5. H.Ibach and H.Luth 3rd edition "Solid State Physics – An Introduction to Principles of Materials Science" Springer International Edition (2004)

Course Code 23BPPH1P03	Course Title Practical LAB-EI -2 based on 23BPPH1T05	Credits 2	No. of lectures 60

Course Outcomes:

CO1	Identify electrical properties of semiconductors using standard experimental techniques.	L2
CO2	Analyse charge transport and breakdown mechanisms in semiconductor devices.	L4
CO3	Explain laser beam characteristics using diffraction and divergence principles.	L2
CO4	Apply digital electronic concepts to study data conversion and signal routing circuits.	L4

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	0	0	2	0
CO2	1	1	0	0	2	0
CO3	2	1	0	0	2	0
CO4	1	1	0	0	2	0

Resistivity of a semiconductor or by four-point probe method.	
Temperature dependence of Zener/Avalanche breakdown diodes.	
DC hall effect	
Divergence and diffraction of helium neon/solid state laser beam.	
Carrire life-time	
Study of 8 Bit DAC	
16 channel digital multiplexer	

Course Code 23BPRM1T02	Course Title Research Methodology in Physics	Credits 4	No.of lectures 60

Course Outcomes:

CO1	Identify ethically use primary, secondary, and tertiary information sources—both print and digital—including journals, indexing and abstracting tools, online databases, and internet resources, for effective literature searching, citation, and research in physical sciences.	L3
CO2	Interpret the present experimental data using appropriate statistical, chemometric, and regression techniques to draw accurate and scientifically valid conclusions.	L2
CO3	Understand the methods of scientific research and writing, including the structure and ethics of scientific papers, reporting of practical and project work, preparation of literature reviews, and effective poster and oral presentations.	L2
CO4	Summarise safety principles and risk management practices.	L2

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	0	0	0	0	0
CO2	2	0	0	0	0	0
CO3	2	0	0	0	0	0
CO4	2	0	0	0	0	0

UNIT-I	Unit1: Research resources	15
	Print: Primary, Secondary and Tertiary sources. Journals: Journal abbreviations, abstracts, current titles, reviews, monographs, dictionaries,text-books,currentcontents,IntroductiontoPhysicalAbstracts and Beilstein, Subject Index, Substance Index, Author Index, Formula Index, and other Indices with examples. Digital: Web sources, E-journals, Journal access, TOC alerts, Hot articles, Citation Index, Impact factor, H-index, E-consortium, UGC infonet, E-books, Internet discussion groups and communities, Blogs, preprint servers, Search engines, Sciurus, Google Scholar, , Wiki-databases,, Science Direct, SciFinder, Scopus. Information Technology and Library Resources: The Internet and World wide web, Internet resources for Physics, finding and citing published information.	

UNIT-II	**Unit II: DATA ANALYSIS**	**15**
	The Investigative Approach: Making and recording Measurements, SI units and their use, Scientific methods and design of experiments. Analysis and Presentation of Data: Descriptive statistics, choosing and using statistical tests, Chemometrics, Analysis of Variance (ANOVA), Correlation and regression, curve fitting, fitting of linear equations, simple linear cases, weighted linear case, analysis of residuals, general polynomial fitting, linearizing transformations, exponential function fit, r and its abuse, basic aspects of multiple linear regression analysis.	
UNIT-III	Methods of scientific research and writing Scientific papers Reporting practical and project work, writing literature surveys and reviews, organizing a poster display, giving an oral presentation. Writing Scientific Papers: Justification for scientific contributions, bibliography, description of methods, conclusions, the need for illustration, style, publications of scientific work, writing ethics, avoiding plagiarism.	**15**
UNIT-IV	Safety and hazards Safe working procedure and protective environment, protective apparel, emergency procedure, first aid, laboratory ventilation, Introduction to Risk and Risk Management, Legal Implications of Safety , Physical Hazards, Mechanical Hazards, Electrical Hazards, Radiation Hazards, Chemical Hazards, Pressure Hazards, Thermal Hazards, Noise Hazards, Additional Safety Issues, Emergency Procedures.	**15**

| | **Reference**
 1. Topping,J.,(1984)Errors of Observation and theirTreatment4th Ed.,Chapman Hill, London
 2. Safety in Physics Education, AAPT, American Association of Physics Teachers, ISBN1-931024-01-4 | |

SEMESTER -II

Course Code 23BPPH2T01	Course Title Advanced Electronics		Credits 4	No. of lectures 60

Course Outcomes:

CO1	Explain the architecture, pin configuration, and working of the **8085 microprocessor** and **8051 microcontroller.**	L2
CO2	Illustrate the concept and applications of power supply & **signal conditioning circuits** using different types of amplifiers.	L2
CO3	Explain the principles and working of data transmission systems and applications of optical fibre communication systems	L2
CO4	Demonstrate the microprocessor/microcontroller-based instrumentation circuits.	L2

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	0	0	0
CO2	2	0	0	0	0	0
CO3	2	0	0	0	0	0
CO4	2	0	0	0	0	0

Unit-I	**Microprocessors and Microcontrollers:**	15
	Microprocessors: Counters and Time Delays, Stack and Sub-routines RSG: Microprocessor Architecture, Programming and Applications with the 8085: R.S. Gaonkar,5thEdition, Penram International **Introduction to Microcontrollers:** Introduction, Microcontrollers and Microprocessors, History of Microcontrollers and Microprocessors, Embedded versus External Memory Devices, 8–bit and 16–bit Microcontrollers, CISC and RISC Processors, Harvard and Von Neumann Architectures, Commercial Microcontroller Devices. AVD: Ch.1 **8051 Microcontrollers**: Introduction, MCS–51 Architecture, Registers in MCS-51, 8051 Pin Description, Connections,8051 Parallel I/O Ports and Memory Organization. AVD: Ch. 2, 3 **8051 Instruction set and Programming**: MCS-51AddressingModesand Instruction set. 8051 Instructions and Simple programs using Stack Pointer. AVD: Ch.4 Reference: AVD: Microcontrollers(Theory and Applications) by Ajay V. Deshmukh, TMH	

UNIT-2	**Analog and Data Acquisition Systems:**	**15**
	Power Supplies: Linear Power supply, Switch Mode Power supply, Uninterrupted Power Supply, Step up and Step-down Switching Voltage Regulators. **Inverters:** Principle of voltage driven inversion, Principle of current driven inversion, sine wave inverter, square wave inverter. **Signal Conditioning:** Operational Amplifier, Instrumentation Amplifier using IC, Precision Rectifier, Voltage to Current Converter, Current to Voltage Converter, Op-Amp Based Butterworth Higher Order Active Filters and Multiple Feedback Filters, Voltage Controlled Oscillator, Analog Multiplexer, Sample and Hold circuits, Analog to Digital Converters, Digital to Analog Converters.	
Unit-III	**Data Transmissions, Instrumentations Circuits & Designs:** 1.**Data Transmission Systems:** Analog and Digital Transmissions, Pulse Amplitude Modulation, Pulse Width Modulation, Time Division Multiplexing, Pulse Modulation, Digital Modulation, Pulse Code Format, Modems. **Optical Fiber:** Introduction to optical fibers, wave propagation and total internal reflection in optical fiber, structure of optical fiber, Types of optical fiber, numerical aperture, acceptance angle, single and multimode optical fibers, optical fiber materials and fabrication, attenuation, dispersion, splicing and fiber connectors, fiber optic communication system, fiber sensor, optical sources and optical detectors for optical fiber**.**	**15**
Unit-IV	**Instrumentation Circuits and Designs:** Microprocessors/ Microcontrollers based D C motor speed controller. Microprocessors /Microcontrollers based temperaturecontroller. Electronic weighing single pan balance using strain gauge/ load cell. Opticalanalogcommunicationsystemusingfiberlink.Electronicintensity meter using optical sensor. IR remote controlled ON/OFF switch.	**15**

Reference Books:	
1. Microprocessor Architecture, Programming and Applications with the 8085 R. S. Gaonkar, 4th Edition. Penram International. 2. The8051Microcontroller and Embedded Systems, Dr.Rajiv Kapadia, Jaico Publishing House. 3. The8051Microcontrolle r& Embedded Systems by M.A.Mazidi, 4. J.G. Mazidi and R.D. Mckinlay 5. The8051Microcontroller: K.J.Ayala:PenramInternational 6. Programming&customizingthe8051Mocrocontroller: Myke Predko, TMH 7. Power Electronics and its applications, AlokJain,2ndEdition, Penram International India. 8. Op-Amps and Linear Integrated Circuits - R. A. Gayakwad , 3rd Edition Prentice Hall India. 9. Operational Amplifiers and Linear Integrated Circuits, Robert F. Coughlin and Frederic F. Driscoll, 6th Edition, Pearson Education Asia. 10. Optical Fiber Communications, Keiser, G. Mcgraw Hill, Int. Student Ed. 11. Electronic Communication Systems; 4th. Ed. Kennedy and Davis, (Tata- McGraw. Hill, 2004. 12. Electronic Instrumentation, H.S.Kalsi,Tata-McGraw.Hill,1999	

Course Code 23BPPH2T02	Course Title Electrodynamics		Credits 4	No. of lectures 60

Course Outcomes:

CO1	Apply Maxwell's equations and relativistic formalisms to analyze electromagnetic fields and energy-momentum flow.	L3
CO2	Develop the equation of electromagnetic wave propagation in vacuum and matter and wave behaviour in waveguides and resonant cavities.	L3
CO3	Demonstrate the fields and radiation produced by moving charges, including Lienard-Wiechert potentials, dipole radiation, and antenna systems.	L2
CO4	Explain the relativistic covariant Lagrangian formalism for point charges, the energy-momentum tensor, and related conservation laws.	L2

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	0	0	0	0	0
CO2	1	0	0	0	0	0
CO3	2	0	0	0	0	0
CO4	2	0	0	0	0	0

Unit-I	Maxwell's equations, The Pointing vector, The Maxwellian stress tensor, Lorentz Transformations, Four Vectors and Four Tensors, The field equations and the field tensor, Maxwell equations in covariant notation.	**15**
Unit-II	Electromagnetic waves in vacuum, Polarization of plane waves. Electromagnetic waves in matter, frequency dependence of conductivity, frequency dependence of polarizability, frequency dependence of refractive index. Wave guides, boundary conditions, classification of fields in wave guides, phase velocity and group velocity, resonant cavities.	**15**
Unit-III	Moving charges in vacuum, gauge transformation, The time dependent Green function, The Lienard- Wiechert potentials, Leinard- Wiechert fields, application to fields-radiation from a charged particle, Antennas, Radiation by multipole moments, Electric dipole radiation, Complete fields of a time dependent electric dipole, Magnetic dipole radiation	**15**
Unit-IV	Relativistic covariant Lagrangian formalism: Covariant Lagrangian formalism for relativistic point charges. The energy-momentum tensor, Conservation laws.	**15**

Main Reference:
1. W.Greiner, Classical Electrodynamics(Springer-Verlag,2000) (WG).

2. M.A. Heald and J.B. Marion, Classical Electromagnetic Radiation, 3rd edition (Saunders, 1983) (HM)

3. Additional references:

4. J.D.Jackson,ClassicalElectrodynamics,4Thedition,(JohnWiley & sons) 2005 (JDJ)

5. W.K.H.PanofskyandM.Phillips,ClassicalElectricityandMagnetis m,2nd edition, (Addison - Wesley) 1962.

6. D.J. Griffiths, Introduction to Electrodynamics,2nd Ed., Prentice Hall, India,1989

7. J.R.Reitz,E.J.Milford and R.W.Christy, Foundation of Electromagnetic Theory, 4th ed., Addison -Wesley, 1993

Course Code 23BPPH2T03	Course Title Quantum Mechanics-II		Credits 4	No. of lectures 60

Course Outcomes:

CO1	Explain time-independent and time-dependent perturbation theory.	L2
CO2	Summarize the principles and applications of the Variational and WKB approximation methods.	L2
CO3	Interpret the scattering amplitudes and their role in analysing interactions in quantum systems.	L2
CO4	Illustrate the role of identical particles, Dirac matrices and spinors in relativistic quantum mechanics.	L2

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	0	0	0
CO2	2	0	0	0	0	0
CO3	2	0	0	0	0	0
CO4	2	0	0	0	0	0

UNIT-I	Perturbation Theory: Time independent perturbation theory: First order and second order corrections to the energy eigenvalues and eigenfunctions. Degenerate perturbation Theory: first order correction to energy. Time dependent perturbation theory: Harmonic perturbation, Fermi's Golden Rule, sudden and adiabatic approximations, applications	15
UNIT-II	Approximation Methods 1. Variation Method: Basic principle, applications to simple potential problems, He- atom. 2. WKB Approximation: WKB approximation, turning points, connection formulas, Quantization conditions, applications.	15
UNIT-III	Scattering Theory Laboratory and center of mass frames, differential and total scattering cross-sections, scattering amplitude, Partial wave analysis and phase shifts, optical theorems S-wave scattering from finite spherical attractive and repulsive potential wells, Born approximation.	15
UNIT-IV	Identical Particles: Symmetric and antisymmetric wave functions, Bosons and Fermions, Pauli Exclusion Principle, slater determinant. Relativistic Quantum Mechanics The Klein Gordon and Dirac equations. Dirac matrices, spinors, positive and negative energy solutions physical interpretation. Nonrelativistic limit of the Dirac equation.	15

Main references:
1. Richard Liboff, Introductory Quantum Mechanics,4thedition, Pearson.
2. DJ Griffiths, Introduction to Quantum Mechanics 4thedition
3. A Ghatak and S Lokanathan, Quantum Mechanics: Theory and Applications, 5th edition.
4. N Zettili, Quantum Mechanics: Concepts and Applications, 2nd edition, Wiley.
5. J.Bjorken and S.Drell, Relativistic Quantum Mechanics, McGraw-Hill (1965).

Additional References
1. WGreiner, Quantum Mechanics: An introductions pringer, 2004
2. R Shankar, Principles of Quantum Mechanics, Springer,1994
3. P.M. Mathews and K.Venkatesan, A Textbook of Quantum Mechanics, Tata McGraw Hill (1977).
4. J.J.Sakurai Modern Quantum Mechanics, Addison-Wessley (1994).

Course Code 23BPPH2P01	Course Title Practical LAB-II based on 23BPPH2T01, 23BPPH2T02 and 23BPPH2T03		Credits 2	No. Of Lectures 60

Course Outcomes:

CO1	Apply optical principles to analyse diffraction, interference, and magnetic field effects on spectral lines.	L3
CO2	Experiment with acoustic and nuclear parameters using ultrasonic interferometry and radiation detection techniques.	L3
CO3	Analyse semiconductor characteristics and implement basic power electronic control circuits.	L4
CO4	Build and test digital logic circuits for computational tools for numerical problem solving.	L3

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	0	2	0
CO2	2	0	0	0	2	0
CO3	2	0	0	0	2	0
CO4	2	0	0	0	2	0

Lab-II		
Zeeman effect using Fabry-Perot etalon/Lummer-Gehrecke plate.		
Ultrasonic interferometry velocity measurements in different fluids.		
Measurement of refractive index of liquids using laser		
IV/CV measurement on semiconductor specimen semiconductor measurements.		
Characteristics of a Geiger Muller counter and measurement of dead time.		
Double slit Fraunhofer diffraction		
Adder subtractor circuits using ICS		
Studyofpresettablecounters74190and74193		
TTL characteristics of totem-pole open collector and tri-state devices.		
Switching voltage regulator integrated circuits		
Pulse width modulation for speed control of DC toy motor.		
Numerical integration/solving ODEs using C++ or Python		
Introduction to Sci-Lab		

References:

1. 1.Advance practical physics-Worsnop and Flint

2. 2.Experiments In modern physics: Mellissions
3. 3.Medical Electronics-Khandpur
4. Sirohi-A course of experiments with He-Ne Laser; Wiley Eastern Ltd
5. Semiconductor measurements-Runyan
6. Experimental physics for students-Whittle&. Yarwood
7. Manual of experimental physics--EV-Smith
8. Digital Principles and applications- Malvino and Leach
9. Digital circuit practice – Jain & Anand
10. Electronic Instrumentation-H.S. Kalsi
11. Integrated Circuits-K.R.Botkar
12. Digital circuit practice-R.P.Jain
13. Semiconductor electronics-Gibson
14. Introduction to solid state physics- C.Kittel
15. Electronic engineering-Millman Halkias
16. Electronic Instrumentation-W. D. Cooper
17. Manual of experimental physics. V. Smith
18. Semiconductor measurements—Runyan
19. Solid state physics — A. J. Dekkar
20. Experimental physics for students : Whittle & Yarwood
21. Experiments in digital principles- D. P. Leach
22. Microprocessor fundamentals- Schaum Series-Tokheim
23. Microprocessor Architecture, Programming and Applicationswiththe8085 - R.S.Gaonkar
24. Digital Electronics by Roger Tokheim
25. Helfrick & Cooper, PHI
26. 8085 Kit User manual

Course Code 23BPPH2T04	Course Title Applied Thermodynamics	Credits 2	No. of lectures 30

Course Outcomes:

CO1	Explain the thermodynamic properties of pure substances, phase behaviour, equations of state.	L2
CO2	Apply thermodynamic relations and gas liquefaction principles to analyse real gas behaviour and phase change processes.	L3
CO3	Explain the thermodynamic equilibrium, phase equilibria, phase diagrams, and solution models for unary, binary, and multicomponent systems.	L2
CO4	Demonstrate the ideal and practical power and engine cycles such as Carnot, Rankine, Otto, and Diesel cycles.	L2

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	0	0	0
CO2	1	0	0	0	0	0
CO3	2	0	0	0	0	0
CO4	2	0	0	0	0	0

UNIT-I	Properties of Pure Substances: Thermodynamic properties of pure substances in solid, liquid and vapor phases, P-V-T behavior of simple compressible substances, phase rule, thermodynamic property tables and charts, ideal and real gases, equations of state, compressibility chart. Thermodynamic Relations: T-ds relations, Maxwell equations, Liquefaction of gases: Joule-Thomson effect, Joule-Thomson coefficient, coefficient of volume expansion, adiabatic and isothermal compressibility's, Clapeyron equation.	**15**
UNIT-II	Equilibrium Concept in Thermodynamics Unary, binary and multicomponent systems, phase equilibria, evolution of phase diagrams, metastable phase diagrams, calculation of phase diagrams, thermodynamics of defects. Solution models Some Thermodynamic cycles: Carnot vapor power cycle, Ideal Rankine cycle, Rankine Reheat cycle, Otto cycle, Diesel cycle,	**15**

References:
1. M. Modell and R.C. Reid, Thermodynamics and its Applications, Prentice-Hall, Englewood Cliffs, New Jersey, 1983.
2. H.B. Callen, Thermodynamics and an Introduction to Thermostatics, Jonh Wiley & Sons, New York, 1985.
3. R.T.DeHoff, Thermodynamics in Materials Science,
4. McGraw-Hill, Singapore,
5. Physical Chemistry of Metals: L.S. Darkenand R.W.Gurry
6. Thermodynamics of Solids: R.A.Swalin
7. Phase Transformations in Metals and Alloys: D.A. Porter and K.E. Easterling
8. Principles of Extractive Metallurgy: H.S.Ray

Course Code 23BPPH2P02	Practical LAB-EI -1 based on 23BPPH2T04	Credits 2	No. Of Lectures 60

Course Outcomes:

CO1	Analyse the electrical and energy-related properties of materials and devices.	L4
CO2	Explain the operating principle and applications of displacement transducers.	L3
CO3	Apply basic microprocessor programming for data handling and waveform generation.	L3
CO4	Experiment with digital interfacing techniques to control external electromechanical devices.	L3

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	0	0	0
CO2	2	0	0	0	0	0
CO3	2	0	0	0	0	0
CO4	2	0	0	0	0	0

	Characteristics of Solar Cell.
	Measurement of dielectric constant
	Linear voltage differential transformer
	Energy bandgap by Four Probe method
	Study of 8085 microprocessor kit and execution of simple programs
	Waveformgenerationusing8085
	In terfacing TTL with buzzers, relays, motors and solenoids.

Course Code 23BPPH2T05	Course Title Solid State Devices	Credits 2	No.of lecture 30

Course Outcomes:

CO1	Explain the metal–semiconductor contacts, Schottky barriers, and their I–V and C–V characteristics including ideality factor and barrier height.	L2
CO2	Summarize the operating principles of BJTs and heterojunction devices for static characteristics, frequency response, switching behaviour, and quantum well structures.	L2
CO3	Explain the structure, operation, and I–V characteristics of MESFETs, MODFETs, and MOS devices.	L2
CO4	Summarize the MOSFET parameters such as mobility, channel conductance, and the basic concepts of integrated circuits.	L2

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	0	0	0
CO2	2	0	0	0	0	0
CO3	2	0	0	0	0	0
CO4	2	0	0	0	0	0

UNIT-I	Semiconductor Devices I:	15
	Metal – Semiconductor Contacts: Schottky barrier – Energy band relation, Capacitance- voltage (C-V) characteristics, Current-voltage (I-V) characteristics; Ideality factor, Barrier height and carrier concentration measurements; Ohmic contacts. Bipolar Junction Transistor (BJT): Static Characteristics; Frequency Response and Switching. Semiconductor heterojunctions, Heterojunction bipolar transistors, Quantum well structures.	
UNIT-II	Semiconductor Devices II:	15
	Metal-semiconductor field effect transistor (MESFET)- Device structure, Principles of operation, Current voltage (I-V) characteristics, High frequency performance. Modulation doped field effect transistor (MODFET); Introduction to ideal MOS device; MOSFET fundamentals, Measurement of mobility, channel conductance etc. from Ids vs, Vds and Ids vs Vg characteristics. Introduction to Integrated circuits**.**	

Main References:

1. S. M. Sze; Semiconductor Devices: Physics and Technology, 2nd edition, John Wiley, New York, 2002.
2. B.G. Streetman and S. Benerjee; SolidStateElectronicDevices,5th edition, Prentice Hall of India, NJ, 2000.
3. W.R.Runyan; Semiconductor Measurements and Instrumentation, McGraw Hill, Tokyo, 1975.

4. Adir Bar-Lev: Semiconductors and Electronic devices, 2nd edition, Prentice Hall, Englewood Cliffs, N.J., 1984.
5. Additional References:
6. Jasprit Singh; Semiconductor Devices: Basic Principles, John Wiley, New York, 2001.
7. Donald A. Neamen; Semiconductor Physics and Devices: Basic Principles, 3rd edition, Tata McGraw-Hill, New Delhi, 2002.
8. M. Shur; Physics of Semiconductor Devices, Prentice Hall of India, New Delhi, 1995.
9. Pallab Bhattacharya; Semiconductor Optoelectronic Devices, Prentice Hall of India, New Delhi, 1995.

S.M.Sze;PhysicsofSemiconductorDevices,2ndedition,Wiley Eastern Ltd., New Delhi, 1985.

Course Code 23BPPH2P03	Practical LAB-EI -2 based on 23BPPH2T05		Credits 2	No. Of Lectures 60

Course Outcomes:

CO1	Apply experimental methods to measure dielectric and ferroelectric properties, including Curie temperature and verification of Curie-Weiss law.	L3
CO2	Apply techniques to determine semiconductor parameters such as energy bandgap, carrier mobility, and junction diode capacitance.	L3
CO3	Analyse characteristics of electronic devices including JFETs and magneto-optic effects to interpret experimental data.	L4
CO4	Analyse and implement digital circuits such as shift registers to study functional behaviour and timing characteristics.	L4

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	0	2	0
CO2	2	0	0	0	2	0
CO3	2	0	0	0	2	0
CO4	2	0	0	0	2	0

	Measurement of dielectric constant, curie temperature and verification of curie Weiss law for ferroelectric material
	Barrier capacitance of a junction diode.
	Faraday effect Magneto optic effect
	Characteristics of Junction Field effect transistor.
	Carrier mobility by conductivity.
	Shift registers
	Energy Bandgap of germanium Diode

PROGRAM(s): M.Sc.-I			SEMESTER: II		
Course: On Job Training in Physics/ Field Projects in Physics			Course Code: 23BPPH2P04		
Teaching Scheme					Evaluation Scheme
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment (CA)(Marks - 40)	Semester End Examination (Marks- 60)
NA	08	–	04	40	60

Learning Objectives:

1. To provide students the opportunity to test their interest in a particular career before permanent commitments are made.

2. Toimproveone'sabilitiesintheactualapplicationoftheoryintheworkplace. To acquire knowledge and abilities that will be useful in their jobs

Course Code 23BPPH2P04	Course Title: On Job Training in Physics		Credit 4	No. of Lecture 120

Course Outcomes:

CO1	Apply theoretical knowledge and practical skills to real-world workplace tasks	L3
CO2	Identify areas for improvement.	L5
CO3	Evaluate work performance through supervisor feedback and self-assessment	L6
CO4	Compile the reports and outcome of On job Training.	L2

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	0	0	2	0
CO2	2	1	0	0	2	0
CO3	2	1	0	0	2	0
CO4	2	1	0	0	2	0

Course Code 23BPPH2P04	Course Title: Field Project in Physics		Credit 4	No. of Lecture 120

Course Outcomes:

CO1	Analyse the project problem.	L4
CO2	Choose a Scientific methodology.	L5
CO3	Evaluate the collected data and project problem findings	L5
CO4	Compose the project outcomes through written reports, presentations, or prototypes	L6

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	0	0	2	0
CO2	2	1	0	0	2	0
CO3	2	1	0	0	2	0
CO4	2	1	0	0	2	0

VPM's B.N. Bandodkar College of Science (Autonomous), Thane

Curriculum Structure for the Undergraduate Degree Programme M.Sc. I Physics

Course Code	SEMESTER – I	Course imparts Employability (EM), Entrepreneurship (EN), Skill Development (SD)			Course integrates with Professional Ethics (PE), Gender Equity (GE), Human Value (HV), Environmental Sustainability (ES)			
Course Code	**Course Title**	**EM**	**EN**	**SD**	**PE**	**GE**	**HV**	**ES**
23BPPH1T01	Mathematical Methods	--	--	√	--	--	--	--
23 BPPH1T02	Classical Mechanics	--	--	√	--	--	--	--
23BPPH1T03	Quantum Mechanics-I	--	--	√	--	--	--	--
23BPPH1P01	Practical LAB-I based on 23BPPH1T01, 23BPPH1T02 and 23BPPH1T03	√	√	√	√	--	--	--
Elective								
23BPPH1T04	Electronic Structures of Solids	--	--	√	--	--	--	--
23BPPH1P02	Practical LAB-EI -1 based on 23BPPH1T04	√	√	√	√	--	--	--
OR								
23BPPH1T05	Solid State Physics	--	--	√	--	--	--	--
23BPPH1P03	Practical LAB-EI -2 based on 23BPPH1T05	√	√	√	√	--	--	--
23BPRM1T02	Research Methodology in Physics	√	√	√	√	√	√	√
	Total	**04**	**04**	**09**	**04**	**01**	**01**	**01**

Course Code	SEMESTER – II	Course imparts Employability (EM), Entrepreneurship (EN), Skill Development (SD)			Course integrates with Professional Ethics (PE), Gender Equity (GE), Human Value (HV), Environmental Sustainability (ES)			
Course Code	**Course Title**	**EM**	**EN**	**SD**	**PE**	**GE**	**HV**	**ES**
23BPPH2T01	Advanced Electronics	√	--	√	--	--	--	--
23BPPH2T02	Electrodynamics	--	--	√	--	--	--	--

Code	Course							
23BPPH2T03	Quantum Mechanics-II	--	--	√	--	--	--	--
23BPPH2P01	Practical LAB-II based on 23BPPH2T01, 23BPPH2T02 and 23BPPH2T03	√	√	√	√	--	--	--
Elective								
23BPPH2T04	Applied Thermodynamics	--	--	√	--	--	--	--
23BPPH2P02	Practical LAB-EI -1 based on 23BPPH2T04	√	√	√	√	--	--	--
OR								
23BPPH2T05	Solid State Devices	--	--	√	--	--	--	--
23BPPH2P03	Practical LAB-EI -2 based on 23BPPH2T05	√	√	√	√	--	--	--
23BPPH2P04	On Job Training in Physics / Field Project in Physics	√	√	√	√	√	√	√
	Total	**05**	**04**	**09**	**04**	**01**	**01**	**01**