R. E. Society's

R. P. Gogate College of Arts & Science and R. V. Jogalekar College of Commerce (Autonomous), Ratnagiri

First Year (Semester I & II)
Master of Science in Physics Programme
(NEP 2020 & CBCS)

For Academic Year 2024-25

Program Outcomes of M.Sc. Physics

Name of Programme	**Master of Science**
Level	PG
No of Semesters	04
Year of Implementation	**2024-25**
Programme Specific Outcomes (PSO)	On completion of the MSc Physics, the learners should be enriched with knowledge and be able to 1. Physics knowledge: Understand current development in various domains of modern Physics like Nuclear Physics, Electrodynamics, Atomic and Molecular Physics, Classical Mechanics, Quantum Mechanics, Statistical Mechanics, Mathematical Physics, Solid state Physics, Advanced Electronics, Solid state devices, Experimental techniques and electronics. 2. Practical Skills and Analytical Abilities: Develop analytical abilities and acquire practical skill in handling measuring equipment required to carry out experiments in different areas of Physics, verify complex Physics problems through experimentation and use them to develop science and technology. Learner will be able to design Assembly level and High-level language program related microcontroller, microprocessor, C++, VHDL, ARM etc. 3. Motivation and life-long learning: Acquire skills like collaborative work, communication and independent learning required for lifelong learning to overcome challenges ahead. 4. Research: Clear competitive examination like SET, NET, JRF, PET and JEST required for pursue research at different research institutes and Universities. Get trained for a career in basic sciences and contribute in educational institutes, industries and emerging branches of science. 5. Ethics: Demonstrate professional behaviour such as (i) being objective, unbiased and truthful in all aspects of work and avoiding unethical, irrational behaviour such as fabricating, falsifying or misrepresenting data or committing plagiarism; (ii)the ability to identify the potential ethical issues in work-related situations; (iii) appreciation of intellectual property, environmental and sustainability issues; and (iv) promoting safe learning and working environment.

Relevance of PSOs to the local, regional, national, and global developmental needs	The Master of Science in Physics programme equips the candidate with knowledge, general competence, and analytical skills on an advanced level, needed in industry, consulting, education, and research and public and private administration. The M.Sc.-I and II (Physics) Programme includes various core courses such as Solid-State physics, statistical mechanics, nuclear and particle physics, spectroscopy and microprocessors and advance experiment in electronics. The choice of courses offers a glimpse into the frontier areas of research and allows learners to work on research projects. The programme also provides adequate exposure for the learners to pursue higher education in the fields of technology (M. Tech.), physics (M.Phil./Ph.D.), and other job opportunities in academia and industry. On completion of the programme, the postgraduates will be able to: 1. Apply knowledge and skill in the design and development of electronic system and programming to fulfil the needs of the electronic industry. 2. Pursue research related to physics and material characterization. 3. Able to teach core physics to higher secondary and undergraduate learners. 4. Demonstrate the highest standards of actuarial ethical conduct and professional actuarial behaviour, critical, interpersonal and communication skills as well as a commitment to life-long learning.

Evaluation Scheme

Course Evaluation Scheme: -

The performance of the learners shall be evaluated into two parts. The learner's performance shall be assessed by Continuous Assessment with 40% marks and by conducting the Semester End Examination with 60% marks.

The allocation of marks for the continuous Evaluation and Semester End Examinations are as shown below: -

A) Continuous Assessment: (40% marks)

Sr.No.	Particulars	% Marks
01	Test	20
02	Assignment	10
03	Active participation in class room and attendance	10

B) Semester End Examination: (60% marks)

The Examination shall be of 2 hours duration.

Standard of Passing:

For each course of M.Sc. Physics, there will be separate head of passing for Continuous Evaluation and Semester End Examination. The learner to earn the course credits, shall have to obtain a minimum of 40% marks in the Continuous Evaluation and 40% marks in Semester End Examination separately.

Conversion of Marks: -

The Continuous Evaluation for 2 credit practical courses of M.Sc. Physics will be of 40 marks. In such cases, the marks obtained by a learner in Continuous Evaluation of a course out of 40, will be converted to marks out of 20.

The Semester End Evaluation for 2 credit practical courses of M.Sc. Physics will be of 60 marks. In such cases, the marks obtained by a learner in Semester End Evaluation of a course out of 60, will be converted to marks out of 30. Converted marks will be reflected in learner's marksheet. There will be no mark conversion for 4 credit courses.

Performance Grading:

Letter Grades and Grade Points

% of Aggregate Marks Obtained	Course Grade Point	Course Grade	Performance Indicator	Credits Earned
90.0 to 100	10	O	Outstanding	As per course credit
80 to 89.99	9	A+	Excellent	
70 to 79.99	8	A	Very Good	
60 to 69.99	7	B+	Good	
55 to 59.99	6	B	Above Average	
50.0 to 54.99	5	C	Average	
40 to 49.99	4	P	Pass	
Less Than 40	0	F	Fail	0
Absent	0	Ab	Absent	

Courses Offered by Department of Physics for M.Sc.-I

Master of Science (M.Sc.) Programme

Under Choice Based Credit System (CBCS)

Course Structure

M.Sc. Physics-I

(To be implemented from Academic Year 2023-24)

No. of Courses	Semester I	Credits		No. of Courses	Semester II	Credits	
	Major Mandatory				Major Mandatory		
PSPH 101	Mathematical Methods	02		PSPH 201	Electrodynamics	02	
PSPH 102	Classical Mechanics	04		PSPH 202	Advanced Electronics	04	
PSPH 103	Quantum Mechanics-I	04		PSPH 203	Quantum Mechanics-II	04	
PSPH 104	Physics LAB-I	04		PSPH 204	Physics LAB-I	04	
	Major Electives				Major Electives		
PSPH 105	Crystal Physics	02	04	PSPH 205	Physics of Semiconductor diodes and Transistors	02	04
PSPH 106	Physics LAB-II	02		PSPH 206	Physics LAB-II	02	
	OR				OR		
PSPH 107	Magnetism	02	04	PSPH 207	Semiconductor Physics and Devices	02	04
PSPHP 108	Physics LAB-III	02		PSPH 208	Physics LAB-III	02	
PSPH 109	Research Methodology	04		PSPH 209	On Job Training/ Field Project	04	
Total Credits		22		Total Credits		22	

SEMESTER-I

No. of Courses	Semester I	Credits
	Major: Mandatory	
PSPH 101	Mathematical Methods	2
PSPH 102	Classical Mechanics	4
PSPH 103	Quantum Mechanics-I	4
PSPH 104	Physics LAB-I	4
	Major: Elective (Any One from below)	
PSPH 105	Crystal Physics	4
PSPH 106	Physics LAB-II	
PSPH 107	Magnetism	4
PSPH 108	Physics LAB-III	
PSPH 109	Research Methodology	4
Total Credits		22

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester I with Effect from the Academic Year 2024-2025

Name of the Course	Mathematical Methods
Course Code	PSPH101
Class	M.Sc.
Semester	I
No of Credits	2
Nature	Theory
Type	Major

Course Outcomes:

On successful completion of this course learners will be able to:

CO-1 Understand the significance of differentiability of complex functions and be familiar with Cauchy-Riemann equations.
CO-2 Evaluate integrals along a path in the complex plane and understand the statement of Cauchy's theorem.
CO-3 Compute the Taylor and Laurent expansions of simple functions, determining the nature of the singularities and calculate residues.
CO-4 Use the Cauchy Residue Theorem to evaluate integrals and sum series.
CO-5 Find the Laplace transform and inverse Laplace Transform of a function.
CO-6 Find the convolution of two functions and the transform of a convolution.
CO-7 Use the Laplace transform in solving differential equations.

Curriculum:

Unit	Title	Learning Points
I	Complex Analysis	Complex variables, Limits, Continuity, Derivatives, Cauchy-Reimann Equation, Analytic functions, Harmonic functions, Elementary functions: Exponential and trigonometric, Taylor and Laurent series, Residues, Residues theorem, Principal part of the functions, Residues at poles, zeroes and poles of order m, contour integral, Evaluation of improper real integral, improper integral involving sines and cosines, Definite Integrals involving sine and cosine functions. Reference: AW
II	Differential Equations	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. Reference: - MLB
III	Integral Transforms	Introduction to Fourier analysis, Integral transforms: three dimensional Fourier transforms and its applications to PDEs (Green function of Poisson's PDE), convolution theorem, Parseval's relation, Laplace transforms, Laplace transform of derivatives, Inverse Laplace transform and Convolution theorem, use of Laplace's transform in solving differential equations. Reference: -MLB

Learning Resources recommended:

A. Main references**:**

1. MLB: - M.L. Boas, Mathematical methods in the Physical Sciences, Wiley India 2006
2. AW: - G. Arfken and H. J. Weber: Mathematical Methods for Physicists, Academic Press 2005

B. Additional references**:**

1. A.K. Ghatak, I.C. Goyal and S.J. Chua, Mathematical Physics, McMillan
2. A.C. Bajpai, L.R. Mustoe and D. Walker, Advanced Engineering Mathematics, John Wiley.
3. J. Mathews and R.L. Walker, Mathematical Methods of physics
4. P. Dennery and A. Krzywicki, Mathematics for physicists
5. T. Das and S.K. Sharma, Mathematical methods in Classical and Quantum Mechanics
6. R. V. Churchill and J.W. Brown, Complex variables and applications, V Ed. Mc Graw. Hill
7. https://www.emathhelp.net/
8. https://www.integral-calculator.com/

Teaching plan:

Unit	Title	Teaching methods	No. of Lecture
I	Complex Analysis	Lecture, Problem solving, Visual aids, computer simulation	10
II	Differential Equations	Lecture, Problem Solving, Video lecture	10
III	Integral Transformation	Lecture, Problem Solving, Video lecture, simulation	10

Evaluation Pattern

A. Continuous Internal Evaluation (20 Marks):

Sr. No.	Particulars	Marks
01	Unit Test	10
02	Assignment	5
03	Active participation in class room and attendance	5

B. Semester End Evaluation (Paper Pattern): (30 Marks)

Question No	Unit	Question Type	Marks
1	I	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	07 03
2	II	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	07 03
3	III	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	07 03

Guidelines for pattern for Semester End Evaluation:

1. All questions shall be compulsory with internal option. Questions may be subdivided into sub questions.
2. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving /numericals based questions, etc.

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester I with Effect from the Academic Year 2024-2025

Name of the Course	Classical Mechanics
Class	M.Sc.-I
Semester	I
Course Code	PSPH102
No of Credits	4
Nature	Theory
Type	Major

Course Outcomes:

On successful completion of this course learners will be able to:

CO-1 Formulate and solve the equations of motion for complicated mechanical systems using the Lagrangian and Hamiltonian formulation of classical mechanics.
CO-2 Use the d'Alembert principle to derive the Lagrange equations.
CO-3 Understand the concept of small oscillation and set up equations.
CO-4 Understand two body central force problem and study it using Lagrangian technique.
CO-5 Understand Keplers laws of motion and find the nature of orbits.
CO-6 Understand the concept of canonical transformations and derive various generating functions.

Curriculum:

Unit	Title	Learning Points
I	Lagrangian Formulation	Review of Newton's laws, 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 Lagrangian formulation. Hamilton's, principle, Calculus of variations, Derivation of Lagrange's equations from Hamilton's principle, Lagrange Multipliers and constraint exterimization problems, Extension of Hamilton's principle to nonholonomic systems, Advantages of a variational principle formulation. Reference: RJ, GPS
II	Central force and classical scattering	Conservation theorems and symmetry properties, Energy Function and the 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. Reference: - GPS,TK
III	Small Oscillations	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. Reference: -GPS, RJ
IV	Canonical Transformation	Canonical Transformations, Examples of canonical transformations, The symplectic approach to canonical

	and Poisson Bracket	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. Reference: -RJ,TK

Learning Resources recommended:

A. Main Reference:
   1. GPS: - Classical Mechanics, H. Goldstein, Poole and Safko, 3rd Edition, Narosa Publication (2001)
   2. RJ: -Classical Mechanics, N. C. Rana and P. S. Jog. Tata McGraw Hill Publication.
   3. TK:-Introduction To Classical Mechanics By R.G. Takwale & P.S. Puranik

B. Additional References:
   1. Classical Mechanics, S. N. Biswas, Allied Publishers (Calcutta).
   2. Classical Mechanics, V. B. Bhatia, Narosa Publishing (1997).
   3. Mechanics, Landau and Lifshitz, Butterworth, Heinemann.
   4. The Action Principle in Physics, R. V. Kamat, New Age Intnl. (1995).
   5. Classical Mechanics ,Dr J. C. Upadhyay,Himalaya publication.
   6. Theory and Problems of Lagrangian Dynamics, Schaum Series, McGraw (1967).
   7. Classical Mechanics of Particles and Rigid Bodies, K. C. Gupta, Wiley Eastern (2001)

Teaching plan:

Unit	Title	Teaching methods	Total No. of Lecture
I	Lagrangian Formulation	Lecture, Problem solving, Visual aids, computer simulation, seminar,	15
II	Central force problem	Lecture, Problem Solving, Video lecture, Group discussion, simulation.	15
III	Small Oscillation	Lecture, Problem Solving, Video lecture, group discussion	15
IV	Canonical Transformation and Poisson Bracket	Lecture, Problem Solving, Video lecture, Group discussion	15

Evaluation Pattern:

A. Continuous Internal Evaluation (40 Marks):

Sr. No.	Particulars	Marks
01	Unit Test	20
02	Assignment	10
03	Active participation in class room and attendance	10

B. Semester End Evaluation (Paper Pattern): (60 Marks)

Question No	Unit	Question Type	Marks
1	I	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05
2	II	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05
3	III	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05
4	IV	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05

Guidelines for pattern for Semester End Evaluation:

1. All questions shall be compulsory with internal option. Questions may be subdivided into sub questions.
2. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving /numericals based questions, etc.

Revised Syllabus of Courses of Master of Science (M.Sc.) Programme at Semester I with Effect from the Academic Year 2024-2025

Name of the Course	Quantum Mechanics-I
Class	M.Sc.-I
Semester	I
Course Code	PSPH103
No of Credits	4
Nature	Theory
Type	Major

Course Outcomes:

On successful completion of this course learners will be able to:

CO-1 Understand the central concepts and principles in quantum mechanics.
CO-2 Set up and solve the Schrödinger equation for simple systems in one and three dimensions.
CO-3 Work with vector spaces.
CO-4 Understand how to calculate wave function, energy Eigen value using matrix formulation.
CO-5 Understand use of Fourier transforms in quantum mechanics.
CO-6 Understand the concepts of angular momentum and spin as well as the rules for quantization and addition of these.
CO-7 Understand the concept of spin-orbit coupling.

Curriculum:

Unit	Title	Learning Points
I	Review and formalism of Quantum Mechanics	**Review of Quantum Mechanics:** 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, completeset of commuting observables. Time development of expectation values, conservation theorems and parity. **Formalism:** Linear Vector Spaces and operators, Dirac notation, Hilbert space, Hermitian operators and their properties, Matrix mechanics: Basis and representations, unitary transformations, the energy representation. Schrodinger, Heisenberg and interaction picture. Reference: - RL
II	Wave packet and Schrodinger equation solutions	**Wave packet:** Gaussian wave packet, Fourier transform. **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. Reference: - NZ, GL
III	Schrodinger equation solutions-3D problems	**Schrodinger equation solutions- 3D 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. Reference: - GL
IV	Angular Momentum	**Angular Momentum:** - Ladder operators, eigenvalues and eigen functions of L^2 and L_z using sphericalharmonics, 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 eigenfunctions, free particlewave function including spin, addition of two spins. Reference: - RL, GL, NZ

Learning Resources Recommended:

A. Main references:
   1. RL: - Richard Liboff, Introductory Quantum Mechanics, 4th edition, Pearson.
   2. DG: - D J Griffiths, Introduction to Quantum Mechanics 4th edition
   3. GL: - A Ghatak and S Lokanathan, Quantum Mechanics: Theory and Applications, 5th edition.
   4. NZ: - N Zettili, Quantum Mechanics: Concepts and Applications, 2nd edition, Wiley.

B. 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, A Textbook of Quantum Mechanics, Tata McGraw Hill (1977).
   4. J. J. Sakurai Modern Quantum Mechanics, Addison-Wesley (1994).

Teaching plan:

Unit	Title	Teaching methods	Total No. of Lecture
I	Review and formalism of Quantum Mechanics	Lecture, Problem solving, Visual aid, computer simulation, seminar	15
II	Wave packet and Schrodinger equation solutions	Lecture,Problem-solving, flipped classroom, Group discussion, simulation.	15
III	Schrodinger equation solutions- 3D problems	Lecture, Problem Solving, flipped classroom, group discussion	15
IV	Angular Momentum	Lecture, Problem Solving, flipped classroom, Group discussion	15

Evaluation Pattern:

A. Continuous Internal Evaluation (40 Marks):

Sr. No.	Particulars	Marks
01	Unit Test	20
02	Assignment	10
03	Active participation in class room and attendance	10

B. Semester End Evaluation (Paper Pattern): (60 Marks)

Question No	Unit	Question Type	Marks
1	I	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05
2	II	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05
3	III	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05
4	IV	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05

Guidelines for pattern for Semester End Evaluation:

1. All questions shall be compulsory with internal option. Questions may be subdivided into sub questions.
2. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving /numericals based questions, etc.

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester I with Effect from the Academic Year 2024-2025

Name of the Course	Physics Lab-I
Class	M.Sc.-I
Semester	I
Course Code	PSPH104
No of Credits	4
Nature	Practical
Type	Major

Course Outcomes:

On successful completion of this course learners will be able to:

CO-1 Understand & practice the skills while performing experiments.
CO-2 Understand the use of apparatus and their use without fear & hesitation.
CO-3 Correlate the physics theory concepts to practical application.
CO-4 Understand the concept of errors and their estimation.
CO-5 Design and trouble shoot electronics circuits.
CO-6 Understand safety and discipline in laboratory practices

Curriculum:

Unit	Title	Learning Points
Group A	General Physics experiments	1. Michelson Interferometer. 2. Analysis of sodium spectrum. 3. Carrier lifetime by pulsed reverse method. 4. Study of He-Ne laser- Measurement of divergence and wavelength. 5. Determination of particle size of lycopodium particles by laser diffraction method. 6. Susceptibility measurement by Quincke's method /Guoy's balance method. 7. h/e by vacuum photocell
Group B	Electronics experiments	1. Diac - Triac phase control circuit. 2. Temperature on-off controller using IC LM35 3. Study of 8-bit DAC. 4. 16-bit digital multiplexer. 5. Delayed linear sweep generator using IC 555 6. Regulated dual power supply using IC LM 317 & IC LM337 voltage regulator ICs. 7. Regulated power supply using IC LM317 voltage regulator

Note:

1. Minimum number of experiments to be performed and reported in the journal = 08 with minimum 4 experiments from each Group. i.e., Group A: 04 and Group B: 04.
2. Journal should be certified by the laboratory in-charge and Head of the Department only if the learner performs satisfactorily the minimum number of experiments as stipulated above.
3. Learner will be allowed to appear for the semester end practical examination of this course only if learner submits a certified journal of this course or a certificate from the head of the Physics Department that learner has completed this practical course as per minimum requirements.
4. At the semester-end Practical exam, the learner shall perform any one experiment from Group A or B. If the learner performs the long experiment from group A, then he will perform a short experiment from Group B, or vice versa.
5. For the semester-end Practical Exam 3 hours of duration for a long experiment and 1 hour of duration for a short experiment.

Learning Resources recommended:

1. Advanced Practical Physics -Worsnop and Flint
2. Atomic spectra- H.E. White
3. Experiments in modern physics –Mellissinos
4. Semiconductor electronics by Gibson
5. A course of experiments with Laser – Sirohi
6. Elementary experiments with Laser- G. White
7. Solid state devices- W.D. Cooper
8. Electronic text lab manual - P.B. Zbar
9. Digital principles and applications by Malvino and leach
10. Digital circuit practice by R.P. Jain
11. Electronic principles -A. P. Malvino
12. Operational amplifiers and linear Integrated circuits - Coughlin & Driscoll
13. Op-amps and linear integrated circuit technology- R. Gayakwad
14. Digital Electronics - Roger Tokheim

Teaching plan:

Unit	Title	Teaching methods	Total No. Lecture
Group A	General Physics	Presentation, Discussion, Experiment,	60
Group B	Electronics	Presentation, Discussion, Experiment,	60

Evaluation Pattern:

A. Continuous Assessment: (40 Marks)

Method	Marks
Journal	20
Lab performance	10
Seminar	10

B. Semester End Examination: (60 Marks)

Question No.	Group	Title	Method	Marks
1	A or B	General Physics and Electronics	Any one long experiment performance from Group A or B as per the practical slip	50
2	A or B	General Physics and Electronics	Any one short experiment performance from Group A or B as per the practical slip	10

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester I with Effect from the Academic Year 2024-2025

Name of the Course	Crystal Physics
Class	M.Sc-I
Semester	I
Course Code	PSPH105
No of Credits	2
Nature	Theory
Type	Elective

Course Outcomes:

On successful completion of this course learners will be able to:

CO-1 Understand inter atomic forces and bonds.
CO-2 Account for how crystalline materials is studied using diffraction, including concepts like the Ewald sphere, form factor, structure factor and scattering amplitude.
CO-3 Understand the concept of reciprocal space and be able to use it as a tool.
CO-4 Understand the significance of Brilloune zones.
CO-5 Understand what phonons are and perform estimates of their dispersive and thermal properties.
CO-6 Understand thermal and electrical properties in the free-electron model.

Curriculum:

Unit	Title	Learning Points
I	Diffraction of Waves by Crystals and Reciprocal Lattice	**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. Reference: CK, MAW
II	Lattice vibration and thermal properties	**Lattice vibration 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. Reference: - CK, MAW

Learning Resources recommended:

A. Main References: -
   1. CK: - Charles Kittel "Introduction to Solid State Physics", 7th edition John Wiley & sons.
   2. MAW: - M.A.Wahab "Solid State Physics –Structure and properties of Materials" Narosa Publications 1999.

B. Additional Main References: -
   1. JRC: - J.Richard Christman "Fundamentals of Solid State Physics" John Wiley & sons
   2. MAO: - M. Ali Omar "Elementary Solid-State Physics" Addison Wesley (LPE)
   3. IL: - H.Ibach and H.Luth 3rd edition "Solid State Physics – An Introduction to Principles of Materials Science" Springer International Edition (2004)

Teaching plan:

Unit	Title	Teaching methods	Total No. of Lecture
I	Diffraction of Waves by Crystals and Reciprocal Lattice	Lecture, Problem solving, visual aid, computer simulation, seminar,	15
II	Lattice Vibrations and thermal properties	Lecture, Problem Solving, Video lecture, Group discussion, simulation.	15

Evaluation Pattern

A. Continuous Assessment (20 Marks):

Sr. No.	Particulars	Marks
01	Unit Test	10
02	Assignment	05
03	Active participation in class room and attendance	05

B. Semester End Evaluation (Paper Pattern): (30 Marks)

Question No	Unit	Question Type	Marks
1	I	A. Long questions with 100% Internal option. A. Short questions with 100% Internal option.	10 05
2	II	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05

Guidelines for pattern for Semester End Evaluation:

1. All questions shall be compulsory with internal option. Questions may be subdivided into sub questions.
2. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving /numericals based questions, etc.

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester I with Effect from the Academic Year 2024-2025

Name of the Course	Physics Lab- II
Class	M.Sc.-I
Semester	I
Course Code	PSPH106
No of Credits	2
Nature	Practical
Type	Elective

Course Outcomes:

On successful completion of this course learners will be able to:

CO-1 Understand & practice the skills while performing experiments.
CO-2 Understand the use of apparatus and their use without fear & hesitation.
CO-3 Correlate the physics theory concepts to practical application.
CO-4 Understand the concept of errors and their estimation.
CO-5 Design and trouble shoot electronics circuits.
CO-6 Understand safety and discipline in laboratory practices

Curriculum:

Unit	Title	Learning Points	No of Lectures
Group A	General Physics	1. Resistivity by four probe method. 2. DC Hall effect. 3. Absorption spectrum of specific liquid	30
Group B	Electronics	1. Active filter circuits (second order) 2. Study of 4-digit multiplex display system 3. Constant current supply using IC 741 and LM317	30

Learning Resources Recommended:

1. Manual of experimental physics - E.V. Smith
2. Semiconductor Measurements – Runyan
3. Semiconductors and solid-state physics – Mackelvy
4. Handbook of semiconductors – Hunter
5. Op-amps and linear integrated circuit technology – R A Gayakwad
6. Operational amplifiers and linear integrated circuits- Coughlin & Driscoll
7. Digital Electronics by Roger Tokheim (5th Ed, page 371)
8. Advance practical physics -Worsnop and Flint.

Note:

1. Minimum number of experiments to be performed and reported in the journal = 04 with minimum 2 experiments from each Group. i.e., Group A: 02 and Group B: 02.
2. Journal should be certified by the laboratory in-charge and Head of the Department only if the learner performs satisfactorily the minimum number of experiments as stipulated above.
3. Learner will be allowed to appear for the semester end practical examination of this course only if learner submits a certified journal of this course or a certificate from the head of the Physics Department that learner has completed this practical course as per minimum requirements.
4. At the semester-end Practical exam, the learner shall perform any one experiment from Group A or B. If the learner performs the long experiment from group A, then he will perform a short experiment from Group B, or vice versa.
5. For the semester-end Practical Exam 3 hours of duration for a long experiment and 1 hour of duration for a short experiment.

Teaching plan:

Unit	Title	Teaching methods	Total No. of Lecture
Group A	General Physics	Presentation, Discussion, Experiment,	30
Group B	Electronics	Presentation, Discussion, Experiment,	30

Evaluation Pattern:

A. Continuous Internal Evaluation: (40 Marks)

Method	Marks
Journal	20
Lab performance	10
Seminar	10

B. Semester End Evaluation (Paper Pattern): (60 Marks)

Question No.	Group	Title	Method	Marks
1	A or B	General Physics and Electronics	Any one long experiment performance from Group A or B as per the practical slip	50
2	A or B	General Physics and Electronics	Any one short experiment performance from Group A or B as per the practical slip	10

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester I with Effect from the Academic Year 2024-2025

Name of the Course	Magnetism
Class	M.Sc.-I
Semester	I
Course Code	PSPH107
No of Credits	2
Nature	Theory
Type	Elective

Course Outcomes:

On successful completion of this course learners will be able to:

CO-1 Understand diamagnetic and paramagnetic behavior of materials and its quantum mechanical formulation.
CO-2 Understand magnetic ordering in ferrimagnetic, ferromagnetic and antiferromagnetic materials.
CO-3 Understand Hund's Rule in magnetism.
CO-4 Use Langevin diamagnetic equation.
CO-5 Solve numericals based on magnetism.

Curriculum:

Unit	Title	Learning Points
I	Diamagnetism and Paramagnetism	Langevin diamagnetic equation, diamagnetic response, Quantum mechanical formulation, core diamagnetism. Quantum Theory of Paramagnetism, Rare Earth Ions, Hund's Rule, Iron Group ions, Crystal Field Splitting and Quenching of orbital angular momentum Adiabatic Demagnetization of a paramagnetic Salt, Paramagnetic susceptibility of conduction electrons. Reference: -CK, JRC, MAW, MAO
II	Magnetic Ordering	Ferromagnetic order- Exchange Integral, Saturation magnetization, Magnons, neutron magnetic scattering Ferrimagnetic order, spiels, Yttrium Iron Garnets, Anti Ferromagnetic order. Ferromagnetic Domains – Anisotropy energy, origin of domains, transition region between domains, Bloch wall, Coercive force and hysteresis. Reference: -CK, JRC, MAW, MAO

Learning Resources recommended:

A. Main References: **-**
   1. CK: - Charles Kittel "Introduction to Solid State Physics", 7th edition John Wiley & sons.
   2. JRC: - J.Richard Christman "Fundamentals of Solid State Physics" John Wiley & sons
   3. MAW: - M.A.Wahab "Solid State Physics –Structure and properties of Materials" Narosa Publications 1999.
   4. MAO: - M. Ali Omar "Elementary Solid-State Physics" Addison Wesley (LPE)

B. Additional References: **-**
   1. IL: - H.Ibach and H.Luth 3rd edition "Solid State Physics – An Introduction to Principles of Materials Science" Springer International Edition (2004)

Teaching plan:

Unit	Title	Teaching methods	Total No. Lecture
I	Diamagnetism and Paramagnetism	Lecture, Problem solving, visual aid, computer simulation, seminar,	15
II	Magnetic Ordering	Lecture, Problem Solving, Video lecture, Group discussion, simulation.	15

Evaluation Pattern

A. Continuous Internal Evaluation (20 Marks):

Sr. No.	Particulars	Marks
01	Unit Test	10
02	Assignment	05
03	Active participation in class room and attendance	05

B. Semester End Evaluation (Paper Pattern): (30 Marks)

Question No	Unit	Question Type	Marks
1	I	B. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	07 03
2	II	C. Long questions with 100% Internal option. D. Short questions with 100% Internal option.	07 03
3	I II	Objective type of questions without internal option	05 05

Guidelines for pattern for Semester End Evaluation:

1. All questions shall be compulsory with internal option. Questions may be subdivided into sub questions.
2. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving /numericals based questions, etc.

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester I with Effect from the Academic Year 2024-2025

Name of the Course	Physics Lab- III
Class	M.Sc.-I
Semester	I
Course Code	PSPH108
No of Credits	2
Nature	Practical
Type	Elective

Course Outcomes:

On successful completion of this course learners will be able to:

CO-1 Understand & practice the skills while performing experiments.
CO-2 Understand the use of apparatus and their use without fear & hesitation.
CO-3 Correlate the physics theory concepts to practical application.
CO-4 Understand the concept of errors and their estimation.
CO-5 Design and trouble shoot electronics circuits.
CO-6 Understand safety and discipline in laboratory practices

Curriculum:

Unit	Title	Learning Points
Group A	General Physics	1. Coupled Oscillations 2. Temperature dependence of avalanche and Zener breakdown diodes. 3. Magneto resistance of Bi specimen
Group B	Electronics	1. Waveform Generator using ICs. 2. Study of elementary digital voltameter 3. Instrumentation amplifier and its application

Learning Resources Recommended:

1. Advanced Practical Physics – Worsnop and Flint
2. Experiments in modern physics -Mellissinos
3. Solid state devices - W.D. Cooper
4. Electronic text lab manual - PB Zbar
5. Electronic devices & circuits - Millman and Halkias
6. Integrated Circuits - K. R. Botkar
7. Op-amps and linear integrated circuit technology by Gayakwad
8. Operational amplifiers and linear integrated circuits- Coughlin & Driscoll
9. Operational amplifiers: experimental manual C.B. Clayton
10. Digital Electronics by Roger Tokheim

Note:

1. Minimum number of experiments to be performed and reported in the journal = 04 with minimum 2 experiments from each Group. i.e., Group A: 02 and Group B: 02.
2. Journal should be certified by the laboratory in-charge and Head of the Department only if the learner performs satisfactorily the minimum number of experiments as stipulated above.
3. Learner will be allowed to appear for the semester end practical examination of this course only if learner submits a certified journal of this course or a certificate from the head of the Physics Department that learner has completed this practical course as per minimum requirements.
4. At the semester-end Practical exam, the learner shall perform any one experiment from Group A or B. If the learner performs the long experiment from group A, then he will perform a short experiment from Group B, or vice versa.
5. For the semester-end Practical Exam 3 hours of duration for a long experiment and 1 hour of duration for a short experiment.

Teaching plan:

Unit	Title	Teaching methods	Total No. Lecture
Group A	General Physics	Presentation, Discussion, Experiment,	30
Group B	Electronics	Presentation, Discussion, Experiment,	30

Evaluation Pattern:

A. Continuous Evaluation: (40 Marks)

Method	Marks
Journal	20
Lab performance	10
Seminar	10

B. Semester End Evaluation (Paper Pattern): (60 Marks)

Question No.	Group	Title	Method	Marks
1	A or B	General Physics and Electronics	Any one long experiment performance from Group A or B as per the practical slip	50
2	A or B	General Physics and Electronics	Any one short experiment performance from Group A or B as per the practical slip	10

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester I with Effect from the Academic Year 2024-2025

Name of the Course	Research Methodology
Class	M.Sc.-I
Semester	I
Course Code	PSPH109
No of Credits	4
Nature	Theory
Type	Compulsory

Course Outcomes:

On successful completion of this course learners will be able to:

CO-1 Understand fundamentals of research methods.
CO-2 Learn design and measurement concept of research.
CO-3 Know data collection and analysis tool.
CO-4 Get knowledge of scientific report writing.

Curriculum:

Unit	Title	Learning Points
I	Fundamentals of Research Methods	**Fundamentals of Research Methods**: Definition of research, Role and objectives of research, importance of research, Applications and types of research, Creativity and innovation, Critical thinking, Research process and steps in it, Collecting and reviewing the literature, Conceptualization and Formulation of: research problem, identifying variables, constructing hypothesis and Synopsis. Interpretation of results and discussion. Reference: - CRK, RK, MS
II	Research Design and Measurement Concepts and Literature Searching	**Research Design and Measurement Concepts**: Selecting and defining a research problem, Need for research design, Features of a good research design, Different research designs, Scales of measurements, Nominal, Ordinal, Internal and ratio scales, Errors in measurements, Validity and Reliability in measurement, Scale Construction Techniques. **Digital**: Web sources, E-journals, Journal access, Citation Index, Impact factor, H-index, E-consortium, UGC info net, eBooks, Internet discussion groups and communities, Blogs, preprint servers, Search engines, Scirus, Google Scholar, Scopus. Reference: - CRK, RK
III	Documentation, scientific writing and Academic Integrity	**Documentation and scientific writing**: Results and Conclusions, Preparation of manuscript for Publication of Research paper, Presenting a paper in scientific seminar, Thesis writing. Structure and Components of Research Report, Types of Report: research papers, thesis, Research Project Reports, Pictures and Graphs, citation styles, writing a review of paper, Bibliography. for illustration, style, publications of scientific work, **Research and Academic Integrity**: Intellectual property rights (IPRs). Plagiarism, Copyright issues, Ethics in research, and case studies. Reference: SP, CRK
IV	Hypothesis Testing and Communication Skills in Research	**Hypotheses:-** Meaning, Nature of hypothesis, Functions of Hypothesis, Importance of Hypothesis, Kinds of Hypothesis, Characteristics of good hypothesis.

		Hypothesis testing: Null and alternate hypothesis, Type I and Type II errors, Level of significance, Power of test, p-value **Communication skills** Importance communication through English, The process of communication and factors that influence communication. Sender, receiver, channel, code, topic, message, context, feedback, noise, filters, and barriers, Verbal and Non verbal communication, Comparison of general communication and business communication. **Presentation skills:** Structure of presentation, Types of presentation, oral power point – Handling power point slides, organization, content, body language, gesture and voice modulation. Reference: RK, CRK

Learning Resources recommended:

A. Main References:

1. CRK:- Kothari C.R., "Research Methodology, Methods and Techniques" (Second revised edition, New Age International Publication, 2004).
2. SP:- Saravanavel P., "Research Methodology" (Kitab Mahal, Sixteenth edition, 2007).
3. RK: -Ranjit Kumar, "Research Methodology, a step-by-step guide for beginners" (Pearson education Australia, Second edition 2005).
4. MS:- Mark Saunders, Philip Lewis, Adrain Thornhiu, "Research Methods for Business Students"(Pearson Education ltd, Seventh edition, 2016)DG: -How to write and publish by Robert A. Day and Barbara Gastel, (Cambridge University Press).

B. Additional Reference: -

1. Thesis & Assignment Writing–J Anderson, B.H.Dursten & M.Poole, Wiley Eastern, 1977
2. A Hand Book of Methodology of Research – P. Rajammal and P. Devadoss, R. M. M. Vidya Press,1976.
3. The Craft of Scientific Writing by Michael Alley, (Springer).

4. Research Methodology by R. Panneerselvam, PHI, New Delhi 2005
5. Research Methodology- A step by step Guide for Beginners, (2nd ed.) Kumar Ranjit, 2005, Pearson Education.
6. How to write and publish by Robert A. Day and Barbara Gastel, (Cambridge University Press).
7. S. Gupta, (2005). Research Methodology and Statistical techniques, Deep and Deep Publications (P) Ltd. New Delhi, India.
8. R. Kothari, (2008). Research Methodology, New Age International, New Delhi, India.
9. Standard /Reputed Journal authors' instructions.
10. Web resources: www.sciencedirect.com for journal references,
11. www.aip.org and www.aps.org for reference styles.
12. Web resources: www.nature.com, www.sciencemag.org,
13. www.springer.com, www.pnas.org, www.tandf.co.uk,
14. www.opticsinfobase.org for research updates.

Teaching Plan: -

Unit	Title	Teaching methods	Total No. of Lecture
I	Fundamentals of Research Methods	Lecture, Visual aid, seminar.	15
II	Research Design and Measurement Concepts and Literature Searching	Lecture, Visual aid, seminar.	15
III	Documentation, scientific writing and Academic Integrity	Lecture, Visual aid, seminar.	15
IV	Hypothesis Testing and Communication Skills in Research	Lecture, Problem solving, computer simulation, seminar.	15

Evaluation Pattern

A. Continuous Assessment (40 Marks):

Sr. No.	Particulars	Marks
01	Unit Test	20
02	Assignment	10

03	Active participation in class room and attendance	10

B. Semester End Evaluation (Paper Pattern): (60 Marks)

Question No	Unit	Question Type	Marks
1	I	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
2	II	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
3	III	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
4	IV	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option	06 06
5	I II III IV	Objective type of questions without internal option	03 03 03 03

Guidelines for pattern for Semester End Evaluation:

1. All questions shall be compulsory with internal option. Questions may be subdivided into sub questions.
2. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving /numericals based questions, etc.
3. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

SEMESTER-II

No. of Courses	Semester II	Credits
	Major: Mandatory	
PSPH 201	Electrodynamics	2
PSPH 202	Advanced Electronics	4

PSPH 203	Quantum Mechanics-II	4
PSPH 204	Physics LAB-I	4
	Major: Elective	
PSPH 205	Physics of Semiconductor diodes and Transistors	04
PSPH 206	Physics LAB-II	
	OR	
PSPH 207	Semiconductor Physics and Devices	04
PSPH 208	Physics LAB-III	
PSPH 209	On Job Training/ Field Project	04
	Total Credits	22

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester II with Effect from the Academic Year 2024-2025

Name of the Course	Electrodynamics
Class	M.Sc.-I
Semester	II
No of Credits	2
Course Code	PSPH201
Nature	Theory
Type	Major

Course Outcomes:

On successful completion of this course learners will be able to:

CO-1 Use four vector and tensor for electrodynamics.
CO-2 Formulate covariant formulation for electrodynamics.
CO-3 Identify the nature of electromagnetic wave and its propagation through different media, interfaces and cavities.
CO-4 Use Maxwell equations in analyzing the electromagnetic field due to time varying charge and current distribution.
CO-5 Explain charged particle dynamics and radiations from localized time varying electromagnetic sources.

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	Electrodynamics in Four vector notation	Four vectors and tensors, Lorentz transformation in 4-vector notation, Transformations of electric and magnetic field; Electromagnetic field Tensor in Four dimensions and Maxwell's Equations, Dual Field Tensor, Covariance of Maxwell's equations. Reference: - WG	10
II	Electromagnetic wave and wave guide	Electromagnetic waves in vacuum, Polarization of plane waves. Electromagnetic waves in matter, Wave guides, boundary conditions, classification of fields in wave guides, phase velocity and group velocity, resonant cavities. Reference: - WG	10
III	Radiation Theory	**Motion of Charged Particles in Electromagnetic Field:** Uniform E and B fields, non-uniform fields, diffusion across magnetic fields, time varying E and B fields, **Radiation by moving charges**: Lienard-Wiechert potentials and fields for a point charge, charges moving with uniform velocity, accelerated charges, radiation from accelerated charges moving (i) with low velocities and (ii) with relativistic velocities, bremsstrahlung, synchrotron radiation; Cherenkov radiation. Rayleigh's scattering and the colour of sky. Reference: - HM	10

Learning Resources recommended:

A. Main Reference:
   1. WG: - W. Greiner, Classical Electrodynamics (Springer- Verlag, 2000) (WG).
   2. HM: - M.A. Heald and J.B. Marion, Classical Electromagnetic Radiation, 3rd edition (Saunders, 1983) (HM)

B. Additional references:
   1. J.D. Jackson, Classical Electrodynamics, 4Th edition, (John Wiley & sons) 2005 (JDJ)
   2. W.K.H. Panofsky and M. Phillips, Classical Electricity and Magnetism,2nd edition, (Addison - Wesley) 1962.
   3. D.J. Griffiths, Introduction to Electrodynamics,2nd Ed., Prentice Hall, India,1989.

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

Teaching plan:

Unit	Title	Teaching methods	Total No. of Lecture
I	Electrodynamics in Four vector notation	Lecture, Problem solving, Visual aids, computer simulation	10
II	Electromagnetic wave and wave guide	Lecture, Problem Solving, Video lecture	10
III	Radiation Theory	Lecture, Problem Solving, Video lecture, simulation	10

Evaluation Pattern

A. Continuous Internal Evaluation (20 Marks):

Sr. No.	Particulars	Marks
01	Unit Test	20
02	Assignment	10
03	Active participation in class room and attendance	10

B. Semester End Evaluation (Paper Pattern): (30 Marks)

Question No	Unit	Question Type	Marks
1	I	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	07 03
2	II	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	07 03
3	III	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	07 03

Guidelines for pattern for Semester End Evaluation:

1. All questions shall be compulsory with internal option. Questions may be subdivided into sub questions.
2. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving /numericals based questions, etc.

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester II with Effect from the Academic Year 2024-2025

Name of the Course	Advanced Electronics
Course Code	PSPH202
Class	M.Sc.-I
Semester	II
No of Credits	4
Nature	Theory
Type	Major

Course Outcomes:

On successful completion of this course learners will be able to:

CO-1 Understand Counters and Time Delays, Stack and Sub-routines for 8085 microprocessors.
CO-2 Understand 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.
CO-3 Understand Instruction set of 8051 microcontrollers.
CO-4 Write programs for 8085 microprocessor and 8051 microcontrollers.
CO-5 Understand the concept of Linear Power supply, Switch Mode Power supply, Uninterrupted Power Supply, Step up and Step-down Switching Voltage Regulators.
CO-6 Understand the principle and operation of various types of inverters.
CO-7 Understand the concept and operation of various types of signal conditioners.
CO-8 Understand the concept and operation of various types of data transmission systems.
CO-9 Understand the structure, mechanism, mathematical analysis needed, types and applications of optical fiber.
CO-10 Understand Microprocessors/ Microcontrollers based Instrumentation Systems.

Curriculum:

Unit	Title	Learning Points
I	Microprocessors and Microcontrollers	**Microprocessors:** Counters and Time Delays, Stack and Sub-routines. **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. **8051 Microcontrollers**: Introduction, MCS–51 Architecture, Registers in MCS-51, 8051 Pin Description, Connections,8051 Parallel I/O Ports and Memory Organization. Reference: - RSG, AVD
II	8051 instructions set and Instrumentation Circuits	**8051 Instruction set and Programming**: MCS-51 Addressing Modes and Instruction set. 8051 Instructions and Simple programs using Stack Pointer. **Instrumentation Circuits and Designs**: Microprocessors/ Microcontrollers based D C motor speed controller, Microprocessors /Microcontrollers based temperature controller, electronic weighing single pan balance using strain gauge/ load cell, Optical analog communication system using fiber link, electronic intensity meter using optical sensor, IR remote controlled ON/OFF switch. Reference: - AVD, MMM, KJA
III	Analog and Data Acquisition Systems	**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.

		Reference: - AJ, RAG, CD
IV	Data Transmission Systems and Fiber Optics	**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. Reference: - BS, HSK

Learning Resources recommended:

A. Main Reference:

1. AVD: -Microcontrollers (Theory and Applications) by Ajay V. Deshmukh, TMH.
2. RSG: - Microprocessor Architecture, Programming and Applications with the 8085 R. S. Gaonkar, 4th Edition. Penram International.
3. RAG: - Op-Amps and Linear Integrated Circuits - R. A. Gayakwad , 3rd Edition Prentice Hall India.
4. AJ: - Power Electronics and its applications, Alok Jain, 2nd Edition, Penram International India.
5. CD: -Operational Amplifiers and Linear Integrated Circuits, Robert F. Coughlin and Frederic F. Driscoll, 6th Edition, Pearson Education Asia.
6. BS: -A text book of optics; Brijlal Subrhamanyam.
7. HSK: - Electronic Instrumentation, H.S. Kalsi, Tata-McGraw. Hill, 1999.
8. MMM: - The 8051 Microcontroller & Embedded Systems by M.A. Mazidi, J.G. Mazidi and R.D. Mckinlay.
9. KJA: - The 8051 Microcontroller: K.J.Ayala: Penram International.

B. Additional Reference

1. RK: - The 8051 Microcontroller and Embedded Systems, Dr. Rajiv Kapadia, Jaico Publishing House.
2. MP: - Programming & customizing the 8051 Mocrocontroller : Myke Predko, TMH.
3. KG: - Optical Fiber Communications, Keiser G., Mcgraw Hill, Int. Learner Ed.
4. KD: - Electronic Communication Systems; 4th. Ed. Kennedy and Davis, (Tata-McGraw. Hill, 2004.

Teaching plan:

Unit	Title	Teaching methods	Total No. Lecture
I	Microprocessors and Microcontrollers	Lecture, Program writing, Visual aid, computer simulation, seminar,	15
II	8051 instructions set and Instrumentation Circuits	Lecture, Program writing, flipped classroom, Group discussion	15
III	Analog and Data Acquisition Systems	Lecture, Problem Solving, flipped classroom, Group discussion, simulation.	15
IV	Data Transmission Systems and Fiber Optics	Lecture, Problem Solving, flipped classroom, group discussion	15

Evaluation Pattern:

A. Continuous Internal Evaluation (40 Marks):

Sr. No.	Particulars	Marks
01	Unit Test	20
02	Assignment	10
03	Active participation in class room and attendance	10

B. Semester End Evaluation (Paper Pattern): (60 Marks)

Question No	Unit	Question Type	Marks
1	I	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05
2	II	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05
3	III	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05
4	IV	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05

Guidelines for pattern for Semester End Evaluation:

1. All questions shall be compulsory with internal option. Questions may be subdivided into sub questions.
2. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving /numericals based questions, etc.

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester II with Effect from the Academic Year 2024-2025

Name of the Course	Quantum Mechanics – II
Course Code	PSPH 203
Class	M.Sc.-I
Semester	II
No of Credits	4
Nature	Theory
Type	Major

Course Outcomes:

On successful completion of this course learners will be able to

CO-1 Understand and formulate time dependent and time independent perturbation theory.
CO-2 Understand various approximation methods and apply it to various problems.
CO-3 Understand scattering theory and its various aspects.
CO-4 Understand the concept of identical particles through its wave functions.
CO-5 Understand how Pauli's exclusion principle is obeyed by fermions.
CO-6 Understand the concept of Relativistic Quantum Mechanics.

Curriculum:

Unit	Title	Learning Points
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. Reference: -RL
II	Approximation Methods	**Variation Method:** Basic principle, applications to simple potential problems, He-atom. **WKB Approximation:** WKB approximation, turning points, connection formulas, Quantization conditions, applications. Reference: - GL, DJG
III	Scattering Theory	**Scattering Theory**: Laboratory and Centre of mass frames, differential and total scattering cross-sections, scattering amplitude, Partial wave analysis and phase shifts, optical theorem, S-wave scattering from finite spherical attractive and repulsive potential wells, Born approximation. Reference: - DJG, NZ, RL
IV	Relativistic Quantum Mechanics and Identical Particles	**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. Reference: - NZ, RL, BD

Learning Resources recommended:

A. Main references**:**

1. RL: - Richard Liboff, Introductory Quantum Mechanics, 4th edition, Pearson.
2. DJG: - D J Griffiths, Introduction to Quantum Mechanics 4th edition
3. GL: - A Ghatak and S Lokanathan, Quantum Mechanics: Theory and Applications, 5th edition.

4. NZ: - N Zettili, Quantum Mechanics: Concepts and Applications, 2nd edition, Wiley.
5. BD: - J. Bjorken and S. Drell, Relativistic Quantum Mechanics, McGraw-Hill (1965).

B. 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, A Textbook of Quantum Mechanics, Tata McGraw Hill (1977).
4. J.J. Sakurai Modern Quantum Mechanics, Addison-Wessley (1994).

Teaching plan:

Unit	Title	Teaching methods	Total No. of Lecture
I	Perturbation Theory	Lecture, Problem solving, Visual aid, computer simulation, seminar,	15
II	Approximation Methods	Lecture, Problem Solving, flipped classroom, Group discussion, simulation.	15
III	Scattering Theory	Lecture, Problem Solving, flipped classroom, group discussion	15
IV	Relativistic Quantum Mechanics and Identical Particles	Lecture, Problem Solving, flipped classroom, Group discussion	15

Evaluation Pattern:

A. Continuous Internal Evaluation (40 Marks):

Sr. No.	Particulars	Marks
01	Unit Test	20
02	Assignment	10
03	Active participation in class room and attendance	10

B. Semester End Evaluation (Paper Pattern): (60 Marks)

Question No	Unit	Question Type	Marks
1	I	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05
2	II	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05
3	III	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05
4	IV	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05

Guidelines for pattern for Semester End Evaluation:

1. All questions shall be compulsory with internal option. Questions may be subdivided into sub questions.
2. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving /numericals based questions, etc.

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester II with Effect from the Academic Year 2024-2025

Name of the Course	Physics Lab-I
Class	M.Sc.-I
Semester	II
Course Code	PSPH204
No of Credits	4
Nature	Practical
Type	Major

Course Outcomes:

On successful completion of this course learners will be able to:

CO-1 Understand & practice the skills while performing experiments.
CO-2 Understand the use of apparatus and their use without fear & hesitation.
CO-3 Correlate the physics theory concepts to practical application.
CO-4 Understand the concept of errors and their estimation.
CO-5 Design and troubleshoot electronics circuits.

Curriculum:

Unit	Title	Learning Points
Group A	General Physics	1. Ultrasonic Interferometry-Velocity measurements in different Fluids. 2. Measurement of Refractive Index of Liquids using Laser. 3. Measurement of dielectric constant. 4. Faraday Effect -Magneto Optics Effect: a. To Calibrate Electromagnet b. To determine verdet's constant For KCL & KI Solution. 5. Double slit-Fraunhofer diffraction. 6. Carrier mobility by conductivity 7. Characteristics of a Geiger Muller counter and measurement of dead time
Group B	Electronics	1. Shift registers. 2. Study of 8085 microprocessor Kit and execution of simple Programmes. 3. Waveform generation using 8085. 4. Study of sample and hold circuit. 5. Switching Voltage Regulator. 6. Pulse width modulation for speed control of dc toy motor. 7. Use of monitor utility in 8085 programs a. Hex counter b. Flashing Message

Note:

1. Minimum number of experiments to be performed and reported in the journal = 08 with minimum 4 experiments from each Group. i.e., Group A: 04 and Group B: 04.
2. Journal should be certified by the laboratory in-charge and Head of the Department only if the learner performs satisfactorily the minimum number of experiments as stipulated above.
3. Learner will be allowed to appear for the semester end practical examination of this course only if learner submits a certified journal of this course or a certificate from the head of the Physics Department that learner has completed this practical course as per minimum requirements.

4. At the semester-end Practical exam, the learner shall perform one long experiment from Group A or B. If the learner performs the long experiment from group A, then he will perform a short experiment from Group B, or vice versa.
5. For the semester-end Practical Exam 3 hours of duration for a long experiment and 1 hour of duration for a short experiment.

Learning Resources recommended:

1. Advance practical physics - Worsnop and Flint
2. Experiments in modern physics – Mellissinos
3. Manual of experimental physics –EV Smith
4. Experimental physics for students - Whittle & Yarwood
5. Medical Electronics- Khandpur
6. A course of experiments with He-Ne Laser – Sirohi, Wiley Eastern Ltd
7. Digital Principles and applications-Malvino and Leach
8. Integrated Circuits - K. R. Botkar
9. Experiment in digital principles – D. P. Leach
10. Semiconductor electronics-Gibson
11. Microprocessor Architecture, programming and applications with the 8085-R.S. Gaonkar
12. Microprocessor fundamentals -Schaum Series, Tokheim
13. Semiconductor Electronics – Gibson
14. 8085 kit user Manual

Teaching plan:

Unit	Title	Teaching methods	Total No. of Lecture
Group A	General Physics	Presentation, Discussion, Experiment,	60
Group B	Electronics	Presentation, Discussion, Experiment,	60

Evaluation Pattern

A. Continuous Internal Evaluation: (40 Marks)

Method	Marks
Journal	20
Lab performance	10
Seminar	10

B. Semester End Examination: (60 Marks)

Question No.	Group	Title	Method	Marks
1	A or B	General Physics and Electronics	one Long Experiment performance from Group A or B as per the practical slip	50
2	A or B	General Physics and Electronics	one Short Experiment performance from Group A or B as per the practical slip	10

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester II with Effect from the Academic Year 2024-2025

Name of the Course	Physics of Semiconductor diodes and Transistors
Class	M.Sc.-I
Semester	II
Course Code	PSPH205
No of Credits	2
Nature	Theory
Type	Elective

Course Outcomes:

On successful completion of this course learners will be able to

CO-1 Understand fabrication methods of different types of p-n junctions.
CO-2 Understand IV and C-V characteristics of p-n junctions.
CO-3 Calculate the contact potential and the maximum electrical field in a p-n junction in equilibrium.
CO-4 Understand breakdown mechanisms in p-n junctions.
CO-5 Calculate the excess carrier concentrations at the boundaries between the space-charge region and the neutral n- and p-type regions of a p-n junction for either forward or reverse bias.
CO-6 Distinguish between the current conduction mechanisms and calculate the minority and majority carrier currents in a forward or reverse biased p-n junction diode.
CO-7 Understand principle of operation and construction of BJT and heterojunction bipolar transistors.

Curriculum:

Unit	Title	Learning Points
I	Semiconductor Devices I	p-n junction : Fabrication of p-n junction by diffusion and ion-implantation; Abrupt and linearly graded junctions; Thermal equilibrium conditions; Depletion regions; Depletion capacitance, Capacitance – voltage (C-V) characteristics, Evaluation of impurity distribution, Varactor, Ideal and Practical Current-voltage (I-V) characteristics; Tunneling and avalanche reverse junction break down mechanisms; Minority carrier storage, diffusion capacitance, transient behavior; Ideality factor and carrier concentration measurements; Carrier life time measurement by reverse recovery of junction diode; p- i-n diode; Tunnel diode, Introduction to p-n junction solar cell and semiconductor laser diode. Reference: - SMS, SB
II	Semiconductor Devices II	Metal – Semiconductor Contacts: Schottky barrier – Energy band relation, Capacitance- voltage (C-V) characteristics, Current-voltage (I-V) characteristics; Schottky barrier – 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 wellstructures. Reference: - SMS, SB, WRR, ABL

Learning Resources recommended:

A. Main References:
   1. SMS: - S.M. Sze; Semiconductor Devices: Physics and Technology, 2nd edition, John Wiley, New York, 2002.
   2. SB: - B.G. Streetman and S. Banerjee; Solid State Electronic Devices, 5th edition, Prentice Hall of India, NJ, 2000.
   3. WRR: - W.R. Runyan; Semiconductor Measurements and Instrumentation, McGraw Hill, Tokyo, 1975.
   4. ABL: - Adir Bar-Lev: Semiconductors and Electronic devices, 2nd edition, Prentice Hall, Englewood Cliffs, N.J., 1984.

B. Additional References:

1. Jasprit Singh; Semiconductor Devices: Basic Principles, John Wiley, New York, 2001.
2. Donald A. Neamen; Semiconductor Physics and Devices: Basic Principles, 3rd edition, Tata McGraw-Hill, New Delhi, 2002.
3. M. Shur; Physics of Semiconductor Devices, Prentice Hall of India, New Delhi, 1995.
4. Pallab Bhattacharya; Semiconductor Optoelectronic Devices, Prentice Hall of India, New Delhi, 1995.

Teaching plan:

Unit	Title	Teaching methods	Total No. of lecture
I	Semiconductor Devices I	Lecture, Problem solving, visual aid, computer simulation, seminar,	15
II	Semiconductor Devices II	Lecture, Problem Solving, Video lecture, Group discussion, simulation.	15

Evaluation Pattern

A. Continuous Assessment (20 Marks):

Sr. No.	Particulars	Marks
01	Unit Test	10
02	Assignment	05
03	Active participation in class room and attendance	05

B. Semester End Evaluation (Paper Pattern): (30 Marks)

Question No	Unit	Question Type	Marks
1	I	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05
2	II	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05

Guidelines for pattern for Semester End Evaluation:

1. All questions shall be compulsory with internal option. Questions may be subdivided into sub questions.
2. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving /numericals based questions, etc.

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester II with Effect from the Academic Year 2024-2025

Name of the Course	Physics Lab-II
Class	M.Sc.-I
Semester	II
Course Code	PSPH 206
No of Credits	2
Nature	Practical
Type	Elective

Course Outcomes:

On successful completion of this course learners will be able to

CO-1 Understand & practice the skills while performing experiments.
CO-2 Understand the use of apparatus and their use without fear & hesitation.
CO-3 Correlate the physics theory concepts to practical application.
CO-4 Understand the concept of errors and their estimation.
CO-5 Design and troubleshoot electronics circuits.

Curriculum:

Unit	Title	Learning Points
Group A	General Physics	1. Barrier capacitance of a junction diode 2. Energy Band gap by four probe method 3. Determine of Young's modulus of metal rod by interference method.
Group B	Electronics	1. Adder-subtractor circuits using ICs 2. Study of Presettable counters- 74190 and 74193 3. TTL Characteristics of Totempole Open collector and tristate devices

Learning Resources Recommended:

1. Electronic instrumentation & measurement: W. D. Cooper
2. Introduction to solid state physics: C. Kittel
3. Solid state physics: A. J. Dekkar
4. Electronic engineering: Millman Halkias
5. Manual of experimental physics: E.V. Smith
6. Experimental physics for students: Whittle & Yarwood
7. Semiconductor measurements: Runyan
8. Experiments in digital principles: D.P. Leach
9. Digital principles and applications: Melvino and Leach
10. Digital circuit practice: R. P. Jain
11. Electronic instrumentation: H. S. Kalsi
12. Advance Practical Physics: Worsnop and Flint

Note:

1. Minimum number of experiments to be performed and reported in the journal = 04 with minimum 02 experiments from each Group. i.e., Group A: 02 and Group B: 02.
2. Journal should be certified by the laboratory in-charge and Head of the Department only if the learner performs satisfactorily the minimum number of experiments as stipulated above.
3. Learner will be allowed to appear for the semester end practical examination of this course only if learner submits a certified journal of this course or a certificate from the head of the Physics Department that learner has completed this practical course as per minimum requirements.
4. At the semester-end Practical exam, the learner shall perform any one experiment from Group A or B. If the learner performs the long experiment from group A, then he will perform a short experiment from Group B, or vice versa.

5. For the semester-end Practical Exam 3 hours of duration for a long experiment and 1 hour of duration for a short experiment.

Teaching plan:

Unit	Title	Teaching methods	Total No. of Lecture
Group A	General Physics	Presentation, Discussion, Experiment,	30
Group B	Electronics	Presentation, Discussion, Experiment,	30

Evaluation Pattern:

A. Continuous Evaluation: (40 Marks)

Method	Marks
Journal	20
Lab performance	10
Seminar	10

B. Semester End Evaluation (Paper Pattern): (60 Marks)

Question No.	Group	Title	Method	Marks
1	A or B	General Physics and Electronics	Any one Long Experiment performance from Group A or B as per the practical slip	50
2	A or B	General Physics and Electronics	Any one Short Experiment performance from Group A or B as per the practical slip	10

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester II with Effect from the Academic Year 2024-2025

Name of the Course	Semiconductor Physics and Devices
Class	M.Sc.-I
Semester	II
Course Code	PSPH207
No of Credits	2
Nature	Theory
Type	Elective

Course Outcomes:

On successful completion of this course learners will be able to:

CO-1 Calculate the intrinsic carrier concentration in semiconductors and apply the concept of compensation and space charge neutrality to calculate the electron and hole concentrations in extrinsic semiconductor samples.
CO-2 Compute the electron and hole concentrations if the Fermi or quasi-Fermi level is given.
CO-3 Understand the carrier generation and various recombination processes and excess carrier concentrations as a function of time for low-level injection conditions in a semiconductor.
CO-4 Determine the drift and diffusion components of electron and hole currents.
CO-5 Understand the applications of continuity equation.
CO-6 Understand the concept of MESFET.
CO-7 Understand I-V characteristics of MESFET, MODFET.

Curriculum

Unit	Title	Learning Points
I	Semiconductor Physics	Classification of Semiconductors; Crystal structure with examples of Si, Ge & GaAs semiconductors; Energy band structure of Si, Ge & GaAs; Extrinsic and compensated Semiconductors; Temperature dependence of Fermi-energy and carrier concentration. Drift, diffusion and injection of carriers; Carrier generation and recombination processes- Direct recombination, Indirect recombination, Surface recombination, Auger recombination; Applications of continuity equation- Steady state injection from one side, Minority carriers at surface, Haynes Shockley experiment, High field effects. Hall Effect; Four – point probe resistivity measurement; Carrier life time measurement by light pulse technique. Reference: SMS
II	Field Effect Transistors	**Field Effect Transistors**: - 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 I_{ds} vs, V_{ds} and I_{ds} vs V_g characteristics, Introduction to Integrated circuits. Reference: - SMS, SB, ABL

Learning Resources recommended:

A. Main References:
   1. SMS: - S.M. Sze; Semiconductor Devices: Physics and Technology, 2nd edition, John Wiley, New York, 2002.
   2. SB: - B.G. Streetman and S. Banerjee; Solid State Electronic Devices, 5th edition, Prentice Hall of India, NJ, 2000.
   3. ABL: - Adir Bar-Lev: Semiconductors and Electronic devices, 2nd edition, Prentice Hall, Englewood Cliffs, N.J., 1984.

B. Additional References:

1. Jasprit Singh; Semiconductor Devices: Basic Principles, John Wiley, New York, 2001.
2. Donald A. Neamen; Semiconductor Physics and Devices: Basic Principles, 3rd edition, Tata McGraw-Hill, New Delhi, 2002.
3. M. Shur; Physics of Semiconductor Devices, Prentice Hall of India, New Delhi, 1995.
4. Pallab Bhattacharya; Semiconductor Optoelectronic Devices, Prentice Hall of India, New Delhi, 1995.
5. WRR: - W.R. Runyan; Semiconductor Measurements and Instrumentation, McGraw Hill, Tokyo, 1975.

Teaching plan:

Unit	Title	Teaching methods	Total No. of Lecture
I	Semiconductor Physics	Lecture, Problem solving, visual aid, computer simulation, seminar,	15
II	Field Effect Transistors	Lecture, Problem Solving, Video lecture, Group discussion, simulation.	15

Evaluation Pattern

A. Continuous Internal Evaluation (20 Marks):

Sr. No.	Particulars	Marks
01	Unit Test	10
02	Assignment	05
03	Active participation in class room and attendance	05

B. Semester End Evaluation (Paper Pattern): (30 Marks)

Question No	Unit	Question Type	Marks
1	I	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05
2	II	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05

Guidelines for pattern for Semester End Evaluation:

1. All questions shall be compulsory with internal option. Questions may be subdivided into sub questions.
2. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving /numericals based questions, etc.

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester II with Effect from the Academic Year 2024-2025

Name of the Course	Physics Lab-III
Class	M.Sc.-I
Semester	II
Course Code	PSPH208
No of Credits	2
Nature	Practical
Type	Elective

Course Outcomes:

On successful completion of this course learners will be able to:

CO-1 Understand & practice the skills while performing experiments.
CO-2 Understand the use of apparatus and their use without fear & hesitation.
CO-3 Correlate the physics theory concepts to practical application.
CO-4 Understand the concept of errors and their estimation.
CO-5 Write flowcharts and assembly language programs for 8085 microprocessors.
CO-6 Execute programs on 8085 microprocessor kit.

Curriculum:

Unit	Title	Learning Points
Group A	General Physics	1) Linear Voltage Differential Transformer 2) I-V/C-V measurement on semiconductor specimen 3) Zeeman Effect using Fabry-Perot etalon/Lummer – Gehrecke plate
Group A	Electronics	1) Ambient Light control power switch. 2) SID & SOD using 8085 3) Interfacing TTL with buzzers, relay, motor and solenoids

Learning Resources Recommended:

1. Semiconductor electronics – Gibson
2. Electronic instrumentation & measurement: W. D. Cooper
3. Introduction to solid state physics - C. Kittel
4. Solid state physics — A. J. Dekkar
5. Electronic engineering - Millman Halkias
6. Manual of experimental physics: E.V. Smith
7. Experimental physics for students: Whittle & Yarwood
8. Semiconductor measurements — Runyan
9. Experiments in digital principles-D.P. Leach
10. Digital principles and applications - Malvino and Leach
11. Microprocessor Architecture, Programming and Applications with the 8085 - R. S. Gaonkar
12. Microprocessor fundamentals- Schaum Series-Tokheim
13. 8085 Kit User manual
14. Electronic Instrumentation – H. S. Kalsi
15. Advance practical physics – Worsnop and Flint

Note:

1. Minimum number of experiments to be performed and reported in the journal = 04 with minimum 02 experiments from each Group. i.e., Group A: 02 and Group B: 02.
2. Journal should be certified by the laboratory in-charge and Head of the Department only if the learner performs satisfactorily the minimum number of experiments as stipulated above.
3. Learner will be allowed to appear for the semester end practical examination of this course only if learner submits a certified journal of this course or a certificate

from the head of the Physics Department that learner has completed this practical course as per minimum requirements.

4. At the semester-end Practical exam, the learner shall perform any one experiment from Group A or B. If the learner performs the long experiment from group A, then he will perform a short experiment from Group B, or vice versa.
5. For the semester-end Practical Exam 3 hours of duration for a long experiment and 1 hour of duration for a short experiment.

Teaching plan:

Unit	Title	Teaching methods	Total No. Of Lecture
Group A	General Physics	Presentation, Discussion, Experiment.	30
Group B	Electronics	Presentation, Discussion, Experiment.	30

Evaluation Pattern:

A. Continuous Internal Evaluation: (40 Marks)

Method	Marks
Journal	20
Lab performance	10
Seminar	10

B. Semester End Evaluation (Paper Pattern): (60 Marks)

Question No.	Group	Title	Method	Marks
1	A or B	General Physics and Electronics	Any one Long Experiment performance from Group A or B per the practical slip	50
2	A or B	General Physics and Electronics	Any one Short Experiment performance from Group A or B as per the practical slip	10

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester II with Effect from the Academic Year 2024-2025

Name of the Course	On Job Training/ Field Project
Class	M.Sc.
Semester	II
Course Code	PSPH209
No of Credits	4
Nature	Practical
Type	On Job Training/ Field Project

Guidelines and Evaluation pattern for On Job Training/ Project/Extended Experiment (100 Marks)

Introduction:

Inclusion of On Job Training/ Field Project in the course curriculum of the M.Sc. programme is one of the ambitious aspects in the programme structure. The main objective of inclusion of On Job Training/ Project is to inculcate ability to interpret particular aspect of the study in his/ her own words.

Guidelines for On Job Training

On-the-Job Training/Field Project: Learners will be required to undertake a designated project or tasks in an organization or industry relevant to their field of study. The course aims to provide learners with practical exposure and hands-on experience in a professional work environment related to their field of study.

Course Objectives:
By the end of the course, learners should be able to:

1. Gain exposure to real-world insights and apply theoretical knowledge to practical situations.
2. Enhance skills regarding problem-solving, decision-making, and communication skills.
3. Understand organizational dynamics and work culture.
4. Build industry connections and networking opportunities.

Course Duration:
Minimum 20 days / 120 hours of On Job Training with an Organization/Private firm.

- The theme of the On Job Training should be based on any study area of the Major course.
- Systematic Report of the work should be submitted.
- Work completion Certificate is Mandatory.

Report Structure:
The learners will be required to submit a comprehensive report at the end of the On-the-Job Training/Field Project. A project report has to be brief in content and must include the following aspects:

a) **Title Page:**

   Mentioning the title of the report, name of the learner, program, institution, and the period of training.

b) **Certificate of Completion:**

A certificate issued by the organization or supervisor confirming the successful completion of the training.

c) **Declaration:**

A statement by the learner declaring that the report is their original work and acknowledging any assistance or references used.

d) **Acknowledgments:**

Recognizing individuals or organizations that provided support, guidance, or resources during the training.

e) **Table of Contents:**

Providing a clear outline of the report's sections and page numbers.

f) **Executive Summary:**

A bird's eye view of learner's entire presentation has to be precisely offered under this Category.

g) **Introduction on the Company:**

A Concise representation of company/organization defining its scope, products/ services etc.

h) **Your Role in the Organization during the on-Job Training:**

The key aspects handled, the department under which learner were deployed and brief Summary report duly acknowledged by the reporting head.

i) **Challenges**:

The challenges confronted while churning out theoretical knowledge into practical world.

j) **Conclusion:**

A brief overview of learner experience and suggestions to bridge the gap between theory and practice.

Course Outcomes:

1. Apply theoretical knowledge and concepts acquired during the academic program to real-world work scenarios.
2. Develop practical skills and competencies necessary for successful professional engagement.
3. Demonstrate effective problem-solving, decision-making, and critical thinking abilities in a work environment.
4. Adapt to and navigate organizational dynamics and work culture in the chosen industry.

5. Prepare a comprehensive report documenting the training/project experience, findings, and recommendations.

Teaching plan:

Title	Teaching methods	Total No. of lectures
Identifying Job Nature relevant subject	Discussion, Job survey	30
Actual training	Actual work	60
preparing report	Presentation and discussion	30

Evaluation Pattern for On Job Training

A. Continuous Internal Evaluation: (40 Marks)

Method	Marks
Certificate for performance in Training Place	30
Presentation	10

B. Semester End Evaluation (Paper Pattern): (60 Marks)

Sr No	Criteria	Marks
1	On Job Training Report as per report structure	40
2	Presentation/Viva	20

Guidelines for Field Project

Course Outcomes:
By the end of the course, learners should be able to:

1 Understand the ethics and research methodology.
2 Do a literature review.
3 Do research.
4 Analyze the research work data.
5 Write research thesis.

6 Design, build and test necessary experimental setup.

Course Duration: One Semester Minimum 120 hours of field project work.

Course Outline:

1. Identifying problem for project work (20 Hours).
2. Literature survey (20 Hours).
3. Designing and implementing the project through necessary experimental work (30 Hours).
4. Data collection and its analysis and interpretation. (20 Hours).
5. Report writing and presentation (30 Hours).

Teaching plan:

Title	Teaching methods	Total No. of Lectures
Identifying problem for project work, literature survey .	Discussion, literature review	30
Deciding methodology and practical implementation of the Project, Field visit.	Discussion, Experimental work	60
Data analysis (if any) and conclusions, preparing project report (a dissertation).	Presentation and discussion	30

Evaluation Pattern for Field Project

A. Continuous Internal Evaluation: (40 Marks)

Method	Marks
Lab performance as per course outline	30
Presentation	10

B. Semester End Evaluation (Paper Pattern): (60 Marks)

Sr No	Criteria	Marks
1	Experimental/Theoretical methodology/Working condition of project or model	15
2	Significance of the study/Society application and Inclusion of recent References	10
3	Depth of knowledge in the subject / Results and Discussions	10
4	Project Report	10
5	Presentation	15

Format of Project Report:

a) **Title Page:**

Mentioning the title of the report, name of the learner, program, institution, and the project.

b) **Certificate of Completion:**

A certificate issued by guide confirming the successful completion of the project.

c) **Declaration:**

A statement by the learner declaring that the report is the original work and acknowledging any assistance or references used.

d) **Acknowledgments:**

Recognizing individuals or organizations that provided support, guidance, or resources during the training/project.

e) Table of Contents:

Providing a clear outline of the report's sections and page numbers.

f) Abstract:

A bird's eye view of learner's entire presentation has to be precisely offered under this category. A brief overview of the project, its objectives and key findings should be mentioned.

g) Introduction:

Background information about the project and its significance. Objectives and scope of the project.

h) Literature Review:

Overview of relevant literature and studies related to the chosen field and development issues.

i) Methodology:

Description of: Planning of experimental procedure as per the need of the project. Designing and implementation of the project as per the objectives through theoretical, experimental or computational methods.

j) Observations and data analysis:

Details of Testing, debugging, troubleshooting as per the need. Data collection and analysis.

k) Conclusion:

Summary of the key findings and outcomes of the project.

l) References & **Appendices:**

List of all sources cited in the project report. Additional supporting materials.

The project report shall be prepared as per the broad guidelines given below:

- Font type: Times New Roman,
- Font size: 12-For content, 14-for Title
- Line Space: 1.5-for content and 1-for in table work, Justified format
- Page Size: A4
- Margin: in Left-1.5, Up-Down-Right-1
- The Project Report shall be hard bounded.

Format

1st page (Main Page)

Title of the problem of the Project

A Project Submitted

to

R. P. Gogate college of Arts & Science and

R.V. Jogalekar College of Commerce College (Autonomous)

under

University of Mumbai

for partial completion of the degree

of

Master in Science

Under the Faculty of science

By

Name of Student

Under the Guidance of

Name of the Guiding Teacher

R. P. Gogate college of Arts & Science and

R.V. Jogalekar College of Commerce College (Autonomous),

Ratnagiri

<Month and Year>

On separate page

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On separate page

Declaration by learner

I the undersigned Miss/Mr. _____ [Name of the learner] here by, declare that work embodied in this project work titled _____ forms my own contribution to the research work carried out under the guidance of [Name of the guiding teacher] _____ is a result of my own project / research work and has not been previously submitted to any other University for any other Degree/ Diploma to this or any other University.

Wherever reference has been made to previous works of others, it has been clearly indicated as such and included in the bibliography.

I, here by further declare that all information of this document has been obtained and presented in accordance with academic rules and ethical conduct.

Name and Signature of the learner

Certified by

Name and signature of the Guiding Teacher

On separate page

Acknowledgment

(To be written by learner)

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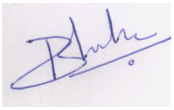

Chairperson
BoS Physics