REVISED SYLLABI AND SCHEME OF EXAMINATIONS FOR DISCIPLINE SPECIFIC COURSES OF MULTIDISCIPLINARY PROGRAMS WITH HONS. IN ONE MAJOR DISCIPLINE B.Sc. (Physical Sciences) Physics

(Based on Curriculum and Credit Framework for UG Programs under NEP)

WITH EFFECT FROM THE SESSION 2026-27

This Scheme and Syllabi will also be applicable for the students admitted in 2025-26 from Semester 3rd onwards and for the students admitted in 2024-25 from Semester 5th onwards.

MAHARSHI DAYANAND UNIVERSITY ROHTAK (HARYANA)

Credit Structure for Undergraduate Programme B.Sc. (Physical Sciences) Physics

Semester	Discipline-Specific Courses (DSC) / Major courses	Minor(MIC)/ Vocational (VOC)/ Skill Enhancement Courses (SEC)/ Internship	Multidisciplinary courses (MDC)	Ability Enhancement courses (AEC)	Research project/ Dissertation	Value-Added Courses (VAC)	Total Credits
I	**DSC - A1 @ 4 credits**	**MIC1 @ 4 credits**	**MDC1 @ 3 credits**	**AEC1 @ 2 credits**	---------------------	---------------------	**24**
	DSC - B1 @ 4 credits	**SEC1@ 3 credits****					
	DSC - C1 @ 4 credits						
II	**DSC - A2 @ 4 credits**	**SEC2 @ 3 credits****	**MDC2 @ 3 credits**	**AEC2 @ 2 credits**	---------------------	**VAC1 @ 2 credits** **VAC2 @ 2 credits**	**24**
	DSC – B2 @ 4 credits						
	DSC – C2 @ 4 credits						
Students exiting the programme after second semester and securing 52 credits including 4 credits of summer internship will be awarded UG Certificate in the relevant Discipline/ Subject							
III	**DSC – A3 @ 4 credits**	**MIC2 @ 4 credits**	**MDC3 @ 3 credits**	**AEC3 @ 2 credits**		---------------------	**24**
	DSC – B3 @ 4 credits	**SEC3@ 3 credits****					
	DSC – C3 @ 4 credits						
IV	**DSC – A4 @ 4 credits**	**MIC3(VOC)@ 4 credits**	---------------------	**AEC4 @ 2 credits**	---------------------	**VAC3 @ 2 credits**	**20**
	DSC – B4 @ 4 credits						
	DSC – C4 @ 4 credits						
Students exiting the programme after fourth semester and securing 96 credits including 4 credits of summer internship will be awarded UG Diploma in the relevant Discipline/Subject							
V	**DSC – A5 @ 4 credits**	**MIC4(VOC)@ 4 credits**	--------------------	--------------------	---------------------	---------------------	**20**
	DSC – B5 @ 4 credits	**Internship @ 4 credits#**					
	DSC – C5 @ 4 credits						
VI	**DSC – A6 @ 4 credits**	**MIC5 @ 4 credits**	--------------------	--------------------	---------------------	--------------------	**20**
	DSC – B6 @ 4 credits	**MIC6(VOC)@ 4 credits**					
	DSC – C6 @ 4 credits						
Students will be awarded 3-year UG Degree in the relevant Discipline/Subject upon securing 132 credits.							
VII*	**DSC – H1 @ 4 credits**	**SEC4 @ 4 credits**	--------------------	--------------------	--------------------	--------------------	**24**
	DSC – H2 @ 4 credits	**OR**					
	DSC – H3 @ 4 credits	**MIC7 (VOC) @ 4 credits**					
	DSC – H4 @ 4 credits	**OR**					
	DSC – H5 @ 4 credits	**Internship @ 4 credits**					
VIII* (4yr UG Hon.)	**DSC – H6 @ 4 credits**	**SEC5 @ 4 credits**	--------------------	--------------------	--------------------	--------------------	**24**
	DSC – H7 @ 4 credits	**OR**					
	DSC – H8 @ 4 credits	**MIC8 (VOC) @ 4 credits**					
	DSC – H9 @ 4 credits	**OR**					
	DSC – H10 @ 4 credits	**Internship @ 4 credits**					
VIII* (4yr UG Hon. with Research)	**DSC – H6@ 4 credits**	**SEC5 @ 4 credits**	--------------------	--------------------	**Research project/ Dissertation@ 12 credits**	--------------------	**24**
	DSC – H7@ 4 credits	**OR**					
	--------------------	**MIC8 (VOC) @ 4 credits**				**TOTAL CREDITS**	**180**
	--------------------	**OR**					
		Internship @ 4 credits					

* Student should select one major discipline (Out of A, B, or C studied during first three years of UG Programmes) in which he/she wishes to pursue Honors. This framework is subject to modification as per UGC guidelines at the University level. The universities may decide to offer the Honours degree Programmes subject to the fulfilment of credit point table

** SEC for imparting practical skills related to Major (A, B and C)/minor.
#Four credits of internship earned by a student during summer internship after 2nd semester or 4th semester will be counted in 5th semester of a student who pursue 3 year UG Programmes without taking exit option.

Semester I (Session 2026-27)															
Discipline Specific Courses/ Major Course			**Credits Distribution**			**Total Credits**	**Workload**			**Total Workload**	**Marks**				
	Nomenclature of Course	**Course Code**	**L**	**T**	**P**		**L**	**T**	**P**		**Theory**		**Practical**		**Total Marks**
											Internal	**External**	**Internal**	**External**	
DSC @ 4 credits	Mechanics and Theory of Relativity	24PHYM401DS01	2	0	2		2	0	4	6	15	35	50	-	100
Semester II (Session 2026-27)															
DSC @ 4 credits	Electricity and Magnetism	24PHYM402DS01	2	0	2		2	0	4	6	15	35	50	-	100
Semester III (Session 2027-28)															
DSC @ 4 credits	Optics	25PHY403DS01	2	0	2		2	0	4	6	15	35	50	-	100
Semester IV (Session 2027-28)															
DSC @ 4 credits	Thermodynamics and Statistical Mechanics	25PHYM404DS01	2	0	2		2	0	4	6	15	35	50	-	100
Semester V (Session 2028-29)															
DSC @ 4 credits	Quantum Mechanics and Nuclear Physics	26PHYM405DS01	2	0	2		2	0	4	6	15	35	50	-	100
Semester VI (Session 2028-29)															
DSC @ 4 credits	Solid State Physics and Electronic Devices	26PHYM406DS01	2	0	2		2	0	4	6	15	35	50	-	100
Semester VII (Session 2029-30)															
DSC – H1 @ 4 credits	Mathematical Physics	24PHY201DS01	3	1	0	4	4	0	0	4	70	30	-	-	100
DSC – H2 @ 4 credits	Classical Mechanics	24PHY201DS02	3	1	0	4	4	0	0	4	70	30	-	-	100
DSC – H3 @ 4 credits	Quantum Mechanics –I	24PHY201DS03	3	1	0	4	4	0	0	4	70	30	-	-	100
DSC – H4 @ 4 credits	Physics of Electronic	24PHY201DS04	3	1	0	4	4	0	0	4	70	30	-	-	100

	Devices														
DSC – H5 @ 4 credits	Practical: General Physics -I	24PHY201DS05	0	0	4	4	0	0	4	8	00	00	30	70	100
Semester VIII (Session 2029-30) **OPTION-I** **(4 Year UG Hons.)**															
DSC – H6 @ 4 credits	Statistical Mechanics	24PHY202DS01	03	01	0	04	03	01	0	04	30	70	-	-	100
DSC – H7 @ 4 credits	Quantum Mechanics -II	24PHY202DS02	03	01	0	04	03	01	0	04	30	70	-	-	100
DSC – H8 @ 4 credits	Atomic & Molecular Physics	24PHY202DS03	03	01	0	04	03	01	0	04	30	70	-	-	100
DSC – H9 @ 4 credits	Solid State Physics	24PHY202DS04	03	01	0	04	03	01	0	04	30	70	-	-	100
DSC – H10 @ 4 credits	Practical: General Physics -II	24PHY202DS05	0	0	04	04	0	0	08	08	-	-	30	70	100

Semester VIII (Session 2029-30) **OPTION-II** **(4 Year UG Hons. With Research)**															
DSC – H7 @ 4 credits	Quantum Mechanics -II	24PHY202DS02	03	01	0	04	03	01	0	04	30	70	-		100
DSC – H9@ 4 credits	Solid State Physics	24PHY202DS04	03	01	0	04	03	01	0	04	30	70	-		100
Dissertation Course	Research Project /Dissertation	27PHY408PD01	0	0	0	12	0	0	24	24	-	-	90	210	300

L: Lecture; T: Tutorial; P: Practical

Note:

- The Syllabi and Scheme of Examinations (SOE) for Discipline Specific Courses/Major Courses for UG Semester 7 and Semester 8 will be same as applicable for Syllabi and S.O.E. for Post Graduate semester 1 and semester 2 respectively.

- The Practical shall consist of the following components:

Total Marks: 100	**Total Marks: 50**
• Attendance: 5 Marks • Practical Assignments/ Practical File: 25 Marks • Experiment Performed & Viva-voce: 70 Marks	• Attendance: 5 Marks • Practical Assignments/ Practical File: 10 Marks • Experiment Performed & Viva-voce: 35 Marks

Syllabi for B.Sc. (Physical Sciences) Physics

Semester-I

Session: 2026-27

Name of Program	B.Sc. (Physical Sciences)	**Program Code**	UMPS4
Name of the Course	Mechanics and Theory of Relativity	**Course Code**	24PHYM401DS01
Hours per Week	06(2+4)	**Credits**	04
Maximum Marks	Theory: 15+35 Practical: 50 Total: 100	**Time of Examinations**	Theory: 03 Hours Practicals: 03 Hours

Note:

Examiner will set nine questions of seven marks each and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing short answer type questions from all units. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each Unit. All questions will carry equal marks.

Course Learning Outcomes (CLO):

CLO 1: Understand the dynamics of system of particles, conservation of energy and momentum application of both translational and rotational dynamics motions simultaneously in analysing rolling with slipping

CLO 2: Differentiate between elastic and plastic body. Elastic constants, determination and their physical significance. Torque and its significance.

CLO 3: Familiar about the special theory of relativity and its applications. Michelson's Morley experiments and its finding.

Unit 1:

Basics of Mechanics: Mechanics of single and system of particles, Conservation law of linear momentum, Angular momentum and mechanical energy for a particle and a system of particles, Centre of Mass and equation of motion, Constrained Motion. Work and Kinetic Energy Theorem. Conservative and neoconservative forces. Potential Energy. Energy diagram. Stable and unstable equilibrium. Elastic potential energy. Force as gradient of potential energy. Work & Potential energy. Work done by non-conservative forces. Law of conservation of Energy.

Unit 2:

Generalized Notations: Degrees of freedom and Generalized coordinates, Transformation equations, Generalized Displacement, Velocity, Acceleration, Momentum, Force and Potential, Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems. Hamilton's variational principle, Lagrange's equation of motion from Hamilton's principle, Linear Harmonic oscillator, Simple pendulum, Atwood's machine

Unit 3:

Rotational Dynamics: Rotation of Rigid body, moment of inertia, torque, angular momentum, kinetic energy of rotation. Theorems of perpendicular and parallel axes with proof. Moment of inertia of solid sphere, hollow sphere, spherical shell, solid cylinder, hollow cylinder and solid bar of rectangular cross-section. Acceleration of a body rolling down on an inclined plane. Kinetic energy of rotation. Motion involving both translation and rotation.

Unit 4:

Special Theory of Relativity: Non-inertial frames and fictitious forces. Uniformly rotating frame. Laws of Physics in rotating coordinate systems. Centrifugal force. Coriolis force and its applications. Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity and order of events. Lorentz contraction. Time dilation. Relativistic transformation of velocity, frequency and wave number. Relativistic addition of velocities. Variation of mass with velocity. Massless Particles. Mass-energy Equivalence. Relativistic Doppler effect. Relativistic Kinematics. Transformation of Energy and Momentum. Energy-Momentum Four Vector.

Practicals:

1. Measurements of length (or diameter) using Vernier calliper, screw gauge and travelling microscope.
2. To study the random error in observations.
3. To determine the height of a building using a Sextant.
4. To study the Motion of Spring and calculate (a) Spring constant, (b) g and (c) Modulus of rigidity.
5. To determine the Moment of Inertia of a Flywheel.
6. Moment of Inertia of irregular body using a Torsion Pendulum.
7. Young's Modulus by Bending of Beam.
8. To determine g and velocity for a freely falling body using Digital Timing Technique
9. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
10. To determine the Young's Modulus of a Wire by Optical Lever Method.
11. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
12. To determine the elastic Constants of a wire by Searle's method.
13. To determine the value of g using Bar Pendulum.
14. To compare Moment of Inertia of a solid Sphere, Hollow Sphere and solid Disc of same mass with the help of Torsion Pendulum.
15. To determine the bending moment of a cantilever beam with uniformly distributed load, uniformly varying load and point load.

Note: A student has to perform atleast eight (08) experiments from the above list.

References:

1. Classical Mechanics by H. Goldstein (2nd Edition).
2. Berkeley Physics Course. Vol. 1. Mechanics by E.M. Purcell
3. Concepts of Modern Physics by Arthur Beiser
4. Mechanics by D.S. Mathur
5. University Physics. FW Sears, MW Zeman sky & HD Young 13/e, 1986.Addison-Wesley
6. Physics – Resnick, Halliday & Walker 9/e, 2010, Wiley
7. Feynman Lectures, Vol. I, R. P. Feynman, R. B. Leighton, M. Sands, 2008, Pearson Education
8. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
9. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
10. Advanced Practical Physics for students, B. L. Flint and H.T. Workshop, 1971, Asia Publishing House.

11. Practical Physics, S.L. Gupta and V. Kumar, Pragati Prakashan Meerut

Semester-II
Session: 2026-27

Name of Program	B.Sc. (Physical Sciences)	**Program Code**	UMPS4
Name of the Course	Electricity and Magnetism	**Course Code**	24PHYM402DS01
Hours per Week	06(2+4)	**Credits**	04
Maximum Marks	Theory: 15+35 Practical: 50 Total: 100	**Time of Examinations**	Theory: 03 Hours Practicals: 03 Hours

Note:
Examiner will set nine questions of seven marks each and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing short answer type questions from all units. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each Unit. All questions will carry equal marks.

Course Learning Outcomes (CLO):
After completing this course, the learner will be able to:
CLO 1: Develop an understanding of the basic concepts of electricity and magnetism; including electric and magnetic fields and their effects on matter.
CLO 2: Demonstrate the ability to successfully apply a conceptual understanding to specific problems in electricity and magnetism.
CLO 3: Apply problem-solving strategies to problems electricity and magnetism
CLO 4: Demonstrate the ability to perform mathematical analyses of problems in electricity and magnetism
CLO 5: Understand and communicate the role electricity and magnetism play daily life and in commonly used technologies.

Unit 1:
Electric Field and Electric Potential: Scalars and Vectors, dot and cross product, Triple vector product, Scalar and Vector fields, Differentiation of a vector, Gradient of a scalar and its physical significance, Integration of a vector (line, surface and volume integral and their physical significance), Gauss's divergence theorem and Stocks theorem. Derivation of field E from potential as gradient, derivation of Laplace and Poisson equations. Electric flux, Gauss's Law and its application to spherical shell, uniformly charged infinite plane and uniformity charged straight wire, mechanical force of charged surface, Energy per unit volume.

Unit 2:
Magnetic Field: Biot-Savart's Law and its simple applications. Ampere's Circuital Law and its application. Properties of B: curl and divergence. Vector Potential. Magnetic Properties of Matter: Force on a dipole in an external field, Electric currents in Atoms, Electron spin and Magnetic moment, types of magnetic materials, Magnetization vector (M), Magnetic

Intensity (H), Magnetic Susceptibility and permeability, Relation between B, H and M, Electronic theory of Dia and Para-magnetism, Domain theory of ferromagnetism (Langvein's theory), Cycle of Magnetization- B-H curve and hysteresis loop: Energy dissipation, Hysteresis loss and importance of Hysteresis Curve.

Unit 3:

Electromagnetic induction: Faraday's laws of induction and Lenz's Law, Self-inductance, Mutual inductance, Energy stored in a Magnetic field, Maxwell equation and their derivations, Displacement Current. Vector and scalar potentials, boundary conditions at interface between two different media, Propagation of electromagnetic wave (Basic idea, no derivation). Poynting vector and Poynting theorem.

Unit 4:

DC current Circuits: Electric current and current density, Electrical conductivity and Ohm's law (Review), Applications to dc circuits. Growth and decay of current in a circuit with (a) Capacitance and resistance (b) resistance and inductance (c) Capacitance and inductance (d) Capacitance resistance and inductance. Alternating Current Circuits: A resonance circuit, Phasor, Complex Reactance and Impedance, Analysis for RL, RC and LC Circuits, Series LCR Circuit: (1) Resonance, (2) Power Dissipation (3) Quality Factor and (4) Band Width, Parallel LCR Circuit.

Practicals:

1. Use of multi-meter for measuring Resistance, A.C. and D.C. Voltage and Current, checking of electrical fuses.
2. To determine an unknown Low Resistance using Potentiometer.
3. To determine an unknown Low Resistance using Carey Foster's Bridge with calibration.
4. Determination of Impedance of an A.C. circuit and its verification.
5. To determine Frequency of A.C. mains using an electromagnet.
6. To determine Frequency of A.C. mains Electrical vibrator.
7. To determine High resistance by substitution method.
8. To compare capacitances using De'Sauty bridge.
9. To verify the Thevenin's and Norton theorems.
10. To verify the Superposition, and Maximum power transfer theorems.
11. To study a series LCR circuit and determine its (a) Resonant frequency, (b) Quality factor.
12. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor.

Note: A student has to perform atleast eight (08) experiments from the above list.

References:

1. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw
2. Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn. 1998, Benjamin Cummings.
3. Feynman Lectures Vol.2, R.P. Feynman, R.B. Leighton, M. Sands, 2008, Pearson Education
4. Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.
5. Electricity and Magnetism, J. H. Fewkes & J. Yarwood. Vol. I, 1991, Oxford Univ. Press.
6. Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education
7. Field and Wave Electromagnetics (2nd Edn.), David K. Cheng, Addison-Wesley

Publishing Company
8. A Textbook of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
9. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
10. A Laboratory Manual of Physics for undergraduate classes, D.P. Khandelwal, 1985, Vani Pub.

Semester -III
Session: 2027-28

Name of Program	B.Sc. (Physical Sciences)	**Program Code**	UMPS4
Name of the Course	Optics	**Course Code**	25PHYM403DS01
Hours per Week	06 (2+4)	**Credits**	04
Maximum Marks	Theory: 15+35 Practical: 50 Total: 100	**Time of Examinations**	Theory: 03 Hours Practicals: 03 Hours

Note:
Examiner will set nine questions of seven marks each and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing short answer type questions from all units. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each Unit. All questions will carry equal marks.

Course Learning Outcomes (CLO):
After completing this course, the learner will be able to:
CLO 1: Understand phenomenon based on light and related theories.
CLO 2: Get skills to identify and apply formulas of optics and wave physics
CLO 3: Understand the event like reflection, refraction, interference, diffraction etc
CLO4: Understand the applications of interference in design and working of interferometers.
CLO5: Understand the applications of diffraction and polarization.
CLO6: Understand the resolving power of different optical instruments.
CLO7: Understand working of optical fiber and their applications in communication

Unit–I
INTERFERENCE: Interference by Division of Wave front: Young's double slit experiment, Coherence, Conditions of interference, Fresnel's biprism and its applications to determine the wavelength of sodium light and thickness of a mica sheet, phase change on reflection. Interference by Division of Amplitude: Plane parallel thin film, production of colours in thin films, classification of fringes in films, Interference due to transmitted light and reflected light, wedge shaped film, Newton's rings

Unit–II
DIFFRACTION Fresnel's diffraction: Huygens-Fresnel's theory, Fresnel's assumptions, rectilinear propagation of light, diffraction at a straight edge, rectangular slit and diffraction at a circular aperture. Fraunhoffer diffraction: Single slit diffraction, double slit diffraction, plane transmission grating spectrum, dispersive power of grating, limit of resolution,

Rayleigh's criterion, resolving power of telescope and a grating.

Unit–III

POLARIZATION: Polarisation by reflection, refraction and scattering, Malus Law, Phenomenon of double refraction, Huygens's wave theory of double refraction (Normal and oblique incidence), Analysis of polarized Light. Nicol prism, Quarter wave plate and half wave plate, production and detection of (i) Plane polarized light (ii) Circularly polarized light and (iii) Elliptically polarized light. Optical activity, Fresnel's theory of optical rotation, Specific rotation, Polarimeters (half shade and Biquartz)

Unit–IV

LASERS: Basic concept of absorption and emission of radiations, amplification and population inversion; Main components of lasers: (i) Active Medium (ii) Pumping (iii) Optical Resonator; Properties of laser beam: Monochromaticity, Directionality, Intensity, Coherence (Spatial & Temporal coherence); Metastable state, Excitation mechanism and Types of Lasers (He-Ne Laser & Ruby Laser), Applications of Lasers.

FIBRE OPTICS: Optical fibres and their properties, Principal of light propagation through a optical fibre, Acceptance angle and numerical aperture, Types of optical fibres: Single mode and multimode fibres, Advantages and Disadvantages of optical fibres.

Practicals:

1. Refractive index and dispersive power of a prism material by spectrometer.
2. To draw a graph between wave length and minimum deviation for various lines from a Mercury discharge source.
3. Determination of wave length of Na light and the number of lines per centimetre using a diffraction grating.
4. Determination of wave length of sodium light using Newton's Rings
5. Resolving power of a telescope.
6. Comparison of Illuminating Powers by a Photometer.
7. Measurement of (a) Specific rotation (b) concentration of sugar solution using polarimeter.
8. Ordinary and extra ordinary refractive indices for calcite or quartz.
9. Resolving power of a prism.
10. Resolving power of a grating.

11 Wave length of Sodium light by Fresnel's biprism

12. To determine the dispersive power and Cauchy constants of the material of a prism using Mercury discharge source.
13. To study double sit interference by He-Ne laser.
14. Diameter of a thin wire by diffraction method (using He-Ne Laser).

Note: A student has to perform atleast eight (08) experiments from the above list.

Reference/Text Books Suggested:

1. Principles of Optics, M. Born and E. Wolf, Pergamaman Press
2. Optics by Ajoy Ghatak, 2008, Tata McGraw Hill
3. Fundamentals of Optics, Jenkins and White, McGraw Hill Book Co. Ltd., New Delhi
4. Optics, K.D. Muller, University Science Books, Mill ally California
5. A textbook of optics by N. Subrahmanyam and Brijlal, S. Chand & Company
6. Lasers and Non-Linear Optics, B.B. Laud, New Age International (P) Ltd., Publishers, New Delhi

7. Laser, Theory & Applications by K. Thyagarajan and A.K. Ghatak, Macmillan India limited
8. B.Sc. Practical Physics, C.L. Arora, S. Chand Publisher, New Delhi
9. Advanced Level Practical Physics, M. Nelkon and Ogborn, Henemann Education Books Ltd., New Delhi
10. Practical Physics, S.S. Srivastava and M.K. Gupta, Atma Ram & Sons, Delhi
11.Practical Physics, S.L. Gupta and V. Kumar, Pragati Prakashan Meerut
12. Modern Approach to Practical Physics, R.K. Singla, Modern Publishers, Jalandhar
13. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, Asia Publishing House

Semester -IV
Session: 2027-28

Name of Program	B.Sc. (Physical Sciences)	**Program Code**	UMPS4
Name of the Course	Thermodynamics and Statistical Mechanics	**Course Code**	25PHYM404DS01
Hours per Week	06(2+4)	**Credits**	04
Maximum Marks	Theory: 15+35 Practical: 50 Total: 100	**Time of Examinations**	Theory: 03 Hours Practicals: 03 Hours

Note:
Examiner will set nine questions of seven marks each and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing short answer type questions from all units. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each Unit. All questions will carry equal marks.

Course Learning Outcomes (CLO):
After completing this course, the learner will be able to:
CO1: Understand the process of thermal conductivity in gases.

CO2: Understand the basic statistical methods and concepts like probability, random variables, expected value, variance, estimators and common probability distributions.

CO3: Understand the relation between microscopic and macroscopic description through statistical mechanics; know and can apply the laws of thermodynamics and principles of free energy; describe thermodynamic processes and heat engines and master the use of the chemical potential to describe diffusive equilibrium, phase equilibrium and chemical processes.

CO4: Understand the efficiency of Carnot's engine and the significance of first law and second of thermodynamics and implications of the second law of thermodynamics and limitations placed by the second law on the performance of thermodynamic systems.

CO5: Ability to evaluate entropy changes in a wide range of processes and determine the reversibility or irreversibility of a process from such calculations.

CO6: Understand the interrelationship between thermodynamic functions and ability to use such relationships to solve practical problems.

Unit–I Thermodynamics-I: Second law of thermodynamics, Carnot theorem, Absolute scale of temperature, Absolute Zero, Entropy, show that dQ/T=O, T-S diagram Nernst heat law, Joule's free expansion, Joule Thomson (Porous plug) experiment. Joule - Thomson effect.

Unit–II Thermodynamics-II: Derivation of Clausius - Clapeyron latent heat equation. Phase diagram and triple point of a substance. Development of Maxwell thermodynamical relations. Application of Maxwell relations in the derivation of relations between entropy, specific heats and thermodynamic variables. Thermodynamic functions: Internal energy (U), Helmholtz function (F), Enthalpy (H), Gibbs-function (G) and the relations between them.

Unit–III Distribution of N (for N = 2, 3, 4) distinguishable and indistinguishable particles in two boxes of equal size, microstates and macrostates, thermodynamical probability, constraints and accessible states, statistical fluctuations, general distribution of distinguishable particles in compartments of different sizes, β-parameter, entropy and probability; Concept of phase space, division of phase space into cells, postulates of statistical mechanics; Classical and quantum statistics, basic approach to these statistics, Maxwell-Boltzmann statistics applied to an ideal gas in equilibrium-energy distribution law, Maxwell's distribution of speed & velocity (derivation required), most probable speed, average and r.m.s. speed, mean energy for Maxwellian distribution.

Unit–IV Dulong and Petit Law, derivation of Dulong and Petit law from classical physics; Need of Quantum statistics- classical versus quantum statistics, Bose-Einstein energy distribution Law, Application of B. E. Statistics to Planck‟s radiation law, degeneracy and B. E. condensation; Fermi-Dirac energy distribution Law, F. D. gas and degeneracy, Fermi energy and Fermi temperature; F. D. energy distribution Law for electron gas in metals, zero point energy, average speed (at 0 K) of electron gas

Practicals:

1. To determine the coefficient of thermal conductivity of copper by Searle's Apparatus.
2. E.C.E. of hydrogen using an Ammeter.
3. Thermal conductivity of a bad conductor by Lee's method.
4. Calibration of thermocouple by potentiometer.
5. To determine the coefficient of increase of volume of air at constant pressure.
6. To determine the coefficient of increase of pressure of air at constant volume.
7. Mechanical Equivalent of heat (J) by Joule's calorimeter.
8. Heating efficiency of electrical kettle with varying voltage.
9. To calibrate a thermocouple to measure temperature in a specified range using null method/direct measurement using an op-amp difference amplifier and to determine neutral temperature.
10. To prove the law of probability by using one coin, two coins and 10 or more coins.
11. Computer simulation of Maxwell-Boltzmann, Fermi-Dirac & Bose-Einstein distributions.
12. Study of statistical distribution from the given data and to find most probable, average, and rms value.

Note: A student has to perform atleast eight (08) experiments from the above list.

References:

1. Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
2. A Treatise on Heat, Meghnad Saha, and B.N. Srivastava, 1969, Indian Press.
3. Thermodynamics, Enrico Fermi, 1956, Courier Dover Publications.
4. Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W. Sears and G.L. Salinger. 1988, Narosa University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

5. Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House.
6. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi. 78
7. A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal, 1985, Vani Publication.
8. Thermal Physics and Statistical Mechanics, S.K. Roy, New Age International Publishers, New Delhi.
9. Thermodynamics and Statistical Physics, J.K. Sharma and K.K. Sarkar, Himalaya Publishing House, Bombay.
10. Introduction to Thermodynamics and its Applications, Stowe Keith, University Press (India) Pvt. Ltd, Hyderabad
11. Thermodynamics and Its Applications, Jefferson Tester, Michael Modell, 3rd Edition
12. Thermodynamics, Statistical Thermodynamics & Kinetics, Thomas Engel, Philip Reid, 2nd Edition 8. Advanced Practical Physics for students, B.L .Flint & H.T. Worsnop, 1971, Asia Publishing House.
13. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
14. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

Semester -V
Session: 2028-29

Name of Program	B.Sc. (Physical Sciences)	**Program Code**	UMPS4
Name of the Course	Quantum Mechanics and Nuclear Physics	**Course Code**	26PHYM405DS01
Hours per Week	06(2+4)	**Credits**	04
Maximum Marks	Theory: 15+35 Practical: 50 Total: 100	**Time of Examinations**	Theory: 03 Hours Practicals: 03 Hours

Note:
Examiner will set nine questions of seven marks each and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing short answer type questions from all units. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each Unit. All questions will carry equal marks.

Course Learning Outcomes (CLO):
After completing this course, the learner will be able to:
CLO 1: Understand the origins of quantum mechanics.
CLO 2: The main objective of this course is to make students aware about the basic formulations in quantum mechanics.
CLO 3: Understand and explain the differences between classical and quantum mechanics.

CLO 4: Understand the idea of wave function.
CLO 5: Understand the uncertainty relations.
CLO 6: Solve the Schrodinger equation for simple 1D time-independent potentials.
CLO 7: Understand the ideas of basics of nucleus and their energy.

Unit–I Failure of Classical E.M. Theory, quantum theory of radiation (old quantum theory), Photon, photoelectric effect and Einstein's photoelectric equation Compton effect (theory and result). Franck-Hertz experiment. Inadequacy of old quantum theory, de-Broglie hypothesis. Davisson and Germer experiment. Phase velocity group velocity, Heisenberg's uncertainty principle. Time-energy and angular momentum, position uncertainty. Uncertainty principle from de-Broglie wave, (wave-particle duality). Gamma Ray Microscope.

Unit–II Basic postulates and formalism: properties of Wave Function, Interpretation of Wave Function, Condition for physical acceptability of Wave Functions. Eigenvalues and Eigen functions, Probability current density, Expectation values of position and linear momentum. Time dependent and time independent Schrodinger equation, Mathematical consideration of Schrodinger equation: Normalization, Orthogonality, Observables. Application of Schrodinger equation in the solution of the following one-dimensional problems: (i) Free particle in one-dimensional box (solution of Schrodinger wave equation, eigen functions, eigen values, quantization of energy and momentum, nodes and anti-nodes, zero-point energy).

Unit–III Nuclear mass and binding energy, systematics nuclear binding energy, nuclear stability, nuclear size, spin, parity, statistics magnetic dipole moment, quadrupole moment (shape concept), Determination of charge by Mosley law Determination of size of nuclei by Rutherford Back Scattering. Interaction of heavy charged particles (Alpha particles), alpha disintegration and its theory Energy loss of heavy charged particle (idea of Bethe formula, no derivation), Energetics of alpha -decay, Range and straggling of alpha particles. Geiger-Nuttal law.

Unit–IV Introduction of light charged particle (Beta-particle), Origin of continuous beta-spectrum (neutrino hypothesis) types of beta decay and energetics of beta decay, Energy loss of beta-particles (ionization), Range of electrons, absorption of beta-particles. Interaction of Gamma Ray, Nature of gamma rays, Energetics of gamma rays, passage of Gamma radiations through matter (photoelectric, Compton and pair production effect) electron position anhelation. Absorption of Gamma rays (Mass attenuation coefficient) and its application. Nuclear Reactors General aspects of Reactor design. Nuclear fission and fusion reactors (Principles, construction, working and use). Ionization chamber, proportional counter, G.M. counter detailed study.

List of Experiments:

1. To determine value of Boltzmann constant using V-I characteristic of PN diode.
2. To determine work function of material of filament of directly heated vacuum diode.
3. To determine the ionization potential of mercury.
4. To determine value of Planck's constant using LEDs of at least 4 different colours.
5. To determine the wavelength of H-alpha emission line of Hydrogen atom.
6. Photo-electric effect: photo current versus intensity and wavelength of light;

maximum energy of photo-electrons versus frequency of light.

7. Measurement of Planck's constant using black body radiation and photo-detector
8. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.
9. To setup the Millikan oil drop apparatus and determine the charge of an electron.
10. To show the tunnelling effect in tunnel diode using I-V characteristics.
11. (a) Draw the plateau using G M counter
    (b) Determine the mass attenuation coefficient by G M counter.
12. Solve the s-wave Schrodinger equation for the ground state and the first excited state of the hydrogen atom using *Python/Fortran.*

Note: A student has to perform **atleast eight (08)** experiments from the above list.

Reference/Text Books Suggested:

1. Quantum Mechanics: Theory & Applications, A. K. Ghatak & S. Lokanathan, 2004, Macmillan.

2. Quantum Mechanics: Concepts and Applications, Nouredine Zettili, Wiley publications.

3. Advanced Quantum Mechanics, Satya Prakash, Kadar Nath Ram Nath publications.

4. Introduction to Quantum Mechanics, David J. Griffiths, Pearson publications.

5. Modern Quantum Mechanics, J. J. Sakurai, Pearson publications

6. Nuclear Physics, D C Tayal, Himalaya Publishing

7. Nuclear Physics- An Introduction, S B Patal, New Age International Publisher.

8. Quantum Physics, Berkeley Physics, Vol.4. E. H. Wichman, 1971, Tata McGraw-Hill Co.

9. Basic ideas and concepts in Nuclear Physics, K. Heyde, 3rd Edn., Institute of Physics Pub.

10. Nuclear Physics, S. N Ghosal, S. Chand Publications.

Semester -VI
Session: 2028-29

Name of Program	B.Sc. (Physical Sciences)	**Program Code**	UMPS4
Name of the Course	Solid State Physics and Electronic Devices	**Course Code**	26PHYM406DS01
Hours per Week	06(2+4)	**Credits**	04
Maximum Marks	Theory: 15+35 Practical: 50 Total: 100	**Time of Examinations**	Theory: 03 Hours Practicals: 03 Hours

Note:

Examiner will set nine questions of seven marks each and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing short answer type questions from all units. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each Unit. All questions will carry equal marks.

Course Learning Outcomes (CLO):

After completing this course, the learner will be able to:

CLO 1: understand and apply key concepts of crystalline and glassy materials, including Unit cell, primitive cell, Bravais lattices, Miller indices

CLO 2: appreciate the crystal structures of Zinc Sulphide, Sodium Chloride, and Diamond

CLO 3: understand the concept of reciprocal lattices, their physical significance, and apply Bragg's Law to interpret X-ray diffraction pattern

CLO 4: explain and apply Einstein's and Debye's theories to understand the specific heat of solids

CLO5: apply understanding of P-N junction diode, LED, photodiode, solar cells, and Zener diodes for designing electronic circuits such as rectifiers, voltage regulator, solar panel etc.

CLO6: able to design amplifier circuits using Bipolar junction transistors

Unit 1:

Crystalline and glassy forms, liquid crystals. Crystal structure, periodicity, lattice and basis, crystal translational vectors and axes, Unit cell and primitive cell, Winger Seitz primitive Cell, symmetry operations for a two-dimensional crystal, Bravais lattices in two and three dimensions, crystal planes and Miller indices, Interplanar spacing, Crystal structures of Zinc sulphide, Sodium Chloride and diamond

Unit 2:

Reciprocal lattice and its physical significance, reciprocal lattice vectors, reciprocal lattice to a simple cubic lattice, body centred cubic lattice and face centred cubic lattice; X-ray diffraction, Bragg's Law and experimental x-ray diffraction methods; Specific heat: Specific heat of solids, Einstein's theory of specific heat, Debye model of specific heat of solids.

Unit 3:

Energy bands in solids. Intrinsic and extrinsic semiconductor, Hall’s effect, P-N junction diode and its V-I characteristics, Resistance of a diode, Zener and avalanche breakdown, Light Emitting diodes (LED), Photo conduction in semiconductors, photodiode, Solar Cell, P-N junction half wave and full wave rectifier, passive filter circuits, Zener diode as voltage regulator, simple regulated power supply.

Unit 4:

Bipolar junction transistors: working of NPN and PNP transistors, Transistor connections (C-B, C-E, C-C mode), constants of transistor, Transistor characteristic curves advantage of C-B configuration, Transistor Amplifiers: Transistor biasing, methods of Transistor biasing and stabilization. D.C. load line, Common-base and common-emitter transistor biasing. Common-base, common, emitter amplifier, Classification of amplifiers, Resistance-capacitance (R-C) coupled amplifier, Feed-back in amplifier, advantage of negative feedback, Emitter follower.

Practicals:

1. To study resistivity of Ge crystal as a function of temperature and to find the band gap energy using Four Probe method
2. To study Hall’s effect in semiconductors and to find carrier type and concentration.
3. To draw forward and reverse bias characteristics of a semiconductor diode.
4. Zener Diode volage regulation characteristics.
5. Verification of Inverse square law by photocell.
6. To study the characteristics of a solar cell
7. Input and output characteristics of C-B Configuration of npn/pnp transistor
8. Input and output characteristics of C-E Configuration of npn/pnp transistor

9. Transistor as voltage Amplifier in C-B Configuration
10. Transistor as voltage Amplifier in C-E Configuration
11. To find Boltzmann constant using I-V characteristics of Ge and Si diodes.
12. Study of half and full wave rectifier using p-n junction diode.

Note: A student has to perform atleast eight (08) experiments from the above list.

References:

1. Introduction to Solid State Physics by Charles Kittel
2. Integrated Electronics by J. Millman and C.C. Halkias (Tata-McGraw Hill).
3. Electronic Devices and Circuit Theory by Robert L. Boylestad (Pearson).
4. Solid State Electronic Devices by Ben G. Streetman (PHI).

Semester-VII
Session: 2029-30

Name of Program	B.Sc. (Physical Sciences)	**Program Code**	UMPS4
Name of the Course	Mathematical Physics	**Course Code**	24PHY201DS01
Hours per Week	04 (1+3)	**Credits**	04
Maximum Marks	Theory: 30+70 Total: 100	**Time of Examinations**	03 Hours

Note:
Examiner will set nine questions of fourteen marks each and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing short answer type questions from all units. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each Unit. All questions will carry equal marks.

Course Learning Outcomes (CLO):

CLO1: The students would get sufficient exposure /understanding of the linear vector space and applications of matrices to physical problems

CO2: The students would be able to solve problems based on differential equations

CO3: The analysis of special functions would equip a student for effective tackling of specific problems.

CO4: The students would be able to realize various applications with proper understanding of series expansion and integral transforms

Unit 1: Vector spaces, Norm of a Vector, Linear independence & dependence, Basis and dimension, Isomorphism of Vector spaces, Scalar/Inner product of vectors, Orthonormal basis, Gram-Schmidt Orthogonalization process, Linear operators, Matrices, Cayley-Hamiltion Theorem, Inverse of matrix, Orthogonal, Unitary and Hermitian matrices, Eigenvalues and eigenvectors of matrices, Similarity transformation, Matrix diagonalization, Simultaneous diagonalization and commutativity

Unit 2: Second order linear differential equation with variable coefficients, Ordinary point, Singular point, Series solution around an ordinary point, Series solution around a regular singular point; the method of Frobenius, Wronskin and getting a second solution, Solution of Legendre's equation, Solution of Bessel's equation, Solutions of Laguerre and Hermite's equations

Unit 3: Special functions, Generating functions for Bessel function of integral order $J_n(x)$, Recurrence relations, Integral representation; Legendre polynomials $P_n(x)$, Generating functions for $P_n(x)$, Recurrence relations, orthogonality, Rodrigue's Relation; Hermite Polynomials; Generating functions, Rodrigue's relation &orthogonality for Hermite polynomials; Laguerre polynomials; Generating function and Recurrence relations, Orthogonality, Rodrigue's Relation, The Gamma Function, The Dirac – Delta Function

Unit 4: Integral transform, Laplace transform, Properties of Laplace transforms such as first and second shifting property, Laplace Transform of Periodic Functions, Laplace transform of derivatives, Laplace Transform of integrals, Inverse Laplace Transform by partial fractions method, Fourier series, Evaluation of coefficients of Fourier series Cosine and Sine series, Applications of Fourier Series, Fourier Transforms, Fourier sine Transforms, Fourier cosine Transforms, Fourier transform of derivatives, Applications of Fourier Transforms

References:

1. Mathematical Physics by P.K. Chattopadhyay (T)
2. Mathematical Physics by B. S. Rajput
3. Matrices and Tensors for Physicists, by A. W Joshi
4. Mathematical Physics by Mathews and Walkers
5. Mathematics for Physicists by Mary L Boas

Semester-VII
Session: 2029-30

Name of Program	B.Sc. (Physical Sciences)	**Program Code**	UMPS4
Name of the Course	Classical Mechanics	**Course Code**	24PHY201DS02
Hours per Week	04 (1+3)	**Credits**	04
Maximum Marks	Theory: 30+70 Total: 100	**Time of Examinations**	03 Hours

Note: Examiner will set nine questions of fourteen marks each and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing short answer type questions from all units. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each Unit. All questions will carry equal marks.

Course Learning Outcomes (CLO):

CLO1: Student would be able to describe and understand the motion of a mechanical system using Lagrange and Hamilton formalisms.

CLO2: Students would become able to understand the concepts of central force motion and moving co-ordinate systems.

CLO3: Student would get basic ideas about the theory of small oscillations and use of Poisson's bracket which will lead to understand the concepts of quantum mechanics.

Unit 1: Survey of Elementary Principles and Lagrangian Formulation: Newtonian mechanics of one and many particle systems, Conservation laws, Constraints and their classification, Generalized coordinates and momenta, Principle of virtual work, D' Alembert's principle and Lagrange's equation, Velocity dependent potentials and dissipation function, Simple applications of Lagrangian formulation, Cyclic coordinates, Symmetries of space and time and conservation laws, Invariance of Lagrangian under Galilean transformation

Unit 2: Moving coordinate systems and Motion in a central force field: Rotating frames, inertial forces, terrestrial applications of Coriolis force, two body problem: Reduction to equivalent one body problem, Central force definition and characteristics, the equation of motion and first integrals, differential equation for the orbit, general analysis of orbits,

condition for closure and stability of circular orbits, Kepler's laws and equations, Rutherford scattering.
Unit 3: Legendre Transformation and Hamilton's equations of motion, Some techniques of calculus of variation, Variational principle, Hamilton's principle from D'Alembert's principle, Lagrange's equation from Hamilton's principle, Hamilton's equations from variational principle, variation and end points, Principle of least action and its forms, Hamilton-Jacobi equation and their solutions, Use of Hamilton-Jacobi method for the solution of Harmonic oscillator problem, Hamilton's principle function, Hamilton's characteristic function and their properties
Unit 4: Canonical transformations, Generating functions, Properties of Poisson bracket, Equation of motion in Poisson bracket, Angular momentum and Poisson bracket relations, Jacobi identity, Invariance of Poisson brackets using canonical transformations, Potential Energy and equilibrium: Stable, unstable and neutral equilibrium, One-dimensional Oscillator, Two coupled oscillators: Solution of differential equation to find normal coordinates and normal modes, Theory of small oscillations, Examples of coupled oscillators: Two coupled pendulum, double pendulum, Free vibrations of a linear triatomic molecule.
References: 1. Classical Mechanics by N C Rana and P S Joag (Tata McGraw Hill, 1991) 2. Classical Mechanics by H Goldstein (Addison Wesley, 1980) 3. Mechanics by A. Sommerfeld (Academic Press, 1952) 4. Introduction to Dynamics by I Perceival and D Richards (Cambridge Univ. Press, 1982)

Semester-VII
Session: 2029-30

Name of Program	B.Sc. (Physical Sciences)	**Program Code**	UMPS4
Name of the Course	Quantum Mechanics –I	**Course Code**	24PHY201DS03
Hours per Week	04 (1+3)	**Credits**	04
Maximum Marks	Theory: 30+70 Total: 100	**Time of Examinations**	03 Hours
Note: Examiner will set nine questions of fourteen marks each and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing short answer type questions from all units. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each Unit. All questions will carry equal marks.			
Course Learning Outcomes (CLO): CLO1: Student would be able to understand the concepts of operators in Quantum mechanics. CLO2: Students would be able to apply Pauli spin matrices to explain angular momentum. CLO3: Students would be capable to solve problems such as hydrogen atom. CLO4: Students can determine energies and wave functions of first and second order.			
Unit 1: General formalism of Quantum Mechanics: States and operators; Representation of States and dynamical variables; Linear vector space; Bra Ket notation, Linear operators; Orthonormal set of vectors, Completeness relation; Hermitian operators, their eigenvalues and eigenvectors, The fundamental commutation relation; Commutation rule and the uncertainty relation; Simultaneous eigenstates of commuting operators; The unitary transformation; Dirac delta function; Relation between kets and wave functions; Matrix representation of operators; Solution of linear harmonic oscillator problem by operator methods			

Unit 2: Angular momentum operator: Angular momentum operators and their representation in spherical polar co-ordinates; Eigenvalues and eigenvectors of L^2, spherical harmonics; Commutation relations among L_x L_y L_z; Rotational symmetry and conservation of angular momentum; Eigenvalues of J^2 and J_z and their matrix representation; Pauli spin matrices; Addition of angular momentum
Unit 3: Solution of Schrodinger equation for three dimensional problems: The three-dimensional harmonic oscillator in both Cartesian and spherical polar coordinates, Eigen values, Eigen functions and the degeneracy of the states; Solution of the hydrogen atom problem, the eigenvalues, Eigen functions and the degeneracy
Unit 4: Perturbation Theory: Time independent perturbation theory; Non degenerate case, the energies and wave functions in first order the energy in second order; Anharmonic perturbations of the form λx^3 and λx^4; Degenerate perturbation theory; Stark effect of the first excited state of hydrogen.
References: 1. Quantum Mechanics by Ghatak and Loknathan 2. Quantum Mechanics by Powell and Craseman 3. Quantum Mechanics by S. Gasiorowicz 4. Quantum Mechanics by A.P. Messiah 5. Modern Quantum Mechanics by J.J. Sakurai 6. Quantum Mechanics by L.I. Schiff 7. Quantum Mechanics by Mathews and Venkatesan

Semester-VII
Session: 2029-30

Name of Program	B.Sc. (Physical Sciences)	**Program Code**	UMPS4
Name of the Course	Physics of Electronic Devices	**Course Code**	24PHY201DS04
Hours per Week	04 (1+3)	**Credits**	04
Maximum Marks	Theory: 30+70 Total: 100	**Time of Examinations**	03 Hours

Note: Examiner will set nine questions of fourteen marks each and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing short answer type questions from all units. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each Unit. All questions will carry equal marks.
Course Learning Outcomes (CLO): CLO1: Students would get familiarity with semiconductor materials and charge transport in semiconductors CLO2: Students would be able to appreciate the functioning and applications of various optoelectronic and memory devices. CLO3: Students would be able to explain the basic physics and application of different transistor types. CLO4: Students having familiarization with negative resistance devices and will be in a position to design switching circuits involving these devices.
Unit 1: Charge carriers in semiconductors: Energy bands, metals, Semiconductors and insulators, Direct and indirect band gap semiconductors, Variation of energy bands with alloy composition, Electrons and holes, effective mass, Intrinsic and extrinsic semiconductors,

Concept of Fermi level, Electron and hole concentration at equilibrium, Temperature dependence of carrier concentrations, Compensation and space charge neutrality, Conductivity and mobility, Effect of temperature and doping on mobility, Hall effect, Invariance of Fermi level
Unit 2: Carrier transport in semiconductors: Optical absorption and luminescence, Carrier lifetime and photoconductivity, Direct/indirect recombination of electrons and holes, Traps and defects, Steady state carrier generation, Quasi Fermi levels, Diffusion and drift of carriers, Diffusion and recombination, Diffusion length, Haynes Shockley experiment, Gradient in quasi-Fermi level, External and internal photoelectric effect
Unit 3: Diode physics and optoelectronic devices: P-N junction diode: Basic structure, Energy band diagram, Built-in potential, Electric field, Space charge width and qualitative description of current flow, Derivation of diode current equation, Zener diode: breakdown mechanisms, Voltage regulator circuit, Power diode, Varactor diode, Optoelectronic devices: Vacuum photodiode, Photo-multipliers tube, P-N junction photodiode, Pin photodiode, Avalanche photodiode, Phototransistor, Solar cell, Light emitting diode (LED), Diode laser: Condition for laser action and optical gain
Unit 4: Transistors: Bipolar junction transistor (BJT), Transistor operating modes, Transistor action, Transistor biasing configurations and characteristics, Field effect transistors: Junction field effect transistor (JFET), Metal oxide semiconductor field effect transistor (MOSFET), Negative resistance devices: Tunnel diode, Backward diode, Uni-junction transistor, p-n-p-n devices and their characteristics, Silicon controlled rectifier and switch and their characteristics.
References: 1. Semiconductor Devices - Physics and Technology by S.M. Sze (Wiley). 2. Solid State Electronic Devices by Ben G. Streetman (PHI). 3. Semiconductor Physics and Devices by Donald A Neamen (Tata-McGraw Hill). 4. Integrated Electronics by J. Millman and C.C. Halkias (Tata-McGraw Hill). 5. Semiconductor Devices by Kanaan Kano (PHI). 6. Semiconductor Optoelectronic Devices by Pallab Bhattacharya (Pearson) 7. Semiconductor Device Fundamentals by Robert F Pierret (Addison-Wesley). 8. Electronic Devices and Circuit Theory by Robert L. Boylestad (Pearson).

Semester-VII
Session: 2029-30

Name of Program	B.Sc. (Physical Sciences)	**Program Code**	UMPS4
Name of the Course	Practical: General Physics -I	**Course Code**	24PHY201DS05
Hours per Week	08	**Credits**	04
Maximum Marks	Practical: 100 Total: 100 (30+70)	**Time of Examinations**	03 Hours

Note: Out of the list of experiments given below one experiment will be allotted through lottery method to each student on the day of examination to perform and then followed by Viva-voce.

Course Learning Outcomes (CLO):

CLO1: Students would be able to determine the values of Stefan's constant, Boltzmann constant and e/m ratio of electron and experimental errors in each case.

CLO2: Students would be able to understand magnetization and related aspects in a ferromagnetic material.

CLO3: Students get familiarized with advanced spectroscopy.

CLO4: Students would be able to understand the different harmonics and their amplitudes in a Fourier series experimentally which provide direct connect between theory and experiment.

List of Experiments

1. To determine the dielectric constant of polar and non-polar liquids
2. To determine the Magnetic susceptibility of a solid sample.
3. To study B-H curve of a given ferrite sample and find energy loss in case of ferrite Core.
4. Stefan's constant by the black copper radiation plates (Electrical Method).
5. To determine the heat capacity of solids
6. To verify the existence of different harmonics and measure their relative amplitudes using Fourier Analysis kit
7. To study of dielectric constant as a function of temperature and determine the Curie temperature
8. To determine the dielectric constant of different solid samples
9. Study of lead tin phase diagram
10. To determine Boltzmann Constant (k) using I-V characteristics of Si/Ge P-N junction diode
11. Dissociation Energy of I_2 molecule
12. Measurement of minority carrier life time using Haynes Shockley experiment

Note: Out of the list as above, a student has to perform atleast 08 (eight) practicals in the semester

Semester-VIII
Session: 2029-30

Name of Program	B.Sc. (Physical Sciences)	**Program Code**	UMPS4
Name of the Course	Statistical Mechanics	**Course Code**	24PHY202DS01
Hours per Week	04 (1+3)	**Credits**	04
Maximum Marks	Theory: 30+70	**Time of**	03 Hours

	Total: 100	**Examinations**	

Note:
Examiner will set nine questions of fourteen marks each and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing short answer type questions from all units. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each Unit. All questions will carry equal marks.

Course Learning Outcomes (CLO):

CLO1 The students are able to appreciate cellular nature of phase space and interface of Statistical Mechanics with Thermodynamics

CLO2 Knowledge of ensemble theory would result in greater insight into solutions of various complex problems

CLO3 The students would be able to analyse the peculiar gas behaviour and are in a position to extend the treatment to complex problems

CLO4 The students would be equipped to explore the applications of Ising Model and to understand different approximations.

Unit 1: Phase space, Ensembles, Liouville theorem, conservation of extension, Equation of motion, Equal a priori probability, Statistical equilibrium, Micro-canonical ensemble, Quantization of phase space, classical limit, symmetry of wave functions effect of symmetry on counting, Various distributions using micro canonical ensemble Entropy of an ideal gas, Equilibrium Conditions, Quasi – Static Process, Entropy of an ideal gas using Micro-canonical Ensemble, Gibbs paradox, Sackur-Tetrode equation, Probability distribution and entropy of a two level system.

Unit 2: Entropy of a system in contact with a reservoir, Canonical ensemble, Ideal gas in a canonical ensemble, Equipartition of energy, Third law of thermodynamics, Photons, Grand canonical ensemble, Ideal gas in Grand Canonical ensemble, Comparison of various ensembles, Quantum distribution using other ensembles

Unit 3: Transition from classical statistical mechanics to quantum statistical mechanics, Indistinguishability and quantum statistics, identical particles and symmetry requirements, Bose Einstein statistics, Fermi Dirac statistics, Maxwell Boltzmann statistics. Bose Einstein Condensation, Thermal properties of B.E. gas, liquid Helium, Energy and pressure of F-D gas, Electrons in metals, Thermionic Emission, Saha Theory of Thermal Ionization

Unit 4: Cluster expansion for a classical gas, Virial equation of state, Van der Waals gas, Phase transition of second kind, Ising Model, Bragg Williams Approximation, Ising Model in one and two dimensions, fluctuations in ensembles, Energy fluctuation in quantum statistics, Concentration fluctuation in quantum statistics, One dimensional random walk, Brownian motion.

References:

1. Statistical Mechanics by K. Huang
2. Statistical Mechanics by B.K. Aggarwal and M. Eisner
3. Statistical Mechanics by R.K. Patharia
4. Statistical Mechanics by Donald A McQuarrie
5. Statistical Mechanics by Avijit Lahiri
6. Statistical Mechanics R Kubo

Semester-VIII
Session: 2029-30

Name of Program	B.Sc. (Physical Sciences)	**Program Code**	UMPS4
Name of the Course	Quantum Mechanics	**Course Code**	24PHY202DS02

	–II		
Hours per Week	04 (1+3)	**Credits**	04
Maximum Marks	Theory: 30+70 Total: 100	**Time of Examinations**	03 Hours

Note:
Examiner will set nine questions of fourteen marks each and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing short answer type questions from all units. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each Unit. All questions will carry equal marks.

Course Learning Outcomes (CLO):
CLO1: Students would be able to explain ground state of hydrogen and helium molecules.
CLO2: Students get enabled to analyse various transitions and their selection rules.
CLO3: Students would be capable to understand 3D collisions.
CLO4: Students would be capable to calculate spin states of identical particles.

Unit 1: Variational methods: Ground state of Helium by both variational and perturbation methods; The hydrogen molecule; WKB approximation; Time dependent perturbation theory; Constant perturbation; Harmonic perturbation; Fermi's golden rule; Adiabatic and sudden approximation.

Unit 2: Semi-classical theory of radiation: Transition probability for absorption and induced emission; Electric dipole transition and selection rules; Magnetic dipole transitions; Forbidden transitions; Higher order transitions; Einstein's coefficients.

Unit 3: Collision in 3D and scattering: Laboratory and C.M. reference frames; scattering amplitude; Differential scattering cross section and total scattering cross section; The optical theorem; Scattering by spherically symmetric potentials; Partial waves and phase shifts; Scattering by a perfectly rigid sphere and by square well potential; Complex potential and absorption; The Born approximation.

Unit 4: Identical particles: The principle of indistinguishability; Symmetric and antisymmetric wave functions; Spin and statistics of identical particles; The Slater determinant; The Pauli exclusion principle; Spin states of a two-electron system; States of the helium atom; Collision of identical particles.

References:

1. Quantum Mechanics by Ghatak and Loknathan
2. Quantum Mechanics by Powell and Crassman
3. Quantum Mechanics by S. Gasiorowicz
4. Quantum Mechanics by A.P. Messiah
5. Modern Quantum Mechanics by J.J. Sakurai
6. Quantum Mechanics by L.I. Schiff
7. Quantum Mechanics by Mathews and Venkatensan.

Semester-VIII (OPTION-1) (4 Year UG Hons.)
Session: 2029-30

Name of Program	B.Sc. (Physical Sciences)	**Program Code**	UMPS4
Name of the Course	Atomic and Molecular Physics	**Course Code**	24PHY202DS03
Hours per Week	04 (1+3)	**Credits**	04
Maximum Marks	Theory: 30+70 Total: 100	**Time of Examinations**	03 Hours

Note:

Examiner will set nine questions of fourteen marks each and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing short answer type questions from all units. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each Unit. All questions will carry equal marks.

Course Learning Outcomes (CLO):

CLO1: Atomic spectra of one and two electron atoms.
CLO2: The change in behaviour of atoms in external applied electric and magnetic field.
CLO3: Diatomic molecules and their rotational vibrational and rotational vibrational spectra.
CLO4: Energy levels and spectrum in diatomic molecules

Unit 1: One Electron systems and Pauli principle: Quantum states of one electron atoms, atomic orbitals, Hydrogen spectrum, Pauli principle, spectra of alkali elements, spin orbit interaction and fine structure in alkali spectra, Spectra of two electron systems, equivalent and non-equivalent electrons

Unit 2: The influence of external fields, Two electron system Hyperfine structure and Line broadening: Normal and anomalous Zeeman effect, Paschen Back effect, Stark effect, Two electron systems, interaction energy in LS and JJ coupling, Hyperfine structure (magnetic and electric, only qualitative)

Unit 3: Diatomic molecules and their rotational spectra: Types of molecules, Diatomic linear symmetric top, asymmetric top and spherical top molecules, Rotational spectra of diatomic molecules as a rigid rotator, energy levels and spectra of non-rigid rotor, intensity of rotational lines

Unit 4: Vibrational and Rotational Vibration spectra of Diatomic molecules: Vibrational energy of diatomic molecule, Diatomic molecules as a simple harmonic oscillator, Energy levels and spectrum, Morse potential energy curve, Molecules as vibrating rotator, vibration spectrum of diatomic molecules, PQR Branches

References:

1. Introduction to Atomic and Molecular Spectroscopy by V.K. Jain
2. Introduction to Atomic spectra by H.E. White
3. Fundamentals of molecular spectroscopy by C.B. Banwell
4. Spectroscopy Vol I and II by Walker and Straughen
5. Introduction to Molecular spectroscopy by G. M. Barrow
6. Spectra of diatomic molecules by Herzberg
7. Molecular spectroscopy by Jeanne. L. McHale
8. Molecular spectroscopy by J.M. Brown
9. Spectra of atoms and molecules by P. F. Bemath
10. Modern spectroscopy by J.M. Holias

Semester-VIII (OPTION-1) (4 Year UG Hons.)
Session: 2029-30

Name of Program	B.Sc. (Physical Sciences)	**Program Code**	UMPS4
Name of the Course	Solid State Physics	**Course Code**	24PHY202DS04
Hours per Week	04 (1+3)	**Credits**	04
Maximum Marks	Theory: 30+70 Total: 100	**Time of Examinations**	03 Hours

Note:

Examiner will set nine questions of fourteen marks each and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing short answer type questions from all units. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each Unit. All questions will carry equal marks.

Course Learning Outcomes (CLO):

CLO1: Differentiate between different lattice types and explain the concept of reciprocal lattice and crystal diffraction using X-rays

CLO2: Explain motion of electron in periodic lattice of solids under different binding conditions, concept of energy band and effect of same on electrical properties.

CLO3: Lattice vibrations in solids and identity different types of defects in crystals

CLO4: Explain various types of magnetic phenomena, superconductivity, Physics behind them and their possible applications.

Unit 1: Crystalline solids, Lattice, The basis, Lattice translation vectors, Direct lattice, Two and three dimensional Bravais lattice, Conventional units cells of FCC, BCC, NaCl, CsCl, Diamond and cubic ZnS, Primitive lattice cell of FCC, BCC and HCP, Packing fraction: Simple Cubic, BCC, FCC, HCP and diamond structures, Interaction of x-rays with matter, Absorption of x-rays, elastic scattering from a perfect lattice, The reciprocal lattice and its application to diffraction techniques, Ewald's construction, The Laue, Powder and rotating crystal methods, Atomic form factor, Crystal structure factor and intensity of diffraction maxima, Crystal structure factors of BCC, FCC, monatomic diamond lattice, polyatomic CuZn.

Unit 2: Vibration of one-dimensional mono and diatomic chains, Phonon momentum, Density of normal modes in one and three dimensions, Quantization of lattice vibrations, Measurement of phonon dispersion using inelastic neutron scattering, Point defects, Line defects and planer (stacking) faults, Fundamental ideas of the role of dislocation in plastic deformation and crystal growth, Observation of imperfection in crystals, X-rays and electron microscopic techniques.

Unit 3: Electron in periodic lattice, Block theorem, Kronig-Penny model and band theory, Classification of solids, Effective mass, Weak-binding method and its application to linear lattice, Tight-binding method and its application to Simple cubic, BCC and FCC crystals, Concepts of holes, Fermi surface: Construction of Fermi surface in two-dimension, de Hass van Alfen effect, Cyclotron resonance, Magneto-resistance.

Unit 4: Weiss Theory of Ferromagnetism Heisenberg model and molecular field theory of ferromagnetism of spin waves and Magnons, Curie-Weiss law for susceptibility. Ferri and Anti Ferro-magnetic order, Domains and Block wall energy, Occurrence of superconductivity, Meissner effect, Type-I and Type-II superconductors, Heat capacity, Energy gap, Isotope effect, London equation, Coherence length, Postulates of BCS theory of superconductivity, BCS ground state, Persistent current. High temperature oxide super conductors (introduction and discovery).

References:

1. Verma and Srivastava: Crystallography for Solid State Physics
2. Azaroff: Introduction to Solids
3. Omar: Elementary Solid-State Physics
4. Ashcroft & Mermin: Solid State Physics
5. Kittel: Solid State Physics
6. Chaikin and Lubensky: Principles of Condensed Matter Physics
7. H. M. Rosenberg: The solid State.

Semester-VIII (OPTION-I) (4 Year UG Hons.)
Session: 2029-30

Name of Program	B.Sc. (Physical	**Program Code**	UMPS4

	Sciences)		
Name of the Course	Practical: General Physics -II	**Course Code**	24PHY202DS05
Hours per Week	08	**Credits**	04
Maximum Marks	Practical: 100 Total: 100 (30+70)	**Time of Examinations**	03 Hours

Note: Out of the list of experiments given below one experiment will be allotted through lottery method to each student on the day of examination to perform and then followed by Viva-voce.

Course Learning Outcomes (CLO):

CLO1: Students would be able to determine the values of Ionization potential of Hg, Planks and e/m ratio of electron and experimental errors in each case.

CLO2: Students would be able determine band gap energy of semiconductor crystals

CLO3: Students get familiarized with LEDs

CLO4: Students would be able to understand the working of p-n junction solar cells

CLO5: Students will be able to measure dielectric constant of ferroelectric solids and their ferroelectric transition temperature.

List of Experiments

1. Determination of ionization potential of mercury
2. Determination of e/m of electron by helical method
3. To study of dielectric constant as a function of temperature and determine the Curie temperature
4. To determine Planck's Constant (h) by measuring the voltage drop across light-emitting diodes (LEDs) of different colours
5. To determine the value of energy levels using Frank-Hertz experiment
6. Characteristics of Phototransistor
7. To calibrate a prism spectrometer with mercury lamp and hence to find the Cauchy's constants
8. To determine refractive indices of liquids, transparent and translucent solutions and solids using Abbe-refractometer
9. To study the velocity of sound and its variation with temperature using Ultrasonic interferometer.
10. To study the characteristics (illumination, I-V, Power-load, Areal and Spectral characteristics) of a Solar cell
11. To Measure the resistivity of Ge crystal using four probe method at different temperatures and hence find the band gap

Note: Out of the list as above, a student has to perform atleast 08 (eight) practicals in the semester

Semester-VIII (OPTION-II) (4 Year UG Hons. With Research)
Session: 2029-30

Name of Program	B.Sc. (Physical Sciences)	**Program Code**	UMPS4
Name of the Course	Quantum Mechanics –II	**Course Code**	24PHY202DS02
Hours per Week	04 (1+3)	**Credits**	04
Maximum Marks	Theory: 30+70 Total: 100	**Time of Examinations**	03 Hours
Note:			

Examiner will set nine questions of fourteen marks each and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing short answer type questions from all units. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each Unit. All questions will carry equal marks.
Course Learning Outcomes (CLO): CLO1: Students would be able to explain ground state of hydrogen and helium molecules. CLO2: Students get enabled to analyse various transitions and their selection rules. CLO3: Students would be capable to understand 3D collisions. CLO4: Students would be capable to calculate spin states of identical particles.
Unit 1: Variational methods: Ground state of Helium by both variational and perturbation methods; The hydrogen molecule; WKB approximation; Time dependent perturbation theory; Constant perturbation; Harmonic perturbation; Fermi's golden rule; Adiabatic and sudden approximation.
Unit 2: Semi-classical theory of radiation: Transition probability for absorption and induced emission; Electric dipole transition and selection rules; Magnetic dipole transitions; Forbidden transitions; Higher order transitions; Einstein's coefficients.
Unit 3: Collision in 3D and scattering: Laboratory and C.M. reference frames; scattering amplitude; Differential scattering cross section and total scattering cross section; The optical theorem; Scattering by spherically symmetric potentials; Partial waves and phase shifts; Scattering by a perfectly rigid sphere and by square well potential; Complex potential and absorption; The Born approximation.
Unit 4: Identical particles: The principle of indistinguishability; Symmetric and antisymmetric wave functions; Spin and statistics of identical particles; The Slater determinant; The Pauli exclusion principle; Spin states of a two-electron system; States of the helium atom; Collision of identical particles.
References: 1. Quantum Mechanics by Ghatak and Loknathan 2. Quantum Mechanics by Powell and Crassman 3. Quantum Mechanics by S. Gasiorowicz 4. Quantum Mechanics by A.P. Messiah 5. Modern Quantum Mechanics by J.J. Sakurai 6. Quantum Mechanics by L.I. Schiff 7. Quantum Mechanics by Mathews and Venkatensan.

Semester-VIII (OPTION-II) (4 Year UG Hons. With Research)
Session: 2029-30

Name of Program	B.Sc. (Physical Sciences)	**Program Code**	UMPS4
Name of the Course	Solid State Physics	**Course Code**	24PHY202DS04
Hours per Week	04 (1+3)	**Credits**	04
Maximum Marks	Theory: 30+70 Total: 100	**Time of Examinations**	03 Hours
Note: Examiner will set nine questions of fourteen marks each and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing short answer type questions from all units. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each Unit. All questions will carry equal marks.			
Course Learning Outcomes (CLO):			

CLO1: Differentiate between different lattice types and explain the concept of reciprocal lattice and crystal diffraction using X-rays

CLO2: Explain motion of electron in periodic lattice of solids under different binding conditions, concept of energy band and effect of same on electrical properties.

CLO3: Lattice vibrations in solids and identity different types of defects in crystals

CLO4: Explain various types of magnetic phenomena, superconductivity, Physics behind them and their possible applications.

Unit 1: Crystalline solids, Lattice, The basis, Lattice translation vectors, Direct lattice, Two and three dimensional Bravais lattice, Conventional units cells of FCC, BCC, NaCl, CsCl, Diamond and cubic ZnS, Primitive lattice cell of FCC, BCC and HCP, Packing fraction: Simple Cubic, BCC, FCC, HCP and diamond structures, Interaction of x-rays with matter, Absorption of x-rays, elastic scattering from a perfect lattice, The reciprocal lattice and its application to diffraction techniques, Ewald's construction, The Laue, Powder and rotating crystal methods, Atomic form factor, Crystal structure factor and intensity of diffraction maxima, Crystal structure factors of BCC, FCC, monatomic diamond lattice, polyatomic CuZn.

Unit 2: Vibration of one-dimensional mono and diatomic chains, Phonon momentum, Density of normal modes in one and three dimensions, Quantization of lattice vibrations, Measurement of phonon dispersion using inelastic neutron scattering, Point defects, Line defects and planer (stacking) faults, Fundamental ideas of the role of dislocation in plastic deformation and crystal growth, Observation of imperfection in crystals, X-rays and electron microscopic techniques.

Unit 3: Electron in periodic lattice, Block theorem, Kronig-Penny model and band theory, Classification of solids, Effective mass, Weak-binding method and its application to linear lattice, Tight-binding method and its application to Simple cubic, BCC and FCC crystals, Concepts of holes, Fermi surface: Construction of Fermi surface in two-dimension, de Hass van Alfen effect, Cyclotron resonance, Magneto-resistance.

Unit 4: Weiss Theory of Ferromagnetism Heisenberg model and molecular field theory of ferromagnetism of spin waves and Magnons, Curie-Weiss law for susceptibility. Ferri and Anti Ferro-magnetic order, Domains and Block wall energy, Occurrence of superconductivity, Meissner effect, Type-I and Type-II superconductors, Heat capacity, Energy gap, Isotope effect, London equation, Coherence length, Postulates of BCS theory of superconductivity, BCS ground state, Persistent current. High temperature oxide super conductors (introduction and discovery).

References:

1. Verma and Srivastava: Crystallography for Solid State Physics
2. Azaroff: Introduction to Solids
3. Omar: Elementary Solid-State Physics
4. Ashcroft & Mermin: Solid State Physics
5. Kittel: Solid State Physics
6. Chaikin and Lubensky: Principles of Condensed Matter Physics
7. H. M. Rosenberg: The solid State.

B.Sc. (Physics) Semester VIII

Research Project/Dissertation (27PHY408PD01)

Max Marks: 300
Credits: 12

Rules

Distribution/allotment of students to be done at the Department/College level. Dissertation work will be based on a research work or completion of experimental techniques or compilation of thematic research studies. The structure of the Dissertation could be as follows:

Sr. No	Structure of Dissertation
1.	Acknowledgement
2.	Certificate of supervisor
3.	Introduction
4.	Review of Literature
5.	Materials & Methods / Theoretical Background
6.	Results and Discussion
7.	Summary
8.	References

Last date of dissertation submission, fee, plagiarism policy, etc. will be as per university guidelines. Evaluation of Project work will be performed by an external examiner (From the panel approved by UGBOS) and an internal examiner (Supervisor/Guide). The bifurcation of the marks will be as follows:

Examiner	Components	Marks

External	Dissertation	90
	Presentation	60
	Viva-voce	60
Internal	Dissertation & overall assessment	90
Total Marks		**300**

Three hard bound copies and one soft bound copy of the dissertation will be prepared (one copy for the departmental/college record, one copy for the guide/supervisor, one copy for the student and a soft bound copy for the library. Any patent /IPR based on experimental work will be in the name of student/s and guide/supervisor as an inventor. A publication based on dissertation work should be with the consent of guide only.