

Revised Syllabi and S.O.E. for B.Sc. (Physics)

REVISED SYLLABI AND SCHEME OF EXAMINATIONS FOR DISCIPLINE SPECIFIC COURSES B.Sc. (Physics)

(Based on Curriculum and Credit Framework and **Formative Assessment**
guidelines for UG Programs under NEP 2020)



MAHARSHI DAYANAND UNIVERSITY
ROHTAK (HARYANA)

To be applicable on the students w.e.f. session 2024-25 (3rd Semester onwards) and on the students w.e.f. session 2025-26 (1st semester onwards)

Revised Syllabi and S.O.E. for B.Sc. (Physics)
Credit Structure for Undergraduate Programmes (Single Major)

Semester	Discipline-Specific Courses (DSC) / Major Course	Minor (MIC)/ Vocational (VOC)/ Skill Enhancement Courses (SEC)/ Internship	Multidisciplinary courses (MDC)	Ability Enhancement courses (AEC)	Dissertation	Value-Added Courses (VAC)	Total Credits
I	DSC - A1 @ 4 credits	MIC1 @ 4 credits	MDC1 @ 3 credits	AEC1 @ 2 credits	-----	VAC1 @ 2 credits	22
	DSC - A2 @ 4 credits	SEC1@ 3 credits					
II	DSC - A3 @ 4 credits	MIC2 @ 4 credits	MDC2 @ 3 credits	AEC2 @ 2 credits	-----	VAC2 @ 2 credits	22
	DSC - A4 @ 4 credits	SEC2@ 3 credits					
Students exiting the programme after second semester and securing 48 credits including 4 credits of summer internship will be awarded UG Certificate in the relevant Discipline/Subject							
III	DSC - A5 @ 4 credits	MIC3 @ 4 credits	MDC3 @ 3 credits	AEC3 @ 2 credits		VAC3 @ 2 credits	22
	DSC - A6 @ 4 credits	SEC3@ 3 credits					
IV	DSC - A7 @ 4 credits	MIC4(VOC)@ 4 credits	-----	AEC4 @ 2 credits	-----	VAC4 @ 2 credits	24
	DSC - A8 @ 4 credits						
	DSC - A9 @ 4 credits						
	DSC - A10 @ 4 credits						
Students exiting the programme after fourth semester and securing 94 credits including 4 credits of summer internship will be awarded UG Diploma in the relevant Discipline/Subject							
V	DSC - A11 @ 4 credits	MIC5(VOC)@ 4 credits	-----	-----	-----	-----	24
	DSC - A12 @ 4 credits						
	DSC - A13 @ 4 credits	Internship @ 4 credits#					
	DSC - A14 @ 4 credits						
VI	DSC - A15 @ 4 credits	MIC6(VOC)@ 4 credits	-----	-----	-----	-----	22
	DSC - A16 @ 4 credits						
	DSC - A17 @ 4 credits	SEC3@ 2 credits					
	DSC - A18 @ 4 credits						
Students will be awarded 3-year UG Degree in relevant major Discipline/Subject upon securing 136 credits.							
VII	DSC - H1 @ 4 credits	SEC4 @ 4 credits OR MIC7 (VOC) @ 4 credits OR Internship @ 4 credits	-----	-----	-----	-----	24
	DSC - H2 @ 4 credits						
	DSC - H3 @ 4 credits						
	DSC - H4 @ 4 credits						
VIII (4yr UG Hon.)	DSC - H5 @ 4 credits	SEC5 @ 4 credits OR MIC8 (VOC) @ 4	-----	-----	-----	-----	24
	DSC - H6 @ 4 credits						
	DSC - H7 @ 4						

Revised Syllabi and S.O.E. for B.Sc. (Physics)

	credits	credits OR Internship @ 4 credits					
	DSC – H8 @ 4 credits						
	DSC – H9 @ 4 credits						
	DSC – H10 @ 4 credits						
VIII (4yr UG Hon. with Research)	DSC – H6@ 4 credits	SEC5 @ 4 credits OR MIC8 (VOC) @ 4 credits OR Internship @ 4 credits	-----	-----	Research project/ Dissertation @ 12 credits	-----	24
	DSC – H7@ 4 credits					TOTAL CREDITS	184

Note:

#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.

Revised Syllabi and S.O.E. for B.Sc. (Physics)

Discipline Specific Courses/ Major Course	Nomenclature of Course,	Course Code	Credits Distribution			Total Credits	Workload			Total Workload	Marks			Total Marks
			L	T	P		L	T	P		Theory		Practical	
											Internal	External		
Semester I														
DSC - A1 @ 4 credits	Mechanics	24PHYS401DS01	2	0	2	4	2	0	4	6	15	35	50	100
DSC - A2 @ 4 credits	Electricity and Magnetism	24PHYS401DS02	2	0	2	4	2	0	4	6	15	35	50	100
Semester II														
DSC - A3 @ 4 credits	Mathematical Physics- I	24PHYS402DS01	3	1	0	4	3	1	0	4	30	70	-	100
DSC - A4 @ 4 credits	Electronic devices and Applications	24PHYS402DS02	2	0	2	4	2	0	4	6	15	35	50	100
Semester III														
DSC - A5 @ 4 credits	Thermal Physics	25PHYS403DS01	2	0	2	4	2	0	4	6	15	35	50	100
DSC - A6 @ 4 credits	Vibrations and Wave Optics	25PHYS403DS02	2	0	2	4	2	0	4	6	15	35	50	100
Semester IV														
DSC - A7 @ 4 credits	Mathematical Physics- II	25PHYS404DS01	3	1	0	4	3	1	0	4	30	70	-	100
DSC - A8 @ 4 credits	Atomic, Molecular and Laser Physics	25PHYS404DS02	2	0	2	4	2	0	4	6	15	35	50	100
DSC - A9 @ 4 credits	Computational Physics	25PHYS404DS03	2	0	2	4	2	0	4	6	15	35	50	100
DSC - A10 @ 4 credits	Digital Electronics and its Applications	25PHYS404DS04	2	0	2	4	2	0	4	6	15	35	50	100
Semester V														
DSC - A11 @ 4 credits	Statistical Physics	26PHYS405DS01	2	0	2	4	2	0	4	6	15	35	50	100
DSC - A12 @ 4 credits	Electromagnetic Theory	26PHYS405DS02	2	0	2	4	2	0	4	6	15	35	50	100
DSC - A13 @ 4 credits	Introductory Quantum Mechanics	26PHYS405DS03	2	0	2	4	2	0	4	6	15	35	50	100
DSC - A14 @ 4 credits	Mathematical Physics- III	26PHYS405DS04	3	1	0	4	3	1	0	4	30	70	-	100

Revised Syllabi and S.O.E. for B.Sc. (Physics)

Semester VI														
DSC – A15 @ 4 credits	Introductory Solid-State Physics	26PHYS406DS01	2	0	2	4	2	0	4	6	15	35	50	100
DSC – A16 @ 4 credits	Nanotechnology	26PHYS406DS02	2	0	2	4	2	0	4	6	15	35	50	100
DSC – A17 @ 4 credits	Introductory Nuclear Physics	26PHYS406DS03	2	0	2	4	2	0	4	6	15	35	50	100
DSC – A18 @ 4 credits	Basic Characterization Techniques	26PHYS406DS04	2	0	2	4	2	0	4	6	15	35	50	100
Semester VII														
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 Devices	24PHY201DS04	3	1	0	4	4	0	0	4	70	30	-	100
DSC – H5 @ 4 credits	Practical: General Physics -I	24PHY201DS05	0	0	4	4	0	0	4	8	00	00	100	100
Semester VIII <u>OPTION-I</u> (4 Year UG Hons.)														
DSC – H6 @ 4 credits	Statistical Mechanics	24PHY202DS01	03	01	0	04	0	0	0	04	30	70	-	100
DSC – H7 @ 4 credits	Quantum Mechanics -II	24PHY202DS02	03	01	0	04	0	0	0	04	30	70	-	100
DSC – H8 @ 4 credits	Atomic & Molecular Physics	24PHY202DS03	03	01	0	04	0	0	0	04	30	70	-	100
DSC – H9 @ 4 credits	Solid State Physics	24PHY202DS04	03	01	0	04	0	0	0	04	30	70	-	100
DSC – H10 @ 4 credits	Practical: General Physics -II	24PHY202DS05	0	0	04	04	0	0	0	08	-	-	100	100

Revised Syllabi and S.O.E. for B.Sc. (Physics)

Semester VIII **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	-	-	300	300

L: Lecture; T: Tutorial; P: Practical

Syllabi for Undergraduate Programme in B.Sc. (Physics)

Semester I

Name of Program	B.Sc. (Physics)	Program Code	USPHY4
Name of the Course	Mechanics	Course Code	24PHYS401DS01
Hours per Week	06 (2+4)	Credits	04(2+2)
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 non-conservative 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. Fly wheel, Torsion pendulum. 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.

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. Worsnop, 1971, Asia Publishing House
11. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition,

Revised Syllabi and S.O.E. for B.Sc. (Physics)

reprinted 1985, Heinemann Educational Publishers
 12. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Edn, 2011, Kitab Mahal.
 13. Practical Physics, S.S. Srivastava and M.K. Gupta, Atma Ram & Sons, Delhi
 14. Practical Physics, S.L. Gupta and V. Kumar, Pragati Prakashan Meerut
 15. Modern Approach to Practical Physics, R.K. Singla, Modern Publishers, Jalandhar

Semester -I

Name of Program	B.Sc. (Physics)	Program Code	USPHY4
Name of the Course	Electricity and Magnetism	Course Code	24PHYS401DS02
Hours per Week	06(2+4)	Credits	04(2+2)
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: 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: Demonstrate the ability to perform mathematical analyses of problems in electricity and magnetism.
 CLO 4: Understand and communicate the role electricity and magnetism play daily life and in commonly used technologies

Unit 1: Electric Field and Electric Potential

Electric field: Conservative nature of Electrostatic Field. Electrostatic Potential. Derivation of electric field E from potential as gradient. Laplace's and Poisson equations. The Uniqueness Theorem. Gauss's Law, Differential form of Gauss's law and applications of Gauss's law. Electrostatic energy of system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and Mechanical force on a conductor. Energy per unit volume. Capacitance of a system of charged conductors. Parallel-plate capacitor. Capacitance of an isolated conductor. Methods of images and its-application to simple electrostatic problems, plane infinite sheet and sphere.

Unit 2:

Magnetic Field: Biot-Savart's Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital Law and its application to (1) Solenoid and (2) Toroid. Properties of \mathbf{B} : curl and divergence. Vector Potential. Magnetic Force on (1) point charge (2)

current carrying wire (3) between current elements. Torque on a current loop in a uniform Magnetic Field.

Unit 3: 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 (Langevin's theory), Cycle of Magnetization- B-H curve and hysteresis loop: Energy dissipation, Hysteresis loss and importance of Hysteresis Curve.

Unit 4: DC current Circuits: Electric current and current density, Electrical conductivity and Ohm's law (Review), Kirchoff's laws for D.C. networks, Network theorems: Thevenin's theorem, Norton theorem, Superposition theorem. Reciprocity theorem, Maximum Power Transfer theorem. 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.

Revised Syllabi and S.O.E. for B.Sc. (Physics)

8. A Text Book 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- II

Name of Program	B.Sc. (Physics)	Program Code	USPHY4
Name of the Course	Mathematical Physics- I	Course Code	24PHYS402DS01
Hours per Week	04(3+1)	Credits	04(3+1)
Maximum Marks	Theory: 30 (internal) + 70 (external) Total: 100	Time of Examinations	Theory: 03 Hours Practicals: 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):

CLO 1 know vector operators such Del and Laplacian operators, gradient and divergence
 CLO 2: write and solve differential equations pertaining to physics problems
 CLO 3: understand Dirac delta function and its properties
 CLO 4: express given function in terms of sine and cosine terms in Fourier series and also to get knowledge in Fourier transforms

Unit 1:

Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its Invariance under rotations. Vector product, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields, Vector Differentiation: Directional derivatives and normal derivatives. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities, Gradient, divergence, curl and Laplacian in spherical and cylindrical coordinates.

Unit 2:

Vector Integration: Ordinary Integrals of Vectors. Multiple integrals, Jacobian. Notion of infinitesimal line, surface and volume elements. Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems and their applications (no rigorous proofs) Orthogonal Curvilinear Coordinates and Multiple integrals: Orthogonal curvilinear coordinates, Derivation of gradient, divergence, curl and Laplacian in Cartesian, spherical and cylindrical coordinate systems. Change of variables and Jacobian. Evaluation of line surface and volume integrals.

Unit 3:

Differential Equations: Classification of differential equations: linear and nonlinear, homogeneous and non-homogenous equations, First order: Separable and exact equations.

Revised Syllabi and S.O.E. for B.Sc. (Physics)

Integrating factor. Second Order: Homogeneous equations with constant coefficients. Wronskin and general solution Statement of Existence and Uniqueness theorem for initial value problems. Solution of non-homogeneous equations by operator (D) method. Particular integral. Method of undetermined coefficients and variation of parameters Equations reducible to those with constant coefficient.

Unit 4:

Fourier Series: Fourier series, Dirichlet conditions (Statement only). Orthogonality of sine and cosine functions. Sine and cosine series. Distinctive features of Fourier expansions. Half-range expansions. Applications Square wave triangular wave, output of full wave rectifier and other simple functions Summary of infinite series. Definition of Dirac delta function. Representation as limit of a Gaussian function and rectangular function. Properties of Dirac delta function.

Reference/Textbooks Suggested:

1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn. Elsevier.
2. An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning
3. Differential Equations, George F. Simmons, 2007, McGraw Hill.
4. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
5. Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book
6. Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and Bartlett Learning
7. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India
8. Essential Mathematical Methods, K.F. Riley & M.P. Hobson, 2011, Cambridge Univ. Press

Syllabi for Under Graduate Programme in B.Sc. (Physics)

Semester -II

Name of Program	B.Sc. (Physics)	Program Code	USPHY4
Name of the Course	Electronic devices and Applications	Course Code	24PHYS402DS02
Hours per Week	06(2+4)	Credits	04(2+2)
Maximum Marks	Theory: 15+35 Practical: 50 Total: 100	Time of Examinations	Theory: 03 Hours Practical: 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 : able to gain knowledge of P-N junction diode and related devices
 CLO 2: acquire knowledge of transistor as an amplifier
 CLO 3: design half wave and full-wave rectifier using p-n junction diode

CLO 4: able to appreciate the different oscillators

Unit 1:

Semiconductors: Energy bands in solids, Intrinsic and extrinsic semiconductors, carrier mobility and electrical resistivity of semiconductors, p-n junction diode and their characteristics, Zener and Avalanche breakdown, Zener diode, Zener diode as a voltage regulator. Light emitting diodes (LED), Photoconduction in semiconductors, Photodiode, Solar Cell

Unit 2:

Transistors: Junction transistors, Working of NPN and PNP transistors, Three configurations of transistor (C-B, C-E, C-C modes), Common base, common emitter and common collector characteristics of transistor, Constants of a transistor and their relation, Advantages and disadvantages of C-E configuration. D.C. load line, Transistor biasing; various methods of transistor biasing and stabilization.

Unit 3:

Transistor Amplifiers: Amplifiers, common base and common emitter amplifiers, coupling of amplifiers, various methods of coupling, Resistance- Capacitance (RC) coupled amplifier (two stage, concept of band width, no derivation), Feedback in amplifiers, advantages of negative feedback, emitter follower.

Unit 4: P-N junction diode as a rectifier, half wave and full wave rectifiers (with derivation), filters (series inductor, shunt capacitance, L-section or choke), Oscillators: Oscillators, Principle of oscillation, classification of oscillators, Condition for self-sustained oscillation: Brakhasuen criterion for oscillation, Tuned collector common emitter oscillator, Hartley oscillator

Practicals:

1. To study I-V characteristics of P-N Junction diode
2. To study series inductor, shunt capacitance, L-section or choke filters
3. Zener Diode voltage regulation characteristics.
4. To study half wave and full wave rectifiers
5. Verification of inverse square law by photo-cell
6. To draw common base and common emitter characteristics of a transistor and calculate transistor characteristics parameters.
7. To study transistor as C-B Amplifier
8. To study transistor as C-E Amplifier
9. To study the ripple factor in a d.c. power supply.
10. Study of Hartley oscillator

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

Reference/Text Books Suggested:

1. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
2. Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
3. Solid State Electronic Devices, B.G. Streetman & S.K. Banerjee, 6th Edn., 2009, PHI Learning
4. Electronic Devices & circuits, S. Salivahanan & N.S. Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill.

Revised Syllabi and S.O.E. for B.Sc. (Physics)

Semester -III

Name of Program	B.Sc. (Physics)	Program Code	USPHY4
Name of the Course	Thermal Physics	Course Code	25PHYS403DS01
Hours per Week	06(2+4)	Credits	04(2+2)
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):

CLO1: Develop a comprehensive understanding of fundamental thermodynamic principles, including the Zeroth and First Laws and their applications to describe various thermodynamic processes.

CLO2: Analyze the concepts of the Second Law of Thermodynamics to evaluate the efficiency of heat engines and refrigerators and apply the Carnot cycle to determine thermodynamic limits.

CLO3: Interpret the concept of entropy and its mathematical formulation, including its role in reversible and irreversible processes, the principle of entropy increase, and the Third Law of Thermodynamics.

CLO4: Apply thermodynamic potentials such as internal energy, enthalpy, Helmholtz free energy, and Gibbs free energy to solve problems related to phase transitions, thermodynamic equilibria, and surface phenomena.

CLO5: Understand Maxwell's thermodynamic relations and their applications to derive thermodynamic properties, including heat capacities, entropy changes, and the behaviour of real and ideal gases in various processes.

Unit 1: Zeroth and First Law of Thermodynamics: Extensive and intensive Thermodynamic Variables, Thermodynamic Equilibrium, Zeroth Law of Thermodynamics & Concept of Temperature, Concept of Work & Heat, State Functions, First Law of Thermodynamics and its differential form, Internal Energy, First Law & various processes, Applications of First Law: General Relation between C_P and C_V , Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Co-efficient.

Unit 2: Second Law of Thermodynamics: Reversible and Irreversible process with examples. Conversion of Work into Heat and Heat into Work. Heat Engines. Carnot's Cycle, Carnot engine & efficiency. Refrigerator & coefficient of performance, 2nd Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence. Carnot's Theorem. Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale.

Unit 3: Entropy: Concept of Entropy, Clausius Theorem. Clausius Inequality, Second Law of Thermodynamics in terms of Entropy. Entropy of a perfect gas. Principle of Increase of Entropy. Entropy Changes in Reversible and Irreversible processes with examples. Entropy of the Universe. Entropy Changes in Reversible and Irreversible Processes. Principle of Increase of Entropy. Temperature-Entropy diagrams for Carnot's Cycle. Third Law of Thermodynamics. Unattainability of Absolute Zero.

Unit 4: Thermodynamic Potentials and Maxwell's Thermodynamic Relations: Extensive and Intensive Thermodynamic Variables. Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy. Their Definitions, Properties and Applications. Surface Films and Variation of Surface Tension with Temperature. Magnetic Work, Cooling due to adiabatic demagnetization, First and second order Phase Transitions with examples, Clausius Clapeyron Equation and Ehrenfest equations. Derivations and applications of Maxwell's Relations, Maxwell's Relations:(1) Clausius Clapeyron equation, (2) Values of C_p-C_v , (3) Tds Equations, (4) Joule-Kelvin coefficient for Ideal and Van der Waal Gases, (5) Energy equations, (6) Change of Temperature during Adiabatic Process.

Practicals:

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
2. To determine the Coefficient of Thermal Conductivity of Cu by Searle's Apparatus.
3. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
4. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's disc method.
5. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).
6. To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two Junctions.
7. To calibrate a thermocouple to measure temperature in a specified Range using Null Method and determine the neutral temperature.
8. To measure temperature using a thermocouple in a specified range by direct voltage measurement with an Op-Amp difference amplifier circuit and determine the neutral temperature.
9. To measure the temperature of ambient using resistance temperature device.

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

References:

1. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
2. A Treatise on Heat, Meghnad Saha, and B.N. Srivastava, 1958, Indian Press
3. Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill
4. Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford University Press
5. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
6. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
7. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
8. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.

Revised Syllabi and S.O.E. for B.Sc. (Physics)

Semester -III

Name of Program	B.Sc. (Physics)	Program Code	USPHY4
Name of the Course	Vibrations and Wave Optics	Course Code	25PHYS403DS02
Hours per Week	06(2+4)	Credits	04(2+2)
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: Know main aspects of the inadequacies of classical mechanics and understand historical development of quantum mechanics and understand the theory of quantum measurements, wave packets and uncertainty principle.

CLO 2: Understand the central concepts of quantum mechanics: wave functions, Interpretation of Wave Function, momentum and energy operator, expectation values, the Schrodinger equation, time dependent and time independent cases, probability density, the normalization techniques, Eigen functions, Eigen values and their significance.

CLO 3: Understanding the behavior of quantum particle encountering the (i) barrier & ii) potential.

CLO 4: Solve Schrodinger equation for ground state energy and wave functions of various simple quantum mechanical one dimensional and three-dimensional potentials.

CLO 5: Learn to present observations, results, analysis and different concepts related to experiments of Elements of Quantum Mechanics.

Unit 1: Superposition of Collinear Harmonic oscillations: Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats). Superposition of N collinear Harmonic Oscillations with (1) equal phase differences and (2) equal frequency differences.

Unit 2: Wave equation. Traveling waves, Plane and spherical waves. Superposition of two harmonic waves. Standing waves on a string. Superposition of N harmonic waves. Pulses and wave packets. Introduction to different models, light waves, electromagnetic nature of light waves. Coherence and Interference: Interaction of independent light sources. Classification in terms of division of amplitude and division of wave front. Young's double slit experiment.

Unit 3: Lloyd's mirror and Fresnel's biprism. Interference in thin films parallel and wedge-shaped films. Fringes of equal inclination (Haidinger fringes) and fringes of equal thickness (Fizeau fringes). Michelson's interferometer: Theory, form of fringes (mention only), applications, visibility of fringes. Theory of partial coherence. Coherence time and coherence length, i.e., temporal and spatial coherence. Fabry-Perot interferometer: Theory, Airy's formula, sharpness of fringes, finesse, visibility of fringes

Unit 4: Fraunhofer diffraction: Single slit, rectangular and circular aperture. Multiple slits. Plane diffraction grating. Resolving power and dispersive power of a plane diffraction grating. Fresnel diffraction: Fresnel's integrals, Cornu's spiral, Fresnel diffraction pattern at a straight edge, a slit and a wire (qualitatively using Cornu's spiral). Holography: Principle of holography, recording and reconstruction method and its theory as interference between two plane waves.

List of Experiments:

1. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
2. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
3. To determine dispersive power and resolving power of a plane diffraction grating.
4. To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.
5. To determine wavelength of sodium light using Newton's Rings.
6. To determine the wavelength of sodium source using Michelson's interferometer.
7. To draw a graph between wave length and minimum deviation for various lines from a Mercury discharge source.
8. Ordinary and extra ordinary refractive indices for calcite or quartz.
9. Measurement of (a) Specific rotation (b) concentration of sugar solution using polarimeter
10. To study double slit interference by He-Ne laser.
11. To determine refractive index of the Material of a prism using sodium source.
12. To find resolving power of telescope.
13. Resolving power of a prism.
13. To determine the frequency of an electric tuning fork by Melde's experiment and verify $\lambda^2 - T$ law.

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

Reference/Text Books Suggested:

1. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill.
2. The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
3. The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.
4. Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
5. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
6. Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
7. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
8. A Text Book 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.

Revised Syllabi and S.O.E. for B.Sc. (Physics)

Semester -IV

Name of Program	B.Sc. (Physics)	Program Code	USPHY4
Name of the Course	Mathematical Physics- II	Course Code	25PHYS404DS01
Hours per Week	04(3+1)	Credits	04(3+1)
Maximum Marks	Theory: 30 (internal) +70 (external) Total: 100	Time of Examinations	Theory: 03 Hours Practicals: 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):

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

CLO 1: apply knowledge of Fourier and Laplace transforms to analyse and solve problems in engineering and science

CLO 2: apply the principles of linear vector spaces to solve problems in physics related to the representation of states and operators

CLO3: utilize matrix algebra to analyse and solve physics problems, including quantum mechanics, linear transformations, and systems of linear equations

CLO 4: apply Fourier transform in solution of differential equations

Unit 1:

Square integrable functions. Inverse Fourier transform, Representation of Dirac delta function as a Fourier Integral, Fourier transform of derivatives, Parseval's theorem, Convolution theorem, Cosine and Sine transforms, three dimensional Fourier transforms with examples, Adjoint of an integral operator, Unitarity of Fourier transform, Application of Fourier transforms to differential equations: One dimensional wave, diffusion and heat flow equations

Unit 2:

Laplace Transforms: Laplace Transform (LT) of Elementary functions. Properties of LTs: Change of Scale Theorem, Shifting Theorem. LTs of Derivatives and Integrals of Functions, Derivatives and Integrals of LTs, LT of Unit Step function, Dirac Delta function, Periodic Functions. Convolution Theorem, Inverse LT, Application of Laplace Transforms to Differential Equations: Damped Harmonic Oscillator, Simple Electrical Circuits

Unit 3:

Real linear vector space: scalar product for real linear vector spaces, Linear independence of vectors, Basis for a vector space, Dimension of vector space, Orthonormal basis, Linear Operators: Algebra of linear operators, Eigenvalues and Eigenvectors of Hermitian, unitary and normal operators, Similarity and unitary transformations

Unit 4:

Matrix representations of vectors and of linear operators on a vector space, Eigenvalues and Eigenvectors of matrices, characteristics (secular) equations, Transformation of basis in a

Revised Syllabi and S.O.E. for B.Sc. (Physics)

vector space, Transformation between orthonormal bases, Diagonalization of matrices

Reference/Textbooks Suggested:

1. Mathematical Methods for Physicists by G. B. Arfken, H. J. Weber, F.E. Harris (Elsevier)
2. A First Course in Partial Differential Equations by H. F. Weinberger (Dover Publications)
3. Mathematical Physics by P. K. Chattopadhyay (New Age International)
4. Essential Mathematical Methods, by K. F. Riley & M.P. Hobson (Cambridge University Press)
5. Mathematical methods for Scientists and Engineers, D.A. Mc Quarrie (Viva Book)
6. Matrices and Tensors in Physics by A. W. Joshi (New Age International)
7. Advanced Engineering Mathematics, by Erwin Kreyszig (Wiley India)
8. Mathematical Physics by H.K. Dass (S. Chand)

Semester -IV

Name of Program	B.Sc. (Physics)	Program Code	USPHY4
Name of the Course	Atomic, Molecular and Laser Physics	Course Code	25PHYS404DS02
Hours per Week	06(2+4)	Credits	04(2+2)
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: Student would able to understand the 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: Atomic spectra, wave number, spectra of Hydrogen atom, explanation of spectral series in Hydrogen atom, Atoms in electric and magnetic fields: Electron spin. Stern-Gerlach experiment. Orbital angular momentum, dipole moment and energy in magnetic field from classical viewpoint Vector model for two valance electron atoms: application of spectra. Coupling Schemes; LS or Russell – Saunder Coupling Scheme and JJ coupling scheme, Interaction energy in L-S coupling (sp, pd configuration), Lande interval rule, Pauli principal and periodic classification of the elements. Interaction energy in JJ Coupling (sp, pd configuration).

Unit 2: Equivalent and non-equivalent electrons. Doublet Structure of alkali spectra. Empirical evidence of multiplets, Selection rules. Total angular momentum. Many-electron

Revised Syllabi and S.O.E. for B.Sc. (Physics)

atoms: Pauli exclusion principle, Many particles in one- dimensional box, Symmetric and antisymmetric wave functions. Atomic shell model and periodic table, Spectral notations for atomic states. Hyperfine structure of spectral lines and its origin; isotope effect, nuclear spin.

Unit 3: Atom in external field: Zeeman Effect (normal and Anomalous), Experimental set-up for studying Zeeman effect, Explanation of normal Zeeman effect (classical and quantum mechanical), Explanation of anomalous Zeeman effect (Lande g-factor), Zeeman pattern of D1 and D2 lines of Na-atom, Paschen-Back effect of a single valence electron system. Weak field Stark effect of Hydrogen atom. Discrete set of electronic energies of molecules. quantization of Vibrational and rotational energies Raman effect (Quantitative description) Stoke's and anti-Stoke's lines.

Unit 4: Main features of a laser: Directionality, high intensity, high degree of coherence, spatial and temporal coherence, Einstein's coefficients and possibility of amplification, momentum transfer, lifetime of a level, kinetics of optical absorption. Threshold condition for laser emission, Laser pumping, He-Ne laser and RUBY laser (Principle, Construction and Working)

List of Experiments:

1. To determine the wavelength of H-alpha emission line of Hydrogen atom.
2. To determine the ionization potential of mercury.
3. To determine the absorption lines in the rotational spectrum of Iodine vapour.
4. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.
5. To setup the Millikan oil drop apparatus and determine the charge of an electron.
6. To study interference fringes and measure the laser's coherence length using He-Ne Laser.
7. To determine He-Ne laser wavelength using a Ruler.
8. To determine the size of Lycopodium Particle using diode laser.
9. To determine the diameter of wire using He-Ne laser.
10. To determine angular spread of He-Ne laser using plane diffraction grating.

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

Reference/Text Books Suggested:

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. Spectra of diatomic molecules by Herzberg
6. Laser and Nonlinear Optics by B.B. Laud (New Age)
7. Lasers: Fundamentals and Applications by Ajoy Ghatak and K. Thyagarajan

Revised Syllabi and S.O.E. for B.Sc. (Physics)

Semester -IV

Name of Program	B.Sc. (Physics)	Program Code	USPHY4
Name of the Course	Computational Physics	Course Code	25PHYS404DS03
Hours per Week	06(2+4)	Credits	04(2+2)
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 Develop an understanding of introduction to computer programming and problem-solving using MATLAB.

CLO 2: Understand the basics of equation representation and graphical analysis using computer.

CLO 3: Comprehend the hands-on training for the Problem solving on computers.

CLO 3: Able to use the computer language as a tool and computational methods to solve physical problems.

Unit 1:

Basics of MATLAB Programming, array operations in MATLAB, loops and execution of control, working with files: Script Files, Function files, Compiled files, Functions, Sub functions, Global Variables, Loops, Branches and control-flow, plotting and programming output, examples.

Unit 2:

Introduction to graphical analysis and its limitations, Introduction to Gnuplot, importance of visualization of computational and computational data, basic Gnuplot commands: simple plots, plotting data from a file, saving and exporting, multiple data sets per file, physics with Gnuplot (equations, building functions, user defined variables and functions), Understanding data with Gnuplot.

Unit 3:

Solution of nonlinear equations: bisection, secant and Newton-Raphson methods. Comparison and error estimation. Program for finding zeros of a given function. Solution of simultaneous linear equations: Gauss elimination and iterative (Gauss-Seidel) method. Computation of eigenvalues and eigenvectors of matrices using iterative process. Program for finding solution of a given system of three coupled linear equations.

Unit 4:

Numerical Differentiation: Taylor Series method, Generalized numerical differentiation, truncation error, Roots of Linear, Non-linear Algebraic and Transcendental equations: Newton-Raphson method; convergence of solutions, Solution of Simultaneous Linear Equations: Gaussian elimination method, Pivoting; Gauss- Jordan elimination method, Matrix inversion, Eigen values and Eigen vectors, Jacobi's method for symmetric matrix.

Practicals:**List of programs using FORTRAN/MATLAB**

1. Numerical solution of ordinary differential equation
2. Simulation of chaotic pendulum
3. Numerical solution of simultaneous linear algebraic equation.
4. Simulation of Planetary Motion.
5. To find the product of two matrices.
6. To find a set of prime numbers and Fibonacci series.
7. To write program to open a file and generate data for plotting using Gnuplot.
8. Plotting trajectory of a projectile projected horizontally.
9. Creating an input Gnuplot file for plotting a data and saving the output for seeing on the screen. Saving it as an eps file and as a pdf file.
10. Numerical solution of equation of motion of simple harmonic oscillator and plot the outputs for visualization.
11. Motion of particle in a central force field and plot the output for visualization.

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

Reference/Text Books Suggested:

1. Introduction to Numerical Analysis by S.S. Sastry, (PHI Learning).
2. Computer Programming in Fortran 77 by V. Rajaraman (PHI Learning).
3. A Document Preparation System by L. Lamport (2nd Edition, Addison-Wesley, 1994).
4. Schaum's Outline of Theory and Problems of Programming with Fortran by S Lipsdutz and A Poe (Mc-Graw Hill).
5. Computational Physics: An Introduction by R. C. Verma, P.K. Ahluwalia and K.C. Sharma (New Age International Publishers).
6. Elementary Numerical Analysis by K.E. Atkinson (3rd Edition, Wiley, 2007).
7. Gnuplot in action: understanding data with graphs, Philip K Janert (Manning 2010)
8. A first course in Numerical Methods by U.M. Ascher and C. Greif (PHI Learning)
9. Getting Started with MATLAB by RudraPratap (Oxford University Press).
10. A concise introduction to MATLAB by William J Palm III (McGraw Hill).

Semester -IV

Name of Program	B.Sc. (Physics)	Program Code	USPHY4
Name of the Course	Digital Electronics and its Applications	Course Code	25PHYS404DS04
Hours per Week	06(2+4)	Credits	04(2+2)
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):

Revised Syllabi and S.O.E. for B.Sc. (Physics)

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

CLO 1: identify, analyse, and construct basic logic gate circuits to perform fundamental logical operations

CLO 2: design and analyse digital circuits involving multiplexers, de-multiplexers, decoders, encoders, and perform binary addition and subtraction using 2's complement

CLO3: implement SR, D, and JK flip-flops, including clocked variations, preset and clear operations for sequential circuit design

CLO 4: design, analyse, and implement asynchronous counters, decade counters, and synchronous counters to perform counting operations in digital circuits

CLO 5: describe the main features, architecture, and functionality of the 8085 microprocessor and gain understanding of microprocessor-based systems

Unit 1:

Difference between Analog and Digital Circuits. Binary Numbers Decimal to Binary and Binary to Decimal Conversion, BCD, Octal and Hexadecimal, numbers, AND, OR and NOT Gates (realization using Diodes and Transistor), NAND and NOR Gates as Universal Gates, XOR and XNOR Gates and application as Parity Checkers

Unit 2:

De Morgan's Theorems. Boolean Laws. Simplification of Logic, Circuit using Boolean Algebra. Fundamental Products, Idea of Minterms and Maxterms, Conversion of a Truth table into Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map,

Unit 3:

Basic idea of Multiplexers, De-multiplexers, Decoders, Encoder, Binary Addition, Binary Subtraction using 2's Complement, Half and Full Adders, Half & Full Subtractors, 4-bit binary Adder/Subtractor, SR, D, and JK Flip-Flops, clocked (Level and Edge Triggered) Flip-Flops, Preset and Clear operations, Race-around conditions in JK Flip-Flop, M/S JK, Flip-Flop

Unit 4:

Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel-in-Parallel-out Shift Registers (only up to 4 bits), Ring Counter, Asynchronous counters, Decade Counter, Synchronous Counter, Main features of 8085 microprocessor, Block diagram, Components, Pin-out diagram, Buses. Registers, ALU

Practicals:

1. To realize AND and OR gates with diodes and resistors and NOT gate with transistor and resistors
2. Construction of AND, OR, NOT and XOR gates using NAND gates
3. To design Half Adder and Full Adder circuits for single bit addition using NAND gates
4. To design Half Subtractor and Full Subtractor circuits for single bit
5. To design an astable multivibrator of given specifications using 555 Timer IC and to study the waveform
6. To design a 4-to-1 multiplexer or to design a 1-to-4 demultiplexer using basic Gates
7. To build RS and D-type Flip-Flop circuits using NAND gates
8. To build JK Flip-Flop circuits using NAND gates
9. To design a 4-bit Counter using Flip-Flop ICs and to study its timing diagram

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

Revised Syllabi and S.O.E. for B.Sc. (Physics)

Reference/Textbooks Suggested:

1. Digital Principles and Applications, A.P. Malvino, D.P. Leach and Saha (Tata McGraw)
2. Fundamentals of Digital Circuits, by Anand Kumar (PHI)
3. Digital Electronics, by Subrata Ghoshal (Cengage Learning)
4. Digital Circuits and systems, by Venugopal (Tata McGraw Hill)
5. Integrated Electronics by J. Millman and C.C. Halkias (Tata McGraw Hill).
6. Digital Electronics by William Gothmann (Prentice Hall of India)

Semester -V

Name of Program	B.Sc. (Physics)	Program Code	USPHY4
Name of the Course	Statistical Physics	Course Code	26PHYS405DS01
Hours per Week	06(2+4)	Credits	04(2+2)
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: Develop an understanding of the basic concepts of Statistical Mechanics and thermodynamic functions
 CLO 2: Understand the different laws of emission of radiation and heat by different objects.
 CLO3: Explore the properties of Bose Einstein distribution and related physical processes.
 CLO 4: Explore the correlation between thermo-dynamical properties and Fermi-Dirac distribution.

Unit 1:

Entropy and thermodynamic probability, Maxwell Boltzmann distribution law, Partition function, Thermodynamic functions of finite number of energy levels, Thermodynamic functions of an ideal gas, Classical entropy expression, Gibbs paradox, Law of equipartition of energy – applications to specific heat and its limitations.

Unit 2:

Properties of thermal radiation, Kirchhoff's law, Stefan-Boltzmann law and Wien's displacement law, Quantum Theory of Radiation Planck's law of black-body radiation, Deduction of Wien's radiation formula, Rayleigh-Jeans law, Stefan-Boltzmann law and Wien's displacement law from Planck's law.

Unit 3:

B.E. distribution law, Thermodynamic functions of an ideal weakly degenerate gas, Strongly degenerate Bose gas, Bose-Einstein condensation properties of liquid He (qualitative description), Radiation as photon gas Bose's derivation of Planck's law, Thermodynamic functions of photon gas, Specific heat of hydrogen: quantization of rotational and vibration

motion, ortho and para hydrogen.

Unit 4:

Fermi-Dirac distribution law, Fermi energy, Thermodynamic functions of an ideal weakly degenerate Fermi gas, Strongly degenerate Fermi gas, Electron gas in a metal, specific heat of metals, Richardson's equation of thermionic emission, Third law of thermodynamics, Absolute definition of entropy, Consequences of third law, unattainability of absolute zero.

Practicals:

1. Measurement of Plank's constant using black body radiation.
2. To determine Stefan's Constant.
3. To determine the coefficient of thermal conductivity of copper by Searle's Apparatus.
4. Plot Planck's law for Black Body radiation and compare it with Wein's Law and
5. Raleigh-Jeans Law at high temperature (room temperature) and low temperature.
6. Plot Specific Heat of Solids by comparing (a) Dulong-Petit law, (b) Einstein distribution function, (c) Debye distribution function for high temperature (room temperature) and low temperature and compare them for these two cases
7. Plot Maxwell-Boltzmann distribution function versus temperature.
8. Plot Fermi-Dirac distribution function versus temperature.
9. Plot Bose-Einstein distribution function versus temperature.
10. Computer simulation of Maxwell-Boltzmann distribution, Fermi-Dirac & Bose-Einstein.
11. 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/programs using any suitable programming language.

Reference/Text Books Suggested:

1. Statistical Mechanics by K. Huang (John Wiley & Sons).
2. Statistical Mechanics by R. K. Pathria (Butterworth Heinemann).
3. Statistical Mechanics by B. K. Aggarwal and Melvin Eisner (New Age International).
4. Statistical Physics by L.D. Landau and E.M. Lifshitz (Pergamon)
5. Statistical Mechanics by R. Kubo (Elsevier)
6. Elementary Statistical Mechanics by Gupta and Kumar (Pragati Prakashan)
7. Advanced Practical Physics for students by B.L. Flint and H.T. Worsnop (Asia Publishing House).
8. Advanced level Physics Practicals by M. Nelson and J.M. Ogborn (4th Edition, Heinemann Educational Publishers).
9. A Text Book of Practical Physics by I. Prakash and Ramakrishna, (11th Edition, Kitab Mahal, New Delhi).
10. A Laboratory Manual of Physics for Undergraduate Classes by D.P. Khandelwal (Vani Publication).

Revised Syllabi and S.O.E. for B.Sc. (Physics)

Semester -V

Name of Program	B.Sc. (Physics)	Program Code	USPHY4
Name of the Course	Electromagnetic Theory	Course Code	26PHYS405DS02
Hours per Week	06(2+4)	Credits	04(2+2)
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, students will be able to: CLO1: Analyze Maxwell's equations and their implications. CLO2: Derive wave equations for electromagnetic fields and understand energy, momentum, and angular momentum densities in electromagnetic systems using the Poynting theorem. CLO3: Explain the propagation of electromagnetic waves in unbounded media with applications to ionospheric wave propagation. CLO4: Understand electromagnetic wave behaviour at boundaries.			
Unit 1: Maxwell's Equations and Fundamentals: Review of Maxwell's equations. Displacement current and its significance. Vector and scalar potentials. Gauge transformations: Lorentz and Coulomb gauges. Boundary conditions at the interface between different media.			
Unit 2: Wave Equations and Electromagnetic Energy: Wave equations and solutions for electromagnetic fields. Plane waves in dielectric media: Transverse nature and characteristics. Poynting theorem and Poynting vector. Electromagnetic energy density: Physical concepts of energy, momentum density, and angular momentum density.			
Unit 3: EM Wave Propagation in Unbounded Media: Plane electromagnetic waves through vacuum and isotropic dielectric media. Refractive index, dielectric constant, and wave impedance. Propagation through conducting media: Relaxation time and skin depth. EM wave propagation through dilute plasma: Electrical conductivity of ionized gases, plasma frequency, refractive index, and skin depth. Applications to wave propagation through the ionosphere.			
Unit 4: EM Wave Propagation in Bounded Media: Boundary conditions at a plane interface between two media. Reflection and refraction of plane waves at plane interfaces between two dielectric media. Fresnel's formulae for perpendicular and parallel polarization cases. Brewster's law, reflection and transmission coefficients. Total internal reflection, evanescent waves, and metallic reflection (normal incidence).			
Practicals: <ol style="list-style-type: none"> To study dependence of radiation on angle for a simple Dipole antenna. To determine the wavelength and velocity of ultrasonic waves in a liquid (Kerosene Oil, Xylene, etc.) by studying the diffraction through ultrasonic grating. To study the reflection and refraction of microwaves. To study the polarization and double slit interference in microwaves. 			

Revised Syllabi and S.O.E. for B.Sc. (Physics)

5. To determine the refractive index of liquid by total internal reflection using Wollaston's air-film.
6. To determine the refractive Index of a glass by total internal reflection using a Gaussian eyepiece.
7. To determine the refractive Index of a liquid by total internal reflection using a Gaussian eyepiece.
8. To verify the Stefan's law of radiation and to determine Stefan's constant.
9. To determine the Boltzmann constant using V-I characteristics of PN junction diode.
10. To determine e/m ratio using Thomson method.

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

References:

1. Introduction to Electrodynamics, D.J. Griffiths, 3rd Ed., 1998, Benjamin Cummings.
2. Elements of Electromagnetics, M.N.O. Sadiku, 2001, Oxford University Press.
3. Introduction to Electromagnetic Theory, T.L. Chow, 2006, Jones & Bartlett Learning
4. Fundamentals of Electromagnetics, M.A.W. Miah, 1982, Tata McGraw Hill
5. Electromagnetic field Theory, R.S. Kshetrimayun, 2012, Cengage Learning
6. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer

Semester -V

Name of Program	B.Sc. (Physics)	Program Code	USPHY4
Name of the Course	Introductory Quantum Mechanics	Course Code	25PHYS405DS03
Hours per Week	06(2+4)	Credits	04(2+2)
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: Know main aspects of the inadequacies of classical mechanics and understand historical development of quantum mechanics and understand the theory of quantum measurements, wave packets and uncertainty principle.

CLO 2: Understand the central concepts of quantum mechanics: wave functions, Interpretation of Wave Function, momentum and energy operator, expectation values, the Schrodinger equation, time dependent and time independent cases, probability density, the normalization techniques, Eigen functions, Eigen values and their significance.

CLO 3: Understanding the behaviour of quantum particle encountering the (i) barrier & ii) potential.

CLO 4: Solve Schrodinger equation for ground state energy and wave functions of various simple quantum mechanical one dimensional and three-dimensional potentials.

<p>CLO 5: Learn to present observations, results, analysis and different concepts related to experiments of Elements of Quantum Mechanics.</p>
<p>Unit 1: 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. G.P. Thomson 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, Electron diffraction from a slit.</p>
<p>Unit 2: 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, Ehrenfest's theorem. Time dependent and time independent Schrodinger equation, Mathematical consideration of Schrodinger equation: Normalization, Orthogonality, Observables, Stationary states, Position, Linear momentum & Energy operators; commutator of position and linear momentum operators;</p>
<p>Unit 3: 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). (ii) One dimensional step potential $E > V_0$ (Reflection and Transmission coefficient) (iii) One dimensional step potential $E < V_0$ (penetration depth calculation). (iv) One dimensional potential barrier, $E > V_0$ (Reflection and Transmission coefficient). (v) One-dimensional potential barrier, $E < V_0$ (penetration or tunnelling coefficient). (VI) Solution of Schrodinger equation for harmonic oscillator (quantization of energy, Zero-point energy, wave equation for ground state and excited states).</p>
<p>Unit 4: Gamow theory of alpha decay. Quantum phenomenon of tunnelling. Tunnel diode-qualitative description. Spectrum for a square well (mention upper bound-no calculation). Bound state problems: General features of a bound particle system. Particle in a spherically symmetric potential rigid rotator. Orbital angular momentum and azimuthal quantum numbers and space quantization. Physical significance. Radial solutions and principal quantum number. Hydrogen atom.</p>
<p>Practicals:</p> <ol style="list-style-type: none"> 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 tunneling effect in tunnel diode using I-V characteristics. 11. Solve the s-wave Schrodinger equation for the ground state and the first excited 12. State of the hydrogen atom using <i>Python/Fortran/MATLAB</i>.

Revised Syllabi and S.O.E. for B.Sc. (Physics)

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

Reference/Text Books Suggested:

1. Quantum Mechanics, Leonard I. Schiff, 3rd Edn 2010, Tata McGraw Hill.
2. A Text book of Quantum Mechanics, P.M. Mathews and K. Venkatesan, 2nd Edn, 2010, McGraw Hill.
3. A. Ghatak & S. Lokanathan, Quantum Mechanics: Theory and Applications, 5th Edition, (Macmillan India, 2004)
4. Quantum Mechanics, Robert Eisberg and Robert Resnick, 2nd Edn, 2002, Wiley.
5. Quantum Mechanics, G. Aruldas, 2nd Edn 2002, PHI Learning of India.
6. Quantum Mechanics, B.H. Bransden and C.J. Joachain, Pearson Education, New Delhi.
7. Introductory Quantum Mechanics, David J. Griffith, 2nd Ed. 2005, Pearson Education.
8. Quantum Physics of Atoms Molecules, Solids, Nuclei and Particles, R.M. Eisberg and R. Resnick, Wiley Eastern Ltd, New Delhi
9. Quantum Mechanics, G R Chatwal and S K Anand, Himalaya Publishing House, New Delhi
10. Quantum Physics (Berkeley Physics Course), E H Witchman, Tata McGraw Hill, Chennai
11. B.Sc. Practical Physics, C.L. Arora, S. Chand Publisher, New Delhi

Semester -V

Name of Program	B.Sc. (Physics)	Program Code	USPHY4
Name of the Course	Mathematical Physics- III	Course Code	26PHYS405DS04
Hours per Week	04(3+1)	Credits	04(3+1)
Maximum Marks	Theory: 30 (internal) +70 (external) Total: 100	Time of Examinations	Theory: 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):

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

CLO 1: apply special functions, such as Legendre polynomials, Bessel functions, and Hermite polynomials, to solve complex differential equations and physical problems

CLO 2: formulate and solve partial differential equations to model and analyse physical phenomena such as heat conduction, wave propagation, and quantum systems

CLO3: apply complex analysis techniques to evaluate complex integrals, study electromagnetic fields, and analyse wave functions

CLO 4: understand and apply tensor analysis to describe physical phenomena in areas such as relativity, continuum mechanics, and electromagnetism

Unit 1:

Singular Points of Second Order Linear, Differential Equations and their importance, Frobenius method and its applications to differential equations, Legendre, Bessel, Hermite

Revised Syllabi and S.O.E. for B.Sc. (Physics)

and Laguerre Differential Equations, Properties of Legendre Polynomials: Rodrigues Formula, Generating Function, Orthogonality. Simple recurrence relations, Expansion of function in a series of Legendre Polynomials, Bessel Functions of the First Kind: Generating Function, simple recurrence relations, Zeros of Bessel Functions and Orthogonality.

Unit 2:

Classification of partial differential equations (PDEs), Solution of PDEs with separation of variables and Eigen functions, Laplace's equation and its solution in Cartesian, spherical polar with axially symmetric coordinate system and cylindrical polar with infinite cylinder coordinate system. Solution of 1-D wave equations, Solution of heat conduction equation in 1-D.

Unit 3:

Brief Revision of Complex Numbers and their Graphical Representation. Euler's formula, De Moivre's theorem, Roots of Complex Numbers, Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions, Examples of analytic functions, Singular functions: poles and branch points, order of singularity, branch cuts, Integration of a function of a complex variable, Cauchy's Inequality, Cauchy's Integral formula, Simply and multiply connected region. Laurent and Taylor's expansion, Residues and Residue Theorem, Application in solving, Definite Integrals.

Unit 4:

Cartesian tensors: first and zero order Cartesian tensors, second and higher order Cartesian tensors. Algebra of tensors: summation, multiplication, contraction, inner product. Isotropic tensors, improper rotation and pseudo tensors, dual tensors, Moment of inertia tensor and stress tensor, non-cartesian tensors, the metric tensors. General coordinate transformation and tensor transformation. Lorentz transformation, four vectors and electromagnetic field tensor. Covariant formulation of Maxwell's equations.

Reference/Textbooks Suggested:

1. A First Course in Partial Differential Equations, H. F. Weinberger (Dover Publications)
2. Mathematical Physics by P. K. Chattopadhyay (New Age International)
3. Essential Mathematical Methods, K. F. Riley & M.P. Hobson (Cambridge University Press)
4. Mathematical methods for Scientists and Engineers, D.A. Mc Quarrie (Viva Book)
5. Matrices and Tensors in Physics by A. W. Joshi (New Age International)
6. Advanced Engineering Mathematics, by Erwin Kreyszig (Wiley India)
7. Mathematical Physics by H.K. Dass (S. Chand)

Revised Syllabi and S.O.E. for B.Sc. (Physics)

Semester -VI

Name of Program	B.Sc. (Physics)	Program Code	USPHY4
Name of the Course	Introductory Solid-State Physics	Course Code	26PHYS406DS01
Hours per Week	06(2+4)	Credits	04(2+2)
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: Comprehend the fundamental concepts of crystal structures and their significance in determining material properties

CLO 2: Analyse the behaviour of dielectric and ferroelectric materials and their applications in modern technology

CLO3: Understand the principles of band theory to explain electrical of solids

CLO 4: Explore magnetic susceptibility, types of magnetism, classical and quantum theories of para-magnetism

Unit 1:

Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors, Lattice and Basis Unit Cell, Miller Indices, crystal planes, Reciprocal Lattice, Types of Lattices, some typical crystal structures: ZnS, NaCl and diamond, Brillouin Zones, Diffraction of X-rays by, Bragg's Law, Atomic and Geometrical Factor, measurement of lattice parameter for cubic lattices

Unit 2:

Microscopic Polarization, Local Electric Field at an Atom, Electric Susceptibility, Polarizability, Clausius Mossotti Equation, Classical Theory of Electric Polarizability, Frequency dependence of dielectric constant, Langevin-Debye equation, Complex Dielectric Constant, Ferroelectric materials, Piezoelectric effect, Pyroelectric effect, Ferroelectric domains, PE hysteresis loop

Unit 3:

Bloch's theorem, Energy bands in solids, Kronig Penny model, Band gap, Conductor, semiconductor and insulator, Effective mass, Conductivity of Semiconductors, mobility, Hall Effect, Measurement of conductivity & Hall coefficient, Discussion: Direct and indirect band gaps of a semiconductor, Measurement of conductivity

Unit 4:

Magnetic Susceptibility, Dia-, Para-, Ferri- and, Ferromagnetic Materials, Classical Langevin Theory of Dia and Paramagnetic materials, Quantum Mechanical Treatment of Paramagnetism, Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic

Revised Syllabi and S.O.E. for B.Sc. (Physics)

Domains, Discussion of B-H Curve, Hysteresis: soft and hard material and Energy Loss

Practicals:

1. To measure the resistivity of a semiconductor (Ge) with temperature by four-probe method and to determine its band gap.
2. Determination of the concentration of majority carriers of a semiconductor using Hall Effect
3. Measurement of susceptibility of paramagnetic salt
4. To measure hysteresis loop of Ferroelectric crystal
5. To measure the Dielectric Constant of a dielectric Materials with frequency
6. To draw the BH curve of Fe using Solenoid & determine energy loss from Hysteresis
7. To measure the Dielectric Constant of a dielectric Materials with temperature and hence to find the ferroelectric curie temperature
8. Measurement of change in resistance of a semiconductor with magnetic field
9. To find the unit cell parameters from given x-ray diffraction data of given SCC material

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

Reference/Textbooks Suggested:

1. Introduction to Solid State Physics by Charles Kittel (Wiley)
2. Solid State Physics: Structure and Properties of Materials by M.A. Wahab (Wiley).
3. Principle of Electronic Materials and Devices by S. O. Kasap (Tata McGraw Hill)
4. Elements of Solid-State Physics, J.P. Srivastava (PHI)
5. Elementary Solid-State Physics: Principles and Applications (Pearson)
6. Solid State Physics, A. J. Dekker (Macmillan)
7. Engineering Physics by H.K. Malik and A.K. Singh (Tata McGraw Hill)

Semester -VI

Name of Program	B.Sc. (Physics)	Program Code	USPHY4
Name of the Course	Nanotechnology	Course Code	26PHYS406DS02
Hours per Week	06(2+4)	Credits	04(2+2)
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):

CLO1: Students would be able to explain the properties of Nanomaterials/nanostructures.

CLO2: Students get enabled to analyze the density of states in various nanostructures and related effect on optical properties.

CLO3: Students get acquainted with important techniques for preparation of Nanomaterials/nanostructures.

<p>CLO4: Understanding quantitatively, the experimental results of x-ray diffraction, photoluminescence and Raman spectra of Nanomaterials opens up avenues of future research.</p>
<p>Unit 1: Free electron theory (qualitative idea) and its features, Idea of band structure, Metals, insulators and semiconductors, Density of states in bands, Variation of density of states with energy, Variation of density of states and band gap with size of crystal, Kroning Penney Model.</p>
<p>Unit 2: Physics of reduced dimensional systems and devices: Quantum confinement, Electron confinement in one, two and three dimensional infinitely deep square well potentials, Various low dimensional systems: Quantum well structure; Quantum dots, Quantum wires.</p>
<p>Unit 3: Synthesis of Nanomaterials/Nanostructures: Different methods of preparation of nanomaterials, Bottom up: Cluster beam evaporation, Ion beam deposition, Chemical bath deposition with capping techniques and Top down: Ball Milling. Synthesis of zero-dimensional nanostructures (Nanoparticles): Sol-Gel Process, Epitaxial core-shell nanoparticles.</p>
<p>Unit 4: Characterization of Nanomaterials/Nanostructures: Determination of crystallite/particle size and strain in nanomaterials using Debye Scherer's formula and Williamson-Hall's plot, Shift in photoluminescence peaks, Variations in Raman spectra of nano-materials.</p>
<p>Practicals:</p> <ol style="list-style-type: none"> 1. To determine the concentration of Allura Red Dye in different drinks using UV-visible spectroscopy 2. Verification of Lambert Beer's law and determination of the concentration of an unknown solution by UV-Vis spectrophotometer 3. To simulate X-Ray Diffraction Experiment 4. Determination of particle size and lattice strain using Williamson's Halls Plot from x-ray diffraction data of a Nanomaterials 5. To record the optical absorption spectrum of semiconducting nanoparticles and hence to estimate the size of nanoparticles using Brus equation 6. To obtain FTIR data of sample and assignment of different functional group present 7. Analysis of Scanning electron micrograph of a material using ImageJ software 8. Analysis of Transmission electron micrograph (Bright and Dark Field images) of a material using ImageJ software 9. To record the optical absorption data of a solid transparent sample such as glass and to find the optical band gap (E_g) energy from cut-off wavelength and find the optical band gap energy (E_g) using Tauc's relation <p>Note: A student has to perform atleast eight (08) experiments from the above list.</p>
<p>Reference/Text Books Suggested:</p> <ol style="list-style-type: none"> 1. Physics of Low Dimensional Semiconductors by John H. Davies (Cambridge Univ. Press). 2. Introduction to Nano-technology by Charles P. Poole & Jr. Frank J. Owens (Wiley Interscience). 3. Quantum Mechanics for Nanostructures by Vladimir V. Mitin, Dmitry I. Sementsov & Nizami Z. Vagidov (Cambridge University Press). 4. Nanostructures & Nanomaterials: Synthesis, Properties & Applications by

Revised Syllabi and S.O.E. for B.Sc. (Physics)

Guozhong Cao (Imperial College Press).

5. Introduction to Nano: Basics to Nanoscience and Nanotechnology by Amretashis Sengupta & Chandan Kumar Sarkar (Editor) [Springer].
6. Solid State Physics by A. J. Dekker (Macmillan).
7. Essentials in Nano-science and nanotechnology by Narendra Kumar, Sunita Kumbhat (Wiley)

Semester -VI

Name of Program	B.Sc. (Physics)	Program Code	USPHY4
Name of the Course	Introductory Nuclear Physics	Course Code	26PHYS406DS03
Hours per Week	06(2+4)	Credits	04(2+2)
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: Students would be able to understand the structure of the nucleus

CLO2: Students would be able to find out the spin, parity, magnetic moments etc. of different nuclei.

CLO3: Students would be able to understand different nuclear decays.

CLO4: Students would gain basic knowledge about Nuclear Accelerators.

Unit 1: Nuclear Structure and Properties of Nuclei: Nuclear composition (p-n hypotheses), Nuclear properties; Nuclear size, spin, parity, statistics, magnetic dipole moment, quadrupole moment (shape concept). Determination of mass by Bain-Bridge, Bain-Bridge and Jordan mass spectrograph. Determination of charge by Mosley Law. Determination of size of nuclei by Rutherford Back Scattering. mass and binding energy, systematic of nuclear binding energy, nuclear stability.

Unit 2: Interaction of heavy charged particles (Alpha particles); Energy loss of heavy charged particle (idea of Bethe formula, no derivation), Range and straggling of alpha particles. Geiger-Nuttal law. Interaction of light charged particle (Beta-particle), Energy loss of beta-particles (ionization), Range of electrons, absorption of beta-particles. Interaction of Gamma Ray; Passage of Gamma radiations through matter (Photoelectric, Compton and pair production effect) electron-positron annihilation. Absorption of Gamma rays (Mass attenuation coefficient) and its application.

Unit 3: Nuclear Accelerators: Linear accelerator, Tandem accelerator, Cyclotron and Betatron accelerators. Nuclear Radiation Detectors. Gas filled counters; Ionization chamber, proportional counter, G.M. Counter (detailed study), Scintillation counter and semiconductor detector.

Unit 4: Nuclear reactions, Elastic scattering, Inelastic scattering, nuclear disintegration, Photonuclear reaction, Radiative capture, Direct reaction, Heavy ion reactions and spallation Reactions. Conservation laws, Q-value and reaction threshold. Nuclear Reactors.

Revised Syllabi and S.O.E. for B.Sc. (Physics)

Nuclear Reactors, General aspects of Reactor Design. Nuclear fission and fusion reactors, (Principle, construction, working and use).

List of Experiments:

1. Investigation of the plateau and optimal operating voltage of a Geiger-Muller counter
2. Investigation of statistical nature of counting rate
3. To investigate the relationship between absorber materials (atomic number), absorption thickness.
4. To verify the inverse square relationship between the distance and intensity of radiation.
5. To investigate the attenuation of radiation via the absorption of beta particles.
6. To determine the maximum energy of decay of a beta particle.
7. Study of the attenuation coefficients of the γ rays for Al, Fe and Pb using NaI scintillation counter
8. Measurement of γ ray energy of Cs-137 source using a NaI Scintillation detector
9. Investigation of possible radiation in different routine materials by operating GM at operating voltage.
10. Study of absorption of beta particles in Aluminium using GM counter.

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

Reference/Text Books Suggested:

1. Kaplan I, Nuclear Physics, 2nd Ed (1962), Oxford and IBH, New Delhi
2. Sriram K, Nuclear Measurement Techniques, (1986), AEWP, New Delhi
3. Ghoshal S N, Atomic and Nuclear Physics Vol II (1994), S Chand & Co New Delhi 28
4. Halliday, Introductory Nuclear Physics, Asia Publishing House, New Delhi
5. Sood D D, Ready A V R and Ramamoorthy, Fundamentals of Radiochemistry, IANCAS (2007), BARC, Bombay
6. Cohen B L, Concepts of Nuclear Physics (1998), Tata Mc Graw Hill, New Delhi
7. Krane K S, Introductory Nuclear Physics (1988), John Wiley & Sons New Delhi
8. Patel S B, Nuclear Physics (1992), Wiley Eastern Ltd, New Delhi
9. Roy R R and Nigam B P, Nuclear Physics (1993), Wiley Eastern Ltd New Delhi.

Semester -VI

Name of Program	B.Sc. (Physics)	Program Code	USPHY4
Name of the Course	Basic Characterization Techniques	Course Code	26PHYS406DS04
Hours per Week	06(2+4)	Credits	04(2+2)
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:

CLO1: understand nitty gritty of image formation in case of light as well as electron

<p>microscopes</p> <p>CLO2: understand basics of Scanning Electron Microscopy</p> <p>CLO3: appreciate various factors affecting image quality in SEM</p> <p>CLO4: analyze crystal structure using x-ray diffraction technique</p> <p>CLO 5: acquainted with different imaging modes and operation of TEM</p>
<p>Unit 1:</p> <p>Basics of X-ray emission from source, electron excitation and X-ray interaction with materials in general, Properties of X-rays, Bragg's Law Derivation, Amorphous vs. crystalline materials, Intensities of diffracted beams: Atomic scattering factor, structure factor calculation for various crystal systems, Multiplicity factor and temperature factor, Indexing of x-ray diffraction patterns, FWHM and line broadening, Crystallite size effect and Scherrer formula, Effect of strain (tensile vs compressive, uniform vs. non-uniform)</p>
<p>Unit 2:</p> <p>Components of electron microscope (electron gun, electro-magnetic lenses etc.), Aberrations (chromatic, spherical, astigmatism etc.) and their corrections, Electron-materials interaction (elastic vs. inelastic scattering, coherent vs. incoherent scattering, interaction volume), Transmission electron microscopy (TEM): Image formation and contrast generation (mass-thickness contrast, atomic number contrast, diffraction contrast etc.)</p>
<p>Unit 3:</p> <p>Modes of TEM, Concept of reciprocal lattice, Ewald sphere, Diffraction from finite crystal, Diffraction pattern (Single crystal vs. polycrystalline diffraction, selected area diffraction etc.), Indexing of diffraction pattern (camera constant, structure, Application of electron diffraction (DF imaging, dislocation contrast, phase identification etc.), TEM sample preparation</p>
<p>Unit 4:</p> <p>Scanning electron microscopy (SEM): Working principle in scanning mode, Signal generation: Inelastic scattering (Secondary vs. backscattered electron, Auger electrons, Characteristic X-ray emission etc.), Detectors: SE (E-T detector), BSE (scintillator vs. solid state), in-Lense detector, Optics of SEM (magnification, pixel, resolution, and depth of field), Resolution in SEM (minimum probe size, beam current etc.), Chemical analysis in SEM</p>
<p>Practicals:</p> <ol style="list-style-type: none"> 1. To record x-ray diffraction data of a simple cubic crystalline material and to find the lattice parameters using manual indexing method 2. Recording of x-ray diffraction data of nanomaterials and hence to find the crystallite size and using Scherer equation 3. Analysis of Scanning electron micrograph of a material using ImageJ software 4. Analysis of Transmission electron micrograph (Bright and Dark Field images) of a material using ImageJ software 5. Indexing of selected area electron diffraction (SAED) pattern of a simple cubic crystalline material 6. To simulate X-Ray Diffraction Experiment 7. Determination of particle size and lattice strain using Williamson's Halls Plot from x-ray diffraction data of a Nanomaterials. 8. Comparison of experimental XRD patterns of samples with standard patterns from a database like the ICDD (International Centre for Diffraction Data) to identify phases.

Revised Syllabi and S.O.E. for B.Sc. (Physics)

9. To study preferred crystallographic orientations using XRD patterns collected at various sample orientations

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

Reference/Textbooks Suggested:

1. Fundamentals of light microscopy and electronic imaging, Douglas B. Murphy, 2001, Wiley-Liss, Inc. USA
2. Encyclopedia of Materials Characterization, Surfaces, Interfaces, Thin Films, Editors C. Richard Brundle, Charles A. Evans, Jr., Shaun Wilson, Butterworth-Heinemann, Boston, USA
3. Elements of X-ray diffraction' B.D. Cullity and S.R. Stock, 2001, Prentice Hall, Inc. USA
4. Transmission electron microscopy" D.B. Williams and C. Barry Carter, 4 volumes, Springer, 1996. USA
5. Scanning Electron Microscopy and X-Ray Microanalysis': Joseph I. Goldstein, Dale E. Newbury, Joseph R. Michael, Nicholas W.M. Ritchie, John Henry J. Scott, David C. Joy, 4th Edition, Springer 2017.
6. Electron microscopy and Analysis: P. J. Goodhew, J. Humphreys, R. Beanland, 3rd Edition, Taylor & Francis 2001.
7. <https://nptel.ac.in/courses/115103030>
8. https://onlinecourses.nptel.ac.in/noc22_mm14/preview
9. <https://archive.nptel.ac.in/courses/113/105/113105101/>

Semester-VII

Name of Program	B.Sc. (Physics)	Program Code	USPHY4
Name of the Course	Mathematical Physics	Course Code	24PHY201DS01
Hours per Week	04 (1+3)	Credits	04
Maximum Marks	Theory: 30 (internal) +70 (external) Total: 100	Time of Examinations	03

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-Hamilton Theorem, Inverse of matrix, Orthogonal, Unitary and Hermitian matrices,

Revised Syllabi and S.O.E. for B.Sc. (Physics)

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

Name of Program	B.Sc. (Physics)	Program Code	USPHY4
Name of the Course	Classical Mechanics	Course Code	24PHY201DS02
Hours per Week	04 (1+3)	Credits	04
Maximum Marks	Theory: 30 (internal) +70 (external) Total: 100	Time of Examinations	03

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

Revised Syllabi and S.O.E. for B.Sc. (Physics)

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)

Revised Syllabi and S.O.E. for B.Sc. (Physics)
Semester-VII

Name of Program	B.Sc. (Physics)	Program Code	USPHY4
Name of the Course	Quantum Mechanics –I	Course Code	24PHY201DS03
Hours per Week	04 (1+3)	Credits	04
Maximum Marks	Theory: 30 (Internal) +70 (external) Total: 100	Time of Examinations	03
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			

Revised Syllabi and S.O.E. for B.Sc. (Physics)

Semester-VII

Name of Program	B.Sc. (Physics)	Program Code	USPHY4
Name of the Course	Physics of Electronic Devices	Course Code	24PHY201DS04
Hours per Week	04 (1+3)	Credits	04
Maximum Marks	Theory: 30 (Internal) + 70 (external) Total: 100	Time of Examinations	03
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-multiplier 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).			

Revised Syllabi and S.O.E. for B.Sc. (Physics)

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

Name of Program	B.Sc. (Physics)	Program Code	USPHY4
Name of the Course	Practical: General Physics -I	Course Code	24PHY201DS05
Hours per Week	08	Credits	04
Maximum Marks	Practical: 100 Total: 100		

Note:

	Marks distribution
Regular assessment through observation and class discussion	20
Lab work (practical file) / field work (report)/Portfolio	30
Assignment/Case study / Mini project (3 X 10)	30
Seminar / Presentation (2 X 7.5)	15
Attendance	05
Total	100

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

Revised Syllabi and S.O.E. for B.Sc. (Physics)

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

Revised Syllabi and S.O.E. for B.Sc. (Physics)
Semester-VIII (OPTION-1) (4 Year UG Hons.)

Name of Program	B.Sc. (Physics)	Program Code	USPHY4
Name of the Course	Statistical Mechanics	Course Code	24PHY202DS01
Hours per Week	04 (1+3)	Credits	04
Maximum Marks	Theory: 30 (internal) +70 (external) Total: 100	Time of Examinations	03
<p>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.</p>			
<p>Course Learning Outcomes (CLO):</p> <p>CLO1 The students are able to appreciate cellular nature of phase space and interface of Statistical Mechanics with Thermodynamics</p> <p>CLO2 Knowledge of ensemble theory would result in greater insight into solutions of various complex problems</p> <p>CLO3 The students would be able to analyse the peculiar gas behaviour and are in a position to extend the treatment to complex problems</p> <p>CLO4 The students would be equipped to explore the applications of Ising Model and to understand different approximations.</p>			
<p>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.</p>			
<p>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</p>			
<p>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</p>			
<p>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.</p>			
<p>References:</p> <ol style="list-style-type: none"> 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 (OPTION-1) (4 Year UG Hons.)

Name of Program	B.Sc. (Physics)	Program Code	USPHY4
Name of the Course	Quantum Mechanics –II	Course Code	24PHY202DS02
Hours per Week	04 (1+3)	Credits	04
Maximum Marks	Theory: 30 (internal) +70 (external) Total: 100	Time of Examinations	03
<p>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.</p>			
<p>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.</p>			
<p>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.</p>			
<p>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.</p>			
<p>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.</p>			
<p>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.</p>			
<p>References:</p> <ol style="list-style-type: none"> 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. 			

Revised Syllabi and S.O.E. for B.Sc. (Physics)
Semester-VIII (OPTION-1) (4 Year UG Hons.)

Name of Program	B.Sc. (Physics)	Program Code	USPHY4
Name of the Course	Atomic and Molecular Physics	Course Code	24PHY202DS03
Hours per Week	04 (1+3)	Credits	04
Maximum Marks	Theory: 30 (internal) +70 (external) Total: 100	Time of Examinations	03
<p>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.</p>			
<p>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</p>			
<p>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</p>			
<p>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)</p>			
<p>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</p>			
<p>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</p>			
<p>References:</p> <ol style="list-style-type: none"> 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. Holiias 			

Revised Syllabi and S.O.E. for B.Sc. (Physics)
Semester-VIII (OPTION-1) (4 Year UG Hons.)

Name of Program	B.Sc. (Physics)	Program Code	USPHY4
Name of the Course	Solid State Physics	Course Code	24PHY202DS04
Hours per Week	04 (1+3)	Credits	04
Maximum Marks	Theory: 30 (internal) +70 (External) Total: 100	Time of Examinations	03

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 identify 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

Revised Syllabi and S.O.E. for B.Sc. (Physics)

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.)

Name of Program	B.Sc. (Physics)	Program Code	USPHY4
Name of the Course	Practical: General Physics -II	Course Code	24PHY202DS05
Hours per Week	08	Credits	04
Maximum Marks	Practical: 100 Total: 100		

Note:

	Marks distribution
Regular assessment through observation and class discussion	20
Lab work (practical file) / field work (report)/Portfolio	30
Assignment/Case study / Mini project (3 X 10)	30
Seminar / Presentation (2 X 7.5)	15
Attendance	05
Total	100

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

Revised Syllabi and S.O.E. for B.Sc. (Physics)

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)

Name of Program	B.Sc. (Physics)	Program Code	USPHY4
Name of the Course	Quantum Mechanics –II	Course Code	24PHY202DS02
Hours per Week	04 (1+3)	Credits	04
Maximum Marks	Theory: 30 (internal) +70 (external) Total: 100	Time of Examinations	03

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

Revised Syllabi and S.O.E. for B.Sc. (Physics)

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.

Revised Syllabi and S.O.E. for B.Sc. (Physics)
Semester-VIII (OPTION-II) (4 Year UG Hons. With Research)

Name of Program	B.Sc. (Physics)	Program Code	USPHY4
Name of the Course	Solid State Physics	Course Code	24PHY202DS04
Hours per Week	04 (1+3)	Credits	04
Maximum Marks	Theory: 30 (internal) +70 (external) Total: 100	Time of Examinations	03

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 identify 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

Revised Syllabi and S.O.E. for B.Sc. (Physics)

5. Kittel: Solid State Physics
6. Chaikin and Lubensky: Principles of Condensed Matter Physics
7. H. M. Rosenberg: The solid State.