Shri Acharyaratna Deshbhooshan Shikshan Prasarak Mandal, Kolhapur

Mahavir Mahavidyalaya, Kolhapur (Autonomous)

Affiliated to Shivaji University, Kolhapur

Syllabus for Choice Based Credit System (CBCS)
Bachelor of Science (B. Sc.) Programme

Part	III	Course	Physics

Under the Faculty of Science & Technology

(To be introduced from Academic Year 2023 – 24 onwards)
Subject to the revisions& modifications made from time to time

Mahavir Mahavidyalaya, Kolhapur (Autonomous)
Affiliated to Shivaji University, Kolhapur

(New syllabus under Autonomy to be introduced from June, 2023 onwards)

Primary Information:			
Programme	**Bachelor of Science (B. Sc.) CBCS**		
Part	**III**	Semester	**V**
Course	**Physics**	Course Code	**DSE-E1**
Paper No.	**IX**	Course Type	**Semester**
Total Marks	**50 Marks**	Implementation	**2023 – 24**
Total Credits	**02**	Contact Hours	**03 / Week**
Course Title	**Mathematical Physics**		

Course Objectives:	
i)	To study cartesian, spherical polar and cylindrical co-ordinate systems.
ii)	To understand wave method of solving partial differential equations.
iii)	To study Frobenious method and special functions.
iv)	To study complex analysis.

Course Syllabus
(CR = Credits / IH: Instructional Hours)

Modules	**CR**	**IH**
Module I : **Unit I - Orthogonal Curvilinear Co-ordinates :** Introduction to Cartesian, spherical polar and cylindrical co-ordinate systems, concept of orthogonal curvilinear co-ordinates, gradient, divergence, curl, del and Laplacian in orthogonal curvilinear co-ordinate system, extension of gradient, divergence, curl, del and Laplacian in spherical polar and cylindrical co-ordinate systems. **Unit II - Partial Differential Equation :** Introduction to differential equations, Method of separation of variables for solving second order partial differential equations, Form of two dimensional Laplace differential equation in Cartesian coordinates and its solution, Three dimensional partial differential equation in Cartesian	01	15

coordinates and its solution, The differential equation of progressive wave and its solution.		
Module II : **Unit I - Frobenious Method and Special Functions :** Singular points of second order differential equations, Application of singularity to Legendre and Bessel differential equation, Series solution method of solving second order linear differential equation (Frobenious method) and its application to Legendre differential equation. **Unit II - Complex Analysis :** Revision of complex numbers and their graphical representation: Geometrical representation, Equal complex numbers, Addition, Subtraction, Multiplication and Division of complex number by geometry. Types of complex numbers, square roots of complex numbers, Logarithmic function of complex variables, Euler's formula, De'Moivre's theorem, Cauchy-Riemann conditions.	01	15

Course Outcomes:
On completion of the course, students will be able to:
i) Understand Cartesian, spherical polar and cylindrical co-ordinate systems.
ii) Solve partial differential equations.
iii) Understand Frobenious method and special functions.
iv) Understand complex analysis.

Primary Information:			
Programme	**Bachelor of Science (B. Sc.) CBCS**		
Part	**III**	Semester	**V**
Course	**Physics**	Course Code	**DSE-E2**
Paper No.	**X**	Course Type	**Semester**
Total Marks	**50 Marks**	Implementation	**2023 – 24**
Total Credits	**02**	Contact Hours	**03 / Week**
Course Title	**Quantum Mechanics**		

Course Objectives:	
i)	To understand wave particle duality, uncertainty principle and its applications.
ii)	To study Schrödinger wave equations, Eigen values and Eigen functions.
iii)	To understand operators, Eigen values and Eigen functions of L^2 and L_z operators Commutation relation between x and p.
iv)	To study the applications of Schrödinger wave equation.

Course Syllabus
(CR = Credits / IH: Instructional Hours)

Modules	CR	IH
Module I: **Unit I -Matter Waves :** Wave particle duality, De-Broglie hypothesis of matter waves, Derivation of wavelength of matter wave, Concept of wave packet, Relation between group velocity - phase velocity and group velocity-particle velocity, Davisson and Germer experiment, Uncertainty principle (statements only): position-momentum and energy- time, Application of uncertainty principle-non existence of free electrons in the nucleus. **Unit II –Schrodinger's Wave Equation :** Wave function and its physical interpretation, Condition of physically acceptable wave function, Normalized and orthogonal wave function, Schrödinger time dependent and time independent (steady state) wave equations in 1D and 3D, Probability current density(continuity equation), Eigen values and Eigen functions, Expectation values of dynamic variables.	01	15

Module II :		
Unit I -Operators in Quantum Mechanics : Definition of an operator, Position operator (x), Linearmomentum operator (p), Commutation relation in quantum mechanics, Commutation relation between x and p, Kinetic energy operator (T), Hamiltonian operator (H), Parity operator (π), Angular momentum operator (L) – components of angular momentum operator in Cartesian coordinate system, Ladder operators, Eigen values of L_z and L^2 (use equations for $L^2$and L_z in spherical polar coordinates). **Unit II –Applications of Schrodinger Equation :** Particle in a rigid box (infinite potential well) in one dimension and three dimension, Step potential- reflection and transmission coefficients, Potential barrier- tunneling effect (qualitative treatment), One dimensional simple harmonic oscillator (operator method)- energy levels, zero point energy, Schrodinger equation for Hydrogen atom in spherical polar coordinates, Separation of radial and angular parts.	01	15

Course Outcomes:
On completion of the course, students will be able to:
i) Understand Concept of wave packet and Uncertainty principle.
ii) Understand Schrödinger time dependent and time independent (steady state) wave equations
iii) Understand operators & Commutation relations.
iv) Understand applications of Schrodinger equation.

Primary Information:			
Programme	**Bachelor of Science (B. Sc.) CBCS**		
Part	**III**	Semester	**V**
Course	**Physics**	Course Code	**DSE-E3**
Paper No.	**XI**	Course Type	**Semester**
Total Marks	**50 Marks**	Implementation	**2023 – 24**
Total Credits	**02**	Contact Hours	**03 / Week**
Course Title	**Classical Mechanics and Classical Electrodynamics**		

Course Objectives:	
i)	To understand Langrangian formulation, D'Alembert's principle and applications.
ii)	To understand Hamiltonian formulation, D'Alembert's principle and application
iii)	To understand concepts in special theory of relativity.
iv)	To understand concept of motion of charged particles in uniform electric and magnetic fields.

Course Syllabus
(CR = Credits / IH: Instructional Hours)

Modules	CR	IH
Module I : **Unit I - Lagrangian Formulation :** Constraints, Degrees of freedom, Generalized coordinates, Principle of virtual work, D'Alembert's principle, Lagrange's equation from D'Alembert's principle, Applications of Lagrange's equation to a particle in space, Atwood's machine and a bead sliding on uniformly rotating wire under force free condition. **Unit II -Hamiltonian Formulation :** Hamilton's principle, Deduction of Hamilton's principle from D'Alembert's principle, Deduction of Lagrange's equation from Hamilton's principle, Applications-shortest distance between two points in a plane, Brachistochrone problem.	01	15

Module II:		
Unit I - Special Theory of Relativity : Inertial and non-inertial reference frames, Galilean transformation equations, Michelson-Morley experiment, postulates of special theory of relativity, Lorentz transformation equations, Relativistic addition of velocities, Length contraction, Time dilation, Variation of mass with velocity, Mass-energy relation. **Unit II - Charged Particles Dynamics :** Poisson's and Laplace's equations and their physical significance, Laplace's equation in one dimension and its solutions, Motion of charged particle - in uniform electric field E, magnetic field B, Crossed uniform electric field E and magnetic field B.	01	15

Course Outcomes:
On completion of the course, students will be able to:
i) Derive Lagrange's equation from D'Alembert's principle& understand application of Lagrange's equation.
ii) Derive Hamilton's equation from D'Alembert's principle& understand application of Hamilton's equation.
iii) Define Relativistic addition of velocities, length contraction, time dilation. & describe mass energy relation
iv) Define Poisons and Laplace equation and their physical significance & describe motion of charged particles in electric and magnetic fields.

Primary Information:			
Programme	**Bachelor of Science (B. Sc.) CBCS**		
Part	**III**	Semester	**V**
Course	**Physics**	Course Code	**DSE-E4**
Paper No.	**XII**	Course Type	**Semester**
Total Marks	**50 Marks**	Implementation	**2023 – 24**
Total Credits	**02**	Contact Hours	**03 / Week**
Course Title	**Digital and Analog Circuits and Instrumentation**		

Course Objectives:	
i)	To understand basic & derived gates.
ii)	To understand amplifier, power supply and oscillator.
iii)	To understand basic theory and applications of Cathode Ray Oscilloscope.
iv)	To understand working of operational Amplifier and Timer.

Course Syllabus

(CR = Credits / IH: Instructional Hours)

Modules	**CR**	**IH**
Module I : **Unit I - Digital Electronics :** Review of basic logic gates, Derived logic gates (NOR, NAND, XOR and XNOR gates), NAND and NOR gates as universal gates, De Morgan's theorems, R-S flip flop, J-K flip-flop, Half adder, Full adder, 4 bit parallel binary adder. **Unit II –Transistors Amplifier and Oscillators:** Single stage transistor CE amplifier, load line analysis- d.c. load line, a.c. load line and Q point, Feedback in amplifiers and its types, theory of feedback oscillator, Barkhausen's criterion for sustained oscillations, Oscillatory circuit (tank circuit),essentials of transistor oscillator, sinusoidal oscillators-phase shift oscillator, Colpitts oscillator, Hartley oscillator, Crystal oscillator using transistors.	01	15

Module II :		
Unit I – Cathode Ray Oscilloscope : Introduction to CRO, Block diagram of CRO, Principle, Construction and working of CRT, Applications of CRO: measurement of A.C. and D. C. voltages, periodic time, frequency and phase difference, Lissajous figures. **Unit II –Operational Amplifier and Timer :** **A) Operational Amplifier:** Differential amplifier and its type, Op-Amp, Block diagram of an Op- Amp. Op-Amp parameters, Characteristics of an ideal and practical Op-Amp (IC 741), Applications of Op-Amps: Inverting amplifier and Non-inverting amplifier, Adder, Subtractor, Differentiator, Integrator. **B) Timer IC:** Block diagram of IC555, IC 555 Pin configuration, Applications of IC 555 as astable and monostable multivibrator.	01	15

Course Outcomes:
On completion of the course, students will be able to:
i) Explain basic & derived gates.
ii) Explain amplifier, power supply and oscillator.
iii) Explain basic theory and applications of Cathode Ray Oscilloscope.
iv) Explain working of operational Amplifier and Timer.

Primary Information:			
Programme	**Bachelor of Science (B. Sc.) CBCS**		
Part	**III**	Semester	**VI**
Course	**Physics**	Course Code	**DSE-F1**
Paper No.	**XIII**	Course Type	**Semester**
Total Marks	**50 Marks**	Implementation	**2023 – 24**
Total Credits	**02**	Contact Hours	**03 / Week**
Course Title	**Nuclear and Particle Physics**		

Course Objectives:	
i)	To understand knowledge of various model compare to nucleus.
ii)	To understand knowledge ofnuclear detectors.
iii)	To understand knowledge of particle accelerators.
iv)	To understand knowledge of particles.

Course Syllabus
(CR = Credits / IH: Instructional Hours)

Modules	CR	IH
Module I: **Unit I - General Properties of Nuclei and Nuclear Model :** Constituents of nucleus and their intrinsic properties, Quantitative facts about size, mass, charge density (matter energy), binding energy, average binding energy and its variation with mass number, Liquid drop model approach, Semi empirical mass formula. **Unit II – Particle Physics :** Particle interactions, Classification of elementary particles, Symmetries and conservation laws-energy, momentum, angular momentum and parity, Baryon number, Lepton number, Concept of quark model.	01	15

Module II :		
Unit I -Nuclear Detectors : Ionization chamber, Geiger Muller counter- construction, working and theory, dead time and recovery time, quenching mechanism, Construction of photo-multiplier tube (PMT), Scintillation detector-principle, construction and working, Wilson cloud chamber, Semiconductor detector, Cerenkov radiations, Cerenkov detector. **Unit II – Particle Accelerators :** Need of accelerators, Cyclotron- construction, working, theory and its limitations, Principle of phase stable orbit, Synchrocyclotron - construction and working, Synchrotrons- electron synchrotron and proton synchrotron, Betatron - principle, construction and working condition, expression of energy gain.	01	15

Course Outcomes:
On completion of the course, students will be able to:
i) Explain about the knowledge of particles & various model compare to nucleus.
ii) Explain about knowledge of nuclear detectors.
iii) Explain about knowledge of particle accelerators.
iv) Explain about the knowledge of particles.

Primary Information:			
Programme	**Bachelor of Science (B. Sc.) CBCS**		
Part	**III**	Semester	**VI**
Course	**Physics**	Course Code	**DSE-F2**
Paper No.	**XIV**	Course Type	**Semester**
Total Marks	**50 Marks**	Implementation	**2023 – 24**
Total Credits	**02**	Contact Hours	**03 / Week**
Course Title	**Solid State Physics**		

Course Objectives:	
i)	To study &Understand types of crystal structure and types of solids.
ii)	To study X-ray diffraction methods for structural analysis of crystals.
iii)	To study magnetic properties of matter.
iv)	To study origin of bands in solid and distinction between metals, semiconductors and insulators.

Course Syllabus
(CR = Credits / IH: Instructional Hours)

Modules	CR	IH
Module I: **Unit I -Crystal Structure :** Solids: amorphous, polycrystalline and crystalline materials; lattice, basis, unit cell- primitive, non-primitive unit cell, symmetry operations, symmetry elements of cube, Bravais lattice in two and three dimensions, Miller indices, Miller indices and inter-planer spacing, Simple crystal structures: SC, BCC, FCC and HCP(Co-ordination number, atomic radius, atoms per unit cell and packing fraction) **Unit II –X-Ray Diffraction by Crystals:** Reciprocal lattice and its properties, Brillouin zone, Diffraction of X-rays by crystals, Ewald construction, Bragg's law in reciprocal lattice, Experimental methods in X-ray diffraction - Laue method, rotating crystal method, powder photograph method (only one method in detail i.e. powder photograph method), Analysis of cubic crystal by powder method.	01	15

Module II :		
Unit I -Magnetic Properties of Materials : Classical Langevin theory of diamagnetic and paramagnetic materials, Quantum mechanical treatment of paramagnetism, Curie's law, Weiss theory of ferromagnetism and ferromagnetic domains, Explanation of B-H curve, Hysteresis and energy loss. **Unit II – Elementary Band Theory of Solids :** Concept of density of states, Bloch theorem (statement only), Kroning–Penny model, Origin of energy gap, Velocity of electrons according to band theory, Effective mass of an electron, Distinction between metals, semiconductors and insulators, Hall Effect - Hall voltage and Hall Coefficient.	01	15

Course Outcomes:
On completion of the course, students will be able to:
i) Understand various types of solids depending on crystal structure.
ii) Understand different methods for structural analysis of crystal.
iii) Understand magnetic properties of matter.
iv) Understand energy bands in solid.

Primary Information:			
Programme	**Bachelor of Science (B. Sc.) CBCS**		
Part	**III**	Semester	**VI**
Course	**Physics**	Course Code	**DSE-F3**
Paper No.	**XV**	Course Type	**Semester**
Total Marks	**50 Marks**	Implementation	**2023 – 24**
Total Credits	**02**	Contact Hours	**03 / Week**
Course Title	**Atomic and Molecular Physics and Astrophysics**		

Course Objectives:	
i)	To understand atomic structure, atomic models and atomic spectra.
ii)	To understand fine structure and Zeeman effect.
iii)	To understand rotational spectra and vibrational spectra.
iv)	To understand Raman Effect and Characteristic properties of Raman lines.
v)	To understand Milky Way galaxy and origin of solar system.

	Course Syllabus (CR = Credits / IH: Instructional Hours)		
Modules		**CR**	**IH**
Module I:		01	15
Unit I -Atomic Structure : Revision of atomic models- Rutherford and Bohr model. Electron orbits, Atomic spectra, Bohr atom, Energy level and spectra, Atomic excitation, Vector atom model- quantum numbers, Pauli's exclusion principle. **Unit II - Atomic Spectra :** Observed hydrogen fine structure, Spectral notations and optical spectral series for doublet structure, Spectrum of sodium and its doublet fine structure, Selection and intensity rules for fine structure doublets, Normal order of fine structure doublets, Electron spin-orbit interaction, Normal and anomalous Zeeman effect and their explanation from vector atom model, Lande's g factor.			

Unit III – Molecular Spectra : Molecular bond, Electron sharing, H_2^+molecular ion, The hydrogen molecule, Rotational energy levels, Rotational spectra, Vibrational energy levels, Vibrational spectra, Vibration – rotation spectra, Electronic spectra of diatomic molecules.			
Module II :		01	15
Unit I -Raman Spectra : Raman Effect, Characteristic properties of Raman lines, Classical and quantum theory of Raman Effect, Difference between Raman spectra and infrared spectra. **Unit II –Structure of Universe :** Big-Bang theory, Steady state theory, Oscillating theory, Hubble law, Cosmological tests, Milky Way galaxy, Origin of solar system - Condensation theory; arguments for and against the theory.			

Course Outcomes:
On completion of the course, students will be able to:
i) Explain atomic structure, atomic models and atomic spectra.
ii) Explain fine structure and Zeeman effect.
iii) Explain rotational spectra and vibrational spectra.
iv) Explain Raman effect and characteristic properties of Raman lines.
v) Explain Milky Way galaxy and origin of solar system.

Primary Information:			
Programme	**Bachelor of Science (B. Sc.) CBCS**		
Part	**III**	Semester	**VI**
Course	**Physics**	Course Code	**DSE-F4**
Paper No.	**XVI**	Course Type	**Semester**
Total Marks	**50 Marks**	Implementation	**2023 – 24**
Total Credits	**02**	Contact Hours	**03 / Week**
Course Title	**Energy Studies and Materials Science**		

Course Objectives:	
i)	To understand the renewable energy systems, its components and interactions between the components.
ii)	The knowledge in a special field such as solar energy, storage.
iii)	To study the superconductivity and types of superconductor.
iv)	To study the nanotechnology & its applications.

Course Syllabus
(CR = Credits / IH: Instructional Hours)

Modules	CR	IH
Module I:	01	15
Unit I – **A) Energy :** Energy, Forms of energy, Man and environment, Energy chains, Classification of energy resources, Energy demands, Age of renewable and alternatives. **B) Wind Energy :** Wind energy, Wind energy chains, Wind energy quantum, Planning of wind farm, Wind power density, Efficiency factor of wind turbine (P-H graph), Power of wind turbine for a given incoming wind velocity, Types of a wind turbine generator unit, Horizontal axis propeller type wind turbine generator unit. **Unit II –Solar Energy :** Solar energy, Solar energy spectrum (UV, Visible and IR), Utilization of solar energy-thermal route, photovoltaic route, Essential subsystems in solar energy plant, Solar constant, Clarity index, Solar insolation, Solar energy from satellite		

station through microwave to earth station, Solar Photovoltaic systems, Merits and limitations of solar PV systems, Prospects of solar PV systems, Power of a solar cell and solar PV panel.		
Module II : **Unit I - Superconductivity :** Idea of superconductivity, Critical temperature, Critical magnetic field, Meissner effect, Type-I and Type-II superconductors, London equation and penetration depth, Isotope effect, Application (magnetic levitation) **Unit II – Nanotechnology :** Introduction to nanoscience and nanotechnology, Length scales relevant to nanoscience, Nanostructures: 1D, 2D and 3Dnanostructures, Size effects in nanosystems, Quantum confinement, Synthesis of nanostructured materials(Top down and bottom up approach), Photolithography, Ball milling, Nucleation and growth, Applications of nanotechnology (Spintronics, Molecular electronics, Nano biotechnology)	01	15

Course Outcomes:
On completion of the course, students will be able to:
i) Perform an initial design of a renewable energy system.
ii) Identify, define, present and communicate issues within the subject area.
iii) To understand superconductivity phenomenon and its types.
iv) To understand nanotechnology & its applications.

Practical Course

Course Objectives:
1. To develop practical skills.
2. To understand experimental determination of wavelength of sodium by various optical methods.
3. To understand absorption spectrum of a liquid KMnO4 solution.
4. To understand experimental determination of Self and Mutual Inductance by various methods.
5. To understand calibration of wire by various electrical methods.
6. To understand experimental determination of surface tension by various methods.
7. To understand experimental determination of Young's modulus (Y) by various methods.
8. To understand use of C programming to solve physics experimental calculations.
9. To understand use of Scilab software to solve physics experimental problems.
10. To understand building and testing of various oscillators using BJT.

Modules	CR
Module I:	Total 16
Group-I 1. Resonance pendulum 2. S.T. of soap solution 3. Y and n using Flat Spiral Spring 4. Y by Koenig's method 5. C program to arrange the given set of numbers in ascending/descending order 6. C program to find largest/smallest number from a given set of numbers 7. Scilab Expt. 1 (problem from Quantum Mechanics) 8. Scilab Expt. 2 (problem from Quantum Mechanics) **Group-II** 1. Cardinal points by Newton's method 2. Diffraction at a Single Slit 3. Diffraction at cylindrical obstacle 4. Lloyd's single mirror 5. Double refracting prism 6. Diameter of Lycopodium powder 7. Spherical aberration 8. Absorption spectrum of a liquid (KMnO4 solution) **Group-III** 1. Self Inductance by Owen's Bridge 2. Mutual inductance using Ballistic galvanometer. 3. Resistance of B.G. by half deflection method 4. e/m of Electron By Thomson's Method/Calibration of wire by Carey Foster bridge 5. Absolute capacity of condenser 6. I-V characteristics of Solar Cell 7. Band gap energy of semiconductor using p-n junction diode 8. Determination of Plank's constant by using LED	

Module II:	
Group–IV 1. To verify the truth tables of NAND, NOR, Ex-OR and Ex-NOR gates by using basic gates with IC-74 series. 2. To verify the De-Morgan's theorems by using IC-74 series. 3. To built and test Colpitts oscillator using BJT. 4. To built and test phase shift oscillator using BJT. 5. To design and test an astable multivibrator using IC-555 Timer. 6. To design and test monostable multivibrator using IC-555 Timer. 7. To study Op-amp as an inverting amplifier. 8. To study Op-amp as Schmitt trigger. **Group-V-A** 1. Study of divergence of LASER beam 2. Measurement of wavelength of LASER using plane diffraction grating 3. Schuster's method and optical levelling of spectrometer 4. Obtaining biprism fringes without lateral shift 5. Polar graph using photocell/photovoltaic cell 6. Testing of electronic components 7. C program – Edit, save and execute given C program 8. C program – Edit, save and execute given C program **Group – V-B** 1. Radius of Capillary bore using mercury thread 2. Determination of lattices constant using given XRD powder pattern 3. Estimation of errors 4. Study of Half and Full adder 5. Simplification of digital circuit using Boolean laws (paper-work). 6. Electrical wiring of bulb, switch and plug. 7. Tracing of given electronic circuit/ build the given circuit using breadboard 8. Assembling of given electronic circuit(soldering method)	

Course Outcomes:
• On completion of this course students will be expected to:
1) Students will be able to take measurements and readings with practical skills.
2) Students will be able to determinate wavelength of sodium by various optical methods.
3) Students will be able to understand absorption spectrum of a liquid KMnO4 solution.
4) Students will be able to determine Self and Mutual Inductance by various methods.
5) Students will be able to calibrate wire by various electrical methods.
6) Determine surface tension of mercury by various practical methods.
7) Determine Young's modulus (Y) by various practical methods.
8) Use C-programm to solve physics experimental calculations.
9) Use Scilab software to solve physics experimental problems.
10) Built and test various oscillators using BJT.

Reference Materials -

Books for Reference

1.	Advanced calculus, Robert C. Wrede, Murray Spiegel.
2.	Mathematical Physics, H. K. Das, Rama Varma.
3.	Modern Physics, R. Murugeshan, 1997, S. Chand and Company Ltd.
4.	Quantum Mechanics Theory and Applications, A. K. Ghatak and S. Lokanathan, Third Edn.1995, Macmillan India Ltd.
5.	Classical Mechanics, Goldstein Herbert, Narosa Publi./ Pearson Edu. 2018
6.	Classical Electrodynamics, Puri S.P., Tata McGraw/Alpha Science 2011
7.	Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.

8.	Electronic devices and circuits, S. Salivahanan and N. Suresh Kumar, 2012, Tata Mc-Graw Hill.
9.	Introductory nuclear Physics, Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
10.	Introduction to Elementary Particles, D. Griffith, John Wiley & Sons
11.	Introduction to Solid State Physics, Charles Kittle, 8th Ed.,2004, Wiley India Pvt. Ltd.
12.	Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006,Prenice-Hall of India
13.	Atomic and Nuclear Physics – H. Semat and T. E. Albright.
14.	Astronomy – Fundamentals and Frontiers – Robert Jastrow and M. H.Thompson
15.	Energy Technology – Non-conventional, Renewable and Conventional – S. Rao and Dr. Parulekar.
16.	Material Science and Engg. - 5th Edition- V. Raghavan PHI Learning Pvt. Ltd. Delhi
17.	Nanotechnology: Principles and Practices, Sulbha K. Kulkarni (2ndEdition), Capital Publishing Co. New Delhi.
Books for Practical	
1.	Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House.
2.	Advanced level Physics Practical, Michael Nelson and Jon M. Ogborn, 4thEdition, reprinted 1985, Heinemann Educational Publishers
3.	A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition,2011, Kitab Mahal, New Delhi.
4.	B.Sc. Practical Physics, C. L. Arora, S. Chand & Company Pvt. Ltd., New Delhi
5.	B.Sc. Practical Physics, Harman Singh, Hemane, 2012 Edition.

Suggested methods of Teaching:	
i)	Offline Traditional Board Teaching
ii)	Power Point Presentation
iii)	Online Teaching on platform of Zoom or Google Meet

Scheme of Course Evaluation		
1.	End Semester Examination (ESE)	40
2.	Continuous Internal Evaluation (CIE)	10
3.	**Total Marks**	**50**

Suggested techniques for Continuous Internal Evaluation (10 Marks)	
1.	Assignments
2.	Open book test
3.	Oral
4.	Attendance

Question Paper Pattern (40 Marks) Theory Exam		
Q. No.	**Nature / Type of Question**	**Marks**
1.	Multiple Choice Questions (MCQ) 6 Questions	**6 Marks** (1 Marks for each question)
2.	Write the answers in short 5 Questions	**10Marks** (2 Marks for each question)
3.	Write short notes Attempt any 3 out of 5 questions	**12Marks** (4 Marks for each question)
4.	Write descriptive questions Attempt any 1 out of 2 questions	**6 Marks**
5.	Write descriptive questions Attempt any 1 out of 2 questions	**6 Marks**
6.	**Total**	**40 Marks**

Practical Examination

(A) The practical examination will be conducted on three consecutive days for three hours per day per batch of the practical examination.

(B) Each candidate must produce a certificate from the Head of the Department in her/his college, stating that he/she has completed in a satisfactory manner the practical course on lines laid down from time to time by Academic Council on the recommendations of Board of Studies and that the journal has been properly maintained. Every candidate must have recorded his/her observations in the laboratory journal and have written a report on each exercise performed. Every journal is to be checked and signed periodically by a member of teaching staff and certified by the Head of the Department at the end of the year. Candidates must produce their journals at the time of practical examination

Question Paper Pattern (200 Marks) Practical Exam		
Q. No.	**Nature / Type of Question**	**Marks**
1.	Group I : One experiment	**30**
2.	Group II : One experiment	**30**
3.	Group III : One experiment	**30**
4.	Group IV : One experiment	**30**
5.	Group V-A : One experiment(15 marks) Group V-B : One experiment (15 marks)	**30**
6.	Group VI I)Certified laboratory journal (certified Journal- 10 marks, neatness-5 marks, punctuality- 5 marks) II) Study Tour Report III) Seminar Report / Project Report	 **20** **10** **20**
Total Marks		**200**