Shri Shivaji Education Society, Amravati's
Shri Shivaji Science and Arts College, Chikhli Dist. Buldhana.
Department of Physics
Program Outcome, Program Specific Outcome and Course Outcome

PROGRAM OUTCOME

PO. No.	POs
PO 1	Understand physics fundamental concepts, including mechanics, electromagnetism, thermodynamics, quantum mechanics, and statistical physics.
PO 2	Analyze and solve complex physical problems using mathematical and computational techniques.
PO 3	Experience in conducting independent research projects, including literature review, hypothesis formulation, experimentation, data collection, and analysis.
PO 4	Communicate complex scientific concepts clearly and effectively to diverse audiences, including peers, professionals, and the general public.
PO 5	Understand global scientific challenges and the role of physics in addressing environmental and sustainability issues.
PO 6	Acquire vocational and technical skills related to allied areas of physics and their practical applications.
PO 7	To acquaint students with the cross-cutting and interdisciplinary areas related to physics and its applications.
PO 8	Apply physics knowledge to develop sustainable solutions and innovations.

PROGRAM SPECIFIC OUTCOME

PSO. No.	PSOs
PSO 1	Graduates will acquire a comprehensive knowledge and sound understanding of fundamentals of Physics.
PSO 2	Graduates will develop practical, analytical and mathematical skills in Physics.
PSO 3	Graduates will acquire technical and vocational skills in physics and allied areas for self-employment and entrepreneurship opportunities.
PSO 4	Graduates will be prepared to acquire a range of general skills, to solve problems, to evaluate information, to use computers productively, to communicate with society effectively and learn independently.
PSO 5	Graduates will acquire necessary skills to enable them to crack competitive examination for career progression or seeking employment.

COURSE OUTCOMES

B. Sc. I SEM – I

Course Type: MJ/MN / Theory
Course Code: 129201
Course Name: Gravitation and Rotational Dynamics

CO. No.	Course Outcomes
CO 1	Interpret the universal law of gravitation, gravitation field and gravitation potential.
CO 2	Apply Kepler's laws to describe the motion of planets and other celestial bodies.
CO 3	Understand the motion of satellites in orbit
CO 4	Know the concept of Black-hole.
CO 5	Relate rotational motion to linear motion through angular and linear quantities.
CO 6	Discuss the basic concepts of rotational dynamics and relate it with appropriate things.
CO 7	Apply the parallel axes theorem and perpendicular axes theorem to calculate moments of inertia.
CO 8	Discuss real world applications of rotational mechanics, such as the dynamics of rotating machinery and vehicles.

Course Type: MJ/MN Lab/ Practical 1
Course Code: 129202
Course Name: Experiments related to Gravitation and Rotational Dynamics

CO. No.	Course Outcomes
CO 1	Determine acceleration due to gravity using various experimental methods such as simple pendulum, bar pendulum, Kater's pendulum, and free-fall method.
CO 2	Determine the moment of inertia of different bodies using torsion pendulum, bifilar suspension, flywheel, and compound pendulum methods.
CO 3	Verify the theorems of parallel and perpendicular axes related to moment of inertia.
CO 4	Analyze oscillatory motion, damping effects, and equivalent pendulum concepts using experimental observations.
CO 5	Demonstrate skills in precision measurement, data analysis, error estimation, graphical representation, and scientific reporting in mechanics experiments.

Course Type: OE-1 Theory
Course Code: 129203
Course Name: Space Science (Wonders of Physics)

CO. No.	Course Outcomes
CO 1	Explain the origin and evolution of the solar system and the role of nuclear reactions in solar energy generation.
CO 2	Describe the properties and motions of planets, satellites, asteroids, and comets in the solar system.
CO 3	Apply Kepler's laws and Newton's law of gravitation to understand planetary motion and determination of planetary masses.
CO 4	Classify stars based on their spectra and luminosity and explain stellar evolution including white dwarfs, neutron stars, and black holes.
CO 5	Discuss the origin, structure, and evolution of galaxies and explain the early history of the universe.

Course Type: OE-2 Theory

Course Code: **129204** Course Name: **Non-Conventional Energy Sources**	
CO. No.	**Course Outcomes**
CO 1	Explain the necessity and different types of non-conventional energy sources for sustainable energy development.
CO 2	Describe the design, working principle, advantages, disadvantages, and applications of fuel cells.
CO 3	Analyze solar energy systems including solar collectors and solar ponds for energy conversion applications.
CO 4	Explain the operation and performance of wind energy conversion systems with horizontal and vertical axis rotors.
CO 5	Discuss the principles and applications of ocean thermal energy conversion, tidal energy, and geothermal energy systems.
Course Type: **SEC-1 Lab/ Practical** Course Code: **129205** Course Name: **Mathematical and Measurement Skills**	
CO 1	Apply trigonometric identities, matrices, determinants, and vector algebra to solve mathematical and physical problems.
CO 2	Analyze straight lines, circles, and conic sections using principles of coordinate geometry.
CO 3	Perform vector operations and interpret their applications in mechanics and geometry.
CO 4	Understand measurement techniques, characteristics of measuring instruments, and methods of error estimation in experiments.
CO 5	Solve numerical problems systematically and develop quantitative reasoning skills relevant to B.Sc. Physics.

B. Sc. I SEM – II

Course Type: **MJ/MN Theory 2** Course Code: **129206** Course Name: **Oscillations and Properties of Matter**	
CO. No.	**Course Outcomes**
CO 1	Understand the mathematical representation of simple harmonic motion using equations and graphs.
CO 2	Relate position, velocity and acceleration in simple harmonic motion.
CO 3	Relate the phase of motion to velocity and acceleration.
CO 4	Apply the principles of simple harmonic motion to real-world applications.
CO 5	Interpret stress-strain curves for different materials.
CO 6	Differentiate between elastic and plastic deformation.
CO 7	Understand how elasticity varies in different materials (metals, polymers, ceramics)
CO 8	Differentiate between cohesive and adhesive forces.
CO 9	Identify and explain the role of surface tension in everyday phenomena, such as soap bubbles, wetting of surfaces, etc.

Course Type: MJ/MN Lab/ Practical 2 **Course Code: 129207** **Course Name: Experiments related to Oscillations and Properties of Matter**	
CO. No.	**Course Outcomes**
CO 1	Students will analyze oscillatory systems such as spring combinations, Helmholtz resonator, bifilar suspension, and torsional pendulum arrangements.
CO 2	Students will determine elastic constants including Young's modulus and modulus of rigidity using vibration, bending, cantilever, optical lever, Maxwell's needle, and torsional methods.
CO 3	Students will determine surface tension and viscosity of liquids using standard experimental methods such as Quinke's, Jaeger's, capillary rise, Poiseuille's, Stoke's, and rotating cylinder methods.
CO 4	Students will study collision phenomena and evaluate the coefficient of restitution for inelastic collisions.
CO 5	Students will demonstrate proficiency in experimental techniques, data analysis, graphical representation, error estimation, and scientific reporting related to mechanics and properties of matter.
Course Type: OE-3 Theory **Course Code: 129208** **Course Name: Medical Physics**	
CO. No.	**Course Outcomes**
CO 1	Explain the role of physics in body mechanics, temperature regulation, and pressure systems in the human body.
CO 2	Describe the physics of respiratory and cardiovascular systems and methods of related measurements.
CO 3	Understand electrical activities of nerves and muscles and interpret basic ECG waveforms.
CO 4	Explain the working principles of diagnostic X-ray systems and radiation therapy techniques.
CO 5	Apply basic medical physics concepts to healthcare, diagnostic, and biomedical applications.
Course Type: OE-4 Theory **Course Code: 129209** **Course Name: Physics Behind Everyday Life**	
CO. No.	**Course Outcomes**
CO 1	Explain the principles of motion, force, energy, momentum, friction, and collisions involved in transportation systems and daily life applications.
CO 2	Analyze the role of projectile motion, rotational dynamics, moment of inertia, and angular momentum in sports activities and athletic performance.
CO 3	Describe the concepts of heat, temperature, thermodynamics, heat transfer, and black body radiation in relation to weather and climate phenomena.
CO 4	Understand the fundamentals of electricity including electrostatics, electric current, resistance, Ohm's law, electric power, refrigeration, and electrical safety used in household applications.
CO 5	Solve conceptual and numerical problems useful for competitive examinations such

	as MPSC, UPSC, SSC, Railway, Police Recruitment, Banking Aptitude, and various entrance examinations.

Course Type: **VSC-1 Lab/ Practical**
Course Code: **129210**
Course Name: **Electric Technician-I**

CO. No.	Course Outcomes
CO 1	Demonstrate safe working practices and apply elementary first aid and emergency response procedures in electrical environments.
CO 2	Identify and appropriately use electrical tools, wires, cables, and accessories for basic electrical applications.
CO 3	Explain and apply fundamental electrical concepts such as current, voltage, resistance, power, and Ohm's law in simple circuits.
CO 4	Perform soldering, wiring, insulation testing, and electrical measurements using standard instruments and meters.
CO 5	Acquire vocational and technical skills relevant to electrical maintenance, instrumentation, self-employment, and allied fields of physics.

Course Type: **SEC-2 Lab/ Practical**
Course Code: **129211**
Course Name: **Mathematical and Instrumentation Skills**

CO. No.	Course Outcomes
CO 1	Perform algebraic operations on complex numbers and apply De Moivre's theorem in solving mathematical problems.
CO 2	Apply differentiation and integration techniques to solve problems related to mathematics and physics.
CO 3	Solve first-order differential equations and interpret their applications in radioactive decay and mechanics.
CO 4	Analyze functions using derivatives, partial differentiation, and definite integrals.
CO 5	Develop quantitative reasoning and computational skills required for higher-level physics and mathematical studies.

COURSE OUTCOMES

B. Sc. II SEM – III

Course Type: **MJ / Theory 3**
Course Code: **129212**
Course Name: **Mathematical Physics, Electrostatics and Magnetostatics**

CO. No.	Course Outcomes
CO 1	Apply mathematical concepts such as gradient, divergence, curl, and integral theorems to solve physics problems.
CO 2	Analyze and compute electric fields and potentials for various charge distributions using Gauss's theorem and other electrostatic principles.
CO 3	Evaluate the capacitance of different capacitor configurations and understand the role of dielectric materials in capacitors.

CO 4	Determine magnetic fields due to current-carrying conductors and solenoids using Biot Savart's law and Ampere's circuital law.
CO 5	Solve numerical problems related to electrostatics and magnetostatics, demonstrating a clear understanding of theoretical concepts.
CO 6	Relate the physical significance of key concepts such as electric flux, potential, and magnetic induction to real-world applications.

Course Type: MJ / Theory 4
Course Code: 129213
Course Name: Solid State Devices – I

CO. No.	Course Outcomes
CO 1	Understand the behaviour of electrons and holes in intrinsic and extrinsic semiconductors, and calculate Fermi levels.
CO 2	Analyze the characteristics of PN junctions under different biasing conditions and their applications in rectifiers.
CO 3	Design basic power supply circuits incorporating rectifiers, filters, and regulators to achieve stable DC output.
CO 4	Evaluate the performance of filter circuits (capacitor, inductor, L-section, π-section) and compute ripple factors.
CO 5	Apply Zener diodes in voltage regulation circuits and solve related numerical problems.
CO 6	Demonstrate the working principles of LEDs, photodiodes, varactor diodes, and SCRs in practical applications such as inverters and temperature control systems.
CO 7	Interpret circuit diagrams and troubleshoot common issues in semiconductor-based electronic systems.

Course Type: MJ Lab/ Practical 3
Course Code: 129214
Course Name: Experiments related to MJ Th3 and MJ Th4

CO. No.	Course Outcomes
CO 1	Analyze and interpret the characteristics of semiconductor devices including P-N junction diodes, LEDs, photodiodes, Zener diodes, and SCRs.
CO 2	Measure capacitance using different experimental methods such as leakage method, de-Sauty's bridge, repeated charge decay method, and ballistic galvanometer techniques.
CO 3	Determine dielectric constant and study behaviour of capacitors under different configurations.
CO 4	Perform experiments involving ballistic galvanometer and evaluate charge sensitivity accurately.
CO 5	Plot equipotential surfaces and explain electric field distribution for different electrode configurations.
CO 6	Determine magnetic susceptibility of liquids and magnetic materials using Quincke's method and Guoy's balance method.
CO 7	Measure and analyze magnetic fields produced by coils, solenoids, and Helmholtz coil arrangements.
CO 8	Use Scilab to represent gradient, divergence, and curl for scalar and vector fields.

Course Type: IKS-Physics Theory

Course Code: **129215** **Course Name:** **Indian Knowledge System (IKS)-Physics**	
CO. No.	**Course Outcomes**
CO 1	Explain the key concepts of Indian Knowledge System and their significance in the history of science.
CO 2	Compare Kanada's atomic theory (Anu theory) with Dalton's atomic theory and evaluate their similarities and differences.
CO 3	Describe ancient Indian perspectives on motion (Gati), forces (Bala), and gravity as documented in texts like "Lilavati" and others.
CO 4	Analyze the contributions of Aryabhata, Varahamihira, and other scholars to astronomy and cosmology, including models like the Surya Siddhanta.
CO 5	Evaluate the influence of ancient Indian scientific thought on modern physics and scientists such as C.V. Raman and S.N. Bose.
CO 6	Appreciate the interdisciplinary connections between traditional knowledge systems and contemporary scientific research.
Course Type: **MN Theory 3** **Course Code:** **129216** **Course Name:** **Mathematical Physics and Solid State Devices**	
CO 1	Apply mathematical concepts such as gradient, divergence, curl, and integral theorems to solve physics problems.
CO 2	Explain the behavior of intrinsic and extrinsic semiconductors, including carrier concentrations and Fermi levels.
CO 3	Describe the operation of PN junctions under different biasing conditions and interpret their characteristics.
CO 4	Compare the performance of half-wave, full-wave, and bridge rectifiers and their applications in power supplies.
CO 5	Demonstrate an understanding of the construction and working principles of Zener diodes, LEDs, and photodiodes.
CO 6	Solve numerical problems related to Mathematical Physics and semiconductor Physics.
Course Type: **MN Lab/ Practical 3** **Course Code:** **129217** **Course Name:** **Experiments related to MN Th3**	
CO 1	Demonstrate the characteristics and applications of various semiconductor devices and electronic components through laboratory experiments.
CO 2	Analyze the operation and efficiency of half-wave, full-wave, and bridge rectifier circuits with different filter arrangements and regulated power supplies.
CO 3	Perform electronic experiments systematically using appropriate instruments while following laboratory safety and standard procedures.
CO 4	Determine and interpret Hall effect parameters and semiconductor behavior from experimental observations.
CO 5	Use Scilab to represent and interpret scalar and vector field operations such as gradient, divergence, and curl for scientific analysis.
Course Type: **OE-5 Theory** **Course Code:** **129218**	

Course Name: Solar Energy and Its Applications	
CO 1	Explain the importance of energy sustainability and the environmental benefits of transitioning to renewable sources like solar energy.
CO 2	Describe the basic principles of solar radiation and how it is harnessed for practical applications.
CO 3	Compare different solar thermal technologies (e.g., water heaters, cookers) and their suitability for specific needs.
CO 4	Outline the process of electricity generation using solar photovoltaics and distinguish between types of solar panels.
CO 5	Discuss emerging solar technologies and their potential to revolutionize transportation, architecture, and large-scale energy production.
CO 6	Evaluate the economic viability of solar energy projects and the impact of government policies on adoption.
CO 7	Contextualize solar energy trends within a regional framework (e.g., India's solar mission or global initiatives).
Course Type: VSC-2 Lab/ Practical **Course Code: 129219** **Course Name: Electrical Installation for Residential Buildings**	
CO 1	Define key electrical terms, list safety rules, and identify basic tools used in residential wiring.
CO 2	Explain working principles of residential circuits and components; interpret wiring diagrams and basic load calculations.
CO 3	Demonstrate proper use of tools and install residential electrical wiring, DBs, switches, sockets, and light fixtures.
CO 4	Diagnose electrical faults in residential systems and suggest corrective actions. Assess electrical installations for adherence to safety codes (like IS/IE rules) and quality workmanship
CO 5	Design, plan, install, and test a fully functional residential electrical wiring project based on a given layout.
Course Type: FP/CEP-1 Project **Course Code: 129220** **Course Name: Field Project / CE Services in Physics: Phase-I**	
CO 1	Students will be able to apply physics principles and analytical techniques to investigate and solve real-world problems in field settings.
CO 2	Students will demonstrate proficiency in using experimental tools, instruments, and data analysis methods relevant to their field project or CE service.
CO 3	Students will be able to design, plan, and execute a field project or community service activity from inception to completion, including documentation and reporting.
CO 4	Students will effectively communicate their project findings and outcomes through written reports, presentations, or community engagement events.
CO 5	Students will demonstrate an understanding of the ethical, environmental, and societal impacts of their work, showing a commitment to responsible scientific practice and community well-being.

COURSE OUTCOMES

B. Sc. II SEM – IV

Course Type: MJ / Theory 5
Course Code: 129221
Course Name: Kinetic Theory of Gases and Thermodynamics

CO. No.	Course Outcomes
CO 1	Explain the assumptions and applications of kinetic theory of gases.
CO 2	Analyse Maxwell's distribution of molecular velocities and calculate most probable, mean, and rms velocities.
CO 3	Apply the concepts of mean free path, degrees of freedom and equipartition of energy to gaseous systems.
CO 4	Explain the behaviour of real gases using Van der Waals equation of state and critical constants.
CO 5	Interpret Andrews' experiment and distinguish between ideal and real gas behaviour.
CO 6	Describe the basic concepts, terminology and laws of thermodynamics.
CO 7	Apply the first law of thermodynamics to isothermal, adiabatic, isochoric and isobaric processes.
CO 8	Analyse reversible and irreversible processes, Carnot cycle, heat engines and refrigerators.
CO 9	Explain entropy changes and relate entropy with the second law of thermodynamics.
CO 10	Derive and apply thermodynamic potentials, Maxwell's relations and heat capacity equations to physical systems.

Course Type: MJ / Theory 6
Course Code: 129222
Course Name: Solid State Devices – II

CO. No.	Course Outcomes
CO 1	Explain the construction, working of CB and CE configurations of BJT and interpret their characteristics.
CO 2	Analyze transistor biasing circuits, stability factors, and the significance of the operating point in amplifier design.
CO 3	Compare the performance of different amplifier classes (A, B, AB and C) and their applications.
CO 4	Describe the working principles of JFETs and MOSFETs, their characteristics, and key differences from BJTs.
CO 5	Interpret the ideal characteristics and parameters of Op-Amps.
CO 6	Design basic Op-Amp circuits (inverting/non-inverting amplifiers, adders, subtractors, differentiators, and integrators).
CO 7	Solve numerical problems related to transistor biasing, FET parameters, and Op-Amp configurations.
CO 8	Evaluate the role of transistors and Op-Amps in modern electronic devices and signal processing applications.

Course Type: MJ / Theory 7 **Course Code:** 129223 **Course Name:** Optics and Laser	
CO. No.	**Course Outcomes**
CO 1	Describe the conditions for interference and apply the superposition principle to analyze thin-film interference and Newton's rings.
CO 2	Solve numerical problems related to wavelength determination using interference (Michelson interferometer) and diffraction (grating) techniques.
CO 3	Distinguish between Fresnel and Fraunhofer diffraction and interpret diffraction patterns from single/double slits.
CO 4	Explain polarization mechanisms (e.g., double refraction, quarter/half-wave plates) and demonstrate how to produce polarized light.
CO 5	Illustrate the working principles of lasers, including population inversion and pumping processes in 3-level/4-level systems.
CO 6	Compare the construction and operation of Ruby, He-Ne, and semiconductor lasers.
CO 7	Discuss real-world applications of lasers and polarized light across diverse fields (e.g., medical surgery, optical communications).
Course Type: MJ Lab/ Practical 4 **Course Code:** 129224 **Course Name:** Experiments related to MJ Th5, Th6 and Th7	
CO. No.	**Course Outcomes**
CO 1	Perform experiments related to heat transfer, gas laws, and thermodynamic properties and analyze the obtained results.
CO 2	Analyze characteristics and applications of transistors, FETs, MOSFETs, and operational amplifier circuits.
CO 3	Determine optical parameters such as wavelength, refractive index, resolving power, and specific rotation using standard optical techniques.
CO 4	Verify laws related to polarization, diffraction, interference, and laser optics experimentally.
CO 5	Demonstrate proficiency in handling laboratory instruments, recording observations, analyzing data, and presenting scientific results effectively.
Course Type: MN Theory 4 **Course Code:** 129225 **Course Name:** Transistor, Op-Amp, Fibre Optics and Laser	
CO 1	Explain the construction, working, and configurations of PNP and NPN transistors, and interpret their characteristics in CB and CE modes.
CO 2	Analyze transistor biasing circuits, stability factors, and the DC load line to determine the operating point in different regions (active, cut-off, saturation).
CO 3	Evaluate the performance of CE amplifiers by calculating input/output impedance, current gain, voltage gain, and power gain using hybrid parameters.
CO 4	Describe the principles of fibre optics, including total internal reflection, light propagation, and the significance of acceptance angle and numerical aperture.
CO 5	Compare the advantages and disadvantages of optical fibres and their applications in communication systems.
CO 6	Illustrate the working of lasers, including population inversion and pumping

	processes in three-level and four-level systems.
CO 7	Discuss the applications of Ruby and He-Ne lasers in medical, industrial, agricultural, and research fields.
CO 8	Solve numerical problems related to transistor biasing, fibre optics, and laser parameters.
Course Type: MN Lab/ Practical 4 **Course Code: 129226** **Course Name: Experiments related to MN Th4**	
CO 1	Analyze the characteristics and performance of transistors in CB and CE configurations and study amplifier behaviour.
CO 2	Construct and study OP-AMP based circuits such as inverting amplifier, non-inverting amplifier, adder, and subtractor.
CO 3	Determine wavelength of LASER light, grating parameters, and thickness of thin wire using diffraction techniques.
CO 4	Study LASER beam divergence, determine focal length of lenses, and evaluate numerical aperture of optical fibre.
CO 5	Demonstrate proficiency in handling electronic and optical instruments, interpreting experimental data, and presenting scientific observations effectively.
Course Type: OE-6 Theory **Course Code: 129227** **Course Name: Physics in Agriculture**	
CO 1	Explain the influence of natural forces, seasonal variations, and climatic conditions on farming and crop growth.
CO 2	Apply knowledge of soil characteristics, water movement, rainwater harvesting, and water conservation methods in agricultural contexts.
CO 3	Demonstrate understanding of greenhouse technology, solar drying methods, cold storage systems, and food preservation techniques.
CO 4	Identify and evaluate the use of renewable energy resources and energy-efficient practices in agriculture for sustainable development.
CO 5	Analyze sustainable farming practices and interpret the role of government schemes, incentives, and policies in promoting modern and eco-friendly agriculture.
Course Type: VSC-3 Lab/ Practical **Course Code: 129228** **Course Name: Mobile Repairing Technician**	
CO 1	Replace broken displays (LCD/OLED), batteries, charging ports, and speakers.
CO 2	Fix power issues (dead phone, overheating) using multimeter and soldering techniques.
CO 3	Flash stock/custom ROMs using Odin, SP Flash Tool, and iTunes.
CO 4	Bypass FRP (Google Lock) and repair IMEI/network issues.
CO 5	Repair water-damaged phones and replace faulty ICs (charging IC, WiFi/BT IC).
CO 6	Perform microsoldering and jumper wire repairs on PCBs.
CO 7	Extract data from locked/crashed phones using software/hardware methods.
CO 8	Understand service center operations, pricing strategies, and customer handling
Course Type: FP/CES-2 Project	

Course Code: **129229**
Course Name: **Field Project / CE Services in Physics: Phase-II**

CO 1	Students will be able to apply physics principles and analytical techniques to investigate and solve real-world problems in field settings.
CO 2	Students will demonstrate proficiency in using experimental tools, instruments, and data analysis methods relevant to their field project or CE service.
CO 3	Students will be able to design, plan, and execute a field project or community service activity from inception to completion, including documentation and reporting.
CO 4	Students will effectively communicate their project findings and outcomes through written reports, presentations, or community engagement events.
CO 5	Students will demonstrate an understanding of the ethical, environmental, and societal impacts of their work, showing a commitment to responsible scientific practice and community well-being.

COURSE OUTCOMES

B. Sc. III SEM – V

Course Type: **MJ / Theory 8**
Course Code: **129230**
Course Name: **Atomic and Molecular Physics**

CO. No.	Course Outcomes
CO 1	Explain the vector atom model and interpret quantum numbers and atomic states.
CO 2	Describe electron spin, magnetic moments, and space quantization phenomena.
CO 3	Apply Pauli exclusion principle and determine electronic configurations of atoms.
CO 4	Analyse atomic spectra using L–S coupling, J–J coupling, and selection rules.
CO 5	Explain spin–orbit interaction and spectral splitting in sodium and helium atoms.
CO 6	Interpret characteristic and continuous X-ray spectra and apply Duane–Hunt law and Moseley's law.
CO 7	Describe the Raman effect and explain the origin and characteristics of Raman spectra.
CO 8	Explain rotational, vibrational, and electronic spectra of diatomic molecules.
CO 9	Apply rigid rotor and harmonic oscillator models to molecular spectroscopy problems.
CO 10	Solve numerical and conceptual problems related to atomic and molecular physics.

Course Type: **MJ / Theory 9**
Course Code: **129231**
Course Name: **Network Theorems and Statistical Mechanics**

CO. No.	Course Outcomes
CO 1	Apply Kirchhoff's laws and network theorems to analyse electrical circuits.
CO 2	Solve problems related to LR, CR, and LCR circuits under transient and AC conditions.
CO 3	Explain the concepts of reactance, impedance, resonance, resonant frequency, and Q-factor in AC circuits.
CO 4	Analyse AC circuits using phasor representation and mathematical techniques.

CO 5	Describe the concepts of phase space, microstates, macrostates, and thermodynamic probability.
CO 6	Apply Maxwell–Boltzmann statistics to molecular speed distribution and related parameters.
CO 7	Differentiate between distinguishable and indistinguishable particles, bosons, and fermions.
CO 8	Explain Bose–Einstein and Fermi–Dirac statistics and their applications to physical systems.

Course Type: MJ / Theory 10
Course Code: 129232
Course Name: Solid State Physics - I

CO. No.	Course Outcomes
CO 1	Explain the structure and properties of crystalline and amorphous solids.
CO 2	Describe crystal systems, Bravais lattices, unit cells, and Miller indices used in crystallography.
CO 3	Calculate coordination number, packing fraction, atomic radius, and volume of unit cells through numerical problems.
CO 4	Explain the principles of X-ray diffraction and analyse crystal structures using Bragg's law and diffraction methods.
CO 5	Identify different types of crystal defects and discuss their effects on material properties.
CO 6	Understand the origin of magnetic moment and explain magnetic parameters such as magnetic field strength, magnetization, permeability, and susceptibility.
CO 7	Classify magnetic materials into diamagnetic, paramagnetic, ferromagnetic, ferrimagnetic, and antiferromagnetic materials.
CO 8	Explain Langevin's theories of diamagnetism and paramagnetism, Curie law, and Weiss molecular field theory.
CO 9	Describe hysteresis behaviour, Curie temperature, ferrites, and applications of magnetic materials.
CO 10	Develop analytical, numerical, and problem-solving skills related to crystallography and magnetic properties of materials.

Course Type: MJ Lab/ Practical 5
Course Code: 129233
Course Name: Experiments related to MJ Th8, Th9 and Th10

CO. No.	Course Outcomes
CO 1	Perform spectroscopic experiments to analyse atomic and molecular spectra and determine physical constants such as the Rydberg constant, dissociation energy, and force constant.
CO 2	Apply and experimentally verify fundamental electrical network theorems including Kirchhoff's laws, Thevenin's theorem, Norton's theorem, superposition theorem, and maximum power transfer theorem.
CO 3	Analyse the behaviour of AC and DC circuits involving R, L, and C components and determine electrical parameters such as impedance, reactance, resonant frequency, phase difference, and Q-factor.
CO 4	Investigate transient phenomena in RC, LR, and LCR circuits including charging,

	discharging, rise and decay processes, and determination of time constants.
CO 5	Study resonance characteristics and filter behaviour in electrical circuits and interpret resonance curves and frequency response experimentally.
CO 6	Demonstrate the ability to use laboratory instruments, electrical components, spectrometers, CROs, transformers, and X-ray diffraction data analysis techniques effectively and safely.
CO 7	Explain crystal structures, identify crystal planes, and determine lattice parameters and crystallite size using X-ray diffraction methods.
CO 8	Investigate magnetic properties of materials through experiments on hysteresis, magnetic susceptibility, superconductivity, and B–H curves.
Course Type: EL Theory 1(a) **Course Code: 129234** **Course Name: Digital Electronics - I**	
CO 1	Perform interconversion between decimal, binary, and hexadecimal number systems and apply binary arithmetic operations.
CO 2	Explain the concepts of binary codes, complements, and their applications in digital systems.
CO 3	Identify and analyse the operation of basic and universal logic gates.
CO 4	Apply Boolean algebra and De Morgan's theorems for simplification of logic circuits.
CO 5	Design and analyse logic circuits using truth tables, SOP method, and Karnaugh maps.
CO 6	Explain the construction and operation of combinational logic circuits such as adders and subtractors.
CO 7	Describe the working of encoders, decoders, multiplexers, and demultiplexers using truth tables and ICs.
CO 8	Develop analytical and problem-solving skills in digital electronics and logic circuit design.
Course Type: EL Theory 1(b) **Course Code: 129235** **Course Name: Python Programming - I**	
CO 1	Understand and apply basic Python syntax, data types, and operators to solve simple problems.
CO 2	Implement decision-making and looping constructs for logical problem-solving.
CO 3	Utilize data structures (lists, tuples, dictionaries) and functions in program development.
CO 4	Perform file handling operations and use standard Python modules effectively.
CO 5	Create basic data visualizations using Matplotlib for analysis of scientific/physical data.
Course Type: EL Lab/ Practical 1(a) **Course Code: 129236** **Course Name: Experiments related to Digital Electronics - I**	
CO 1	Identify and verify the operation of basic and universal logic gates using truth tables.
CO 2	Construct and analyse digital logic circuits using NAND and NOR gates.
CO 3	Perform binary arithmetic operations using digital electronic circuits and ICs

CO 4	Design and verify combinational logic circuits such as adders and subtractors.
CO 5	Analyse and implement encoder, decoder, multiplexer, and demultiplexer circuits.
CO 6	Apply Boolean logic and truth tables for digital circuit verification and analysis.
CO 7	Develop practical skills in handling digital ICs, breadboards, and laboratory instruments.
CO 8	Develop analytical, experimental, and troubleshooting skills in digital electronics.
Course Type: **EL Lab/ Practical 1(b)** **Course Code:** **129237** **Course Name:** **Experiments related to Python Programming - I**	
CO 1	Write, execute, and debug Python programs using appropriate syntax and structures.
CO 2	Apply programming techniques to solve numerical and physics-based problems.
CO 3	Handle data using data structures, files, and basic scientific libraries.
CO 4	Visualize and interpret data using plots and graphical tools.
Course Type: **MN Theory 5** **Course Code:** **129238** **Course Name:** **Solid State Physics and Network Theorems**	
CO 1	Explain the structure and properties of crystalline and amorphous solids.
CO 2	Describe crystal systems, Bravais lattices, unit cells, and Miller indices used in crystallography.
CO 3	Explain the principles of X-ray diffraction and identify different types of crystal defects.
CO 4	Analyze electrical circuits using Kirchhoff's laws and mesh current analysis.
CO 5	Apply Superposition, Thevenin's, Norton's, and Maximum Power Transfer theorems to solve electrical network problems.
CO 6	Understand the behavior of transient currents in LR, CR, and LCR circuits.
CO 7	Explain the concepts of alternating current, reactance, impedance, and phasor representation.
CO 8	Analyze resonance conditions in LCR circuits and determine resonant frequency and Q-factor.
CO 9	Solve numerical problems related to crystallography and electrical circuits.
CO 10	Develop analytical, experimental, and problem-solving skills in solid-state physics and circuit analysis.
Course Type: **MN Lab/ Practical 5** **Course Code:** **129239** **Course Name:** **Experiments related to MN Th5**	
CO 1	Explain crystal structures, identify crystal planes, and analyse X-ray diffraction patterns for the determination of lattice parameters and crystallite size.
CO 2	Apply and experimentally verify fundamental electrical network theorems including Kirchhoff's laws, Thevenin's theorem, Norton's theorem, superposition theorem, and maximum power transfer theorem.
CO 3	Analyse the behaviour of AC and DC circuits involving resistance, capacitance, and inductance and determine electrical parameters such as impedance, reactance, capacitance, and inductance.
CO 4	Investigate resonance phenomena in series and parallel LCR circuits and determine

	resonant frequency, phase difference, and Q-factor experimentally.
CO 5	Study transient behaviour in RC, LR, and LCR circuits including charging–discharging processes, rise and decay of current, and determination of time constants.
CO 6	Examine the characteristics of RC filters and interpret the frequency response and resonance curves of electrical circuits.
CO 7	Use laboratory instruments such as multimeters, CROs, function generators, and electrical circuit components effectively and safely during experiments.
CO 8	Record observations systematically, analyse experimental data, estimate errors, and present scientific results using graphs, tables, and proper calculations.
Course Type: VSC-4 Lab/ Practical **Course Code: 129240** **Course Name: Maintenance and Repairing of Domestic Appliances**	
CO 1	Explain the construction and working of common domestic electrical appliances.
CO 2	Identify electrical components and circuits used in household appliances.
CO 3	Perform basic servicing, maintenance, and repair of domestic appliances.
CO 4	Diagnose common faults and carry out troubleshooting safely.
CO 5	Demonstrate practical skills useful for self-employment and technical service sectors.
Course Type: SEC-3 Lab/ Practical **Course Code: 129241** **Course Name: Fundamentals of Computer Applications in Physics Laboratory and Scilab Programming**	
CO 1	Demonstrate understanding of computer fundamentals, scientific software tools, and applications of computers in Physics laboratories and research.
CO 2	Perform scientific data analysis using spreadsheets, including statistical calculations, graphical representation, and error estimation.
CO 3	Write, execute, and debug Scilab programs using control statements, arrays, functions, and plotting tools for scientific computations.
CO 4	Apply Scilab techniques to solve numerical problems involving calculus, matrices, linear algebra, and ordinary differential equations related to physical systems.
CO 5	Develop and simulate basic physical models such as RC circuits, harmonic oscillators, and mass–spring systems using Xcos and computational methods.
Course Type: FP/CEP-3 Project **Course Code: 129242** **Course Name: Field Project / CE Services in Physics: Phase-III**	
CO 1	Students will be able to apply physics principles and analytical techniques to investigate and solve real-world problems in field settings.
CO 2	Students will demonstrate proficiency in using experimental tools, instruments, and data analysis methods relevant to their field project or CE service.
CO 3	Students will be able to design, plan, and execute a field project or community service activity from inception to completion, including documentation and reporting.
CO 4	Students will effectively communicate their project findings and outcomes through written reports, presentations, or community engagement events.
CO 5	Students will demonstrate an understanding of the ethical, environmental, and societal impacts of their work, showing a commitment to responsible scientific practice and

	community well-being.

COURSE OUTCOMES

B. Sc. III SEM – VI

Course Type: MJ / Theory 11
Course Code: 129243
Course Name: Nuclear and Particle Physics

CO. No.	Course Outcomes
CO 1	Explain various nuclear properties such as nuclear size, mass, binding energy, magnetic moment, and nuclear stability.
CO 2	Describe the nature of nuclear forces, radioactive decay processes, and the basic concepts of alpha, beta, and gamma radiations.
CO 3	Apply concepts of mass defect, binding energy, packing fraction, radioactive decay, and Q-value to solve numerical problems.
CO 4	Discuss different nuclear models, including the liquid drop model and shell model, along with their applications and limitations.
CO 5	Explain the principles of nuclear fission, fusion, chain reactions, nuclear reactors, and the role of nuclear energy in stellar processes.
CO 6	Understand the working principles, construction, and applications of radiation detectors such as ionization chambers, proportional counters, Geiger–Müller counters, and semiconductor detectors.
CO 7	Describe the construction, working, and limitations of particle accelerators such as linear accelerators and cyclotrons.
CO 8	Classify elementary particles and explain their properties, interactions, quantum numbers, and conservation laws.
CO 9	Understand the quark model, fundamental interactions, and the significance of the Gell-Mann–Nishijima relation in particle physics.
CO 10	Develop analytical and problem-solving skills related to nuclear physics, radiation physics, and elementary particle physics.

Course Type: MJ / Theory 12
Course Code: 129244
Course Name: Quantum Mechanics

CO. No.	Course Outcomes
CO 1	Explain the failure of classical physics and the experimental foundations of quantum mechanics.
CO 2	Describe wave-particle duality, matter waves, photoelectric effect, and Compton effect.
CO 3	Apply Heisenberg's uncertainty principle and interpret the physical significance of wave functions.
CO 4	Solve problems related to de Broglie wavelength, uncertainty relations, and quantum mechanical systems.
CO 5	Understand and apply Schrödinger time-dependent and time-independent

	equations.
CO 6	Explain quantum mechanical operators, eigenvalues, and eigenfunctions.
CO 7	Analyse the behaviour of particles in one-dimensional and three-dimensional potential boxes.
CO 8	Describe quantum tunnelling, harmonic oscillator, and zero-point energy with their applications.
CO 9	Develop analytical, mathematical, and problem-solving skills in quantum mechanics.

Course Type: MJ / Theory 13
Course Code: 129245
Course Name: Solid State Physics - II

CO. No.	Course Outcomes
CO 1	Explain the electrical properties of solids using classical and quantum free electron theories.
CO 2	Describe concepts such as mean free path, drift velocity, electrical conductivity, thermal conductivity, and Wiedemann–Franz law.
CO 3	Understand the limitations of classical free electron theory and the significance of Sommerfeld's quantum theory.
CO 4	Explain density of states, Fermi energy, Bloch theorem, and band structure of solids.
CO 5	Classify materials as metals, semiconductors, and insulators on the basis of band theory.
CO 6	Apply concepts of electrical properties and band theory to solve numerical problems.
CO 7	Describe the phenomenon of superconductivity, Meissner effect, and properties of Type-I and Type-II superconductors.
CO 8	Explain Cooper pair formation, BCS theory, and applications of superconducting materials.
CO 9	Understand the properties, synthesis methods, and applications of nanomaterials and nanotechnology.
CO 10	Analyse the effect of nanoscale dimensions on optical, electrical, magnetic, and mechanical properties of materials.

Course Type: MJ Lab/ Practical 6
Course Code: 129246
Course Name: Experiments related to MJ Th 11, Th 12 and Th 13

CO. No.	Course Outcomes
CO 1	Demonstrate understanding of radioactive decay, nuclear statistics, and radiation detection techniques through experiments using Geiger–Müller counters and scintillation detectors.
CO 2	Determine important nuclear parameters such as operating voltage, plateau region, resolving time, half-life, and absorption coefficient using standard nuclear physics experimental methods.
CO 3	Verify and analyse fundamental concepts of quantum physics including black body radiation, photoelectric effect, Planck's constant, work function, and inverse square law.

CO 4	Study and interpret the electrical characteristics of photocells and explain the interaction between radiation and matter experimentally.
CO 5	Determine semiconductor properties such as energy gap, Hall coefficient, conductivity, dielectric constant, and resistance variation with temperature using appropriate experimental techniques.
CO 6	Perform experiments related to thermistors, thermocouples, superconductors, and semiconductor devices and explain their physical behaviour and technological applications.
CO 7	Apply experimental methods such as four-probe technique, reverse-bias method, Hall effect measurements, and temperature-dependent studies in solid-state physics.
CO 8	Use laboratory instruments and radiation detection systems effectively and safely while conducting modern physics and solid-state physics experiments.
Course Type: EL Theory 2(a) **Course Code: 129247** **Course Name: Digital Electronics - II**	
CO 1	Explain the construction, working, and applications of various types of flip-flops.
CO 2	Analyse sequential logic circuits using truth tables and logic diagrams.
CO 3	Describe the operation of asynchronous and synchronous counters and shift registers.
CO 4	Design and analyse up, down, up-down, and modified counters.
CO 5	Explain the working principles of analog-to-digital and digital-to-analog converters.
CO 6	Differentiate between various A/D and D/A conversion techniques.
CO 7	Describe the classification, hierarchy, and operation of semiconductor memories.
CO 8	Explain the functioning and applications of RAM, ROM, PROM, EPROM, EEPROM, and flash memory.
CO 9	Develop analytical and problem-solving skills in sequential and digital electronic systems.
Course Type: EL Theory 2(b) **Course Code: 129248** **Course Name: Python Programming - II**	
CO 1	Apply NumPy for efficient numerical computations and array-based operations.
CO 2	Solve linear algebra problems (systems of equations, eigenvalues, eigenvectors) relevant to physics.
CO 3	Implement numerical methods such as integration, root finding, and curve fitting using SciPy.
CO 4	Solve ordinary differential equations numerically and interpret the results.
CO 5	Develop and analyze computational models for basic physical systems such as motion, decay, and fields.
Course Type: EL Lab/ Practical 2(a) **Course Code: 129249** **Course Name: Experiments related to Digital Electronics - II**	
CO 1	Analyse and verify the operation of different types of flip-flops and sequential logic circuits.
CO 2	Construct and study the functioning of shift registers and binary counters using

	digital ICs.
CO 3	Design and analyse up, down, up-down, and ring counters.
CO 4	Understand and implement analog-to-digital and digital-to-analog conversion techniques.
CO 5	Study and analyse the operation of semiconductor memory devices such as RAM.
CO 6	Develop practical skills in assembling, testing, and troubleshooting digital electronic circuits.
CO 7	Apply theoretical knowledge of sequential circuits and memory systems in practical applications.
CO 8	Develop analytical, experimental, and problem-solving skills in digital electronics laboratory work.
Course Type: EL Lab/ Practical 2(b) **Course Code: 129250** **Course Name: Experiments related to Python Programming - II**	
CO 1	Perform numerical computations using NumPy for array operations and mathematical analysis.
CO 2	Apply linear algebra and numerical methods to solve scientific and engineering problems.
CO 3	Develop computational models and simulations for basic physical systems.
CO 4	Visualize, analyze, and interpret numerical and simulation data effectively.
Course Type: MN Theory 6 **Course Code: 129251** **Course Name: Quantum Mechanics and Solid State Physics**	
CO 1	Explain the failure of classical physics in describing black body radiation and other quantum phenomena.
CO 2	Describe the principles of photoelectric effect, Compton effect, and wave–particle duality.
CO 3	Explain De Broglie hypothesis, matter waves, wave packets, phase velocity, and group velocity.
CO 4	Understand and apply Heisenberg uncertainty principle in different physical situations.
CO 5	Explain the concept of wave function, normalization, orthogonality, probability density, and expectation values.
CO 6	Solve numerical problems related to quantum concepts and uncertainty relations.
CO 7	Describe the origin of magnetic moment and explain magnetic properties of materials.
CO 8	Classify magnetic materials and explain Langevin's theories of diamagnetism and paramagnetism.
CO 9	Understand the concepts of nanotechnology, quantum confinement effect, and nanoscale properties.
CO 10	Explain the synthesis methods and applications of nanomaterials in medical and industrial fields.
Course Type: MN Lab/ Practical 6 **Course Code: 129252** **Course Name: Experiments related to MN Th6**	

CO 1	Determine important physical constants such as Stefan's constant and Planck's constant using experimental methods based on thermal radiation and photoelectric effect.
CO 2	Study and analyse the V–I characteristics of photocells and verify the inverse square law and work function of metals experimentally.
CO 3	Explain the operation and characteristics of transformers and investigate magnetic hysteresis and B–H curves of ferromagnetic materials.
CO 4	Measure magnetic fields using Hall probes, magnetometers, and related instruments, and interpret magnetic field behaviour experimentally.
CO 5	Determine magnetic susceptibility of solids and liquids using Gouy's balance and Quincke's methods, respectively.
CO 6	Determine the Curie temperature and classify dia-, para-, and ferromagnetic materials based on their magnetic properties.
CO 7	Understand and perform basic synthesis techniques for nanomaterials using chemical reduction, sol–gel, and electrochemical deposition methods.
CO 8	Record observations systematically, analyse experimental data, estimate uncertainties, and present scientific results using graphs, tables, and calculations.
Course Type: VSC-5 Lab/ Practical **Course Code: 129253** **Course Name: Solar Energy Technology and Applications**	
CO 1	Explain the basic concepts of solar radiation, photovoltaic effect, and solar energy conversion.
CO 2	Identify and describe various components used in solar PV systems and their functions.
CO 3	Differentiate between on-grid, off-grid, and hybrid solar systems with their applications.
CO 4	Perform installation, testing, troubleshooting, and maintenance of solar PV systems following safety procedures.
CO 5	Analyze the performance and energy output of solar PV systems for domestic, agricultural, and industrial applications.
Course Type: Int/App/OJT – 129254 **Course Code: 129254** **Course Name: Internship/ Apprenticeship/ On-the-Job Training (OJT) in the Physics domain**	
CO 1	Students will be able to apply principles of physics and scientific methods in professional and industrial settings.
CO 2	Students will demonstrate proficiency in handling instruments, laboratory equipment, computational tools, and data analysis techniques relevant to the internship/OJT domain.
CO 3	Students will acquire practical problem-solving skills and workplace experience through participation in real-time projects or technical assignments.
CO 4	Students will be able to prepare technical reports, maintain work records and effectively present their internship outcomes.