

N.S.S.R.s

Mrs. Kesharbai Sonajirao Kshirsagar Alias Kaku Arts, Science and Commerce College Beed

Department of Physics

COs (Course Outcomes)

B.Sc. First Year

Mechanics and Properties of Matter

- i Understand Newton's laws of motion.
- ii Recognize different forces existing in nature and their physical significance.
- iii Acquire deep knowledge of physical quantities such as elasticity, viscosity, and surface tension.
- iv Develop the capacity to investigate and analyze daily problems related to mechanical Movement

Practical: Mechanics and Properties of Matter

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Basic Instrumentation Skill

- i Gain understanding of measurement fundamentals including instrument accuracy, precision, and errors, as well as principles of voltage, current, and resistance measurement using voltmeters, ammeters, and multimeters.
- ii Master the use of CRO for voltage (DC and AC), frequency, and time period measurements, and understand signal and pulse generator specifications, alongside distortion factor meter usage and wave analysis.
- iii Learn analog versus digital instrument distinctions, comprehend digital multimeter block diagrams and operations, and understand time interval, frequency, and period measurements using universal counters, emphasizing time-base stability, accuracy, and resolution

Practical: Basic Instrumentation Skill

- i Employ digital multimeters for measuring DC voltages, currents, resistance, and AC voltages.
- ii Acquire advanced knowledge in circuit tracing and troubleshooting techniques for electronic equipment, including understanding the operation of signal and pulse generators.
- iii Conduct frequency measurements using oscilloscopes and analyze and compare two frequencies using oscilloscope analysis.

GE/OE-1: Everyday Physics

i The course imparts essential physics principles to real-world contexts, covering transportation fundamentals, sports analysis, and sustainable weather solutions.

ii Students will understand concepts such as linear and circular motion, friction, and energy/momentum, applying them to transportation and sports.

iii Additionally, they'll explore sustainable weather management and green energy technologies, gaining practical knowledge about home electricity systems.

DSC-3: Optics

i Acquire the basic concept of optics and its applications.

ii Explain how image formation takes place in lenses

iii Understand the operations of many modern optical devices

iv Understand the optical phenomenon such as interference and diffraction.

Practical: Optics

i Understanding of interference and diffraction phenomena through hands-on experimentation.

ii Appreciation of practical applications of optical instruments across various scientific disciplines.

iii Proficiency in conducting precise measurements and observations using optical instruments.

iv Analyze experimental results critically and compare them with theoretical expectations.

VSC-1: Electrical Measurements

i Understand and apply fundamental electrical measurement concepts.

ii Gain the skill in selecting appropriate measurement methods and minimizing errors.

iii Understanding of electrical device characteristics and their role in measurement circuits.

iv Calibrate instruments and verify their accuracy against standards

Practical: Electrical Measurements

Student develop the skill reading the electrical instruments.

ii. Minimization of errors and get exposure to know the idea of measurements.

iii. To do handling and repair the electrical instruments.

VSC-1: Electronic Communications

i. Analyze the power and transmission bandwidth of Amplitude and Frequency Modulated signals.

Familiarize the process of reproduction of base band signal.

ii. Analyze various pulse analog and pulse digital Modulation Techniques.

iv. Understand the transmission of binary data in communication systems.

Practical: Electronic Communications

- i. Gain a thorough understanding of modulation principles and techniques, including Amplitude Modulation (AM) and Frequency Modulation (FM), facilitating proficiency in signal modulation.
- ii. Develop skills in demodulation methods such as Amplitude Demodulation and Frequency Demodulation, enabling the extraction of modulating signals from carrier waves.
- iii. Acquire knowledge and practical experience in various pulse modulation techniques like Pulse Width Modulation (PWM), Pulse Amplitude Modulation (PAM), Pulse Position Modulation (PPM), and Pulse Code Modulation (PCM), enhancing abilities in signal encoding and transmission.
- iv. Understand digital modulation techniques including Delta Modulation (DM), Frequency Shift Keying (FSK), and Binary Phase Shift Keying (BPSK), enabling proficiency in digital communication systems and applications.

GE/OE-2: Physics in Sports

On completion of the course, students will be able to,

- i Explain how Newton's laws relate to athletic performance.
 - ii Evaluate sports equipment design and performance.
 - iii Assess the effects of environmental conditions of athletic performance.
 - iv Apply strategies for optimizing performance in various conditions.
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B.Sc. Second Year

Modern Physics

Able to explain the factors influencing photoelectric effect, explain the experimental setup and apply it for applications

Understand the fundamentals of lasers, laser systems, their characteristics and diversified applications including industry, medicine and Défense

Use this knowledge for applications of lasers in specific fields of their interest

Solve numerical problems on the photoelectric effect, X-rays, and lasers.

Practical: Modern Physics

Verify the inverse square law and measure Planck's constant using the photoelectric effect.

Compare luminous intensities of different light sources using photocells.

Understand and apply the principles of laser optics for diffraction, beam divergence, and precision measurements. Analyse experimental data from photocell and laser-based experiments to draw meaningful conclusions about physical constants.

Electricity and Magnetism

Develop an understanding on the concepts of electricity and magnetism.

To understand the knowledge of various mathematical operations required for electrostatics and magnetostatics.

Explain the fundamental concepts and operations of vector analysis.

To increase the ability to perform calculations of various mathematical expressions and laws. To develop ability among the students to identify, remember and grasp the meanings

Practical: Electricity and Magnetism

Measure the energy band gap of a semiconductor and analyze temperature dependence.

Perform accurate resistance and capacitance measurements using bridge methods.

Determine high resistance and absolute capacity of a condenser using B.G. techniques.

Investigate transient behavior in RC circuits and determine e/m using Thomson's method

Minor-1: Soil Physics

Explain the fundamental concepts, importance, and interdisciplinary interactions of soil physics.

Describe soil formation, profile development, texture, and methods for particle size analysis.

Analyze soil physical properties, including density, porosity, structure, and water content.

Interpret the energy state of soil water, soil-moisture potential, and measurement techniques

Minor-2: Digital Electronics

Describe and explain the fundamentals of digital electronics. Perform number system conversions and basic logic operations.

Design and simulate simple combinational and sequential logic circuits.

Recognize the importance of digital systems in scientific research and experiments.

GE/OE: Data Analysis Techniques Using Excel

Understand and apply basic Excel functionalities for data management.

Perform data cleaning, sorting, filtering, and visualization techniques.

Use statistical functions for data interpretation and decision-making.

Create professional reports and dashboards.

Utilize Excel for business and social science applications.

VSC-1: Solar Cell Devices

Explain the principles of photovoltaic energy conversion.

Identify and compare materials used in various types of solar cells.

Demonstrate an understanding of solar cell fabrication and testing techniques.

Analyze solar cell performance using key metrics like efficiency and fill factor.

Discuss challenges and future trends in solar cell technology

Practical Solar Cell Devices

Analyze the I-V characteristics of a solar cell and determine key performance parameters.

Evaluate the effect of light intensity and temperature variations on solar cell efficiency.

Compare the electrical behavior of solar cells connected in series and parallel configurations.

Interpret spectral response and quantum efficiency data for solar cell performance assessment.

DSC-9: Heat and Thermodynamics

Understand the concepts of heat and thermodynamics.

Describe and apply the physical concepts of heat, and laws of thermodynamics.

Develop ability among the students to identify, remember and grasp the meanings, definitions and laws of heat and thermodynamics.

Perform calculations of heat conduction in various geometries.

Practical Heat and Thermodynamics

Understand the theoretical principles of basic practical Physics

Develop awareness of minimizing errors.

Handle carefully various instruments.

Correlate theoretical concepts with the help of experiments.

Gain knowledge about heat, conduction of heat, thermal conductivity of different materials and other phenomena of heat.

DSC-10: Electrodynamics

apply Gauss's law to calculate electric fields.

Explain and derive Maxwell's equations.

Analyze electromagnetic waves in different media.

Solve problems on induction and displacement current.

Use Poynting's theorem for energy flow analysis.

Practical Electrodynamics

Measure and analyze the magnetic properties of materials using a magnetometer.

Determine inductance and charge sensitivity using bridge and galvanometer techniques.

Verify the capacities of condenser using De'Sauty's method.

Determine the AC mains frequency using a sonometer experiment.

Minor-3: Nuclear Chemistry

Understand the principles of radioactivity and radioactive decay, including half-life and radioactive equilibrium, and their applications in various fields.

Analyze nuclear reactions, including fission and fusion, and evaluate the processes and energy changes involved in nuclear reactors and radiation chemistry.

Apply the use of radioactive isotopes and tracers in medicine, agriculture, analytical chemistry, and age determination techniques.

Minor-4: Thermal Physics

Explain and apply the concepts of temperature, thermometers, and various temperature scales. Develop proficiency in calculating and interpreting thermal conductivity using different methods.

Apply the laws of thermodynamics to various thermodynamic processes and calculate work done in specific processes,

Students will be capable of using and understanding temperature.

GE/OE-2: Renewable Energy

SEC 2: Generative AI

Apply Generative AI tools to create innovative and practical content across domains.

Evaluate and address ethical considerations, such as copyright, misinformation, and privacy.

Explore career opportunities and emerging trends in Generative AI.

Practical SEC 2: Generative AI

Demonstrate proficiency in using Generative AI tools on mobile platforms to generate text, images, audio, and videos effectively.

Apply Generative AI techniques to solve practical problems and create innovative content for arts, commerce, and business applications.

Showcase creativity and technical skills in utilizing Generative AI tools responsibly and ethically in real-world scenarios.

B.Sc. Third Year

DSC-13: Classical Mechanics

Analyse motion using Newton's laws and conservation principles.

Apply Lagrangian formulation to obtain equations of motion.

Solve problems on central forces, oscillations and collisions.

Explain motion in rotating frames and Coriolis effects.

Describe rigid body dynamics and angular momentum.

Practical Classical Mechanics

Determine Young's modulus (Y) using both Koenig's and Searle's methods with proper analysis.

Evaluate the coefficient of viscosity (η) using Searle's viscometer and oscillating disc method.

Measure surface tension using the capillary rise method and interpret intermolecular forces.

Analyze physical phenomena such as elastic collisions, damped oscillations, and spring systems using theoretical and experimental approaches.

Verify laws governing transverse vibrations and understand wave behavior using Melde's apparatus

DSC-14: Solid State Physics

Classify and Identify Structures: Categorize crystal systems and symmetry groups using unit cell parameters and Wigner-Seitz cell definitions.

Derive Structural Constants: Mathematically calculate inter-planar distances and packing fractions (P.F.) for SC, BCC, FCC, and diamond lattices.

Critique Thermal Models: Evaluate the success and physical limitations of the Debye model compared to classical theories in predicting heat capacity at low temperatures.

Relate Physical Constants: Apply the Wiedemann-Franz Law to describe the relationship between thermal and electrical conductivities in metallic conductors.

Analyze Carrier Dynamics: Interpret experimental data from Hall Effect measurements to determine charge carrier concentration, mobility, and type.

Practical Solid State Physics

Analyze and interpret Lissajous figures to determine frequency relationships and phase differences.

Determine fundamental constants such as Rydberg's constant and Cauchy's constants using spectrometer-based techniques.

. Evaluate physical parameters like Hall coefficient, Poisson's ratio, and temperature of flame using appropriate experimental methods.

Measure electrical quantities such as low resistance, internal resistance, and thermocouple emf using potentiometer techniques.

Study and interpret absorption spectra (e.g., iodine) and determine wavelengths using a diffraction grating.

DSE-2: Atomic and Molecular Physics

Students will be able to analyze the strengths and weaknesses of various atomic models, particularly the Bohr model and its successors.

Students will apply quantum mechanical principles to explain atomic structure and behaviors, including the effects of spin and coupling.

Raman and Magnetic Resonance Techniques:

Students will demonstrate proficiency in Raman spectroscopy and related techniques, identifying their characteristics and practical applications in scientific research.

Practical Atomic and Molecular Physics

Analyze and interpret interference patterns (biprism, Edser's A pattern) to determine the wavelength of light.

Evaluate optical fibre parameters such as numerical aperture and bending loss, and understand signal transmission.

Determine dispersion constants using Hartmann formula and study cardinal points using goniometer.

Measure and analyze spectral response of the photoconductor (LDR) and verify the characteristics of photoelectric devices.

Determine fundamental constants such as h using photocell and Planck's constant (h) using LED through graphical methods.

Minor - 5: Synthesis of Nanomaterials

Explain the unique properties of nanomaterials and their differences from bulk materials.

Course Outcomes: After successful completion of this

Classify nanomaterials based on dimensionality and describe synthesis techniques.

Discuss top-down and bottom-up approaches for nanomaterial preparation.

Outline basic characterization methods and applications in technology.

Identify risks and sustainable practices in nanomaterial synthesis.

Minor-6: Environmental Physics

Explain the basic components of the environment and their physical interactions.

Describe the energy flow in ecosystems and the Earth's energy balance, including greenhouse effects and climate change.

Analyze the causes and impacts of air and noise pollution and understand measurement methods.

Explain different renewable energy sources such as solar, wind, and hydropower

VSC-2: Applied Electronics

Apply Superposition, Thevenin's, Norton's, and Maximum Power Transfer theorems to simplify and solve complex DC networks.

Compare and contrast the performance of Half-wave, Full-wave, and Bridge rectifiers in terms of efficiency and output characteristics.

Design and evaluate voltage regulator circuits using Zener diodes, transistors, and Three-terminal ICs (78XX/79XX).

Analyze the frequency response of different filter circuits (RC, RL, and RLC) and their roles in smoothing DC output.

Construct and troubleshoot timing circuits using IC-555 in Monostable and Astable modes for real-world applications.

Derive mathematical expressions for time delay and frequency for IC-555-based multivibrators.

Practical Applied Electronics

compare results with theoretical calculations. Analyze the effect of RC, RL, and RLC filters on the ripple factor and efficiency of different rectifier configurations.

Construct and characterize voltage regulators using Zener diodes and transistors, measuring their percentage regulation.

Implement fixed voltage regulation using 78XX and 79XX ICs and understand their practical applications in dual power supplies. Design an IC-555 based Monostable and Astable multivibrator for a specific time delay and frequency,

verifying the output on an oscilloscope. Generate and analyze a linear ramp signal using the IC-555 timer for sweep circuit applications.

Accurately record observations, perform error analysis, and derive logical conclusions from

RP: Research Project

Design and execute a mini research project independently or in a group.

Analyze experimental/simulation data using scientific tools and methods.

Demonstrate understanding of advanced concepts beyond the prescribed syllabus.

Prepare a structured project report following scientific format.

Present and defend the work effectively through a seminar/viva voce.

DSC-17: Quantum Mechanics

Explain fundamental concepts of quantum mechanics

Solve basic Schrödinger equation problems

Interpret operators and expectation values

Understand the hydrogen atom and angular momentum

Distinguish classical and quantum behaviour

Practical Quantum Mechanics

Analyze and plot Gaussian distributions and interpret statistical behavior of physical systems.

Determine Debye temperature and study blackbody radiation, relating experimental results with theoretical models. Simulate and interpret quantum systems such as a harmonic oscillator, a particle in a 1D box, and

quantum random processes. Apply concepts of quantum computing basics, including qubits, superposition, and quantum Fourier transform.

Verify photoelectric effect laws and calculate de-Broglie wavelength, demonstrating wave-particle duality and quantum nature of matter.

DSC-18: Mathematical Physics

Apply vector products and vector calculus operations in physical problems. Evaluate line, surface, & volume integrals and use Gauss, Green's, and Stokes theorems.

Solve first-order and second-order linear homogeneous differential equations.

Explain the concepts of probability, Microstates and macrostates, and phase space.

Describe and compare Maxwell-Boltzmann, Fermi-Dirac, and Bose-Einstein statistics.

Use mathematical tools and statistical methods in advanced physical applications.

Practical Mathematical Physics

Perform and verify vector operations, identities, and triple products in practical problems.

Determine and interpret gradient, divergence, curl, and evaluate line and surface integrals.

Verify Gauss', Green's, and Stokes theorems using suitable vector fields. Solve differential equations and apply partial and total differentiation in physical contexts.

Analyse statistical distributions (M-B, F-D, B-E) and apply mathematical simulations. methods in experiments

DSC-21: Physics in Ancient India

Compare ancient Indian concepts of matter and motion with classical physics.

Identify scientific ideas embedded in Vedic and post-Vedic texts.

Discuss India's role in high-energy physics and space research.

Demonstrate how ancient Indian geometry and number systems influenced global mathematics.

Analyze case studies of IKS in metallurgy and architecture.

Formulate small research questions bridging IKS and physics.

DSE-6: Transistor Amplifiers and Oscillators

Differentiate between BJT and FET based on their IV characteristics and current gain parameters (α and β).

Perform DC load line analysis to determine the stability of the operating point in various biasing circuits.

Design and analyze a Voltage Divider Bias circuit and calculate its stability factor for thermal runaway prevention. Demonstrate the graphical and mathematical process of signal amplification in the CE amplifier.

Illustrate the working mechanism and frequency limitations of RC-coupled transistor amplifiers.

Practical Transistor Amplifiers and Oscillators

Plot and interpret the input/output characteristics of BJTs and calculate current gains (a, b, y) for different configurations.

Extract JFET parameters, including dynamic drain resistance (r_a), trans-conductance (g), and amplification factor (μ), from transfer and drain curves,

Locate the Operating Point (Q-point) on the DC Load Line and evaluate the thermal stability of different biasing schemes.

Design a Voltage Divider Bias circuit to provide a stable operating point for a common-emitter amplifier.

Construct an RC-coupled amplifier and determine its lower and upper cut-off frequencies from the frequency response curve.

Build and troubleshoot Hartley and Wien Bridge oscillators, verifying that the output frequency matches theoretical predictions based on component values.

Validate the Barkhausen Criterion by observing the onset of sustained oscillations in RC and LC feedback circuits.

Minor - 7: Sound

Explain the fundamentals of sound waves and calculate parameters.

Apply Newton's formula and Laplace's correction to determine the velocity of sound in air and solve numerical problems.

: Analyse the acoustical properties of buildings and evaluate reverberation time.

Describe the generation of ultrasonic waves using piezoelectric and magnetostriction oscillators.

Identify and explain various applications of ultrasonics.

Minor - 8: Biophysics

Evaluate biological phenomenon like diffusion, Osmosis, and surface tension using chemical kinetics and Fick's laws.

Evaluate biological phenomena like diffusion, osmosis, and surface tension using chemical kinetics
Apply the

Nernst equation and capacitor models to explain electrical signals in biological membranes. Correlate the molecular structure of DNA, RNA, and mitochondria with their roles in bioenergetics.

Utilize principles of UV-Visible, FTIR, XRD, and Electron Microscopy to characterize biological samples.

OJT: On Job Training

Demonstrate practical understanding of industrial/research processes related to Physics.

Apply experimental and analytical skills in real-world applications.

Prepare a training report documenting observations, work carried out, and learning outcomes.

Exhibit professional skills, including teamwork, time management, and workplace ethics.

Present and explain their training experience effectively through presentation/viva voce.