Shri Shivaji Education Society Amravati's

Science College,

Congress Nagar, Nagpur

Department of Physics

Vision

To be the best known science college to provide a value-based education, foster a scientific temperament, and instill scientific ideals.

Mission

To cultivate modern scientific knowledge via extracurricular, co-curricular, and academic activities.

Quality Policy

Committed to provide high-quality education by continuously enhancing research, teaching, learning, moral and ethical principles.

M Sc (Physics)

as per NEP-2020 implemented from 2023-24

Programme Objectives (POs):

M Sc (Physics) programme is meant to systematize and give a method and structure to learner experiences with imparting students with an in-depth knowledge and understanding through the core courses which form the basis of Physics. The elective courses are designed for more specialized and/or interdisciplinary content to equip students with a broader knowledge base. The recent developments in physical sciences, has been included in the curricula to meet out the present day needs of academic and research, institutions, and industries.

Research methodology, on the job training and research-based projects included in the curricula will

enrich the students towards new findings leading to inspiration for research degree and orientation for job opportunities. After completing this Programme the learner,

PO 1: will have knowledge of fundamental laws and principles of physics along with their applications in diverse areas.

PO 2: will develop teaching and research skills which might include advanced Laboratory techniques, numerical methods, computer interfacing, etc.

PO 3: will become effective teacher and/or researcher; and will be able to exhibit good scientific knowledge and temperament in diverse fields/environment.

PO 4: will develop the skill to plan, execute and report on experimental and/or theoretical physics problems with effective scientific approach in future endeavour.

Programme Specific Outcomes (PSOs):

While studying M.Sc., Physics Programme, the learner shall be able to

PSO 1: provide well defined study of theoretical and experimental physics to impart in depth understanding in fundamental aspects of all core areas of Physics.

PSO 2: acquire core as well as specialized/disciplinary knowledge in physics.

PSO 3: equip the student to pursue research and development in any areas of theoretical, experimental, and computational physics.

PSO 4: learn how to design and conduct experiments demonstrating them understanding of scientific methods/processes/phenomena; and understand analytical methods required to interpret and analyse results and draw conclusions.

PSO 5: bridge the gap between textbook knowledge and practical problems through well-designed laboratory sessions.

PSO 6: develop written and oral communications skills in communicating physics- related topics; and realize and develop an understanding of the impact of science particularly physics on the society.

PSO 7: apply conceptual understanding and critical thinking of the physics to general real-world situations; and learn to analyse physical problems and develop correct solutions using theoretical and experimental techniques/tools and skills.

Semester - I

Paper 1 (Core 1) Mathematical Physics (MPH1T01)

Course Outcomes (COs):

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

• Understand the methods of mathematical physics.

• Understand the basic elements of mathematical physics and demonstrate an ability to use vector analysis in the solution of physical problems.

• Analyse the various types of matrix operations for solving problems in various branches of physics.

• Apply mathematical skills to solve problems in quantum mechanics, electrodynamics, and other fields of theoretical physics.

• Impart knowledge about various mathematical tools employed to study physics problems.

Paper 2 (Core 2) Electronics (MPH1T02)

Course Outcomes (COs)

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

• Learn the general characteristics of important semiconductor materials and PN-junction for the construction of various types of transistors.

• Understand the use of semiconductor devices in linear and digital circuits.

• Analyse and design basic op-amp circuits, particularly various linear and non-linear circuits, active filters and signal generators, and data converters.

• Evaluate the characteristics of classification of memories and sequential memory and analyse the working of various A/D and D/A Converters.

• Understand the basic principle of amplitude, frequency and phase modulation in Communication Electronics.

Paper 3 (Elective -1B) Experimental Techniques in Physics (MPH1T03B)

Course Outcomes (COs)

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

• Understand the different types of radiation and the concept of detection of radiation using various detectors.

• Learn the fundamental aspect of classification of sensors and their principle of operation.

• Describe the principle of working of TGA, DTA, DSC used for thermal analysis.

• Understand the experimental technique for magnetic characterization using VSM and dielectric properties using impedance analyser.

• Explain the spectroscopic techniques of FTIR, UV-VIS, DRS, XPS, ESR, NMR used for materials characterization.

Paper 4 (RM) Research Methodology (MPH1T04)

Course Outcomes (COs)

On completion of the course students will be able to,

• Understand the basic concepts regarding importance of research.

• Impart knowledge about research problems identification, research question and formulation of hypotheses.

• Understand the differences of qualitative vs. quantitative research methodology, field experiments vs. laboratory experiments.

• Execute the methods of data collection and strategies of data processing and analysis.

• Learn the ethical issues including copy right, royalty, intellectual property rights, patent law, and plagiarism in publishing research.

Semester - II

Paper 5 (Core 3) Complex Analysis and Numerical Methods (MPH2T05)

Course Outcomes (COs):

On completion of the course students will be able to

• Represent complex numbers, analyse limit, continuity, and differentiation of functions of complex variables.

• Learn analytic functions, Cauchy Reimann conditions, how to find roots of nonlinear equations numerically and understand how iterations work.

• Interpolate with evenly or unevenly spaced data.

• Interpret and apply the basic methodology of numerical differentiation and numerical integration to a broad range of physics problems.

• Enrich with various computational methods like Euler, Newton-Raphson and Runge-Kutta etc. to solve the problems.

Paper 6 (Core 4) Statistical Physics (MPH2T06)

Course Outcomes (COs):

On completion of the course students will be able to,

• Understand various models in statistical mechanics and apply statistical tools to solve the problems in Physics.

• Identify the connection between statistical mechanics and thermodynamics.

• Understand Bose's concept of fifth state of matter and any possibility of sixth state of matter or not.

• Understand the significance and characteristics of phase transitions and critical phenomena.

• Learn Einstein's theoretical analysis and Langevin theory of Brownian motion.

Paper 7 (Elective - 2 B) X-Rays (MPH2T07B)

Course Outcomes (COs)

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

• Basic concepts of production of X-rays, Designing concepts conventional of X-ray generators, Basics of Advanced radiation source Synchrotron and its advantages over conventional sources.

• Interaction of X-rays with the matter and applications of X-rays based on different physical processes involved after interaction of x-rays with matter.

• The method of X-ray radiography and its applications in medical and industrial fields.

• Designing concepts of different X-ray spectrographs. Different theoretical concepts regarding X-ray spectra and their interpretation.

• Interpretation of X-ray absorption spectra. Experimental techniques for obtaining X-ray absorption spectra and its important applications.

Semester - III

Paper 8 (Core 5) Classical Mechanics (MPH3T08)

Course Outcomes (COs)

On completion of the course students will be able to,

• Interpret the notion of degrees of freedom, identify them for a given mechanical system and DÁlembert's principle, Formulation of Lagrangian mechanics and problem solving.

• Describe the Canonical transformations and generating functions and properties of Poisson's bracket.

• Enable to solve Hamilton-Jacobi equations and use it for the solution of harmonic oscillator problem.

• Demonstrate an understanding of intermediate classical mechanics topics such as coordinate transformations, oscillatory motion, gravitation and other central forces, and Lagrangian mechanics.

• Evaluate the Central Force Problems and Relativistic Mechanics.

Paper 9 (Core 6) Quantum Mechanics – I (MPH3T09)

Course Outcomes (COs)

On completion of the course students will be able to,

• Introduce postulates and working principles of quantum mechanics.

• Familiarity with operator and matrix formalism of quantum mechanics.

• Solve Schrodinger equation for simple systems.

• Formulate the Heisenberg & Dirac formulation of quantum mechanics.

• Learn angular momentum operator, spin and be able to add angular momenta.

Paper 10 (Core 7) Electrodynamics (MPH3T10)

Course Outcomes (COs)

On completion of the course students will be able to,

• Provide basic understanding of the concepts of electricity, magnetism and electromagnetic waves.

• Describe EM waves in vacuum as well as matter to solve the difficult problems of electrodynamics.

• Analyse and apply the laws of electromagnetism and Maxwell's equations.

• Understand the basics of electrostatics and magnetostatics to solve the electric and magnetic fields problems for different configurations.

• Describe relativistic electrodynamics to understand the magnetism as a relativistic phenomenon.

Paper 11 (Elective - 3 A) Materials Science (MPH3T11A)

Course Outcomes (COs):

On completion of the course students will be able to,

• Review of principle of thermodynamics and understand the fundamental concepts of phase rule and phase diagram.

• Understand the kinetics of phase transformation, homogeneous and heterogeneous nucleation and growth of particles.

• Explain the concept of equilibrium and nonequilibrium processing of materials and their importance.

• Describe the various physical and chemical route of materials synthesis.

• Understand the metallic and non-metallic, ceramic and other materials processing and heat treatment methodologies.

Semester - IV

Paper 12 (Core 8) Nuclear and Particle Physics (MPH4T12)

Course Outcomes (COs)

On completion of the course students will be able to,

• Explain the nuclear structure and properties, nuclear forces and two body problems.

• Discuss the stability and properties of different nuclei by various nuclear models.

• Describe radioactive α, β, γ -decay of nuclei by their respective quantum mechanical theories, Conservation laws and various nuclear reactions.

• Know various nuclear radiation detectors and particle accelerators.

• Discuss the Elementary particles as the building blocks of matter and interacting fields. Describe Quark Hypothesis, Quark structures of Mesons and Baryons.

Paper 13 (Core 9) Quantum Mechanics - II (MPH4T13)

Course Outcomes (COs):

On completion of the course students will be able to,

• Discuss the time independent perturbation theory and its application (Zeeman and Stark effect).

• Explain the time dependent perturbation theory and semi-classical theory of radiations and its applications.

• Describe the ground state of helium atom using WKB approximation.

• Analyse and apply the central field approximation for system of identical particles and system of non-interacting particles, Born-Oppenheimer approximation.

• Understand Klein- Gordon equation, Dirac's relativistic equation, Field quantization of the non-relativistic Schrodinger equation.

Paper 14 (Core 10) Solid State Physics (MPH4T14)

Course Outcomes (COs):

Upon completion of the course students will be able to,

• Understand the basics of free electron theory and band theory.

• Understand lattice vibrations of linear monoatomic and diatomic chains, dispersion relations, acoustic and optical phonons.

• Describe Dulong and Petit's law, Einstein and Debye models, T3 law, etc theories of lattice specific heat.

• Explain electrical conductivity, Hall effect and magnetic properties of solids.

• Describe type I and II superconductors, elements of BCS theory, and elementary of high temperature superconductor and applications.

Paper 15 (Elective - 4A) Properties of Materials (MPH4T15A)

Course Outcomes (COs):

On completion of the course students will be able to,

• Understand the mechanical response and mechanical properties of materials.

• Explain the corrosion and degradation of materials and strategies of corrosion prevention.

• Get the knowledge of laws of diffusion, types of diffusion and methods of determining diffusion coefficients.

• Impart knowledge of Solid State Ionics.

• Describe silver ion conductors, cation conductors, oxygen ion conductors, halide ion conductors, proton conductors and electronic conductors with ionic transport