

Shivaji University, Kolhapur

Name of Department: Physics

Name of Programme: M.Sc. Physics

Vision	
To Develop the Department as a Centre for Advanced Studies in Material Science and Technology. To integrate Physics and Engineering Courses	
Mission	
To Start the Courses in the Emerging Areas (as per UGC guidelines) Like Nanotechnology, Computational Physics so as to develop it as Advanced Centre of Material Science and Engineering.	
Program Outcomes (PO)	
PO1	Students are able to apply, and disseminate knowledge of physics in theoretical and experimental domains under different specializations.
PO2	Develop the ability to identify, formulate, analyze and solve problems in theoretical and experimental domains of physics at both curricular and research level through critical thinking.
PO3	Use ICT based skills and making scientific software literate to apply in academics.
PO4	Inculcate research culture, providing research ambience and develop related technical proficiency.
PO5	Develop attitude to pursue further research and finding placement avenues through it.
PO6	Inculcate academic and social ethical values among the students.
Program Specific Outcomes (PSO)	
PSO1	Student are able to apply the knowledge of core concepts of physics in semester exams, in the NET, SET and GATE, national level exams as well as in the research level projects work which is suitable to communicate/present further in workshops and conferences
PSO2	Through assignments, NET-SET coaching workshops and research based project work in both theoretical and experimental domains, students are able to reveal analytical skills and critical thinking.
PSO3	In day to day access to study material, through presentations, students are capable enough to make use of PowerPoint presentations, Moodle (LMS), Web-based academic links and can also get hands on experience of using proprietary software like Matlab, Mathematica under experiential learning.
PSO4	Through the research culture of the department and skills acquired therein, students are capable of sustaining subsequent academic progression inside the country and overseas as well.
PSO5	Regular practice of Self-declaration of the authenticity, uniqueness of project work, plagiarism check, and departmental scrutiny etc. inculcates the ethics in the research publication.

Course Outcomes		
Course code	Course title	Course Outcomes
M.Sc. Part-I Semester-I		
MSU0325MML936G1	Mathematical Physics	1. Students are able to understand the basics of vector spaces and are able to solve special type of matrices that are relevant in physics. 2. Students are able to understand the different ways of solving first and second order differential equations. 3. Students are able to understand and solve the problems based on special functions like Hermite, Bessel, Laguerre and Legendre functions. 4. Students are able to understand fundamentals and applications of Fourier series, Fourier and Laplace transforms, their inverse transforms etc. 5. Students are able to apply Cauchy's theorem, Taylor's theorem and Laurent's theorem for complex analysis.
MSU0325MML936G2	Classical Mechanics	1. Students are able to understand and solve central force problems and understands the conservation of energy, linear momentum and angular Momentum in system 2. Students are able to understand how to impose constraints on a system in order to simplify the methods used in solving physics problems. 3. Students are able to understand the concept of Poisson brackets and canonical transformations and are able to solve problems on Poisson brackets and canonical transformations. 4. Students are able to understand the concept of special theory of relativity.
MSU0325RML936G	Research Methodology	1. Students are able to understand meaning, types, approaches and significance of research 2. Students are able to understand the research designs and methods of data collection 3. Students are able to search the research articles and carry on literature survey. 4. Students are able to understand how to write and submit the research paper, research project and thesis. 5. Students are able to understand applications of various pums and gauges for formation of vacuum and methods of leak detection. 6. Students are able to understand low temperature techniques and microscopic techniques.
MSU0325MEL936G1	Semiconductor Physics	1. Student will be able to create, apply, and disseminate the basic properties of semiconductors materials and Physics behind them through solving problems. 2. Student will be able to create the ability to identify, formulate, analyze and solve problems in semiconductors physics. 3. Student will be able to create the quantitative and qualitative understanding of semiconductors.

		4. Student will be able to apply quantitative and qualitative studies for designing the electronic devices under various fields
MSU0325MEL936G2	Stellar Evolution: Birth, Evolution and Death of the Stars	1. Students are able to understand the Formation of the Stars 2. Students are able to understand the Stellar Evolution 3. Students are able to get more insight about Death of the Stars 4. Students are capable of correlating Neutron Stars and Black Holes
MSU0325MEL936G3	Fundamentals of Plasma Physics	1. Students are able to understand Introduction, Uniform E and B Fields, Non-uniform B Field, Non-uniform E Field 2. Students are able to understand Introduction, Relation of Plasma Physics to Ordinary Electromagnetics, The Fluid Equation of Motion, Fluid Drifts Perpendicular to B 3. Students are able to get more insight about The Meaning of $f(v)$, Equations of Kinetic Theory, Derivation of the Fluid Equations, Plasma Oscillations and Landau Damping, The Meaning of Landau Damping 4. Students are capable of correlating Introduction, Sheaths, Ion Acoustic Shock Waves, The Ponderomotive Force, Parametric Instabilities, Plasma Echoes
MSU0325MEL936G4	Laser Physics	1. Students are able to create, apply, and disseminate theoretical knowledge of laser systems 2. Students developed the critical thinking ability to identify and analyze laser behavior 3. Students are encouraged to do research in field of lasers. 4. Students develop related skill through practicals based on laser applications.
MSU0325MMP936G1	Physics Lab -1	1. Students are able to understand and calculate crystal structure of materials, and identify the different modes lattice dynamics 2. Students are able to understand theory behind B-H curve and apply for different materials. 3. Students are able to understand and able to calculate heat capacity of material, and calculate thermal and electrical conductivity of copper. 4. Students are able to understand concept of interference from fabry-perrot etalon experiment 5. Students are able to understand Hall effect and solve problems related to it. 6. Students are able to analyses critically statistical data using software. 7. Students are able to understand fundamental of mathematica and are able to solve various problems using it. 8. Students are able to understand and design circuits of a stable and monostable multivibrators, amplifiers etc.

MSU0325MMP936G2	Physics Lab –II	1. Students are able to write and submit certified seminar reports. 2. Students are able to present their practical seminar work. 3. Students are able to understand the physics behind the experiment. 4. Students are able to write the tutorial based on practicals.
M.Sc. Part-I Semester-II		
MSU0325MML936H1	Quantum Mechanics	1. Students are able to understand different types of operators used in quantum mechanics and are able to use them to solve different problems. 2. Students are able to understand and solve problems related to Variational Method and WKB Approximation. 3. Students are able to understand Perturbation Theory, semi-classical theory of radiation. 4. Students are able to understand and calculate Time-dependent potentials and are also able to understand time-independent potentials 5. Students are able to understand scattering theory.
MSU0325MML936H2	Condensed Matter Physics	1. Students are able to understand different crystal structures, interaction with X-ray and also understands various properties about crystals 2. Students are able to understand different types of crystal defects. 3. Students are able to understand different properties of semiconducting and superconducting properties 4. Students are able to understand theoretical background of dielectric and magnetic properties of material
MSU0325FPP936H	Field Project	1. Student will be able to apply, and disseminate the basic Physics to solve the problems. 2. Student will be able to create the ability to identify, formulate, analyze and solve problems in industry. 3. Student will be able to create the quantitative and qualitative understanding of properties of materials and physics behind them. 4. Student will be able to apply quantitative and qualitative studies for designing the materials and materials based devices.

MSU0325MEL936H1	Semiconductor Devices	1. Student will be able to apply and disseminate the basic properties of semiconductors materials and Physics behind them through solving problems. 2. Student will be able to understand the basics of fabrication of Transistors and microwave devices, Photonic devices and memory devices. 3. Student will be able to understand Magneto-optic and acousto-optic effects, Material's properties related to get these effects. 4. Student will be able to understand Piezoelectric, Electrostrictive and Magnetostrictive effects, Sensors, and actuator devices.
MSU0325MEL936H2	Magnetospheric Plasma Dynamics	1. To understand the earth's magnetic field and magnetosphere 2. To understand reconnection at magnetopause 3. To understand magnetospheric configuration 4. To understand geomagnetic storms
MSU0325MEL936H3	Interaction of electromagnetic waves with electron beams and plasmas	1. Students are able to understand and apply fundamental Maxwell's equations in context of dispersions phenomenon 2. Students are able to understand coupled mode equations and the phenomenon of mode conversion very critically. 3. Students are able to understand basic phenomenon of self- focusing of laser beams in plasmas and successfully completed project work on it. 4. Students are able to understand fundamental of NLS, concept of soliton.
MSU0325MEL936H4	Molecular Spectroscopy	1. Students are able to create, apply, and disseminate theoretical knowledge of spectroscopic techniques 2. Students developed the critical thinking ability to identify and analyse properties of Material 3. Students are encouraged to do research in field of Spectroscopy. 4. Students develop related skill through practicals based on spectroscopy.
MSU0325MMP936H1	Practical Lab - III	1. Students are able to understand deep knowledge of fourier analysis, passive filters and solar cell. 2. Students are able to understand thermal diffusivity of brass, mutual inductance of coil and series and parallel resonant circuits. 3. Students are able to understand numerical solutions of and plotting of simple functions using python. 4. Students are able to understand fundamental and programming of mathematica includes 2D and 3D plots. 5. Students are able to understand crystal structure. 6. Students are able to understand plank's constant. 7. Students are able to understand deep knowledge of fourier analysis, passive filters and solar cell. 8. Students are able to understand thermal diffusivity of brass, mutual inductance of coil and series and parallel

		resonant circuits. - Students are able to understand numerical solutions of and plotting of simple functions using python. - Students are able to understand fundamental and programming of mathematica includes 2D and 3D plots.
MSU0325MMP936H2	Practical Lab - IV	- Students are able to write and submit certified seminar reports. - Students are able to present their practical seminar work. - Students are able to understand the physics behind the experiment. - Students are able to write the tutorial based on practicals.
M.Sc. Part-II Semester-III		
MSU0325MML916I1	Statistical Mechanics	- Students are able to understand and think critically Basic concepts, Statistical Equilibrium and thermodynamic Laws and Functions - Students are able to understand and solve numerical Statistical Ensembles Theory. - Students are able to understand and apply Quantum distribution functions. - Students are able to understand Phase Transitions and Critical Phenomenon. - Students are able to understand Entropy and specific heat of a perfect gas, Entropy and probability distribution.
MSU0325MML916I2	Atomic and Molecular Physics	- Students are able to understand and distinguish Atom Model for Two Valence Electrons i. e. l-s coupling, j-j coupling and the Pauli exclusion principle. - Students are able to understand and differentiate various Zeeman Effect, Paschen-Back Effect and Stark basic effect - Students are able to understand basic phenomenon of microwave spectroscopy and Classification of molecules. - Students are able to understand fundamental the simple harmonic oscillator, the anharmonic oscillator instrumentation and chemical analysis by infra-red spectroscopy.
MSU0325MEL916I1	Thin solid films: Deposition and properties	- Students are able to understand the various physical deposition technique for thin film preparation - Students are able to understand the different chemical methods mechanism and preparation of compound thin film. - Students are able to get more insight about mechanism of nature, structure, and growth of the crystallographic films. - Students are capable of correlating electric, magnetic and optical properties of the thin film with crystalline

		structure
MSU0325MEL916I2	Ionospheric Physics and Space Weather	1. To understand the Physical and Chemical process in Atmosphere 2. To understand Ionosphere 3. To understand Implications of Space weather effects 4. To understand Global Navigation Satellite System (GNSS)
MSU0325MEL916I3	Introduction to General Relativity	1. Students get acquainted with the geometric approach to special relativity. 2. Students learned vectors and tensors and its importance in general relativity 3. Students learned elements of fluid dynamics 4. Students learned the concept of non-Euclidean geometry 5. Students learned to construct field equations for a given matter distribution. 6. Students learned to solve Einstein's field equations for spherical mass distribution.
MSU0325MEL916I4	Nonlinear Optics and Fiber Optics	1. To create, apply, and disseminate theoretical knowledge of Nonlinear Effects 2. To develop the critical thinking ability to identify and analyse nonlinear phenomena 3. To encourage research in field of Non-linear optics 4. To develop related skill through practicals based on nonlinear phenomena
RP-PH1	Research Project-I	1. Students are able to do literature survey based on thrust area. 2. Students are able to design research problem and develop hypothesis. 3. Students are able to synthesize the different materials. 4. Students are able to characterize the materials for different applications. 5. Students are able to make conclusions based on results of characterizations.
MSU0325MMP916I1 (SSP- V & VI)	SOLID STATE PHYSICS LAB – V & VI	1. Students are able to understand all the thin film deposition techniques. 2. Students are able to understand different synthesis techniques the thin film. 3. Students are able to study the physical properties of thin film by XRD, FTIR and analyses them. 4. Students are able to study the structural properties of thin film by SEM, FESEM and analyses them
MSU0325MMP916I1 (MO- V & VI)	Modern Optics LAB – V & VI	1. Students are able to understand Michelson Interferometer experiment and apply theory behind it. 2. Students are able to understand optical absorption, theory behind it and application about it. 3. Students are able to calibrate optical instrument such as the spectrograph, Constant Deviation spectrograph etc. 4. Students are able to understand basics of different spectra

		and hologram as well as recording the same.
MSU0325MMP916I1 (SP- V &VI)	Space Physics LAB –V & VI	1. Students are able to understand and apply programming language such as Python and MatLab 2. Students are able to understand and apply Proton precession magnetometer. 3. Students are able to understand and apply Amplitude Modulation. 4. Students are able to understand and able to compute NavIC-IRNSS: Data Mining and analysis using MatLab. 5. Students are able to understand and apply Total electron content by NavIC-IRNSS. 6. Students are able to analyses critically Solar Data Analysis-I and II for Electromagnetic and Energetic particle respectively.
MSU0325MMP916I1 (THP- V &VI)	Theoretical Physics LAB –V & VI	1. Students are able to understand Mathematica. 2. Students are able to understand Symbolic Manipulations 3. Students are able to understand and apply mathematica functions. 4. Students are able to analyse mathematica plot
M.Sc. Part-II Semester-IV		
MSU0325MML916J1	Electrodynamics	1. Students are able to understand and solve E.M. wave equations in waveguide of the arbitrary cross section: TE and TM modes. 2. Students are able to understand and analyze Reflection and refraction, polarization, Fresnel's law, interference, coherence, and diffraction. 3. Students are able to understand the applications to linear and circular motions: cyclotron and synchrotron radiations. 4. Students are able to understand the Cerenkov radiation and Bremsstrahlung. 5. Students are able to understand the Structure of Space time, Relativistic Mechanics. 6. Students are able to understand and solve numerical on Relativistic Energy and Momentum, Relativistic Kinematics, Relativistic Dynamics, Relativistic Electrodynamics, Magnetism as a Relativistic Phenomenon.
MSU0325MML916J2	Nuclear and Particle Physics	1. Students are able to understand the nuclear forces and their potentials to apply for experiments 2. Students are able to analyze the single particle nuclear shell model and related phenomena 3. Students are able to understand and apply selectionrule

		of elementary particles and fission, fusion reactions. Students are able to understand and apply the Gellmann Nishijima formula to solve numerical problems.
RP-PH2	Research Project-II	- Students are able to pursue further research in the subject related to project work. - Students are able to submit satisfactory prototype and thesis/ Dissertation. - Students are able think critically to analyse the given problem for getting its solution.
MSU0325MEL916J1	Physical Properties of solids	- Students are able to understand electrical conductivity of metals - Students are able to understand transport properties of metals - Students are able to understand concepts of Phonons, Plasmons, Polaritons, and Polarons - Students are able to understand concepts of Point defects and Luminescence
MSU0325MEL916J2	Astrophysics of the Sun	- Students are able to understand the basic structure of sun and get briefly accounted with Helioseismology. - Students are able to understand the various data analysis techniques to drag the information. - Students are able understand real environment of the sun with various field at its surface. - Students are able to understand the surface structure of sun and various models regarding its theories.
MSU0325MEL916J3	Introduction to Quantum Field Theory	- Students will learn the classical field theory - Students will learn the canonical quantization of classical fields for spin-0, spin-1 and spin-$\frac{1}{2}$ particles - Students will learn to use Feynman diagram tool to solve scattering problems in particle physics - Students will learn to quantize the electromagnetic field with path integral approach - Students will learn to do the tree-level computation of cross- sections and decay processes - Students will learn radiative corrections in QFT, namely vacuum polarization, vertex correction and self-energy.
MSU0325MEL916J4	Holography and Its applications	- To create, apply, and disseminate theoretical knowledge of Holography - To develop the critical thinking ability to apply holographic techniques in various fields - To encourage research in field of Holography - To develop related skill through practicals based on holography
MSU0325MMP916J1 (SSP- VII)	SOLID STATE PHYSICS LAB – VII	Students are able to do synthesis different metal oxides using different techniques.

		2. Students are able to do characterization of thin films. 3. Students are able to analysis results of thin films. 4. Students are expertise in the preparation and characterization of thin film.
MSU0325MMP916J1 (SP- VII)	SPACE PHYSICS LAB – VII	1. Students are able to know about radar system. 2. Students are able to understand and to handle IRNSS. 3. Students are able understand the constellations. 4. Students are able to understand structure of ionosphere & magnetoshpere.
MSU0325MMP916J1 (TH- VII)	THEORETICAL PHYSICS LAB – VII	1. Students are able to set experiential learning of Theoretical aspects. 2. Students are able to modify and design the setup the experiments. 3. Students are able to interpret the experimental findings using existing Theoretical framework.
MSU0325MMP916J1 (MO- VII)	MODERN OPTICS LAB – VII	1. Students are able to calculate vibrational parameters of CN, AIO, C2 2. Students are able to understand the theory of molecular transitions and apply it to analyze mixtures. 3. Students are able to measure Brewster angle and apply it to measure optical behavior of materials like glass. 4. Students are able to demonstrate optical phenomenon to determine the wavelength of light by grating