Department of Physics

Programme Outcomes (POs), Programme Specific Outcomes (PSOs) and Course Outcomes (COs)

Master of Science in Physics

Programme Outcomes (POs)

Programme Code	Programme Title	Programme Specific Outcome
MSP	Master of Science in Physics	The curriculum for master's degree course is designed to equip the students with advanced knowledge in several areas of physics. To achieve this specific object, various subjects like mathematical physics, quantum mechanics, classical mechanics, electronics, plasma physics, computational physics, atomic and molecular physics, condensed matter physics, statistical physics, general theory of relativity and astrophysics have been included in the syllabus. The department also offers elective papers in condensed matter physics, electronics and communication technology, advanced high energy physics and advanced laser and nonlinear optics. The syllabus for master degree courses is also developed on the basis of UGC model syllabus and at par with IIT and central university curricula. After completing a four-semester master degree course in physics, a student will be adequately knowledge for a career in physics or in a related field in academia, industry and research laboratories. **Programme Outcomes (POs):** After due completion of the programme students will be able to **PO 1.** Apply the knowledge of principles and concepts of physics to solve practical problems. **PO 2.** Employ numerical methods and interpret mathematical models of physical problems. **PO 3.** Develop skills to design, plane and execute experiments and interpret the results. **PO 4.** Develop communication skills to impart the knowledge to the both specialized and non-specialized public, with an emphasis towards societal development.

Programme Specific Outcome (PSO)

Programme Code	Programme Title	Programme Specific Outcome
MSP	Master of Science in Physics	**Programme Specific Outcomes (PSOs):** At the end of the programme the students will be specifically able to **PSO 1.** Understand the concepts of physics, particularly in Classical Mechanics, Quantum Mechanics, Electronics, Electromagnetism, Atomic, Molecular and Laser physics, Nuclear Physics etc. and impart the knowledge how the fundamental laws of nature are realized. **PSO 2.** Gain the knowledge of certain advanced subjects such as Condensed Matter Physics, High Energy Physics, Astro and Particle Physics, Laser and Nonlinear Optics etc. **PSO 3.** Learn to carry out hands on experiments related to the subjects cited above and develop the skills to operate advance machineries. **PSO 4.** Develop the knowledge to identify cutting edge research problems and also develop methodologies to solve them.

Course Outcomes (COs)
M.Sc. Physics

Paper Code	Title of the Paper	Course Outcomes (COs)
		Upon successful completion of the courses student will have the knowledge and skills to
MSP-101	Mathematical Physics-I	1. The students will be able to understand and apply the mathematical skills to solve quantitative problems in the study of physics. 2. Learn about special type of matrices that are relevant in physics. 3. Will enable students to apply integral transform to solve mathematical problems of interest in physics. 4. Learn the fundamentals and applications of Fourier series, Fourier and Laplace transforms, their inverse transforms etc as an aid for analyzing experimental data. 5. The students will be able to formulate and express a physical law in terms of tensors, and simplify it by use of coordinate transforms. 6. Get introduced to Special functions like Gamma function, Beta function, Delta function, Dirac delta function, Bessel functions and their recurrence relations. 7. Learn different ways of solving second order differential equations.
MSP-102	Classical Mechanics	1. Students will know concept of classical mechanics . 2. Understand the foundations of chaotic motion.

		3. Deep knowledge on lagrangian dynamics& Hamiltonian dynamics. 4. Know the theory of small oscillation. 5. Brief knowledge on fluid motion.
MSP-103	Quantum Mechanics - I	1. Aspects of historical developments of quantum mechanics and interpretation of wave particle duality 2. Development of central concept and principles of quantum mechanics such as Schrödinger equation, wave functions, and its statistical interpretation 3. Solution of Schrödinger equation for simple systems in one and three dimensions 4. Ideas of probability, evolution of time, expectation values, and uncertainty of quantum systems. 5. Knowledge of angular momentum, spin and their rules for quantization.
MSP-104	Electronics	1. Understand the basic knowledge of various semiconductor devices such as BJT, FET and MOSFET. 2. Acquire knowledge on Operational Amplifier and its applications. 3. Know the building blocks of digital systems and the logic families. 4. Analyze the transmission of multiple signals through different modulation techniques. 5. Develop knowledge on signal transmission through different antenna types.
MSP-105	Physics Laboratory-I	1. To develop knowledge of semiconductor and their properties through hands on practice 2. Physics of propagation of ultrasonic through liquid, ideas of ultrasonography used in medical science. 3. Working of LASERs and determination of LASE R wavelength, usability of LASERs in different domains of engineering and Technology 4. Knowledge of rectifiers and amplifiers and their fabrication for operations etc. 5. Know to calculate the specific charge of an electron.
MSP-201	Electromagnetics & Plasma Physics	1. Will gain a clear understanding of Maxwell's equations and electromagnetic boundary conditions. 2. To explain and solve advanced problems based on classical electrodynamics using Maxwell's equations. 3. Know that laws of reflection, refraction are outcomes of electromagnetic boundary conditions. 4. Students will grasp the idea of electromagnetic wave propagation through wave guides and transmission lines. 5. The students will be able to analyze s radiation systems in which the electric dipole, magnetic dipole or electric quadruple dominate. 6. The students will have an understanding of the covariant formulation of electrodynamics and the concept of retarded time for charges undergoing acceleration. 7. Students will extend their understanding of special theory of relativity by including the relativistic electrodynamics.

		8. Understand the rather complex physical phenomena observed in plasma.
MSP-202	Computational Physics	1. Students will have deep knowledge on computer programming. 2. Various methods to solve numerical problems. 3. Learn to find the solution of linear and non linear systems. 4. Learn to find the roots of different equation by using Newton Raphson and bisection method.
MSP-203	Condensed Matter Physics	1. Learn about crystalline state of solids and X-ray diffraction 2. Learn about various types of crystal bonding and lattice dynamics 3. Learn about dielectric properties of solids 4. Learn about energy bands in solids and free electron theory of metals 5. Learn about magnetic properties and various aspects of semiconductors
MSP-204	Atomic, Molecular and laser Physics	On successful completion of the course the students will be able to- 1. Know about the emission and absorption spectra of the atoms. 2. Would know about the different energy levels in atoms and various coupling schemes. 3. Understand about the spectra of molecules 4. Would know the Born-Oppenheimer approximation and its application on molecular spectroscopy. 5. Understand laser and its properties, different types of Lasers, applications of Lasers.
MSP-205	Physics Laboratory-II	1. Learn the skill to measure the wavelength of a given laser by using Michelson's Interferometer. 2. Will be able to verify Heisenberg's uncertainty principle using a plane transmission grating and He-Ne Laser. 3. Will get the knowledge to find the value of Plank's constant and photoelectric wave function of the material of the cathode using photoelectric cell. 4. Will be able to analyze the B-H curve for a given ferromagnetic material using CRO and determine the loss of energy due to hysteresis. 5. Understand the concept of dielectric constant and hence able to estimate the value of dielectric constants of different dielectric materials. 6. Learn to measure the numerical aperture and propagation loss in an optical fiber using He-Ne laser source. 7. Learn the technique to measure the wavelength separation of sodium D-lines using a diffraction grating. 8. Will be able to study the I-V characteristics of a solar cell.
MSP-206	Computational Physics Practical	Learn the basic of C programming which includes the following points 1. Students will be able to write the Computer languages(C, C^{++}). 2. Will be able to write the programs of the numerical

		problems. 3. Know to use the concept of array in programming. 4. String and string manipulative function in programming.
MSP-301	Mathematical Physics - II	1. Understand the basics of group theory and its applications. 2. Have a detail understanding of Special functions and polynomials. 3. Learn the mathematical technique to solve integral equations. 4. Learn to apply Path integral method to various physics problems. 5. Understand the basic concept of Linear Algebra.
MSP-302	Quantum Mechanics - II	1. Describe model physical system using common approximation approaches for dynamical calculations 2. Explain the relativistic quantum mechanical equations, namely, Klein-Gordon equation and Dirac equation 3. Describe second quantization and related concepts. 4. Explain the formalism of relativistic quantum field theory. 5. Draw and explain Feynman graphs for different interactions
MSP-303	Nuclear Physics	1. Students will have a basic knowledge of nuclear size, shape, bindingenergy.etc and also the characteristics of nuclear force in detail. 2. The students will have an understanding of the , nuclear decay modes, radioactive decay, and the interaction of nuclear radiation with matter; and develop an insight into the building block of matter along with the fundamental interactions of nature. 3. Will be able to gain knowledge about various nuclear models and potentials associated. 4. Grasp knowledge about Nuclear reactions, Fission and Fusion and their characteristics. 5. To provide broad understanding of basic experimental nuclear-detection techniques. 6. Understand the basic forces in nature and classification of particles and study in detail conservations laws and quark models in detail.
MSP-304(A)	Elective: Condensed Matter Physics-I	1. Learn about advanced electrical properties of solids 2. Learn about advanced magnetic properties of solids 3. Learn about advanced optical properties of solids 4. Learn about superconductivity 5. Learn about critical phenomena of solids
MSP-304(B)	Elective: Electronics and Communication Technology-I	1. Understand the basics and principles of analog signal transmissions. 2. Understand the details of AM, FM and PM and the frequency spectrum. 3. Analyze the conversion of analog to digital transmission of signals through different digital modulation technique. 4. Know the important parameters of transmission lines at radio frequencies. 5. Have knowledge on microwave generation and amplification through microwave devices
MSP-304(C)	Elective: High Energy Physics	1. Understand the basic forces in nature and classification of particles and study in detail conservations laws and quark

		models in detail. 2. Understand conceptually the content of the Standard Model and the idea of symmetries (electroweak unification and the Higgs boson only mentioned). 3. Use basic Feynman diagrams to illustrate the electromagnetic, weak and strong forces. 4. Understand conceptually cross section, helicity/handedness, width and branching ratio and be able to perform calculations of simple particle interactions using the above and basic relativistic energy momentum formulae. 5. Understand and use the concept of universality. 6. Understand conceptually the key aspects of the electromagnetic force, illustrating the idea with basic calculations of electron-electron scattering and electron-positron annihilation. 7. Understand conceptually the key aspects of the strong force, including asymptotic freedom and quark confinement, illustrating the ideas with basic calculations of the meson masses and electron-positron annihilation to quarks.
MSP-304(D)	Elective: Laser & Nonlinear Optics-I	1. Concept of properties of LASERs and understanding of their designing parameters 2. Idea of different types of LASERs, their working principles and applications 3. Development of nonlinear optics and its advantages over linear counterpart 4. Knowledge of different nonlinear optical effects or phenomena and their applications 5. Spectroscopic aspects of nonlinear optics and its applications in advanced communications.
MSP-305	Physics Laboratory-III	1. Will learn the characteristic of a G. M. counter and develop the skill to determine its operating voltage, hence verify the inverse square law for the given radioactive sample. 2. Will learn the determination of end point energy of beta particles by half thickness method by GM Counter. 3. Learn the estimation of efficiency of the G.M. detector for (a) Gamma source & (b) Beta Source. 4. Develop the knowledge to examine the statistical properties of radiation detection and to show that for 5. Will develop a knowledge to determine the spot size and angle of divergence of a given laser source. 6. Get the concept of determination of magnetic susceptibility of ferromagnetic substance by Quinck's method. 7. Will acquire the knowledge of determination of Boltzmann constant by using Boltzmann kit. 8. Will get a detail idea of determination of the Lande g-factor using Electron Spin Resonance.
MSP-306	Elements of modern Physics (MDC)	1. Students from other departments will have a preliminary idea about Quantum Mechanics. 2. Concepts of Hydrogen atom. 3. Know the band theory of solids, semiconductors and superconductivity. 4. Brief knowledge on Special Theory of Relativity.

		5. Brief knowledge of LASER Spectroscopy.
MSP-401	Statistical Physics	1. Understand the basic concept of statisticical mechanics to describe systems containing huge numbers of particles. Perform mean field calculations 2. Know & understand the Fundamental Postulate of Equilibrium Statistical Mechanics. 3. Understand & be able to apply Classical Thermodynamics to simple problems. 4. Understand & be able to apply the Micro-Canonical, Canonical, & Grand Canonical Ensembles to appropriate physical systems. 5. Understand the quantum statistical physics of Fermions & Bosons. 6. Be able to apply Fermion & Boson Statistics to various many particle systems.
MSP-402	General Theory of Relativity & Astrophysics	1. Development of fundamental principles of the general theory of relativity. 2. Meaning of basic concepts like the equivalence principles, inertial frames and how gravity is understood as a manifestation of a curved space-time. 3. Knowledge on motion in the gravitational field, time dilation and frequency shifts, bending of light, gravitational waves and cosmological models with expanding space. 4. Idea of stellar distances and celestial coordinates 5. Idea of different magnitudes of the stars and their calculations 6. Evolution of the whole universe, formation of galaxies and stars 7. Hertzsprung Russell diagram and stellar demise 8. The Big Bang cosmological model, and the evidence to support it.
MSP-403(A)	Elective: Condensed Matter Physics-II	1. Learn about advanced semiconductor physics 2. Learn about p-n junction based devices 3. Learn about physics of thin films 4. Learn about soft matter physics 5. Learn about different experimental techniques in condensed matter physics
MSP-403(B)	Elective: Electronics and Communication Technology-II	1. Understand the basic concepts of electromagnetic waves and its propagation in free space. 2. Know the different parameters, patterns and the types of antennas used in communication system. 3. Understand different types of linear beam tubes for microwave generation. 4. Analyze and calculate the range, angle or velocity of objects using the RADAR detection technique. 5. Know the different optoelectronic devices and fiber optics for optical communication.
MSP-403(C)	Elective: Advanced High Energy Physics	1. Be familiar with the limiting procedure of Quantum Field Theory and be able to perform simple calculations for these phenomena. 2. Will have a deep understanding of the concept of Quantum Chromodynamics in including calculation of

		scattering amplitudes of electron-proton inelastic scattering. 3. Understand concept of electro-weak interaction in detail. 4. Learn about the qualitative as well as quantitative study of neutrino-nucleon scattering. 5. Understand conceptually the key aspects of the weak force, illustrating the ideas with basic calculations of muon decay and two family neutrino mixing. 6. Understand qualitatively the CKM matrix and its consequences. 7. Know about the questions that the Standard Model does not answer or explain, current ideas on possible physics beyond the Standard Model, and current constraints from searches for new physics. 8. Get idea of neutrino oscillation and neutrino mass. 9. Understand the basics concepts of Higgs Mechanism, Grand Unified theory and String theory. 10. Know about the current experimental status of High Energy Physics.
MSP-403(D)	Elective: Laser & Nonlinear Optics-II	1. Idea of LASER induced phenomena like pair excitation, LASER cooling etc. 2. Fundamental importance of LASERs in different domains like plasmas, nuclear fusions, atmospheric optics, biology, medical etc. 3. Knowledge of quantum mechanical treatment of nonlinear optics 4. Third order nonlinearity in different materials and applicability of those materials 5. Developments of nonlinear fiber optics that revolutionalize the communication techniques.
MSP-404	Project	1. To develop skills in research and methods available, towards addressing specific project objectives. 2. To identify noble research area and carry out literature survey. 3. Able to analyse research literatures. 4. Able to learn different software packages depending upon the nature of project. 5. Would be able to design the methods and carry out the procedure as per the project. 6. Able to prepare and present a Research Seminar. 7. Able to produce clear and concise written dissertation.