Master of Science (Physics)

Program Outcomes (POs)

PO01 Knowledge about Science :Foster learning through accumulation of knowledge in Science : Using research-based knowledge and research methods to provide valid conclusions.

PO02 Identification, Design/ Development of solutions to scientific problems :Apply knowledge of theories and practices of science to identify and solve problems related to science.

PO03 Analytical & Critical thinking :Foster analytical and critical thinking abilities for data-based decision making.

PO04 Ability to analyze the societal problems/issues :Ability to understand, analyze and communicate problems relevant to the society such as agriculture, food, health, environment, water and energy, which are related to science.

PO05 Individual and Team Work : Ability to lead self and others in the achievement of organizational goals, contributing effectively to a team environment and to communicate scientific information to stakeholders, being able to comprehend and write reports, develop documentation, make presentation and to give and receive clear instructions.

PO06 Usage of modern tools and techniques :Ability to adopt various tools for decision making and problem solving

PO07 Value based Leadership :Ability to develop value based leadership.

Programme Specific Outcomes (PSOs)

Code	Title	Description
PSO01	Ability to communicate and explain the core concepts and theories in the fields of classical and modern physics	Ability to communicate and explain the basic concepts and theories in Classical mechanics, Quantum mechanics, Basic Electronics, Mathematical methods of physics, Statistical mechanics, Electrodynamics, computational methods of physics, Condensed matter physics, Nuclear and Particle physics, various Spectroscopies, Astrophysics and relativity and Laser physics. Also, be able to discuss advanced concepts in the areas of specializations, namely, Materials Science and Electronics.
PSO02	Ability to apply the concepts, and to use the laboratory skills to analyze and solve problems	Ability to apply the concepts, and to use the laboratory skills in General physics, General Electronics, Modern Physics,

	related to physics.	Materials Science and Electronics to analyze and solve problems pertaining to physics.
PSO03	Applying basic concepts/ theories of Physics for solving current social issues in key fields such as renewable energy, novel materials, microelectronics and nanomaterials	Applying basic concepts/ theories of Physics to address and solve current social issues, and in key fields such as renewable energy, novel materials, microelectronics and nanomaterials for development of sensors and devices.
PS004	Demonstrate abilities to identify problems for research in the feilds of study in Physics and skills to use the methods of research and arriving at rational conclusions	To be able to take up research activities in the various fields of physics, by way of planning and designing experiments to study problems of both fundamental and applied aspects of physics.
PSO05	Demonstrate leadership quality for roles in organizations concerned with research and development or applications of physics	Demonstrate the ability to take decisions and problem solving skills as physicists, technical managers and teachers in organizations requiring expertise in Physics, combining ethical, environmental and economic considerations

Course Outcomes (COs)

2019-20 Batch

Semester	Course Code	Course Name	Course Outcomes (COs)
I	**18MSPH1H01**	CLASSICAL MECHANICS	CO1: Ability to explain the basic concept to compare the Newtonian mechanics and D'Alembert's mechanics CO2: Ability to APPLY the concept of 'Alembert's principle, homogeneity of space and time CO3: Ability to explain non-inertial motions, and scattering phenomena CO4: Ability to explain the dynamics of rigid body and small oscillators
	18MSPH1H02	QUANTUM MECHANICS – I	CO1 Ability to explain the concepts of wave-particle duality, uncertainty and complementarity; Hilbert space, operators, parity, unitarity and completeness;

			Schrodinger picture, Heisenberg picture and Interaction picture CO2 Ability to apply the concepts and solve the problem of particle moving in a one-dimensional potential barrier, step and infinite square well the linear harmonic oscillator CO3 Ability to compute commutation relations and matirx representation of operators CO4 Ability to analyse the significance of Stern-Gerlach experiment
	18MSPH1H03	ELECTRONICS (GENERAL)	CO1 Ability to explain the fundamentals of semiconductor physics CO2 Ability to explain the design and working of BJT / FET amplifiers CO3 Ability to explain the fundamentals and areas of applications for the integrated circuits CO4 Ability to design and analyse the various circuits for the linear and non-linear applications of op-amp
	18MSPH1H04	MATHEMATICAL METHODS OF PHYSICS	CO1 Ability to explain the cartesian, cylindrical and spherical coordinate systems; to determine area element, volume element and Jacobian; to carry out coordinate transformations Ability to determine the gradient, divergence and curl of vectors and apply Gauss's and Stoke's theorem Ability to determine eigen values

			and eigen functionns of matrices; Ability to explain the concept of tensors and carry out tensor algebra CO2 Ability to apply the power series method for solving ordinary differential equations Ability to explain the beta, gamma functions and Dirac delta function and apply their properties in solving integrals Ability to solve the Legendre, Bessel and Hermite equations and apply the polynomials in solving problems CO3 Ability to carry out the algebra of complex numbers Ability to apply Caushy's integral theorem and Cauchy's residue theorem in evaluating definite integrals Ability to perform integral transformations such as Fourier, sine and cosine, Laplace, inverse Laplace transformations and solve differential equations CO4 Ability to explain hyperbolic, parabolic and elliptic surfaces Ability to apply the method f separation of variables to solve one dimensional wave equation and heat equations Ability to solve boundary value problems using Green's functions
	18MSPH1H5L	GENERAL PRACTICAL – I	CO 1 Ability to determine the thermal conductivity of a good conductor of heat following Forbe's method CO 2 Ability to calibrate a given

			thermister and use it as a thermometer CO 3 Ability to determine the average size of the Lycopodium powder using the diffraction pattern (Young's method) CO 4 Ability to use a spectrometer along with polarizer and analyser to verify the Fresnel's law of reflection CO 5 Ability to determine the elastic constants of a transparent material in the form of a rectangular beam by Cornu's method CO 6 Ability to set up the circuit and verify the Stefan's law CO 7 Ability to view the absorption bands of KMnO4 and verify Hartmann's interpolation formula CO 8 To be able determine the characteristics of the given Solar cell CO 9 Ability to use the Babinet compensator to determine the thickness of mica sheet CO 10 Ability to determine the distance between the plane mirrors in the Fabry Perot Etalon
	18MSPH1H3L	ELECTRONICS (GENERAL) PRACTICAL	Ability to construct Astable multivibrator using transistors Ability to construct Rectifier circuits using op-amp Ability to construct Clipper and Clamper circuits using op amp Ability to construct Summing, scaling and averaging amplifier

			using op-amp Ability to construct Active low pass and high pass (1st order) filter using op-amp Ability to construct RC phase shift oscillator Ability to construct Wien bridge Oscillator Ability to construct Twin T notch filter using op-amp Ability to construct Astable multivibrator using IC555 timers Ability to implement Boolean expressions Ability to construct Half adder and full adder Ability to construct RS and JK flipflop

Semester	Course Code	Course Name	Course Outcomes (COs)
II	**18MSPH2H01**	STATISTICAL MECHANICS	CO1 Ability to explain the concepts of phase space, ensemble, Ergodic hypothesis, Liouville theorem, equal a priori probability and effect of symmetry on counting Ability to explain different statistical ensembles, their distribution functions, ranges of applicability and corresponding thermodynamic potentials CO2 Ability to compare the classical and quantum concepts in statistical mechanics Ability to apply Maxwell-Boltzmann law to calculate the most-probable, average and

			r.m.s. velocity in an ideal gas Ability to explain the concepts of Entropy and Gibb's paradox Ability to evaluate the partition functions CO3 Ability to apply statistical physics methods, such as Boltzmann distribution, Gibbs distribution, Fermi-Dirac and Bose-Einstein distributions to solve problems in physical system CO4 Ability to apply statistical methods to analyze Black Body Radiation, Bose-Einstein condensation, supefluidity and ferromagnetic ordering CO5 Ability to analyze non-equilibrium conditions and fluctuations in physical systems and explain the electrical noise Nyquist theorem
	18MSPH2H02	QUANTUM MECHANICS – II	CO1 Ability to solve the 3-D Schrödinger equation, in Cartesian and spherical polar co-ordinates, for hydrogenic atoms and evaluate the expectation values of rn CO2 Ability to explain the concepts of symmetry and conservation laws, Parity, Time-reversal symmetry and permutation symmetry; Ability to apply approximation methods such as variational method the WKB approximation CO3 Ability to explain the concepts of time-independent and time-dependent

			perturbation theory Ability to apply perturbation theory to harmonic oscillator, linear Stark effect and Zeeman effect Ability to explain the concepts of scattering and partial wave analysis and apply to scattering by a central potential and screened Coulomb potential CO4 Ability to explain the relativistic Klein-Gordon and Dirac equations and apply the concepts of relativistic quantum mechanics to explain spin and magnetic moment of an electron
	18MSPH2H03	ELECTRODYNAMICS	CO 1 Ability to explain the concepts of electrostatics and multipole expansion and apply Gauss's law, Biot-Savart law and Ampere's law CO 2 Ability to explain the concepts of magnetostatics and multipole expansion, gauge transformations, skin effect CO 3 Ability to explain the concepts of electromagnetic waves and its propagation in conducting and non conducting media CO 4 Ability to explain the concepts of Einstein's special theory of relativity and relations for relativistic energy and momentum CO 5 Ability to explain the concepts of electromagnetic radiation, field transformations, and tensor notations
	18MSPH2H04	COMPUTATIONAL	CO 1 Ability to apply

		METHODS IN PHYSICS	successive bisection method, False-position metho, Newton-Raphson method, Secant method to solve non-linear and transcendental equations Ability to solve simultaneous equations using Gauss elimination method, Gauss-Siedel iterative method, Matrix inversion and Power and Jacobi method CO 3 Ability to apply Newton's forward and backward interpolation method, Cubic Spline for interpolation and extrapolation and curve-fitting CO 4 Ability to apply Trapezoidal rule, Simpson's 1/3 and 3/8 th rule Ability to apply Euler's method, Runge-kutta method, Milner's and Adam and Moulton predictor corrector method to solve differential equations Ability to explain the basic concepts of partial differential equations, generation of random numbers and Monte-Carlo techniques
	18MSPH2H5L	GENERAL PRACTICAL – II	CO 1 Ability to determine the beam divergence of He-Ne Laser CO 2 Ability to determine the thickness of Mica sheet using Edser-Butler method CO 3 Ability to determine the wavelength of light using a ruler and diffraction grating CO 4 Ability to determine the absorption coefficient of

			KMnO4 solution as function of concentration CO 5 Ability to analyze elliptically polarized light CO 6 Ability to set up the Miller Sweep circuit CO 7 Ability to study the interference pattern due to Young's Double slit using Laser light CO 8 To be able determine the Rydberg constant using hydrogen spectra CO 9 Ability to use the online virtual lab (MHRD web resource) and simulate concepts of physics
	18MSPH2H4L	COMPUTER EXERCISES	CO 1 Ability to write a code to implement Bisection method and Newton-Raphson method CO 2 Ability to write a code to implement Newton's forward and Backward interpolation CO 3 Ability to write a code to implement Gauss elimination method CO 4 Ability to write a code to implement Gauss Siedel method CO 5 Ability to write a code to implement Least square fitting method- linear regression CO 6 Ability to write a code to implement Least square fitting method- polynomial fitting CO 7 Ability to write a code to implement Trapezoidal rule, Simpson's 1/3rd rule and

			Simpson's 3/8 rule CO 8 Ability to write a code to implement Euler's method, Runge-Kutta 2nd order and 4th order method CO 9 Ability to write a code to implement Milner's predictor corrector methods CO10 Ability to write a code to implement Adam- Moulton predictor corrector methods CO11 Ability to write a code to implement Monte-Carlo simulation

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III	**18MSPH3H01**	CONDENSED MATTER PHYSICS	CO1 Ability to differentiate different types of crystal structures and analyze crystal structures in terms of symmetry, packing efficiency, bond structures, coordination number etc. CO2 Ability to explain the theory of different experimental techniques employed for crystal structure determination CO3 Ability to explain both the classical and quantum theories employed to account for the specific heat, thermal expansion and thermal conductivity of solids CO4 Ability to recall free electron theory and Fermi

			distribution function and explain heat capacity, electrical and thermal conductivity of solids CO5 Ability to explain the band theory of solids and their classification CO6 Ability to explain dielectric properties of solids and apply the concept to determine the dipole moments of molecules CO7 Ability to explain the various kinds of magnetism in terms of both the classical theory and quantum theory
	18MSPH3H02	NUCLEAR AND PARTICLE PHYSICS	CO1 Ability to explain the fundamental concepts regarding the size, shape density, binding energy and electric and magnetic moments of nucleus. Ability to explain Yukawa's theory of nuclear forces Ability to evaluate the ground state properties of deutron Ability to explain nuclear reaction mechanism and analyze Q – values in nuclear reactions CO2 Ability to explain nuclear structure through different models and analyze spin and parity of a nucleus Ability to explain nuclear decay mechanism and their medical applications CO3 Ability to explain the interaction mechanism of

			nuclear particles with matter Ability to analyze the angle dependency of Compton shift and attenuation of Gamma rays Ability to compare and assess different types of nuclear detectors and their merits CO4 Ability to explain the classification of elementary particles and their properties Ability to explain baryonic conservation and Gell-Mann Nishijima formula
	18MSPH3H31	MATERIALS SCIENCE (SPECIAL)-I	CO 1 Ability to explain and describe the basic structure of materials at the molecular, microscopic, and macroscopic scales, and ability to describe modern methods of characterizing materials at each of these length scales. Ability to explain the differences in the mechanical behavior of engineering materials based upon bond type, structure, composition, and processing CO 2 Ability to explain and describe the basic structures and the distribution of molecular weights and percentage of crystalline nature Ability to compare and assess point, line and interfacial defects in materials and how these affect engineering properties of materials and limit their use

			CO 3 Ability to evaluate the stress, strain and elastic modulii and explain the concepts of creep, fatigue, wear, hardness, toughness and plasticity in engineering materials CO 4 Ability to explain the concepts of phase diagrams and phasse transformations. Ability to apply the concept to a system of binary alloy. Ability to assess the effect of treatment processes such as annealing, hardening and tempering Ability to explain the concepts of nucleation and growth, solidification, crystallization and grain growth
	18MSPH3H32	ELECTRONICS (SPECIAL) - I	CO 1 Ability to explain fundamental properties of light and operation principles of basic optoelectronic devices Ability to explain the basic mechanisms of light generation (including lasers) and compare the characteristics and design architectures and trade-off of semiconductor lasers CO 2 Ability to evaluate the properties of power semiconductor devices and high frequency semiconductor devices Ability to compare the performance of power semiconductor devices such as SCR, thyristor,

			DIAC,TRIAC CO 3 Ability to explain the concepts of Linear Circuits and apply the concepts to design circuits for various applications such as signal generators, filters, electronically regulated power supply and voltage regulators CO 4 Ability to explain the concepts of optoelectronics devices such as solar cells, LED and phototransistors and their characteristics
	18MSPH3S41	ATOMIC, MOLECULAR & RESONANCE SPECTROSCOPY	CO1 Ability to explain the concepts of atomic spectra, including the relativistic corrections; Ability to explain the concepts of Microwave, Infra-Red and electronic spectroscopy CO2 Ability to apply the concepts and analyze the various spectra CO3 Ability to calculate various fundamental parameters, such as bond lengths and structures from the spectra CO4 Ability to explain and apply the concepts of NMR, NQR, ESR and Mossbauer spectroscopy and analyze the spectra.
	18MSPH3S42	X-RAY CRYSTALLOGRAPHY	CO 1 Ability to explain and describe the general features of Crystalline materials and its point group and space group of symmetry and phenomenon of x ray scattering from the crystalline

			lattice. CO 2 Ability to explain and describe the basic structures of crystals and synthesis of crystals by comparing different types of mechanism involved in crystal growth. Ability to explain and describe dislocation in crystal and hardening factors such as strain hardening in crystals. CO 3 Ability to calculate the inter-atomic spacing and inter planer spacing through x-ray diffraction techniques Ability to compare the moving film method and static beam method of x-ray crystallography. CO 4 Ability to explain basic aspects of Chemistry and electron and neutron diffraction in crystals Ability to explain ionic crystals, molecular crystals, hydrogen bonded crystals Ability to explain inelastic properties and elastic properties of atom
	18MSPH3H05L	MODERN PHYSICS PRACTICAL	CO 1 Ability to analyze X-ray diffractogram CO 2 Ability to determine characteristics of GM counter and verification of inverse square law CO 3 Ability to determine β efficiency of GM counting system

			CO 4 Ability to determine emission band spectrum of PN molecule CO 5 Ability to determine Solar rotation period by the study of sun-spots CO 6 Ability to analyze rotational Raman spectrum CO 7 Ability to determine LDR and photocell characteristics CO 8 Ability to estimate Masses of spectroscopic binary system CO 9 Ability to estimate stellar surface temperatures CO10 Ability to record and analyze Electron spin resonance spectrum CO11 Ability to determine Hubble's Constant CO12 Ability to draw H-R diagram
	18MSPH3H31L	MATERIALS SCIENCE (SPECIAL) PRACTICAL -I	CO 1 Ability to determine the Energy gap of semiconductor junction materials CO 2 Ability to determine the Fermi energy of metals CO 3 Ability to determine the Electrical conductivity of glass CO 4 Ability to determine the Thermal conductivity of glass CO 5 Ability to determine

			the Poisson's ratio of rubber CO 6 Ability to measure the Grain size using Metallurgical microscope CO 7 Ability to determine the Glass transition temperature of polymers CO 8 Ability to determine the Phase diagram of two component systems CO 9 Ability to determine the Activation energy of point defects CO10 Ability to determine the Resistivity of the materials using four probe method CO11 Ability to determine the Concentration of charge carriers for semi-conductors-Hall effect CO12 Ability to measure the type of charge carriers for semi-conductors CO13 Ability to prepare the PbS thin film by chemical coating CO14 Ability to determine the concentration of transition metal ions using UV -Vis spectrophotometer
	18MSPH3H32L	ELECTRONICS (SPECIAL) PRACTICAL -I	CO 1 Ability to determine the properties of power semiconductor devices CO 2 Ability to evaluate performance characteristics of semiconductor devices and electronics circuits and analyze their operation under

			different load conditions.

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IV	**18MSPH4H01**	ASTROPHYSICS AND RELATIVITY	CO1 Ability to explain stellar properties, various versions of telescopes, relativity and physics of stars and sun. CO2 Ability to distinguish and analyze the properties of stellar objects, classification of galaxies, origin and evolution of the universe. CO3 Ability to visualize experimental methods of Radio astronomy, Doppler effect and stellar aberrations for validation of the theoretical concepts of evolution of the universe and relativity. CO4 Ability to solve the problems of Astrophysics using Doppler effect, bending of light and gravitational red shift.
	18MSPH4H21	MATERIALS SCIENCE (SPECIAL)-II	CO 1 Ability to explain electrical resistivity due to thermal, impurity, defect and grain boundary scattering Ability to explain the transparency of alkali metals in UV Ability to explain the mechanism of oxidation and corrosion Ability to explain corrosion resistant materials and surface engineering Ability to describe solid solutions and diffusion in alloys CO 2 Ability to classify solids based on band theory of solids Ability to determine effect of doping and mobility of charge

			carriers Ability to explain superconductivity in terms of microscopic and macroscopic theories Ability to explain tunneling phenomena and Josephson effects and applications CO 3 Ability to explain the response of dielectric material to AC electric fields and dielectric breakdown Ability to explain the types of ferroelectrics Ability to compare the structure of traditional and engineering ceramics CO 4 Ability to explain basic aspects of dia, para and ferro magnetic materials Ability to explain the Landau and Lifshitz concept of thickness of Bloch walls Ability to explain antiferromagnetic and ferrimagnetic materials Ability to explain the use of neutron diffraction in the determination of magnetic structure
	18MSPH4H22	ELECTRONICS (SPECIAL)-II	CO 1 Ability to create the appropriate truth table from a description of a combinational logic function Ability to explain the operation and timing constraints for latches and registers Ability to draw a circuit diagram for a sequential logic circuit and

			analyze its timing properties Ability to evaluate combinational and sequential logic designs CO 2 Ability to explain the Interfacing of memory and various I/O devices with 8086 microprocessor Ability to explain the architecture and operation of Programmable Interface Devices Ability to programme and interface with 8086 microprocessor CO 3 Ability to explain logical AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR functions and to explain and simplify the logical statements using Boolean rules and De-Morgan's theorems Ability to apply different combinational and sequential circuits (Flip flop) by designing the circuit for given specifications Ability to explain counters and registers, memory units and displays. CO 4 Ability to write assembly language programs of microcontrollers for various applications to be used in industries, research field and in commercial field applications
	18MSPH4H31	MATERIALS SCIENCE (SPECIAL)-III	CO 1 Ability to explain basic properties of various materials like polymers, composites, Nano materials. CO 2 Ability to differentiate

			and analyze the properties of various composite materials, polymers and Nano materials and their applications CO 3 Ability to visualize experimental methods of various characterizations to validate various theoretical concepts. CO 4 Ability to formulate scientific solution for some real life problems using the knowledge on composite materials, polymers and Nano materials.
	18MSPH4H32	ELECTRONICS (SPECIAL)-III	CO 1 Ability to explain the basic concepts of the analog communication systems, to compute modulation index, bandwidth and power requirements for various analog modulation schemes including AM,FM and PM CO 2 Ability to explain and to analyze and demonstrate the various analog continuous wave modulation and demodulation techniques including AM, FM and PM. CO 3 Ability to explain and to define various antenna parameters and analyze radiation patterns of antennas, various applications of antennas and also Surface wave, sky wave, space wave, ionosphere propagation, Effects on environment Ability to explain Fiber optics communication, basic structure, types and light propagation through optic fiber, modes of

			propagation, losses in fibers. CO 4 Ability to predict propagation effects of electromagnetic waves in the terrestrial, atmosphere, space, and urban environments, Ability to compute link budgets and select antennas, frequencies, and paths for radio communication and radar systems, to describe statistical characteristics of propagating signals, to Identify factors that hamper and enhance radio propagation in a variety of scenarios.
	18MSPH4S41	LASER PHYSICS AND APPLICATIONS	CO 1 Ability to explain the characteristics of laser beam Ability to explain the concept of population inversion and significance of Einstein's coefficients and concept of optical absorption, spectral width, and broadening mechanisms CO 2 Ability to explain the basic concepts of optical resonators, mode locking, quality factors, threshold condition for 2 and 3 level systems. CO 3 Ability to explain the basic concepts of solid, liquid and gas state laser generation and semiconductor lasers. CO 4 Ability to explain the basic concepts of holography and ability to apply in microscopy and interferometry CO 5 Ability to explain the Spectral characteristics of laser

			emission- and the use of lasers in high resolution spectroscopy, fluorescence and Raman scattering. CO 6 Ability to analyse nonlinear phenomenon such as second harmonic generation, parametric amplification, self focusing of high intense laser beams and various multiphoton processes CO 7 Ability to explain the propagation of light in optical fibers employing Maxwell's equations and obtain estimates of optical pulse distortion and attenuation
	18MSPH4H21L	MATERIALS SCIENCE (SPECIAL) PRACTICAL -II	CO 1 Ability to determine the Molecular weight of polymers CO 2 Ability to prepare of polymers CO 3 Ability to determine the Functional group of a polymer CO 4 Ability to test the Hardness of materials CO 5 Ability to determine Diamagnetic susceptibility and size of the molecule CO 6 Ability to determine Paramagnetic susceptibility and magnetic moment of the molecule CO 7 Ability to determine Ferromagnetic Curie temperature CO 9 Ability to determine Phase diagram of Pb-Sn system CO10 Ability to determine

			Percentage of Nickel in stainless steel CO11 Ability to determine Percentage of Chromium in stainless steel CO12 Ability to determine Resistivity of the metals using four probe method CO13 Ability to determine Concentration of charge carriers for semi-conductors. CO14 Ability to determine Measure the type of charge carriers for semi-conductors CO15 Ability to prepare Thin films using Spin-coating Unit CO16 Ability to Study the Vacuum throughput
	18MSPH4H22L	ELECTRONICS (SPECIAL) PRACTICAL -II	CO 1 Ability to construct basic combinational circuits and verify their functionalities. CO 2 Ability to apply the design procedures to design basic sequential circuits and to verify their operation CO 3 Ability to evaluate the possible causes of discrepancy in practical experimental observations in comparison to theory. CO 4 Ability to explain the architecture and Instruction set of Intel 8086 microprocessor CO5 Ability to set up programming strategies and select proper mnemonics and run their programme on the training boards and programme with Assembly Language

			Programming.