

Class		M.Sc. Physics (Previous)	
Semester/Year		I Year	
Subject & Subject Code		Physics - MPHYS20Y101	
Paper		Classical Mechanics and Mathematical Methods in Physics, Paper - I	
Max. Marks		60(ETE) + 40(IA) = 100	
Credit		Total Credits	
L	T	P	4
4	0	0	
Course Objective			
<p>1. To develop an understanding of Lagrangian and Hamiltonian formulation which allow for simplified treatments of many complex problems in classical mechanics and provides the foundation for the modern understanding of dynamics.</p> <p>2. To provide students the ability to hone the mathematical skills necessary to approach problems in advanced physics courses.</p>			
Course Outcome			
<p>1. The students will be able to apply the Variational principles to real physical problems.</p> <p>2. The students will be able to model mechanical systems, both in inertial and rotating frames, using Lagrange and Hamilton equations.</p> <p>3. The students will be able to understand and apply the mathematical skills to solve quantitative problems in the study of physics.</p> <p>4. Will enable students to apply integral transform to solve mathematical problems of interest in physics.</p> <p>5. The students will be able to use Fourier transforms as an aid for analyzing experimental data.</p>			
Student learning outcome			
Student will able to -			
<p>1. Demonstrate a rigorous understanding of the fundamentals of classical mechanics and mathematical methods, involved in theories & principles of physics.</p> <p>2. Sharpen his skill and knowledge and utilize/apply his knowledge in further research and science.</p>			
Unit	Syllabus		Periods
UNIT-I	<p>Holonomic and non-holonomic constraints, D'Alembert's principle, generalized coordinates.</p> <p>Lagarngian, Lagrange's equation and its applications, velocity dependent, potential in Lagrangian formulation, generalized momentum, Legendre transformation, Hamiltonian, Hamilton's Canonical equation, calculus of variation and its application to simple problems, Hamilton's variational principle.</p>		15

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Unit	Syllabus	Periods
UNIT- II	Derivation of Lagrange's and Hamilton's canonical equations from Hamilton's variational principle, extension of Hamilton's principle to non-conservative and non-holonomic systems, method of Lagrange's multipliers, conservation principle and Noether's theorem, conservation of energy, linear momentum and angular momentum as a consequence of homogeneity of time and space and isotropy of space respectively.	15
UNIT- III	Canonical transformation, Integral invariants of Poincare, Lagrange's and Poisson brackets as canonical invariants, Equation of motion in Poisson bracket formulation, Infinitesimal canonical transformation and generators of symmetry, Liouville's theorem, Hamilton Jacobi equation and its applications. Action-angle, variables adiabatic invariance of action angle variables, Kepler problem in action angle variables, theory of small oscillations in Lagrangian formulation, normal coordinates and its application, orthogonal transformation, Eulerian angles, Euler theorem, eigen values of the inertia tensor, Euler equations, Force free motion of rigid body.	15
UNIT- IV	Fourier transforms: Fourier integrals, Fourier's transform and inversion theorem, Falting theorem, application of integral transforms to pulse propagation, Discrete Fourier transform, Fast Fourier transform, Laplace transform, Laplace transform of derivatives and integrals, derivatives integrals of Laplace transform, Laplace transform of periodic function, inverse Laplace transform, convolution theorem, impulsive functions, application of Laplace transform in solving linear differential equation with constant coefficients and with variable coefficients, linear partial differential equations.	15
UNIT- V	Analytic functions, Cauchy-Riemann conditions, Harmonic function, elementary complex functions and their properties, mapping Z and Z complex integration, definite integrals, Cauchy Goursat's theorem, Cauchy integral theorem, Indefinite integrals, Cauchy integral formula, Morera's theorem, Fundamental theorem of algebra, analytic continuation, branches of multi valued function. Taylor's series, Laurent's series, integration and differentiation of power series, zeros of analytic functions, singular point, residues, Cauchy residue theorem, poles evaluation of improper integrals, Jordan's lemma, integration around a branch point, multi valued functions.	15

References:

- 1 Classical Mechanics: Goldstein
- 2 Classical Mechanics: L.P. Landau & H. M. Lifshitz
- 3 Classical Mechanics: A. Ray Chaudhary
- 4 Complex Variables & Functions: Churchill, Brown, Varchy
- 5 Applied Mathematics for Engineers and Physicist: Pipes & Harvill
- 6 Mathematical Methods: Potter & Goldberg

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Class		M.Sc. Physics (Previous)	
Semester/Year		I Year	
Subject & Subject Code		Physics - MPHYS20Y102	
Paper		Classical Electrodynamics, Paper - II	
Max. Marks		60(ETE) + 40(IA) = 100	
Credit		Total Credits	
L	T	P	4
4	0	0	
Course Objective 1. To understand and evaluate fields and forces in Electrodynamics and Magneto dynamics. 2. To provide concepts of relativistic electrodynamics and its applications in branches of Physical Sciences.			
Course Outcome Student will understand - 1. The fundamental of Electrostatics and Magnetostatics its related boundary value problems. 2. Multipoles, Electrostatics of macroscopic media dielectrics, Time Varying Fields, Maxwell's Equations, Conservation Laws, Plane Electromagnetic Waves and Wave Equation. 3. Magneto Hydrodynamics and Plasma Physics & Covariant form of Electromagnetic Equations. 4. Radiation by Moving Charges and Scattering and dispersion.			
Student learning outcome Student will able to - 1. Demonstrate a rigorous understanding of the fundamentals of classical electrodynamics involved in theories & principles of physics. 2. Sharpen his skill and knowledge and utilize/apply his knowledge in further research and science.			
Unit	Syllabus		Periods
UNIT - I	Electrostatics: Electric field, Gauss law, differential form of Gauss law, Curl of electric field and the scalar potential, surface distribution of charges and dipoles and discontinuities in the electric field and potential, Poisson and Laplace equations, Green's theorem, uniqueness of the solution with Dirichlet or Neumann boundary conditions, formal solution of the electrostatics boundary value problem with Green's function, Electrostatics potential energy and energy density, capacitance. Boundary Value Problems in Electrostatics: Method of images, point charge in the presence of a grounded conducting sphere, point charges in the presence of a charged insulated conducting sphere, point charges near a conducting sphere at a fixed potential, conducting sphere in an uniform electric field by method of images, Green function for the sphere, general solution for potential, conducting sphere with Hemispheres at different potential, orthogonal functions and its expansion.		15

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Unit	Syllabus	Periods
UNIT - II	<p>Multipoles, Electrostatics of Macroscopic Media Dielectrics: Multipole expansion of potential multipole expansion of the energy of a charge distribution in an external field, elementary treatment of electrostatics with permeable media, boundary value problems with dielectrics, molecular polarizability and electric susceptibility, models for molecular polarizability, electrostatic energy in dielectric media.</p> <p>Magnetostatics: Differential equation of Magnetostatics and Ampere's law, vector potential and magnetic induction for a circular current loop, magnetic field of a localized current distribution, magnetic moment, force and torque on and energy of a localized current distribution in an external magnetic field, macroscopic equations, boundary conditions on B & H, methods of solving boundary value problems in magnetostatics, uniformly magnetized sphere in an external field, permanent magnetic shielding, spherical shell of permeable material in an uniform field.</p>	15
UNIT - III	<p>Time Varying Fields, Maxwell's Equations, Conservation Laws: Energy in a magnetic field, vector and scalar potential, Gauge transformations, Lorentz Gauge, Coulomb Gauge, Green functions for the wave equation, derivation of the equations of macroscopic electromagnetism, Poynting's theorem and conservation of energy and momentum for a system of charged particles and E.M. fields, conservation laws for macroscopic media.</p> <p>Plane Electromagnetic Waves and Wave Equation: Plane wave in a nonconducting medium, frequency dispersion characteristics of dielectrics, conductors and plasmas, waves in a conducting or dissipative medium, superposition of waves in one dimension, group velocity, Causality in the connection between D and E, Kramers-Kroning relation.</p>	15
UNIT - IV	<p>Magneto Hydrodynamics and Plasma Physics: Introduction and definitions, MHD equations, magnetic diffusion, viscosity and pressure, pinch effect, instabilities in a pinched plasma column, magneto hydrodynamic waves, plasma oscillations, short wavelength limit on plasma oscillations and Debye shielding distance.</p> <p>Covariant form of Electromagnetic Equations: Mathematical properties of the space time of special relativity, invariance of electric charge, covariance of electrodynamics, transformation of electromagnetic field.</p>	15

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Unit	Syllabus	Periods
UNIT - V	Radiation by Moving Charges: Lienard-Wiechart potentials for a point charge, total power radiated by an accelerated charge, Larmor's formula and its relativistic generalization, angular distribution of radiation emitted by an accelerated charge, radiation emitted by a charge in arbitrary extremely relativistic motion, distribution in frequency and angle of energy radiated by accelerated charges, Thomson scattering and radiation, scattering by quasi free charges. Scattering and dispersion:-Introductory considerations, radiative reaction force from conservation of energy, Abraham Lorentz evaluation of the self force, difficulties with Abraham Lorentz model, integral-differential equation of motion including radiation damping, line breadth and level shift of an oscillator, scattering and absorption of radiation by an level shift of an oscillator, scattering and absorption of radiation by an oscillator, energy transfer to harmonically bound charge.	15

References:

- 1 Classical electrodynamics: J. D. Jackson
- 2 Classical Electricity and Magnetism: Panofsky & Philips
- 3 Introduction to Electrodynamics: Griffiths
- 4 Classical theory of fields Landau & Lifshitz
- 5 5. Electrodynamics of continuous Media: Landau & Lifshitz

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Class			M.Sc. Physics (Previous)		
Semester/Year			I Year		
Subject & Subject Code			Physics - MPHYS20Y103		
Paper			Quantum Mechanics and Atomic & Molecular Physics, Paper- III		
Max. Marks			60(ETE) + 40(IA) = 100		
Credit		Total Credits			
L	T	P	4		
4	0	0			
<p>Course Objective</p> <ol style="list-style-type: none"> 1. Show an understanding of quantum mechanics in three dimensions and Quantitative details of Atomic & molecular physics. 2. Use the tools, methodologies and conventions of physics to test and communicate ideas and explanations. 					
<p>Course Outcome</p> <ol style="list-style-type: none"> 1. Student will understand – States Amplitudes and Operators; Observable and Description of Quantum System; Hamiltonian Matrix and time evolution 2. Quantum mechanical states, Transition Between Stationary States and the Co- ordinate Representation. 3. Hydrogen Atom and Interaction with External Fields 4. Symmetries and Angular Momentum & their Eigen values; Systems with Identical Particles 5. Quantative study of Spectroscopy 					
<p>Student learning outcome</p> <p>Student will able to -</p> <ol style="list-style-type: none"> 1. Demonstrate a rigorous understanding of the fundamentals of Quantum Mechanics and atomic & molecular physics, involved in theories & principles of physics. 2. Sharpen his skill and knowledge and utilize/apply his knowledge in further research and science. 					
Unit		Syllabus			Periods

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Unit	Syllabus	Periods
UNIT - I	<p>States Amplitudes and Operators: States of a quantum mechanical system, Bra and Ket Algebra, representation of quantum mechanical states, properties of quantum mechanical amplitude, operators and change of state of a complete set of basic states, product linear operators, language of quantum mechanics, postulates, essential definition and consequent relations.</p> <p>Observable and Description of Quantum System: Process of measurement, expectation values, time dependent of a quantum mechanical amplitude, Observables with no classical analogue, Spin dependence of quantum mechanical amplitude on position, the wave function, superposition of amplitudes, Identical particles, creation and annihilation operators, simple harmonic oscillator.</p> <p>Hamiltonian Matrix and time evolution of quantum mechanical states: Hermiticity of the Hamiltonian Matrix, Time independent perturbation of an arbitrary system, Simple matrix examples of time independent perturbation, Energy eigen states of two state system, Diagonalizing of energy matrix, Time independent perturbation of a two state system, Perturbative solution: weak field and strong field cases, General description of a two state system, Pauli matrices, Ammonia molecule as an example of two state system, asymmetric harmonic oscillator.</p>	15
UNIT - II	<p>Transition Between Stationary States: Transition in two state system, Time dependent perturbation-The Golden rule, Phase space, Emission and absorption of radiation, Induced dipole transition and spontaneous emission of radiation, Energy width of a quasi stationary state.</p> <p>The Co-ordinate Representation: Compatible observable, quantum conditions and uncertainty relations, co-ordinate representation of operators: position, momentum and angular momentum, time dependence of expectation values, The Schrodinger equation, energy quantization, periodic potential as an example.</p>	15
UNIT - III	<p>Hydrogen Atom: Gross structure energy spectrum probability distribution of radial and angular ($l = 1, 2$), Wave functions (no derivation), Effect of spin, relativistic correction to energy levels and fine structure, magnetic dipole interaction and hyperfine structure, the Lamb shift (only a qualitative description).</p> <p>Interaction with External Fields: Non degenerate first order stationary perturbation methods, Atom in a weak uniform external electric field and first and second order Stark effect, Calculation of the polarizability of the ground state of H-atom and of an isotropic harmonic oscillator, Degenerate stationary perturbation theory, Linear Stark effect for H-atom levels, Inclusion of spin orbit and weak magnetic field, Zeeman effect, Strong magnetic field and calculation of interaction energy.</p>	15

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Unit	Syllabus	Periods
UNIT - IV	Symmetries and Angular Momentum: Symmetry transformation and conservation laws, Invariance under space and time translations and space rotation; Conservation of momentum, energy and angular momentum. Angular momentum operators and their eigen values, Matrix representation of angular momentum operators and their eigen states, Coordinate representation of the orbital angular momentum operators and their eigen states (spherical harmonics), Composition of angular momentum. Clebsch-Gordon coefficient, Tensor operators and Wigner Echart theorem, Commutation relations J_+ , J_- and J with reduced spherical tensor operator, Matrix elements of vector operators, Time reversal invariance and vanishing of static electric dipole moment of stationary state.	15
UNIT - V	Systems with Identical Particles: Indistinguishability and exchange symmetry, Many particles wave function and Pauli's exclusion principle, Spectroscopic terms for atoms, The Helium atom, Variational method and its use in the calculation of ground state and excited state energy, Helium atom, Hydrogen molecule, Heitler London methods for H_2 molecule, WKB method for one dimensional problem, Application to bound states (Bohr Sommerfield quantization) and the barrier penetration (Alpha decay problems). Spectroscopy (Quantitative): General feature of spectra of one and two electron system, Vibration band spectrum of a molecule, P.Q. & R. branches, Raman spectra for rotational and irrotational transitions, comparison with infrared spectra, General features of electronic spectra, Frank Condon principle.	15

References:

- 1 Quantum Mechanics-A Modern Approach : Ashok Das & A.C. Melissions
- 2 Quantum Mechanics: P.A.M. Dirac
- 3 Quantum Mechanics (2nd ed.): E. Merzbecker
- 4 Quantum Mechanics- Non relativistic theory: L.P. Landau &H. M. Lifshitz
- 5 Quantum Mechanics: Thankapann (New Age International pub.)
- 6 Quantum Mechanics- Theory & Applications: A. Ghatak & S. Loknathan
- 7 Atomic Spectra: White
- 8 Molecular Spectra: Hertzberg
- 9 Atomic and Molecular Physics: T.A. Littlefield
- 10 Elementary Atomic Structure: G. R. Woodgate
- 11 Quantum Physics Atoms, Molecules, Solid & Nuclear Particles: Eistenberge & Resnick.
- 12 Quantum Mechanics, B H Branson and C. J. Joachain, Pearson Education.

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School of Basic and Applied Sciences

Class			M.Sc. Physics (Previous)		
Semester/Year			I Year		
Subject & Subject Code			Physics - MPHYS20Y104		
Paper			Electronics, Numerical Methods and Computer Programming, Paper - IV		
Max. Marks			60(ETE) + 40(IA) = 100		
Credit		Total Credits			
L	T	P	4		
4	0	0			
Course Objective					
<p>1. To develop an understanding of fundamentals of electronics in order to deepen the understanding of electronic devices that are part of the technologies that surround us.</p> <p>2. To learn about approximation, error in numerical analysis, interpolation and solution of non- linear equations along with their application using computer programming.</p>					
Course Outcome					
<p>1. To understand working & functioning of amplifiers and wave shaping circuits their applications.</p> <p>2. Student will understand the working and applications of logic & Integrated Circuits and Multivibrators.</p> <p>3. Students will learn how to reach to accuracy by minimizing the errors during experiments and reach to approximation using different methods of interpolation.</p> <p>4. Students will able to solve non- linear and integration of first order differential equation.</p> <p>5. Student will able to learn programing in C Language.</p>					
Student learning outcome					
Student will able to -					
<p>1. Demonstrate a rigorous understanding of the fundamentals of Electronics, Numerical Methods and Computer Programming, involved in theories & principles of physics.</p> <p>2. Sharpen his skill and knowledge and utilize/apply his knowledge in further research and science.</p>					
Unit	Syllabus				Periods
UNIT - I	<p>Linear Small Signal and Direct Coupled Amplifier:-R.C. Coupled C.E. Amplifier and its response in different frequency ranges, effect of cascading expression of bandwidth in low and high frequency ranges, emitter follower, tuned amplifier(single signal) single and double tuned amplifiers, Differentials amplifier, common mode rejection ratio, operational amplifier and its basic applications.</p> <p>Wave Shaping Circuits: Exponential circuit response, differentiation and integration by R.C. and L.R circuits, clipping or limiting circuit, clamping circuit, general feature of a time base signal, thyatron sweep circuits, circuits to improve linearity, Miller and Boot strap sweep circuits.</p>				15

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Unit	Syllabus	Periods
UNIT - II	<p>Logic and Integrating Circuits: Boolean algebra, binary counting, counting to a base other than two, binary counter, conversion of binary counter in a decade counter, Decoder, logic gates : NOT, OR, AND, NAND and their circuits, Micro electronic devices, basic principles of LED & solid state laser. basic concepts about fabrication and characteristics of integrated circuits.</p> <p>Multivibrators: Astable, monostable, and bistable multivibrators, frequency of a stable vibrator, frequency control and synchronization, triggering of bistable, Blocking oscillator.</p>	15
UNIT - III	<p>Errors in Numerical Analysis: - Computer arithmetic, sources of errors, Round off errors, Errors analysis, Condition and stability, Approximation, functional and errors analysis, The method of Undetermined coefficients.</p> <p>Interpolation:- Interpolation, Finite differences, Gauss central difference formula, Newton's formula for interpolation, Lagrange's interpolation formula, Double interpolation, Numerical differentiation, Newton and Stirling's formula, Solution of linear systems, Direct and iterative, Eigen value problems.</p>	15
UNIT - IV	<p>Solution of Non-Linear Equation: Bisection method, Newton's Method, Modified Newton's method, Method of integration, Newton's method and method of integration for a system of equations, Newton's method for the case of complex roots, Integration of functions: Trapezoidal and Simpson's rules, Gaussian quadrature formula, singular integrals, Double integration.</p>	15
UNIT - V	<p>Integration of Ordinary Differential Equation:- Predictor Corrector method, Runge-Kutta methods, Simultaneous and higher order equations, Numerical integration and differentiation of Data, Least squares approximation, computer simulation, Monte Carlo method, Curve fitting.</p> <p>Introduction to C: Data type (int, float, double, char, long, long double etc.) operators (Unary, Binary and ternarys), input /output statement (scanf(), printf()), control statements (if, for, while, do while, switch -case-default), Function (type of Function, function definition, function calling, formal arguments, actual arguments, function prototype), Program structure, string (Array, character array), string manipulation functions like strlen(), strcpy(), strcat(), strcmp(), etc.</p>	15

References:

- 1 Electronics-fundamentals and Applications : Ryder
- 2 Integrated Electronics : Millman & Halkias
- 3 Pulse digital and switching Waveforms : Millman & Taub
- 4 Network-Line and Fields : Ryder
- 5 Electronics Devices and Circuits : Bapat
- 6 Programming in Basic : B. Balguruswamy (McGraw Hill-1985)
- 7 Introductory Methods of Numerical Analysis : S.S. Sastry
- 8 A first course in Numerical Analysis : A. Ralston & P. Rabinowitz (McGraw Hill-1985)

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Class		M.Sc. Physics (Previous)	
Semester/Year		I Year	
Subject & Subject Code		Physics Practical - MPHYS20Y105	
Paper		Paper - I & Paper - II, Practical	
Max. Marks		60(ETE) + 40(IA) = 100	
Credit		Total Credits	
L	T	P	4
0	0	4	

PRACTICALS

List of Experiments:

- 1 Use of Michelson's Interferometer to determine:
 - i. Wave length of monochromatic light.
 - ii. D1 for sodium doublet.
 - iii. Thickness of the given mica sheet.
- 2 Use Fabry parot's interferometer to determine:
 - i. Wave length of sodium light.
 - ii. D1 for sodium doublet.
- 3 Verify Fresnel's Laws.
- 4 Determine the wavelength of Neon light taking Hg source as a standard source applying Hartman's formula.
- 5 Use Bebinat's compensator,
 - i. To analyze elliptically polarized light.
 - ii. To determine the phase difference introduced between ordinary & extraordinary rays.
- 6 Determine Stefan's constant.

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