Shree H. N. Shukla College of Science

(Affiliated to Saurashtra university)
Nr. Lalpari Lake, B/h Marketing Yard, Rajkot-360 003
Ph. No. : 9099063150, 97277 53360

Paper: Physics-501

(Mathematical Physics, Classical Mechanics & Quantum Mechanics)

UNIT 1: (12 hour : 14 Mark)

Fourier Series: Definition, Evaluation of the Coefficients of Fourier Series, Cosine Series, Sine Series, Dirichlet's Theorem (Statement only), Extension of Interval, Complex form of Fourier series, Advantages of Fourier series, Properties of Fourier series, Physical Applications of Fourier series analysis (square wave, full wave rectifier, half wave rectifier, triangle wave), Fourier integrals, Fourier Transforms, Fourier sine and cosine Transforms, Numerical Problems.

Dirac-Delta Function: Introduction, Representation of the Dirac delta Function, derivative at a discontinuity, properties of Dirac delta function, the three dimensional Dirac delta function, Numerical Problems.

Reference books :

1. Mathematical Physics By Rajput, Publisher: Pragati Prakashan, Meerut.
2. Quantum Mechanics theory and applications By Ajoy Ghatak & S Lokanathan Publisher: Macmillan India Limited.
3. Mathematical Physics By H K Dass & Dr. Rama Verma, ublisher:S.Chand
4. Mathematical Physics By P.K.Chattopadhyay

UNIT 2: (12 hours: 14 Mark)

Variational Principle and Lagrangian Formulation: Constrained motion, Constraints, degree of freedom, Generalized co ordinates, Generalized notation for displacements & Velocity, Limitation of Newton's laws, variation Technique for many independent variables, Euler-Lagrange differential equation, Hamilton's Variational Principle, Deduction of Lagrange's equations of motion from Hamilton's principle (for Conservative System), D'Alembert's principle, Lagrange's equations from D'Alembert's principle, Rayleigh's dissipation function, Deduction

of Hamilton's Principle from D'Alembert's principle, Deduction of Newton's second law from Hamilton's principle, Application of Lagrange's equation of motion – linear Harmonic oscillator, Simple Pendulum, Spherical Pendulum, Electric Circuit, Compound pendulum, Atwood machine, Numerical problems.

UNIT 3: (12 hour: 14 Mark)

Hamiltonian Formulation: Superiority of Lagrangian approach over Newtonian approach, Non- Holonomic System: Lagrangian method of undetermined multipliers, Application in simple pendulum, Conservation theorems- cyclic or ignorable Co-ordinate, generalized momentum, Phase space and the motion of the System, Hamiltonian, Hamilton's canonical equations of motion, Physical significance of H, Advantage of Hamiltonian approach, Deduction of canonical equations from variational principle, Applications of Hamilton's equations of motion – simple pendulum, Compound Pendulum, linear harmonic oscillator, charged particle in an Electromagnetic field, Numerical problems.

Reference books for 2 & 3:

1. Classical Mechanics By Gupta, Kumar, Sharma Publisher: Pragati Prakashan, Meerut **12th edition.**
2. Introduction to Classical Mechanics By R G Takwale & P S Puranik Publisher: TMG
3. Classical Mechanics By Herbert Goldstein Publisher: Narosa Publishing House

UNIT 4: (12 hour: 14 Mark)

Wave particle duality and Schrödinger equation: Introduction, particle nature of radiation, Compton effect, Wave nature of matter, Uncertainty principle, Schrödinger equation, Commutator, Physical interpretation of ψ, Expectation values, Proof of the uncertainty principle, Eigenfunction of operator p_x , General solution of the one dimensional Schrödinger equation for a free particle, Time evolution of

a wave packet, Group velocity of wave packet, Stationary state, Boundary and Continuity conditions, Degeneracy, Orthogonality of eigenfunctions, Parity, Some exact solutions- particles in a one dimensional infinitely deep potential well; particles in a one dimensional potential well of finite depth, Three dimensional Schrödinger equation, Particle in a box- density of states, Numerical Problems.

UNIT 5: (12 hour: 14 Mark)

Harmonic oscillator & Angular momentum: Introduction, Solution of the time dependent Schrödinger equation, Eigenfunctions, Angular momentum operator, Eigen values and Eigenfunctions of L^2 ,Spherically symmetric potentials, Two body problem, Hydrogen-like atom, Bra and ket notation, Linear operator, Eigenvalue equation, Completeness condition, Examples from Matrix Algebra, Solution of the Eigen value problem, Harmonic oscillator wave functions, Coherent state, Time evolution of the coherent state, Number operator, Density operator, Numerical Problems.

Reference books for 4 & 5:

1. Quantum Mechanics theory and applications By Ajoy Ghatak & S Lokanathan Publisher: Macmillan India Limited.
2. A text book of quantum mechanics By P M Mathews & K Venkatesan Publisher: TMG.