Seat No. _____

HAJ-003-2015025

B. Sc. (Sem. V) (CBCS) Examination

May – 2023

Physics : Paper-501

Faculty Code : 003
Subject Code : 2015025

Time : $2\frac{1}{2}$ Hours / Total Marks : **70**

Instructions :

(1) Attempt all questions.
(2) Make suitable assumption wherever necessary.
(3) Figure on the right indicates full marks.
(4) Non programmable calculator is permitted.
(5) Notations have their usual meaning.

1 (a) Write answer of following questions : **4**

(1) Write Fourier Series for interval ($-\pi$ to $+\pi$).
(2) Write DIRICHLET'S condition.
(3) Write one advantage of Fourier series.
(4) Write the complex form of Fourier Series.

(b) Answer any **one** : **2**

(1) Develop $f(x)$ in Fourier series in the interval (–2,2) if $f(x)=0$ for $-2<x<0$ and $f(x)=1$ for $0<x<2$.

(2) Find the Fourier integrals of the function

$$f(x)=0,\frac{1}{2} \text{ or } e^{-x} \text{ for } x<0, x=0 \text{ or } x>0$$

respectively.

(c) Answer any **one** : **3**

(1) Explain Parseval's theorem.
(2) Obtain Fourier series for a triangle wave.

(d) Answer any **one** : **5**

(1) Obtain Fourier series for a full wave rectifier.

(2) Give definition of Fourier Series and derive the co-efficient of Fourier Series.

2 (a) Write answer of following questions : **4**

(1) Define the term Constraint.

(2) What is the degree of freedom for a particle moving in a plane ?

(3) Lagrangian L = _____

(4) Write Lagrange equation of motion for conservative system.

(b) Answer any **one** : **2**

(1) A particle of mass m moves on a plane in the field of force given by $F = rkr\cos\theta$. Where k is constant and r is the radial unit vector. Obtain the difference equation of the orbit of the particle.

(2) Derive the Euler-Lagrange differential equation.

(c) Answer any **one** : **3**

(1) Derive Newton's second law of motion from Hamilton's principle.

(2) Explain the principle of virtual work.

(d) Answer any **one** : **5**

(1) Derive Lagrange's equation of motion from Hamilton's principle.

(2) Derive Lagrange's equation of motion for simple pendulum.

3 (a) Write answer of following questions : **4**

(1) Define phase space.

(2) Write Lagrange's equations for non-holonomic system.

(3) Configuration space is a _____ dimensional space.

(4) According to Hamilton's principle, the path followed by a system is such that Time integral of L is minimize. (True/False)

(b) Answer any **one** : **2**

(1) A particle is moving near the surface of earth. The kinetic and potential energy of the particle is $T = \frac{1}{2}m(\dot{x}^2 + \dot{y}^2 + \dot{z}^2)$ and V = mgz. Deduce Hamilton's equations of motion for such conservative system.

(2) Calculate Hamiltonian of a system having Lagrangian is

$$L = \frac{1}{2}m(\dot{y}^2 + l^2\dot{\theta}^2 + 2\dot{y}l\dot{\theta}\cos\theta) - mgl(1 - \cos\theta).$$

(c) Answer any **one** : **3**

(1) Give the advantages of Lagrangian approach.

(2) Explain application of Lagrange's method of undetermined multipliers in simple pendulum.

(d) Answer any **one** : **5**

(1) Derive Hamilton's canonical equations of motion.

(2) Explain Hamiltonian for a charged particle in an electromagnetic field.

4 (a) Write answer of following questions : **4**

(1) What is normalization condition ?

(2) 1ev = _____ Joule.

(3) Write Uncertainty Principle.

(4) Define commutator.

(b) Answer any **one** : **2**

(1) An electron of momentum 8×10^{-19} gm cm / sec is passed through a circular hole of radius 10^{-4} cm. What is the uncertainty introduced in the angle of emergence ? Take h = 10^{-27} erg sec.

(2) Normalized the wave function $\Psi(x) = A \cdot e^{ikx}$ over the region $-a < x < a$.

(c) Answer any **one** : **3**

(1) Give Physical interpretation of Ψ.

(2) Explain Wave Functions and Box Normalization.

(d) Answer any **one** : **5**

(1) Explain Particle in a one dimensional potential well of finite depth.

(2) Derive three dimensional Schrödinger equation.

5 (a) Write answer of following questions : **4**

(1) Write angular momentum operator.

(2) The eigenvalues of L^2 are _____.

(3) Write the eigenvalue equation.

(4) Give necessary and sufficient condition for an operator to be a null operator.

(b) Answer any **one** : **2**

(1) The speed of an electron $(m = 1.67 \times 10^{-31} kg)$ is measured in experiment to be $5 \times 10^6 m/s$ the value from this measurement has an uncertainty of 10%. Estimate the minimum uncertainty in the position.

(2) If $H = \frac{P^2}{2m} + \frac{1}{2} m\omega^2 x^2$, then prove that $[x, H] = \frac{ihP}{m}$.

(c) Answer any **one** : **3**

(1) Explain the eigenfunctions of linear harmonic oscillator.

(2) Write the fundamental Postulates of Wave Mechanics.

(d) Answer any **one** : **5**

(1) Derive solution of one dimensional time dependent Schrodinger equation.

(2) Eigen values and Eigen functions of Self-Adjoint Operators.

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