

B.Sc. Semester - 5 (Remedial) (CBCS) Examination
March/April-2023(Old Course)
MATHEMATICAL PHYSICS CLASSICAL MECHANICS AND
QUANTUM MECHANIC (CORE)

Time: 2:30 Hours

Marks: 70

Instructions:

1. All questions are compulsory.
2. Figures to the right indicate marks.

Q.1(a) Answer the following questions (any one) (07)

- 1) Write Fourier series and evaluate their coefficients.
- 2) Obtain Fourier series for a half wave rectifier function.

Q.1(b) Answer the following questions (any one) (04)

- 1) Obtain Fourier cosine series.
- 2) Explain properties of Fourier series.

Q.1(c) Answer the following questions (any three) (03)

- 1) What is Fourier coefficient a_0 ?
- 2) Is the half wave rectifier function even or odd?
- 3) For a triangular wave function $f(-x) = \text{-----}$.
- 4) If the $f(x)$ is odd function, then $f(-x) = \text{-----}$.
- 5) Write the formula of Fourier series.

Q.2(a) Answer the following questions (any one) (07)

- 1) Explain generalized coordinates. Give some illustrations to choose the set of generalized coordinators.
- 2) Obtain Lagrange's equation of linear harmonic oscillator.

Q.2(b) Answer the following questions (any one) (04)

- 1) Explain virtual work.
- 2) Obtain Lagrange's equation of motion using $L = T - V$.

Q.2(c) Answer the following questions (any three) (03)

- 1) Write the expression of generalized displacement.
- 2) Write the set of Lagrange's equation of motion.
- 3) On which base the constraints holonomic and non-holonomic are classified?
- 4) How many degrees of freedom of a simple pendulum?
- 5) Write the equation of D'Alembert's principle.

Q.3(a) Answer the following questions (any one) (07)

- 1) Deduce Hamilton's canonical equations of motion.
- 2) Explain Lagrange's method of undetermined multipliers.

Q.3(b) Answer the following questions (any one) (04)

- 1) Obtain Hamilton's equation of linear harmonic oscillator.
- 2) Describe phase space.

Q.3(c) Answer the following questions (any three) (03)

- 1) $\frac{\partial L}{\partial q_j} = 0$, then L is referred to as _____.
- 2) What is the equation of simple pendulum?
- 3) Lagrange's equation of motion is invariant in form with respect to ----- transformation.
- 4) In the conservative system, the potential energy is only _____ dependent.
- 5) Write Hamilton's variational principle.

Q.4(a) Answer the following questions (any one) (07)

- 1) Derive one-dimensional time dependent Schrodinger equation for free particle.
- 2) Explain Compton effect.

Q.4(b) Answer the following questions (any one) (04)

- 1) Explain uncertainty principle.
- 2) Describe boundary condition.

Q.4(c) Answer the following questions (any three) (03)

- 1) What is the total energy E of a free particle?
- 2) $[x, p_x] = \underline{\hspace{1cm}} = \underline{\hspace{1cm}} = i\hbar$, fill up the blanks.
- 3) $[x, y] = \underline{\hspace{1cm}}?$
- 4) $[x, p_z] = \underline{\hspace{1cm}}?$
- 5) Write continuity equation.

Q.5(a) Answer the following questions (any two) (07)

- 1) Describe two body problem.
- 2) Explain coherent states.

Q.5(b) Answer the following questions (any one) (04)

- 1) Deduce the simplified form for the oscillator.
- 2) Explain properties of bra vectors.

Q.5(c) Answer the following questions (any three) (03)

- 1) What is the Hamiltonian for a linear harmonic oscillator?
- 2) What is the ground state energy of a harmonic oscillator?
- 3) When $\langle A|A \rangle$ becomes greater than zero?
- 4) Which way a ket vector symbolized?
- 5) Fill up the blank: $L_z = -i\hbar \underline{\hspace{1cm}}$.
