

B.Sc. Semester - 5 (CBCS) Examination**Oct/Nov. - 2022(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.

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- 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) Define Hamilton's variational principle and obtain Lagrange's equation of motion using $L = T - V$.
- Q. 2(b) Answer the following questions (any one) (04)
- 1) Explain virtual work.
 - 2) Obtain Lagrange's equation of linear harmonic oscillator.
- Q. 2(c) Answer the following questions (any three) (03)
- 1) Mention the name of constraints which are classified on the base on time.
 - 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 expression of generalized displacement.
- Q. 3(a) Answer the following questions (any one) (07)
- 1) Deduce Hamilton's canonical equations of motion.
 - 2) Obtain the Hamilton's equation of motion.

- 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 q_j is referred to as _____.
 - 2) What is the equation of compound pendulum?
 - 3) Lagrange's equation of motion are 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) Describe one dimensional time independent Schrodinger equation.
- 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) $[x, p_x] = \text{_____} = \text{_____} = i\hbar$, fill up the blanks.
 - 3) The minimum frequency that causes the emission of a photoelectron with zero kinetic energy is called -----.
 - 4) $[p_y, p_z] = \text{_____}$?
 - 5) Write continuity equation.
- Q. 5(a) Answer the following questions (any two) (07)
- 1) Describe two body problem.
 - 2) Obtain solution of Hermite's differential equation.
- Q. 5(b) Answer the following questions (any one) (04)
- 1) Obtain Schrodinger wave equation 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: $L_z = -i\hbar \text{_____}$.
