647510 **BSCmcmCC5010** **Seat No :_____**

B.Sc. Semester - 5 (*CBCS*) Examination

December - 2020 (Old Course)

MATHEMATICAL PHYSICS CLASSICAL MECHANICS AND QUANTUM MECHANIC (CORE)

Time: 1:30 Hours **Marks: 42**

Instructions:

1. Figures to the right indicate marks.
2. There are five questions in the question paper.
3. Answer any three of the following questions.

Q.1(A) Attempt any one (07)

1. Define Fourier series and evaluate its coefficients.
2. Write expression for Fourier integral and obtain expression for Fourier transform.

Q.1(B) Attempt any one (04)

1. Deduce Fourier sine series.
2. A piece wise monotonic and bounded periodic function f(x) with period 2π is given as

   $f(x) = -1$ for $-\pi<x<0$

   $=1$ for $0<x<\pi$

   Obtain its Fourier series.

Q.1(C) Attempt any three (03)

1. If f(x) is an even function, then which type the function f(x)sinx is?
2. If f(x) is an odd function, then – f(-x) = ?
3. If (x) is an even function, then $\int_{-} f(x)cosnx\,dx$ = ?
4. What will be the coefficient a_0 of a series.

   $f(x) = \frac{}{4} - \frac{2}{}(cosx - sinx + cos3x - sin3x + \ldots)$?
5. A function is even, then which Fourier coefficient becomes zero?

Q.2(A) Attempt any one (07)

1. Define Hamilton`s Variational principle and obtain Lagrange`s equations for a Lagrangian function $(q_j, \dot{q}_j, t)$.
2. Define D`Alembert`s principle. Deduce Lagrange`s Lagrange`s equations from D;Alembert`s Principla.

Q.2(B) Attempt any one (04)

1. Describe the classification of constraints with illustration.
2. The kinetic energy and potential energy of a simple harmonic oscillator are $T = \frac{1}{2}m\dot{y}^2$ and $V = mw^2y^2$ respectively. Find Lagrange`s equations of mation.

Q.2(C) Attempt any three (03)

1. The constraints holonomic and non holonomic are classified on the basis of _____.
2. How many degrees of freedom of a compound pendulum?
3. How many degrees of freedom of 3N particles with Nequations of constraints in space?
4. The product $Q_j\delta q_j$ must have the dimension of_____.
5. What is the generalized coordinate if a simple pendulum?

Q.3(A) Attempt any one. (07)

1. Explain Hamiltonian.Derive Hamilton`s canonical equation of simple pendulum.
2. Explain Larange`s method of undetermined multipliers.

Q.3(B) Attempt any one (04)

1. Apply Hamilton`s equations of motion to obtain equation of simple pendulum.

2. Obtain Hamiltonian for a charged particle in an electromagnetic field.

Q.3(C) Attempt any three (03)

1. $\frac{L}{q_j} = 0$, then q_j is referred to as _____.
2. The 2n dimensional space having n coordinates q_j, j = 1,2,3,…,n and n momenta p_j, j = 1,2,3,…,nis known as _____space.
3. If a coordinate is cyclic, it would reduce the numbers of variable by _____in Hamiltonian formulation.
4. In conservation system, the potential energy is only _____dependent.
5. If $L = \frac{1}{2}m(x^2 + y^2) - \frac{1}{2}k(x^2 + y^2)$, then $\frac{L}{x}$= ?

Q.4(A) Attempt any one. (07)

1. Define Compton Effect and discuss kinematics of Compton scattering.
2. Derive the general solution of the one dimensional Schrodinger equation for a free particle.

Q.4(B) Attempt any one (04)

1. Find eigenvalues of the wave function (i) sinx (ii) cosx (iii) e^{ix} and (iv) sinnx of the operator $\frac{d^2}{dx^2}$.
2. Write note on degeneracy.

Q.4(C) Attempt any three (03)

1. With which name the expression $\Delta p \times \Delta x = \frac{\hbar}{2}$ is known?
2. What is the total energy E of a free particle?
3. $[y, P_y]$ = ?
4. What is called a in equation $A\psi(x) = a\psi(x)$?
5. What is normalization condition?

Q.5(A) Attempt any one. (07)

1. Deduce the simplified form for the oscillator and derive Hermite`s differential equation.
2. Explain the two body problem.

Q.5(B) Attempt any one (04)

1. $L_x = -i\hbar\left(y\frac{}{z} - Z\frac{}{y}\right)$, obtain it in spherical polar coordinates.
2. Explain bra vectors.

Q.5 (C) Attempt any three (03)

1. $u(y) = C_0 + C_1y + C_2y^2 + \ldots$ Then $\frac{du}{dy}$ = ?
2. The ground state energy of a harmonic oscillator is _____.
3. Which way a ket vector symbolized?
4. A bra vector and a Ket vector will be known as _____if their scalar product is zero.
5. <A | B>, forms the _____product of two vectors.

****