647510 **BSc5PhyC501x** **Seat No :________**

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

Oct/Nov - 2025 (NEW COURSE)

Mathematical Physics, Classical Mechanics & quantum Mechanics(Core)

Time: 2:30 Hours **Marks: 70**

Instructions:

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

Que.1(A) Answer the following questions (any two) (10)

1) Write the fundamental theorem for Divergence with geometrical interpretation.
2) Discuss the stock's integral for integral calculus.
3) Give the relations between fundamental theorem.

Que.1(B) Answer the following questions (any one) (04)

1) Write the fundamental theorem for gradient with geometrical interpretation.
2) Write six product rules for differential calculus.

Que.2(A) Answer the following questions (any two) (10)

1) Define the Fourier series and evaluate its co-efficient.
2) Explain any two application of Fourier series.
3) Find a series of sine and cosine of function (x) in the interval $-\pi < x < \pi$,
   Also deduce that $\frac{\pi^2}{8} = 1 + \frac{1}{3^2} + \frac{1}{5^2} + \cdots$
   f(x) = 0, when $-\pi < x < 0$
   f(x) = $\frac{\pi x}{4}$, when $0 < x < \pi$

Que.2(B) Answer the following questions (any one) (04)

1) Obtain cosine series.
2) Obtain sine series.

Que.3(A) Answer the following questions (any two) (10)

1) Obtain the equation for simple pendulum from Lagrange's equation.
2) Obtain equation of motion for Atwood's machine, using Lagrange's equation of motion.
3) Obtain the Lagrange's equation of motion.

Que.3(B) Answer the following questions (any one) (04)

1) Describe the classification of constraints.
2) Explain cyclic or ignorable coordinates.

Que.4(A) Answer the following questions (any two) (10)

1) Obtain the Schrodinger's equation for free particle in one and three dimensions.
2) Obtain the solution of a particle in a square well potential when $E < 0$.
3) Prove one of the Ehrenfest's theorem equation.

Que.4(B) Answer the following questions (any one) (04)

1) Find the normalized wave function for $\varphi(\phi) = A \sin m\phi \quad 0 < \phi < 2\pi$.
2) Describe admissibility conditions on the wave function.

Que.5(A) Answer the following questions (any two) (10)

1) Prove that momentum operator is self-adjoint. Show that eigen values of self-adjoint operator are real.
2) Describe the fundamental Postulate of wave mechanics.
3) Explain Dirac delta function in detail

Que.5(B) Answer the following questions (any one) (04)

1) Prove that: $[x, P_x] = [y, P_y] = [z, P_z] = i\hbar$
2) Prove that: 1. $(A + B)^\dagger = A^\dagger + B^\dagger$ 2. $(CA)^\dagger = C^* A^\dagger$

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