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

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

Oct/Nov - 2021 (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.

Q.1(A) **Answer the following questions. (Any Two Out of Three)** (10)

1. Write a short note on Green's theorem.
2. Discuss the stock's integral for integral calculus.
3. Write six product rule for differential calculus.

Q.1(B) **Answer the following questions. (Any One Out of Two)** (04)

1. Write the fundamental theorem for gradient with geometrical interpretation.
2. Give the relations between fundamental theorem.

Q.2(A) **Answer the following questions. (Any Two Out of Three)** (10)

1. Define the Fourier series and evaluate its co-efficient.
2. Find a series of sine and cosine which represent $x + x^2$ in the interval $-\pi < x < \pi$. Also deduce that $\frac{\pi^2}{6} = \sum_{n=1}^{\infty} \frac{1}{n^2} = 1 + \frac{1}{2^2} + \frac{1}{3^2} + \cdots$
3. Represent f(x) = $1 \begin{cases} 0 < x < \frac{1}{2}, & 0 \\ \frac{1}{2} < x < 0 \end{cases}$

Q.2(B) **Answer the following questions. (Any One Out of Two)** (04)

1. Obtain cosine and sine series.
2. Obtain Fourier series for a full wave rectifier function.

Q.3(A) **Answer the following questions. (Any Two Out of Three)** (10)

1. Obtain the equation for spherical 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.

Q.3(B) **Answer the following questions. (Any One Out of Two)** (04)

1. Describe the classification of constraints and explain the term "virtual displacement" and obtain the principle of virtual work.
2. Define: cyclic co-ordinate. Show that "Generalized momentum corresponding to a cyclic co-ordinate is conserved during the motion of a system." Obtain the Hamilton's equation from Lagrangian functions.

Q.4(A) **Answer the following questions. (Any Two Out of Three)** (10)

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.
3. Prove one of the Ehrenfest's theorem equation.

Q.4(B) **Answer the following questions. (Any One Out of Two)** (04)

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 $E < 0$.

Q.5(A) **Answer the following questions. (Any Two Out of Three)** (10)

1. Prove that momentum operator is self-adjoint. Show that eigen values of self-adjoint operator are real.
2. Prove that: $[x, P_x] = [y, P_y] = [z, P_z] = i\hbar$
3. Prove that: 1. $(A+B)^{\dagger} = A^{\dagger} + B^{\dagger}$ 2. $(CA)^{\dagger} = C^{*}A^{\dagger}$

Q.5(B) **Answer the following questions. (Any One Out of Two)** (04)

1. Describe the fundamental Postulate of wave mechanics.
2. Explain Dirac delta function in detail.

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