647510 **BSc5PhyC501x** **Seat No :_____**

B.Sc. Semester - 5 (Remedial) (*CBCS*) Examination
Feb/Mar. -2021 (NEW COURSE)
Mathematical Physics, Classical Mechanics & quantum Mechanics (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.

1(a) Answer the following questions (any two). **(10)**

(1) Explain in detail : The Curl of a vector function .
Give its geometrical interpretation .

(2) Explain in detail : The Divergence of a vector .
Give its geometrical interpretation .

(3) *Write short note on : The fundamental theorem for gradient.*

1(b) Answer the following question (any one). **(4)**

(1) Write six product rules for extra ordinary derivatives .

(2) Explain : Gradient of a function .

2(a) Answer the following question (any two). **(10)**

(1) Obtain Fourier series for a square wave function .

(2) Write the complex form of Fourier series .
Derive the formulae for Fourier coefficients $\mathbf{C_0}$ and $\mathbf{C_n}$, of the complex form of Fourier series .

(3) Evaluate the Fourier coefficients $\mathbf{a_0}$, $\mathbf{a_n}$ and $\mathbf{b_n}$ of Fourier series .

2(b) Answer the following question (any one). **(4)**

(1) Write the expression of Fourier integral for a given function f(x) .
Obtain the expression for Fourier sine transform .

(2) Define : Dirac-delta function in one dimension .
Write the statement of Dirichlet's theorem .

3(a) Answer the following question (any two). **(10)**

(1) Obtain Hamilton's equations of motion. Discuss the physical significance of Hamiltonian H .

(2) Deduce the Lagrange's equations of motion for conservative system from D'Alembert's principle .

(3) What are constraints ? Discuss the classification of constraints with suitable illustrations .

3(b) Answer the following question (any one). **(4)**

(1) Obtain equation of motion for Atwood's machine , using Lagrange's equation of motion .

(2)Derive the equation of motion for simple pendulum , using Lagrange's equation of motion .

4(a) Answer the following question (any two). **(10)**

(1) Derive the three dimensional time-independent Schrodinger's equation .

(2) Explain the conservation of probability and expectation values.

(3) Explain particle in a one dimensional potential well of finite depth .

4(b) Answer the following question (any one). **(4)**

(1) Explain : Normalization of the wave functions.

(2) Derive one-dimensional time dependent Schrodinger equation for a free particle.

5(a) Answer the following question (any two). **(10)**

(1) Derive the solution of the eigen value problem for harmonic oscillator .

(2) Prove that momentum operator is self adjoint . Show that eigen values of self-adjoint operator are real .

(3) Derive the equation for the time evolution of the coherent state .

5(b) Answer the following question (any one). **(4)**

(1) Explain the two fundamental postulates of wave mechanics related to representation of states .

(2) Discuss : Properties of stationary states .

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