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BCF-003-001501 Seat No. _____

B. Sc. (Sem. V) (CBCS) (W.E.F. 2012) Examination

August – 2021

Physics : Paper - 501

(Mathematical Physics, Classical Mechanics & Quantum Mechanics)

(Old Course)

Faculty Code : 003

Subject Code : 001501

Time : $2\frac{1}{2}$ Hours] [Total Marks : **70**

Instructions : (1) All questions are compulsory.

(2) Symbols have their usual meaning.

(3) Figure on right side indicate marks.

All questions are compulsory

1 Answer the questions. **20**

(1) Write the value of Fourier coefficient b_n.

(2) Fourier series is used for _____.

(3) Cosine function is _____ and sine function is _____.

(4) Write the value of bn in interval of (o, l)

(5) Generalized force Q_j = _____

(6) Give the equation of De'Alembert's principle.

(7) In case of simple pendulum, only _____ variable is sufficient for description of motion.

(8) If coordinate 9_k does not appear in the Lagrangian function L, corresponding to linear momentum P_k is constant of motion, such type of coordinate 9_k is called _____.

(9) Hamiltonian is the function of _____.

(10) Define : Phase space.

(11) The equation of simple pendulum is _____.

(12) Lagrange undetermine multiplier is denoted by the symbol _____

(13) $\frac{W}{K^2} =$ _____

(14) Schrodinger's equation for a free particle in three dimension is _____

(15) In $|\Psi|^2 = \Psi\Psi^*$, where Ψ^* is called of _____ Ψ.

(16) According to probability interpretation, the normalize wave function is _____.

(17) $(AB)^{\dagger} =$ _____

(18) $\left[L_x, L_y\right] =$ _____

(19) The N^2 is called the _____ of the wave function.

(20) Expectation value of energy $< E > =$ _____

2 (A) Answer any **three** of the following questions : **6**

(1) Obtain the sine series.

(2) What is called holonomic and nonholonomic constraints ?

(3) Discuss cyclic coordinates.

(4) What is the phase space ?

(5) Obtain Lagrange's equation from Hamilton's principle.

(6) Write the Maxwell's equation for electro magnetic field. Obtain the equation.

$$\vec{E} = -\nabla\phi - \frac{\partial \vec{A}}{\partial t}$$

(B) Answer any **three** of the following questions : **9**

(1) Evaluate the a_a, a_n coefficient of Fourier series.

(2) Obtain the Fourier series of the function

$$f(x) = \begin{cases} 0, & -\pi \le x \le 0 \\ 1, & 0 \le x \le \pi \end{cases}$$

(3) Obtain the equation of simple pendulum from Lagrange's equation.

(4) Obtain Hamilton's equation from Lagrangian function.

(5) Explain Lagrange's undetermined multiplier.

(6) Obtain the Hamilton's equation of motion.

(C) Answer any **two** of the following questions : **10**

(1) Explain the two applications of Fourier series in detail.

(2) Explain Rayleigh's dissipation function.

(3) Obtain the equation for Atwood's machine from Lagrange's equation.

(4) Derive the Hamilton's equation from Newton's equation.

(5) Explain the phase space.

3 (A) Answer any **three** of the following questions : **6**

(1) Obtain the Schrodinger equation for a free particle in three dimension.

(2) Explain physical interpretation of Ψ

(3) Explain : Eigen function and eigen value.

(4) Show that $\left[x, P_y\right] = 0$

(5) Show that $\left(A^{\dagger}\right)^{\dagger} = A$

(6) Show that expectation value of self adjoint operator is real.

(B) Answer any **three** of the following questions : **9**

(1) Explain the box-normalization with example.

(2) Obtain the time independent Schrodinger equation.

(3) Obtain the equation $\frac{d < P_x >}{dt} = \langle F_x \rangle$

(4) Prove that

(i) $(A+B)^{\dagger} = A^{\dagger} + B^{\dagger}$

(ii) $(CA)^{\dagger} = C^{*} A^{\dagger}$

(5) Show that momentum operator is self adjoint.

(6) Describe the fundamental postulate of wave mechanics.

(C) Answer any **two** of the following questions : **10**

(1) Obtain the Schrodinger equation for a free particle in one dimension.

(2) Explain : The conservation of probability.

(3) Explain Dirac delta function in detail.

(4) Show that eigen values of self-adjoint operator are real.

(5) Obtain the Ehrenfest's theorem.