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HCL-003-001501 Seat No. _____

B. Sc. (Sem. V) (CBCS) Examination

October - 2017

Physics : P - 501

(Mathematical Phy., Classical Mechanics & Quantum Mech.)
(New Course)

Faculty Code : 003
Subject Code : 001501

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

Instructions :

(1) Attempt all the questions.
(2) Figures on right side indicate marks.
(3) Notations have their usual meanings.

1 All questions are compulsory : **20**

(1) If $a_o = 1/2$, $a_n = (-1)^n \pi$ and $b_n = 0$, then what will be the fourier series ?

(2) Write the value of fourier co-efficient b_n.

(3) In what interval the function $x/1-x$ does not satisfy the Dirichlet conditions ?

(4) Configuration space is a _____ dimensional space.

(5) Lagrange's undetermined multiplier is denoted by _____.

(6) What is the equation of generalized velocity ?

(7) If the kinetic energy and potential energy of the system are 150 J and –25 J respectively, find the value of Lagrangian of the system.

(8) $\frac{\partial L}{\partial q_j} =$ _____ $and \frac{\partial L}{\partial \ddot{q}_j} =$ _____

(9) The equation of simple pendulum is _____.

(10) The force constant K = _____.

(11) In $E\Psi = H\Psi$, where Hamiltonian operator H is equal to _____.

(12) For conservation of probability, the value of

$\partial/\partial t \int |\Psi|^2 \, d^3x$ = _____.

(13) In $|\psi|^2 = \psi\psi^*$, where ψ^* is called _____ of Ψ

(14) According to Ehrenfest's theorem expectation value of momentum is _____.

(15) The relation between energy and momentum is _____.

(16) Expectation value of potential energy <v> = _____.

(17) If the particle is stay in the potential well (is bounded by the potential) its total energy is _____.

(18) The N^2 is called the _____ of the Wave-Function.

(19) $[Z, P_z]$ = _____

(20) $(AB)^+$ = _____

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

(1) Obtain the cosine series.

(2) Explain the meaning of Scleronomous and rheonomous constraints with illustrations of each.

(3) Discuss cyclic coordinates.

(4) Obtain the equation of generalized momentum from Lagrange's equation of motion.

(5) Explain Hamilton's principle.

(6) What is the phase space ?

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

(1) Obtain the Fourier series of the function

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

(2) Describe the extension of interval.

(3) Obtain the equation of charge for LC series circuit.

(4) Explain Rayleigh's dissipation function.

(5) Explain Lagrange's undetermined multiplier.

(6) Explain the configuration space.

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

(1) Define the Fourier series. Evaluate the coefficients.

(2) Obtain the Lagrange's equation of motion.

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

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

(5) Obtain the equation of simple pendulum and compound pendulum from Hamilton's equation.

3 (a) Answer the following questions in short : (any three) **6**

(1) Obtain the Schrodinger's equation for free particle in three dimensions.

(2) Explain the stationary state.

(3) Explain : Eigen function and Eigen value.

(4) Define : Adjoint operator and self-adjoint operator.

(5) Show that : $[X, P_x] = i\hbar$

(6) Show that : $(A^+)^+ = A$

(b) Answer the following questions : (any three) **9**

(1) Explain the normalization of wave function.

(2) Obtain the time independent Schrodinger's equation.

(3) Write short note on expectation value.

(4) Prove that :

(i) $(A+B)^+ = A^+ + B^+$

(ii) $(CA)^+ = C^* A^+$

(5) Show that $[L_x, L_y] = i\hbar L_z$

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

(c) Answer the following questions in detail : (any two) **10**

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

(2) Obtain the Ehrenfest's theorem.

(3) Obtain the solution of a particle in a square well potential when energy E < O.

(4) Explain Dirac delta function in detail.

(5) Describe the fundamental postulates of wave mechanics.
