

B.Sc. Semester - 5 (Remedial) (CBCS) Examination**Feb/Mar. -2021 (OLD COURSE)****MATHEMATICAL PHYSICS CLASSICAL MECHANICS AND QUANTUM MECHANIC(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.
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1(a) Answer the following question (any one).**(7)**

- (1) Obtain the Fourier series for a Half-wave rectifier function.
- (2) Derive the formulae of Fourier coefficients a_0 , a_n and b_n , using the orthogonal relations of sine and cosine function.

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

- (1) State and prove Parseval's theorem in the form of Fourier coefficients a_0 , a_n and b_n .
- (2) Write and briefly explain the Dirichlet's conditions.

1(c) Answer the following question (any three).**(3)**

- (1) If $f(x)$ is an even function, then which type of series does it represent? Whether sine or cosine series?
- (2) Write the Fourier sine and cosine integrals, for a function $f(x)$.
- (3) Define Dirac delta function, in one dimension.
- (4) Write complex form of Fourier series.
- (5) Mention any three physical applications of Fourier series analysis.

2(a) Answer the following question (any one).**(7)**

- (1) Deduce the Lagrange's equations of motion for conservative system, from D'Alembert's principle.
- (2) Explain generalized coordinates. Give some illustrations to choose the set of generalized coordinates.

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

- (1) Obtain equation of motion of a compound pendulum using Lagrange's equations.
- (2) Explain: Virtual work.

2(c) Answer the following question (any three).**(3)**

- (1) What are the degrees of freedom?
- (2) Write D'Alembert's principle.
- (3) Give the expression of Hamilton's variational principle.
- (4) Write Euler-Lagrange differential equations.
- (5) Are the dimensions of generalised velocity, necessarily the dimensions of linear or angular velocity?

3(a) Answer the following question (any one).**(7)**

- (1) Write Hamilton's canonical equations of motion. Discuss the physical significance of Hamiltonian H .
Explain: Conservation theorem.
- (2) Explain Lagrange's method of undetermined multipliers.

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

- (1) Apply Hamilton's equations of motion to obtain equation of motion of simple pendulum.
- (2) Write the advantages of Lagrange's equations over Newton's equations of motion.

3(c) Answer the following question. (any three).**(3)**

- (1) What is a cyclic co-ordinate?
- (2) Define: Phase space.
- (3) If a co-ordinate is cyclic, then it would reduce the number of variables by which value, in Hamiltonian formulation?
- (4) Write the Hamiltonian (H) of the system.
- (5) Under which conditions, the Hamiltonian H is equal to total energy E of the system?

- 4(a) Answer the following question (any one).** (7)
- (1) Describe the proof of uncertainty principle .
 - (2) What is Compton effect ? Deduce the expression for the Compton shift.
- 4(b) Answer the following question (any one).** (4)
- (1) Define Commutator . Give three illustrations of commutation relations .
 - (2) Explain normalization of the wave functions .
- 4(c) Answer the following questions.(any three).** (3)
- (1) Define operator .
 - (2) Write one-dimensional time dependent Schrodinger equation for a free particle .
 - (3) Write the orthogonality condition .
 - (4) On which factors do the photo-electric current depends ?
 - (5) Mention the normalization condition .
- 5(a) Answer the following question (any one).** (7)
- (1) Write the Hermite's differential equation . Obtain the solution of Hermite's differential equation.
 - (2) Derive the expression of energy for hydrogen like atom .
- 5(b) Answer the following question (any one).** (4)
- (1) Obtain Schrodinger wave equation for the oscillator .
 - (2) Explain : (a) The number operator . (b) The density operator .
- 5(c) Answer the following question (any three).** (3)
- (1) Define : Ket vectors .
 - (2) Define : Null operator .
 - (3) Give the symbol of bra vector .
 - (4) What is the Hamiltonian for a linear harmonic oscillator?
 - (5) Mention any one property of a linear operator.
