

M.Sc.(Phy.) Semester - 1 (CBCS) Examination

Jan/Feb.-2022 [NEW COURSE]

Mathematical Physics and Classical Mechanics(Core (New))

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.

- Q.1 Answer in brief any seven: 14
- (a) What are the homogeneous and inhomogeneous linear differential equations?
 - (b) Define the Wronskian of the homogeneous solution.
 - (c) What is the Wronskian for $y_1 = \sin x$, $y_2 = \cos x$ and $X = \sin x$?
 - (d) What are different integral transforms and their kernel?
 - (e) Define the Laplace transform.
 - (f) Write main applications of Virial theorem.
 - (g) For Poisson's bracket, prove $[X, X] = 0$.
 - (h) Write the conditions for the eccentricity (e) and energy (E) for hyperbolic and parabolic orbits.
 - (i) Define the action of a system with its appropriate form.
 - (j) Explain in brief, inertial and non-inertial frame of references.
- Q.2 Answer any two of following questions: 14
- (a) Write a note on changing independent variable process for solving the homogeneous equations.
 - (b) Discuss the exact equations to obtain the solution of homogeneous equations.
 - (c) Find the solution for $y'' + x y'' + y = 0$ equation using Frobenius' method.
- Q.3 Answer any two of following questions: 14
- (a) Find the Laplace transform of $\cos kt$.
 - (b) Find the Laplace transform of t , e^{kt} and $\cosh kt$.
 - (c) Derive differential equation of orbit and write its main applications.
 - (d) Write a note on Bertrand's theorem.
- Q.4 Answer any two of following questions: 14
- (a) Define extended canonical and canonical transformations. Explain how Hamilton's variation principle is used to connect the old and new canonical systems.
 - (b) Define Poisson's brackets. For angular momentum, prove that $[l_1, l_2] = l_3$, where $l_1 = x_2 p_3 - x_3 p_2$, $l_2 = x_3 p_1 - x_1 p_3$, $l_3 = x_1 p_2 - x_2 p_1$.
 - (c) Discuss Virial theorem in detail with necessary mathematical expressions.
- Q.5 Answer any two of following questions: 14
- (a) Obtain the Hamilton-Jacobi equation. What is the Hamilton's principal function "S"? What is its physical significance?
 - (b) Write a note on coriolis force.
 - (c) Discuss in detail the complete solution of inhomogeneous equations when one integral is known as a complementary function.
 - (d) Explain the solution for inhomogeneous equations by using variable of parameters process and particular integral.
