

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

Nov/Dec - 2022 [NEW COURSE]

## Mathematical Physics and Classical Mechanics(Core (New))

Time: 2:30 Hours

Marks: 70

## Instructions:

1. All questions are compulsory.
2. Figures to the right indicate marks.

- Q.1** Answer in brief any **seven**: **14**
- (a) Provide two examples for second order differential equations.
  - (b) Define homogeneous differential equation with suitable two examples.
  - (c) Discuss in brief the Wronskian of homogeneous solution.
  - (d) Find the Laplace transform of 1?
  - (e) Prove that Laplace transform of  $e^{-2t} \sin 3t = 3 / (s^2 + 4s + 13)$ .
  - (f) Find the Fourier cosine transform of  $F(x) = 1$  for  $n = 0$ .
  - (g) For the Poisson's brackets, prove that  $\dot{q}_i = [q_i, H]$  gives Hamilton's canonical equation:  $\dot{q}_i = \frac{\partial H}{\partial p_i}$ .
  - (h) For Poisson's bracket, prove  $[X, X] = 0$ .
  - (i) Define the action of a system with its appropriate form.
  - (j) What are the main applications of Virial theorem?
- Q.2** Answer any **two** of following questions: **14**
- (a) Obtain a solution for  $y'' + xy'' + y = 0$  equation using Frobenius' method.
  - (b) Obtain the Hamilton-Jacobi equation. What is the Hamilton's principal function "S"? What is its physical significance?
  - (c) Write a note on coriolis force.
- Q.3** **07**
- (a) Write a note on changing independent variable process for solving the homogeneous equations. **07**
  - (b) Discuss in detail the exact equations for the solution of homogeneous equations. **07**
- OR**
- (a) Describe the complete solution of inhomogeneous equations when one integral is known as a complementary function. **07**
  - (b) Discuss the solution of inhomogeneous equations using variation of parameters method. **07**
- Q.4** Answer any **two** of following questions: **14**
- (a) Write Bertrand's theorem and discuss this theorem with necessary derivations.
  - (b) Define canonical and extended canonical transformations and derive transformation equations for  $F_1$  and  $F_2$  generating functions.
  - (c) Define Poisson bracket. Prove that the Poisson bracket remains invariant under canonical transformation.
- Q.5** Answer any **two** of following questions: **14**
- (a) What will be the Laplace transform for  $\sin kt$ ? Derive the same in detail.
  - (b) Find the Laplace transform of  $t, t^n$  and  $\cosh kt$ .
  - (c) Find out the values of (i)  $L \{ e^{kt} \}$  and (ii)  $L \{ t^{-1/2} \}$ .
  - (d) Define the Fourier transform. Provide list of its applications. Find out the value of Fourier transform for  $F(x) = e^{-|x|}$  function.

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