



**JBD-1603010102010100** Seat No. \_\_\_\_\_

**M. Sc. (Sem. I) (CBCS) Examination**

**December - 2019**

**CT - 01 : Physics**

*(Mathematical Physics and Classical Mechanics)*

Time :  $2\frac{1}{2}$  Hours]

[Total Marks : 70

- Instructions :** (1) Attempt all questions.  
(2) All questions carry equal marks.  
(3) Mathematical symbols have equal meanings.

- 1 Answer in brief any seven : 14
- (a) Define differential equation. What is a degree of a differential equation? 2
- (b) Discuss in brief the Wronskian of homogeneous solution. 2
- (c) What is the significance of recurrence relation for any given homogeneous differential equation? 2
- (d) Define Laplace, Fourier - Bessel, Mellin and Fourier transforms. 2
- (e) Find the Laplace transform for 1. 2
- (f) If Lagrangian is given as :  $L = \left(\frac{1}{2}\right)m\left(r^2 + r^2\dot{\theta}^2\right) - V(r)$ , 2  
then prove that  $P_{\theta} = \frac{\partial L}{\partial \dot{\theta}} = mr^2\dot{\theta}$ .
- (g) What is generating function in canonical transformation? 2
- (h) Prove for Poisson's bracket,  $[X, X] = 0$ . 2
- (i) Show that total time derivative of Hamilton is characteristics function of W gives action of the system. 2
- (j) On earth, where one finds the maximum effect of coriolis acceleration? Why? 2

- 2** Answer any **two** of following questions :
- (a) Write a note on "exact equations-a final procedure to find out the solution of any given homogeneous differential equation. **7**
- (b) Discuss in detail the complete solution of inhomogeneous equations when one integral is known as a complementary function. **7**
- (c) Obtain a solution for  $y'' + xy'' + y = 0$  equation using Frobenius' method. **7**

- 3** (a) Find the Laplace transform of  $t$ ,  $t^n$  and  $\sinh kt$ . **7**
- (b) Find the Laplace transform of  $\cos kt$ . **7**

**OR**

- (a) Define canonical and extended canonical transformations and derive the transformation equations only for generating function  $F = F_1(q, Q, t)$ . **7**
- (b) Define poisson brackets and prove that the poisson brackets remain invariant under canonical transformation. **7**

- 4** Answer any **two** of following questions :
- (a) Solve integral equation for orbit and obtain the following equation  $u = \frac{mk}{l^2} \left[ 1 + \sqrt{1 + \frac{2El^2}{mk^2}} \cos(\theta - \theta') \right]$ . **7**
- Why this equation is superior to the solution obtained by differential equation of orbit? Which geometrical shape this equation represents?
- (b) Discuss the following effects observed due to coriolis acceleration with necessary figures : **7**
- (i) Whirling wind of cyclone and
- (ii) Deflection of missile.
- (c) Obtain Hamilton - Jacobi equation and describe its physical significance. **7**

- 5** Answer any two of following questions :
- (a) Discuss in detail various aspects of Fourier sine and cosine transforms. **7**
  - (b) Discuss in detail the "evaluation of integrals - an application of Fourier transform". **7**
  - (c) Write a note on Virial theorem. **7**
  - (d) Discuss in detail the scattering of particles. **7**
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