

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

Oct/Nov. -2019 - [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.

1. Answer in brief any **seven**:

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- (a) What are ordinary and partial differential equations? Give the examples.
- (b) Define homogeneous and inhomogeneous differential equations.
- (c) Define the Wronskian of the homogeneous solution.
- (d) Define Laplace, Fourier – Bessel, Mellin and Fourier transforms.
- (e) Find the Fourier transform of $F(x) = e^{-|x|}$.
- (f) For Poisson's bracket, prove $[X, X] = 0$.
- (g) What is the physical significance of Hamilton's principal function?
- (h) Write important uses of Bertrand's theorem.
- (i) Why earth is ellipsoid oblate in shape?
- (j) If operator

$$\left(\frac{d}{dt}\right)_{fix} = \left(\frac{d}{dt}\right)_{rot} + \vec{\omega}X$$

operates on $\vec{\omega}X$ then what relation is obtained? What is its physical significance?

2. Answer any **two** of following questions:

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- (a) Discuss the changing independent variable for the solution of homogeneous equations.
- (b) Describe the complete solution of inhomogeneous equations when one integral is known as a complementary function.
- (c) Discuss in detail the Frobenius' method for a differential equation: $y'' + xy' + y = 0$.

3. (a) Discuss in detail Fourier sine and cosine transforms.

- (b) Write a note on solution of boundary value problems using Fourier transforms.

OR

- (a) Obtain the solution of the following equation of orbit in integral form

$$\int dt = \int \frac{dr}{\left[\frac{2}{m}(E - V(r)) - \frac{l^2}{2mr^2}\right]^{1/2}}$$

- (b) With the help of Coriolis force, explain the following phenomenon: (i) Flight of missile, (ii) Whirling of cyclones, (iii) Oblate ellipsoid shape of earth.

4. Answer any **two** of following questions:

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- (a) Write a note on Hamilton–Jacobi theory.
(b) Write a note on Virial theorem.
(c) Explain in detail the Bertrands theorem.

5. Answer any **two** of following questions:

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- (a) What will be the Laplace transform for $\sin kt$?
(b) What will be the Laplace transform for $\sin hkt$ and $\cos hkt$?
(c) Find out the Laplace transforms of (i) $t^{-1/2}$ and (ii) t .
(d) Discuss in detail some simple properties of Laplace transforms.