

(i) Printed Pages : 3

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(ii) Questions : 9

Sub. Code :

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Exam. Code :

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M.Sc. (Physics) 1st Semester
(2125)

CLASSICAL MECHANICS

Paper-PHY-8012

Time Allowed : Three Hours]

[Maximum Marks : 80

Note :— Attempt **FIVE** questions in all, selecting **ONE** question each from Unit I-IV and the compulsory question from Unit V.

UNIT—I

1. (a) What is D'Alembert's principle? Derive Lagrange's equations of motion for conservative and non-conservative systems.
- (b) Obtain equation of motion for a bead sliding on a uniformly rotating straight wire under a force-free space. 8,8
2. (a) Deduce Lagrange's equations of motion using variational principle for systems involving forces not derivable from potential function.
- (b) Using variational principle, find the curve for which the surface area is minimum. 8,8

UNIT—II

3. (a) What are infinitesimal rotations? Show that a set of infinitesimal rotations forms a vector.
- (b) What is Coriolis force? Find an expression for the deviation of falling body from the vertical. 8,8

4. (a) Obtain Euler's equations of motion for a rigid body with one point fixed.
- (b) Show that the components of angular velocity along body set of axis are given in terms of Euler angles given by :

$$\omega_1 = \dot{\Phi} \sin \theta \sin \psi + \dot{\theta} \cos \psi ,$$

$$\omega_2 = \dot{\Phi} \sin \theta \cos \psi - \dot{\theta} \sin \psi ,$$

$$\omega_3 = \dot{\Phi} \cos \theta + \dot{\psi} . \quad 8,8$$

UNIT-III

5. (a) Find the frequency and normal coordinates of vibration of a linear triatomic molecule considering small displacement from the mean position. Also discuss different cases.
- (b) Explain briefly the small oscillations & their applications.

10,6

6. (a) Derive Hamilton's principle from variational principle.
- (b) What is Δ -variation? Discuss how it differs from δ -variation.
- (c) What are cyclic coordinates? Show that if a coordinate is cyclic in Lagrangian, it will also be cyclic in Hamiltonian.

8,4,4

UNIT-IV

7. (a) Show that the Poisson brackets are invariant under canonical transformations.

- (b) Show that the transformation :

$$P = q \cot p, Q = \log \left(\frac{\sin p}{q} \right) \text{ is canonical.}$$

Show that the generating function is

$$F = e^{-Q} (1 - q^2 e^{2Q})^{1/2} + q \sin^{-1} (q e^Q). \quad 8,8$$

8. (a) Solve the Harmonic oscillator problem by Hamilton-Jacobi method.

- (b) State and prove Jacobi's Identity. 10,6

UNIT—V

9. (a) Explain the term virtual displacement and state principle of virtual work.
- (b) What are holonomic and non-holonomic constraints? Explain with examples.
- (c) The wind deviates towards the west in northern hemisphere. Explain.
- (d) Why simple pendulum is in stable equilibrium?
- (e) What is Rayleigh dissipation function ?
- (f) Show that Lagrange's equations are unaltered if the Lagrangian is multiplied by a scalar or a scalar constant is added to it. 3,3,3,3,2,2