(i) Printed Pages : 3 Roll No. .....

(ii) Questions : 9 Sub. Code : 3703

Exam. Code : 0472

M.Sc. Physics 1st Semester

(2123)

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 to IV. Unit V is compulsory.

UNIT—I

I. (a) Derive the equation $\frac{d}{dt}\left(\frac{\partial L}{\partial \dot{q}_j}\right) - \frac{\partial L}{\partial q_j} = 0$ for a conservative system.

(b) Obtain equation of motion for Atwood's machine using Lagrangian method.

(c) What are the difficulties on account of constraints ? 8,6,2

II. (a) A mass slides in a gravitational field on a frictionless wire connecting points P and Q in a verticle plane. For what shape of the wire is the time of descent a minimum ?

(b) Using variational principle, derive expression for growth of current in LR circuit. 8,8

UNIT—II

III. (a) What is coriolis force ? Find an expression for the deviation of a falling body from the verticle.

(b) Find a relation between time rate of change of a vector as viewed in the space set of axis and body set of axis. Hence find the components of angular velocity in terms of Euler angles in body set of axis. 8,8

IV. (a) Explain the precessional motion of a symmerical top under the effect of gravitational field.

(b) Explain principal axis and principal moment of inertia of a rigid body. 12,4

UNIT—III

V. (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 small oscillations and their applications. 12,4

VI. (a) Derive Hamilton's principle from Variational principle.

(b) The lagrangian of an anharmonic oscillator of unit mass is :

$$L = \frac{1}{2}\dot{x}^2 - \frac{1}{2}w^2x^2 - \alpha x^3 + \beta x \dot{x}^2$$

α and β being constants. Find the Hamiltonian and deduce canonical equation of motion.

(c) State Jacobi's form of least action principle. 8,6,2

UNIT—IV

VII. (a) Determine the canonical transformation defined by generating function :

$$F(q, Q, t) = \frac{1}{2} m\, w(t)\, q^2 \cot Q .$$

Also find the new Hamiltonian K.

(b) Set up equations of motion in Poisson bracket formulation and thus deduce Hamilton equations. 8,8

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

(b) Find the frequency of a linear Harmonic oscillator using action angle variables. 10,6

UNIT—V

IX. (a) Why the cyclones rotate clockwise in southern hemisphere ? 3

(b) Show that the generalized momentum conjugate to a cyclic coordinate is conserved. 3

(c) Show that the lagrange's equations are unaltered if the lagrangian is multiplied by a scaler or a scaler constant is added to it. 3

(d) Show that the generating function $F = \sum_i q_i\, p_i$ generates the identity transformations. 3

(e) Define action and angle variables. 2

(f) Describe configuration space. 2