



S-2607

M. Sc. (Part - I) Examination
March / April - 2011
Physics : Paper - 412
(Classical Mechanics)

Time : 3 Hours]

[Total Marks : 70

Instructions :

(1)

नीचे दृशावेव निशानीवाणी विगतो उत्तरवाडी पर अवश्य लपवी. Fillup strictly the details of signs on your answer book.	Seat No. :
Name of the Examination :	<input type="text"/>
<input type="text" value="M. Sc. (Part - 1)"/>	<input type="text"/>
Name of the Subject :	<input type="text"/>
<input type="text" value="PHYSICS : PAPER - 412"/>	<input type="text"/>
Subject Code No. : <input type="text" value="2"/> <input type="text" value="6"/> <input type="text" value="0"/> <input type="text" value="7"/>	<input type="text"/>
Section No. (1, 2,.....) : <input type="text" value="Nil"/>	<input type="text"/>
	Student's Signature

- (2) Draw necessary diagrams whenever required.
(3) Symbols used have their usual meaning.
(4) Figures to the right hand side indicate full marks.

- 1 Write any two : 14
- (i) Find the equation of motion of the centre of mass of a system of particles under the influence of internal and external forces. 7
- (ii) (a) What are constraints? Explain various classifications of constraints, giving example in each case. 4
- (b) Explain effect of coriolis force on a freely falling particle. 3
- (iii) (a) State Hamiltonian principle and derive Langrange's equation of motion for a conservative system. 4
- (b) Using the method of small oscillations, calculate the frequencies of a vibration of a linear tri-atomic molecule. 3
- 2 Write any two : 14
- (i) Derive the Lagrange's equation of motion for a conservative holonomic system. Why should we say the derivation of Lagrange's equations for a system is equivalent to Newton's equation of motion? 7

- (ii) (a) Discuss the motion of a charged particle in an electromagnetic field. 4
- (b) What is Rayleigh dissipation function? Give physical significance of it. 3
- (iii) (a) Write short notes on Langrange's undetermined multipliers. Why are the multipliers called undetermined? 4
- (b) Discuss the advantages of Langrange formulation over Newton's formulation of classical mechanics. 3
- 3 Write any two :** 14
- (i) Derive Rutherford scattering cross section formula for a repulsive scattering of charged particles by coulomb field. 7
- (ii) (a) Show that the motion of a particle under a centre force field is restricted in a plane. 4
- (b) Show by means of substitution $r=1/u$ that the differential equation for the path of a particle in a central field is 3
- $$\frac{d^2u}{d^2\theta} + u = -\frac{f(1/u)}{\mu h^2 u^2}$$
- (iii) (a) Describe the equation of motion in arbitrary potential field. 4
- (b) The nature of the orbit is determined by the value of its eccentricity $\epsilon = \sqrt{1 + \frac{2El^2}{\mu k^2}}$ 3
- Discuss the various special cases depending upon the value of E and ϵ .
- 4 Write any two :** 14
- (i) Describe the motion of a symmetrical top in earth's gravitational field when any arbitrary point on the symmetry axis is fixed. 7
- (ii) (a) Take any one of the Euler's angles. Define the corresponding rotation and give the rotation matrix which induces this rotation. Show that this matrix is orthogonal. 4
- (b) Derive the equation of Torque-free motion for symmetric top. 3
- (iii) (a) Explain the term : moment of inertia and product of inertia. When are the product of inertia zero? 4
- (b) Derive the torque-free motion of an asymmetric top. 3

- 5 Write any two : 14
- (i) Discuss briefly how the Poisson's brackets are useful in physical studies. Evaluate the fundamental Poisson's bracket. 7
- (ii) (a) State Jacobi identity and show that they satisfy poisson bracket of two constant of motion is also a constant of motion. 4
- (b) Show that $\sum_k q_k Q_k$ generates exchange transformation. 3
- (iii) (a) Write notes on infinitesimal transformation. 4
- (b) In canonical transformation show that 3
- (i) $\frac{\partial q_i}{\partial Q_k} = \frac{\partial P_k}{\partial p_j}$
- (ii) $\frac{\partial q_i}{\partial P_k} = \frac{\partial Q_k}{\partial p_j}$.
-