M.Sc. First Year (Physics) CBCS Pattern Semester-II

PSCPHYT07 - Core Paper-VII : Classical Mechanics

P. Pages : 2 **GUG/W/23/11222**

Time : Three Hours * 6 2 5 0 * Max. Marks : 80

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1. Either:

a) Explain the terms: **8**

i) 'D' Alembert's principle

ii) Hamilton's principle

iii) Principle of virtual work

iv) Constraint

b) Derive Lagrange's equation from D'Alembert's principle for conservative system. **8**

OR

e) Identify and explain the constraints for (i) rigid body (ii) spherical pendulum with variable length. **8**

f) Find the equation of motion and force of constraint in case of simple pendulum by using Lagrange's method of undetermined multiplier's. **8**

2. Either:

a) Explain concept of Routhian **8**

Find Routhian for the Lagrangian L given by : $L = \frac{1}{2}\mu(\dot{r}^2 + r^2\dot{\theta}^2) + \frac{GMm}{r}$ where

$\mu = \frac{mM}{m+M}$.

b) By using Hamilton dynamics write down the equation of motion of a particle in a central force field. **8**

OR

e) Define 'Hamiltonian principle'. Obtain Hamilton's canonical equation of motion. **8**

f) Explain the term canonical transformation. Show that Poisson's bracket is invariant under canonical transformation. **8**

3. Either:

a) What is meant by 'Laboratory system' and the 'Centre of mass system' in a two body scattering problem? How will you transform the differential cross – section, energy and scattering angle from the centre of mass system to the Laboratory system? **8**

b) A particle describing a closed orbit under the influence of a central force. Derive the quantities which remain invariant during the motion. Show that total energy and angular momentum of a particle under a central force is conservative. Also show that rate at which the area is swept out by the radius vector is constant. **8**

OR

e) Show that total energy and angular momentum of a particle under a central force is conservative. Also show that rate at which the area is swept out by the radius vector is constant. **8**

f) Obtain an expression for the reduced mass of the system. **8**

4. **Either:**

a) State and prove Euler's theorem. **8**

b) What do you understand by Normal co-ordinates and normal modes of Vibrations? **8**

OR

e) Explain Periodic motion in small oscillations. **8**

f) Consider a homogeneous cube of density r, mass M and side a. Taking origin Oat corner and axes along the edges of the cube, determine the inertia tensor, the principal axes and their associated moments of inertia. **8**

5. a) What are constraints? Give the difference between the holonomic and non-holonomic constraint with one example each. **4**

b) Define scattering cross section, scattering angle and Impact Parameter. **4**

c) What is stability of orbit? Also write the conditions for the closure. **4**

d) Explain the term "Principal axes transformation". **4**

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