B.Sc. (With Credits)-Regular-Semester 2012 Sem IV

B.Sc.24112 - Mathematics Paper-II (Classical Mechanics & Statics)

P. Pages : 2 **GUG/S/18/5611**

Time : Three Hours Max. Marks : 60

Notes : 1. Solve all the **five** question.
2. Question No. 1 to 4 has an alternative solve each question in full or its alternative in full.
3. All question carries equal marks.

UNIT – I

1. a) The algebraic sums of the moments of a system of coplanar forces about points whose co-ordinates are (1,0), (0,2) and (2,3) referred to rectangular axes are G_1, G_2 and G_3 respectively. Find the tangent of the angle which the direction of the resultant force marks with the axis of x. **6**

b) Five weightless nods of equal length are joined together so as to form a rhombus ABCD with one diagonal BD. If a weight is be attached to C and the system be suspended from A, Show that there is a thrust in BD equal to $W/\sqrt{3}$. **6**

OR

c) Prove that cartesian equation of the uniform catenary. $y = c.\cosh\frac{x}{c}$. **6**

d) If T is the tension at any point P of a catenary and T_o that at the lowest point c, then show that $T^2 - T_o^2 = W^2$ where W is the weight of the arc CP of the catenary. **6**

UNIT – II

2. a) Discuss the motion of a particle in a plane by using polar coordinates. **6**

b) Construct a Lagrangian for a spherical pendulum and them obtain the Lagrange's equation of motion. **6**

OR

c) Prove that, the Lagrange's equations of motion can be written in the form $\frac{\partial}{\partial t}\frac{\partial L}{\partial q_i} - \frac{\partial L}{\partial q_i} = Q_i^1$ for a system which is partly conservative. The quantity L refers to the conservative Part and Q_i^1 to the forces which are not conservative. **6**

d) If L is a Lagrangian for a system of n degrees of freedom satisfying Lagrange's equation, show by direct substitution that $L^1 = L + \frac{dF}{dt}$' $F = F(q_1 --- qn, t)$. also satisfies Lagrange's equation where F is any arbitrary but differentiable function of its argument. **6**

UNIT – III

3. a) Prove that, in a central force field the areal velocity is conserved, **6**

b) A particle moves on a curve $r^n = a^n \cos nQ$ under the influence of a central force field. Find the law of force. **6**

OR

c) State and prove Kepler's first law of planetary motion. **6**

d) If the potential energy is a homogeneous function of degree -1 in the radius vector r_i then prove that the motion of a conservative system takes place in a finite region of space only if the total energy is negative. **6**

UNIT – IV

4. a) Find the equation of motion of a particle of mass moving in space in a conservative force field F by using Hamilton's principal. **6**

b) A particle of mass falls a given distance so in time $t_o = \sqrt{25_o / g}$ and the distance fallen in time t is given by $5 = at + bt^2$. Where a and b are constants. Show that Hamilton principle is valid only when $a = o$ and $b = {}^{g}/{}_{2}$. **6**

OR

c) Obtain the Hamiltonian and then deduce the equation of motion for a simple pendulum. Show that the Hamiltonian of the system is the total energy and also the constant of motion. **6**

d) State and prove. the principle of least action. **6**

5. Solve **any six.**

a) Show that $p = c \sec^2 \psi$, where p is the radius of curvature of the curve at any point p. **2**

b) Prove that the vertical component of the tension at any point p of the curve is equal to the weight of the part of the string between the vertex and p. **2**

c) Write the Lagrangian and. equation of motion for a mass m suspended by a spring of force constant K and allowed to swing vertically. **2**

d) Define:- **2**
   i) Stationary or scleronomus constraint.
   ii) Moving or rheonomous constraint.

e) Prove that path of a particle in a central force field lies in one plane. **2**

f) State the virial theorem. **2**

g) Prove that if a generalized co-ordinate does not appear in H, then the corresponding conjugate momentum is conserved. **2**

h) Define. **2**
   i) Cyclic coordinate
   ii) Generalized momentum.

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