LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION – MATHEMATICS

SIXTH SEMESTER – APRIL 2010

MT 6604/MT 5500 - MECHANICS - II

Date & Time: 17/04/2010 / 9:00 - 12:00 Dept. No. | | Max. : 100 Marks

PART – A

Answer ALL the questions: **(10 x 2 =20 marks)**

1. Define Centre of Gravity.
2. Where does the C.G of a uniform circular arc of radius 'a' subtending an angle 90° lie?
3. Write any two applications of the principle of virtual work.
4. Define span and sag of a catenary.
5. What is amplitude and frequency of a particle executing simple harmonic motion?
6. Define Simple Pendulum.
7. What are the radial and transverse components of a velocity?
8. What is the *p-r* equation of Hyperbola?
9. What is the moment of inertia of a circular disc about a tangent line?
10. Write down the expression for angular momentum and kinetic energy of a rigid body rotating about a fixed axis.

PART – B

Answer any FIVE questions: **(5 x 8 = 40 marks)**

11. Find the center of gravity of a solid hemisphere.
12. Find the center of gravity of a sector of a circle of radius a subtending an angle 2α at the center. Deduce the center of gravity of the quadrant of the circle.
13. A solid hemisphere is supported by a string fixed to a point A on its rim and to a point O on a smooth vertical wall with which a curved surface of the sphere is in contact at P. If θ and φ are the inclinations of the string and the plane base of the hemisphere to the vertical, prove that $\tan\varphi = \frac{3}{8} + \tan\theta$.
14. Derive the equation of the common catenary in the form $y = C \cosh x/c$.
15. A string 10 cms long can just support a mass of 20 gms. A mass of 3 gms is attached at one end and the other end is kept fixed. If the mass revolves uniformly in a horizontal circle, find the greatest number of revolutions it can make per second.

(P.T.O.)

16. A second pendulum is carried down with a lift at a uniform acceleration of 20 cm/sec^2. How many seconds an hour will it lose?

17. Derive the differential equation of the central orbit in polar co-ordinates.

18. Find the moment of inertia of the right solid cone of height *h* and semi-vertical angle α about its axis.

PART – C

Answer any TWO questions: (2 x 20 = 40 marks)

19. (a) A square hole is punched out of a circular lamina of a radius 'a' having a radius as its diagonal. Show that the centre of gravity of the remaining is at a distance $\frac{a}{4\pi - a}$ from the center of the circle.

(b) Four rods, each of length *a* and weight W are smoothly joined together to form a rhombus *ABCD*, which is kept in shape by a light rod *BD*. The angle *BAD* is 60° and the rhombus is suspended in a vertical plane from A. Find the thrust in *BD*. (10 + 10)

20. (a) An endless uniform chain rests in equilibrium over a smooth pulley and is in contact with its over three quarters of the circumference . Show that the length of the free portion is $\frac{\sqrt{2}}{\log(\sqrt{2}+1)}$ times the radius of the pulley.

(b) If a particle moving with S.H.M. has velocity *u*, v, *w*, when its distances from an arbitrary point in the straight line are *a*, *b*, *c* respectively, prove that its period *T* is given by the equation $\frac{4\pi^2}{T^2}(b-c)(c-a)(a-b) = \begin{vmatrix} u^2 & v^2 & w^2 \\ a & b & c \\ 1 & 1 & 1 \end{vmatrix}$.

(10 + 10)

21. (a) A particle P describes the orbit $r^n = a^n \cos n\theta$ under a central force, the pole being the centre. Find the law of force.

(b) Derive the expression for the Kinetic energy of a rigid body moving in 2-dimentions. (10 + 10)

22. (a) Find the moment of inertia of a parabolic plate cut off by an ordinate at a distance h from the vertex, about the tangent at the vertex.

(b) Find the moment of inertia of a hollow sphere about a diameter, its internal and external radii being *b* and *a*. (10 + 10)

$$$$$$$