LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION – MATHEMATICS

FIFTH SEMESTER – NOVEMBER 2007

AB 13

MT 5500 - MECHANICS - II

Date : 24/10/2007 Dept. No. Max. : 100 Marks
Time : 9:00 - 12:00

PART – A

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

1. State the formula for the coordinates of the C.G. of a rigid body.
2. Define neutral equilibrium
3. Write down any two forces which can be ignored in forming the equation of virtual work.
4. What is the intrinsic equation of the catenary?
5. Define the amplitude of S.H.M.
6. Write the tangential and normal components of acceleration of a particle moving along a curve
7. Define central orbit.
8. Define areal velocity.
9. State the perpendicular axes theorem for M.I.
10. State D'Alembert's principle.

PART – B

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

11. A right circular cone is cut out of a uniform solid right circular cylinder such that the base of the cone is the same as the base of the cylinder. If the C.G of the remaining solid is the vertex of the cone, find the height of the cone.

12. A solid hemisphere is supported by a string fixed to point on its rim and to a point on a smooth vertical wall with which the curved surface of the hemisphere is in contact. If θ *and* ϕ are the inclinations of the string and the plane base of the hemisphere to the vertical, prove that $\tan\phi = \frac{3}{8} + \tan\theta$.

13. A string of length ℓ, is to be suspended from two points A and B, in the same horizontal line so that either terminal tension is n times that at the lowest point. Show that the span AB must be $\frac{\ell}{\sqrt{n^2-1}} log\left(n+\sqrt{n^2-1}\right)$.

14. Obtain the resultant of two simple harmonic motions with the same period in the same straight line.

15. In S.H.M, if f is the acceleration and v the velocity at any instant and T the periodic time, prove that $f^2T^2 + 4\pi^2 v^2$ is constant.

16. Derive the differential equation of central orbit in the form $\frac{d^2u}{d\theta^2}+u=\frac{F}{h^2u^2}$.

17. The velocities of a particle along and perpendicular to the radius from a fixed origin are λr and $\mu\theta$; find the path and show that the accelerations, along and perpendicular to the radius vector are $\lambda^2 r - \frac{u^2\theta^2}{r}$ and $\mu\theta(\lambda+\frac{\mu}{r})$.

18. Determine the M.I of a uniform solid hemisphere about its diameter.

PART – C

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

19. a) Find the C.G of a sector of a uniform thin circular plate subtending an angle 2α at the centre.

    b) State and prove the principle of virtual work. (10 + 10)

20. a) Obtain the equation of common catenary in Cartesian form.

    b) Two masses M and M^1 are attached to the lower end of an elastic string, whose upper end is fixed and then hung at rest. M^1 falls off, show that the distance of M from the upper end of the string at time t is a + b + c $\cos\sqrt{\frac{g}{b}}$ t, where a is the unstretched length of the string and b, c are the lengths by which it would be extended when supporting M and M^1 respectively. (10 + 10)

21. a) Determine the components of velocity and acceleration of a particle along the radial and transverse directions.

    b) A particle describes $r^n = a^n \cos n\theta$ under a central force to the pole. Find the law of force. (10 + 10)

22. a) Define compound pendulum. Find the time of a small oscillation of compound pendulum.

    b) A solid sphere is rolling down a plane, inclined to the horizon at an angle α and rough enough to prevent any sliding. Find its acceleration. (10 + 10)

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