LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION – **MATHEMATICS**

SIXTH SEMESTER – **APRIL 2016**

MT 6604/MT 5500 – MECHANICS - II

Date: 18-04-2016 Dept. No. Max. : 100 Marks
Time: 09:00-12:00

PART-A

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

1. State the centre of gravity of a compound body.
2. Find the C.G. of a uniform hollow right circular cone.
3. State Hooke's law.
4. What is common catenary?
5. Define Periodic time, frequency.
6. Define simple pendulum.
7. Define central orbit.
8. Define Apse.
9. State the theorem of perpendicular axes.
10. Define compound pendulum.

PART-B

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

11. Find the C.G of the area enclosed by the parabola $y^2 = ax$ and $x^2 = by\left(a > 0, b > 0\right)$.
12. If α, β are the inclinations to the horizon of the tangents at the extremities of a portion of a common catenary and l the length of the portion, show that the height of the one extremity above the other is $\dfrac{l\sin\frac{\alpha+\beta}{2}}{\cos\frac{\alpha-\beta}{2}}$, the two extremities being on one side of the vertex of the catenary.
13. Find the velocity and acceleration of a particle moving on a curve.
14. Find the centroid of the arc of the catenary $y = c\cosh\dfrac{x}{c}$ which is included between the lines $x = 0$ and $x = a$.
15. Derive the radial and transverse components of velocity and acceleration.
16. A particle describes the following orbit under a central force, the pole being the centre. Find the law of force. (i) $r = ae^{\theta\cot\alpha}$ (ii) $\dfrac{l}{r} = 1 + e\cos\theta$.
17. State and prove theorem of parallel axes.
18. Show that the M.I of the part of the paraboloid of revolution about its axis is $\dfrac{Mr^2}{3}$ where M is its mass and r is radius of its base.

PART-C

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

19. Find the C.G of the area bounded by the y- axis, the line $y = 2a$ and the cycloid $x = a(\theta + \sin\theta), y = a(1 - \cos\theta)$ that lies in the first quadrant.

20. (a) A solid hemisphere is supported by a string fixed to a point on its rim and to a point on the 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 the principle of virtual work, that $\tan\phi = \frac{3}{8} + \tan\theta$. (10)

    (b) A string of length a forms the shortest diagonal of a rhombus of four uniform rods, each of length b and weight W which are hinged together. If one of the rods be supported in a horizontal position, prove that the tension in the string is $\frac{2W\left(2b^2 - a^2\right)}{b\sqrt{4b^2 - a^2}}$. (10)

21. (a) Find the resultant of two simple harmonic motions of the same period in the same straight line. (10)

    (b) Show that the composition of 2 simple harmonic motions of the same period along 2 perpendicular lines is an ellipse. (10)

22. (a) If the law of acceleration is $5\mu u^3 + 8\mu c^2 u^5$ and the particle is projected from an apse at a distance c with velocity $\frac{3\sqrt{\mu}}{c}$, prove that the equation of the orbit is $r = c\cos\frac{2\theta}{3}$. (10)

    (b) Derive the K.E of a rigid body moving in 2-dimensions. (10)

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