LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

FIFTH& SIXTH SEMESTER – APRIL 2017

MT 5500 / MT 6604 - MECHANICS - II

Date: 22-04-2017 Dept. No. Max. : 100 Marks

9:00-12:00

PART – A

ANSWER ALL THE QUESTIONS: **(10 X 2 = 20)**

1. State the centre of gravity of a compound body.
2. Write down the formula for centre of gravity of a rigid body.
3. Define Virtual work.
4. Define catenary.
5. Derive an expression for amplitude.
6. Define simple pendulum.
7. Define central orbit.
8. Write down the expression of the differential equation of a central orbit.
9. State the theorem of parallel axes.
10. State D'Alembert's principle.

PART – B

ANSWER ANY FIVE QUESTIONS: **(5 X 8 = 40)**

11. Find the centre gravity of a solid hemisphere.
12. Derive the equation of the common catenary in the form $y = C\cosh\left(\frac{x}{c}\right)$.
13. The maximum speed in a S.H.M is V and the amplitude is a. Show that when the speed is v, the acceleration is $\frac{V}{a}\sqrt{V^2 - v^2}$.
14. A string , of length l, hangs between two points, not in the same vertical line, And the tangents at the end points are inclined at the angles α *and* β with the horizondal. Show that the height of one extremity above the other is $\frac{l\sin\frac{\alpha+\beta}{2}}{\cos\frac{\alpha-\beta}{2}}$ the two extremities being on the same side of the vertex of the catenary.
15. Drive the Pedal (p-r) equation of a central orbit.
16. A point P describes with a constant angular velocity about O the equiangular Spiral $r = ae^{\theta}$, O being the pole of the spiral. Obtain the radial and transverse acceleration of P.
17. State and prove theorem of parallel axes.
18. Find the work that must be done on a uniform flywheel of mass 50 lbs and radius $6''$ to increase its speed of rotation from 5 to 10 r.p.s.

PART – C

ANSWER ANY TWO QUESTIONS: (2 X 20 = 40)

19.a) ABC is an equilateral triangle of side 2 m. Weights of 5,1 and 3 kg are placed at the mid points of BC, CA and AB respectively. Show that the C.G.is at a distance of $\frac{2\sqrt{19}}{9}\ m$ from B.

b) Find the position of the C.G of the arc of the cardioid $r = a(1 + cos\theta)$ lying above the initial line.

20. a) A uniform chain , 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 $\frac{l}{\sqrt{n^2-1}} \log(n + \sqrt{n^2 - 1})$.

b) A heavy chain of length $2l$ has one end tied at A and the other is attached to a small heavy ring which can slide on a rough horizontal rod which passes through A.If the weight of the ring be n times the weight of the chain , show that the greatest possible distance of the ring from A is $\frac{2l}{\lambda} \log(\lambda + \sqrt{1 + \lambda^2})$, where $\frac{1}{\lambda} = \mu(2n + 1)$, where $\mu$is the coefficientof friction.

21. a) A particle is moving in a st.line with S.H.M. Its velocity has values 5 ft /sec when its distances from the mean position are 2 ft and 3 ft Respectively. Find the length of its path and the period of its motion.

b) If a second pendulum loses 10 seconds per day at the bottom of a mine, find (i) depth of mine (ii) the number of seconds the pendulum loses half way down the mine.

22. a) A particle describes the following orbit under a central force,the pole being the centre. Find the law of forces .

(i) $r = ae^{\theta cot\alpha}$ (ii) $\frac{l}{r} = 1 + ecos\theta$

b) Show that the moment of inertia of a rectangle lamina of mass M and sides $2a$ *and* $2b$ about a diagonal is $\frac{2Ma^2b^2}{3(a^2+b^2)}$.

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