LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

SIXTH SEMESTER – **NOVEMBER 2016**

MT 6604/MT 5500 – MECHANICS - II

Date: 15-11-2016 Dept. No. Max. : 100 Marks

Time: 09:00-12:00

PART – A

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

1. Define centre of mass. Define centre of mass of a rigid body.
2. State the centre of gravity of a compound body.
3. Define virtual work.
4. Define Catenary.
5. Define simple Harmonic motion.
6. Define centripetal force.
7. Write down the p-r equation of hyperbola.
8. What are the radial and transverse components of velocity?
9. Write down the formula for M.I. of rectangular lamina.
10. What is the K.E. of a rigid body moving in two dimensions?

PART – B

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

11. Find the centre of gravity of a solid hemisphere.
12. A square hole is punched out of a circular lamina of diameter 'a' having radius as its diagonal.

    Show that the C.G. of the remainder is at the distance $\frac{a}{8\pi - 4}$ from the centre of the circle.
13. A regular hexagon is composed of six equal heavy rods freely jointed together and two opposite angles are connected by a string which is horizontal, one rod being in contact with a horizontal plane; at the middle point of the opposite rod of a weight W' is placed. If W be the weight of each rod,

    show that tension in the string is $\frac{3w + w'}{\sqrt{3}}$.
14. Find the resultant of two simple harmonic motions of the same period in the same straight line.
15. Obtain the differential equation of a central orbit.
16. A body moving in a straight line OAB with S.H.M has zero velocity when at the points A and B whose distances from O are and b respectively, and has velocity v when half way between them.

    Show that the complete period is $\frac{\pi(b-a)}{v}$.
17. Find the M.I. of the square lamina about a diagonal of length ℓ.
18. A uniform circular disc of radius a and mass M is rotating with an angular velocity w about a fixed axis at right angles to the plane at a distance b from the centre. Find the kinetic Energy.

PART – C

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

19. a) Find the C.G. of the area in the first quadrant bounded by the coordinate axes and the curve $x^{\frac{2}{3}} + y^{\frac{2}{3}} = a^{\frac{2}{3}}$. (10)

b) Four equal rods, each of length a, are jointed to form a rhombus ABCD and the points B and D are joined by a string of length ℓ. The system is placed in a vertical plane with A resting on a horizontal plane and AC vertical. Prove that the tension in the string is $\frac{2w\ell}{\sqrt{4a^2 - \ell^2}}$ where *w* is the weight of each rod. (10)

20. a) A string of length 2ℓ hangs over two small smooth pegs in the same horizontal level. Show that, if *h* is the sag in the middle, the length of either part of the string that hangs vertically is $h + \ell - 2\sqrt{hl}$. (10)

b) A body consisting of a cone and a hemisphere on the same base rests on a rough horizontal table, the hemisphere being in contact with the table. Show that the greatest height of the cone so that the equilibrium may be stable is $\sqrt{3}$ times the radius of the sphere. (10)

21. a) A particle describes the orbit $r = ae^{\theta}\cot\alpha$ under a central force, the pole being the centre. Find the law of force. (10+10)

b) Two particles of masses M and M^1 respectively are attached to the lower end of an elastic string whose upper end is fixed and are 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; *b* and *c* are the distances by which it would be stretched to the end A, the extension is b.

22. a) Find the M.I. of a thin uniform parabolic lamina bounded by the parabola $y^2 = 4a(h - x)$ and y axis about the y axis. (10)

b) A solid sphere rolls down an inclined plane of inclination α to the horizon which is sufficiently rough to present sliding. Show that the acceleration is always constant. (10)

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