

**LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034**



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

**SIXTH SEMESTER – APRIL 2023**

**MT 6604 – MECHANICS - II**

Date: 05-05-2023

Dept. No.

Max. : 100 Marks

Time: 09:00 AM - 12:00 NOON

**PART-A**

**(10 × 2 = 20 marks)**

**Answer all questions.**

1. Write the difference between center of gravity and center of mass.
2. State the conditions for the non-existence of center of gravity.
3. Define virtual work.
4. What is common catenary?
5. Write any two applications of simple harmonic motion.
6. Define periodic time and frequency.
7. Write the  $p-r$  equation of a central orbit
8. Define apse.
9. State the theorem of perpendicular axes.
10. Explain the conservation of angular momentum.

**PART-B**

**(5 × 8 = 40 marks)**

**Answer any 5 Questions.**

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  $2a$  at the center.
13. Derive the intrinsic equation of the common catenary.
14. Derive the principle of virtual work for a system of coplanar forces acting on a rigid body.
15. Show that the composition of two simple harmonic motions of the same period along two perpendicular lines is an ellipse.
16. A particle executing simple harmonic motion in a straight line has velocities 8,7,4 at three points distant one foot from each other. Find the period.
17. Derive the pedal  $p-r$  equation of a central orbit.
18. State and prove the theorem of parallel axes.

**PART-C**

**(2 × 20 = 40 marks)**

**Answer any 2 Questions.**

19. a) Find the *C.G* of the area enclosed by the parabola  $y^2 = ax$  and  $x^2 = by$  ( $a > 0, b > 0$ ).

**(10 marks)**

b) 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 center of the circle.

**(10 marks)**

20. a) A string of length  $2l$  hangs over two small 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  $h + l - 2\sqrt{hl}$ .

**(10 marks)**

b) 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  $\theta$  and  $\phi$

are the inclination of the string and the plane base of the hemisphere to the vertical, prove that

$$\tan \phi = \frac{3}{8} + \tan \theta.$$

**(10 marks)**

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

b) A particle moves in a *S.H.M* along a straight line. In the first second, after starting from rest, it

travels a distance  $a$  and in the next second, it travels a distance  $b$  in the same direction. Prove

that the amplitude of the motion is  $\frac{2a^2}{3a-b}$ .

**(10 marks)**

22. a) Find the moment of inertia of a solid sphere.

**(10 marks)**

b) Find the moment of inertia of an elliptic lamina.

**(10 marks)**

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