

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



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

**FIFTH SEMESTER – NOVEMBER 2019**

**16/17UMT5MC02 – STATICS**

Date: 31-10-2019

Dept. No.

Max. : 100 Marks

Time: 09:00-12:00

**SECTION – A**

**Answer ALL questions**

**(10 × 2 = 20)**

1. State fundamental theorem of Statics.
2. What is the resolved part of a force  $F$  (i) along the direction of the force  $F$  (ii) in the direction perpendicular to  $F$ .
3. Define moment of a force  $F$ .
4. Define a couple and the arm of a couple.
5. Give an example of a body where the centre of mass is not a point of the body.
6. State the formula for coordinates of the centre of gravity a rigid body.
7. State Hooke's law.
8. When do you say that a body is in stable equilibrium?
9. Define catenary.
10. What is the shape of the catenary when the parameter is very large?

**SECTION – B**

**Answer any FIVE questions.**

**(5 × 8 = 40)**

11. Two forces acting on a particle are such that if the direction of one of them is reversed, the direction of the resultant is turned through a right angle. Prove that the forces must be equal in magnitude.
12. State and prove Lami's theorem.
13. Find the resultant of two like parallel forces.
14. A non uniform rod  $AD$  rests on two supports  $B$  and  $C$  at the same level where  $AB = BC = CD$ . If a weight  $p$  is hung from  $A$  or a weight  $q$  is hung from  $D$ , the rod just tilts. Show that the weight of the rod is  $p + q$  and the centre of gravity of the rod divides  $AD$  in the ratio  $2p + q : p + 2q$ .

15. Show that the C.G of a thin uniform triangular lamina is the same as the C.G. of three particles of equal weight placed at the vertices of the lamina.
16. Find the C.G. of a uniform circular arc subtending angle  $2\alpha$  at the centre.
17. Find the work done in stretching an elastic string from its natural length  $l$  to the length  $l$ .
18. 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  $h + l - \sqrt{2hl}$ .

### SECTION – C

**Answer any TWO questions**

**(2 × 20 = 40)**

19. (a) Determine the magnitude and direction of the resultant of two given forces with a common point of application.  
(b) State and prove Varignon's theorem on moments. **(10+10)**
20. (a) A uniform rod AB of length  $2a$  and weight  $W$  is resting on two pegs C and D in the same level at a distance  $d$  apart. The greatest weights that can be placed at A and B without tilting the rod are  $W_1$  and  $W_2$  respectively. Show that  $\frac{W_1}{W+W_1} + \frac{W_2}{W+W_2} = \frac{d}{a}$ .  
(b) Find the centre of gravity of a uniform solid tetrahedron. **(10+10)**
21. (a) A solid hemisphere is supported by a string fixed to a 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  $\theta$  and  $\phi$  are the inclinations of the string and the plane base of the hemisphere to the vertical, prove that  $\tan\phi = \frac{3}{8} + \tan\theta$ .  
(b) Discuss the work done by the tension in an elastic string. **(10+10)**
22. (a) Discuss the stability of a body rolling over a fixed body.  
(b) Find the Cartesian equation of the catenary. **(10+10)**

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