LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

FIFTH SEMESTER – **APRIL 2019**

MT 5510– STATICS

Date: 16-04-2019 Dept. No. Max. : 100 Marks

Time: 09:00-12:00

SECTION – A

Answer ALL questions(10 ò 2 = 20)

1. What is parallelogram of forces?
2. State the conditions for the equilibrium of a system of concurrent forces.
3. Define torque of a force about a point.
4. Define a couple and the arm of a couple.
5. What are the situations where the centre of gravity is not defined?
6. What is the centre of gravity of a thin uniform rod?
7. Define virtual work.
8. State any two forces which can be ignored in forming the equation of virtual work.
9. State the intrinsic equation of catenary.
10. What is the shape of the catenary when the parameter is very large?

SECTION – B

Answer any FIVE questions. **(5 ò 8 = 40)**

11. The angle between two forces of magnitude P+Q and P-Q is 2α and the resultant of the forces makes an angle θ with the bisector of the angle between the forces. Show that P tanθ = Q tanα.

12. State and prove Lami's theorem.

13. A straight rod PQ of length 2a and weight W rests on smooth horizontal pegs R and S at the same level at a distance a apart. If two weights pW and qW are suspended from P and Q respectively, show that when the reaction at R and S are equal, the distance PR is given by $\frac{a}{2}\left(\frac{1-p+3q}{1+p+q}\right)$.

14. Find the centre of gravity of a uniform solid circular cone.

15. A right circular cone is cut out of a uniform soild right circular cylinder such that the base of the cone is the same as the base of the cylinder. If the C.G. of the remaining solid is the vertex of the cone , find the height of the cone.

16. Find the work done in stretching an elastic string from its natural length l to the length l'.

17. A telegraphic wire , stretched between two points at a distance a feet apart , sags n feet in the middle. Prove that the tension at the ends is approximately ω $(\frac{a^2}{8n} + \frac{7}{6}n)$, where ω is the weight per unit length of the wire.

18. A string of length 2*l* 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 $h+ l - 2\sqrt{hl}$.

SECTION – C

Answer any TWO questions **(2 ò 20 = 40)**

19. (a) Two strings AB and AC are knotted at A, where weight W is attached. If the weight hangs freely and in the position of equilibrium , with BC horizontal , AB:BC:CA = 2:4:3, show that the tension in the string are $\frac{7W}{2\sqrt{15}}$ *and* $\frac{11W}{4\sqrt{15}}$.

(b) Two beads of weights W and W' (W' >W) can slide on a smooth circular wire in a vertical plane. They are connected by a light string which subtends an angle 2β at the centre of the circle when the beads are in equilibrium on the upper half of the wire. Prove that the inclination α of the string to the horizontal is given by $\tan\alpha = \frac{W'-W}{W'+W}\tan\beta$. **(10+10)**

20. (a) Find the resultant of two like parallel forces and two unlike parallel forces.

(b) State and prove Varignon's theorem. **(10+10)**

21.(a) A uniform solid right circular cylinder of height l and base radius r is sharpened at one end like a pencil. If the height of the resulting conical part is h, find the distance through which C.G. is displaced, it being assumed that there is no shortening of the cylinder.

(b) State and prove the principle of virtual work for a system of coplanar forces acting on a rigid body**.** **(10+10)**

22. (a) 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 horizontal. 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.

(b) Find the intrinsic equation of catenary. **(10+10)**

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