LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

FIFTH SEMESTER – **APRIL 2018**

MT 5510– STATICS

Date: 04-05-2018 Dept. No. Max. : 100 Marks

Time: 09:00-12:00

SECTION – A

Answer ALL questions **(10 × 2 = 20)**

1. When do you say that a concurrent system of forces is in equilibrium?
2. What is meant by composition of forces and resolution of a force?
3. Define like parallel forces and unlike parallel forces.
4. Define moment of a force.
5. State the formula for coordinates of the centre of gravity a rigid body.
6. What is the centre of gravity of a thin uniform rod?
7. State the principle of virtual work for a system of coplanar forces acting on a rigid body.
8. When a body is said to be in neutral equilibrium?
9. Define catenary.
10. What is a suspension bridge?

SECTION – B

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

11. The magnitude of the resultant of two given forces of magnitudes P and Q is R. The magnitude of the resultant is doubled either when the force of magnitude Q is doubled or reversed in the direction. Prove that P:Q:R = $\sqrt{2}$:$\sqrt{3}$: $\sqrt{2}$.
12. Two strings AB and AC are knotted at A, where a 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 tensions in the strings are $\frac{7W}{2\sqrt{15}}$ and $\frac{11W}{4\sqrt{15}}$.
13. Find the resultant of two unlike parallel forces with unequal magnitudes.
14. Find the centre of gravity of a uniform solid tetrahedron.
15. Find the centre of gravity of a uniform solid right circular cone.

16. A string of length a forms the shorter diagonal of a rhombus of four uniform rods, each of length b and weight W which are hinged together. If one of the rods be supported in a horizontal position, prove that the tension in the string is $\frac{2W(2b^2-a^2)}{b\sqrt{4b^2-a^2)}}$.

17. State and prove Lami's Theorem.

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 – 2 $\sqrt{hl}$.

SECTION – C

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

19 (a) A weight is supported on a smooth plane inclined at the angle α with the horizon, by a string inclined to the vertical at the angle β. If the inclination of the plane is increased to γ and the inclination of the string with the vertical is unaltered, the tension in the string is doubled in supporting the weight. Prove that $\cot\alpha - 2\cot\gamma = \cot\beta$.

(b)Two beads of weight 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 $\tan\alpha = \frac{W'-W}{W'+W}\tan\beta$.

20 (a) State and prove Varignon's theorem on moments.

(b) A uniform ladder of length l and weight W rests with its foot on the rough ground and its upper end against a smooth wall , the inclination to the vertical being α. A force P is applied horizontally to the ladder at a point distance c from the foot so as to make the foot approach the wall. Prove that P must exceed $\frac{lW}{l-c}\left(\mu + \frac{1}{2}\tan\alpha\right)$ where μ is the coefficient of friction at the foot.

21 (a) Find the centre of gravity of the area bounded by y- axis , the line y = 2a and the cycloid $x = a(\theta + \sin\theta)$, $y = a(1 - \cos\theta)$ that lies in the first quadrant.

(b) A rod lies in equilibrium with its ends on two smooth planes inclined at angles α,β to the horizontal , the planes intersecting in a horizontal line. Show that the inclination of the rod to the horizontal is $\tan^{-1}\frac{\sin(\alpha\sim\beta)}{2\,sin\alpha\,sin\beta}$.

22(a) A string of length ι hangs between two points not in the same vertical line and the tangents at the end points are inclined at an angle α and β with the horizontal.Show that the height of one extremity above the other is $\frac{l\sin\frac{\alpha+\beta}{2}}{\cos\frac{\alpha-\beta}{2}}$.

(b)A uniform chain of length 2ι has its ends attached to two points in the same horizontal line at a distance 2a apart. If ι is only a little greater than a , show that the tension in the chain is approximately equal to a weight of the chain of length $\sqrt{\frac{a^3}{6(l-a)}}$ and the sag or depression of the lowest point of the chain below its end is $\frac{1}{2}\sqrt{6a(l-a)}$nearly.

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