LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

FIFTH SEMESTER – **APRIL 2016**

MT 5510 – STATICS

Date: 30-04-2016 Dept. No. Max. : 100 Marks

Time: 09:00-12:00

PART - A

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

1. State the triangle law of forces.
2. State the conditions for equilibrium of concurrent forces.
3. Define torque of a force.
4. Define limiting friction.
5. Locate the centre of gravity of a thin uniform rod.
6. Write the coordinates of the centre of gravity of the uniform solid formed by the revolution of the area bounded by the centre $y = f(x)$, the x – axis and the lines x = a , x = b about the x – axis.
7. State the principle of virtual work for a system of coplanar forces acting on a rigid body.
8. State any two forces which can be ignored in forming the equation of virtual work.
9. Define Catenary.
10. Define (i) Sag and (ii) Span associated with a Catenary.

PART – B

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

11. State and prove Lami's theorem.
12. One end of a uniform rod is attached to a hinge and the other end is supported by a string attached to the extremity of the rod. The rod and the string are inclined at the same angle θ to the horizontal. Show that the action at the hinge is $\frac{W}{4}\sqrt{9+\cot^2\theta}$ where W is the weight of the rod.
13. State and prove Varignon's theorem on moments.
14. A ladder which stands on a horizontal ground against a vertical wall is so loaded that its centre of gravity is at the distances a and b from the lower and upper ends, respectively. Show that if the ladder is in limiting equilibrium its inclination θ to the horizontal is given by $\tan\theta = \frac{a - b\mu\mu^1}{(a+b)\mu}$ where μ, μ^1 are the coefficients of friction between the ladder and the ground and the wall respectively.
15. Prove that the centre of gravity of a thin uniform triangular lamina is the same as the centre of gravity of three particles of equal weights placed at the vertices of the lamina.
16. Find the centre of gravity of a uniform hollow right circular cone.
17. Derive the equation of virtual work.
18. Find the work done in stretching an elastic string from its natural length l to the length l'.

PART – C

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

19. a) The greatest and the least possible magnitudes of the resultant of two variable forces of given magnitudes are respectively R and S. Show that the magnitude of the resultant of the forces, when α is the angle between them, is $\sqrt{R^2\cos^2\frac{\alpha}{2}+S^2\sin^2\frac{\alpha}{2}}$.

b) 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 direction. Prove that $P:Q:R=\sqrt{2}:\sqrt{3}:\sqrt{2}$. (10+10)

20. a) Find the resultant of two unlike parallel forces P and Q and determine the position of the point of application.

b) If a finite number of forces acting on a particle be represented by the sides of a polygon taken in order, prove that the forces are in equilibrium. (10+10)

21. a) Find the centre of gravity of the area enclosed by the parabolas $y^2 = ax$ and $x^2 = by$ $(a > 0,\ b > 0)$.

b) A string of length 2l hangs ner 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 $h+l-2\sqrt{hl}$. (10 + 10)

22. Derive the intrinsic equation of Catenary and also derive in cartesian form. (20)

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