LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION - **MATHEMATICS**

FIFTH SEMESTER – NOVEMBER 2015

MT 5510 - STATICS

Date : 11/11/2015 Dept. No. Max. : 100 Marks

Time : 09:00-12:00

PART-A

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

1. State Lami's theorem.
2. Prove that $R = 2P\cos\frac{\sim}{2}$ and $\tan^{-} = \tan\frac{\sim}{2}$ if P and Q are equal in magnitude.
3. Define a couple.
4. Define dynamical friction.
5. Find a gravity of compound body.
6. Define the centre of gravity of a rigid body.
7. State the Hooke's law.
8. Define neutral equilibrium.
9. Define catenary.
10. Define span and sag.

PART-B

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

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 direction. Prove that $P:Q:R=\sqrt{2}:\sqrt{3}:\sqrt{2}$.
12. State the laws of friction.
13. A weight W is supported by friction on a plane inclined at an angle α to the horizon. Show that it cannot be moved up the plane by any horizontal force less than Wtan2α.
14. Find the centre of gravity of a sector of a uniform thin circular plate subtending angle $2\sim$ at the centre.
15. 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 horizontal position, prove that the tension in the string is $\frac{2W\left(2b^2-a^2\right)}{b\sqrt{4b^2-a^2}}$.
16. Two equal uniform rods are firmly joined at one end do that the angle between them is $\sim$ and they rest on a smooth sphere of radius r. Show that they are in a stable or unstable equilibrium according as the length of a rod is greater or less than $4r\,\mathrm{cosec}\sim$.
17. State and prove polygon law of forces.

18. A string of length *l*, hangs between two points, not in the same vertical line, and the tangets at the end points are inclined at angles ~ and with the horizontal. Show that the height of one extremity above the other is $\frac{l\sin\frac{\sim+}{2}}{\cos\frac{\sim-}{2}}$ the two extremities being the same side of the vertex of the Catenary.

PART-C

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

19. (a) Two weights P and Q are suspended from a fixed point O by strings OA and OB and are kept apart by a light rod AB. If the strings OA and OB make angles α and β with the rod, show that the angle θ which the rod makes with the vertical is given by

$$\tan^{-} = \frac{P+Q}{Q\cot \quad -P\cot\sim}.$$ (15)

(b) 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 in equal in magnitude. (5)

20. (a) State and prove Varignon's theorem on moments. (10)

(b) A ladder which stands on a horizontal ground leaning against a vertical wall is so loaded that its centre of gravity is at the distances *a* and *b* from the the lower and upper ends respectively. Show that if the ladder is in limiting equilibrium, its inclination ¯ to the horizontal is given by $\tan^{-} = \frac{a-b\ll\ll'}{(a+b)}$ where « and «′ are the coefficients of friction between the ladder and the ground and the wall respectively. (10)

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

(b) A uniform chain of length 2*l* has its ends attached to two points in the same horizontal line at a distance 2*a* apart .If *l* 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. (10)

22. Derive the intrinsic equation of catenary and also derive in Cartesian form. (20)

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