LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

FIFTH SEMESTER – **NOVEMBER 2014**

MT 5510 - STATICS

Date : 07/11/2014 Dept. No. Max. : 100 Marks

Time : 09:00-12:00

PART – A $(10 \times 2 = 20)$

Answer **ALL** the questions:

1. State the conditions for equilibrium of a system of concurrent forces.
2. State the law of parallelogram of forces.
3. Define torque of a force.
4. Define cone of friction.
5. What is the centre of gravity of the uniform rod?
6. Define the centre of gravity of a rigid body.
7. State any two forces which can be ignored in forming the equation of virtual work.
8. When do you say a body at rest is in unstable equilibrium?
9. Write the intrinsic equation of a catenary.
10. Define suspension bridge.

PART – B $(5 \times 8 = 40)$

Answer any **FIVE** questions:

11. State and prove Lami's theorem.

12. A system of forces in the plane of ΔABC is equivalent to a single force at A, acting along the internal bisector of the angle BAC and a couple of moment G_1. If the moments of the system about B and C are respectively G_2 and G_3, prove that $(b+c)G_1 = bG_2 + cG_3$.

13. State and prove Varignon's theorem on moments.

14. 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 form the lower and upper ends respectively. Show that if the ladder is in equilibrium, its inclination θ to the horizontal is given by $\tan\theta = \frac{a - b\mu\mu'}{(a+b)\mu}$, where μ, μ' are the coefficients of friction between the ladder and the ground and the wall respectively.

15. Determine the centre of gravity of a compound body.

16. Find the centre of gravity of a uniform solid hemisphere of radius r.

17. Find the work done in stretching an elastic string from its natural length l to the length l^1.

18. Find the shape of the catenary when the parameter is very large.

PART – C $(2\times 20 = 40)$

Answer any **TWO** questions:

19.

a) The angle between two forces of magnitudes $P+Q$ and $P-Q$ is 2α and the resultant of forces makes angle θ with the bisector of the angle between the forces. Show that $P\tan\theta = Q\tan\alpha$.

b) O is the circum centre of the ΔABC. Forces of magnitudes P,Q,R acting respectively along $\overline{OA},\overline{OB},\overline{OC}$ are in equilibrium. Prove that $\frac{P}{a^2\left(b^2+c^2-a^2\right)} = \frac{Q}{b^2\left(c^2+a^2-b^2\right)} = \frac{R}{c^2\left(a^2+b^2-c^2\right)}$. (10+10)

20.

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

b) Find the equilibrium of the particle on a rough inclined plane acted on by an external force. (12+8)

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 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 $h+l-2\sqrt{hl}$.

(10+10)

22.

a) Derive the equation of virtual work for a system of coplanar forces acting on a rigid body.

b) A body consisting of a cone and a hemisphere on the same base rests on a rough horizontal table. Show that the greatest height of the cone so that the equilibrium may be stable is $\sqrt{3}$ times the radius of the sphere. (12+8)

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