LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

FIFTHSEMESTER – APRIL 2017

MT 5510- STATICS

Date: 27-04-2017 Dept. No. Max. : 100 Marks
01:00-04:00

PART-A

Answer all the questions **(10 x 2=20)**

1. State the Parallelogram law of forces.
2. State polygon law of forces.
3. Define arm of couple.
4. Define coefficient of friction.
5. What is the centre of gravity of a uniform solid hemisphere of radius 'r'?
6. What is the centre of gravity of a uniform hollow right circular cone?
7. State the principle of virtual work for a system of coplanar forces acting on a rigid body.
8. Define Stable equilibrium.
9. Define catenary.
10. Define span and sag.

PART-B

Answer any five questions **(5 x 8=40)**

11. State and prove Lami's theorem.
12. Three equal strings of no sensible weight are knotted together to form an equilateral ΔABC and a weight W is suspended from A. If the triangle and weight be supported with BC horizontal by means of two strings at B and C each at angle 135^0 with BC, show that the tension in BC is $\frac{W}{6}\left(3-\sqrt{3}\right)$.
13. State and prove varignon's theorem on moments.
14. Find the center of gravity of uniform solid circular cone.
15. Find the centroid of the arc of the catenary $y = c\cosh\frac{x}{c}$ which is included between the lines $x=0$ and $x=a$.
16. A rod AB is movable about a pivot at A and B is attached a string whose other end is tied to a ring. The ring slides along a smooth horizontal wire passing through A. Prove that the horizontal force necessary to keep the ring at rest is $\frac{W\cos\alpha\cos\beta}{2\sin\left(\alpha+\beta\right)}$ where W is the weight of the rod and α,β the inclinations of the rod and string to the horizontal.
17. A uniform chain, of length l, is to be suspended from two points A and B, in the same horizontal line so that either terminal tension is n times that at the lowest point. Show that the span AB must be $\frac{1}{\sqrt{n^2-1}}\log\left(n+\sqrt{n^2-1}\right)$.
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 $h+l-2\sqrt{hl}$.

PART-C

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

19. (a) 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 $\tan\alpha = \frac{W'-W}{W'+W}\tan\beta$. **(15)**

(b) Two forces P and Q have a resultant R and the resolved part of R in the direction of P is of magnitude Q. Show that the angle between P and Q is $2\sin^{-1}\sqrt{\frac{P}{2Q}}$. **(5)**

20. (a) Find the resultant of two like parallel forces. **(15)**

(b) Two like parallel forces P and $Q(P>Q)$ act at A and B respectively. If the magnitude of the forces are interchanged, show that the point of application of the resultant on AB will be displaced through the distance $\frac{P-Q}{P+Q}.AB$. **(5)**

21. Find the intrinsic equation of catenary and also find in Cartesian form.

22. (a) Find the center of gravity of a sector of uniform thin circular plate subtending angle 2α at the center. **(10)**

(b) A solid hemisphere is supported by a string fixed to a point on its rim and to a point on the smooth vertical wall with which the curved surface of the hemisphere is in contact. If θ and ϕ are the inclinations of the string and the plane base of the hemisphere to the vertical, prove that the principle of virtual work, that $\tan\phi = \frac{3}{8} + \tan\theta$. **(10)**

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