LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

FIFTH SEMESTER – **NOVEMBER 2019**

MT 5510 – STATICS

Date: 04-11-2019

Time: 09:00-12:00

Dept. No.

Max. : 100 Marks

PART-A

ANSWER ALL QUESTIONS: (10×2 =20)

1. State the parallelogram law of forces.

2. State the condition for equilibrium of forces.

3. Define a couple.

4. Define (a) like parallel forces and (b) unlike parallel forces

5. What is the centre of gravity of a uniform solid sphere of radius 'r'?

6. Give an example of a body where the centre of mass is not necessarily a point of the body.

7. State Hook's law.

8. State the equation of virtual work.

9. State the intrinsic equation of catenary.

10. Define span and sag.

PART –B

ANSWER ANY FIVE QUESTIONS: (5×8=40)

11. State and prove Lami's theorem.

12. Two weights P and Q are suspended from a fixed point O by strings OA and OB are kept by a light rod AB. If the strings OA and OB make angle r and s with the rod, show that the angle θ which the rod makes with the vertical is given by $\tan \theta = \dfrac{P+Q}{Q\cot s - P\cot r}$.

13. Find the resultant of two unlike parallel forces with unequal magnitudes.

14. Two unlike parallel forces P and Q ($P > Q$) acts at A and B respectively. Show that if the direction of P be reversed the resultant is displaced through the distance $\dfrac{2PQ}{P^2 - Q^2}$.

15. Find the centre of gravity of a uniform solid circular cone.

16. Prove that the centre of gravity of a thin uniform triangular lamina is the same as the centre of gravity of three weights placed at the vertices of the lamina.

17. Find the work done in stretching an elastic string from its natural length l to the length $l^{'}$.

18. Derive the Cartesian equation of the catenary.

PART – C

ANSWER ANY TWO QUESTIONS: $(2\times20= 40)$

19. (a) Two forces of magnitudes P and Q $(P > Q)$ act on a particle and the angle between the force is r . If the magnitude of the forces are interchanged, show that the resultant turns through the angle

$$2\tan^{-1}\left[\frac{P-Q}{P+Q}\tan\frac{r}{2}\right].$$ **(10 Marks)**

   (b) State and prove the polygon law of forces. **(10 Marks)**

20. (a) State and prove the Varigon's theorem on moments. **(10 Marks)**

   (b) A uniform rod AB of length $2a$ and weight W is resting on two pegs C and D in the same level at a distance d apart. The greatest weights that can be placed at A and B without tilting the rod are W_1 and W_2 respectively. Show that $\dfrac{W_1}{W + W_1} + \dfrac{W_2}{W + W_2} = \dfrac{d}{a}$.

   (10 Marks)

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

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

22. (a) A rod lies in equilibrium with its ends on smooth planes inclined at an angle r and s to the horizontal, the planes intersecting in a horizontal line. Show that the inclination of the rod to the horizontal is

$$\tan^{-1}\left(\frac{\sin(r : s)}{2\sin r \sin s}\right)$$
   (10 Marks)

   (b) A uniform chain l , is to be suspended from two points A and B , is the same horizontal line, so that either terminal tension is n times that at the lowest point, Show that the span AB must be

$$\frac{1}{\sqrt{n^2 - 1}}\log(n - \sqrt{n^2 - 1}) .$$ **(10 Marks)**

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