Date: 25-11-2022   Dept. No.   Max. : 100 Marks
Time: 09:00 AM - 12:00 NOON

PART-A

Answer all questions: **(10x2=20 Marks)**

1. Define the composition and resolution of a system of concurrent forces.
2. State the parallelogram law of forces.
3. Define (a) like parallel forces and (b) unlike parallel forces.
4. Define moment of a force.
5. Define center of mass.
6. State the formula for coordinates of the center of gravity of a rigid body.
7. Define unstable equilibrium and give one example
8. State Hook's law.
9. Define sag.
10. Define catenary.

PART-B

Answer any FIVE questions: **(5x8=40 Marks)**

11. Determine the magnitude and direction of the resultant of two given forces with a common point of application.
12. 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 force must be equal in magnitude.
13. Find the resultant of two like parallel forces.
14. State and prove Varignon's theorem on moments.
15. Find the center of gravity of a uniform triangular lamina.
16. Find the center of gravity of a solid circular cone.
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: **(2x20=40 Marks)**

19. a) State and prove the Lami's theorem. **(10 marks)**

    b) 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 angle α and β with the rod, show that the angle θ which the rod makes with the vertical is give by

    $$\tan\theta = \frac{P+Q}{Q\cot\beta - P\cot\alpha}.$$ **(10 marks)**

20. a) 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)

    b) Find the center of gravity of a uniform circular arc subtending angle 2α at the centre.

    (10 marks)

21. a) Discuss the stability of a body rolling over a fixed body. **(10 marks)**

    b).State and prove the principle of virtual workfor a system of coplanar forces acting on a rigid body. **(10 marks)**

22. a) 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 meddle, the length of either part of the string that hangs vertically is $h + l - \sqrt{2hl}$. **(10 marks)**

    b) A string of length l hangs between two points not in the same vertical line and the tangents at the end points are inclined at an angle α and β with the horizontal. Show that the height of one extremity above the other is $\dfrac{l\sin\left(\dfrac{\alpha+\beta}{2}\right)}{\cos\left(\dfrac{\alpha-\beta}{2}\right)}$ the two extremities being on the same side of the vertex of the catenary. **(10 marks)**

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