NATIONAL INSTITUTE OF TECHNOLOGY SILCHAR
ENGINEERING MECHANICS
First / Second Semester (All Branch)

COURSE NO. ME 101 **L T P C**
3 1 0 4

ASSIGNMENT - 3

1. Referring to Fig. A, calculate the tensions S_1 and S_2 in the two strings AB and AC that support the lamp of weight $Q = 40\ N$. Use the method of projection. *Ans.* $S_1 = 30\ N$, $S_2 = 50\ N$.

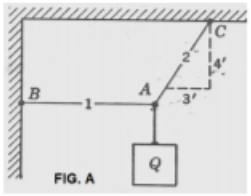

FIG. A

2. A roller of weight $W = 1000\ N$ rests on a smooth inclined plane and is kept from rolling down by a string AC as shown in Fig B. Using the method of projections, find the tension S in the string and the reaction R_b at the point of contact B. *Ans.* $S = 733\ N$, $R_b = 897\ N$.

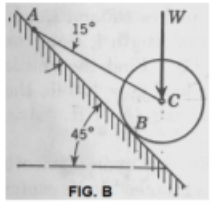

FIG. B

3. Two equal loads P are supported by a flexible string $ACDB$, as shown in Fig. C. Determine the tensile forces S_1 and S_2 in the portions AC and CD respectively, of the string, if the span $l = 30\ cm$ and the sag $h = 5\ cm$. Neglect the weight of the string. *Ans.* $S_1 = \sqrt{5}P$, $S_2 = 2P$.

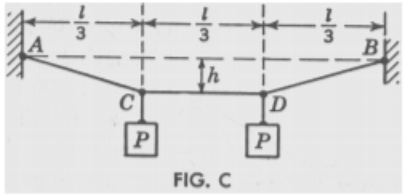

FIG. C

4. On the string $ACEDB$ are hung three equal weights Q symmetrically placed with respect to the vertical line through the midpoint E (Fig. D). Determine the value of the angles β if the other angles as shown in the figure. *Ans.* $\beta = 30^0$.

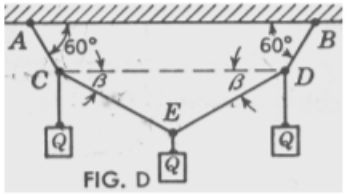

FIG. D

5. In Fig. E, weights P and Q are suspended in a vertical plane by strings 1, 2, 3 arranged as shown. Find the tension induced in each string if $P = 500\ N$ and $Q = 1000\ N$. *Ans.* $S_1 = 1000\ N$; $S_2 = 1000\ N$; $S_3 = 134\ N$.

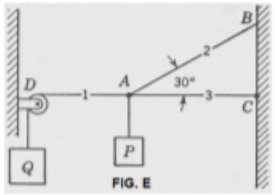

FIG. E

[Turn over]

6. To pull up a post, the arrangement shown in Fig. F is used. A cable ABC is fixed to the post at A and to the frame at C having the portion AB vertical and the inclined there to by a small angle α. The cable BDE fastened to the ring at B and to the frame at E has the portion BD horizontal and the portion DE inclined to the horizontal by the small angle β. On the ring at D a man pulls vertically downward with his entire weight Q. Determine the vertical pull P applied to the post at A if $\alpha = \beta = 0.1$ radian and $Q = 150\ N$ *Ans.* $P = 15000\ N$.

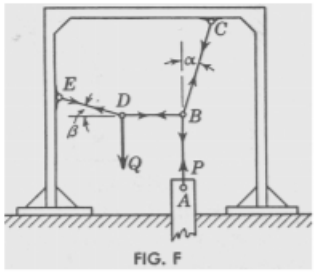

FIG. F

7. Two vertical masts AB and CD are guyed by the wires BF and DG in the vertical plane and connected by a cable BD of length L, from the middle point E of which suspended a lode Q (Fig. G). Find the tensile force S in each of the two guy wires BF and DG if the load $Q = 100\ N$, the length $L = 20\ cm$, and the sag $D = 1\ cm$. *Ans.* $S = 1000\ N$.

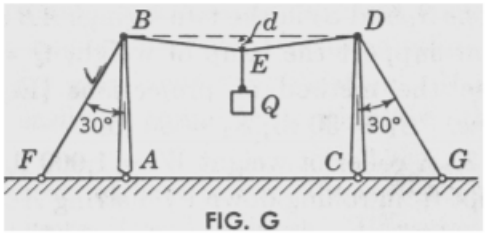

FIG. G

8. A ball of weight W rests upon a smooth horizontal plane and has attached to its center two string AB and AC which pass over frictionless pulleys at B and C carry loads P and Q respectively as shown in Fig. H. If the string AB is horizontal, find the angle α that the string AC makes with the horizontal when the ball is in position of equilibrium. Also find the pressure R between the ball and the plane. *Ans.* $Cos\ \alpha = P/Q$; $R = W - \sqrt{Q^2 - P^2}$.

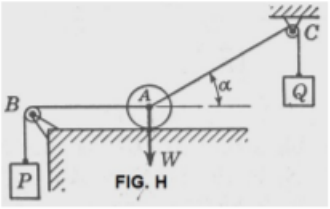

FIG. H

9. Determine the axial forces S_1 and S_2 induced in the bar AC and BC in Fig. I due to the action of horizontal applied load at C. The bars are hinged together at C and to the foundation at A and B. *Ans.* $S_1 = 782\ N$ *tension,* $S_2 = 640\ N$ *compression.*

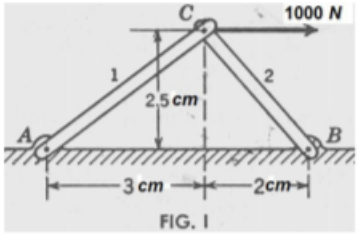

FIG. I

10. Determine the forces produced in the bar of the system shown in Fig. J owing to the horizontal force P applied at the hinge B. *Ans.* $S_1 = 0$; $S_2 = P$; *tension,* $S_3 = \sqrt{2P}$ *compression* ; $S_4 = P$, *Tension.*

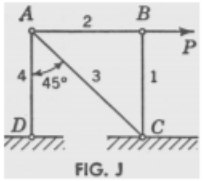

FIG. J

11. A hinged square $ABCDE$ (Fig. K) with diagonal BD is submitted to the action of two equal and opposite forces P applied as shown. Determine the forces produced in all bars. *Ans.* $S_1 = S_2 = S_4 = S_5 = 0$; $S_3 = P$, *tension.*

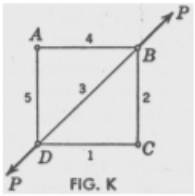

FIG. K

12. Determine the forces that will be produced in all bars of the frame $ABCD$ (Fig. K) if the external force P are applied in the same manner to the hinges A and C. *Ans.* $S_1 = S_2 = S_4 = S_5 = P/\sqrt{2}$; *tension,* $S_3 = P$ *compression.*

13. In the bar AB of the square frame $ABCD$ (Fig. L) a tensile force P is produced by tightening turn buckle F. Determine the forces produced in the other bars. The diagonals AC and BD pass each other freely at E. *Ans.* $S_1 = S_2 = S_3 = P$, *tension* $S_4 = S_5 = \sqrt{2P}$ *compression.*

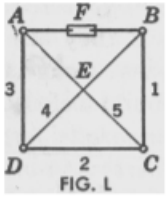

FIG. L

14. By means of a turnbuckle A, a tensile force P is produced in one of the radial bars of the hinged regular octagon shown in Fig. M. Determine the forces produced in the other bars of the system. *Ans. P, tension in each radial bar, 1.306 P, compression in each outside bar.*

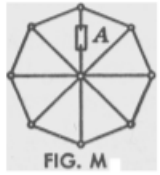

FIG. M

15. Determine the axial force induced in each bar of system shown in Fig. N due to the action of the applied forces P. *Ans.* $S_1 = S_2 = P$, *tension* ; $S_3 = S_4 = S_5 = 0$.

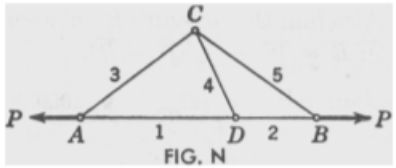

FIG. N

16. A load $P = 1000\ N$ is bracketed from a vertical wall by two bars AB and AC hinged together at A and to the wall at B and C as shown in Fig. Q. Using the method of projections, compute the axial forces S_1 and S_2 induced in these bars. *Ans.* $S_1 = 500\ N$ tension, $S_2 = 866\ N$

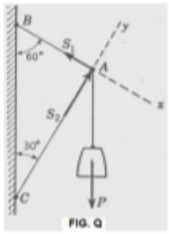

FIG. Q

17. A rigid bar AB with rollers of weights $P = 50\ N$ and $Q = 100\ N$ at its ends is supported inside a circular ring in a vertical plane as shown in Fig. O. The radius of the ring and the length AB are such that the radii AC and BC from a right angle at C; that is $\alpha+\beta = 90^0$. Neglecting friction and the weight of the bar AB find the configuration of equilibrium as defined by the angle $(\alpha - \beta)/2$ that AB makes with the horizontal. Find also the reactions R_a and R_b and the compressive force S in the bar AB. *Ans.* $(\alpha - \beta)/2 = 18^0 26'$, $R_a = 67.1\ N$, $R_b = 134\ N$, $S = 63.3\ N$.

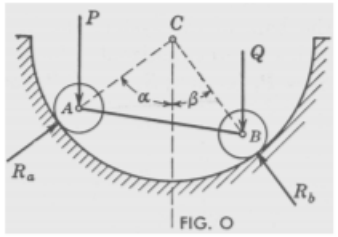

FIG. O

18. A small ring B carries a vertical load P and is supported by two strings BA and BC, the later of which carries at its free end a weight $Q = 10\ N$, as shown in Fig. R. Find the magnitude of the load P and the tension S in the string AB if the angles that the strings AB and AC make with the vertical are shown in the figure and the system is in equilibrium. *Ans.* $P = 13.7\ N$, $S = 13.7\ N$

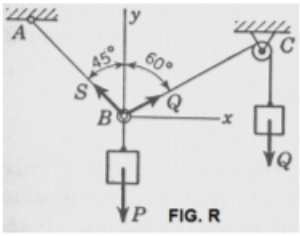

FIG. R

19. Three bars in one plane, hinged at their ends as shown in Fig. S, are submitted to the action of a force $P = 10\ N$ applied at the hinge B as shown. Determine the magnitude of the force Q that it will be necessary to apply at the hinge C in order to keep the system of bars in equilibrium if the angles between the bars and the lines of action of the forces are as given in the figure. *Ans.* $Q = 16.3\ N$.

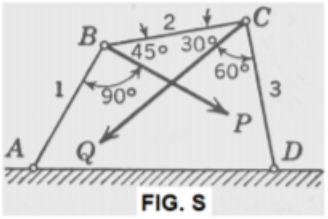

FIG. S

20. A small ring A can slide without friction along a curved bar CD which has a circular axis of radius a (Fig. T). Determine the position of equilibrium as defined by the angle α if the loads P and Q are acting as shown in the figure. *Ans.* $\alpha = 2arcsin\frac{Q}{2P}$.

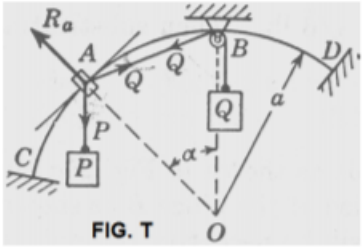

FIG. T

****