B-2110 10664/NH (1)

Total No. Of Sheets Used.. 02 Total No. Of Questions ---09 Subject:- Mathematics

Time ;- 03 hours Max. Marks:- 40 Paper:- Statics Min.Marks:- 14

Note:- The candidates are required to attempt any two question each from Section A and B and Section C is compulsory .

SECTION A

1. A) Resultant of forces P and Q is at right angle to P and the resultant of forces P' and Q' acting at same angle is right angles to Q'. Show that $PP' = QQ'$.

b) A string ABCD is suspended from two fixed points A and D. It carries weight of 30 kg, and W kg. respectively at two points B and C on it. The inclination to the vertical of AB is 30° and that of CD is 60°, the angle BCD being 120°. Find W and the tension in the different parts of the string.

2) a) ABC is a triangle and O a point in its plane. A force R acts along AO. Resolve R into two forces parallel to in acting at B and C respectively where O is the circumcenter of the circle.

b) P and Q are magnitudes of two like parallel forces. If second force moved parallel to itself through a distance x, prove that their resultant moves through a distance $\frac{Qx}{P+Q}$.

(3) a) A man on the ground is pulling a vertical tree with a given force by means of a rope p meters long. At what point of the tree must one end of a rope be attached so that he may have the greatest tendency to pull it over.

b) Determine magnitude , direction and line of action of the resultant of any number of coplanar forces.

4) a) State and prove Varigons theorem.

b) The parallel forces of magnitude P, Q and R acts at a point A,B and C respectively of a triangle ABC. Prove that their centre is orthocenter of the triangle if $\frac{P}{Tan\,A} = \frac{Q}{Tan\,B} = \frac{R}{Tan\,C}$.

SECTION-B

5) a) The ends of an elastic string 0.17m long are attached to two points A and B 0.13m apart in the same horizontal line. A weight of 4kg is attached to the point O of the string 0.05m from end A. Find the tension in each portion of the string.

b) One end of uniform rod is attached to hinge and the other end is supported by a string attached to the extremity of the rod. The rod and the string are inclined at the same angle α to the horizontal. Show that the action of the hinge is $\frac{W}{4}\sqrt{8 + Cosec^2\alpha}$ where W is the weight of the rod.

Contd

6) a) A uniform ladder rests with one end on a horizontal floor and other against a vertical wall, the coefficients of friction are $\frac{3}{7}$ and $\frac{1}{3}$ respectively. Find the inclination of the ladder when it is about to slip.

b) An equilateral triangle rests in a vertical plane with its base resting on a rough horizontal plane, a gradually increasing horizontal force acts at its vertex in the plane of triangle. Prove that the triangle will slide before it turns about the end of its base. If the coefficient of friction be less than $\frac{1}{\sqrt{3}}$.

7) a) Find Centre of Gravity of Hollow sphere.

b) A uniform quadrilateral ABCD is such that the diagonal AC bisect it and BD divides it in two parts in the ratio 2:1. Show that its C.G. divides AC in the ratio 5:4.

8. a) ABCD is of side $2a$. E is a mid-point of the side BC. Find the distance from A of the center of gravity of the portion AECD.

b) A square is described externally on a side on an equilateral triangle. Find C.G. of the Lamina of compound body.

SECTION- C

9)

a) Show that coefficient of friction is equal to tangent of angle of friction.

b) Distinguish between Centre of mass and center of inertia.

c) Define equilibrium of two forces.

d) Resolve a force of 100kg into two components making angles of $60°$ and $90°$ with it on the opposite sides.

e) State Triangle Law of forces and $m - n$ theorem.

f) State Necessary and sufficient condition that a system of coplanar forces acting on a rigid body to be in equilibrium.

g) State and prove Generalized theorem of monemts.

h) Discuss in detail geometric representation of the moment of a force about a point.