Roll No. .....

92134

B. A. 3rd Semester
Examination – November, 2014

MATH-III (Statics)

Paper : BM-233

Time : Three hours] *[Maximum Marks : 26*

Before answering the questions, candidates should ensure that they have been supplied the correct and complete question paper. No complaint in this regard, will be entertained after examination.

Note : Attempt ***five*** questions in all, selecting ***one*** question from each Section. Question No. **9** is ***compulsory***.

SECTION – I

1. (a) Forces each equal to P act at a point parallel to the sides of a triangle ABC. Show that their resultant is given by : 2½

$$P\sqrt{3-2\cos A-2\cos B-2\cos C}$$

(b) Two unlike parallel forces P and Q, (P > Q), x meter apart act at two points of a rigid body. Show that if direction of P be reversed, the resultant is displaced through a distance : 2½

$$\frac{2PQ}{P^2 - Q^2} x \text{ meters.}$$

2. (a) The sides of a regular hexagon ABCDEF are 2 m each. Along the sides AB, CB, DC, DE, EF and FA act forces respectively equal to 1, 2, 3, 4, 5 and 6 kg weight. Find the algebraic sum of the moments of the forces about A. 2½

(b) ABCD is a rectangle with AB = 4 m and BC = 3m. Along AB, BC, CD, DA and AC act forces 2, 7, 6, 10 and 5 kg wt respectively. Show that the system reduces to a couple and find its moments. 2½

SECTION – II

3. (a) A heavy uniform rod is in equilibrium with one end resting against a smooth vertical wall and the other against a smooth plane inclined to the wall at an angle θ. Prove that if α be the inclination of the rod to the horizontal, then 2 tan α = tan θ. 2½

(b) The force acting parallel to a rough inclined plane of inclination α to the horizon, just sufficient to draw a weight up the plane is n times the force which will just let it be on the point of sliding down the plane. Prove that : 2½

$$\tan \alpha = \mu \frac{n+1}{n-1}$$

4. (a) A uniform ladder rests in limiting equilibrium with one end on a rough floor, whose coefficient of friction is μ and with the other end against a smooth vertical wall. Show that inclination to the vertical is $\tan^{-1}(2\mu)$. 2½

(b) Find the centroid (C. G.) of a plane lamina in form of a quadrant of an ellipse when matter is distributed uniformly. 2½

SECTION – III

5. (a) Six equal rods AB, BC, CD, DE, EF and FA are each of weight W and are freely joined so as to form a hexagon. The rod AB is fixed in horizontal position and the middle points of AB and DE are joined by a string. Prove that its tension is 3W. 2½

(b) A rhombus ABCD is formed of four equal uniform rods freely jointed together and suspended from the point A. It is kept in position by a light rod joining the mid points of BC and CD. Prove that if T be thrust in this rod and W the weight of rhombus, then : 2½

$$T = W \tan\frac{A}{2}$$

6. (a) Show that the quantities (LX + MY + NZ) and $(X^2+Y^2+Z^2)$ are invariants for any given system of forces, whatever origin and axis may be choosen. 2½

(b) A force P acts along the axis of x and another force nP alonrg a generator of the cylinder $x^2 + y^2 = a^2$. Show that the central axis lies on the cylinder : 2½

$$n^2(nx - z)^2 + (1+n^2)^2 y^2 = n^4 a^2.$$