Exam Code: 0003
Sub. Code: 0243

2012
B.A./B.Sc. (General) Third Semester
Mathematics
Paper – III: Statics

Time allowed: 3 Hours Max. Marks: 30

NOTE: *Attempt five questions in all, selecting atleast two questions each Unit.*

x-x-x

UNIT – I

I. a) Prove that the maximum magnitude of the resultant of two concurrent forces of magnitude P and Q is P + Q and its acts in the direction of the forces.

b) If the greatest possible resultant of two forces $\bar{P}$ and $\bar{Q}$ acting at a point is n times the least, show that the angle between them when their resultant is half of their sum is $Cos^{-1}\left[\frac{-(n^2+2)}{2(n^2-1)}\right]$. (2x3)

II. a) State and prove λ - μ theorem.

b) The resolved part of a force of magnitude 100 Kgwt in a direction is half of it. Find its inclination with the force and the other resolved part. (2x3)

III. a) Two weights P and Q are suspended from a fixed point O by strings OA and OB which are kept apart by a light rod AB. If the strings make angles α and β with the rod, show that the angle θ which the rod makes with the vertical is

$$Tan\theta = \frac{P+Q}{P\cot\alpha - Q\cot\beta}$$

b) Forces of magnitude 2, P, 5, Q and 3 Kgwt. act along the sides AB, CA, AD, AE and FA respectively of a regular hexagon. Find P and Q if the system is in equilibrium. (2x3)

IV. a) A heavy uniform rod 4m long rests horizontally on two pegs, which are 1m apart. A weight of 10 kg suspended from one end on a weight of 4kg suspended from the other end will just tilt the rod up. Find weight of rod and the distance of pegs from center of rod.

P.T.O.

b) Two unlike parallel forces $\vec{P}$, $\vec{Q}$ (P > Q) act at two points x units apart. Show that if the direction of $\vec{P}$ is reversed, the resultant is displaced through a distance $\frac{2PQ}{P^2 - Q^2} x$ units. (2x3)

UNIT – II

V. a) Forces of magnitude $5\sqrt{3}$ kg. wt., 5 kg wt and 9 kg wt. act along the sides BC, CA and AB of an isosceles triangle ABC whose angle A is 120^0. Find the resultant of the forces in magnitude and direction and the point on BC where the line of action of resultant meets it.

b) Forces $\vec{P}$, $\vec{Q}$ and $\vec{R}$ act along the sides BC, CA and AB respectively of triangle ABC. If the resultant passes through circum center, show that $P\cos A + Q\cos B + R\cos C = 0$ (2x3)

VI. a) Six Coplanar forces act on a rigid body along the sides AB, BC, CD, DE, EF and FA of a regular hexagon of side 1 unit of magnitude. Their magnitudes are 10, 20, 30, 40, P and Q units respectively. Find P and Q so that the system reduces to a couple. Also find moment of this couple.

b) Like parallel forces $\vec{P}$, $\vec{Q}$ and $\vec{R}$ act at the angular points A, B, C of the triangle ABC. Prove that the perpendicular distance of their centre from the side BC is $\frac{P}{P+Q+R}\left(\frac{2\Delta}{a}\right)$ where Δ is the area of triangle ABC and BC = a. (2x3)

VII. a) A uniform ladder of weight $\vec{w}$ rests with one end against a smooth vertical wall and other resting on the smooth floor. If the inclination of the ladder to the horizontal is 60^0. Find the horizontal force that must be applied at the lower end to prevent the ladder from slipping.

b) A uniform rod of weight $\vec{w}$ can turn freely about one of its ends. If the rod is pulled aside from the vertical by a horizontal force of magnitude $\frac{3}{4}w$ acting at the other end of the rod. Find the inclination of the rod at rest to the vertical and reaction of the hinge. (2x3)

VIII. a) A body of weight w can just be sustained on a rough inclined plane by a force $\vec{P}$ along the plane or by a horizontal force $\vec{Q}$. Show that coefficient of friction is $P\sqrt{\frac{1}{W^2}+\frac{1}{Q^2}-\frac{1}{P^2}}$

b) A uniform ladder rests at an angle of 45^0 with the horizontal, with its upper extremity against a rough wall and its lower extremity on a rough ground with coefficient of friction μ' and μ respectively. Show that the least horizontal force which would move the lower extremity towards wall is $\frac{1}{2}W\left(\frac{1+2\mu-\mu\mu'}{1-\mu'}\right)$ (2x3)

x-x-x