Total No. of Questions : 8] [Total No. of Printed Pages : 7

(1126)

B.A./B.Sc. (General) IIIrd Semester (0003) Examination

0243

MATHEMATICS

(Paper : III)

(Statics)

Time : 3 Hours] **[Maximum Marks : 30**

Note :– Attempt *five* questions selecting at least *two* questions from each Unit. Each question carries 6 marks.

Unit–I

1. (a) Two forces P and Q acting at a point have a resultant R. If P is doubled, R is doubled and if Q is doubled and reversed in direction, even then R is doubled. Show that P : Q : R = $\sqrt{6} : \sqrt{2} : \sqrt{5}$.

(b) State and prove $\lambda - \mu$ theorem. 3,3

2. (a) Prove that the resultant of two forces acting at a point is maximum when they act in the same direction and is equal to their sum.

(b) If AD be the altitude of ΔABC. Show that the force AD acting along AD has components $\frac{a^2+b^2-c^2}{2a^2}$. AB and $\frac{c^2+a^2-b^2}{2a^2}$. AC along AB and AC respectively. 3,3

3. (a) A heavy uniform rod 4 m long rests horizontally on two pegs which are 1 m apart. A weight of 10 kg suspended from one end or a weight of 4 kg suspended from the other end will just tilt the rod up. Find weight of the rod and distances of the pegs from the centre of the rod.

(b) A man carries a load at one end of a stick and the other end of which he holds in his hand. The stick is placed on his shoulder. If W is the weight of the load; a, b be the distance of the load and his hand from his shoulder; prove that the pressure on his shoulder is $W\left(1+\frac{a}{b}\right)$. 3,3

4. (a) Two weights P and Q are suspended from a fixed point O by strings OA, OB which are kept apart by a light rod AB. If the strings make angles α and β with rod, show that the angle θ which the rod makes with the vertical is given by $\tan\theta = \frac{P+Q}{P\cot\alpha - \cot\beta}$.

(b) ABCDEF is a regular hexagon. Forces of magnitudes $1, 2\sqrt{3}, 2, 4\sqrt{3}, 5$ kg.wt. respectively

act at one of the angular points of the hexagon towards the five others, taken in order. Find the magnitude and direction of the resultant of the forces. 3,3

Unit–II

5. (a) Forces P, Q, R act along the sides BC, CA, AB respectively of triangle ABC. If the resultant passes through the orthocentre, show that $P \sec A + Q \sec B + R \sec C = 0$.

(b) Parallel forces P, P, P act at angular points of a right angled ΔABC and parallel forces 2P, 2P, 2P act at the middle points of the sides. If the sides of the triangle including right angles are 6 and 8 units respectively. Find the distance of the centre of these forces form C, the right angle. 3,3

6. (a) Forces of magnitude 1, 2, 3, 5, P, Q act along AB, BC, CD, DA, AC, BD respectively and ABCD is a square of side 'a'. Find the values of P and Q for the system to reduce to a couple. Find also the moment of the couple.

(b) Six coplanar forces act on a rigid body along the sides AB, BC, CD, DE, EF, FA of a regular hexagon of side one unit. Their magnitudes are 10, 20, 30, 40, P, Q units respectively. Find P and Q so that the system reduces to a couple and show that the moment of the couple is $75\sqrt{3}$ units.

7. (a) A ladder rests at an angle α to the horizon with its ends resting on a smooth plane and

against a smooth vertical wall, the lower end being attached by a string to the junction of wall and flour. Find the tension in the string. Also find the tension in the string when a man whose weight is one half as that of the ladder has ascended two third of its length.

(b) A smooth uniform beam of length $2a$, rests against a smooth vertical plane and over a peg at a distance b, from the plane. If α be the inclination of the beam to the vertical, show that $\sin^3\alpha = \frac{b}{a}$.

8. (a) Define co-efficient of friction and find the least force necessary to drag a body along a rough horizontal plane.

(b) A uniform ladder rests at an angle of 45° with the horizontal with its upper extremity against a rough wall and its lower extremity on the rough ground with coefficients of friction μ' and μ respectively. Show that the least horizontal force which would move the lower extremity towards the wall is $\frac{1}{2}W\frac{1+2\mu-\mu\mu'}{1-\mu'}$. 3.3

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