

4. (a) A weight can be just supported on a rough inclined plane by a force P acting along the plane or by a force Q acting horizontally; show that the weight is

$\frac{PQ}{\sqrt{Q^2 \sec^2 \phi - P^2}}$, where ϕ is the angle of friction.

- (b) Find the centre of gravity of the area of the curve $x^{2/3} + y^{2/3} = a^{2/3}$ lying in the first quadrant.

Unit III

5. (a) A rectangular lamina ABCD rests with the sides AB, AD on two smooth pegs in a horizontal line. Prove that if the distance between the pegs is half a diagonal of the rectangle, then AB, AD bisect the angle between AC and the horizon.
- (b) Prove that any system of forces acting on a rigid body can be reduced in general to a force acting at an arbitrary chosen point of the body and a couple.

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Roll No.

CC-343

Dual Degree/B.Sc. (Hons.)

EXAMINATION, Dec. 2018

(Third Semester)

(Main & Re-appear)

MATHEMATICS

MAT315H

Statics

Time : 3 Hours]

[Maximum Marks : 75

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

Note : Attempt *Five* questions in all, selecting at least *one* question from each Unit. All questions carry equal marks.

Unit I

1. (a) The resultant of two forces P and Q trisects the angle between them. Show that if $P > Q$, then the angle between

them is $3\cos^{-1}\left(\frac{P}{2Q}\right)$ and the resultant is

$$\frac{P^2 - Q^2}{Q}.$$

- (b) P and Q are two like parallel forces. If P moved parallel to itself through a distance x , show that their resultant moves through

the distance $\frac{P}{P+Q}x$.

2. (a) At what point of a tree must one end of a rope of given length l be attached so that a man pulling at the other end with a given force may have the greatest tendency to pull it over.

- (b) Forces of magnitude 1, 2, 3, 4, $2\sqrt{2}$ act respectively along the sides AB, BC, CD, DA and diagonal AC of the square ABCD of side 'a'. Show that their resultant is a couple and find its moment.

Unit 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 $2\tan\alpha = \tan\theta$.
- (b) Two equal heavy rods of weight W and length $2a$ are freely hinged together and placed symmetrically over a smooth fixed sphere of radius r . Show that the inclination of each rod to the horizontal is given by :

$$r(\tan^3\theta + \tan\theta) = a$$

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

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

Unit IV

7. Find the resultant wrench of two given wrenches.
8. (a) Find the null point of the plane $x + y + z = 0$ for the force system $(X, Y, Z; L, M, N)$.
- (b) A heavy uniform rod rests with one end against a smooth vertical wall and with a point in its length resting on a smooth peg. Find the position of equilibrium and show that it is unstable.

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