53 (ME 201) ENME

2019

ENGINEERING MECHANICS

Paper : ME 201

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

Answer **any five** questions.

1. (a) State triangle law of forces with a neat sketch. **4**

   (b) What is a free body diagram ? State the conditions of equilibrium for a system of coplanar forces. **2+2=4**

   (c) State the law of parallelogram of forces and show that the resultant $R = \sqrt{P^2 + Q^2}$, when the two forces P and Q are acting at right angles to each other. **3+4=7**

(d) Three collinear forces F_1, F_2, and F_3 are acting on a body. What will be the resultant of these forces, if 5

    (i) all are acting in the same direction

    (ii) force F_3 is acting in opposite direction ? 5

2. (a) Find the magnitude of two equal forces acting at a point with an angle of $60°$ between them, if the resultant is equal to $30 \times \sqrt{3}\,N$. 5

(b) Four forces of magnitude P, 2P, 3P and 4P are acting at a point 'O'. The angles made by these forces with x-axis are $0°$, $60°$, $150°$ and $300°$ respectively. Find the magnitude and direction of the resultant force. 7

(c) The forces 20N, 30N, 40N, 50N and 60N are acting at one of the angular points of a regular hexagon towards other five angular points, taken in order. Find the magnitude and direction of the resultant force. 6

(d) What is the effect of moment on a body ? 2

3. (a) A weight of 900N is supported by two chains of lengths 4m and 3m as shown in fig (i), where $\angle ACB = 90°$. Determine the tension in each chain. 7
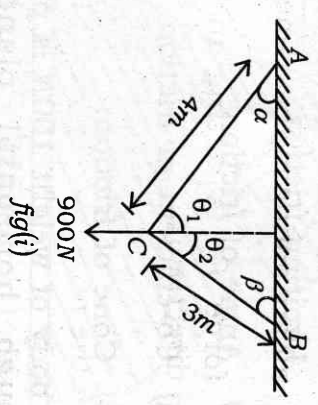
fig (i)

(b) Three smooth circular cylinders rest in a rectangular ditch having vertical walls and a horizontal bottom as shown in fig (ii). Neglecting friction, determine the reactions at contact points A, B, C and D. The weights of the cylinder P, Q and W are 200N, 400N, 300N, respectively with radii, $r_1 = 120mm$, $r_2 = 180mm$ and $r_3 = 150mm$ and bottom base of ditch $a = 540mm$. 13

$a = 540mm$
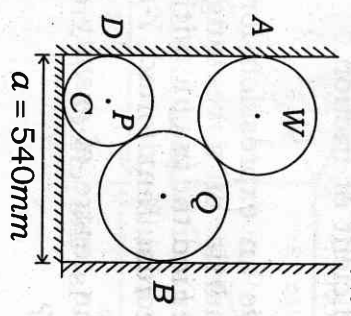
4. (a) State the laws of friction.　5

(b) Define the following terms in friction :
　　1.5×4=6

　　(i) Limiting friction

　　(ii) Angle of friction

　　(iii) Co-efficient of friction

　　(iv) Cone of friction.

(c) A body of weight 100N is placed on a rough horizontal plane. If the co-efficient of friction between the body and the plane is 0.5, find the horizontal force to just slide the body on plane.　4

(d) A body of weight 500 N is pulled up an inclined plane, by a force of 350N. The inclination of the plane is 30° to the horizontal and the force is applied parallel to the plane. Determine the co-efficient of friction.　5

5. (a) Derive an expression for the moment of inertia of a rectangular area of dimensions ($a \times b$) with respect to centroidal X-axis and Y-axis.　8
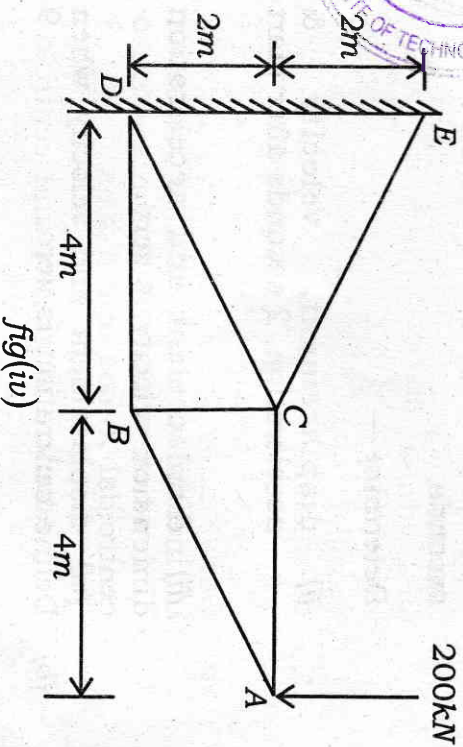
(b) Define centre of gravity and centroid.　2

(c) Locate the centroid of the plane area shown in fig(iii).　10

fig(iii)
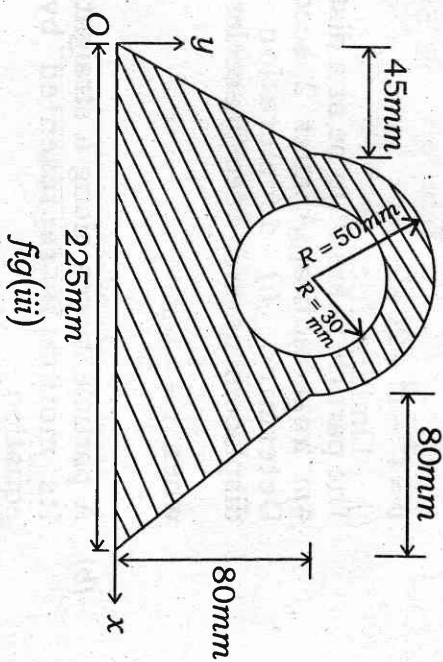
Find the forces in all the members of the truss shown in fig(iv).　20

fig(iv)

7. (a) The velocity of a particle moving in a straight line is given by the expression 7

$$v = t^3 - t^2 - 2t + 2$$

The particle is found to be at a distance 4m from station A after 2 seconds. Determine (i) acceleration and displacement after 4sec (ii) acceleration when $t = \frac{1}{3}$ sec.

(b) A particle moves along a straight line. Its motion is represented by the equation

$$s = 16t + 4t^2 - 3t^3$$

where, 's' is in metres and 't' is in seconds.

Determine—

(i) displacement, velocity & acceleration, 2 seconds after start

(ii) displacement and acceleration when velocity is zero.

(iii) displacement and velocity when acceleration is zero. 9

(c) Define the following : 1×4=4

(i) Speed

(ii) Velocity

(iii) Acceleration

(iv) Displacement

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