Total No. of printed pages = 6

19/3rd Sem/UME302

2021

ENGINEERING MECHANICS

Full Marks – 100

Time – Three hours

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

Answer any *five* questions.

1. (a) What do you mean by resultant force ? Distinguish between the composition of force and resolution of force. 2+2=4

   (b) Explain briefly the triangular and polygon law of forces with neat diagram. 3+3=6

   (c) What is a couple ? What is the arm of a couple and its moment ? 2

   (d) What is the physical meaning of moment of force ? State Varignon's principle of moment. 4

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(e) What do you mean by free body diagram ? Write the necessary and sufficient condition of equilibrium of a body. 4

2. (a) The following forces act at a point : 6

(i) 50 N towards North-East.

(ii) 40 N towards East.

(iii) 25 N inclined at 30° West of North.

(iv) 30 N inclined at 60° South of West.

Determine the resultant of the above force system.

(b) The resultant of two forces, one of which is double the other is 260N. If the direction of the larger force is reversed and the other remains unaltered, the resultant reduces to 180N. Determine the magnitude of the forces and the angle between the forces. 5

(c) Four forces of 25 N, 20 N, 15 N and 10 N are acting simultaneously along straight lines OA, OB, OC and OD such that $\angle AOB = 45°$; $\angle BOC = 100°$ and $\angle COD = 125°$.

Find the magnitude and direction of the resultant force. 5

(d) Find the magnitude of two like parallel forces acting at a distance of 1m apart whose resultant force is 300N acting at a distance of 200 mm from one of the forces. 4

3. (a) A beam AB of length 5 m supported at A and B carries two point loads W1 and W2 of 3 kN and 5 kN which are 1 m apart. If the reaction at B is 2 kN more than that at A, find the distance between the support A and the load 3 kN. 7

(b) Two like parallel forces of 50N and 100N act at the ends of a rod 360 mm long as shown in Figure (i). Find the magnitude of the resultant force and the point where it acts. 4

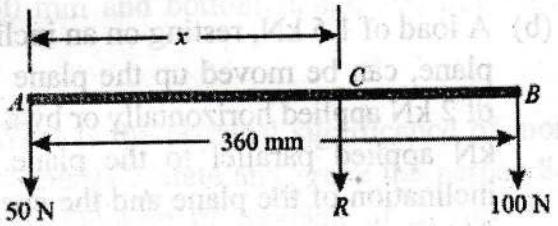

Fig.-(i)

(c) Two identical rollers, each weighing Q=50 N, are supported by an inclined plane and a vertical wall as shown in Figure-(ii). Assuming smooth surfaces, find the reactions induced at the points of support A, B and C. 9

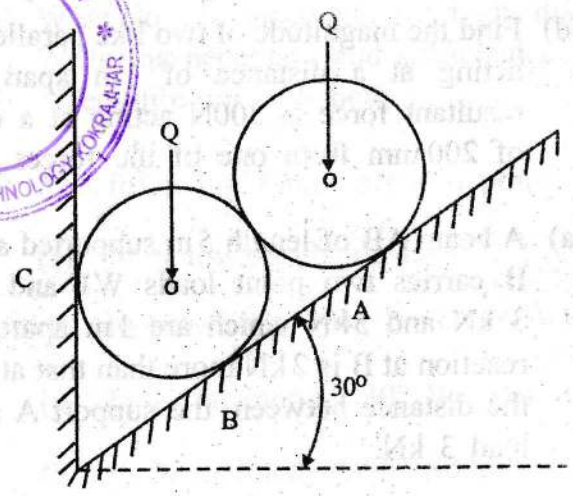

Fig-(ii)

4. (a) State the laws of static friction. What are the limiting forces of friction and the coefficient of friction ? 4+4

(b) A load of 1.5 kN, resting on an inclined rough plane, can be moved up the plane by a force of 2 kN applied horizontally or by a force 1.25 kN applied parallel to the plane. Find the inclination of the plane and the coefficient of friction. 6

(c) A body of weight 450N is pulled up an inclined plane, by a force of 300N. 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. 6

5. (a) Distinguish between the centre of gravity and centroid. How many centre of gravity a body has ? 2+1=3

(b) A semi-circular area is removed from a trapezium as shown in Figure-(iii). Locate the co-ordinates of the centroid of the remaining area. All dimensions are in mm. 7

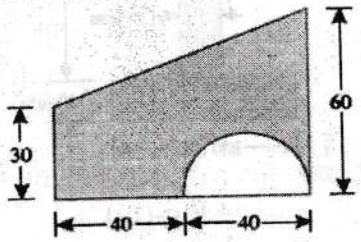

Fig-(iii).

(c) Find the centre of gravity of an I-section with top flange 100 mm × 20 mm, web 200 mm × 30 mm and bottom flange 300 mm×40 mm. 10

6. (a) What is the physical significance of moment of inertia ? State and prove the perpendicular axis theorem of moment of inertia 1+5=6

(b) An isosceles triangular section ABC has base width 80 mm and height 60 mm. Determine the moment of inertia of the section about the centre of gravity of the section and the base BC. 4

(c) Using parallel axis theorem, find the moment of inertia of the following Figure-(iv). 10

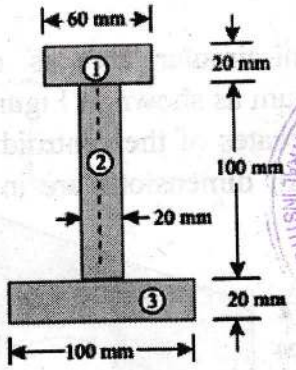

Fig-(iv)

7. (a) Distinguish between a truss and a frame. What do you mean by deficient and redundant plane trusses ? 2+3=5

(b) Determine the force in each member of the truss as shown in Figure (v), and state if the members are in tension or compression. 15

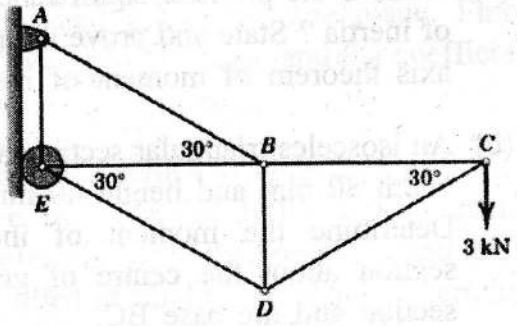

Fig-(v)