Total No. of printed pages = 9

19/2nd Sem/DME 205

2022

ENGINEERING MECHANICS

Full Marks – 100

Time – Three hours

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

Answer *all* questions from Section – A and any *four* from Section – B.

SECTION – A

1. Fill in the blanks : 1×10=10

   (i) The forces whose lines action lie on the same plane, are known as _____.

   (ii) The process of splitting up a force into number of components is called _____.

   (iii) The coefficient of friction depends on _____.

   (iv) The friction experienced by body in motion is known as _____.

[Turn over

(v) The unit of moment of force in S.I system is _____.

(vi) The centroid of a triangle is the point of intersection of its _____.

(vii) Two parallel forces equal in magnitude and opposite in direction and separated by a definite distance form a _____.

(viii) The centroid of a circle lies at its _____.

(ix) The S.I unit of angular velocity is _____.

(x) The weight of 10 kg mass is _____ N.

2. State the True or False of the following : 1×5=5

(i) Displacement is a vector quantity.

(ii) Two like parallel forces act in opposite direction.

(iii) The unit of force is not a derived unit.

(iv) Lami's theorem is applicable only for coplanar forces.

(v) Maximum value of static friction is called the angle of repose.

3. Choose the correct answer : 1×5=5

(i) Consider two parallel forces are acting on bar as shown in the Fig.1. The magnitude of the resultant force is

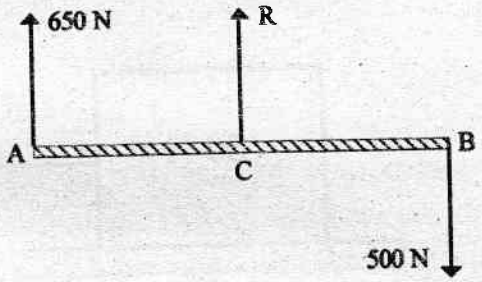

Fig. 1

(a) 1150N (b) 150N

(c) 0 (d) 90°

(ii) Two forces 3N and 4N are acting at an angle of 90°. The magnitude of the resultant force is

(a) 7N

(b) 25N

(c) 5N

(d) 12N

(iii) A body of weight 30N is lying on a horizontal plane as shown in Fig. 2. The coefficient of friction between the contact surface is 0.3. The minimum amount of force requires to move the body along the plane is

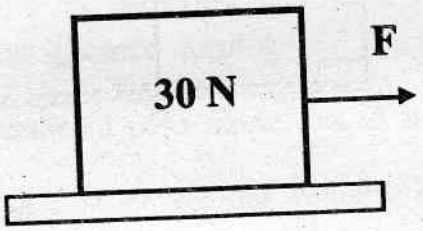

Fig. 2

(a) 30.0N (b) 100.0N

(c) 30.3N (d) 9.0N

(iv) A car starting from rest is accelerated at the rate of 0.5 m/s^2. The distance covered by the car in 30 seconds is

(a) 225N

(b) 250N

(c) 125N

(d) 450N

(v) The centroid of a semi-circle from its base measured along vertical radius of 50 cm is

(a) 23.23 (b) 21.23

(c) 24.21 (d) 25.00.

SECTION – B

4. (a) What do you mean by non-coplanar concurrent forces ? Distinguish between the resolution of force and composition of the force. 1+4=5

(b) State the triangular and parallelogram law of forces. 2+3=5

(c) The following forces act at a point :

(i) 45N towards North-East

(ii) 60N towards East

(iii) 40N inclined at 35° West of North

(iv) 50N inclined at 55° South of West.

Determine the magnitude and direction of the resultant force of the above force system. 10

5. (a) What do you mean by moment of a force? State Varignon's principle of moment of force. 2+2=4

(b) State the term 'equilibrium'. What are the necessary and sufficient conditions of equilibrium of a body? 1+2=3

(c) A simply supported beam of length 6m is loaded as 4 kN at a distance of 1m from left support, 3 kN at the middle of the beam and 6 kN at a distance 2m from right support. Find the reactions at the two ends. 8

(d) A body of weight 50N is suspended from a horizontal beam AB by two strings AC and BC as shown in Fig. 3. The strings AC and BC make angle 30° and 45° with the beam AB. Using Lami's theorem, find the tensions in the strings AC and BC. 5

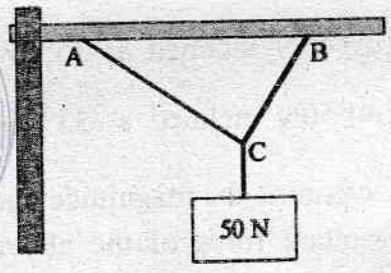

Fig. 3

6. (a) Distinguish between the centroid and centre of gravity. How many centres of gravity a body has ? 3+1=4

(b) Locate the centroid of the following Fig. 4 from the x-axis. 4 2

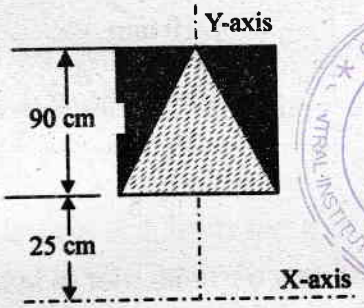

Fig. 4

(c) Find the centroid of the following Fig. 5 and Fig. 6 w.r.t. given reference axes. 8+6=14

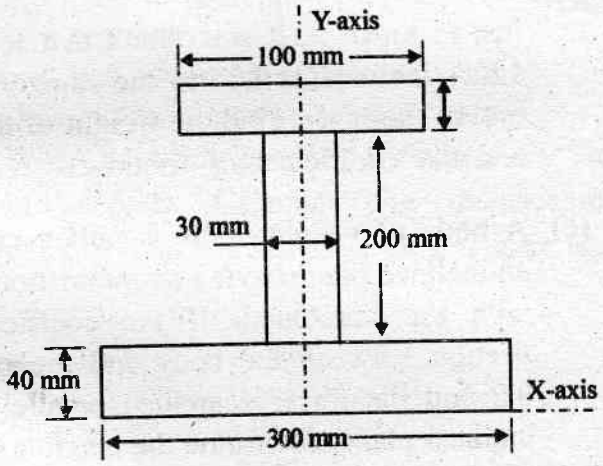

Fig. 5

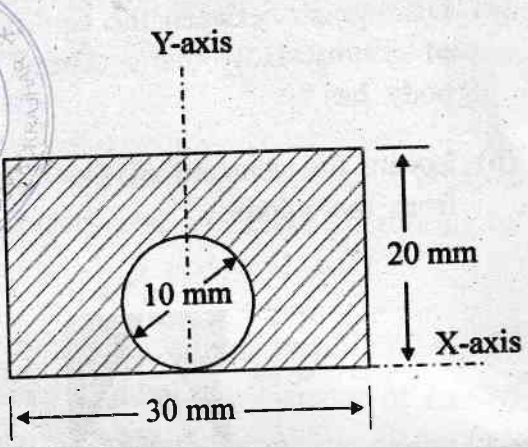

Fig. 6

7. (a) Define coefficient of friction and angle of friction. State the laws of dynamic frictions. 2+2+2=6

(b) A body resting on a horizontal plane required a pull of 100N inclined at 30° to horizontal just to move it. It was found that a push of 120N inclined at 30° to the horizontal just moves the body. Find the weight of the body and the coefficient of friction. 10

(c) A body of weight 400N is pulled up along an inclined plane having an inclination of 25° with the horizontal. If the coefficient of friction between the body and the plane is 0.2 and the force is applied parallel to the inclined plane, determine the maximum force required. 4

8. (a) State velocity and uniform acceleration of a body. Show that the equation of motion for distance covered (s) by a body is

$$s = ut\frac{1}{2}at^2$$

Where, u is the initial velocity,

t is the time taken to travel a distance 's'. 2+4=6

(b) A stone is dropped from the top of a tower 60 m high. At the same time, another stone is thrown upward from the foot of the tower with a velocity of 20 m/s. When and where the two stones will meet? 8

(c) The straight motion of an object is given by

$$s = 12t + 3t^2 - 2t^3$$

Where, s = Displacement in meters, t = Time in seconds. Calculate the displacement, velocity and acceleration after 2 seconds. 6