

Total No. of printed pages = 4

ME 181104

Roll No. of candidate

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2021

B.Tech. 1st Semester End-Term Examination

ENGINEERING MECHANICS

(New Regulation (w.e.f 2017 - 18) and New Syllabus)

(Group - B) (w.e.f 2018 - 2019)

Full Marks – 70

Time – Three hours

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

Answer question No. 1 and any *four* from the rest.

1. Choose the correct answer : (10 × 1 = 10)
- (i) Which of the following is a vector quantity?
- (a) Energy (b) Mass
(c) Momentum (d) Angle
- (ii) The process of finding out the resultant force is called _____ of forces.
- (a) Composition (b) Resolution
(c) Decomposition (d) None of these
- (iii) According to the law of moments, if a number of coplanar forces acting on a particle are in equilibrium, then
- (a) their algebraic sum is zero
(b) the algebraic sum of their moments about any point is equal to the moment of their resultant force about the same point
(c) their lines of action are at equal distances
(d) the algebraic sum of their moments about any point in their plane is zero
- (iv) If three forces acting in one plane upon a rigid body, keep it in equilibrium, then they must either
- (a) meet in a point
(b) be all parallel
(c) at least two of them must meet
(d) all the above are correct

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- (v) The point, through which the whole weight of the body acts, irrespective of its position, is known as
- (a) centre of mass (b) centre of gravity
(c) centre of percussion (d) None of these
- (vi) Coefficient of friction depends upon
- (a) Area of contact only (b) Nature of surface only
(c) Both (a) and (b) (d) None of these
- (vii) The friction experienced by a body, when at rest, is known as
- (a) static friction (b) dynamic friction
(c) coefficient of friction (d) limiting friction
- (viii) The angle of inclination of the plane at which the body begins to move down the plane, is called
- (a) angle of friction (b) angle of repose
(c) angle of projection (d) None of these
- (ix) A screw jack used for lifting the loads is
- (a) A reversible machine (b) A non-reversible machine
(c) An ideal machine (d) None of these
- (x) Which of the following is the example of lever of first order
- (a) arm of man (b) pair of scissors
(c) all of the above (d) none of the above
2. (a) Define the term Free Body Diagram. (2)
(b) State the conditions of equilibrium of Co-planar concurrent forces. (3)
(c) A ball of weight 120 N rests in a right-angled groove, as shown in Figure 1. The sides of the groove are inclined to an angle of 30° and 60° to the horizontal. If all the surfaces are smooth, then determine the reactions R_A and R_C at the points of contact. (10)

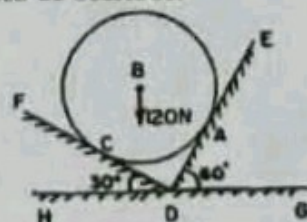


Figure 1

3. (a) Define and explain the terms: Perfect Frame, Imperfect Frame, Deficient Frame and Redundant Frame. (5)
- (b) A truss of span 9 m is loaded as shown in Figure 2. Find the reactions and forces in the members marked as 1, 2 and 3. (10)

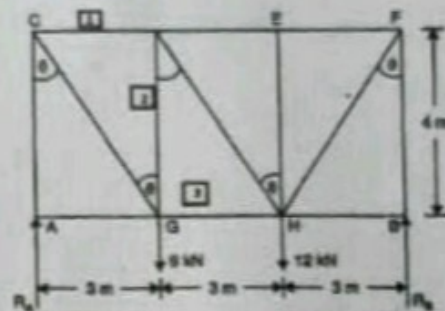


Figure 2

4. (a) State the Laws of Friction. (5)
- (b) A body of weight 500 N is lying on a rough plane inclined at an angle of 25° with the horizontal. It is supported by an effort (P) parallel to the plane as shown in Figure 3. (5)

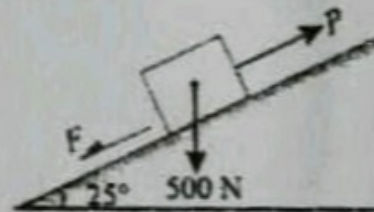


Figure 3

Determine the minimum and maximum values of P, for which the equilibrium can exist, if the angle of friction is 20° .

- (c) A uniform ladder of length 3.25 m and weighing 250 N is placed against a smooth vertical wall with its lower end 1.25 m from the wall. The coefficient of friction between the ladder and floor is 0.3. What is the frictional force acting on the ladder at the point of contact between the ladder and the floor? (5)
5. (a) Find the centre of gravity of a channel section $100 \text{ mm} \times 50 \text{ mm} \times 15 \text{ mm}$. (5)

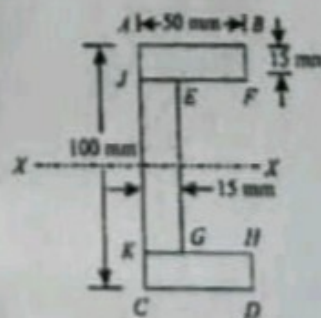


Figure 4

- (b) A semicircular area is removed from a trapezium as shown in Figure 5 (dimensions in mm). (10)

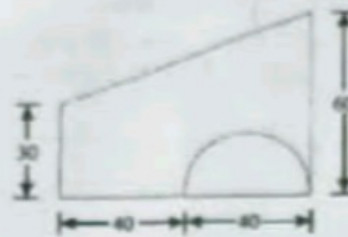


Figure 5

Determine the centroid of the remaining area.

6. (a) Define the following terms: Lifting Machine, Mechanical Advantage, Velocity Ratio, Ideal Machine, and Reversibility of a machine. (5)
- (b) State the "Law of Machine". State the types of lifting machine. (2 + 3 = 5)
- (c) A machine is raised a load of 360 N through a distance of 200 mm. The effort, a force of 60 N moved 1.8 m during the process. (5)
- Calculate :
- (i) Velocity Ratio
- (ii) Mechanical Advantage
- (iii) Effect of friction and
- (iv) Efficiency at this load
7. (a) State the principle of virtual work. (2)
- (b) Define Linear Impulse and Momentum. (3)
- (c) A weight (W) of 5 kN is raised by a system of pulleys as shown in Figure 6.



Figure 6

Using the method of virtual work, find the force P, which can hold the weight in equilibrium. (10)