END TERM EXAMINATION

SECOND SEMESTER [B.TECH] JULY 2023

Paper Code: ES-114 ***Subject: Engineering Mechanics***

Time: 3 Hours ***Maximum Marks: 75***

Note: Attempt five questions in all including Q. No.1 which is compulsory. Select one question from each unit. Assume suitable missing data (if any).

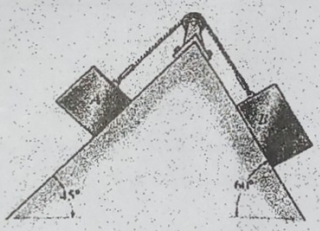
Q1 **Short questions:-** **(1.5x10=15)**

(a) State the principle of transmissibility of forces.
(b) Define couple and explain its properties.
(c) Define free body diagram with one suitable example.
(d) Briefly explain the significance of moment of inertia.
(e) Define centroid and write the centroid of quadrant of an arc of radius R.
(f) Write any two differences between truss and frames.
(g) Write two assumptions made for analyzing the perfect truss.
(h) Define Coulomb's Law of Friction.
(i) State D'Alembert's Principle.
(j) Define instantaneous centre of rotation.

UNIT-I

Q2 (a) If a block A weighs 1.5 kg, then, determine the largest mass of block B without causing motion of the system as shown in Fig. 1. The coefficient of static friction between the blocks and inclined planes is 0.2. **(9)**

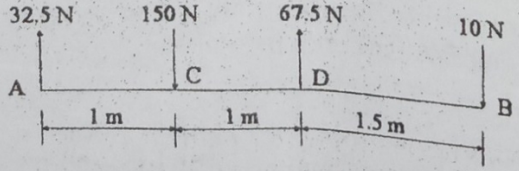
Fig. 1



(b) Derive the expression to determine the mass moment of inertia of circular disc of radius R, thickness t and mass M about its axis of rotation. **(6)**

Q3 (a) A system of parallel forces is acting on a rigid bar as shown in Fig. 2. Reduce the system to (i) a single force (ii) a single force and a couple at A (iii) a single force and a couple at B. **(9)**

Fig. 2



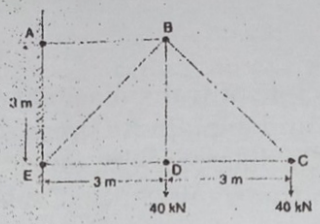
(b) Derive the expression for finding the centroid of a triangle of base 'b' and height 'h' from its base. **(6)**

UNIT-II

Q4 (a) A body of weight 500 N is pulled up an inclined plane, by a force of 350 N. The inclination of the plane is 30^0 to the horizontal and the force is applied parallel to the plane. Determine the coefficient of friction. **(6)**

(b) Find the forces in AB, BE and DE members of the given truss (Fig. 3) and identify nature of forces in the members. **(9)**

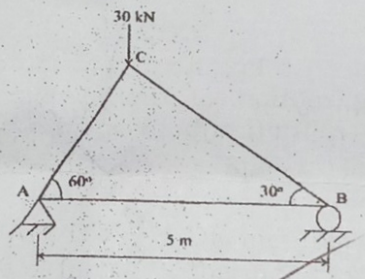
Fig. 3



Q5 (a) Determine the forces in magnitude and nature in all members of truss system as shown in Fig. 4 using method of joints. **(9)**

(b) Find the power transmitted by a belt running over a pulley of 600 mm diameter at 200 rpm. The coefficient of friction between the belt and the pulley is 0.25, angle of lap 160^0 and maximum tension in the belt is 2.5 kN. **(6)**

Fig. 4



UNIT-III

Q6 (a) A body of 5 kg mass is initially at rest on a rough horizontal surface ($\mu = 0.2$) and is acted upon by a 20 N pull applied horizontally. Calculate: **(8)**

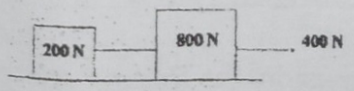
(i) The work done by the net force on the body in 5 seconds

(ii) Change in the kinetic energy of the body in 5 seconds.

(b) A stone is dropped into a well is heard to strike the water after 4 seconds. Find the depth of well, if the velocity of sound is 350 m/sec. **(7)**

Q7 (a) Two weights 800 N and 200 N are connected by a thread and move along a rough horizontal plane under the action of a force 400 N applied to the first weight of 800 N as shown in Fig. 5. The co-efficient of friction between the sliding surfaces of the weights and the plane is 0.3. Determine the acceleration of the weights and the tension in the thread using D'Alembert's principle. **(9)**

Fig. 5



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(b) State and prove the law of conservation of energy. **(6)**

UNIT-IV

Q8 (a) Two ships leave a port at the same time. The first moves in North-West direction at 50 km/hr and second at 40 km/hr in 35° South of West direction. Find the relative velocity of second ship with respect to first. Also find the distance between them after 25 minutes. **(7)**

(b) Define statically determinate beams. Also write the types of beams with suitable diagrams. **(8)**

Q9 (a) A link AB is moving in a vertical plane. At certain instant, when the link is inclined at 60° to the horizontal, the point A is moving horizontally at 2 m/sec, while B is moving in a vertical direction. Find the velocity of B. **(5)**

(b) Construct shear force and bending moment diagrams for the cantilever beam as shown in Fig. 6. **(10)**

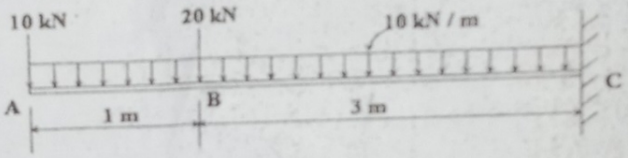

Fig. 6

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