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END TERM EXAMINATION

SECOND SEMESTER [B.TECH] June 2024

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

Time: 3 Hours **Maximum Marks: 60**

Note: Attempt all question as directed. Internal choice is indicated.

Q1 Answer the following questions (any **four**) **(4x5=20)**

(a) State the principle of transmissibility of forces.
(b) State the mathematical condition for a rigid or a perfect truss.
(c) State D'Alembert's principle.
(d) What is the point of contraflexure in case of a beam.
(e) Define instantaneous centre of rotation.
(f) What is a self locking condition in case of a machine.

UNIT-I

Q2 (a) State and proof Varignon's Theorem. **(3)**

(b) Find the moment of inertia of the cross section of the iron beam (Fig.1) with respect to the centroidal axis. **(7)**

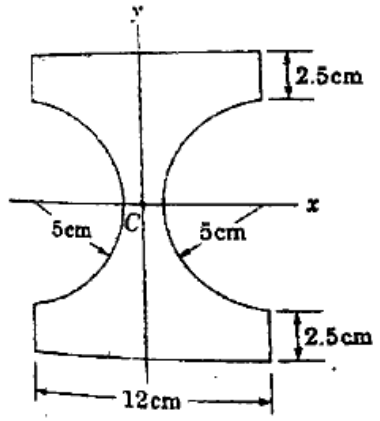

Figure 1

Q3 (a) State Pappus Theorem with an example. **(1)**

(b) State the prove parallel axis theorem. **(3)**

(c) Two equal weights each of 1000N is supported by a flexible string (Fig. 2). Find the tensions in the portion AB, BC and CD of the string **(6)**

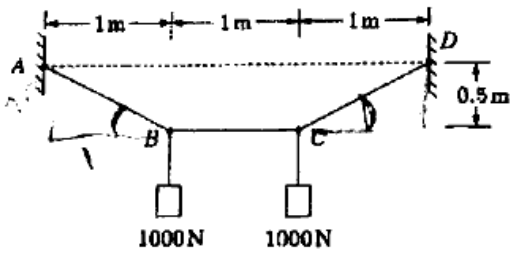

Figure 2

P.T.O.

UNIT-II

Q4 (a) Two blocks are connected by a horizontal link AB and rest on two planes (Fig.3).What is the smallest weight W_A of the block A for which the equilibrium can exist? Assume the coefficient of friction for the block A and the horizontal surface to be 0.4 and the angle of friction for the block B on the inclined plane is 20°. **(6)**

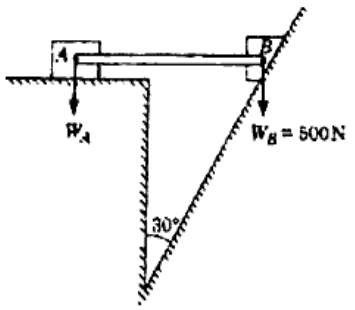

Figure 3

(b) A truss is loaded and supported (Fig. 4). Find the axial forces in the members AB, EF and CD. **(4)**

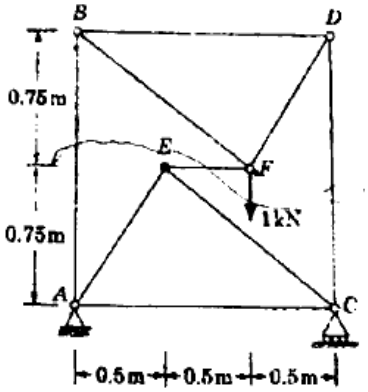

Figure 4

Q5 (a) For a belt drive, prove that $T1/T2 = e^{\mu\theta}$. **(3)**

(b) A truss has been loaded and supported as shown in Fig. 5. Find out the forces in all the members of the truss when joint A is hinged and joint B is roller supported. **(7)**

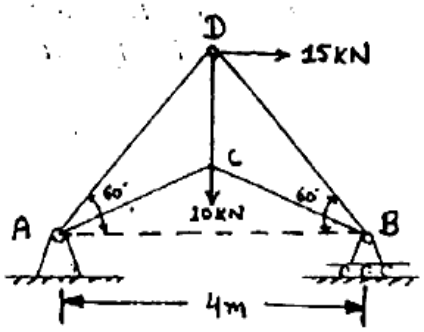

Figure 5

P.T.O.

UNIT-III

Q6 (a) A small block rests on a turn table which, starting from rest, is rotated in such a way that the block undergoes a constant tangential acceleration $a_t = 2m/s^2$. Determine how long it will take for the block to start slipping on the turntable and the speed v of the block at that instant. Refer Fig.6. **(6)**

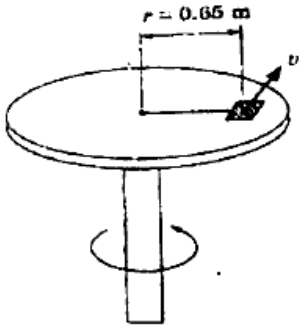

Figure 6

(b) A sphere of weight 12N moving at 4m/sec strikes another sphere of weight 60N moving in the same direction at 0.8m/sec. Find the loss of kinetic energy during the impact and show that the direction of motion of first sphere is reversed, e=0.75. **(4)**

Q7 (a) A passenger weighing 800N enters an elevator weighing 9kN. When the elevator accelerates upwards, the passenger experiences an apparent weight gain of 90N. When the elevator decelerates to zero velocity, the passenger experiences an apparent weight loss of 110N. Find the values of (i) Acceleration and deceleration. (ii) Elevator cable tension in the beginning and at the end. **(6)**

(b) A glass ball is dropped on to a smooth horizontal floor from which it bounces to a height of 9m. On the second bounce it rises to a height of 6m. From what height the ball was dropped and what is the coefficient of restitution between the glass and the floor. **(4)**

UNIT-IV

Q8 (a) Draw the shear force and bending moment diagram for a cantilever beam as shown in figure 7. Also locate the point of contraflexure, if it exists for such a beam. **(7)**

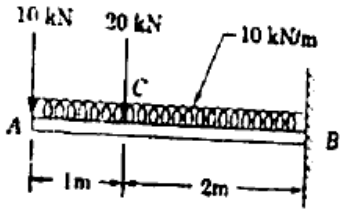

Figure 7

(b) A straight rod AB, 50cm long has one end B moving with a velocity of 4m/s and the other end A moving along a vertical line YO as shown in figure 8. Find the velocity of the end A and of the midpoint of the rod when it is inclined at 60° with horizontal. **(3)**

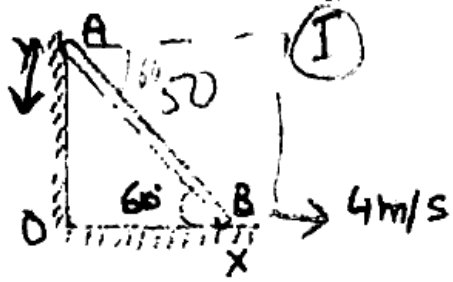

Figure 8

Q9 (a) A reciprocating engine mechanism is shown in figure 9. The crank OA is of length 15cm and rotating at 600 r.p.m. The connecting rod AB is 70cm long. Find the (i) Angular velocity of the connecting rod (ii) The velocity of piston B. **(7)**

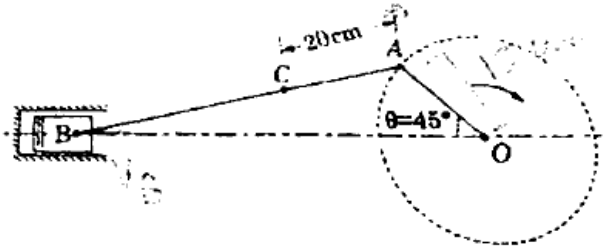

Figure 9

(b) A roller of radius 5.0 cm rides between two horizontal bars moving in the opposite directions as shown in figure 10. Calculate the distance 'd' defining the position of instantaneous centre of rotation of the roller. Assume no slip conditions at the point of contact A and B. **(3)**

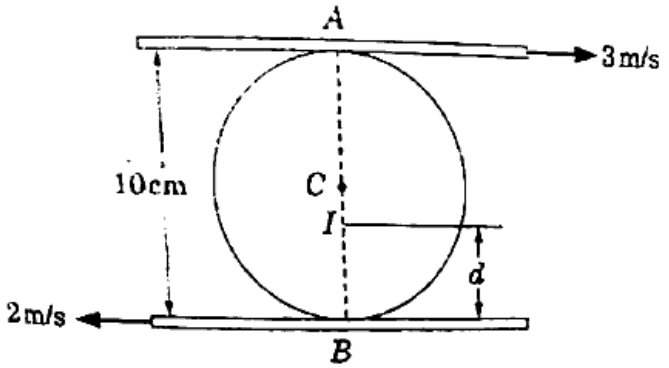

Figure 10

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