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Question Paper Code : 11651

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2026.

Third Semester

Civil Engineering

ME3351 – ENGINEERING MECHANICS

(Common to Automobile Engineering/Civil Engineering (Environmental Engineering)/Industrial Engineering/Industrial Engineering and Management/Materials Science and Engineering/Mechanical Engineering/Mechanical Engineering (Sandwich)/Mechanical Engineering (Specialised in Automobile)/Mechanical Engineering (Specialised in Smart Manufacturing)/Mechanical and Automation Engineering/Mechatronics Engineering/Production Engineering/Robotics and Automation/Safety and Fire Engineering)

(Regulations 2021)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State Lami's theorem.
2. Compare and contrast between particle and rigid body.
3. Write down the conditions of equilibrium of a particle in space.
4. Mention the equation of equilibrium of a rigid body.
5. State parallel axis theorem.
6. Define Polar moment of Inertia and state its significance.
7. State the angle of repose.
8. Why is static coefficient of friction μ , always greater than kinetic coefficient of friction μ_k ?
9. State the law of conservation of momentum.
10. Define inertia force.

PART B — ($5 \times 13 = 65$ marks)

11. (a) Figure 1. below shows cylinders, A of weight 100 N and B of weight 50 N, resting on smooth inclined planes. They are connected by a bar of negligible weight hinged to each cylinder at their geometric centers by smooth pins. Find the force P, as shown, that holds the system in the given position.

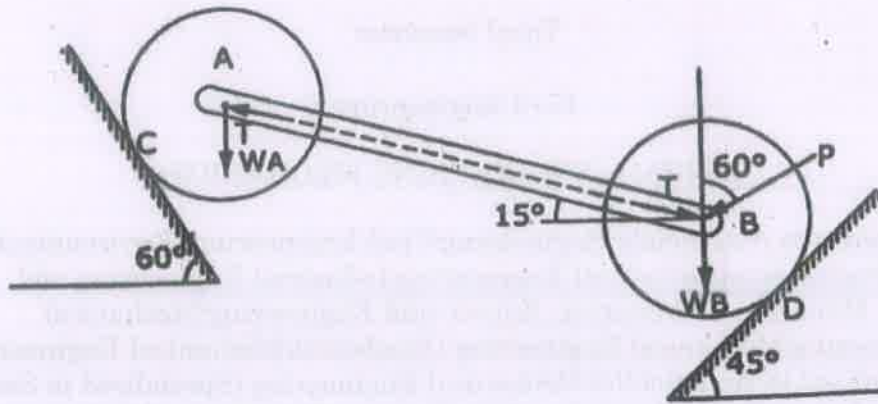


Figure 1

Or

- (b) State and derive the expression for magnitude and direction of the resultant using the Parallelogram law of forces.
12. (a) A beam AB of span 10 m span is loaded as shown in Figure 2. Determine the reactions at A and B.

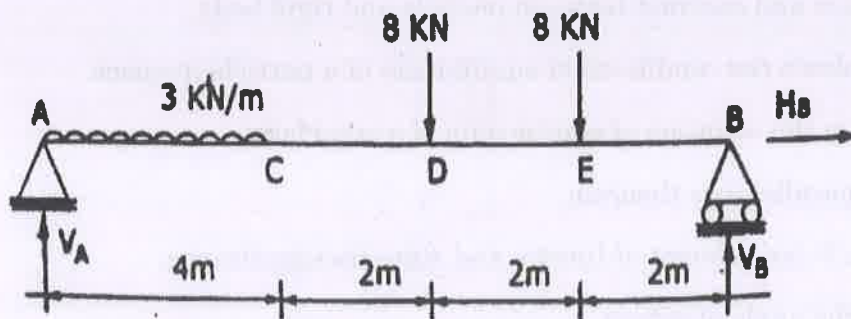


Figure 2

Or

- (b) Calculate the reactions R_1 , R_2 and R_3 for the beams AB and CD supported as shown in the Figure 3. There being a hinge connecting B and C.

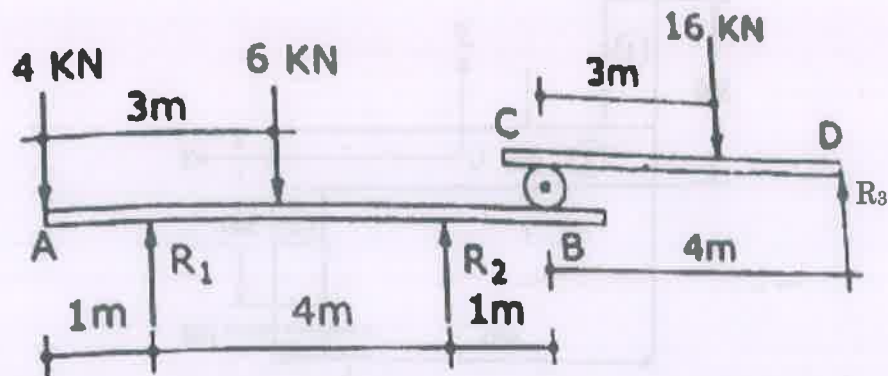


Figure 3

13. (a) Find the mass moment of inertia of the plate shown in Figure 4 with respect to the axis AB. Thickness of the plate is 5 mm and density of the material is 6500 kg/m^3 .

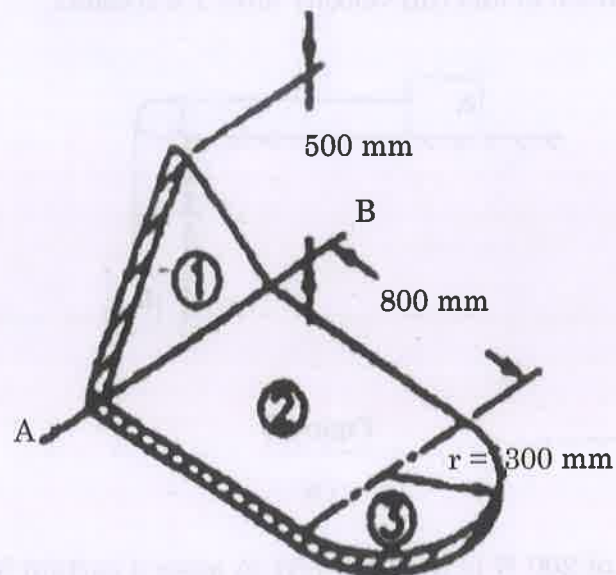


Figure 4

Or

- (b) Calculate Moment of Inertia about the co-ordinate axes of plane area shown in Figure 5. Also find Polar Moment of Inertia. All the dimensions are in 'mm'.

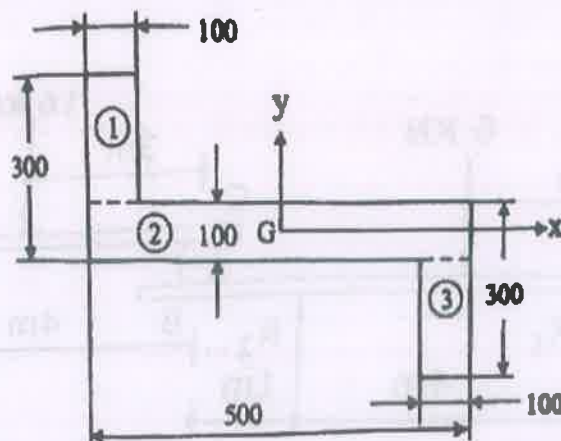


Figure 5

14. (a) Two blocks 'A' and 'B' of masses $m_A = 280$ kg and $m_B = 420$ kg are joined by an inextensible cable as shown in Figure 6. Assume that the pulley is frictionless and $\mu = 0.30$ between block 'A' and the surface. The system is initially at rest. Determine (i) Acceleration of block A (ii) velocity after it has moved 3.5 m and (iii) velocity after 1.5 seconds.

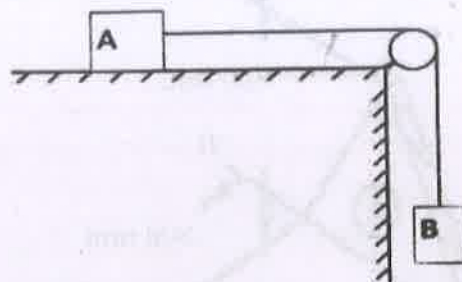


Figure 6

Or

- (b) An effort of 200 N is required just to move a certain body up an inclined plane of angle 15° , the force is acting parallel to the plane. If the angle of inclination of the plane is made 20° , the effort required being again parallel to the plane, is found to be 230 N. Predict the weight of the body and coefficient of friction.

15. (a) The position of the particle is given by the relation $S = 1.5t^3 - 9t^2 - 22.5t + 60$, where S is expressed in meters and t in seconds. Determine (i) the time at which the velocity will be zero (ii) the position and distance travelled by the particle at that time (iii) the acceleration of the particle at that time and (iv) the distance travelled by the particle from $t = 5$ s to $t = 7$ s.

Or

- (b) A cricket ball hit at a height of 1.5 m from the ground by a batsman with a velocity of 20 m/s, at an angle of 30° to the horizontal was caught by field man at a height of 50 cm from the ground. Find out the distance between the two players.

PART C — ($1 \times 15 = 15$ marks)

16. (a) Two cables are tied together at point O and loaded as shown in the Figure 7. Determine the tensions in OO_1 , and OO_2 .

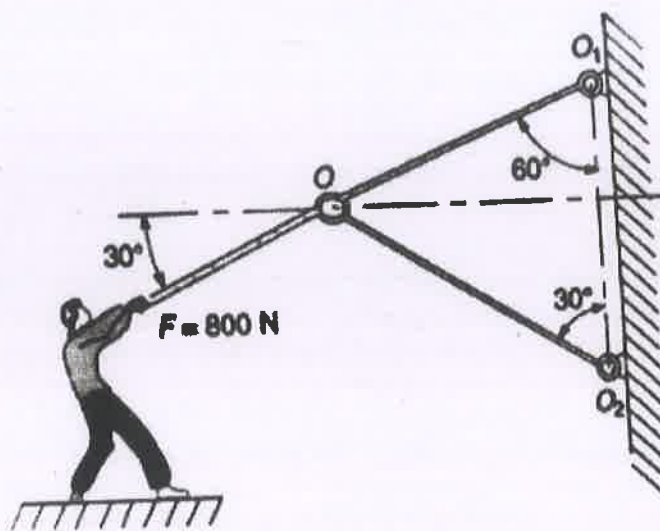


Figure 7

Or

- (b) Four tugboats are used to bring a large ship to its pier. Each tugboat exerts a 5000N force in the direction as shown in Figure 8. Determine the equivalent force – couple system at point 'O' and the point on hull where a single more powerful tugboat should push to produce the same effect as the original four boats.

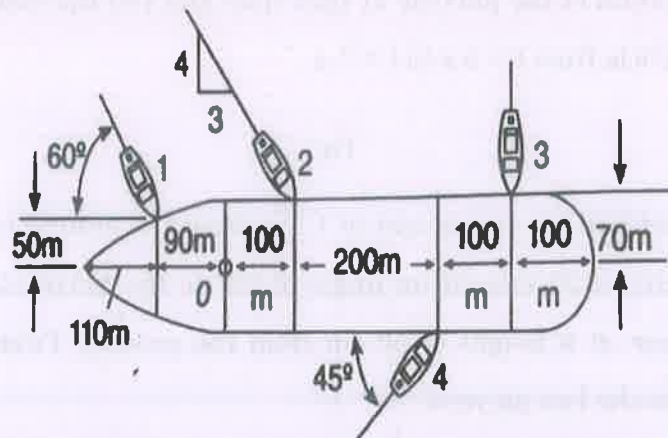


Figure 8