R13

Code No: 111AC

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.Tech I Year Examinations, June - 2015

ENGINEERING MECHANICS

(Common to CE, ME, CHEM, MCT, MMT, AE, AME, MIE, PTE, CEE, MSNT, AGE)

Time: 3 hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A.
Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART- A

(25 Marks)

1.a) Two forces 15 N and 12 N are acting at a point. The angle between the forces is 60^0. Find the magnitude and direction of the resultant. [2M]

b) A force F = (3i - 4j +12k) N acts at point A (1, -2, 3) m. What is the moment of the force about the point B (2, 1, 2) m. [3M]

c) State the main laws of dry friction. [2M]

d) A rope is wrapped three turns around a cylinder. Determine the force required to just support a weight of 1 kN. $\mu = 0.3$ between the rope and the cylinder. [3M]

e) State and explain parallel axis theorem. [2M]

f) Derive the expression of moment of inertia of triangular area about the base. [3M]

g) State the difference between curvilinear motion and rotary motion. [2M]

h) A body of mass 200 kg resting on a rough horizontal plane is pulled by a force of 50 kN along the plane. Determine the acceleration of the body along the plane by taking $\mu = 0.2$ between the body and the plane. [3M]

i) Explain the concept of simple harmonic motion [2M]

j) A body of mass 5kg is initially at rest on a rough horizontal surface ($\mu = 0.2$) and is acted upon by 20 N pull applied horizontally. Find the change in kinetic energy of the body in 5 seconds. [3M]

PART-B

(50 Marks)

2.a) Two cylinders of diameters 100 mm and 50 mm, weighing 200 N and 50 N, respectively are placed in a trough as shown in figure 1. Neglecting the friction, find the reactions at contact surfaces 1, 2, 3 and 4.

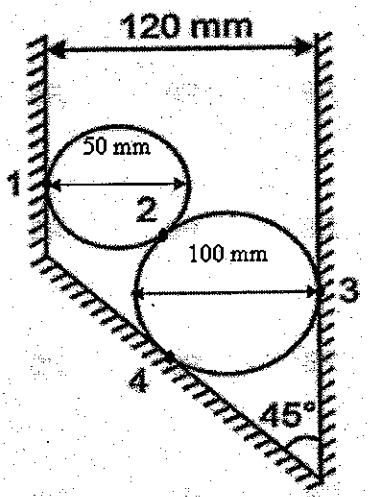


Figure: 1

b) A rectangular plate of negligible weight is suspended by three vertical wires as shown in figure 2.
i) Assume that the plate is subjected to a concentrated vertical force Q. Determine the location of the point of application of Q so that the forces in the wires are equal.
ii) Calculate the forces in the wires if the plate is subjected to a vertical constant distributed load p per meter. [5+5]

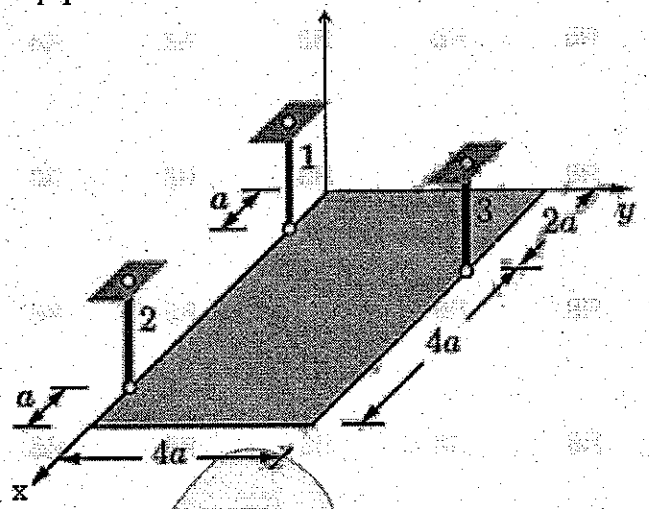


Figure: 2

OR

3.a) A triangular plate is subjected to the force system shown in figure 3. Let $P_1 = 7$ kN, $P_2 = 10$ kN, $P_3 = 15$ kN and $M = 7$ kNm. Find the resultant force and its point of action on X and Y axis.

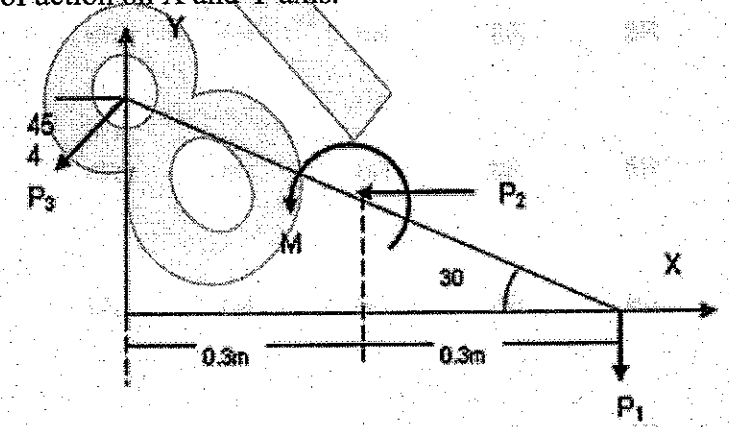


Figure: 3

b) A turnbuckle F is tightened until the tension in cable AE is 5 kN. Determine the tensions in the cables AB, AC and AD for the system shown in figure 4. [5+5]

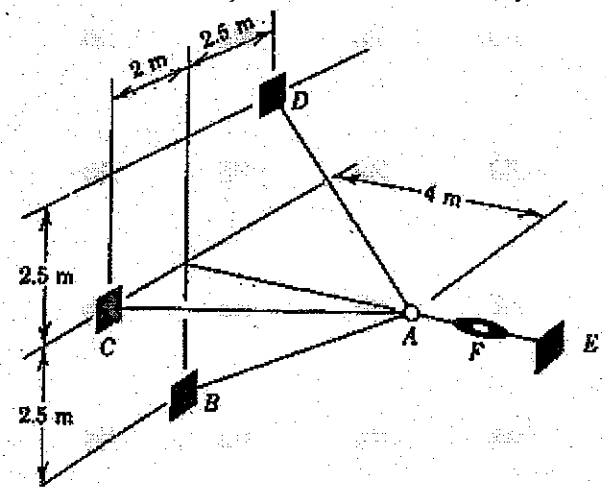


Figure: 4

4.a) The ladder as shown in figure 5 is 6m long and is supported by a horizontal floor and a vertical wall. The coefficient of friction between the floor and the ladder is 0.4 and between the wall and the ladder is 0.25. The weight of the ladder is 200 N. The ladder is also supports a vertical load of 900 N at C which is at a distance of 1 m from B. Determine the least value of θ for which the ladder may be placed without slipping.

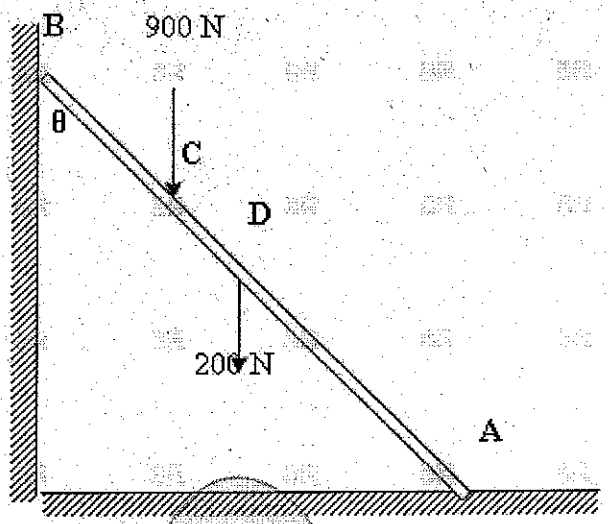


Figure: 5

b) Find the power transmitted by a cross belt drive connecting two pulleys of 45 cm and 20 cm diameters which are 1.95 m apart. The maximum permissible tension in the belt is 1kN, coefficient of friction is 0.25 and the speed of larger pulley is 100 r.p.m. [5+5]

OR

5.a) In figure 6, W_1 weighs 200 N and W_2 weighs 120 N. They are tied together by a string parallel to the plane. The coefficient of friction between W_1 and the plane is 0.25 and between W_2 and the plane is 0.5. Determine the value of the angle θ at which the sliding will occur. What is the tension in the string?

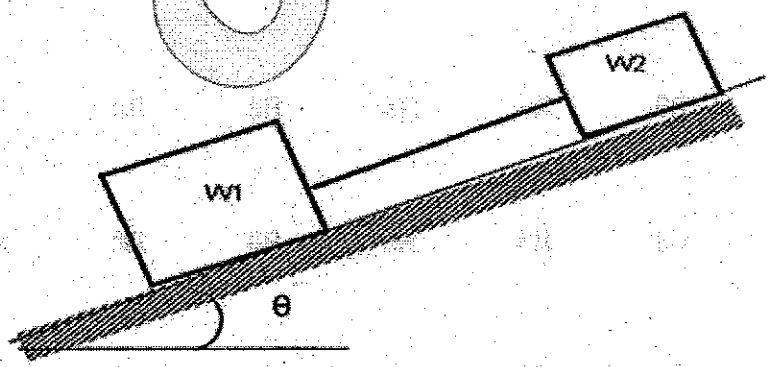
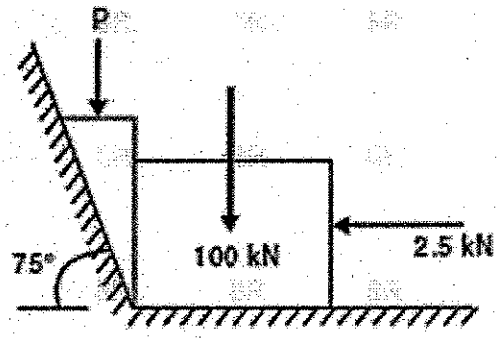


Figure: 6

b) Determine the force P required to start the wedge as shown in figure 7. The angle of friction for all contact surfaces is 15^0. Neglect the weight of the wedge. [5+5]



6.a) Determine the moment of inertia of a shaded portion made by a semi circular cut of radius 5 cm from the quarter circle of radius 10 cm, as shown in figure 8, about the given x and y axis.

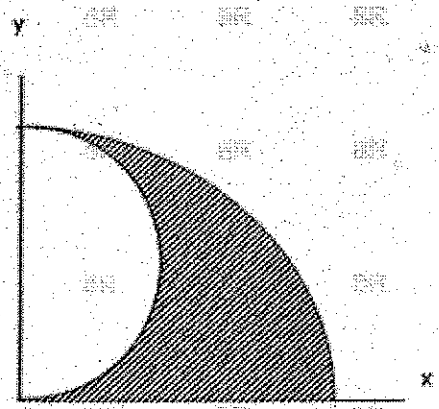


Figure: 8

b) Find the centroidal coordinates of the shaded area with reference to the axes as shown in figure 9. All dimensions are in mm. [5+5]

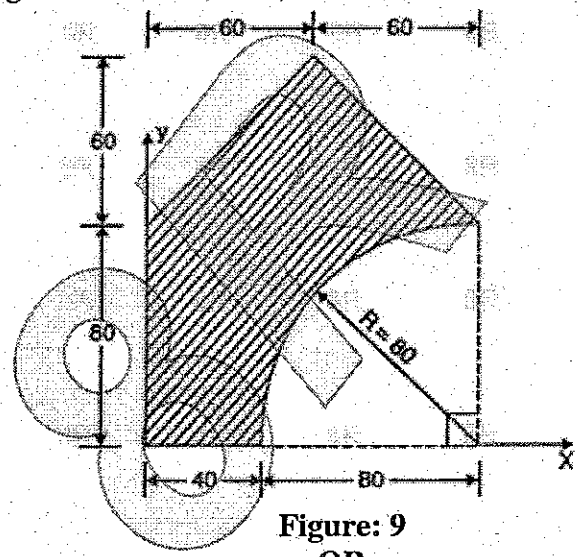


Figure: 9

OR

7.a) Determine the coordinates of the centroid of the shaded area formed by the intersection of a straight line $y = mx$ and the curve $y = kx^2$ as shown in figure 10.

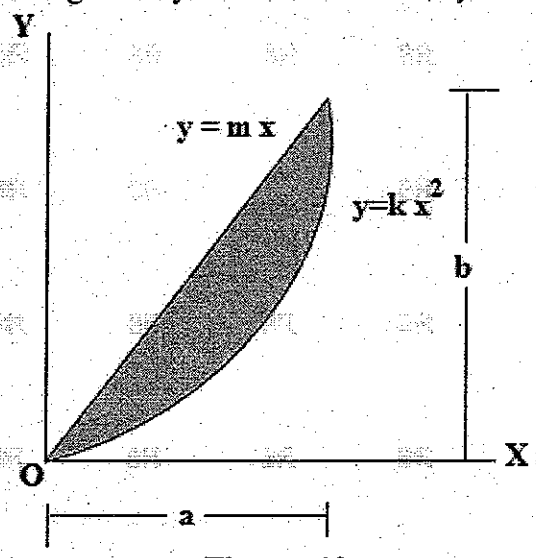


Figure: 10

b) Determine the mass moment of inertia of a solid sphere of radius r and mass m about any axis. [5+5]

8.a) Two trains P and Q start from rest simultaneously from stations A and B are facing each other, with accelerations 0.5 m/sec^2 and 0.6 m/sec^2 reaching their maximum speeds of 90 KMPH and 72 KMPH respectively. If they cross each other midway between the stations, find the distance between the stations and the time taken by each train.

b) A projectile is aimed at a mark on the horizontal plane through the point of projection and falls 10 m short when the angle of projection is 15^0 while it overshoots the mark by 25 m when the inclination is 40^0. Neglecting the air resistance, find the correct distance of target and the required angle of projection if the velocity remains constant. [5+5]

OR

9.a) Two adjacent guns having the same muzzle velocity of 350 m/sec fire simultaneously at angles of θ_1 and θ_2 for the same target situated at the range of 4200 m. Find the time difference between the two hits.

b) A wheel rotating about a fixed axis at 25 revolutions per minute is uniformly accelerated for 80 seconds during which it makes 50 revolutions. Find the i) angular velocity at the end of this interval and ii) time required for the velocity to reach 100 revolutions per minute. [5+5]

10.a) Two men, m_1 of mass 50 kg and m_2 of mass 75 kg, dive off the end of a boat of mass m = 250 kg so that their relative velocity with respect to the boat is 4 m/sec. If the boat is initially at rest, find its final velocity if:
i) Two men dive simultaneously
ii) The man of mass 75 kg dives first followed by the man of mass 50 kg.
iii) The man of mass 50 kg dives first followed by the man of mass 75 kg.

b) A particle is moving with its acceleration directed to and proportional to its distance from a fixed point. When the distance of the particle from equilibrium position has values of 1.2 m and 1.5 m, the corresponding values are 5 m/sec and 3 m/sec. Determine the amplitude and time period of oscillation. [5+5]

OR

11.a) A ball of mass m = 5 kg is dropped on to a spring of stiffness k = 500 N/m from a height h = 10 cm. Find the maximum deflection δ of the spring.

b) The frequency of a particle following SHM is 2 cycles per second. Its speed is 4 m/sec at its mean position. Find the distance between two extreme positions. Also find its speed when it is half way between mid-position and on extreme position. [5+5]

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