Code No: 121AC **R15**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD
B.Tech I Year Examinations, August/September - 2016
ENGINEERING MECHANICS
(Common to CE, ME, CHEM, MCT, MMT, MEP, AE, AME, MIE, MIM, 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) Distinguish clearly between resolution of forces and composition of forces. [2]

b) The resultant of two concurrent forces is 1500 N and the angle between the forces is 90^0. The resultant makes an angle of 36^0 with one of the force. Find the magnitude of each force [3]

c) What is a wedge? State its uses and the method of solving the problems on wedge friction. [2]

d) A shaft running at 200 r.p.m is to drive a parallel shaft at 300 r.p.m. The pulley on the driving shaft is 60 cm diameter. Calculate the diameter of the pulley on the driven shaft by taking belt thickness into account, which is 5 mm thick. [3]

e) Explain the terms moment of inertia and radius of gyration of a plane figure. [2]

f) Find the centroid of the plane lamina shown in figure 1. [3]

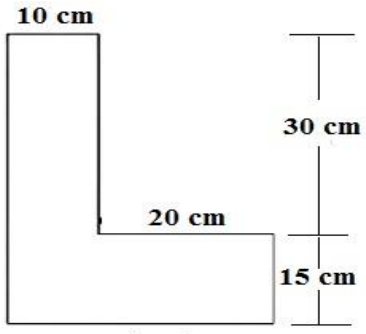

Figure: 1

g) What do you mean by instantaneous centre of rotation? [2]

h) A flywheel of an engine has a mass of 605 tonnes and radius of gyration 1.8 meters. If the maximum and minimum speeds of the flywheel are 120 r.p.m and 118 r.p.m respectively, find the fluctuation of energy. [3]

i) Distinguish between free vibration and forced vibration. [2]

j) Find the work done in drawing a body weighing 1000 N through a distance 10 m along a horizontal surface by a horizontal force of 400 N. [3]

PART-B

(50 Marks)

2.a) A machine component of length 2.5 meters and height 1 meter is carried upstairs by two men, who hold it by the front and back edges of its lower face. If the machine component is inclined at 30^0 to the horizontal and weighs 100 N, find how much of the weight each man supports?

b) A 1000 N cylinder is supported by a horizontal rod AB and a smooth uniform rod CD which weighs 500 N as shown in figure 2. Assuming the pins at A, B, C and D, to be frictionless and weight of AB negligible, find the reactions at C and D. [5+5]

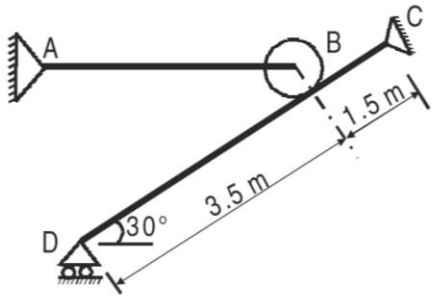

Figure: 2

OR

3.a) ABCD is a square, each side being 20 cm and E is the middle point of AB. Forces of 7, 8, 12, 5, 9 and 6 kN act on the lines of directions AB, EC, BC, BD, CA and DE respectively. Find the magnitude, direction and position of the resultant force.

b) Two smooth circular cylinders, each of weight W=1000N and radius 15 cm, are connected at their centres by a string AB of length = 40 cm and rest upon a horizontal plane, supporting above them a third cylinder of weight = 2000N and radius 15 cm as shown in the figure 3. Find the force S in the string AB and the pressure produced on the floor at the points of contact D and E. [5+5]

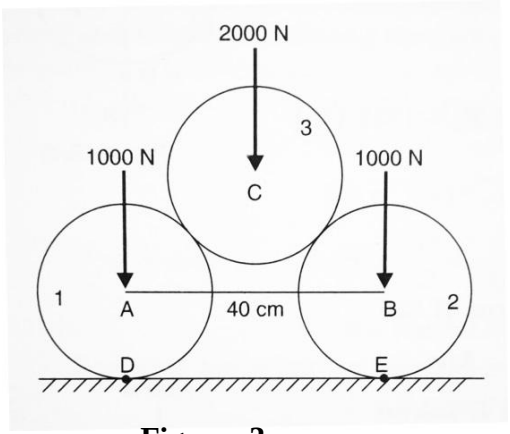

Figure: 3

4.a) Find the power required to run the pulley belt drive if
i) The differential tension is 2 kN.
ii) The maximum tension is 8 kN.

b) The level of precast beam weighing 20,000 N is to be adjusted by driving a wedge as shown in figure 4. If coefficient of friction between the wedge and pier is 0.35 and that between beam and the wedge is 0.25, determine the minimum force P required on the wedge to make adjustment of the beam. Angle of the wedge is 15^0. [5+5]

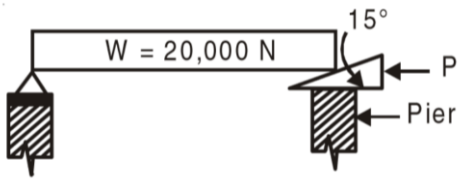

Figure: 4

OR

5.a) A cross belt drive is to transmit 7.5 KW at 1000 rpm of the smaller pulley. The diameter of the smallest pulley is 250mm and velocity ratio is 2. The centre distance between the pulley is 1250mm. A flat belt of thickness 6 mm and of coefficient friction 0.3 is used over the pulleys. Determine the necessary width of the belt if the maximum allowable stress in the belt is 1.75N/mm^2 and density of the belt is 1000Kg/m^3.

b) A ladder 6 m long and with 300N weight is resting against a wall at an angle of 60^0 to the ground. A man weighing 750N climbs the ladder. At what position along the ladder from the bottom does he induce slipping? The coefficient of friction for both the wall and the ground with the ladder is 0.2. [5+5]

6.a) Determine the coordinates x_c and y_c of the centre of a 100 mm diameter circular hole cut in a thin plate so that this point will be the centroid of the remaining shaded area shown in Figure 5. All dimensions are in mm.

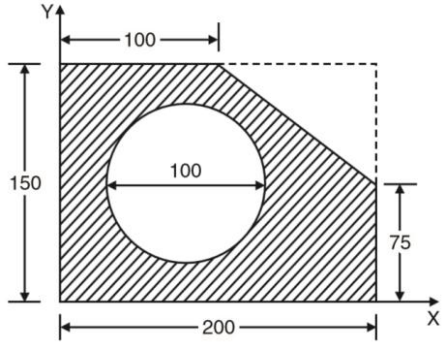

Figure: 5

b) Determine the moment of inertia of a T-section shown in the figure 6 about an axis passing through the centre of the section and perpendicular to the stem or vertical leg. [5+5]

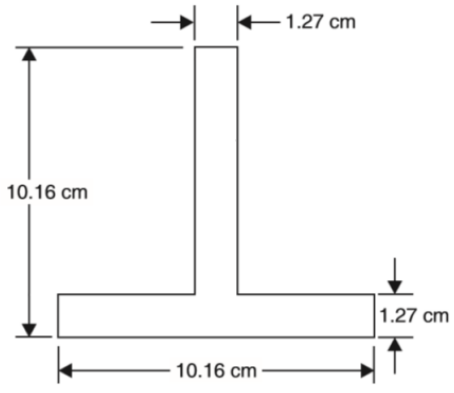

Figure: 6

OR

7. Find the position of the centre of gravity of the plane lamina in the form of a quarter of an ellipse, shown in the figure 7. [10]

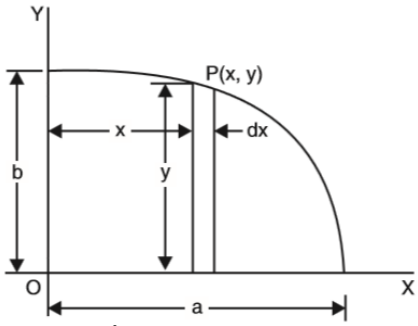

Figure: 7

8. The initial angular velocity of a rotating body is 2 rad/s and initial angular acceleration is zero. The rotation of the body is according to the relation $\alpha=3t^2-3$. Find:

a) Angular velocity and

b) Angular displacement when t = 5 seconds

Consider the angular displacement in radians and time in seconds. [5+5]

OR

9. The pulley shown in the figure 8 weighs 600 N and has a radius of 0.8 m. A rope passing over this pulley supports 800 N load at one end and 400 N at another end. Determine the tension in the string and the angular acceleration of the pulley if the blocks are allowed to move. [10]

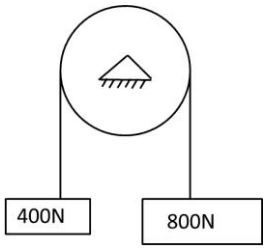

Figure: 8

10.a) The compound pendulum in the figure 9 consist of a slender rod 0.6 m long weighing 30 N to which is attached a solid circular disc of 0.3 m diameter that weighs 40 N. Compute the period of small oscillations.

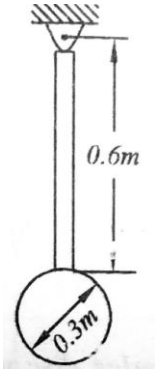

Figure: 9

b) A train weighing 10,000 kN is being pulled up a 2 percent grade. The train resistance is constant at constant rate from 6 mps to 12 mps in a distance of 300 m. Determine the pull exerted by the locomotive. [5+5]

OR

11.a) A pulley of radius 2m, weighing 150 N is mounted over an axle of diameter 0.25m. The friction between pulley and axle is constant at 50 N. It supports of a block A of weight 200 N and start from rest from the position shown in the figure 10. How many turns the pulley make before it stops, if block A dropped from a height of 1.2 m.

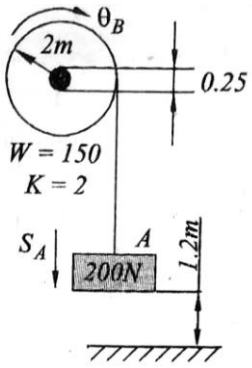

Figure: 10

b) A particle is moving with SHM. The frequency is 3 oscillation per sec and the amplitude is 375 mm. Calculate the maximum acceleration and the maximum velocity of the particle during the motion. [5+5]

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