Code No: 131AE

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech I Year I Semester Examinations, May - 2018
ENGINEERING MECHANICS
(Common to CE, EEE, ME, ECE, CSE, EIE, IT, MCT, ETM, MMT, AE, MIE, PTM, CEE, MSNT)

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)　Classify different types of system of forces.　　　　　　　　　　　　[2]

b)　The cable exerts a tension of 2 kN on the fixed bracket at A as shown in the figure 1. Write the vector expression for the tension T.　　　　　　[3]
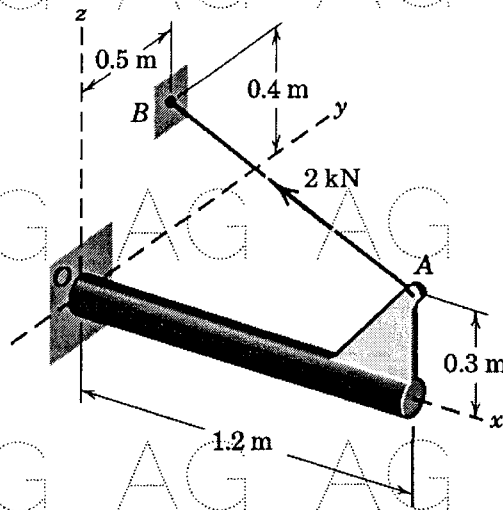

Figure: 1

c)　Define the terms *"coefficient of friction"* and *"angle of friction"*.　　[2]

d)　What is a wedge? Explain how the wedge is used to raise heavy loads.　[3]

e)　Write down the expression for the centroid of a quarter circle.　　　[2]

f)　State and prove Pappus theorem I.　　　　　　　　　　　　　　　　[3]

g)　Define mass moment of inertia of a body about an axis.　　　　　　[2]

h)　Determine the mass moment of inertia of a rectangular plate of size "a" × "b" and thickness "t" about its centroidal axes.　　　　　　　　　　　[3]

i)　State the D'Alembert's principle for a particle.　　　　　　　　　　[2]

j)　A force of 100 N acts on a body having a mass of 4 kg for 10 seconds. If the initial velocity of the body is 5 m/sec, determine the acceleration produced in the direction of force and distance moved by the body in 10 seconds.　　　　　　[3]

2. Three cylinders are placed in a rectangular ditch as shown in figure 2. Neglecting friction, determine the reaction between cylinder A and the vertical wall. Weights of cylinders A, B, C are 75 N, 200 N 100N and Radius is 100 mm, 150 mm, 125 mm respectively. [10]
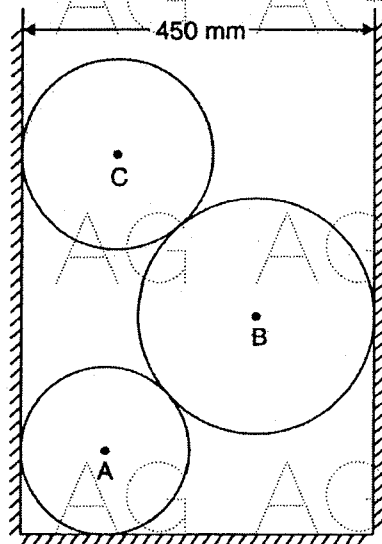

Figure: 2

OR

3.a) State and Prove Lami's Theorem.

b) A 75 N vertical force is applied to the end of a bar 3 m long which is attached to a shaft at O as shown in figure 3. Determine:
i) The moment of the 75 N force about O
ii) The magnitude of the horizontal force applied at A which creates the same moment about O
iii) The smallest force applied at A which creates the same moment about O
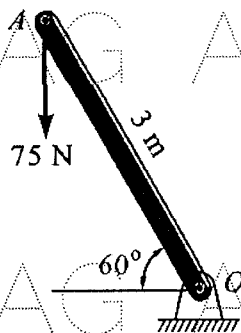iv) How far from the shaft at O a 200 N vertical force must act to create the same moment about O? [4+6]

Figure: 3

4. Two identical planes AC and BC, inclined at 60^0 and 30^0 to the horizontal meet at C as shown in figure 4. A load of 1000 N rests on the inclined plane BC and is tied by a rope passing over a pulley to a block weighing W Newton and resting on the plane AC. If the coefficient of friction between the load and the plane BC is 0.28 and that between the block and the plane AC is 0.20, find the least and greatest values of W for the equilibrium of the system. [10]
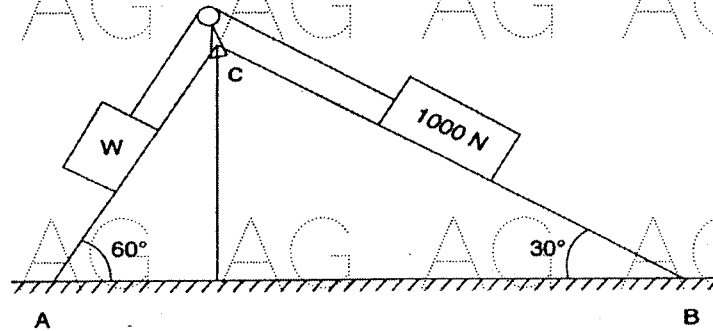

Figure: 4

OR

5.a) Determine the magnitude and direction of the friction force acting on the 100-kg block shown in the figure 5 if, first, P = 500 N and, second, P = 100 N are applied. The coefficient of static friction is 0.20, and the coefficient of kinetic friction is 0.17. The forces are applied with the block initially at rest.
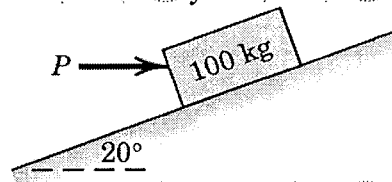

Figure: 5

b) A screw jack has square threads of mean diameter 10 cm and pitch is 1.25 cm. Determine the force that must be applied at the end of 50 cm long lever, to raise and to lower the weight of 50kN. Find the efficiency of screw jack and determine whether it is self-locking or not? (Assume μ=0.2) [5+5]

6. A corner of radius 20 mm is cut off from a square plate of 40 mm side as shown in the figure 6. Find the moment of inertia of the remaining plate about its axes of symmetry. [10]
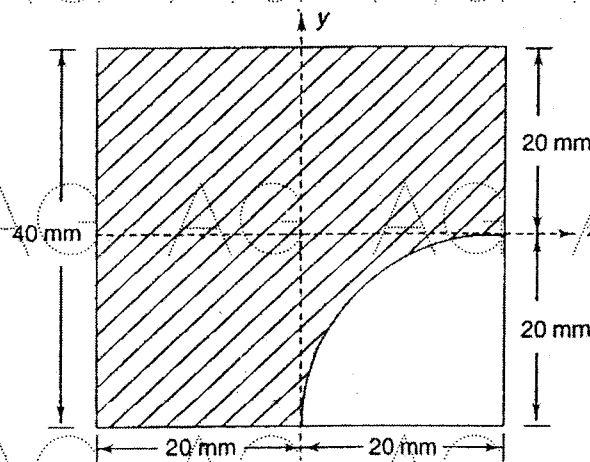

Square plate

Figure: 6

OR

7.a) With respect to the coordinate axes x and y, locate the centroid of the shaded area shown in the figure 7.
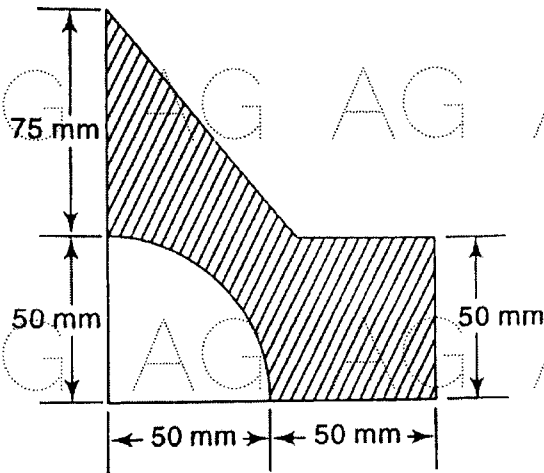

Figure: 7

b) A uniform wire is bent into the shape as shown in the figure 8. The straight segments lie in the X-Z plane and the line of 80 mm length makes an angle of 30^0 with the X-axis. The semi-circular segment is in the X-Y plane. Locate the centroid of the wire. [5+5]
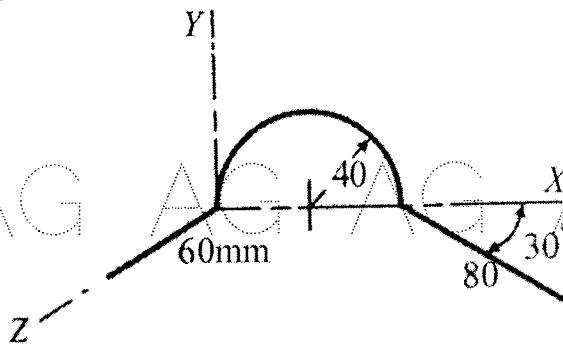

Figure: 8

8.a) Determine the mass moment of inertia of a uniform ring having radius 'R' and thickness 't'.

b) Determine the mass moment of inertia of a solid cone of height 'h' and base radius 'r' about its axis of rotation. [5+5]

OR

9. A right circular cone made of steel has a height of 500 mm and a base diameter of 600 mm. A hole 150 mm deep and 200 mm diameter is drilled from the centre of the base of the cone and filled with lead. Lead weighs 11400 kg/m^3 and steel weighs 7860 kg/m^3. Determine the mass moment of inertia of the resulting solid with respect to its geometrical axis. [10]

10.a) An engine of mass 50 tonnes pulls a train of mass of 250 tonnes up a gradient of 1 in 125 with a uniform speed of 36 kmph. Find the power transmitted by the engine, if the tractive resistance is 60 Newton per tonnes. Also find the power transmitted by the engine, if the acceleration of the engine is 0.2 m/s^2 up the gradient.

b) Two bodies A and B of mass 80 kg and 20 kg are connected by a thread and move along a rough horizontal plane under the action of a force 400 N applied to the first body of mass 80 kg as shown in Figure 9. The coefficient of friction between the sliding surfaces of the bodies and the plane is 0.3. Determine the acceleration of the two bodies and the tension in the thread, using D' Alembert's principle. [5+5]
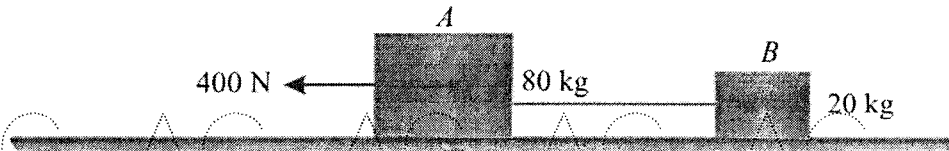

400 N A 80 kg   B 20 kg

Figure: 9

OR

11.a) The coil spring has a spring modulus k = 200N/mm. How much work must be done to compress it the first 30 mm from its free length and additional 20 mm from 30 to 50 mm.

b) Two blocks weighing 100 N and 40 N are supported at the ends of a rope of negligible weight which is passing over a rough surface of pulley mounted on the horizontal axis. The pulley may be assumed as a solid disc with a weight of 50 N. Find the tension in two ropes and linear acceleration of the blocks. [4+6]

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