Subject Code: R13210/R13 **Set No - 1**

I B. Tech II Semester Regular/Supplementary Examinations May - 2016

ENGINEERING MECHANICS

(Common to ECE, EEE, EIE, Bio-Tech., E Com E, Agri E)

Time: 3 hours **Max. Marks: 70**

Question Paper Consists of **Part-A** and **Part-B**
Answering the question in **Part-A** is Compulsory,
Three Questions should be answered from **Part-B**

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PART-A

1. (a) What is meant by angle of repose? Explain.
   (b) State and prove Lami's theorem.
   (c) Describe the various methods of finding out the centre of gravity of a body.
   (d) Derive the equation for moment of inertia of a rectangular section about centroidal axis.
   (e) What do you understand by the term 'relative velocity'? Explain.
   (f) Explain the concept of work-energy for a rigid body.

[3+3+4+4+4+4]

PART–B

2. (a) Explain the different types of friction.
   (b) An automobile is pulled by means of trucks as shown in Figure.1 below. If the resultant of the two forces acting on the automobile is 25 kN being directed along the positive direction of X-axis, determine the angle of the cable attached to the track at B such that the force F_B in this cable is minimum. What is the magnitude of force in each cable when this occurs?

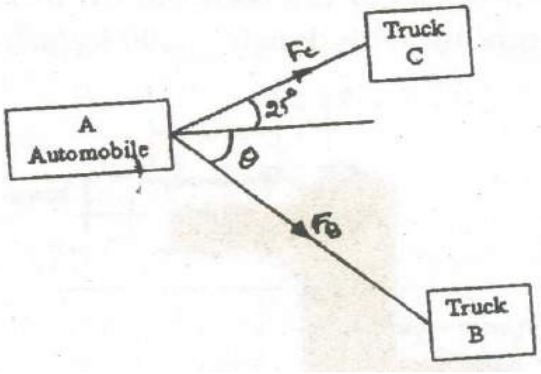

Figure.1

[8+8]

3. (a) Find the reactions developed at supports A and B of the loaded beam shown in Figure 2.

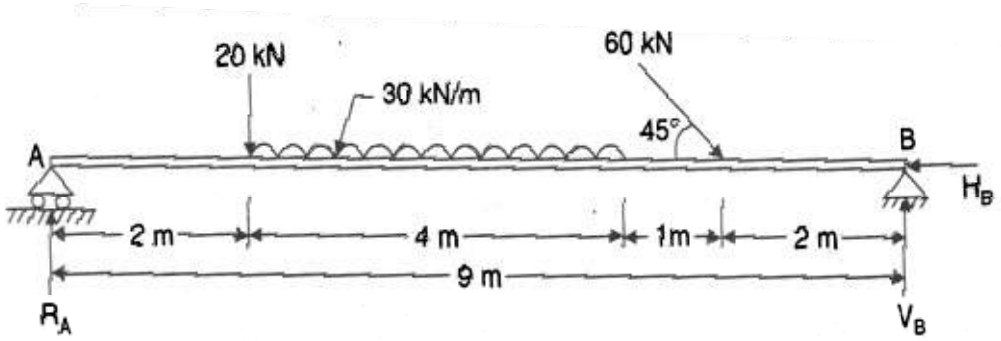

Figure.2

(b) A post is held vertical in position by three cables AB, AC and AD as shown in Figure.3 below. If tension in cable AB is 40N, calculate the required tension in AC and AD so that the resultant of three forces applied at A is vertical.

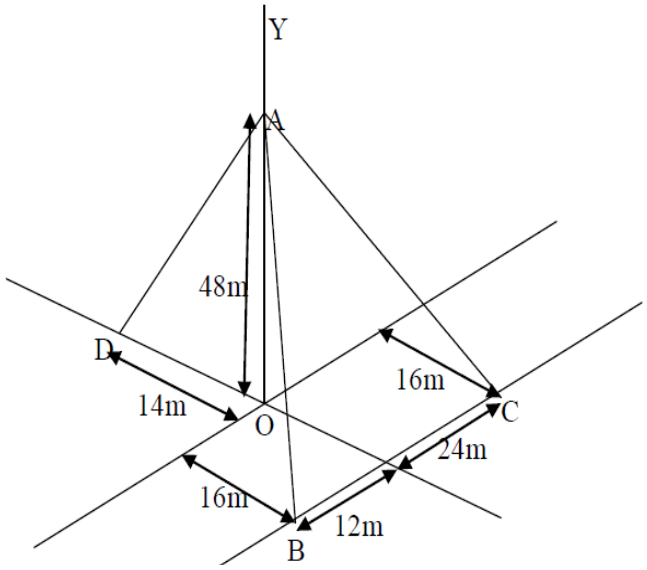

Figure.3

[7+9]

4. (a) A hemisphere of 60 mm diameter is placed on the top of cylinder having equal diameter. Find the common Centre of gravity of the body from the base height of cylinder 30 mm.

(b) Locate the centroid of a right angled triangular section with base 'b' and height 'h' by the method of integration.

[10+6]

5. (a) State and prove parallel axis theorem.
   (b) Find the moment of inertia of shaded area shown in Figure.4 below about centroidal axes.

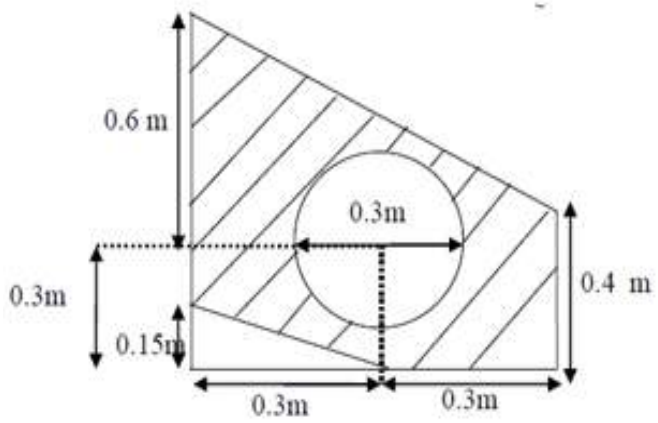

Figure.4

[6+10]

6. (a) A bullet of mass 80 gm and moving with a velocity of 200 m/s is fired into a log of wood and it penetrates to a depth of 8 cm. If the bullet moving with the same velocity were fired into a similar piece of wood 5 cm thick, with what velocity would it merge? Also find the force of resistance assuming it to be uniform.
   (b) A system of friction less pulleys carries two weights hung by chords as Figure.5 shown below. Find the tension in the chords and acceleration of the system.

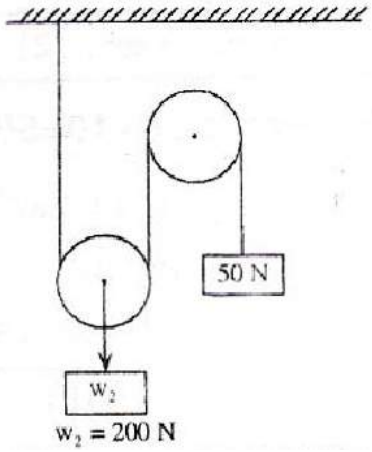

Figure.5

[8+8]

7. (a) A pile of mass 100 N is driven 12 cm into the ground by every blow of the pile driver of 20 N mass which is dropped through 2 m, before reaching the pile find out
   (i) Kinetic energy lost in each blow of the pile driver
   (ii) Resistance offered by the ground to the pile.
   (b) Determine the time required for the weights shown in Figure 6 to attain a velocity of 9.81 m/sec. What is the tension in the chord? Take = 0.2 for both planes. Assume the pulleys as frictionless.

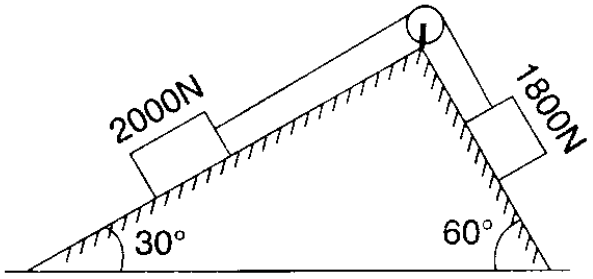

Figure 6

[9+7]

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Subject Code: R13210/R13 **Set No - 2**

I B. Tech II Semester Regular/Supplementary Examinations May - 2016

ENGINEERING MECHANICS

(Common to ECE, EEE, EIE, Bio-Tech., E Com E, Agri E)

Time: 3 hours **Max. Marks: 70**

Question Paper Consists of **Part-A** and **Part-B**
Answering the question in **Part-A** is Compulsory,
Three Questions should be answered from **Part-B**

*****

PART-A

1. (a) What do you understand by the term parallel forces? Discuss their classification.
   (b) Discuss the various types of equilibrium.
   (c) What is the importance of Pappu's theorems? Explain.
   (d) Derive the equation for moment of inertia of a hollow rectangular section about centroidal axis.
   (e) A projectile is fired with a velocity of 100 m/s at an elevation of 60^0. Find its velocity and direction after 10 seconds of firing.
   (f) Explain the principles of conservation of energy and conservation of momentum with simple examples.

[4+3+3+4+4+4]

PART–B

2. (a) Two rollers of same diameters are supported by an inclined plane and a vertical wall as Figure.1 shown below. The upper and the lower rollers are respectively 250N and 300N in weight. Assuming smooth surfaces, find the reactions induced at the points of support A, B, C and D.

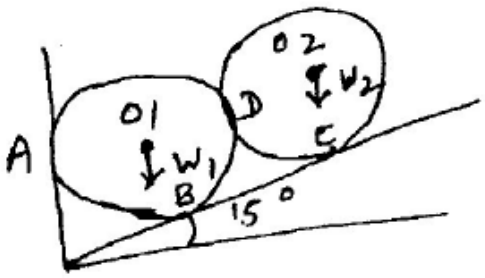

Figure.1

2. (b) If the coefficient of the friction between all surfaces is 0.3. What is the horizontal force required to get the 300 kg block shown in Figure.2 below moving to the right?

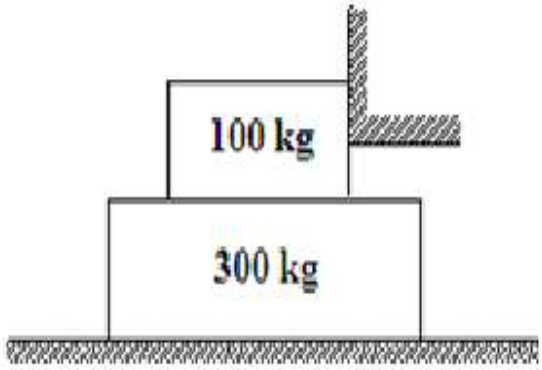

Figure.2

[9+7]

3. (a) Determine reactions developed at supports in the beam shown in Figure 3.

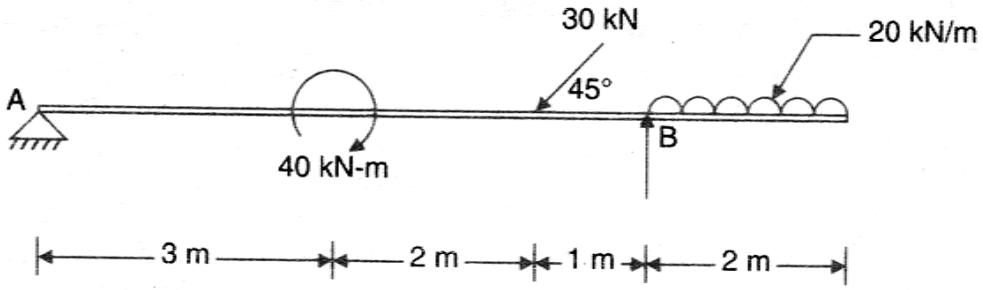

Figure.3

(b) Four forces of magnitudes 20N, 40N, 60N, and 80N are acting respectively along the four sides of a square ABCD of side 2m as shown in Figure 4. Determine the resultant moment about the point A.

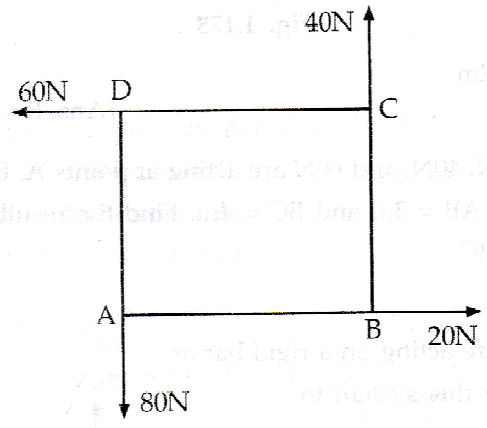

Figure 4

[10+6]

4. (a) Find the centre of gravity of the section shown Figure.5 below about XX and YY axis.

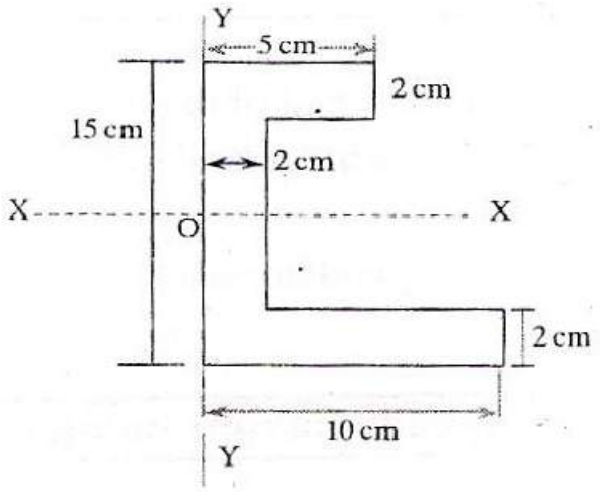

Figure.5

(b) Determine the centroid of a parabolic spandrel $y = k x^2$.

[8+8]

5. (a) Find moment of inertia of the following section shown in Figure 6 about X and Y axes. All dimensions are in cm.

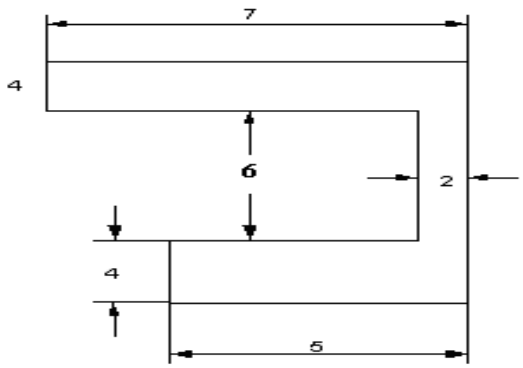

Figure.6

5. (b) Calculate the moment of inertia of shaded region about the horizontal axis AA shown in Figure 7.

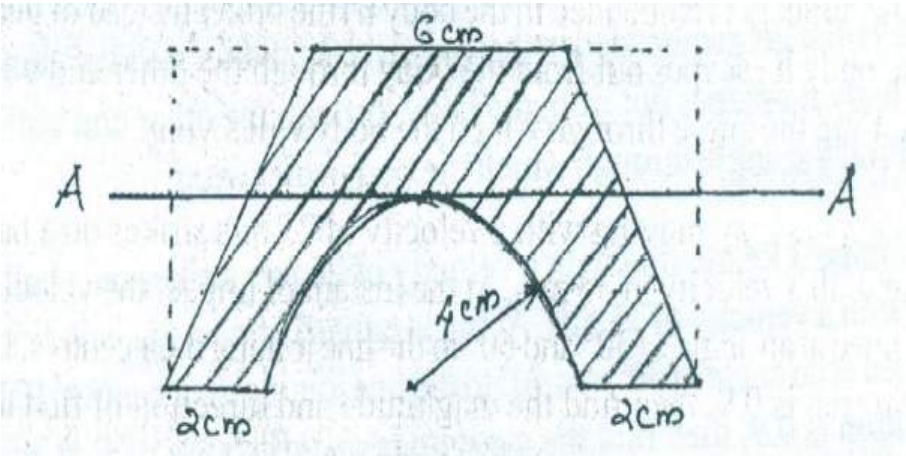

Figure 7

[7+9]

6. (a) A police officer observes a motorist who is approaching at a uniform speed of 80kmph. He, in his patrol car, starts chasing it as it just crosses him. After accelerating for 8seconds at a constant rate, he attains his top speed of 120kmph. How long does it take to overtake the motorist and at what distance?

   (b) For the system shown in Figure 8, find the acceleration of the block 'P' of weight 44.48 N, if the coefficient of friction between the block 'Q' of weight 53.38 N and the horizontal plane on which it slides is 1/3. Neglect inertia of the pulley and friction on its axle.

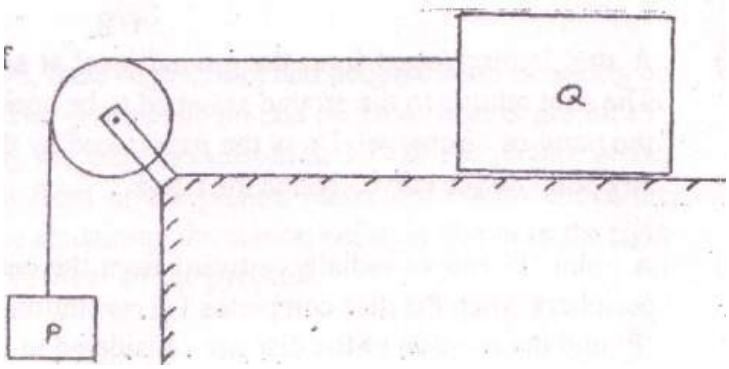

Figure 8

[8+8]

7. (a) A block of mass 8 kg is dragged up an inclined plane by a rope inclined at 15^0 to the plane while the plane is inclined at 30^0 to the horizontal. Find the velocity of the block after 4 seconds if dragged from rest. Take the coefficient of kinetic friction between the block and the plane as 0.2. Also assume that a force of 100 N is applied through the rope for dragging the block upwards the plane. Apply impulse momentum equation.

   (b) Derive work energy equation and impulse momentum equation for linear motion of a rigid body. [10+6]

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Subject Code: R13210/R13 **Set No - 3**

I B. Tech II Semester Regular/Supplementary Examinations May - 2016

ENGINEERING MECHANICS

(Common to ECE, EEE, EIE, Bio-Tech., E Com E, Agri E)

Time: 3 hours **Max. Marks: 70**

Question Paper Consists of **Part-A** and **Part-B**
Answering the question in **Part-A** is Compulsory,
Three Questions should be answered from **Part-B**

*****

PART-A

1. (a) State and explain Varignon's principle of moments.
   (b) How would you find out the equilibrium of non-coplanar forces?
   (c) Differentiate centroid and center of gravity.
   (d) Derive the equation for moment of inertia of a circular section about centroidal axis.
   (e) Explain the kinetics of a rigid body when it is in plane motion.
   (f) Explain the principle of impulse momentum for rigid bodies.

[4+3+4+4+3+4]

PART–B

2. (a) A block of weight W_1 = 1350 N rests on a horizontal surface and supports another block of weight W_2 =750 N on top of it as shown in Figure 1. Block of weight W_2 is attached to a vertical wall by an inclined string AB. Find the force 'P' applied to the lower block, that will be necessary to cause the slipping to impend. Coefficient of friction between blocks 1 and 2 = 0.25 and coefficient of friction between block 1 and horizontal surface = 0.4.

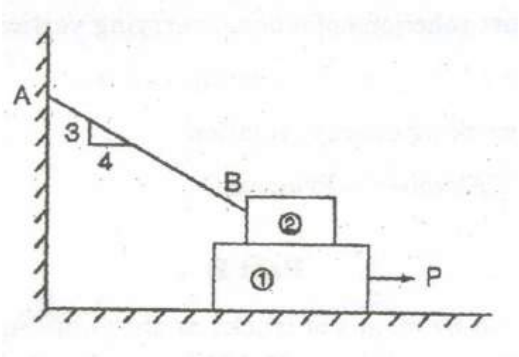

Figure 1

2. (b) A string ABCD attached to two fixed points A and D has two equal weights of 500N attached to it at B and C the weights rest with the portion AB and CD inclined at angles of 45˚and 50˚respectively to the vertical as shown in the Figure.2 below. Find all the forces acting in the string.

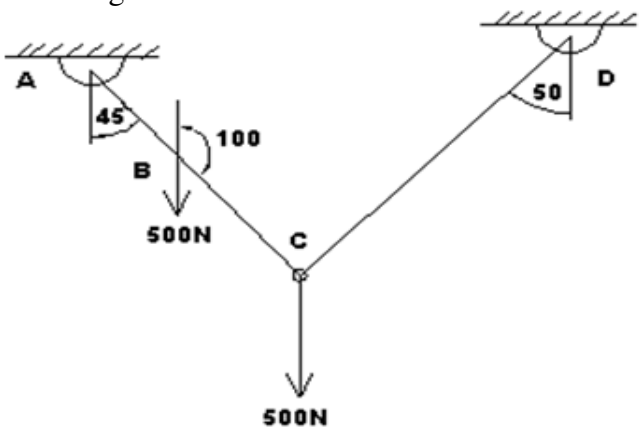

Figure 2

[9+7]

3. (a) Determine the support reactions in the Figure 3 below.

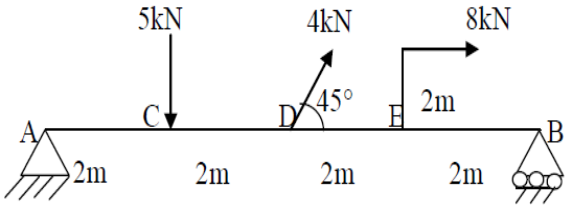

Figure 3

(b) Three forces 200N, 500 N and 600 N are acting along the three diagonals of adjacent faces of a cube of side 2 m as shown in Figure 4. Determine the resultant of forces.

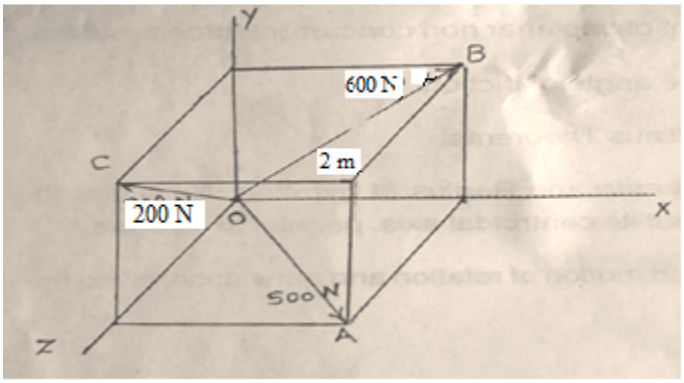

Figure 4

[8+8]

4. (a) A solid body is formed by joining the base of a right circular cone of height 12 cm to the equal base of right circular cylinder of height 4 cm. Calculate the distance of centre of mass of the solid from its bottom.
   (b) Find the location of centroid of I section shown in Figure 5 below.

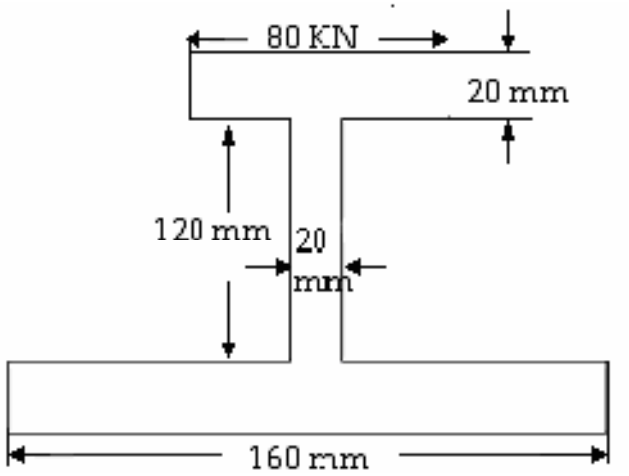

Figure 5

[10+6]

5. (a) Find the moment of inertia of the Figure 6 below, section about horizontal and vertical axis through the centroid.

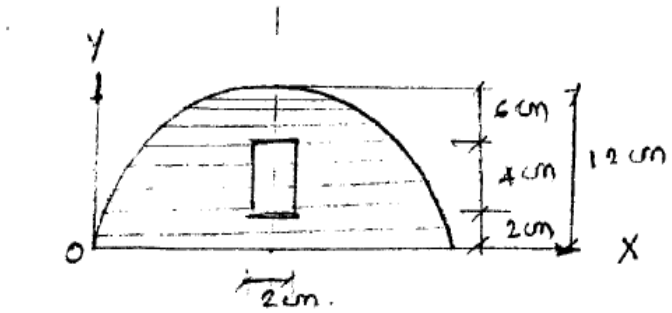

Figure 6

   (b) Determine the moments of inertia about X axis of a T section of flange 100mm x 80 mm and Web 20 mm x 80 mm about its centroidal axis.

[9+7]

6. (a) A vehicle covers a distance of 500 m in 35 seconds with a constant acceleration of 0.6 m/sec^2. Determine
   (i) Initial velocity
   (ii) Final velocity
   (iii) The distance traveled during the first 5 second.
   (b) A homogeneous sphere of mass m_1 and radius r_1 and a homogeneous cylinder of mass m_2 and radius r_2 roll along an incline without slipping. They start from rest at the top and reach the bottom at different times, which of the two reaches the bottom earlier?

[8+8]

7. Two light vehicles weighing W_1 = 1000N and W_2 = 500 N are connected by flexible cables but inextensible string passing round a pulley and are free to roll on a inclined plane as shown in Figure 7 below. If the vehicles are released from rest in the position shown, find the interval of time required for them to exchange the positions. Rolling resistant and friction in the pulley may be neglected take g = 9.80 m/sec^2.

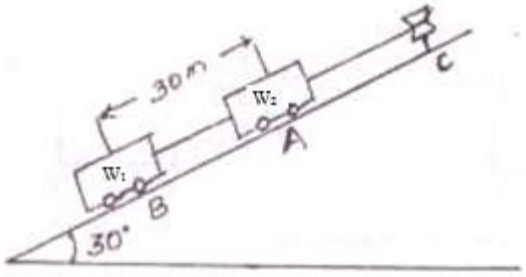

Figure 7

[16]

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Subject Code: R13210/R13 **Set No - 4**

I B. Tech II Semester Regular/Supplementary Examinations May - 2016

ENGINEERING MECHANICS

(Common to ECE, EEE, EIE, Bio-Tech., E Com E, Agri E)

Time: 3 hours **Max. Marks: 70**

Question Paper Consists of **Part-A** and **Part-B**
Answering the question in **Part-A** is Compulsory,
Three Questions should be answered from **Part-B**

*****

PART-A

1. (a) Differentiate between moment and a couple.
   (b) Enunciate any two principles of equilibrium.
   (c) Define Pappu's Theorems.
   (d) Derive the equation for moment of inertia of a hollow circular section about centroidal axis.
   (e) A bullet is fired with a velocity of 100 m/s at an angle of 45^0 with the horizontal. How high the bullet will rise?
   (f) Explain the terms 'work' and 'energy'.

[3+4+4+4+4+3]

PART–B

2. (a) The bar AC, 10 m long supports a load of 6000 N as shown in Figure 1 below The cable BC is horizontal and 5 m long. Determine the forces in the cable and the bar.

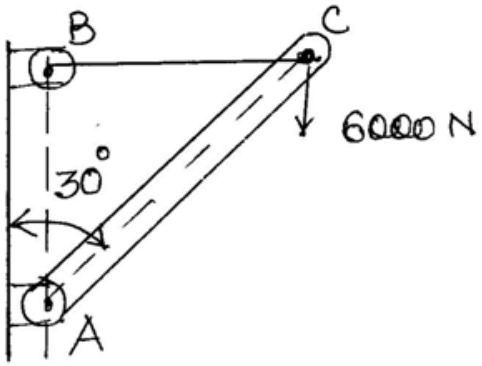

Figure 1

2. (b) An inclined plank as shown in Figure 2 below is used to unload a container weighing 4 kN from a truck 1.5 m high. Calculate the coefficient of friction between the container and the plank.

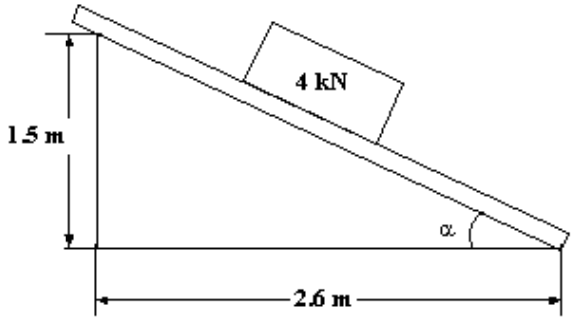

Figure 2

[8+8]

3. (a) If the tension in wire 'AB' is 75 kN, determine the required values of tensions in 'AC' and 'AD', so that the resultant of the three forces applied at 'A' is vertical as shown in Figure 3 below. Find also the resultant.

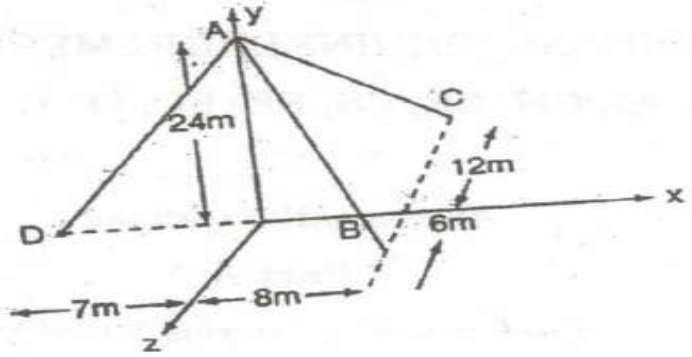

Figure 3

(b) Determine the reactions at supports A and B of the overhanging beam shown in Figure 4.

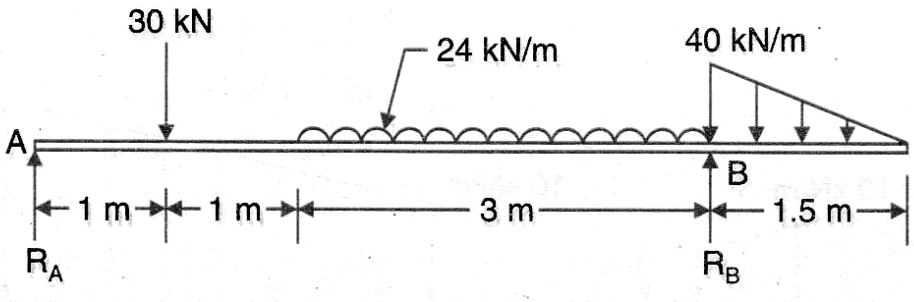

Figure 4

[9+7]

4. (a) Locate the centroid of a semi-circular section with radius 'r' by the method of integration.
   (b) Locate the centroid of the given composite area as shown in Figure 5 below.

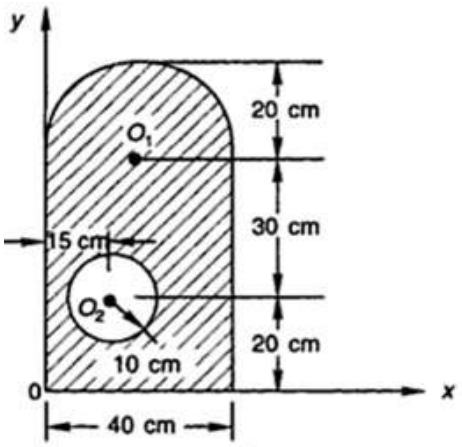

Figure 5

[6+10]

5. Find the mass moment of inertia of the body shown in Figure 6 below with respect to X and Yaxis. The body is made of aluminium with density 2800kg/m^3.

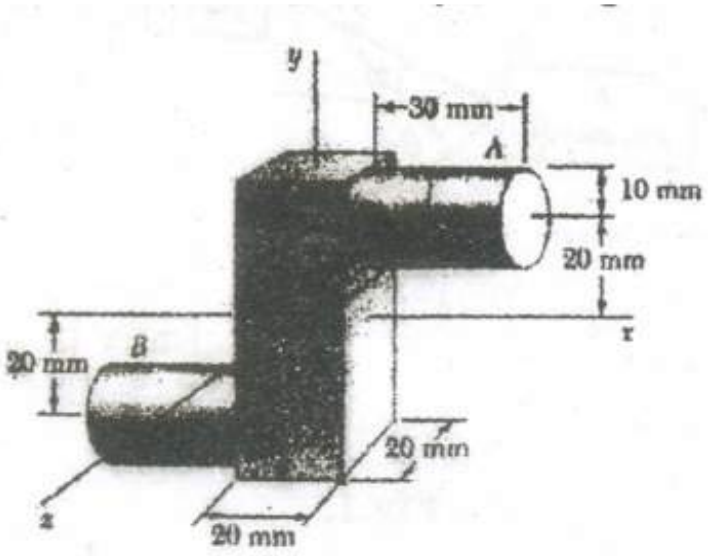

Figure 6

[16]

6. (a) Five men lined up at one end of a floating raft, initially at rest, run in succession with a velocity of 3.05 m/s relative to the raft and dive off at the far end. Neglecting resistance of the water to horizontal motion of the raft, find its velocity after the last man dives. Each man weighs 756 N and the raft weighs 4448N.
   (b) Two weights 80N and 20N are connected by a thread and move along a rough horizontal plane under the action of 40N applied to first weight of 80N.The coefficient of friction between the sliding surfaces of the weights and the plane is 0.3.Determine the acceleration of the weights and the tension in the thread.

[8+8]

7. (a) Explain Kinetic energy of a rigid body in plane motion.
   (b) A body weighing 196.2 N slides up a 30^0 inclined plane under the action of an applied force 300 N acting parallel to the inclined plane. The coefficient of friction is 0.2. The body moves from rest. Determine
   (i) Acceleration of the body
   (ii) Kinetic energy of the body after 4 seconds
   (iii) Work done on the body in 4 seconds
   (iv) Impulse applied in 4 seconds

[6+10]

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