Code No: R21031 **R10** SET - 1

II B. Tech I Semester, Regular Examinations, Nov – 2012
ENGINEERING MECHANICS
(Com to ME, AE, AME, MM)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
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1. a) State and prove Lame's theorem
   b) Three smooth cylinders, each of diameter *d* and weight W are placed in a rectangular channel of width 5times radius of cylinders as shown in Figure1. Determine the reactions at all contact surfaces.

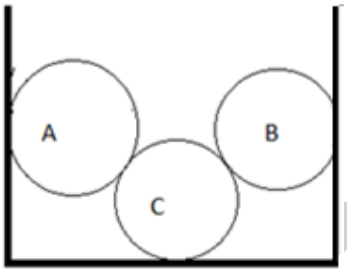

Figure 1

2. a) State parallelogram law of forces.
   b) Determine the resultant of coplanar parallel system shown in Fig.2. All dimensions are in mm. The loads are W_1=10kN,W_2=20kN, W_3=30kN and W_4=40kN

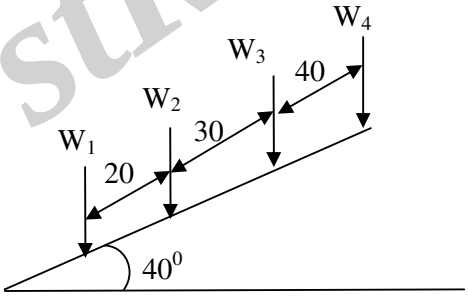

Figure 2.

3. a) State and prove theorems of Pappus.
   b) Determine the centroid of composite section shown in Figure 3.

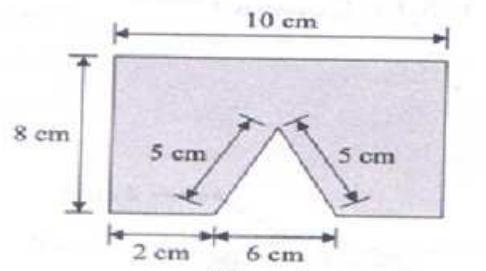

Figure 3
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4. Calculate the moment of inertia of the section about an axis parallel to the base of it and passing through its centre of gravity (refer Figure 4).

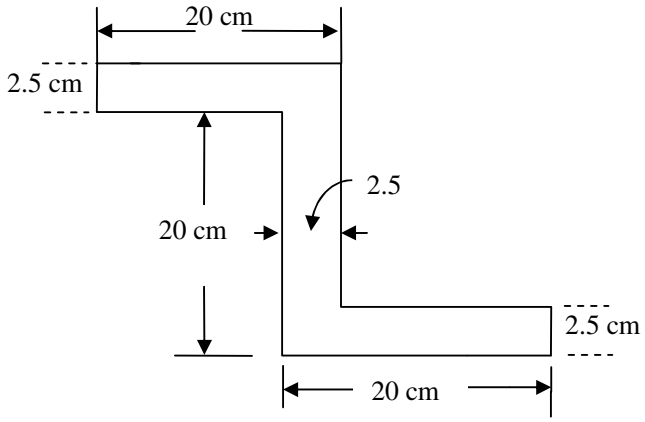

Figure 4

5. a) Enumerate the assumptions made while finding the forces in a frame
b) Determine the forces in all members of the frame in Figure 5 by the method of sections and tabulate the results.

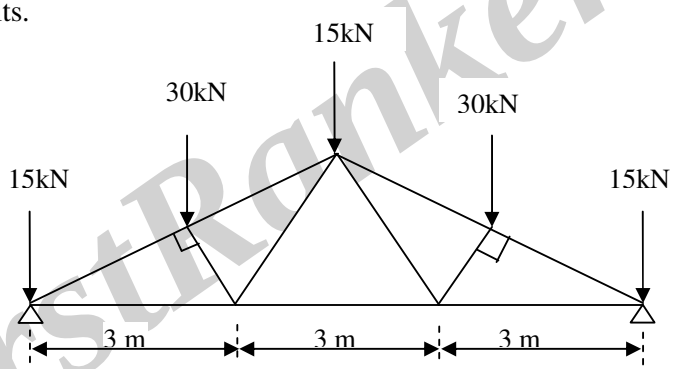

Figure 5

6. A bullet travelling horizontally with a velocity of 600m/sec and weighing .25N strikes a wooden block of weight 50N resting on a rough horizontal floor. The coefficient of friction between the floor and the block is 0.5. Find the distance through which the block is displaced from the initial position.

7. a) What is the energy of motion for a rigid body rotating about a fixed axis?
b) A 70kg sprinter starts from rest and accelerate uniformly for 5.8s over a distance of 34.5m. Neglecting air resistance, determine the average power developed by the sprinter.

8. a) Explain the following: coefficient friction
b) An effort of 1500N is required to just move a certain body up an inclined plane of angle 12^0, force acting parallel to the plane. If the angle of inclination is increased to 18^0, then the effort required is 1800N. Find the weight of the body and the coefficient of friction.

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1. Two smooth spheres each of radius 100mm and weight 100N rest in a horizontal channel having vertical walls, the distance between which is 360 mm as shown in Fig.1. Find the reactions at the point of contacts A, B, C and D of the spheres.

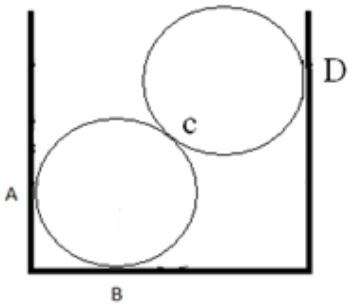

Figure 1

2. a) State and explain equations of equilibrium.
b) Determine the reactions at A & B of the overhanging beam as shown in Figure 2.

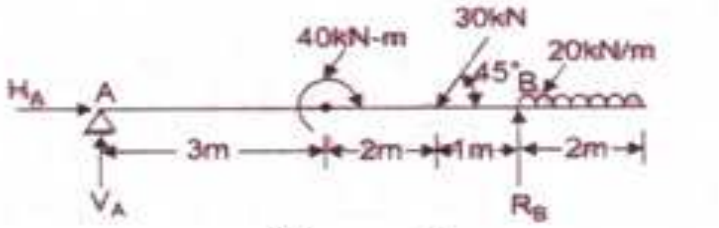

Figure 2
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Code No: R21031 **R10** SET - 2

3. a) State the Lami's theorem.
   b) Determine the centroid of composite section shown in Figure 3.

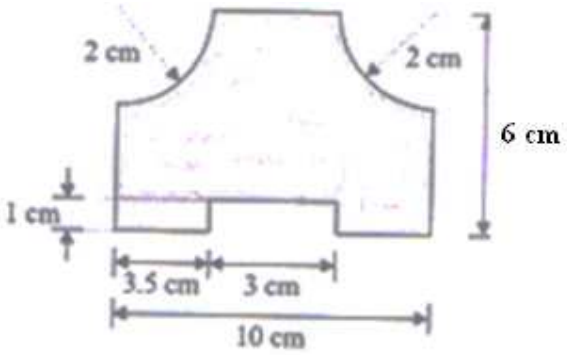

Figure 3

4. Calculate the moment of inertia of T section about an axis parallel to the base of the T and passing through its centre of gravity (refer Fig.4).

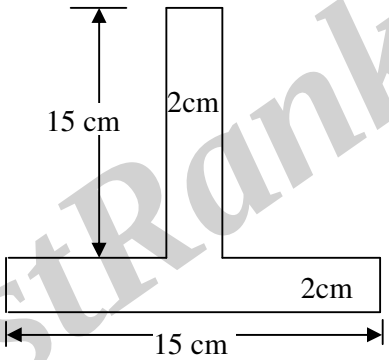

Figure 4

5. a) Explain different types of frames.
   b) Determine the forces in all members of the frame in fig.5 by the method of sections and tabulate the results.

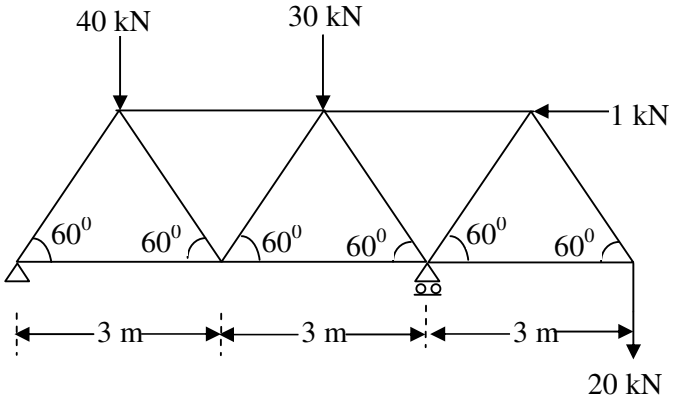

Figure 5

Code No: R21031 **R10** SET - 2

6. a) A stone is dropped from a tall tower of height 180m at the same another one is projected from the foot of the tower with a velocity of 44m/sec. determine when and where the two meet?
b) A stone is projected so as to just pass over a wall 60m high at a distance of 6m from the point of projection. What is the angle of projectiopn if the velocity of projection is 40m/sec. neglect air resistance.

7. A man of mass 75 kg and a boy of mass 25 kg dive off the end of the boat of the mass 20 kg so that their relative horizontal velocity with respect to the boat is 3m/s. If initially the boat is at rest find its final velocity if a) the two dive off simultaneously b) the man dives first followed by the boy.

8. a) Explain the following: limiting friction and impending friction
b) A turn buckle used to join two compartments (turn buckle have left start thread on one side and right start threads on other side). Its thread pitch is 12mm and mean diameter 40mm. the coefficient of friction between the nut and thread is 0.18. Determine the work done in drawing the compartments together a distance of 240mm against a steady load of 2500N. If load is doubled for the same distance, what is the work done ?

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1. A corner plate ABC is hinged to a fixed support at A and rests on a roller at C. If a force of W is acting at D as shown in Figure 1, find the reactions at the support.

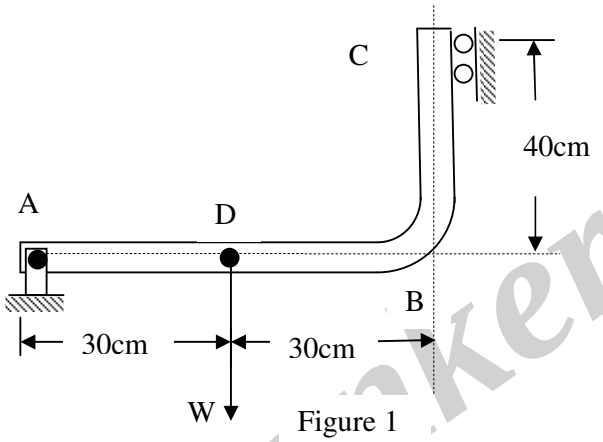

Figure 1

2. a) Explain the method of resolution of forces.
b) A system of forces acting on a body is shown in Figure 2. Determine the resultant. Slope for quadrant 1 force is 1/2 and for second quadrant force is 4/3.

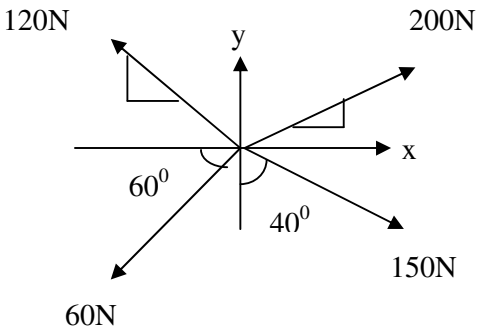

Figure 2
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Code No: R21031 **R10** SET - 3

3. a) State the theorems of Pappus.

   b) Determine the centroid of composite section shown in Figure 3.

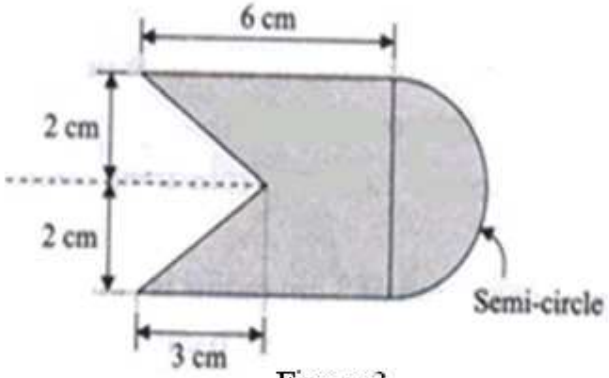

Figure 3

4. Calculate the moment of inertia of the section shown in the Figure 4 about an axis parallel to the base of the section and passing through its centre of gravity

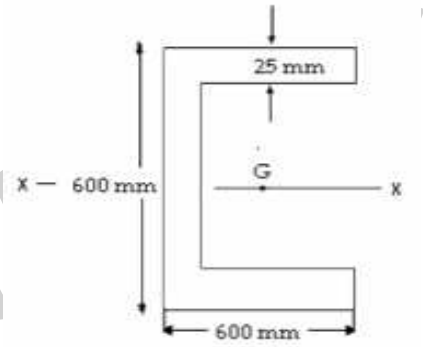

Figure 4

5. Determine the forces in all members of the frame in figure 5 by the method of joints and tabulate the results

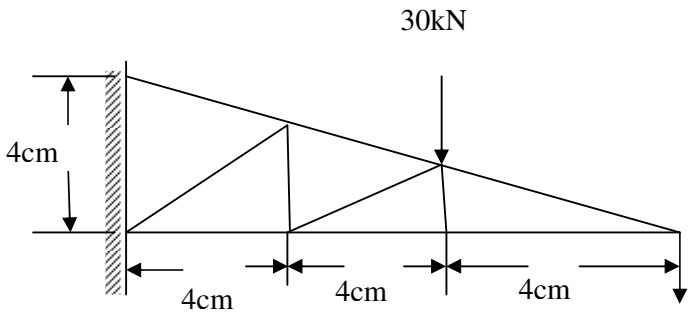

Figure 5

Code No: R21031 **R10** SET - 3

6. a) A fire brigade man wants to extinguish a fire at a height of 6m above the nozzle standing at a distance of 5m away from the fire. Find i) the minimum velocity of the nozzle discharge required. ii) Velocity of discharge if the fireman could extinguish with angle of projection of 60^0.

7. A tram car weighs 120kN, the tractive resistance being 5N/kN. What is the power required to propel the car at a uniform speed of 20kmph?
   i) On level surface ii) up an incline of 1 in 300 and iii) down an inclination of 1 in 300.

8. a) Explain Coulomb's laws of friction
   b) Determine the force required to move a load of 240N up a rough plane. The force is applied parallel to the plane. The inclination of the plane is such that a force of 60N inclined at 30^0 to a similar smooth plane would keep the same load in equilibrium. Coefficient of friction is 0.03.

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1. a) Explain moment of forces and its applications.
b) Two equal loads of 2500N are supported by a flexible string ABCD at points B and C as shown in Fig.1.Find the tensions in the portions AB, BC and CD of the string.

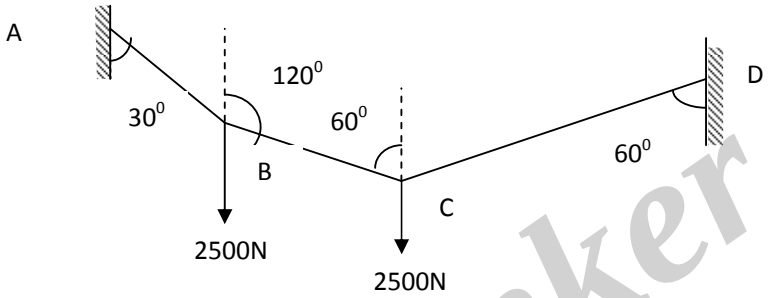

Figure 1

2. a) State Lami's theorem.
b) A body is subjected to the three forces as shown in Fig.2. If possible determine the direction of the force F so that the resultant is in x-direction., when (i) F= 5000N and (ii) F= 3000N.

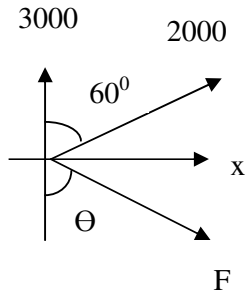

Figure 2
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Code No: R21031 **R10** SET - 4

3. a) What are the differences between centroid and centre of gravity?
   b) Determine the centroid of composite section shown in Figure 3.

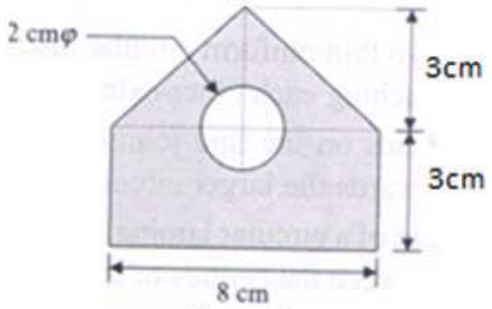

Figure 3

4. Calculate the moment of inertia of L section about an axis parallel to the base of the L and passing through its centre of gravity (refer Figure 4). Thickness of the section is 2cm. All dimensions are in cm.

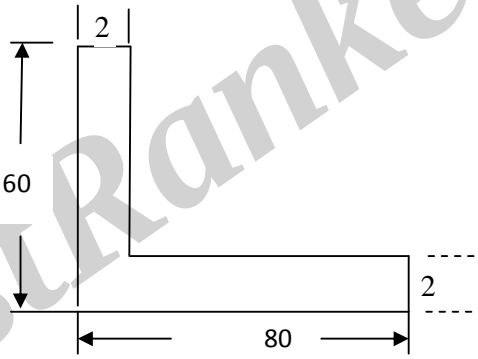

Figure 4

5. Determine the axial forces in all members of the frame in Fig.5 by the method of joints and tabulate the results

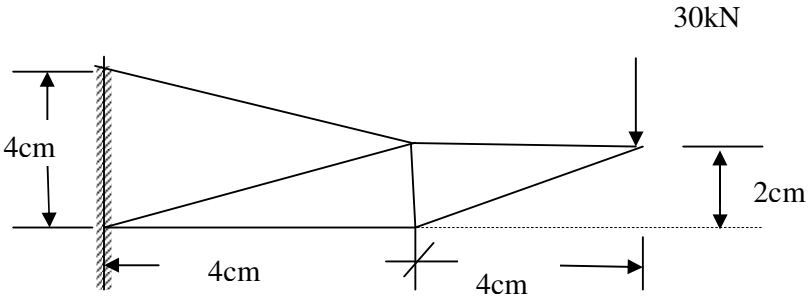

Figure 5

Code No: R21031 **R10** SET - 4

6. a) Distinguish between kinematics and kinetics.
   b) A body of 3kg mass is suspended by an inextensible string of length 1m. it is rotated in a circular path of 0.5 m radius. Determine the tension in the string and the constant speed of the body.

7. a) State the work – energy principle.
   b) In the world records, a man pulled a Boeing 747-400 weighing 187 tons, a distance of 91m in 1min 27.7sec. If the force of friction is 1kN/ton then determine the work done by the man and power exerted by him, if he maintained constant speed during this operation.

8. Derive an expression for the efficiency of a screw jack with square threads on its screw for lifting a load. Deduce the condition for maximum efficiency.