SEM 1 – 3 (RC 2016-17)

F.E. (Semester – I) (RC 2016-2017) Examination, November/December 2016

ENGINEERING MECHANICS (New)

Duration : 3 Hours | Total Marks : 100

Instructions *: 1) Attempting* ***one*** *question from the Part –* ***C*** *is* ***compulsory.***

2) Assume ***any*** *data* ***if required*** *and state them* ***clearly.***

PART – A

Answer **any two** of the following :

1. a) A vertical pole is anchored to a concrete block. Three cables are attached to the pole as shown. If the reactions at "A" are as shown, determine the tensions in the three cables. **10**

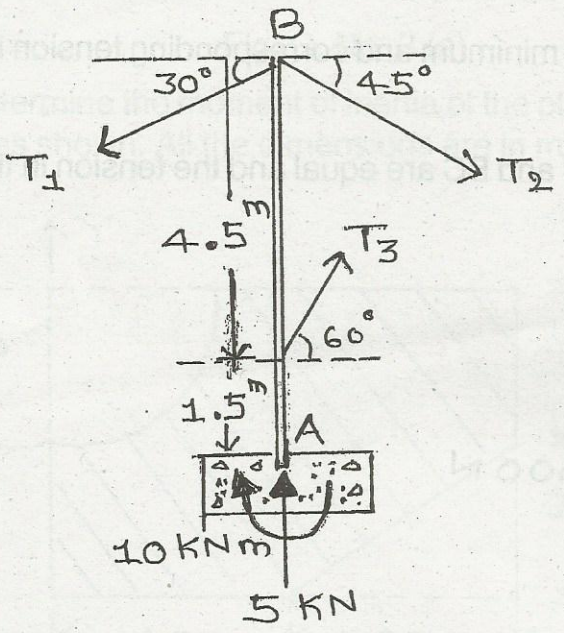

Fig. Q. No. 1 (a)

b) Determine the position of centroid of shaded area with respect to axes shown. All the dimensions are in mms. 10

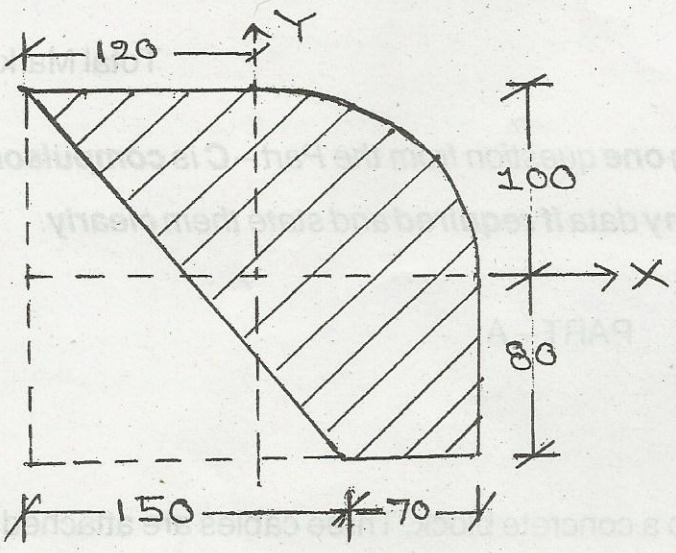

Fig. Q. No. 1 (b)

2. a) Determine the value of angle "α" for which

i) the tension in the cable BC is minimum and corresponding tension in the cable.

ii) the tensions in the cables AC and BC are equal and the tension in the cable. 10

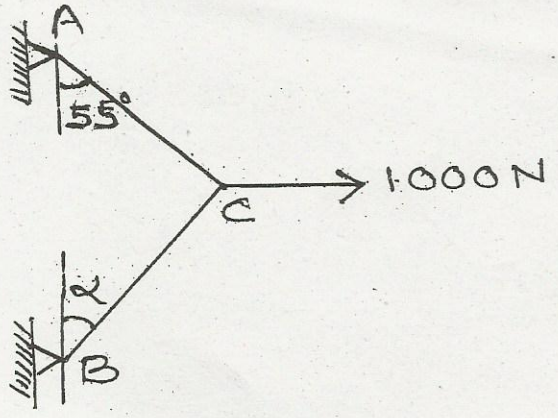

Fig. Q. No. 2 (a)

b) Derive an expression for mass moment of inertia of a right circular cone about its axis.

Assume :

R = Radius at the base of cone

H = Height of the cone

M = Mass of the cone. **10**

3. a) Two beams AC and CD are hinged at "C". Determine the reaction at "B" using the principle of virtual work.

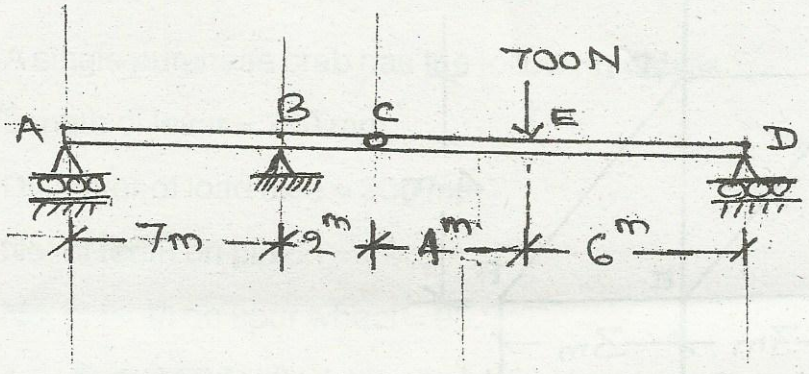

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Fig. Q. No. 3 (a)

b) Determine the moment of inertia of the plane figure about both the reference axes shown. All the dimensions are in mms.

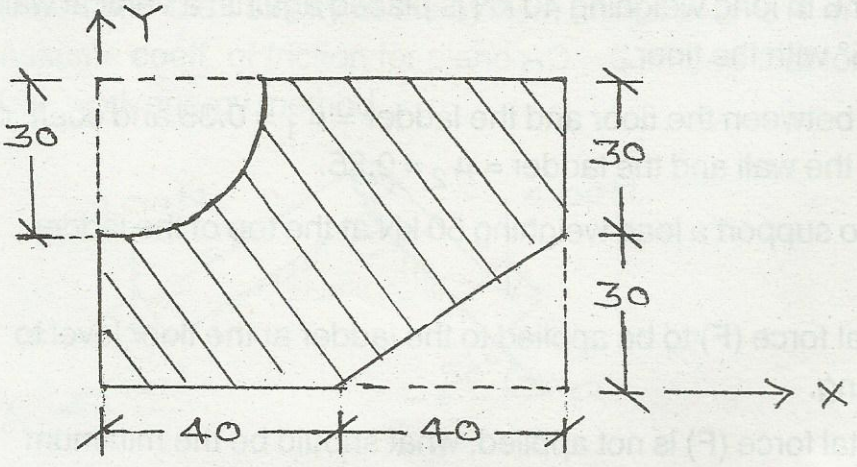

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Fig. Q. No. 3 (b)

b) Determine the position of centroid of shaded area with respect to axes shown. All the dimensions are in mms. **10**

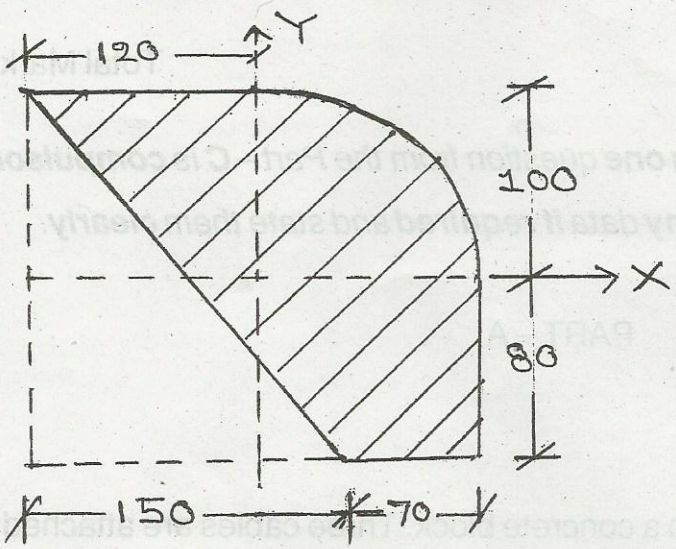

Fig. Q. No. 1 (b)

2. a) Determine the value of angle "α" for which **10**

i) the tension in the cable BC is minimum and corresponding tension in the cable.

ii) the tensions in the cables AC and BC are equal and the tension in the cable.

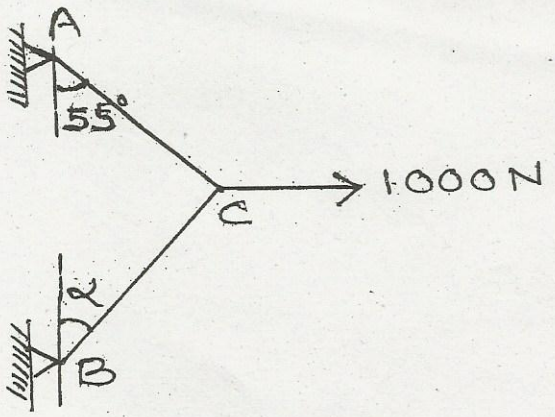

Fig. Q. No. 2 (a)

b) Derive an expression for mass moment of inertia of a right circular cone about its axis.

Assume :

R = Radius at the base of cone

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3. a) Two beams AC and CD are hinged at "C". Determine the reaction at "B" using the principle of virtual work.

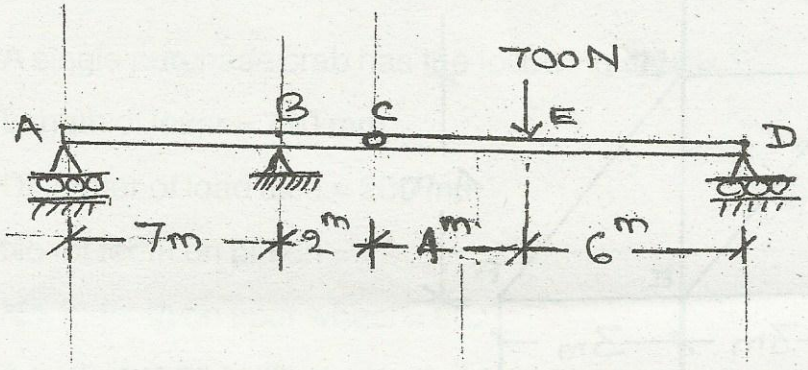

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Fig. Q. No. 3 (a)

b) Determine the moment of inertia of the plane figure about both the reference axes shown. All the dimensions are in mms.

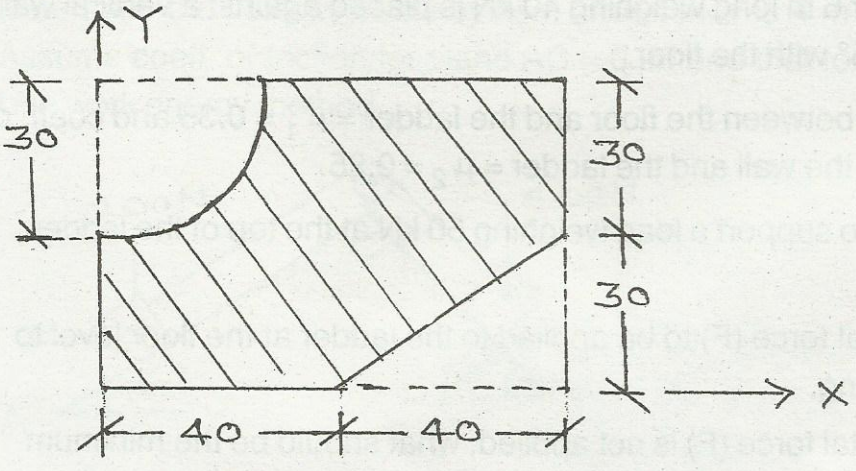

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Fig. Q. No. 3 (b)

PART – B

Answer **any two** of the following :

4. Determine the forces in all the members of the plane frame shown and tabulate the results.

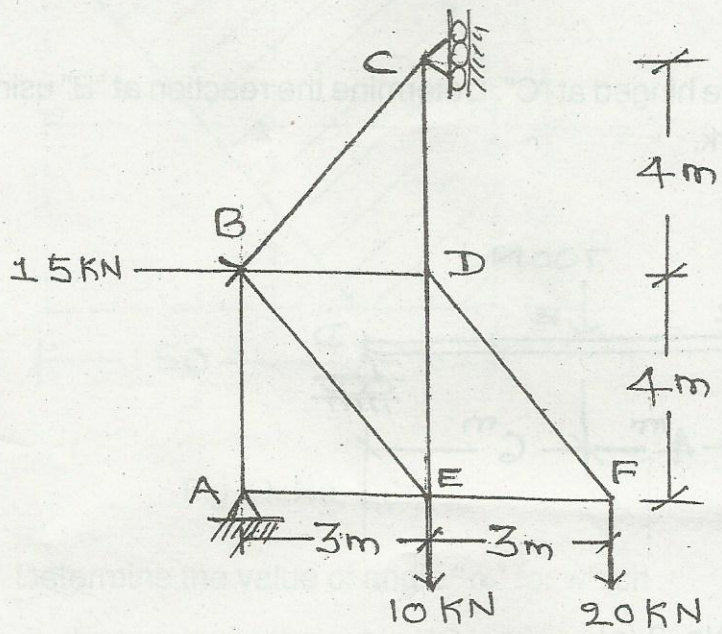

Fig. Q. No. 4

20

5. a) A uniform ladder 6 m long weighing 40 kN is placed against a vertical wall at an angle of 45° with the floor.

Coeff. of friction between the floor and the ladder = $\mu_1 = 0.35$ and coeff. of friction between the wall and the ladder = $\mu_2 = 0.25$.

The ladder has to support a load weighing 50 kN at the top of the ladder. Determine :

i) The horizontal force (F) to be applied to the ladder at the floor level to prevent slipping.

ii) If the horizontal force (F) is not applied, what should be the minimum inclination of the ladder with the horizontal when there is no slip ? 10

b) Find the time taken by the block to attain a velocity of 20 m/sec. starting from rest. If the external force of 2 kN is then removed, how much further will the block move ? Assume the coeff. of friction = μ = 0.30. Use Impulse Momentum Equation. **10**

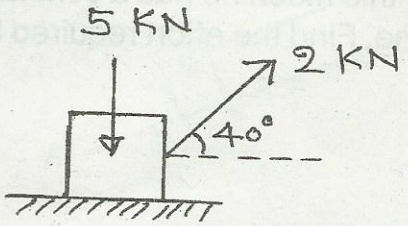

Fig. Q. No. 5 (b)

6. a) A single purchase crab has the following details : **10**

Length of lever = 700 mm

Diameter of load axle = 200 mm

No. of teeth on pinion = 12

No. of teeth on spur wheel = 96.

An effort of 60 N lifted a load of 1.8 kN and an effort of 120 N lifted a load of 3960 N. Determine :

i) Law of machine

ii) Efficiency of the machine in both the cases.

b) Determine the velocity of the system after it moves 4 m starting from rest. Assume coeff. of friction for plane AC = 0.20 and that for plane BC = 0.30. Use work energy method. **10**

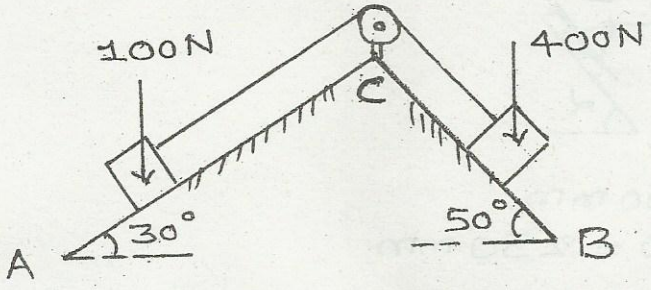

Fig. Q. No. 6 (b)

PART – C

Attempt **any one** of the following :

7. a) What load will be lifted by an effort of 12 N, if the velocity ratio is 18 and efficiency of the machine at this load is 60%. If this machine has a constant friction resistance, determine the law of machine. Find the effort required to run this machine at **8**

   i) No load

   ii) A load of 900 N.

   b) Two blocks are connected by a weightless rigid bar as shown. Find the horizontal force (p) required to be applied to the block of 3 kN just to move the block of 1 kN in upward direction. Assume angle of friction as 15° for all contacting surfaces. **12**

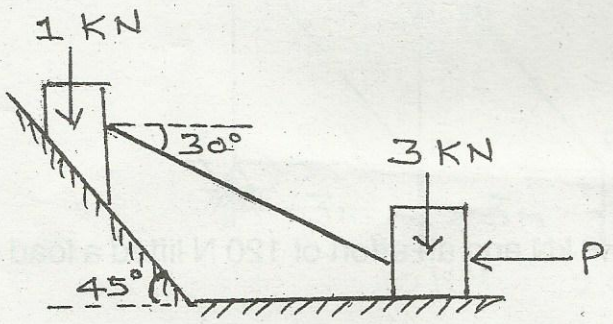

Fig. Q. No. 7. (b)

8. a) Determine the value of angle 'α' for the reaction at B to be minimum. What are the corresponding values of reactions. **6**

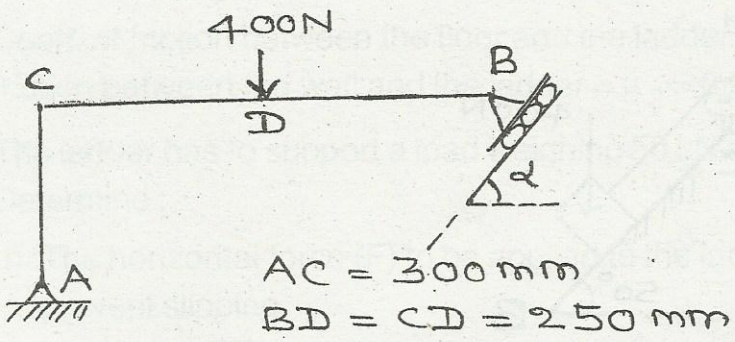

Fig. Q. No. 8. (a)

b) For the connected system shown, find the acceleration of the system and tension in the string. Assume coeff. of friction = μ = 0.30. Use D'Alembert's principle. **10**

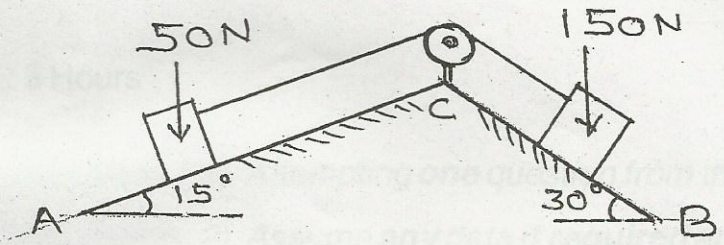

Fig. Q. No. 8 (b)

c) A thin homogeneous semi-circular plate of radius "R" is suspended from its corner as shown. Find the angle made by the straight edge AB with the vertical. **4**

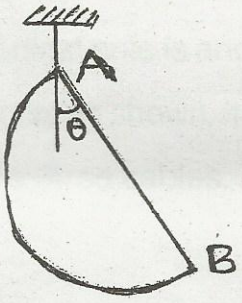

Fig. Q. No. 8 (c)