First Semester Examination
2020/2021 Academic Session

February 2021

EAS151 – Statics and Dynamics

Duration : 2 hours

Please check that this examination paper consists of **EIGHT (8)** pages of printed material before you begin the examination.

Instructions : This paper contains **FIVE (5)** questions. Answer **THREE (3)** questions in **PART A** and **ONE (1)** question in **PART B.**

All questions **MUST BE** answered on a new page.

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PART A

Answer **THREE (3)** questions in **PART A**

1. (a). The 200N force shown in **Figure 1** is to be resolved into components along lines a-a' and b-b'. Knowing that the component along a-a' is to be 150N, determine the angle α and the corresponding value of the component along b-b' by using:

(i). Graphical method

[7 marks]

(ii). Trigonometry solution

[3 marks]

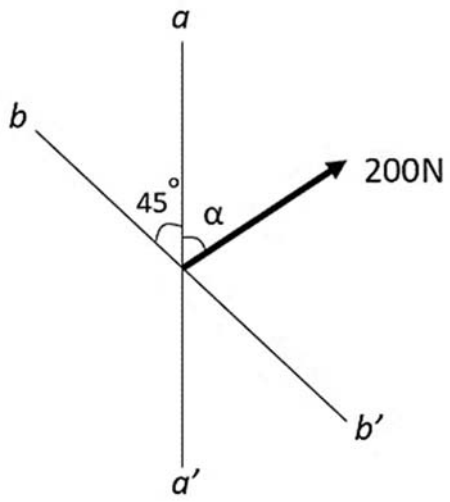

Figure 1

(b). A container of weight W is supported from ring A as shown in **Figure 2**. Cable BAC passes through the ring and is attached to fixed supports at B and C. Two forces $\mathbf{P} = \mathbf{P}_i$ and $\mathbf{Q} = \mathbf{Q}_k$ are applied to the ring to maintain the container in the position shown. Knowing that W = 1200N, determine P and Q. The tension is the same for cable BAC.

[15 marks]

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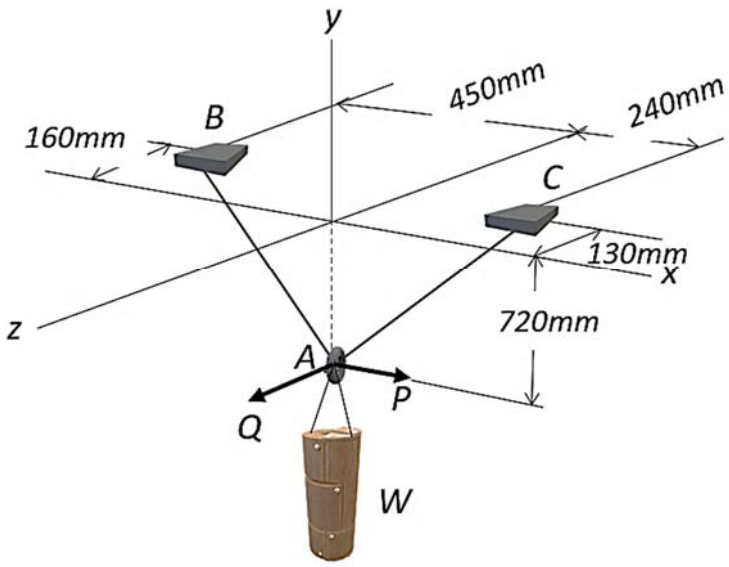

Figure 2

2. (a). The antenna tower is held in place by three cables at B, C and D as shown in **Figure 3**. The forces of these cables acting on the antenna are given as F_B = 520 kN, F_C = 680 kN and F_D = 560 kN. Determine the magnitude and coordinate direction angles of the resultant moment acting about O.

[20 marks]

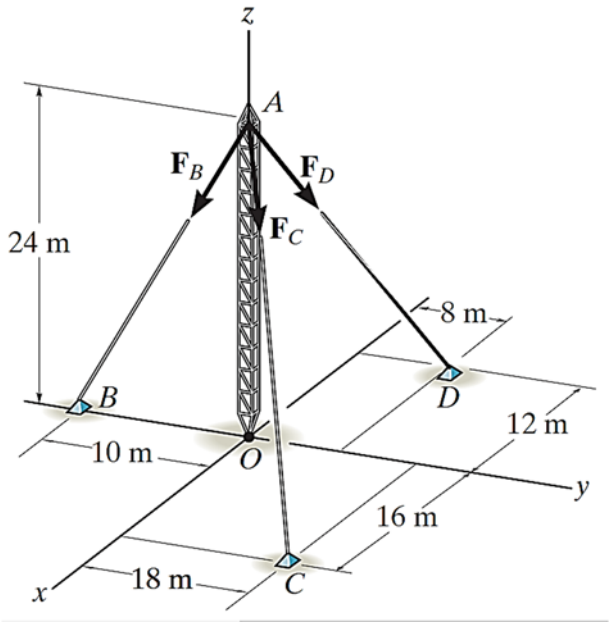

Figure 3

(b). Two traffic lights are hanging from a horizontal pole as shown in **Figure 4**. The total mass of both traffic lights is 18.2 kg and the total length of horizontal pole from ***O*** is 3 m. Assume the mass of both traffic lights is the same. Calculate the equivalent single resultant force replacing these traffic lights which acts at a distance *d* from ***O***. The support must provide the same resistance to translation and rotation in order to keep the member in the horizontal position.

[5 marks]

Figure 4

3. (a). A simply supported beam as shown in **Figure 5** is loaded by two concentrated loads of 4 kN and F at B and D, respectively, and a UDL of 5 kN/m from B to C. A couple moment of 10 kNm is acting at B. Determine the magnitude of force F and its placement ***d*** on the beam so that the loading system is equivalent to a resultant force of 3.2 kN acting vertically upward at A and a counter-clockwise couple moment of 6.4 kNm at A.

[12 marks]

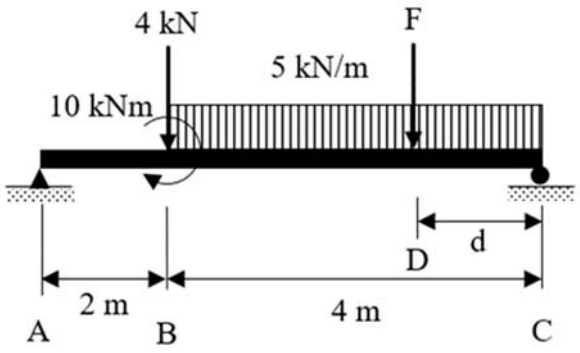

Figure 5

(b). A single overhanging beam is supported by a pin at A and roller at D as shown in **Figure 6**. The beam is loaded by a combination of the following loads. A uniformly distributed load of 12 kN/m and 8 kN/m along span CD and DE, respectively. A trapezium load with minimum and maximum of 6 kN/m and 12 kN/m along span BC. A concentrated load of 15 kN at C.

(i). Sketch the free-body diagram of the beam

[3 marks]

(ii). Determine the reaction forces at supports A and D of the beam.

[10 marks]

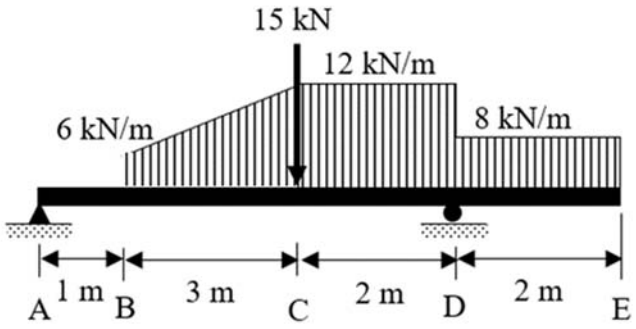

Figure 6

4. (a). By referring to **Figure 7**, determine the centroid of the shaded area.

[13 marks]

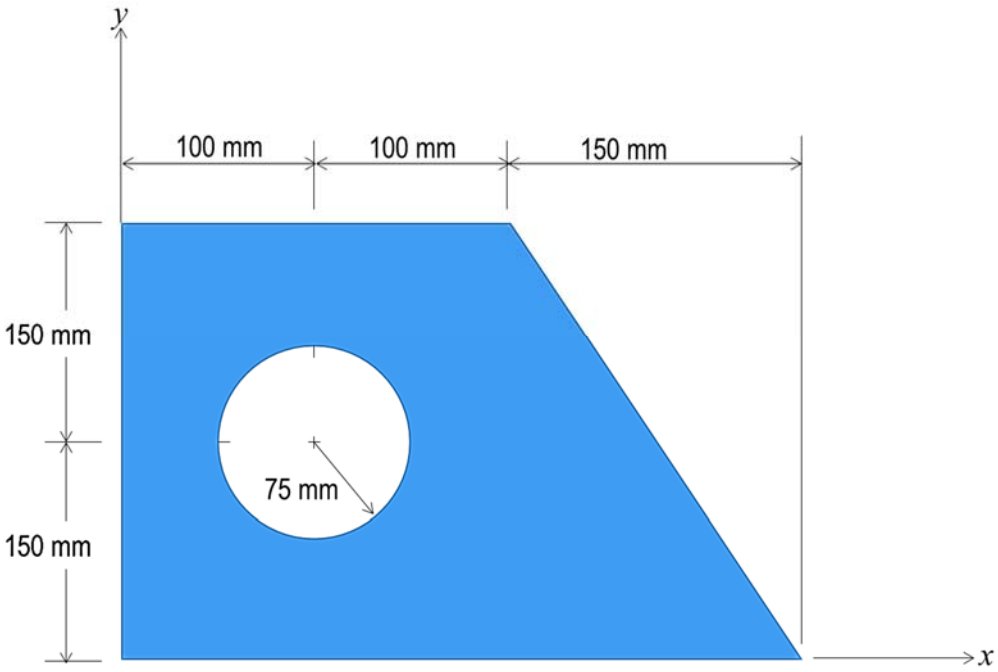

Figure 7

(b). From **Figure 7**, determine the second moment of area of the shaded area about the y- axis.

[12 marks]

PART B – COMPULSORY QUESTION

5. (a). A particle starts from rest with an acceleration of 10 m/s^2. The acceleration then decreases linearly with time to zero in 10 seconds. After that, the particle continues to move at a constant speed. Determine whether the particle is able to cover a distance of 650 m from the start after 15 seconds.

[5 marks]

(b). **Figure 8** shows a projectile being launched with a speed v_0 = 25 m/s from the floor of a 5.75 m high tunnel. If it is given that the launch angle θ =20º,

(i). Determine the clearance between the ceiling of the tunnel and highest position of the projectile.

(ii). Determine the distance from A of the landing position of projectile on the floor of the tunnel.

[10 marks]

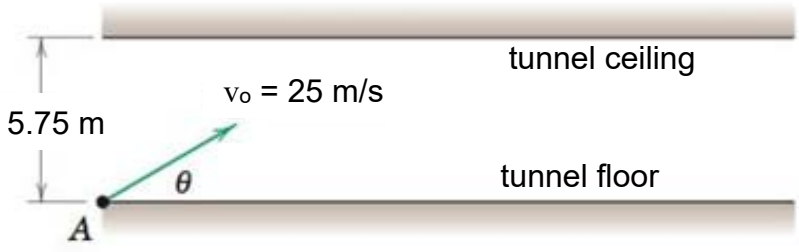

Figure 8

(c). A 20 kg cylinder is latched in place with the 85 kN/m spring compressed by 30 mm as shown in **Figure 9**. The cylinder that is not attached to the spring is released suddenly from its latched position. Determine:

(i). the maximum height reached by the cylinder

(ii). the velocity of the cylinder when the spring has moved up by 10 mm from its initial position.

[10 marks]

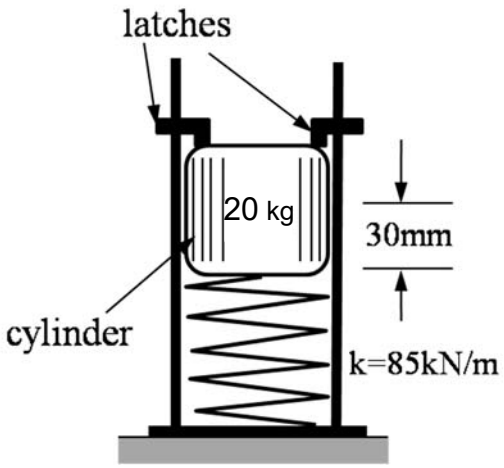

Figure 9

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