Second Semester Examination
2023/2024 Academic Session

July / August 2024

EMM 252 – Engineering Dynamics
(Dinamik Kejuruteraan)

Duration: 3 hours
(Masa: 3 Jam)

Please check that this examination paper consists of FIVE (5) pages of printed material before you begin the examination.

[Sila pastikan bahawa kertas peperiksaan ini mengandungi LIMA (5) muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]

Instructions: Answer ALL **FOUR (4)** questions.

*[**Arahan**: Jawab **EMPAT (4)** soalan]*

1. (a) A parcel delivery system employs an unmanned aerial vehicle to drop a parcel from a height of 200 meters above the ground with a horizontal speed of 10 m/s. Determine the velocity of the parcel when it impacted the ground.

(40 marks)

(b) Figure 1 (b) shows an internal combustion engine. The length of the crank OA is 145mm and the connecting rod AP is 150 mm. The piston P is moving upwards at a velocity of 3000 mm/s when the crank angle Θ=30 degrees. Calculate the angular velocity of the crank OA.

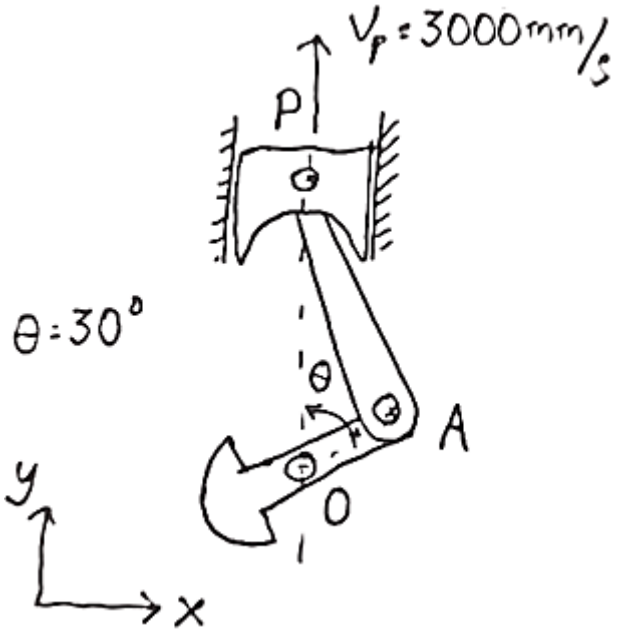

Figure 1 (b)

(60 marks)

2. Figure 2 shows an arm AB which is pivoted at point A and has a slot along its length. The pin C is made to move within the slot of the arm AB and the same time it is mounted on a disc is rotating counter clockwise about point O at an angular speed of 4 rad/s. For the instance shown, the arm OA is 60 degrees to the horizontal, AC=180 mm, OC=60 mm and Θ=30 degrees. Using the rotating axes with the y-axis aligning with AB, calculate the angular velocity and angular acceleration of the arm AB.

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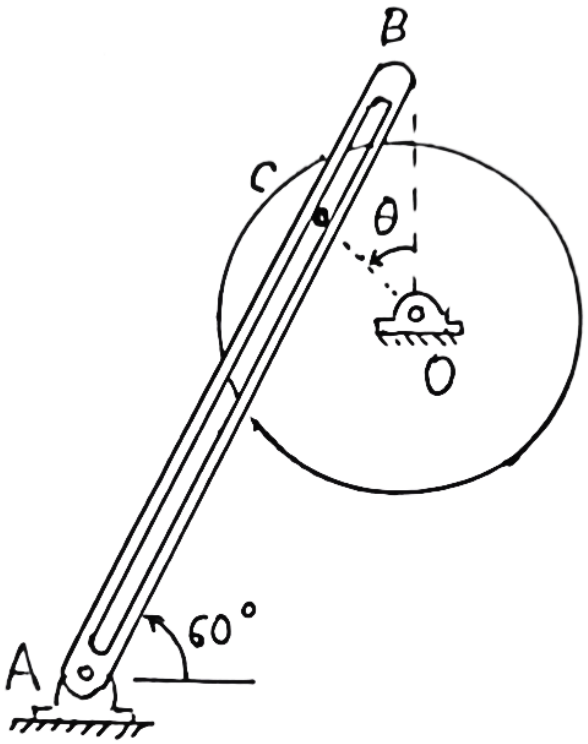

Figure 2

(100 marks)

3. (a) The jet aircraft shown in Figure 3 (a) has a mass of 5 Mg and a centre of mass at *G*. A towing cable is attached to the upper portion of the nose wheel, which exerts a force of T= 40 kN. The nose wheel at *A* is free to roll. The coefficient of kinetic friction between the wing wheels at *B* and the road is μ_k= 0.25.

By neglecting the lifting force of the wings and the mass of the wheels:

(i) Draw the free body diagram and the kinetic diagram of the aircraft.

(ii) Determine the acceleration of the aircraft.

(iii) Determine the normal reactions on the nose wheel at *A* and each of the two wing wheels located at *B.*

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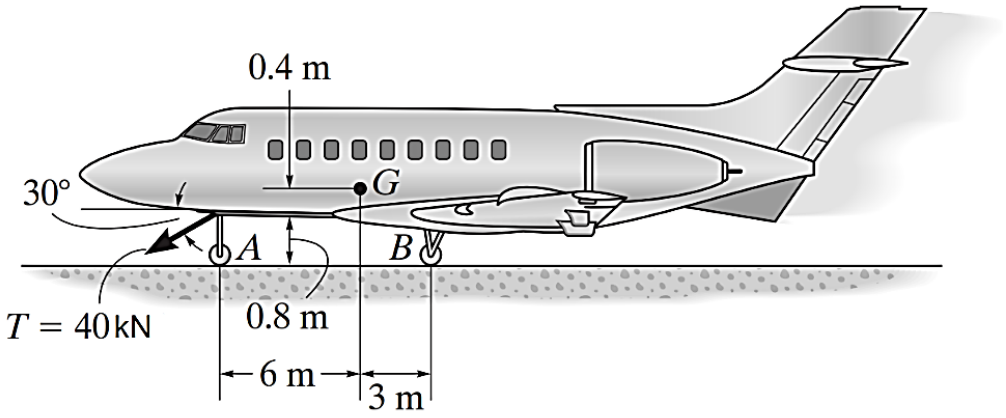

Figure 3 (a)

(50 marks)

(b) Figure 3 (b) shows a uniform slender rod beam of length 4 m and mass 150 kg is pinned at point *A* and restrained by the cord at *B*. If the cord suddenly fails:

(i) Draw the initial free body diagram and the kinetic diagram of the beam.

(ii) Determine the initial angular acceleration of the beam.

(iii) Determine the horizontal and vertical components of the initial reaction at the point *A*.

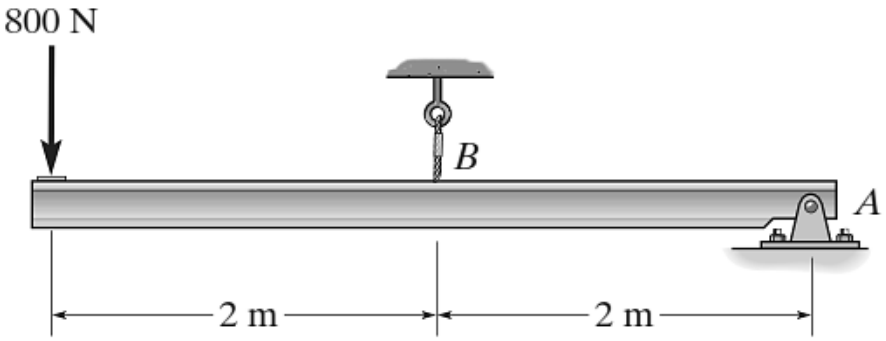

Figure 3 (b)

(50 marks)

4. (a) Electric vehicle (EV) is one of the national agenda in promoting low-carbon technology, but the EV is typically heavier than conventional vehicles and also currently more expensive.

(i) Explain why the electric vehicle is heavier than the conventional vehicle (give one comparison example for a similar size vehicle)

(ii) Explain how the weight affects the vehicle's energy consumption from an engineering dynamics perspective.

(iii) Suggest potential strategies for electric vehicle manufacturers to mitigate the impact of heavier vehicles on energy consumption.

Support your explanation with sketches.

(40 marks)

(b) Figure 4 (b) shows a test of impact on the fixed crash dummy. The test is conducted using the 136 kg ram that is released from rest at $\theta = 30^o$ and allowed to fall and strike the dummy at $\theta = 90^o$. If the coefficient of restitution between the dummy and the ram is e = 0.4, determine the angle θ to which the ram will rebound before momentarily coming to rest.

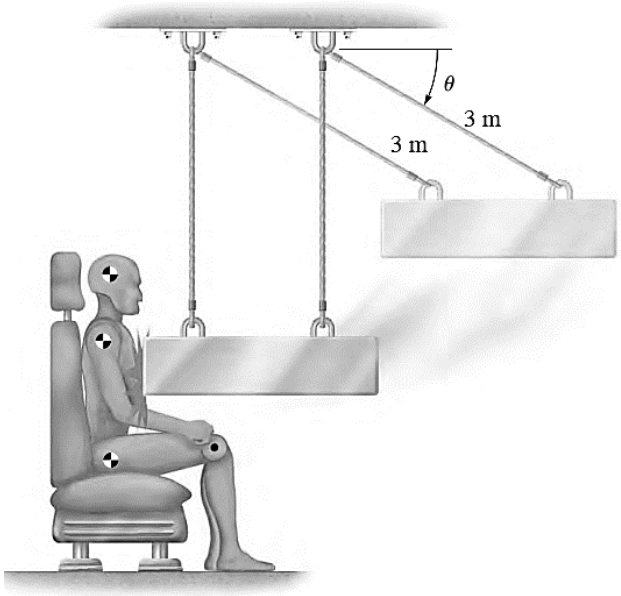

Figure 4 (b)

(60 marks)

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