Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2021/2022

COURSE NAME	:	MECHANICS OF MACHINE
COURSE CODE	:	DAM 23803/ DAM 21703
PROGRAMMECODE	:	DAM
EXAMINATION DATE	:	JULY 2022
DURATION	:	3 HOURS
INSTRUCTION		1. ANSWER **FIVE (5)** QUESTIONS **ONLY.**
		2.THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK.**
		3.STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK.

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

Q1 (a) In gear terminology, circular pitch, diametral pitch and module of the gear are important parameters. Explain how those **three (3)** parameters related to each other.

(5 Marks)

(b) A motor used to accelerate a hoist through two sets of gear reducing systems, as shown in **Figure Q1 (b)**. Gear ratio of sets 1 and 2 is 1:3.5, while gear sets 3 and 4 have a 1:4.5 gear ratio. Diameter of the hoist is 1.2 m. The motor shaft has a moment of inertia of 7 kgm^2, while the middle shaft and hoist shaft have moment of inertia of 30 kgm^2 and 600 kgm^2, respectively. The gear efficiency of both gear sets is 90%. Neglect the friction effect. The motor needs to bring up the 10 tones load with acceleration 0.5 m/s^2.

(i) Determine the overall gear ratio of the system.

(2 Marks)

(ii) Calculate the torque required to overcome the equivalent inertia (refer to motor side).

(4 Marks)

(iii) Calculate the torque required to accelerate the load through gear system.

(4 Marks)

(iv) Find the total torque required by the motor to accelerate a load of 10 tones at 0.5 m/s^2.

(5 Marks)

Q2 (a) Discuss the difference between flat belt, V belt and timing belt. Include their advantages and disadvantages.

(6 Marks)

(b) In power transmission, belt-drive system depends on friction. However, belt slip contribute to the inefficiency of the drive.

(i) Describe the phenomena of belt slip.

(2 Marks)

(ii) Belt slip considered as one of the factors that contribute to the inefficiency of the drive. Explain it.

(2 Marks)

(c) As shown in **Figure Q2(c)**, a multiple V-belt drive with a groove angle of 30° is required to transmit 25.5 kW from a pulley 175 mm in diameter to another pulley 313 mm in diameter rotating at 202 rev/min. The coefficient of friction between the belt and the pulley is 0.25 and the maximum permissible belt tension is 500 N for each of the ten belts used.

(i) Calculate the torque on the smaller pulley.

(3 Marks)

(ii) Determine the angle of contact.

(3 Marks)

(iii) Suggest the ideal centre distance.

(4 Marks)

Q3 (a) Explain about the static balancing and dynamic balancing and give two (2) examples for each type of balancing.

(6 Marks)

(b) **Figure Q3(b)** shows four masses A, B, C and D are to be completely balanced at radius 120 mm, 150 mm and 180 mm and 210 mm respectively. Mass B, C and D are 20 kg, 15 kg and 5 kg. The planes which the mass revolve are spaced 100cm apart. Find the required mass A and the angular settings relative to a plane so that the shaft is in complete balance. Find the angular position of mass A if its radius is 185mm and the position of planes A and D.

(14 Marks)

Q4 (a) Describe the differences between static friction and dynamic friction with examples.

(6 Marks)

(b) A screw thread has a helix angle of 120. If the coefficient of friction is 0.5 and the mean diameter of the square thread is 83.5 mm, calculate;

(i) the pitch of the tread.

(4 Marks)

(ii) the efficiency when raising a load of 1.5 kN.

(4 Marks)

(iii) the torque required.

(6 Marks)

Q5 (a) Indicate the velocity of pin joint as illustrated in **Figure Q5(a)**. The radius of the pin joint is given as *r*.

(4 Marks)

(b) The four bars chain in **Figure Q5(b)** comprises of link AB = 0.5 m, link BC = 0.9 m and link CD = 0.8 m. Point D is positioned at 1.7 m below and 0.4 m to the right of point A. Link AB is rotating at a constant speed of 2.5 rad/s.

(i) Redraw the **Figure Q5(b)** using appropriate scale.

(5 Marks)

(ii) Draw the velocity diagram and determine the angular velocity of all the links.

(5 Marks)

(iii) Draw the acceleration diagram and determine the tangential and radial acceleration of each of the links.

(6 Marks)

Q6 (a) Define natural frequency for undamped free vibration and list **two (2)** methods used to determine the natural frequency.

(4 Marks)

(b) A uniform thin rod AB as shown in **Figure Q6(b)** is hinged at point A. The moment of inertia of the thin rod at point A is 80 kgm2. A concentrated mass of 2 kg is then fixed at the point C and balanced horizontally by two springs positioned at point D and E. Given the spring stiffness of spring D and E are 4.0 kN and 2.0 kN respectively.

(i) Determine the moment of inertia of the complete assembly at point A.

(4 Marks)

(ii) Determine the force experienced by both spring in term of θ where θ is the angle of deflection.

(6 Marks)

(iii) Calculate the natural frequency of the complete assembly.

(6 Marks)

-END OF QUESTIONS –

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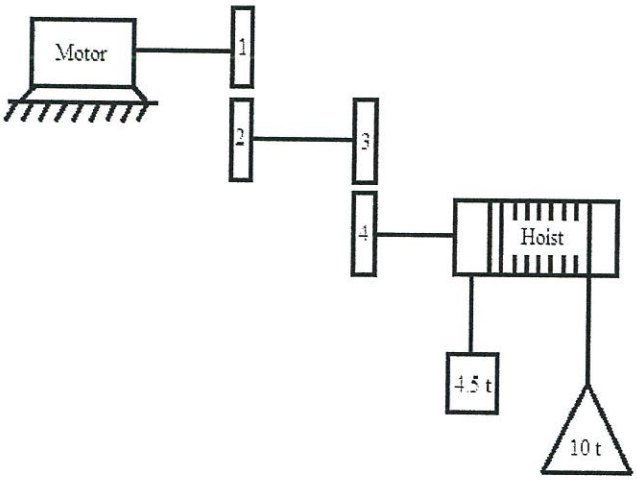

Figure Q1(b)

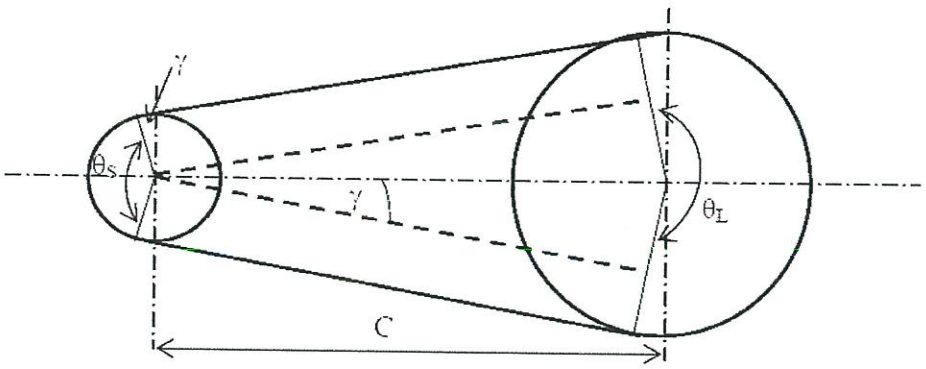

Figure Q2(c)

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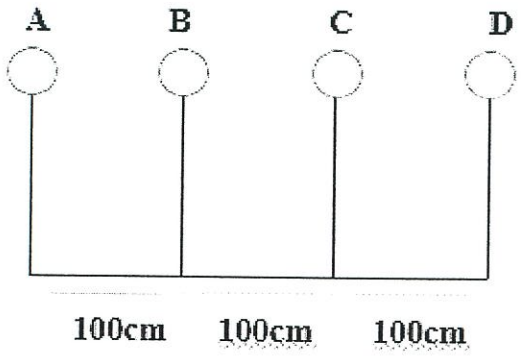

Figure Q3(b)

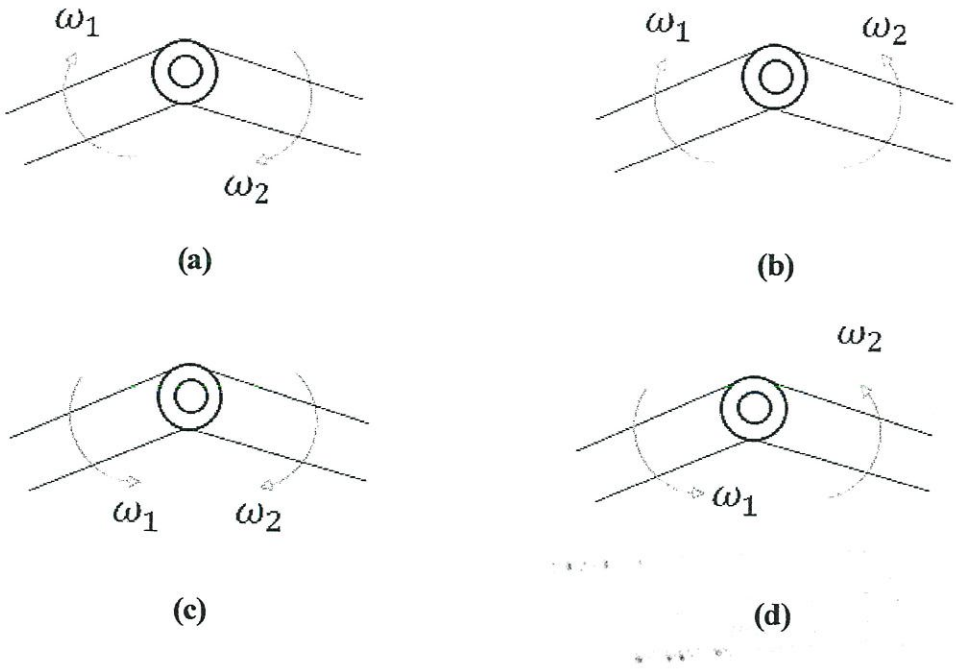

Figure Q5(a)

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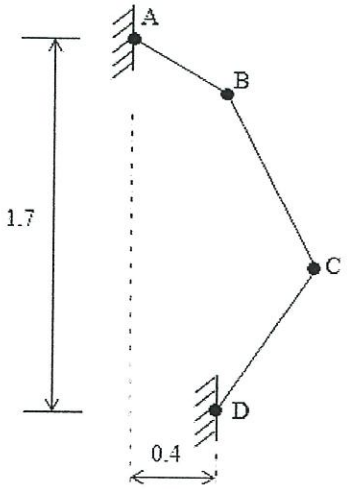

Figure Q5(b)

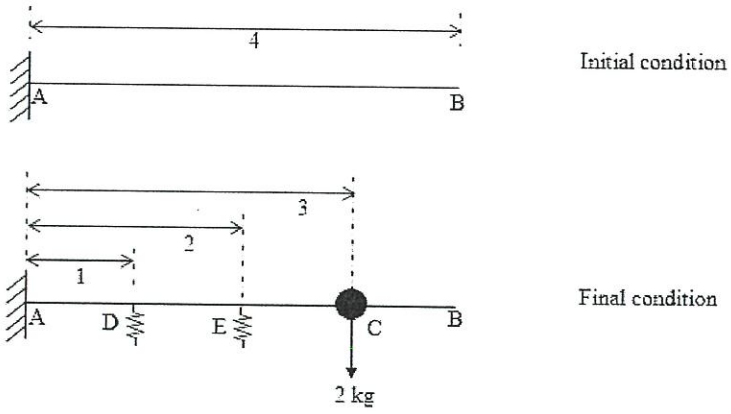

Figure Q6(b)