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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020**

COURSE NAME : MECHANICS OF MACHINES
COURSE CODE : BDA20303
PROGRAMME : BDD
EXAMINATION DATE : DECEMBER 2019 / JANUARY 2020
DURATION : 3 HOUR
INSTRUCTION : PART A : ANSWER ALL
QUESTIONS
PART B : ANSWER FOUR (4) ONLY
OUT OF FIVE (5) QUESTIONS

THIS QUESTION PAPER CONSISTS OF SIX (6) PAGES

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PART A (COMPULSARY)

Answer ALL questions.

- Q1** A slider D which only allowed a vertical stroke movement are connected to a mechanism as shown in **Figure Q1**. The crank OA is rotating anti-clockwise at 180 RPM. The links dimensions are as follows: OA = 180 mm, CB = 240 mm, AB = 360 mm and BD = 540 mm.
- (i) Find the velocity of point A, v_{AO} . (1 marks)
 - (ii) Draw the space and velocity diagram at an instant. (9 marks)
 - (iii) Determine the angular velocity of links AB. (3 marks)
 - (iv) Determine the rubbing velocity on the pin A, given pins radius is 15 mm. (3 marks)
 - (v) If a 2 kN of external force pushing downward is exerted to slider D. Calculate the required torque at crank OA, τ_A to overcome the external force assuming the mechanism are 100% efficient. (4 marks)

PART B (OPTIONAL)

Answer FOUR (4) ONLY out of FIVE (5) questions.

- Q2**
- (a) Describe three key differences between spur gear and helical gear then illustrate the geometry of these two gears. (5 marks)
 - (b) The axes of two parallel shafts are to be approximately 600 mm apart and have to be connected by spur gears, having a circular pitch of 30 mm. If rpm of A is 200 and that of B is 600, find;
 - (i) The number of teeth on each wheel (2 marks)
 - (ii) Pitch diameter of each wheel (3 marks)
 - (iii) Circular pitch of each wheel (3 marks)
 - (iv) Exact centre to centre distance apart of the two shafts (3 marks)
 - (v) If the tangential pressure between the teeth of gears, acting at the point of contact of the two pitch circle is 18 kN, find the power transmitted by A. (4 marks)

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- Q3** (a) A maximum power transmitted by pulley and belt are much depending on friction effects. Briefly explain the importance of belt's material selection and pulley's design specifications individually to reduce belt slippage. (6 marks)
- (b) An open belt drive system using a flat belt with a cross-section of 500 mm² and density of 1300 kg/m³. The angle of lap is 165° on the smaller wheel. The coefficient of friction is 0.35 and the maximum tension allowed in the belt is 600 N. When the belt runs at 10 m/s;
- (i) Calculate centrifugal force exerted in the belt drive system, (1 marks)
- (ii) Deduce power transmitted, (3 marks)
- (iii) Find the critical belt speed, V_p . (2 marks)
- (iv) As to increase the system capability, a technician had replaced with 60° groove angle V belt. Predict the new power to be transmit. (8 marks)
- Q4** (a) State the difference between full balancing and partial balancing and list **ONE** (1) practical example for each of them to support your answer. (3 marks)
- (b) A shaft carries four masses in parallel planes A, B, C and D in this order along its length. The masses at B and C are 18 kg and 12.5 kg respectively, and each has an eccentricity of 60 mm. The masses at A and D have an eccentricity of 80 mm. The angle between the masses at B and C is 100° and that between the masses at B and A is 190°, both being measured in the same direction. The axial distance between the planes A and B is 100 mm and that between B and C is 200 mm. If the shaft is in complete dynamic balance,
- (i) Draw the illustration of the planes if the 1st mass is used as the reference plane. Tabulate all the given data in a table. (3 marks)
- (ii) By considering the illustration in and table above, calculate the magnitude of the masses at A and D. (8 marks)
- (iii) Find the distance between planes A and D. (4 marks)
- (iv) Deduce the angular position of the mass at D. (2 marks)

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- Q5** (a) A clutch is a mechanical device which is used to connect or disconnect the source of power from the remaining parts. Explain the different between Positive Clutches and Friction Clutches. Also state the 2 (two) merits of both systems. (5 marks)
- (b) A multiple plate clutch has more number of clutch plates. A typical clutch consist of the following important components which are drive (friction) plates and driven (steel) plates. If a multiple plate clutch with an effective diameter of 250 mm and 150 mm are able to transmit 60 kW at 1200 rpm. Also the end thrust is given as 4.5 kN and coefficient of friction is 0.13. Solve below questions;
- (i) Determine torque to be carry by friction clutch. (2 marks)
- (ii) Calculate number of plates required with uniform wear and uniform pressure theory. Compare your results. (13 marks)
- Q6** (a) A driver pulley of an open flat belt system is tensioned to 1200 N whilst stationary as shown in **Figure Q6(a)**. The angle of contact at pulley is given as 160° . Calculate the tensions in both sides, T_t and T_s given that the pulley diameter is 200 mm while transmitting 2 kW of power at 300 RPM. (10 marks)
- (b) A 2000 N load is placed on a square threaded jack as shown in **Figure 6(b)**. Given the threaded mean diameter is 50 mm, pitch, $l = 12.5$ mm and coefficient of friction, $\mu = 0.13$. The hand lever effective radius, r is known as 200 mm.
- (i) Calculate the screw angle of threaded, θ . (2 marks)
- (ii) Find the angle of static friction, ϕ . (2 marks)
- (iii) Calculate the minimum force, F to raise the load. (6 marks)

END OF QUESTIONS

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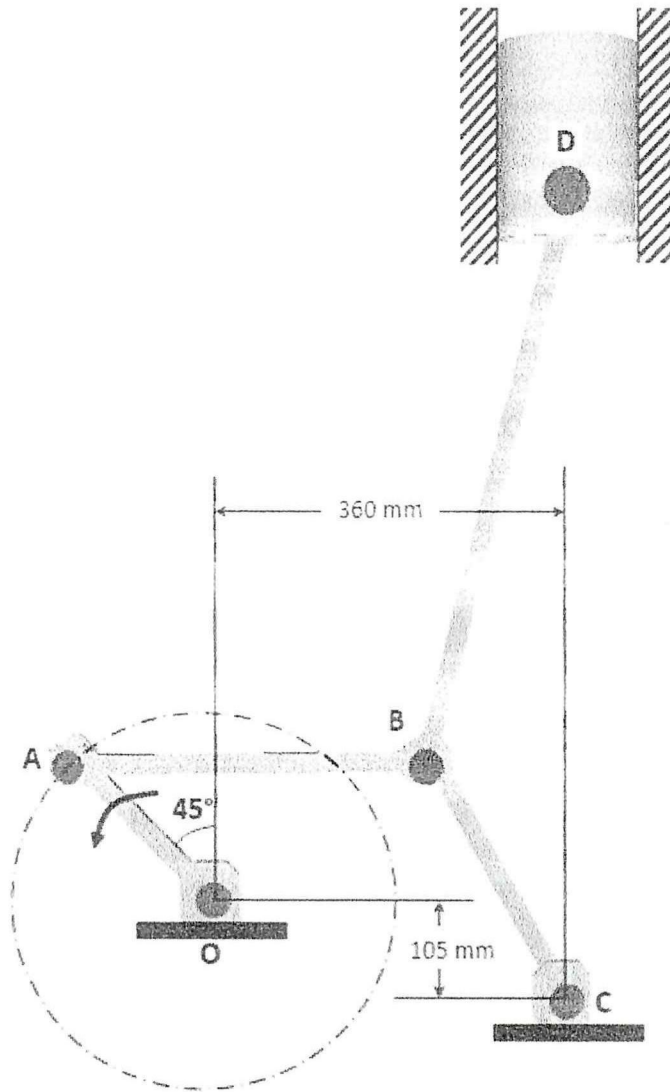


Figure Q1

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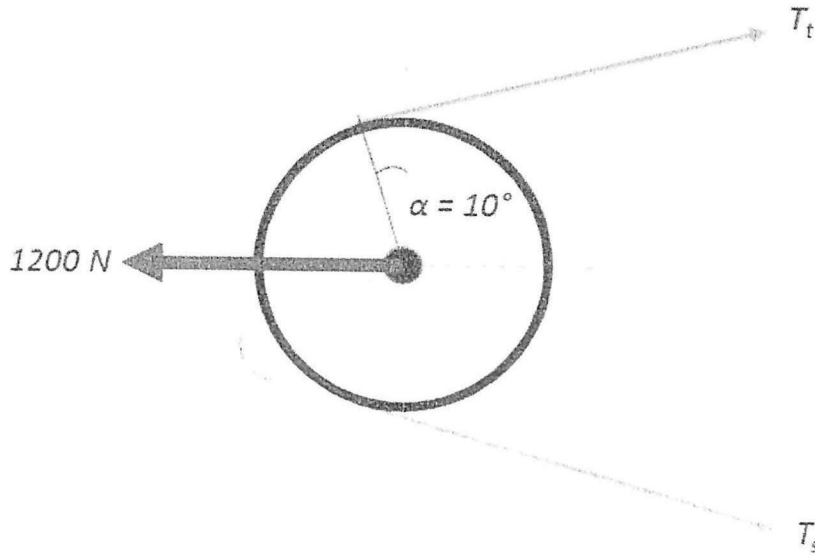


Figure Q6(a)

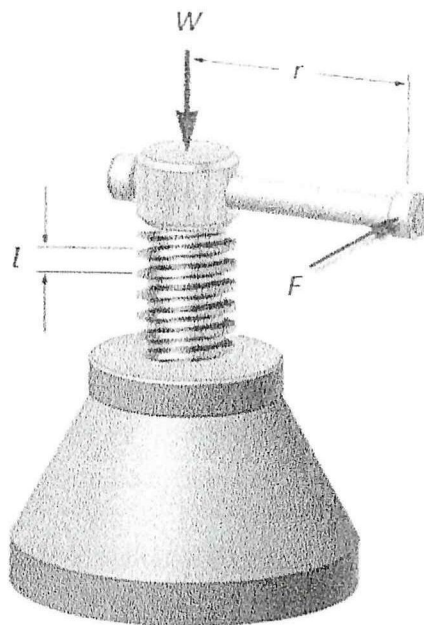


Figure Q6(b)

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