

CONFIDENTIAL



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
(ONLINE)
SEMESTER II
SESSION 2019/2020**

COURSE NAME : MECHANICS OF MACHINES
COURSE CODE : BDA20303
PROGRAMME : BDD
EXAMINATION DATE : 9 JULY 2020
DURATION : 4 HOURS
INSTRUCTION : PART A : ANSWER **ALL**
QUESTIONS
PART B : ANSWER **FOUR (4) ONLY**
OUT OF **FIVE (5) QUESTIONS**

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

CONFIDENTIAL

TERBUKA

PART A (COMPULSARY)Answer **ALL** questions.

- Q1** A mechanism, as shown in **Figure Q1** has the following dimensions: $OA = 200$ mm; $AB = 1500$ mm; $BC = 600$ mm; $CD = 500$ mm and $BE = 400$ mm. Given crank OA rotates uniformly at 120 RPM clockwise.
- (a) Find velocity at point A, v_{AO} . (2 marks)
 - (b) Draw the space diagram at an instant. (4 marks)
 - (c) Using scale 10 mm = 0.55 ms⁻¹, draw the velocity diagram at an instant. (8 marks)
 - (d) Determine the velocity of point B, C and D. (3 marks)
 - (e) Find angular velocity of link BC. (3 marks)

PART B (OPTIONAL)Answer **FOUR (4) ONLY** out of **FIVE (5)** questions.

- Q2** (a) Classify the type of gears based on relative axis position with an appropriate illustration and labels. (5 marks)
- (b) In the planetary gear train shown in **Figure Q2**, the annulus A rotates at 300 rpm about the axis of fixed wheel S which has 80 teeth. The armed spider (arm) is driven at 180 rpm. The annulus is connected to input shaft whereas the arm is connected to the output shaft. If the efficiency of gear system is 98% and input torque is 100 Nm, identify the following information regarding these problems
- (i) The number of teeth on planet gear, P (6 marks)
 - (ii) Holding torque for fixed wheel (6 marks)
 - (iii) Power transmitted by the gear train. (3 marks)
- Q3** (a) The choice of type of belt to be used is important so that the required power can be delivered efficiently. List four (4) factors to be considered in selecting a suitable belt type to be used for a particular application. (2 marks)

- (b) An exhaust fan systems consists of 4 parallel v-belts wrapped around driver pulleys A and driven pulley B with a diameter of 100 mm and 240 mm respectively. Coefficient of friction, μ between belt and pulleys is known as 0.25. Pulley groove, α has been design at an angle of 60° . The maximum permissible tension is 3860 N, cross-sectional area of the belt is $A = 160 \text{ mm}^2$ and density of belt's material $\rho = 1000 \text{ kg/m}^3$. If the driver pulley A and driven pulley B rotates at a speed of 1800 RPM and 700 RPM individually due to slippages.
- (i) Find the angle of contact of pulley A, given the pulley centre to centre distance is 1000 mm. (2 marks)
 - (ii) Calculate the tension distributed by centrifugal forces in one V-belt. (2 marks)
 - (iii) Deduce total power transmitted by the driver pulley A. (6 marks)
 - (iv) Deduce total power received by the driven pulley B. (6 marks)
 - (v) Find the belt slip percentage at pulley B (2 marks)

- Q4** (a) Explain what is the difference between centrifugal and centripetal forces. (2 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) Tabulate all the given data in a table. (2 marks)
 - (ii) Draw/illustrate the position of the planes and angular position of the masses if plane A is used as the reference (4 marks)
 - (iii) By considering the illustration in (ii) and table in (i) above, draw the couple polygon and force polygon diagram to some suitable scale (4 marks)
 - (iv) Calculate the magnitude of the masses at A and D, the distance between planes A and D and the angular position of the mass at D. (8 marks)

- Q5** (a) The dry friction force is depending on the coefficient of friction, μ of a surface contact and will affect the angle of friction or limiting angle, θ . Explain with sketches on how to derive the equations of $\tan \theta = \mu$ of a square block with a mass of m at an inclination plane of θ .
(4 marks)
- (b) **Figure Q5** shows a crate has a mass of 50 kg and the coefficient of static friction between the crate and the plane is $\mu_s = 0.25$.
- (i) Determine the minimum horizontal force P required to hold the crate from sliding down the plane.
(8 marks)
- (ii) Determine the minimum force P required to push the crate up the plane.
(8 marks)
- Q6** (a) A double stage compound gear system as shown in **Figure Q6(a)** has a meshing efficiency, η of 0.8 individually. Moment inertia of each shaft A, shaft B to C and shaft D are 5 kg/m^3 , 30 kg/m^3 and 20 kg/m^3 respectively. Calculate the required motor power at input shaft to overcome the equivalent inertia given angular acceleration of motor is 10 rad/s^2 .
(10 marks)
- (b) A manual square threaded jack as shown in **Figure Q6(b)** is use to lift a car at Service and Repair Workshop. Given the threaded mean diameter is 100 mm, pitch, $p = 25$ mm and coefficient of friction, $\mu = 0.2$. The handle length effective radius, l is known as 500 mm.
- (i) Calculate the minimum force, F to raise up the car.
(6 marks)
- (ii) Calculate the minimum force, F to lower down the car.
(4 marks)

- END OF QUESTION -

FINAL EXAMINATION

SEMESTER/SESSION : II / 2019/2020

PROGRAMME : BDD

COURSE : MECHANICS OF MACHINES

COURSE CODE : BDA20303

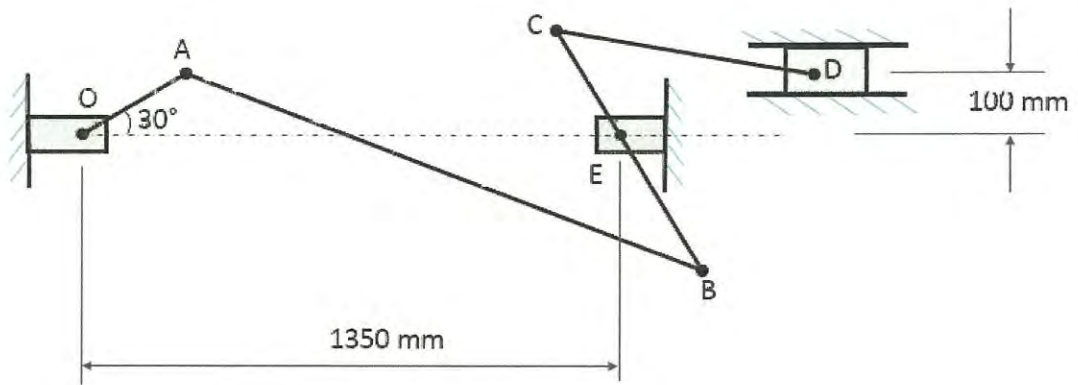


Figure Q1

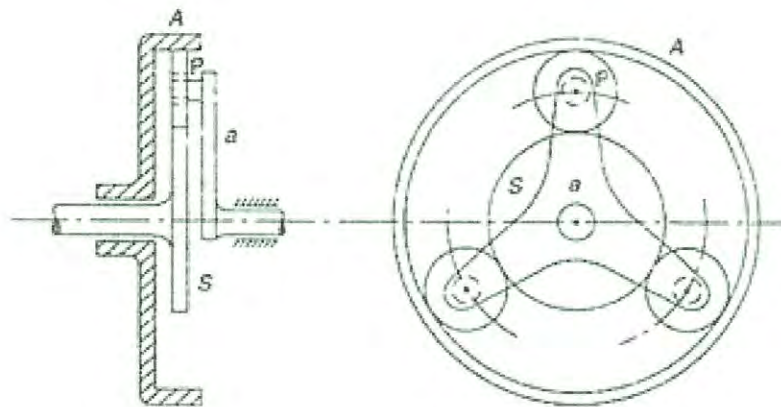


Figure Q2

FINAL EXAMINATION

SEMESTER/SESSION : II / 2019/2020

PROGRAMME : BDD

COURSE : MECHANICS OF MACHINES

COURSE CODE : BDA20303

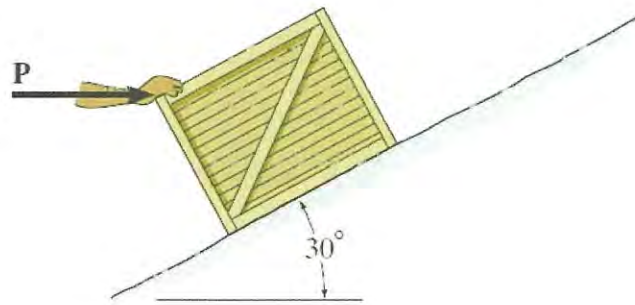


Figure Q5

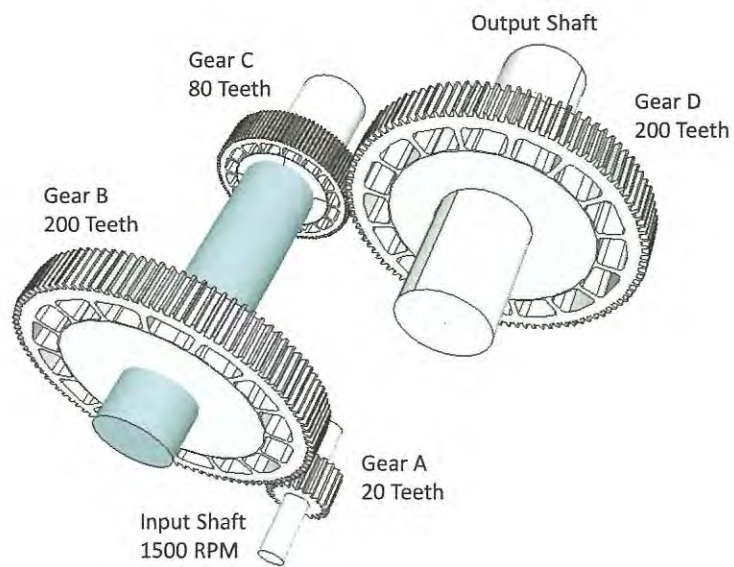


Figure Q6 (a)

FINAL EXAMINATION

SEMESTER/SESSION : II / 2019/2020

PROGRAMME : BDD

COURSE : MECHANICS OF MACHINES

COURSE CODE : BDA20303

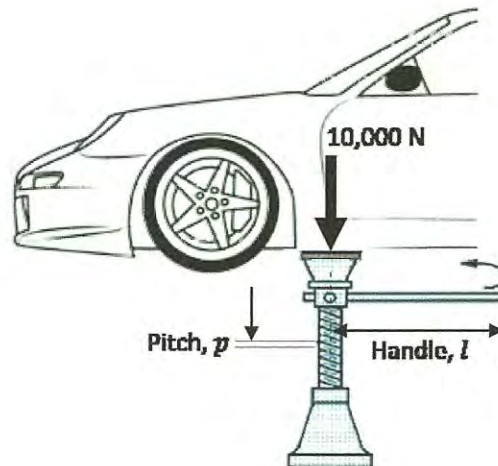


Figure Q6 (b)