UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2018/2019

COURSE NAME	:	MECHANICS OF MACHINES
COURSE CODE	:	BDA 20303
PROGRAMME CODE	:	BDD
EXAMINATION DATE	:	JUNE/JULY 2019
DURATION	:	3 HOURS
INSTRUCTION	:	1) PART A (COMPULSORY): ANSWER **ALL** QUESTIONS 2) PART B (OPTIONAL): ANSWER **ONE (1)** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

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PART A (COMPULSORY):
ANSWER **ALL** FOUR QUESTIONS

Q1 (a) In gear drive system explain the following terms;

(i) Pitch circle

(ii) Addendum circle

(iii) Dedendum circle

(3 marks)

(b) Name the gear used for power transmission in intersecting shaft and what functions do these gears fulfill?

(3 marks)

(c) An electrical motor produces 1047 kW to the driver gear shaft as shown in **Figure Q1.** The angular velocity of driver gear shaft is 100 rpm and angular velocity of the follower gear shaft is 125 rpm. If the gear efficiency of the gear system is $\eta = 0.955$, Calculate:

(i) The gear ratio of the system

(ii) The torque produced by the electrical motor

(iii) The power at the follower gear shaft and

(iv) The torque at the output shaft

(14 marks)

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Q2 A flat rubber belt is used to drive a bucket elevator in a potash plant. It uses an electric motor (normal torque) rated at 14.3 kW at 2250 rpm. The motor operated at full load speed for 15 hours daily. It is fitted with a pulley 200 mm diameter. The design data for the belt drive system is as follows;

i. Allowable stress for belt : 2.3 MPa
ii. Density of rubber belt : 90 kg/m^3
iii. Angle of contact for load pulley : 160°
iv. Coefficient of friction between belt and pulley : 0.3
v. Thickness of rubber belt : 10 mm
vi. Design power is equal to (Service factor) X (motor rated power)

Table Q2: Belt service factors

belt service factors

Driven machine type	Driver type: AC motors: Normal torque[a] DC motors: Shunt-wound Engines: Multiple-cylinder			Driver type: AC motors: High torque[b] DC motors: Series-wound, compound-wound Engines: 4-cylinder or less		
	<6 h per day	6–15 h per day	>15 h per day	<6 h per day	6–15 h per day	>15 h per day
Agitators, blowers, fans, centrifugal pumps, light conveyors	1.0	1.1	1.2	1.1	1.2	1.3
Generators, machine tools, mixers, gravel conveyors	1.1	1.2	1.3	1.2	1.3	1.4
Bucket elevators, textile machines, hammer mills, heavy conveyors	1.2	1.3	1.4	1.4	1.5	1.6
Crushers, ball mills, hoists, rubber extruders	1.3	1.4	1.5	1.5	1.6	1.8
Any machine that can choke	2.0	2.0	2.0	2.0	2.0	2.0

[a]Synchronous, split-phase, three-phase with starting torque or breakdown torque less than 175% of full-load torque.
[b]Single-phase, three-phase with starting torque or breakdown torque greater than 175% of full-load torque.

(a) Calculate the design power using **Table Q2** if flat belt is used to operate for 15 hours daily.

(3 marks)

(b) Determine the operating tension on the tight side, T_1 and slack side, T_2.

(5 marks)

(c) Examine the width of the rubber belt by considering the centrifugal force effect on the system.

(8 marks)

(d) If centrifugal force effect is not included in the system, compare the new width of the rubber belt with your answer in Q2(b). Explain the difference.

(4 marks)

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Q3 (a) Reciprocating parts of an engine rotates and generate inertia forces which tends to induce shaking forces. Explain with a suitable diagram how to balance the primary inertia force of a reciprocating inline engine.

(4 marks)

(b) Dissolve Tank is equipped with shaft carries blade of A, B, C and D, placed in parallel planes perpendicular to the shaft rotating axis as shown in **Figure Q3.** The masses of B and C are 36 kg and 25 kg, respectively, and both are concentrated at a radius of 150 mm, while the masses in planes A and D are both at a radius of 200 mm. The angle between blade B and C is 100° and that between B and A is 190°. Both angle measured from plane B. The planes containing A and B are 250 mm apart and those containing B and C are 500 mm apart. If the shaft is to be in complete dynamic balance, determine;

(i) The mass of A and D.

(10 marks)

(ii) The distance between the planes, of blade C and D.

(3 marks)

(iii) The angular position of blade D from B.

(3 marks)

Q4 (a) List and explain **two (2)** major classification of friction in our daily life.

(4 marks)

(b) Static friction force is a necessary for human beings. Write down **six (6)** advantages of static friction in daily life.

(6 marks)

(c) A mass of weight W sits on a level surface shown in **Figure Q4.** One end of the surface is raised until the block begins to slide down the ramp at a constant velocity. The angle between the ground and the ramp's surface is θ. Examine the coefficient of friction between the block and the incline plane.

(10 marks)

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PART B (OPTIONAL):
ANSWER **ONE(1)** OUT OF TWO QUESTIONS

Q5 (a) In a particular mechanism system, explain the below terms:

(i) Kinematics link
(ii) Kinematic chain.
(iii) Lower pair.
(iv) Higher pair.

(4 marks)

(b) **Figure Q5** shows a space diagram of mechanism in a typical kinematics systems. Crank AB rotates at 200 RPM. Dimensions of the links are AB = 120 mm, link of BC = 480 mm, CD = 180 mm, DE = 360 mm, EF = 120 mm and FP = 360 mm,

(i) Determine the velocities at point C and P.

(10 marks)

(ii) Calculate the rubbing velocity at F if the pin diameter is 12 mm.

(2 marks)

(iii) Examine the torque produced at A if force 500 N is applied at slider P and system efficiency is 100%.

(4 marks)

Q6 A four crank inline engine has the two outer cranks set at 120° to each other, and their reciprocating masses are each 400 kg, The distance between the planes of rotation of adjacent cranks are 450 mm, 750 mm and 600 mm. The position of the planes of rotation of the cranks and their angular setting are shown in **Figure Q6**. By taking the plane of crank A as the reference point and the engine is to be in complete primary balance;

(a) Determine the reciprocating mass m_2 and m_3.

(14 marks)

(b) Find the relative angular positions for each of the inner cranks.

(1 marks)

(c) If the length of each cranks is 300 mm, the length of each connecting rods is 1.2 m, and the speed of rotation is 240 rpm. Compare the maximum secondary unbalanced force with the primary unbalanced force.

(5 marks)

-END OF QUESTIONS-

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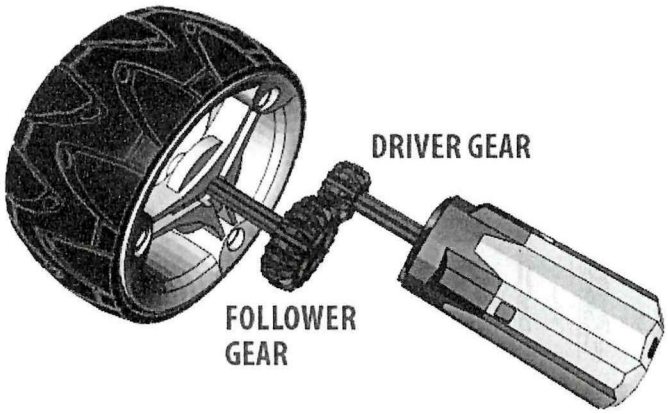
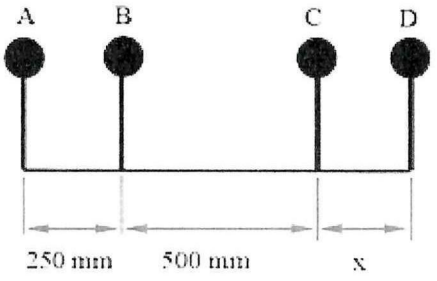


Figure Q1



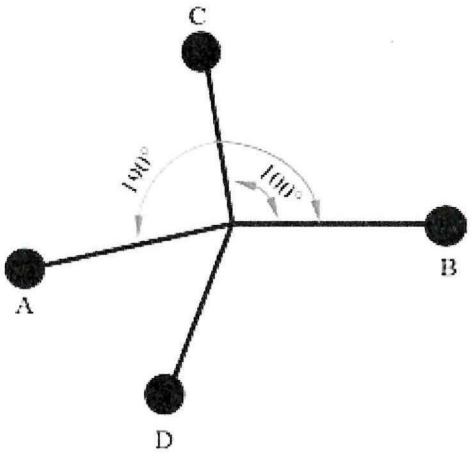


Figure Q3

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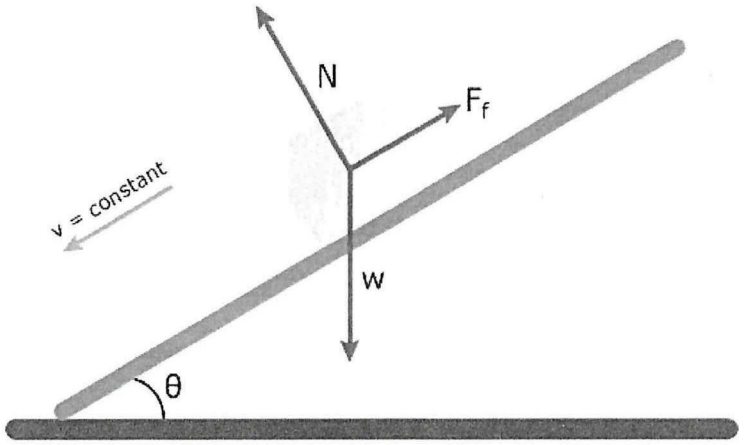

Figure Q4

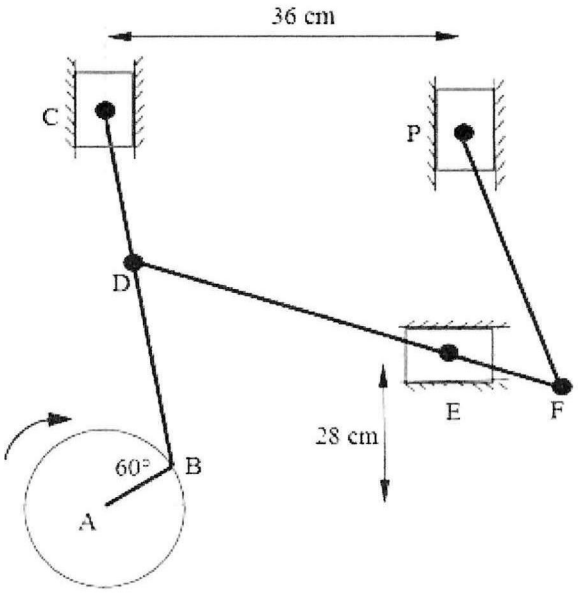

Figure Q5

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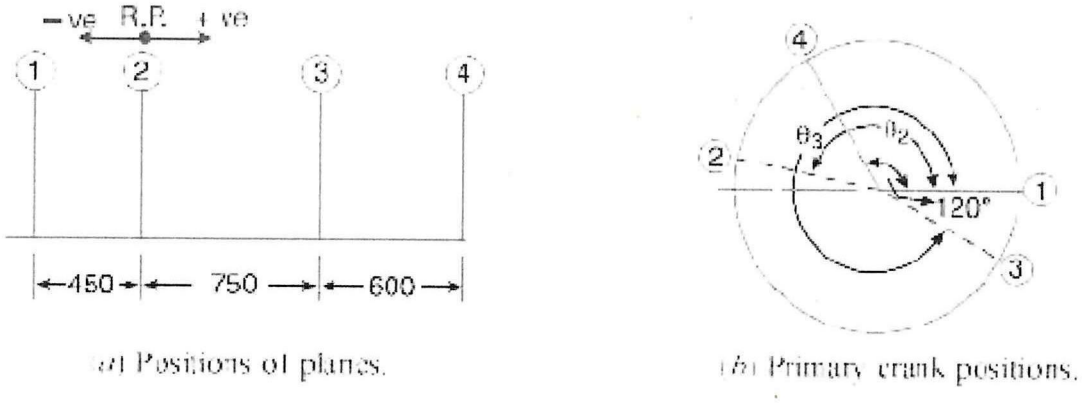

(a) Positions of planes. (b) Primary crank positions.

Figure Q6

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