Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2023/2024

COURSE NAME	:	MECHANICS OF MACHINE
COURSE CODE	:	BDA 20303
PROGRAMME CODE	:	BDD
EXAMINATION DATE	:	JULY 2024
DURATION	:	3 HOURS
INSTRUCTIONS	:	1. ANSWER **FIVE (5)** QUESTIONS FROM SIX (6) QUESTIONS ONLY 2. THIS FINAL EXAMINATION IS CONDUCTED VIA ☐ Open book ☒ 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 **SIX (6)** PAGES

Q1 Answer the following questions,

(a) List three types of the gear and explain the meaning of gear efficiency.

(6 marks)

(b) Total mass for a two wheeled motorcycle including passenger is 190 kg. The engine produces torque of 25 Nm at speed of 1800 RPM. The effective diameter of the wheel is 610 mm. The motorcycle is moving on a road with a speed of 23 km/h. If the wind friction and gear efficiency are 185 N and 90%, respectively.

(i) Determine the angular velocity, ω of the wheel

(2 marks)

(ii) Determine the power, P of the engine

(2 marks)

(iii) Calculate the torque, T of the wheel.

(4 marks)

(iv) Calculate the acceleration, a of the motorcycle at a speed of 23 km/h.

(6 marks)

Q2 Please answer the following questions:

(a) Explain the difference between centripetal force and centrifugal force. Support your with sketch.

(5 marks)

(b) Flat belt system has an angle of lap with 160°. Given the wheel speed, the wheel diameter and the coefficient of friction as 1378 RPM, 300 mm and 0.4, respectively. If the tension in a belt is 30N when stationary,

(i) Estimate the velocity of the wheel

(3 marks)

(ii) Calculate the tension for each side

(8 marks)

(iii) Calculate the power transmitted when the belt is on the point of slipping on the smaller wheel

(4 marks)

Q3 A rotor has the following properties as shown in **Table Q3.1**. The shaft is balanced by two counter masses m_P and m_Q revolving in planes midway of planes A and B, and midway of C and D. Taking mass P as a reference plane, determine the magnitudes and their respective angular positions;

(20 marks)

Table Q3.1

Mass	Magnitude (kg)	Radius (mm)	Angle (θ)	Axial distance from first mass A (mm)
A	9	100	0°	0
P	m_P	100	θ_P	l_P
B	7	120	60°	160
C	8	140	135°	320
Q	m_Q	100	θ_Q	l_Q
D	6	120	270°	560

Q4 Please answer the following questions:

(a) Sketch and explain the advantage of cone clutch

(4 marks)

(b) A clutches are mechanical devices linking power sources and output components, like drive shafts and driven shafts. They engage and disengage power transmission in various systems plate. A series of multiple clutch has three discs on the driving shaft and two discs on the driven shaft, providing four pairs of contact surfaces each of 240 mm external diameter and 120 mm internal diameter is concern. Given the clutch assembly are able to transmit 25 kW of power at 1575 RPM within coefficient of friction, $\mu = 0.3$

(i) Determine the total torque transmitted.

(2 marks)

(ii) Calculate the total axial force of the spring pressing the plates together assuming uniform pressure theory.

(6 marks)

(iii) Later wear and tear took place and all of the contact surfaces has worn off by 1.25 mm individually. If the clutches assembly has six unit of coil spring with a stiffness of 13,000 N/m each. Predict the new available power of the clutch assuming uniform wear theory having the same value of rotational speed and coefficient of friction

(8 marks)

Q5 Answer the following questions

(a) Explain the differences between machine and mechanism.

(4 marks)

(b) A four bar linkage ABCD is fixed to ground at A and D. The rotational anchor AB with 40 mm length rotates at 120 RPM clockwise. Other dimensions are stated in **Figure Q5.1**

(i) Determine thr velocity at point B, v_{BA}

(2 marks)

(ii) Analyze the space and velocity diagram at an instant

(9 marks)

(iii) Evaluate the angular velocity of link CD

(5 marks)

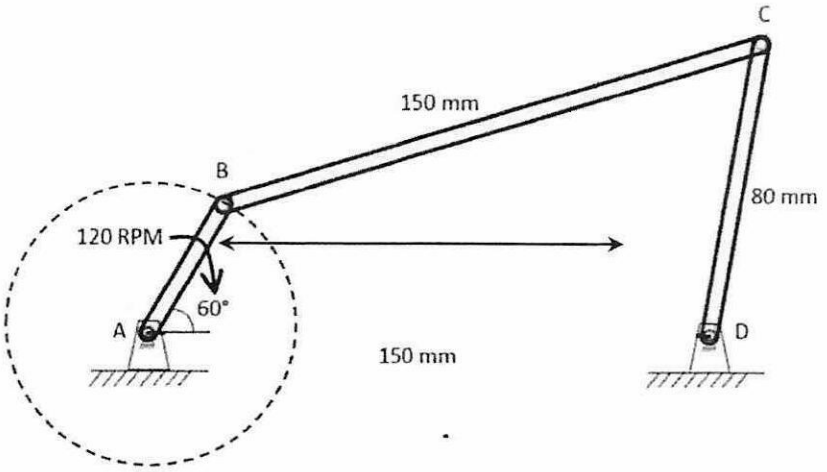

Figure Q5.1

Q6 The mechanism as shown in **Figure Q6.1** consists of five links with various lengths. Given the lengths of *AB* and *DE* are 150 mm, *BC* and *CD* are 450 mm and *EF* is 375 mm. The lever *DC* oscillates about the fixed-point *D*, where it is connected to *AB* by the coupler *BC*. Then, block *F* moves in the horizontal guides being driven by the *EF*. If link *AB* at 45° and angular velocity, ω_{AB} rotates in clockwise direction at a uniform speed of 120 RPM,.

(a) Estimate the velocity of v_{AB}, v_{CB} and v_{CD} by using the velocity diagram

(10 marks)

(b) Calculate the angular velocity of ω_{CD} and ω_{CB} including their directions.

(6 marks)

(c) Evaluate the rubbing velocity at the pin C if the diameter of pin is 40 mm.

(4 marks)

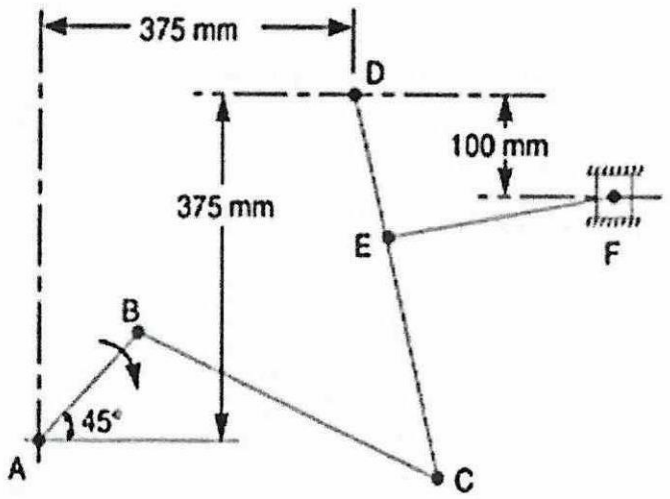

Figure Q6.1

- END OF QUESTIONS -

APPENDIX A

LIST OF FORMULA

Gear Ratio, $i = \frac{\omega_2}{\omega_1} = \frac{\alpha_2}{\alpha_1} = \frac{D_1}{D_2}$

Equivalent of Moment Inertia , $I_{eq} = \left(I_A + \frac{I_B i^2}{\eta}\right)$

Flat Belt Ratio, $\frac{T_t}{T_s} = e^{\mu\theta}$

V Belt Ratio, $\frac{T_t}{T_s} = e^{\left(\frac{\mu\theta}{sin\left(\frac{\alpha}{2}\right)}\right)}$

Power Transmisson for Belt Ratio, $P = (T_t - T_s)v$

Centrifugal Force, $T_c = \rho A v^2$

Limiting Angle of Friction, $\tan\theta = \mu$

Screw Thread, $\tan\alpha = \frac{p}{\pi d}$

Motion Up the Plane for Screw, $P = W\frac{\tan\alpha + \mu}{1 - \mu\tan\alpha}$

Motion Down the Plane for Screw, $P = W\frac{\mu - \tan\alpha}{1 + \mu\tan\alpha}$

Linear Velocity, $v = r\omega$

Radial Acceleration, $a_R = r\omega^2 = \frac{v^2}{r}$

Tangential Acceleration, $a_T = r\alpha$