UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(TAKE HOME)
SEMESTER II
SESSION 2019/2020

COURSE NAME	:	MECHATRONIC MECHANISM
COURSE CODE	:	BEH 41103
PROGRAMME CODE	:	BEJ
EXAMINATION DATE	:	JULY 2020
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS
		OPEN BOOK EXAMINATION

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

Q1 (a) (i) Define mechanism in mechanical engineering.

(1 mark)

(ii) Identify engineering principles in mechanics, dealing with motion, time and forces.

(3 marks)

(iii) Explain planar mechanism.

(1 mark)

(iv) Give **TWO (2)** examples of planar mechanism in applications.

(2 marks)

(b) The main purpose of mechanism is to exhibit motion such that a target spot or path could be achieved.

(i) Point out the meaning of mobility of a mechanism.

(2 marks)

(ii) Distinguish the meaning of mobility if the index number is m > 0 or m = 0 or m < 0.

(3 marks)

(iii) Sketch the kinematic diagram of the linkages shown by **Figure Q1(b).**

(4 marks)

(iv) Calculate mobility of the mechanism shown by **Figure Q1(b)**, by applying Kutzbach Criterion.

(4 marks)

(c) **Figure Q1(c)** shows a crank 50 mm radius which rotates at 2000 rev/min anticlockwise. Calculate the velocity of the piston for the position shown and the angular velocity of link AB about A.

(5 marks)

Q2 (a) (i) Define gears in power transmission system.

(2 marks)

(ii) State the purposes of using gears in power transmission system.

(3 marks)

(b) A simple gear train has **TWO (2)** spur gears. The input gear has 20 teeth and the output gear has 100 teeth. The input rotates at 2000 rev/min clockwise.

    (i) Calculate the gear ratio and the output speed.

(2 marks)

    (ii) The input torque is 15 Nm and the efficiency is 65%. Calculate the output power and the holding torque.

(2 marks)

(c) An epicyclic gear box shown in **Figure Q2(c)** has a fixed outer gear C with 240 teeth. The planet gears have 20 teeth. The input is the arm/cage A and the output is the sun gear D. Calculate the number of teeth on the sun gear and the ratio of the gear box.

(6 marks)

(d) Power Transmission (Belting)

    (i) Compare the use of power transmission system between gear systems and belting systems.

(2 marks)

    (ii) Illustrate open belt drive and cross belt drive.

(2 marks)

    (iii) A belt embraces the shorter pulley by an angle 145° and run at speed of 2400 m/min. Dimensions of the belt are: width, 25 cm and thickness, 10 mm. Its density is $1 \, gm/cm^3$. Calculate the maximum power that can be transmitted at the above speed, if the maximum permissible stress in the belt in not to exceed $250N/cm^2$ and friction coefficient is 0.25.

(6 marks)

Q3 (a) (i) Illustrate the physical phenomena if a rotating shaft as shown in **Figure Q3(a)** is "unbalanced".

(3 marks)

    (ii) Explain the physic of the phenomena illustrated in **Q3(a)(i)**.

(4 marks)

CONFIDENTIAL

TERBUKA

(b) Calculate the 4th mass that should be added at a radius of 50 mm in order to statically balance a system consist of multiple masses in the same plane. Given that:
- Mass A is 1 kg at 100 mm radius
- Mass B is 1.5 kg at 75 mm radius.
- Mass C is 2.0 kg at 90 mm radius.
- The angles between Mass A and B is 45° ; Mass A and C is 165°.

(4 marks)

(c) The planes as shown in **Table Q3(c)** and **Figure Q3(c)** containing masses B and C is 400 mm apart. The angle between planes containing B and C is 90°. B and C make angles of 200° and 110° respectively with D in the same sense. Calculate:

(i) The distance between planes A and B, and planes A and D.

(6 marks)

(ii) The magnitude and the angular position of mass A.

(4 marks)

(d) Demonstrate the procedures of car tire balancing using a balancing machine.

(4 marks)

Q4 (a) (i) Sketch the free body diagram of the model of Limiting Angle of Friction, where a mass is to be moved on a horizontal surface.

(5 marks)

(ii) Derive the equation of the limiting angle of friction, $\emptyset$.

(2 marks)

(b) Demonstrate the terminology of pitch p, lead l and lead angle λ of screw thread.

(5 marks)

(c) A body resting on a rough horizontal plane required a pull of 180 N inclined at 30° to the plane just to move it. It was found that a push of 220 N inclined at 30° to the plane just moved the body. Calculate the weight of the body and the coefficient of friction.

(4 marks)

(d)   Mean diameter of a square threaded spindle of screw jack is 35 mm and the screw pitch is 10 mm. If the coefficient of friction between the screw and the nut is 0.15, by neglecting friction between the nut and the collar. Calculate:

      (i)   Force required to apply at the end of 1 m in length tommy bar to raise a load of 20 kN.

(5 marks)

      (ii)   Efficiency of the screw.

(4 marks)

- END OF QUESTIONS -

CONFIDENTIAL

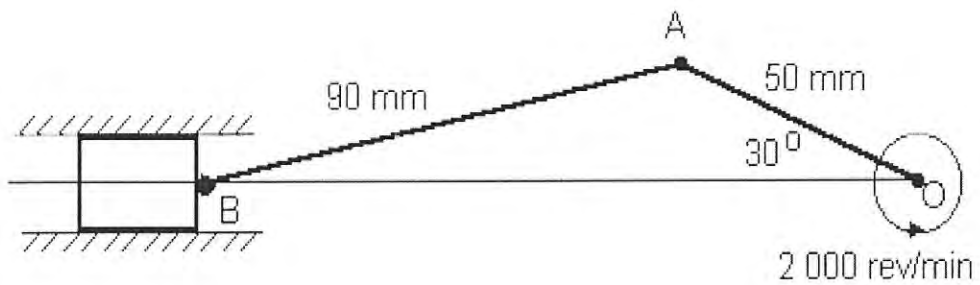| FINAL EXAMINATION			
SEMESTER/SESSION	: SEM II/2019/2020	PROGRAMME CODE	:BEJ
COURSE NAME	: MECHATRONIC MECHANISM	COURSE CODE	:BEH41103
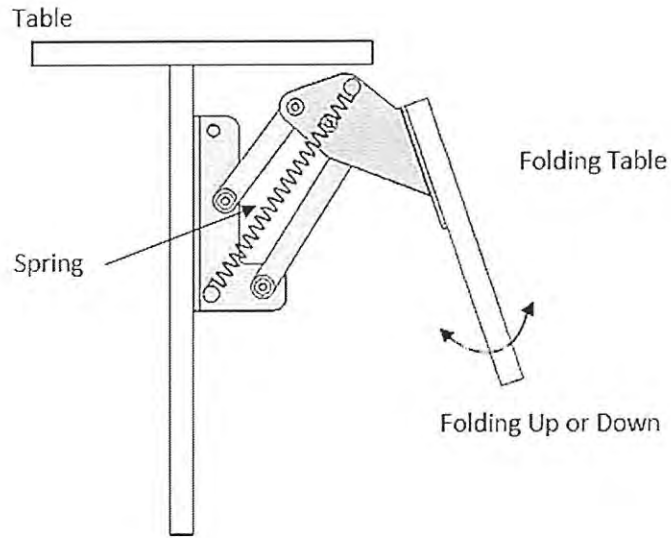
Figure Q1 (b)

Figure Q1 (c)

6

TERBUKA

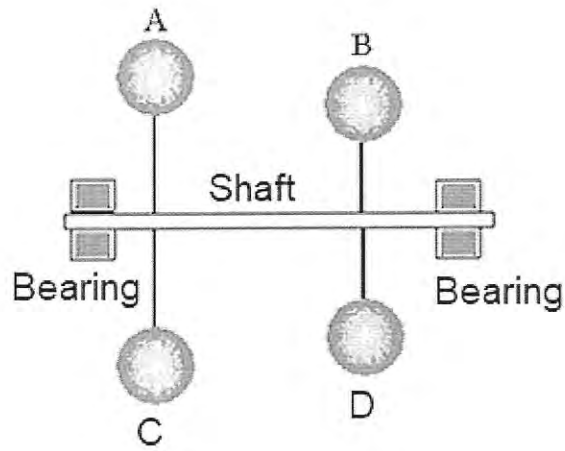| FINAL EXAMINATION		
SEMESTER/SESSION : SEM II/2019/2020	PROGRAMME CODE	:BEJ
COURSE NAME : MECHATRONIC MECHANISM	COURSE CODE	:BEH41103
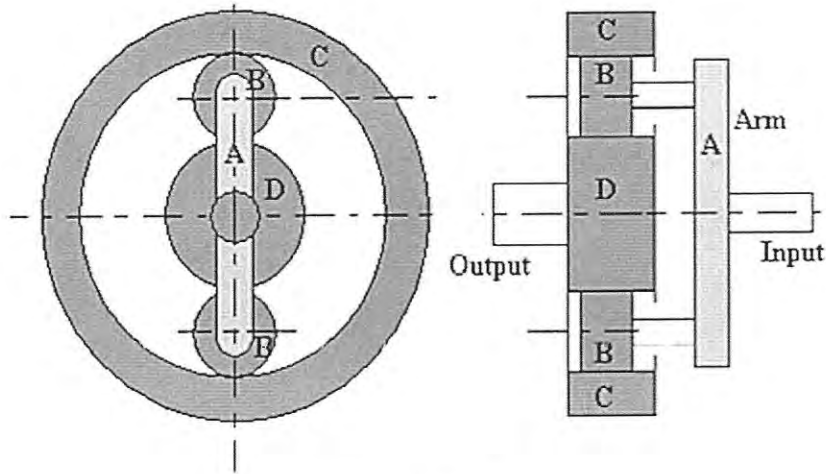
Figure Q2 (c)

Figure Q3 (a)

TERBUKA

Table Q3 (c)

	A	B	C	D
Mass (kg)	M_A	60	50	80
Radius (mm)	180	240	120	130

Figure Q3 (c)

TERBUKA