INTI International University & Colleges

FINAL
ALTERNATIVE ASSESSMENT

(COVER PAGE)

Session	:	**April 2021**
Programme	:	Diploma in Mechanical Engineering (DMEN)
Course	:	**EGM2160: Mechanics of Machines**
Date of Examination	:	28 July 2021 (Wednesday)
Time	:	12.00noon – 2.15pm Reading Time : Nil
Duration	:	2 Hours 15 Minutes

Special Instructions :

This paper consists of **FOUR (4)** questions. Answer **ALL** questions. All questions carry equal marks.

Material permitted :
Non-Programmable Scientific Calculator

Materials provided :
Nil

Examiner(s)	:	**Phua Chin Lai**
Chief Moderator	:	Tham Chan Seng

*This paper consists of **6** printed pages, including the cover page*

DIPLOMA IN MECHANICAL ENGINEERING PROGRAMME (DMEN)
EGM2160: MECHANICS OF MACHINES
FINAL ALTERNATIVE ASSESSMENT: APRIL 2021 SESSION

Instructions: This paper consists of **FOUR (4)** questions. Answer **ALL** questions. All questions carry equal marks.

Question 1

(a) A cone clutch is required to transmit 30 kW at 1200 rev/min. The mean diameter of the bearing surface is 250 mm and the cone angle is 25°. Assuming μ = 0.3 and a normal pressure of 140 kN/m^2, compute

(i) the axial load required

(ii) the width of the conical contact surface.

(12 marks)

(b) A centrifugal friction clutch has a driving member consisting of a spider carrying four shoes. The inside diameter of the drum is 300 mm and the radial distance of the center of gravity of each shoe from the shaft axis is 125 mm. Compute the necessary mass of each shoe, if the power of 22.5 kW is to be transmitted at 750 rev/min with the engagement beginning at 75% of the running speed. Assume $\mu = 0.25$.

(13 marks)

Question 2

(a) Figure Q2(a) shows an epicyclic gear. The gear B has 120 teeth externally and 100 teeth internally. The driver A has 20 teeth and arm E is connected to the driven shaft. Gear D has 60 teeth. If gear A revolves at 100 rev/min counter-clockwise and gear D revolves at 27 rev/min counter-clockwise, find the speed of arm E.

(17 marks)

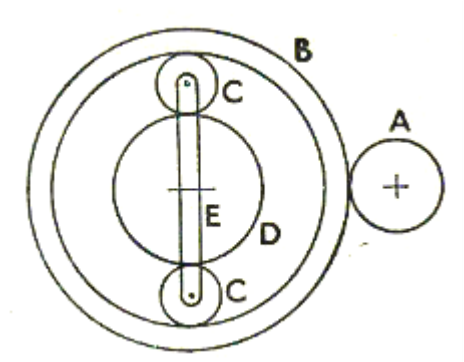

Figure Q2(a)

(b) A compound train consist of six gears. The number of teeth on the gears are tabulated in Table 2(b)

Gear	*A*	*B*	*C*	*D*	*E*	*F*
No. of teeth	80	40	60	20	40	30

Table 2(b)

The gears *B* and *C* are on one shaft while the gears *D* and *E* on another shaft. The gear *A* drives gear *B*, gear *C* drives gear *D* and gear *E* drives gear *F*. If gear *A* transmits 2 kW at 200 rev/min and the gear train has an efficiency of 85%, compute the torque on gear *F*.

(8 marks)

Question 3

(a) A Watt governor with the length of the upper arm, 350 mm and its inclination to the vertical is 30°. Calculate the percentage increase in speed, if the balls rise by 25 mm.

(10 marks)

(b) The Proell governor as shown in Figure Q3(b), each ball has a mass of 1.8 kg and the effect of friction is equivalent to a force of 9 N at the sleeve. Given AB = 150 mm, BC = 50 mm and BD = 150 mm.

If the governor is to rise to it mean position as shown in the diagram when the speed is 120 rev/min, the extension BC of lower arm is being vertical, compute the mass of the central load on the sleeve. Assume the governor to be symmetrical in which only one side of the diagram is shown.

(15 marks)

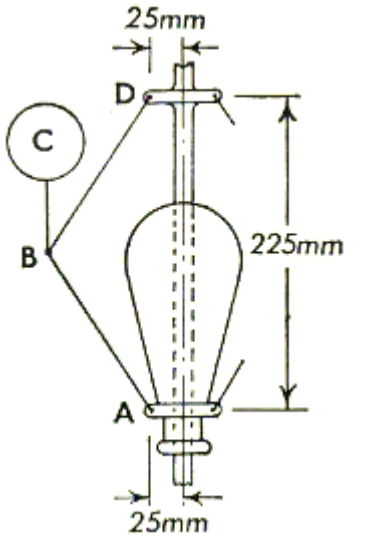

Figure Q3(b)

Question 4

(a) A Porter governor shown in Figure Q4(a), it has 300 mm arms and the rotating balls each have a mass of 1.8 kg. At the mean speed of 120 rev/min, the arms make 30º to the vertical. Compute

(i) the central dead load, (7 marks)

(ii) the lowest and highest speed if the sleeve movement is ± 25 mm. (5 marks)

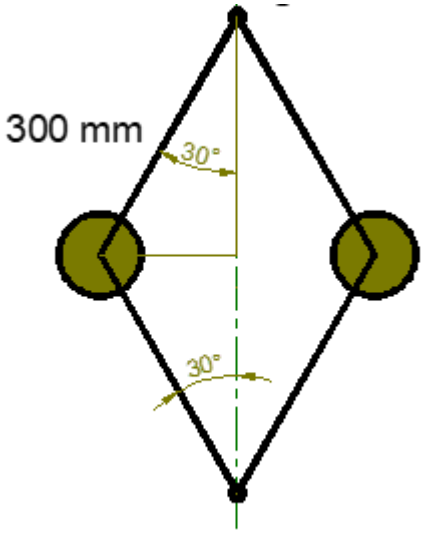

Figure Q4(a)

(b) A machine is driven by a friction disc clutch, both sides of the disc are being effective in producing driving friction. The external and internal diameter of the disc are 200 mm and 125 mm respectively. The axial pressure applied to the disc is 70 kN/m^2 and μ =0.25. Assuming the pressure is uniformly distributed, compute

(i) the torque transmitted (6 marks)

(ii) if the machine is at rest, the clutch is suddenly engaged, how long does it take for the machine to attain a speed of 300 rev/min. Given the mass moment inertia of the rotating parts of the machine is 4.7 kgm^2.

(7 marks)

Formula Sheet

Plate clutch

Uniform pressure	**Uniform wear**
$W = \pi P(r_1{}^2 - r_2{}^2)$	$W = 2\pi C(r_1 - r_2)$ where $C = Pr$
$R = \frac{2}{3}\left(\frac{r_1{}^3 - r_2{}^3}{r_1{}^2 - r_2{}^2}\right)$	$R = \frac{1}{2}(r_1 + r_2)$
$T = n\mu WR$	$T = n\mu WR$

Centrifugal clutch

$T = n\mu(P_c - P_s)r_D$, where $P_c = m\omega^2 r_G$, $P_s = m{\omega_1}^2 r_G$ *or* F_{spring}, r_D = drum radius and r_G = radius of center gravity of mass

~THE END~

EGM2160 (F)/ April 2021 Session/ formatted