INTI International University & Colleges

**FINAL**
**ALTERNATIVE ASSESSMENT**

(COVER PAGE)

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| Session | : | **January 2021** |
| Programme | : | Diploma in Mechanical Engineering (DMEN) |
| Course | : | **EGM2160: Mechanics of Machines** |
| Date of Examination | : | 12 March 2021 (Friday) |
| Time | : | 8.00am – 10.15am  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

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|---|---|---|
| Examiner(s) | : | **Phua Chin Lai, Tham Chan Seng** |
| Chief Moderator | : | Soo Swee Yoong |

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

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

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

**Question 1**

(a) A motor drives a machine through a friction clutch which transmits a torque of 150 Nm, while slip occurs during engagement. The rotor of the motor has a mass of 60 kg, with radius of gyration 140 mm and the inertia of the machine is equivalent to a mass of 20 kg at the driving shaft with radius of gyration 80 mm. If the motor is running at 750 rev/min. and the machine is at rest, compute,

(i) The angular speed after the engagement of the clutch and the time taken,

(12 marks)

(ii) The kinetic energy lost during the operation.

(5 marks)

(b) Compute the maximum, minimum and average pressure in a plate clutch when the axial force is 4 kN. The inside radius of the contact surface is 50 mm and the outside radius is 100 mm. Assume uniform wear.

(8 marks)

**Question 2**

(a) Figure Q2(a) shows an epicyclic gear has a fixed annular wheel C concentric with a sun wheel A. A planet wheel B gears with A and C and can rotate freely on a pin carried by an arm D which rotates about an axis co-axial with that A and C. If $T_A$ and $T_C$ are the numbers of teeth on A and C respectively,

(i) Show that the ratio of the speeds of D to A is $T_A/(T_A + T_C)$. (8 marks)

(ii) If the least number of teeth on any wheel of A or B is 18, and $T_A + T_C = 120$, compute the greatest and least speeds of D when the wheel A rotates at 500 rev/min. (9 marks)

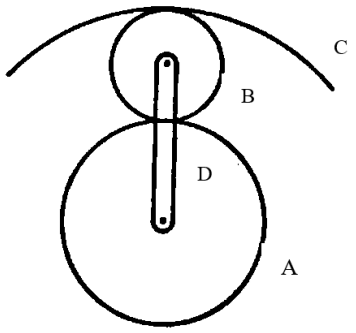


Figure Q2(a)

(b) Two parallel shafts are to be connected by spur gearing. The approximate distance between the shafts is 600 mm. if shaft *A* runs at 120 rev/min. and shaft *B* at 360 rev/min., compute,

(i) The number of teeth on each wheel, if the module is 8 mm, (6 marks)

(ii) The exact distance of the shafts. (2 marks)

**Question 3**

(a) A multi plate clutch is to transmit 12 kW at 1500 rev/min. The inner and outer radii for the plates are to be 50 mm and 100 mm respectively. The maximum axial spring force is restricted to 1 kN. Assuming constant wear, compute,

(i) The necessary number of pairs of surfaces,
(ii) The necessary axial force, if $\mu = 0.35$.

(12 marks)

(b) The length of the upper arm of a Watt governor as shown in Figure Q3(b) is 400 mm and its inclination to the vertical is 30°. Compute the percentage increase in speed, if the balls rise by 20 mm.

(13 marks)

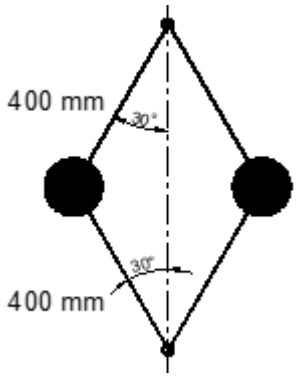


Figure Q3(b)

**Question 4**

(a) A governor of the Proell type is shown in diagrammatically, with certain dimensions in Figure Q4(a). The central load acting on the sleeve has a mass of 25 kg and the two rotating weights each have a mass of 3.2 kg. When the governor sleeve is in mid-position the arm AB of the cranked lever ABC is vertical, and the radius of the path of rotation of the weights is 175 mm. If the governor speed is to be 160 rev/min when in mid-position, compute,

(i) The length of the arm AB, and (5 marks)

(ii) The tension in the link BD. Neglect friction. (Hint: section member method) (5 marks)

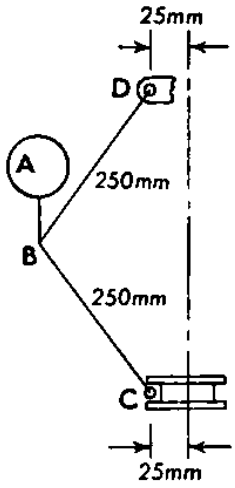


Figure Q4(a)

(b) A Porter governor shown in Figure Q4(b), its upper and lower arms are each 200 mm long, and are each inclined at 30° to the vertical when the sleeve is in its lowest position. The points of suspension are each 36 mm from the axis of the spindle. The mass of each rotating ball is 3 kg, and that of the central load on the sleeve 20 kg. If the movement of the sleeve is 36 mm, compute the range of speed of the governor.

(15 marks)

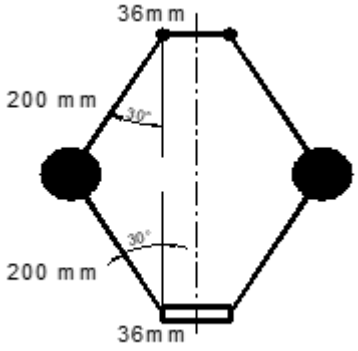


Figure Q4(b)

**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)/ January 2021 Session/ formatted*