

**FINAL  
ALTERNATIVE ASSESSMENT**

(COVER PAGE)

Session : April 2022

Programme : Diploma in Mechanical Engineering (DMEN)

Course : EGM 2169: Machine Components Design

Date of Examination : 03 August 2022(Wednesday)

Time : 08.00am-10.30am Reading Time : Nil

Duration : 2 Hours 30 Minutes

**Note:** 30 minutes is added into the duration of the examination to factor in any connectivity matters and for you to scan and upload your scripts

**Special Instructions :**

This paper consists of **FOUR (4)** questions. Answer **ALL** questions.

Material permitted : Non-Programmable Scientific Calculator

Materials provided : Nil

Examiner(s) : Ashwindran Naidu Sanderasagran

Chief Moderator : Chin Lai Phua

*This paper consists of 11 printed pages, including the cover page*

INTI INTERNATIONAL COLLEGE PENANG  
DIPLOMA IN MECHANICAL ENGINEERING PROGRAMME (DMEN)  
EGM 2169: MACHINE COMPONENTS DESIGN  
FINAL ALTERNATIVE ASSESSMENT: APRIL 2022 SESSION

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

**Question 1**

A vertical flat plate welded to a solid cylindrical shaft with diameter 62 mm and length 178 mm as shown in Figure Q1. The end of shaft is subject to a concentrated load of 20 kN. Determine the maximum normal and shear stress in the weld, if the size of the weld is 15 mm.

(25 marks)

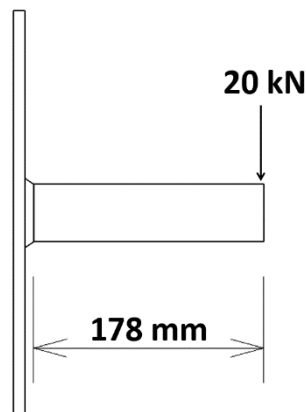


Figure Q1

**Question 2**

The rivet group shown in Figure Q2 connects two narrow lengths of plate, one of which carries a 15-kN load positioned as shown. If the ultimate shear strength of a rivet is 350 N/mm<sup>2</sup> and its compressive failure strength is 600 N/mm<sup>2</sup>, determine the minimum allowable values of rivet diameter and plate thickness.

(25 marks)

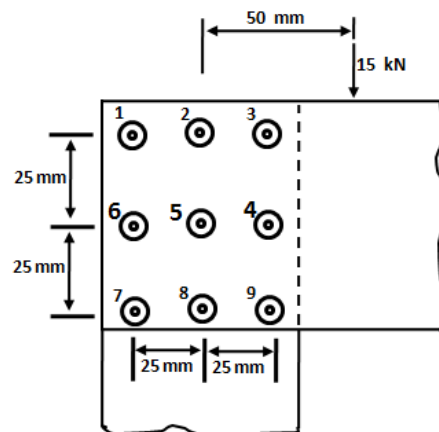


Figure Q2

**Question 3**

A pinion of 24 teeth drives a gear of 60 teeth at a pressure angle of  $20^\circ$ . The pitch radius of the pinion is 38 mm and outside radius is 41 mm. The pitch radius of the gear is 95 mm and the outside radius is 98.5 mm. Calculate the length of the action and contact ratio.

(25 marks)

**Question 4**

A vertical shaft of 140 mm diameter is positioned on a footstep bearing, which rotates at 120 rev/min. The shaft results a vertical load of 30 kN. The coefficient of friction is 0.06. Determine the power lost in friction, assuming in

(i) Uniform pressure and

(13 marks)

(ii) Uniform wear.

(12 marks)

**-THE END -**

*EGM 2169(F)/ 2022*

## Subject: Machines Components Design (EGM2169)

## Formula Sheet

## Eccentrically loaded riveted joint

$$P \times e = \frac{F_1}{L_1} (L_1^2 + L_2^2 + L_3^2 + \dots)$$

$$R = \sqrt{P_s^2 + F^2 + 2P_s \times F \times \cos \theta}$$

$$P_s = \frac{P}{n}, \text{ acting parallel to the load } P$$

$$\bar{x} = \frac{x_1 + x_2 + x_3 + \dots}{n}$$

$$\bar{y} = \frac{y_1 + y_2 + y_3 + \dots}{n}$$

## Simple Bending Equation

$$\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$$

## Simple Torsion Equation

$$\frac{T}{J} = \frac{\tau}{R} = \frac{G\theta}{L}$$

## For Shaft Design

## Equivalent Twisting Moment

$$T_e = \sqrt{M^2 + T^2}$$

## Equivalent Bending Moment

$$M_e = \frac{1}{2} \left[ M + \sqrt{M^2 + T^2} \right]$$

## Maximum Normal Stress

$$\sigma_n = \left( \frac{\sigma_x + \sigma_y}{2} \right) + \frac{1}{2} \sqrt{(\sigma_x - \sigma_y)^2 + 4\tau^2}$$

## Maximum Shear Stress

$$\tau_{max} = \frac{1}{2} \sqrt{(\sigma_x - \sigma_y)^2 + 4\tau^2}$$

**For Journal Bearings**

Coefficient of friction

$$\mu = (33 \times 10^{-8}) \left( \frac{ZN}{p} \right) \left( \frac{d}{c} \right) + 0.002$$

Heat generated

$$H_g = \mu WV$$

Heat dissipated

$$H_d = CA(t_b - t_a)$$

Uniform pressure, frictional torque

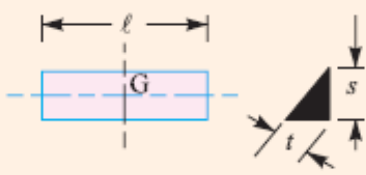
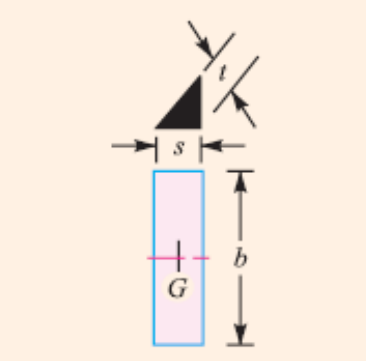
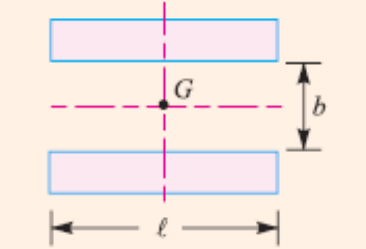
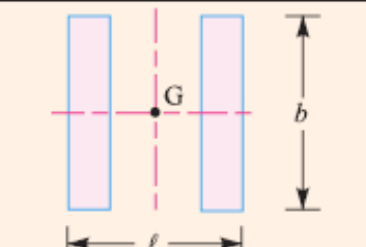
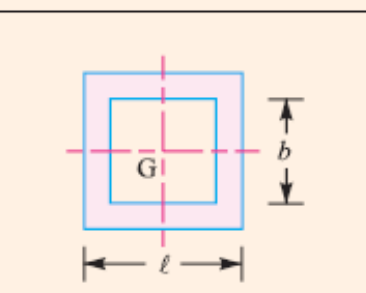
$$T = \frac{2}{3} \mu WR$$

Uniform wear, frictional torque

$$T = \mu W \frac{R}{2}$$

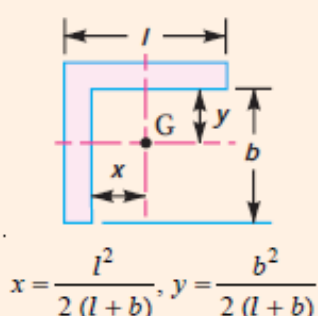
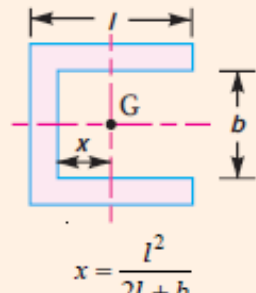
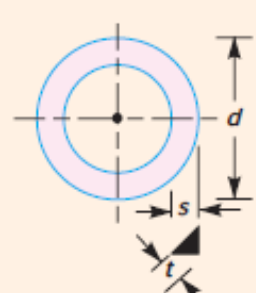
## Welded joints

Table 10.7. Polar moment of inertia and section modulus of welds.

S.No	Type of weld	Polar moment of inertia (J)	Section modulus (Z)
1.		$\frac{t.l^3}{12}$	—
2.		$\frac{t.b^3}{12}$	$\frac{t.b^2}{6}$
3.		$\frac{t.l(3b^2 + l^2)}{6}$	$t.b.l$
4.		$\frac{t.b(b^2 + 3l^2)}{6}$	$\frac{t.b^2}{3}$
5.		$\frac{t(b+l)^3}{6}$	$t \left( bl + \frac{b^2}{3} \right)$

Continue next page

## Welded joints

S.No	Type of weld	Polar moment of inertia (J)	Section modulus (Z)
6.	 $x = \frac{l^2}{2(l+b)}, y = \frac{b^2}{2(l+b)}$	$t \left[ \frac{(b+l)^4 - 6b^2l^2}{12(l+b)} \right]$	$t \left( \frac{4lb + b^2}{6} \right) \text{ (Top)}$ $t \left[ \frac{b^2 (4lb + b)}{6(2l + b)} \right]$ <p style="text-align: right;">(Bottom)</p>
7.	 $x = \frac{l^2}{2l + b}$	$t \left[ \frac{(b+2l)^3}{12} - \frac{l^2(b+l)^2}{b+2l} \right]$	$t \left( lb + \frac{b^2}{6} \right)$
8.		$\frac{\pi t d^3}{4}$	$\frac{\pi t d^2}{4}$

**Gear**

## Spur Gear design

$$W_T = \frac{P}{v} \times C_s$$

$W_T$  = Permissible tangential tooth load in newtons

$P$  = Power transmitted in watts

$$* v = \text{Pitch line velocity in m/s} = \frac{\pi DN}{60}$$

$D$  = pitch circle diameter

Circular pitch,

$$p_c = \frac{\pi D}{T} = \pi m, \quad D = m.T$$

Pitch line velocity

$$v = \frac{\pi \cdot D \cdot N}{60} = \frac{\pi m \cdot T \cdot N}{60} = \frac{p_c \cdot T \cdot N}{60}$$

$m$  = Module in metres

$T$  = Number of teeth

$N$  = Speed in r.p.m

$C_s$  = Service factor

Length of path contact,

$$L_p = (r_{a1}^2 - r_{b1}^2)^{0.5} + (r_{a2}^2 - r_{b2}^2)^{0.5} - (r_1 + r_2) \sin \alpha$$

Contact ratio,  $M_c$

$$M_c = \frac{L_p}{P_b}$$

Value of service factor

Type of load	Type of service		
	Intermittent or 3 hours per day	8-10 hours per day	Continuous 24 hours per day
Steady	0.8	1.00	1.25
Light shock	1.00	1.25	1.54
Medium shock	1.25	1.54	1.80
Heavy shock	1.54	1.80	2.00

Lewis equation

$$W_T = \sigma_w \cdot b \cdot p_c \cdot y = \sigma_w \cdot b \cdot \pi m \cdot y$$

Buckingham equation

$$W_D = W_T + W_I$$

$W_D$  =Dynamic load

**~THE END~**

EGM2169 (F)/ April 2022 Session/ formatted