Mechanical Eng. Dept.
ME 352

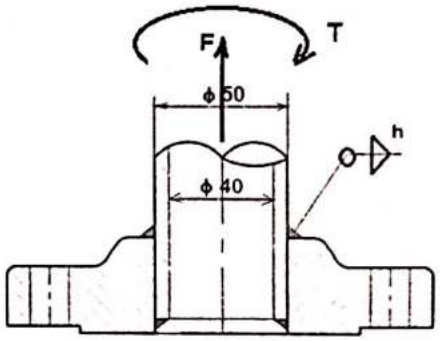
Taibah University
College of Engineering

Mechanical Design II
April 2018
MT-II
Time allowed: 60 Min.

Student Name: ..... I.D. #:.....

Problem (1) [8 Marks]

For the welded joints shown in figure below, find the weld size (**h**) under the following applied loads, (if its allowable shear strength = **100 MPa**).
Axial force, **F= 50** kN and Torsional load, **T = 2** kN.m



$$\tau_{d.s.} = \frac{F}{0.707 h \Sigma \ell}$$

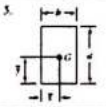
$$= \frac{50{,}000}{2 \times 0.707 h (2\pi \times 25)} = \frac{225.22}{h} \ N/mm^2$$

$$\tau_T = \frac{Tr}{J} = \frac{Tr}{2 \times 0.707 h J_u}$$

$$= \frac{2 \times 10^6 \times 25}{2 \times 0.707 h (2\pi \times 25^3)}$$

$$= \frac{360.36}{h} \ N/mm^2$$

Torsional Properties of Fillet Welds*

Weld	Throat Area	Location of G	Unit Second Polar Moment of Area
5. 	$A = 1.414h(b + d)$	$\bar{x} = b/2$ $\bar{y} = d/2$	$J_u = \frac{(b+d)^3}{6}$
6. 	$A = 1.414\pi hr$		$J_u = 2\pi r^3$

$$\tau_{Max.} = \tau_{d.s.} + \tau_T = \frac{585.6}{h} \leq 100 \Rightarrow h \geq 5.85 \ mm$$

Problem (2) [6 Marks]

An engine has its rated output power of **100 HP.** The clutch used is of multi-plate type as shown in figure below. The maximum contact pressure of the clutch lining is **850 kPa**. The external diameter and internal diameters of each friction plate are **250** and **150 mm**, respectively. Determine the maximum torque which can be transmitted by this clutch and at what speed. Coefficient of friction of clutch lining with flywheel = **0.35**.

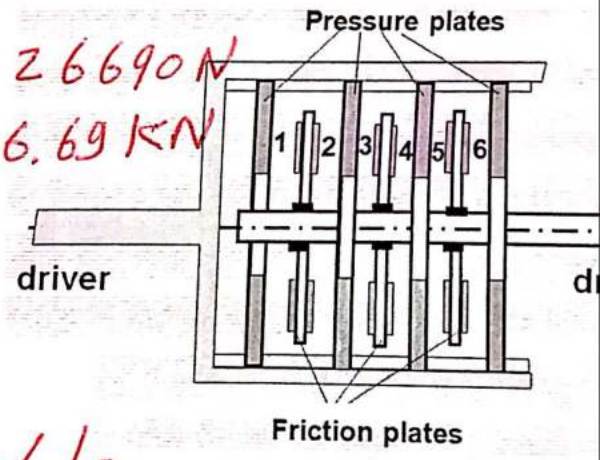
$F_a = 0.850\,\pi\,(125^2 - 75^2) = 26690\,N$

$= 26.69\,KN$

$T_b = 6 \times 26690 \times 100 \times 0.35$

$= 56049\ N.m$

$\omega = \dfrac{power}{T} = 13.38\ rad./s$



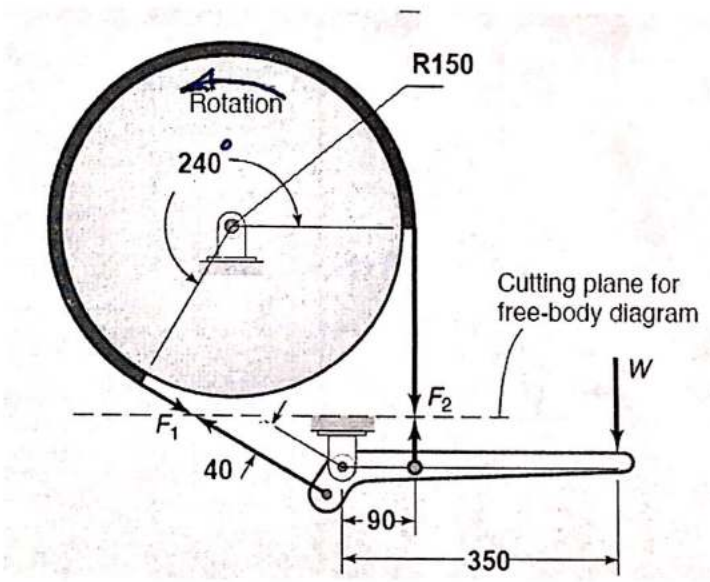
$F_a = P_c \pi\,(R_o^2 - R_i^2)$

$T_b = Z F_a R_m$

Problem (3) [6 Marks]

The band brake shown in figure below is actuated by force **W.** The band has a face width of **40 mm** and a mean coefficient of friction of **0.35**. If the maximum contact pressure between the band and drum is not to exceed **0.49 MPa**, find the following:

a- The band forces(**F1** and **F2**).
b- The braking torque.
c- Actuating force **W**.



$$\frac{F_2}{F_1} = e^{\mu\theta} = e^{0.35 \times \frac{240\pi}{180}}$$

$$= 4.286$$

$$P_{c_{MAX}} = \frac{F_2}{bR} = \frac{F_2}{40 \times 150}$$

$$F_2 = 2940\ N$$

$$F_1 = 685.95\ N$$

$$W \times 350 = F_2 \times 90 - F_1 \times 40$$

$$W = 677.6\ N$$

$$T_b = (F_2 - F_1)R = (2940 - 685.95) \times 0.150 = 338\ N.$$