

CARLETON UNIVERSITY

TEST #1
FEB 6 2014

DURATION: 1 HOUR

No. of Students: 51

Department Name & Course Number: **Mechanical & Aerospace Engineering MECH 4101**
Instructor(s): **SHASHANK PANT**

AUTHORIZED MEMORANDA

Course notes and calculator are permitted.

1. A long cylinder with **closed ends** is made of brass and has an internal radius of 35 mm and external radius of 75 mm. The temperature at the inner radius is 70°C greater than that at the outer radius under steady state conditions. Determine the magnitude of the **external pressure** that would initiate yielding in the cylinder according to:
 - (a) Tresca's criterion with the thermal load.
 - (b) Von-Mises yield criterion with the thermal load.

$$\text{Von-Mises Criterion: } \frac{1}{2} [(\sigma_\theta - \sigma_r)^2 + (\sigma_r - \sigma_z)^2 + (\sigma_\theta - \sigma_z)^2] = \sigma_y^2$$

For brass:

Young's modulus	$E = 97 \text{ GPa}$
Yield stress	$\sigma_y = 240 \text{ MPa}$
Poisson's ratio	$\nu = 0.35$
Coefficient of thermal expansion	$\alpha = 20 \times 10^{-6} / ^\circ\text{C}$