N.T	Ctudent I D
Name	Student I.D

Department of Mining and Materials Engineering Faculty of Engineering Prince of Songkla University

Final Exam for Semester: 2 Date: February 20, 2007

Subject: 237-221 Mechanical Metallurgy

Academic Year: 2006 Time: 09.00-12.00

Room: R300

Instructions

1. There are 6 problem sets. Please do all of them. Write your answers on the space provided after each problem set. If you need more space, you can write on the back of the paper.

2. Only one piece of A4-size note is allowed. You may write on both sides of the note. Please return it with your answers.

3. Dictionary, calculator, and stationery are allowed.

4. Text books, course notes, and other studying materials are not allowed.

5. This final exam is counted for 45% of the total grade.

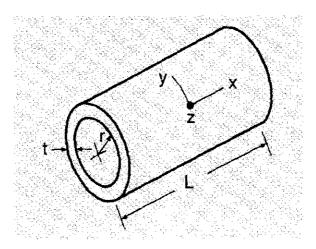
Asst. Prof. Dr. Thawatchai Plookphol

Problem No.	Full Score (points)	Student's Score (points)
1.	20	
2.	20	
3.	10	
4	10	
5.	10	
6.	20	
Total	90	

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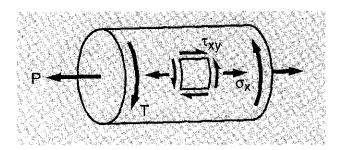
1. A cylindrical pressure vessel 10 m long (L) has closed ends, a wall thickness (t) of 5 mm, and an inner diameter (d) of 3 m. If the vessel is filled with air to a pressure of 2 MPa, how much do the length, diameter, and wall thickness change, and in each case is the change an increase or decrease? The vessel is made of a steel having elastic modulus E = 200,000 MPa and Poisson's ratio v = 0.3. Neglect any effects associated with the details of how the ends are attached. (20 points)



Hint: Assume thin-walled pressure vessel condition.		

N T	Student I.D
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- 2. A solid shaft having diameter (d) of 50 mm made of AISI 1020 steel with yield strength (σ_y) of 260 MPa is subjected to an axial load (P) of 200,000 N and a torque (T) of 1,500 N·m.
- 2.1 According to Tresca's yield criterion (Maximum shear stress yield criterion), will the yielding occur or not? Please show your calculation. (18 points)
 - 2.2 What is safety factor of the shaft? (2 points)



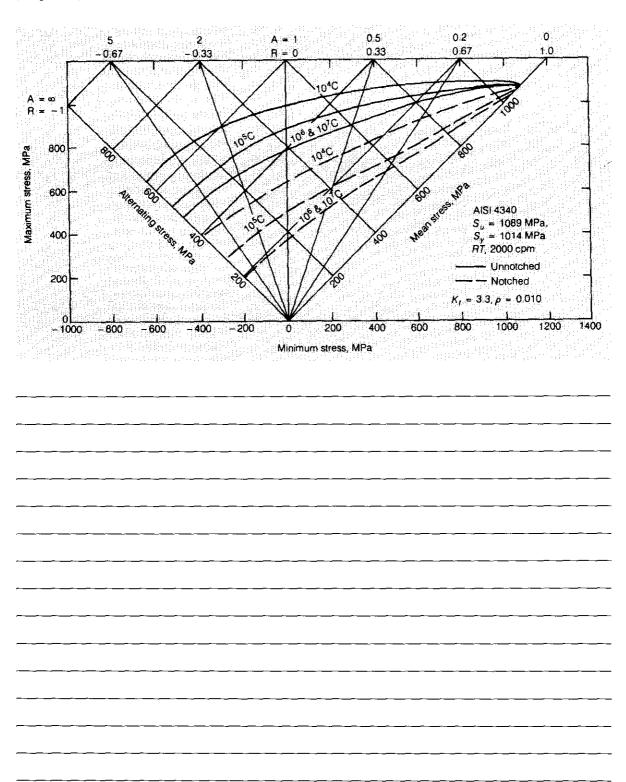
Given:	$\sigma_x = \frac{4P}{\pi d^2}$	$\tau_{xy} = \frac{16T}{\pi d^3}$	
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237-221 Final Exam

Page 6 of 10

Name.....Student I.D....

4. A rod made of AISI 4340 steel with diameter of 10 mm is subjected to a fluctuating axial load that varies from a maximum of 40,000 N tension to a minimum of 20,000 N compression. Use the diagram given below to estimate the fatigue life of the steel rod. (10 points)



Page 8 of 10

237-221 Final Exam

Page	e 9	of	10
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Name	Student LD	

6. The following data were obtained from creep tests at a constant temperature of 250 °C on 7075-T651 aluminum alloy.

σ (MPa)	$\dot{\mathcal{E}}_{SS}$ (s ⁻¹)
40	1.57×10 ⁻⁷
60	5.88×10 ⁻⁷
80	1.96×10 ⁻⁶
100	6.63×10 ⁻⁶
120	2.37×10 ⁻⁵

The steady state creep rate $\dot{\varepsilon}_{ss}$ can be expressed as

$$\dot{\varepsilon}_{ss} = A\sigma^n \exp(-\frac{Q_c}{RT})$$

6.1 Estimate the stress exponent n. (15 points)

6.2 What creep mechanism do you conclude from the experiments? Explain reason to		
support your answer. (5 points)		
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