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

Department of Mining and Materials Engineering

Faculty of Engineering

Prince of Songkla University

Mid-term Exam for Semester: 2 Academic Year: 2010

Date: December 21, 2010 Time: 9.00-12.00

Subject: 237-508 Structures and Mechanical Properties of Materials Room: หัวหุ่นฯ

Instructions

1. There are 4 problem sets. Please do all of them. Write your answers in the space provided. If you need more space, you can write on the back of paper.
2. Text books and other studying materials are not allowed.
3. Dictionary, calculator, and stationery are also allowed.
4. This mid-term exam is counted for 25% of the total grade.

Asst. Prof. Dr. Thawatchai Plookphol

Problem No.	Full Score (points)	Student's Score (points)
1.	20	
2.	40	
3.	30	
4.	10	
Total	100	

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

1. Explain the following terms:

1.1 Homogenous solid (2 points)

1.2 Isotropic solid (2 points)

1.3 Anisotropic solid (2 points)

1.4 Principal stresses (2 points)

1.5 Stress invariants (2 points)

1.6 Equilibrium equation (2 points)

1.7 Compatibility equation (2 points)

1.8 Linear elasticity (2 points)

1.9 Non-linear elasticity (2 points)

1.10 Elastic constant (2 points)

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

2. The three-dimensional state of stress is given by

$$\overline{\overline{\sigma}} = \begin{bmatrix} -300 & 0 & 100 \\ 0 & 100 & 0 \\ 100 & 0 & -100 \end{bmatrix} \text{ MPa.}$$

2.1 Determine the three principal stresses. (15 points)
2.2 Calculate the maximum shear stress. (5 points)
2.3 Determine the normal stress (σ) and shear stress (τ) acting on a plane with normal $\overline{n} = \left(\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}, 0\right)$. (20 points)

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

3. A silver single crystal experiences the 3-D state of stress of

$$\sigma_{ij} = \begin{bmatrix} 200 & 100 & 50 \\ 100 & 100 & 100 \\ 50 & 100 & -200 \end{bmatrix} \text{ MPa.}$$

Elastic constants of the crystal are given by

$S_{11} = 2.29\times10^{-2}$ GPa^{-1}
$S_{44} = 2.17\times10^{-2}$ GPa^{-1}
$S_{12} = -0.983\times10^{-2}$ GPa^{-1}

Determine the engineering strains, $[\varepsilon]$ in the silver crystal by assuming deformation is linear elastic. (30 points)

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

4. Explain the kinetic processes of grain boundary sliding in crystalline solid in term of equilibrium and compatibility equations (10 points)

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

Formula

$$\bar{\bar{s}} = \bar{\bar{\sigma}} \cdot \hat{n}$$

$$s_i = \sum_{j=1}^{3} \sigma_{ij} n_j$$

$$s^2 = s_1^2 + s_2^2 + s_3^2$$

$$\sigma = S_1 \cdot n_1 + S_2 \cdot n_2 + S_3 \cdot n_3$$

$$s^2 = \sigma^2 + \tau^2$$

where,

s = Total stress acting on the plane,
σ = Normal stress acting on the plane,
τ = Shear stress acting on the plane,
n_1, n_2, and n_3 are the direction cosines.