

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: 2009

Date: December 22, 2009

Time: 9.00-12.00

Subject: 237-508 Structures and Mechanical Properties of Materials

Room: S203

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. Only two (2) pieces of A4-size note are allowed. You may write on both sides of the note. Please return it with your answers.
3. Dictionary, calculator, and stationery are also allowed.
4. Text books and other studying materials are not allowed.
5. This mid-term exam is counted for 30% of the total grade.

Asst. Prof. Dr. Thawatchai Plookphol

| Problem No. | Full Score (points) | Student's Score (points) |
|-------------|---------------------|--------------------------|
| 1. | 20 | |
| 2. | 40 | |
| 3. | 20 | |
| 4. | 10 | |
| Total | 90 | |

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1. Explain the following terms:

- 1.1 Principal stresses (2 points)
 - 1.2 Stress invariants (2 points)
 - 1.3 Equilibrium equation (2 points)
 - 1.4 Compatibility equation (2 points)
 - 1.5 Linear elasticity (2 points)
 - 1.6 Non-linear elasticity (2 points)
 - 1.7 Viscoelasticity (4 points)
 - 1.8 Viscoplasticity (4 points)

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3. An aluminum single crystal experiences the 3-D state of stress of

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

Elastic constants of the crystal are given by:

$$\begin{aligned} S_{11} &= 15.7 \text{ TPa}^{-1} \\ S_{12} &= -5.7 \text{ TPa}^{-1} \\ S_{44} &= 35.1 \text{ TPa}^{-1} \end{aligned}$$

Determine the engineering strains, $[\varepsilon]$ in the aluminum specimen by assuming deformation is linear elastic. (20 points)

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