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

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

Final Examination for Semester: 2 Academic Year: 2006
Date: February 19, 2007 Time: 09.00-12.00
Subject: 237-508 Structures and Mechanical Properties of Materials Room: A203

Instruction

1. There are 5 problem sets. Please do all of them and 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. It can be written on both sides.
3. Dictionary, calculator and stationery are allowed.
4. Text books, course notes, lecture notes and other studying materials are not allowed.
5. This final exam is counted for 50% of the total grade.

Asst. Prof. Dr. Thawatchai Plookphol

Problem No.	Full Score (points)	Student's Score (points)
1.	10	
2.	10	
3.	10	
4.	10	
5.	10	
Total	50	

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1. Explain the following terms:

1.1 Elasticity	(2 points)
1.2 Plasticity	(2 points)
1.3 Workhardening	(2 points)
1.4 Hall-Petch Effect	(2 points)
1.5 Recovery	(2 points)

Please describe how the microstructures evolve and/or relate to the mechanical behavior.

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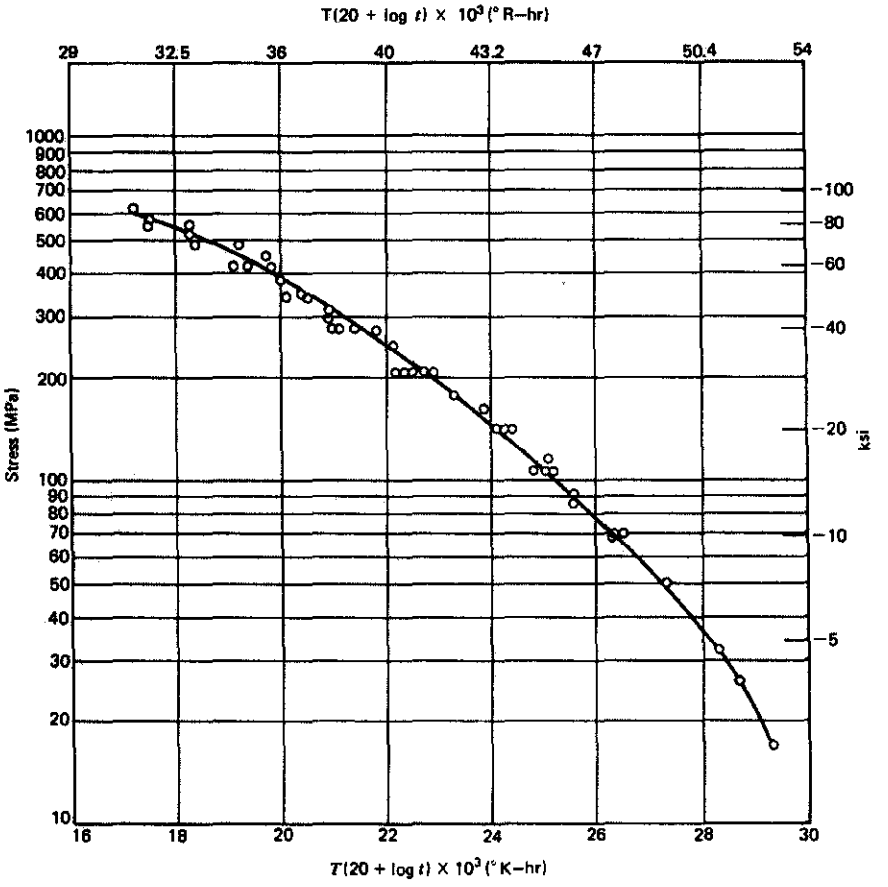
2. A Larson-Miller plot for S-590 iron-based alloy is given below.



2.1 Determine the expected life for a sample tested at 500°C with stress 200 MPa. (5 points)

2.2 What is the maximum operational temperature such that failure should not occur in 10,000 hours at stress level of 100 MPa? (5 points)

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3. If you are planning to perform creep experiment on the alloy you have developed. The information from literature review suggests that creep behavior of the alloy may be governed by a power law creep of the form,

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

where, $\dot{\varepsilon}_{ss}$ is the steady state creep rate

A is the material constant

σ is the creep stress

n is the creep stress exponent

Q_c is the activation energy for creep

R is the universal gas constant (8.314 J/mole·K), and

T is the absolute temperature.

Please propose the experimental procedure to get the creep parameters.

3.1 The creep stress exponent, n. (5 points)

3.2 The activation energy for creep, Q_c. (5 points)

Explain how to set up the creep experiment.

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4. Explain the following creep mechanisms:

4.1 Power law dislocation creep (5 points)

4.2 Diffusional creep

(a) Nabarro-Herring creep (2.5points)

(b) Coble creep (2.5 points)

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5. The linear relationship between crack growth rate ($\frac{dc}{dN}$) and stress intensity range (ΔK) on the log-log scale can be expressed as

$$\frac{dc}{dN} = C(\Delta K)^p$$

5.1 Estimate the values of constants C and p for aluminum alloy from the data shown below. (5 points) **Please use basic SI units.**

5.2 Describe the microstructural evolution due to the fatigue loading. (5 points)

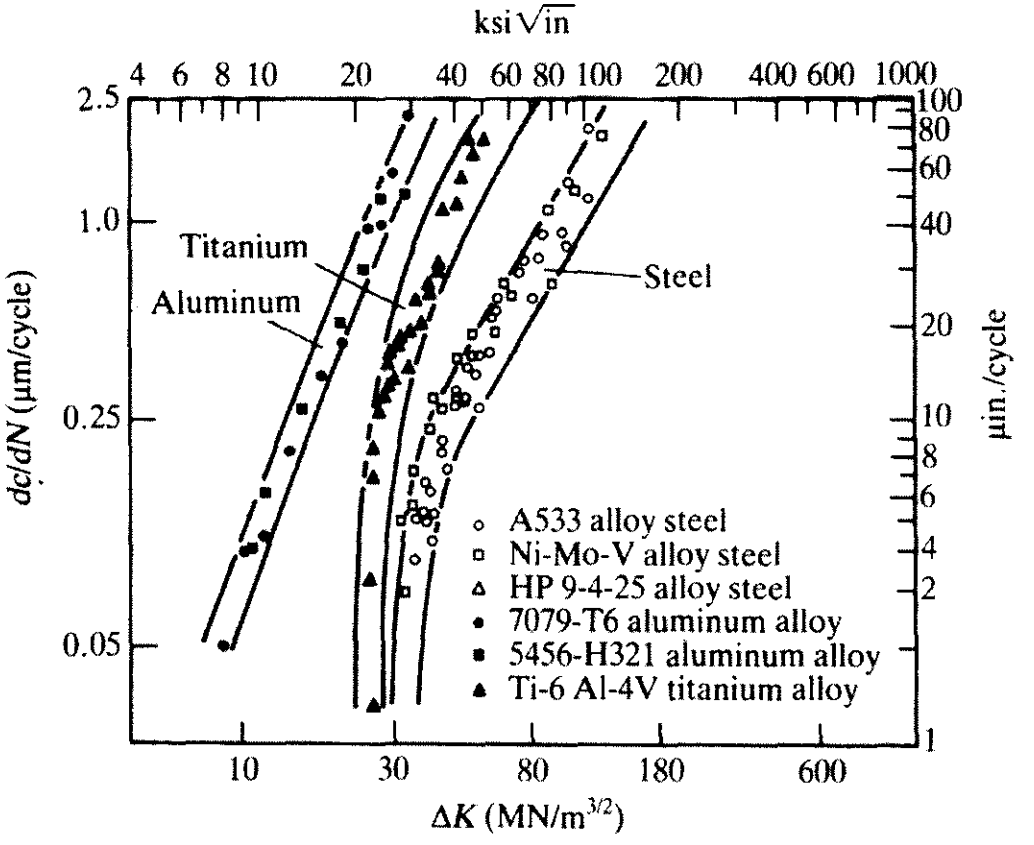

Figure 2