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

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

Final Exam for Semester: 2
Date: February 29, 2012
Subject: 237-221 Mechanical Behavior of Materials

Academic Year: 2011
Time: 09.00-12.00
Room: S817

Instruction

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, course notes, and other studying materials are not allowed.
3. Dictionary, calculator, and stationery are allowed.
4. This final exam is counted for 25% of the total grade.

Asst. Prof. Dr. Thawatchai Plookphol

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

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

1. Explain the following terms (please draw diagram or picture to support your answer)

1.1 Solid-solution strengthening (5 points)

1.2 Precipitation strengthening (5 points)

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

1.3 Work-hardening strengthening (5 points)

1.4 Grain–boundary strengthening (5 points)

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

1.5 Fatigue endurance limit (5 points)

1.6 Fatigue crack growth. (5 points)

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

1.7 Creep test (5 points)

1.8 Dislocation creep mechanism (5 points)

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

2. A fatigue specimen made of AISI 4340 steel with diameter of 12.5 mm is subjected to cyclic axial load that varies from a maximum of 50,000 N tension to a minimum of 10,000 N compression. Calculate the followings: (20 points)

   2.1 The mean stress, σ_m

   2.2 The stress range, σ_r

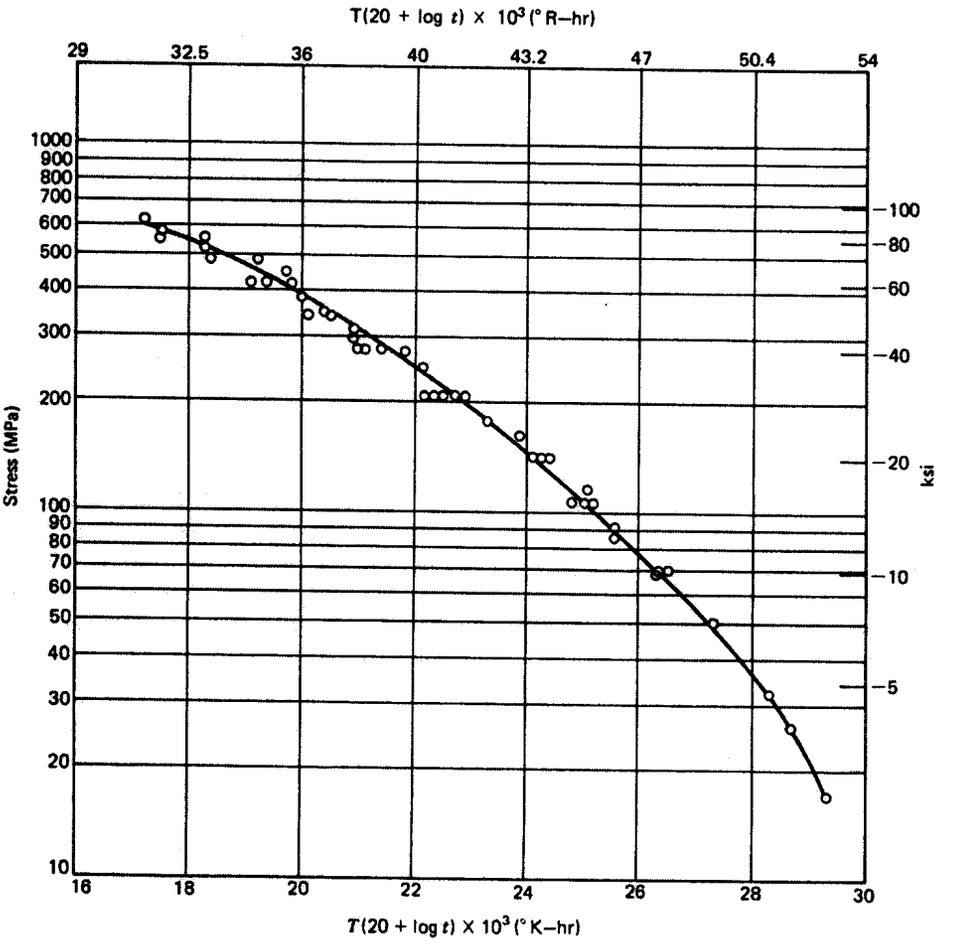
   2.3 The alternating stress, σ_a

   2.4 The stress ratio, R

   2.5 The amplitude ratio, A

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

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



3.1 A turbine component made of S-590 alloy is subjected to temperature of 600°C and stress of 400 MPa. Estimate the rupture life of the component. (10 points)

3.2 What is the maximum operational temperature such that failure should not occur in 100,000 hours at stress level of 200 MPa? (10 points)

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

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

σ (MPa)	$\dot{\varepsilon}_{ss}$ (s^{-1})
40	1.6×10^{-7}
60	5.9×10^{-7}
80	2.0×10^{-6}
100	6.6×10^{-6}
120	2.4×10^{-5}

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

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

4.1 What are the parameters A, n, and Q_c? (6 points)

4.2 Estimate the value of n. (10 points)

4.3 What creep mechanism may be concluded from the experiments? Explain reason to support your answer. (4 points)