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

Department of Mining and Materials Engineering

Faculty of Engineering

Prince of Songkla University

Mid-term Exam for Semester: 1 Academic Year: 2014

Date: October 11, 2014 Time: 13.30 – 16.30

Subject: 238-502 Adv. Mat. Proc. and Mat. Select. Room: Robot

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Instructions

1. There are 4 problem sets (8 pages including cover page). Please do all of them. Write your answers in the space provided.
2. Textbook and course notes are not allowed.
3. Dictionary and calculator are allowed.
4. This mid-term exam is accounted for 25 % of total grade of this course.

Asst. Prof. Dr. Thawatchai Plookphol

Problem No.	Full Score (points)	Student's Score (points)
1.	10	
2.	10	
3.	30	
4.	20	
Total	70	

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Problem 1 (10 points)

Explain three basic stages in a design process; identify main activities which are performed in each stages of the design process and how the materials selection involves in each stages.

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Problem 2 (10 points)

2.1 What is the Material Index, *M*? (5 points)

2.2 What is the Ashby's materials selection chart? (5 points)

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Problem 3 (30 points)

Material Index for a Light, Strong Beam

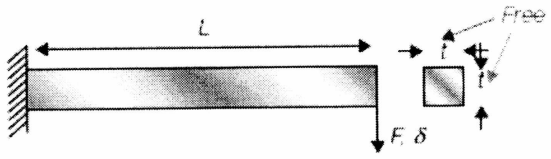

Figure 3

In stiffness-limited applications, it is elastic deflection that is the active constraint: It limits performance (Figure 3). In strength-limited applications, deflection is acceptable provided the component does not fail; strength is the active constraint. Derive the material index for selecting materials for a beam of length L, specified strength, and minimum weight. For simplicity, assume the beam to have a solid square cross-section $t \times t$.

The equation for the failure load of a beam is given by

$$F_f = \frac{I\sigma_f}{y_m L}.$$

Where y_m is the distance between the neutral axis of the beam and its outer filament ($y_m = t/2$) and $I = t^4/12 = A^2/12$ is the second moment of the cross-section.

3.1 Translate the design requirements and itemize them into a table. (10 points)

3.2 Derive a material index, M for the beam. (20 points)

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Problem 4 (20 points)

Use the Strength – Density chart shown in Figure 4.

For $M_1 = \rho < 3{,}000 \quad \frac{\text{kg}}{\text{m}^3}$ and

$$M_2 = \frac{\sigma_f^{2/3}}{\rho} \geq 0.02 \quad \frac{(\text{MPa})^{2/3}}{(\text{kg/m}^3)}.$$

4.1 Draw material selection lines M_1 and M_2 (10 points)

4.2 Identify and label the selection region on the chart. (5 points)

4.3 Identify the selected material(s). (5 points)

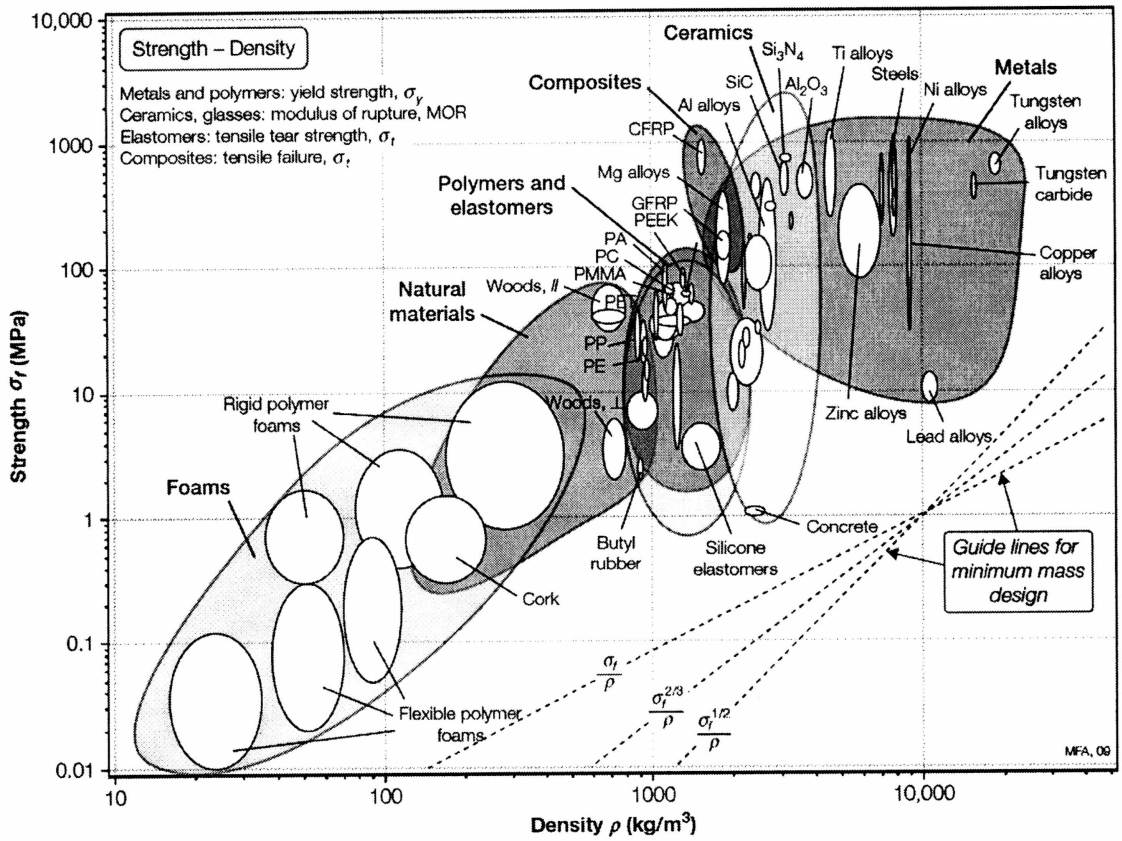

Figure 4.