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

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

Mid-Term Examination for Semester: 1   Academic Year: 2014

Date: October 14, 2014   Time: 13.30-16.30

Subject: 237-405 Materials and Process Selection   Room: S203

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. Text books 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.	20	
2.	20	
3.	40	
4.	20	
Total	100	

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Problem 1 (20 points)

According to Ashby's material selection strategy, there are four basic steps which are translation, screening, ranking, and documentation. Explain the details of each step.

1.1 Translation (5 points)

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1.2 Screening (5 points)

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1.3 Ranking (5 points)

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1.4 Documentation (5 points)

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Problem 2 (20 points)

Explain the following terms:

2.1 Conceptual design (5 points)

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2.2 Embodiment design (5 points)

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2.3 Materials performance index, M. (5 points)

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2.4 Material selection chart or Ashby's chart. (5 points)

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Problem 3 (40 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.

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Problem 4 (20 points)

Use the fracture toughness - modulus ($K_{IC} - E$) chart to identify materials with

$$M_1 = K_{1C} \geq 100 \quad MPa \cdot m^{1/2} \quad and$$

$$M_2 = G_{1C} = \frac{K_{1C}^2}{E} \geq 10 \quad kJ/m^2$$

4.1 Draw the selection lines M_1 and M_2 on the chart, please show your work how to obtain the lines (10 points)
4.2 Label the selection region on the chart (5 points)
4.3 Identify the materials (5 points)