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: 2008

Date: July 29, 2008   Time: 9.00-12.00

Subject: 237-405 Materials and Process Selection   Room: A400

Instructions

1. There are 4 problem sets. Please do all of them and write your answers in the space provided after each problem set.
2. Textbooks and course notes are not allowed.
3. Dictionary and calculator are allowed.
4. This mid-term exam is accounted for 25 % of total grade.

Asst. Prof. Dr. Thawatchai Plookphol

Problem No.	Full Score (points)	Student's Score (points)
1.	15	
2.	15	
3.	55	
4.	15	
Total	100	

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<u>Problem 1</u> (15 points)

1.1 Explain three basic stages of general design process.

1.2 Identify main activities which are performed in each stages of the design process.

1.3 How does the materials selection get involve in each stages of the design process?

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Problem 2 (15 points)

Explain the following terms:

2.1 Material performance index or material index (*M*).

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2.2 Shape factor for an elastic bending beam (ϕ_B^e).

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2.3 Material property chart or *Ashby's* chart.

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Problem 3 (55 points)

Derive a material index (M) for a light and stiff beam having length L and rectangular section area of width b and thickness t. The length of beam, L is specified but the width and thickness of beam are free. The beam must support a bending load F without deflecting too much, meaning that the bending stiffness S and the maximum displacement δ_{max} are specified. The material for making the beam is free for selection.

$$F$$

$$\delta$$

$$L$$

$$t$$

$$b$$
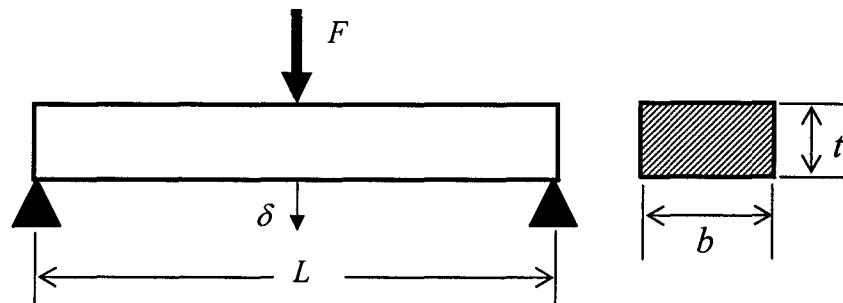
The mid-point deflection of an elastic beam of length L loaded in three-point bending by a central load F is given by

$$\delta = \frac{FL^3}{48EI}.$$

The deflection at which failure occurs is

$$\delta_{max} = \frac{\sigma_f L^2}{6tE},$$

where I is the second moment of area; for beam of rectangular section, $I = \dfrac{bt^3}{12}$ and E

and σ_f are the modulus and failure stress of the material of the beam.

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Problem 4 (15 points)

The material index for an efficient furnace wall insulator is given by

$$M = \frac{a^{\frac{1}{2}}}{\lambda}$$

where a is the thermal diffusivity and λ is the thermal conductivity.

4.1 Draw a selection line with $M = \dfrac{a^{\frac{1}{2}}}{\lambda}$ passing through

$$a = 10^{-6} \quad m^2/s \quad and \quad \lambda = 1 \quad W/mK \ .$$

Please show your work how to get the selection line.

4.2 Identify three materials which have the same performance.