

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: 2010

Date: August 8, 2010

Time: 9.00-12.00

Subject: 237-502 Adv. Mat. Proc. and Mat. Selection Room: S203

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**Instructions**

1. There are 4 problem sets. 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.	25	
2.	25	
3.	25	
4.	25	
Total	100	

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**Problem 1** Explain the following terms:

1.1 Conceptual design (5 points)

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1.2 Material index,  $M$  (5 points)

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1.3 Materials selection chart (5 points)

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1.4 Trade-off plot (5 points)

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1.5 Penalty function (5 points)

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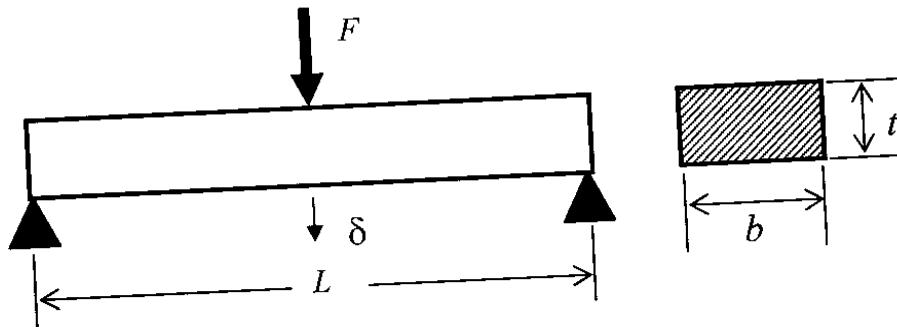
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**Problem 2** (25 points)

Derive a material index ( $M$ ) for **low cost and stiff beam** having length  $L$  and solid rectangular section. The beam must support a bending load  $F$  without fracture. The following conditions must also be met:

$$\text{The ratio of thickness to width, } \frac{t}{b} = \frac{1}{2}$$

$$\text{The maximum deflection at failure, } \delta_{\max} = \frac{1}{6} \frac{\sigma_f L^2}{tE}$$



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**Problem 3** (25 points)

The design requirements for an elastic seal are as follows:

<b>Function</b>	Elastic seal
<b>Constraints</b>	Limit on contact pressure, Low cost
<b>Objectives</b>	Maximize conformity to surface
<b>Free variables</b>	Choice of material

The contact width of the seal must be maximized by maximizing the material index

$$M_1 = \frac{\sigma_f}{E} > 50$$

It is also required that the contact stress  $\sigma$  be kept low to avoid damage due to the flat surface. The contact pressure is kept below 100 MPa, that is

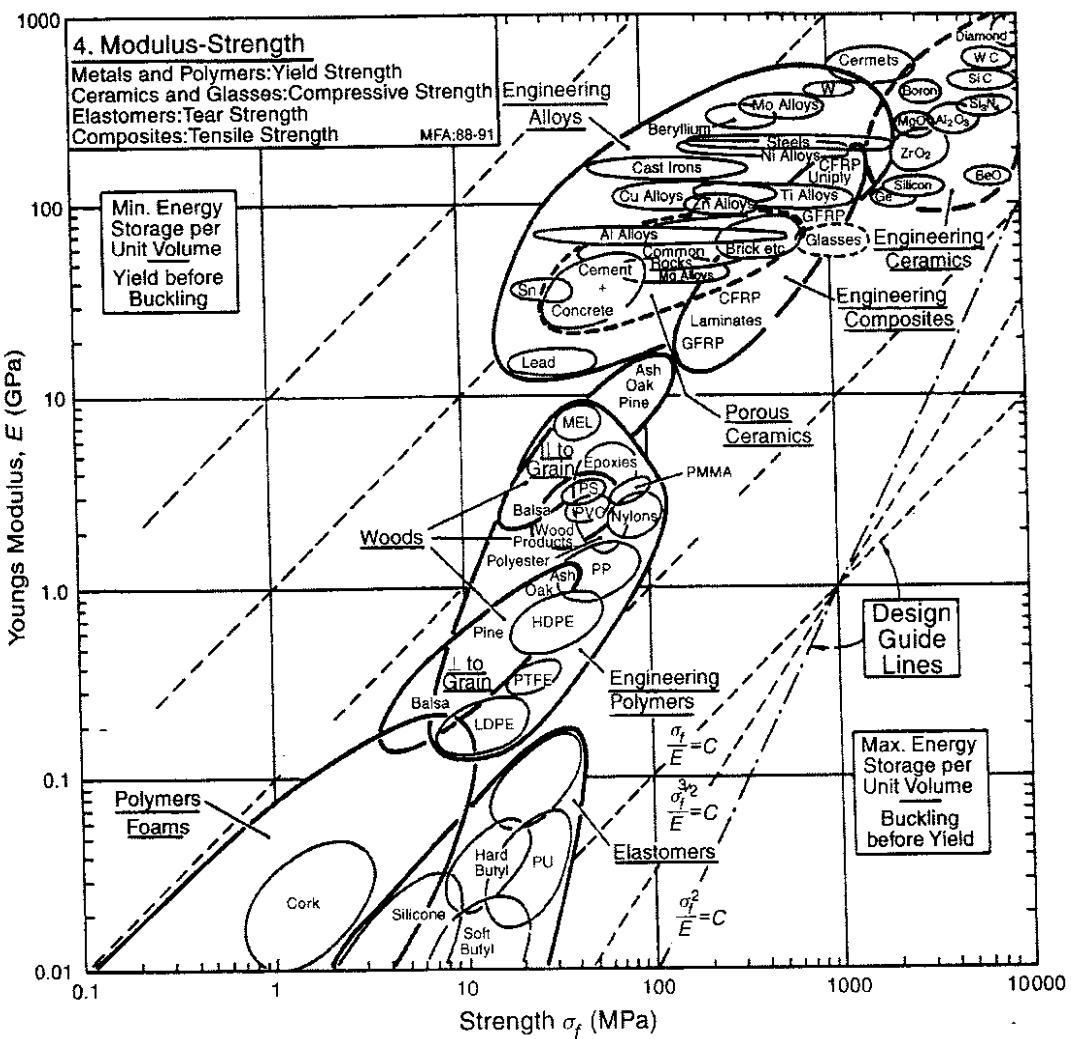
$$M_2 = \sigma_f \leq 100 \text{ MPa.}$$

Use the Modulus-Strength chart and answer the following questions;

- 4.1 Draw the selection line  $M_1$ .
  - 4.2 Draw the selection line  $M_2$ .
  - 4.3 Label the selection region.
  - 4.4 Identify five materials.

Note that please show clearly how to get the answers.

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**Problem 4** In case of multiple objectives and multiple constraints how do you tackle the problem? Explain the procedures used for materials selection. (25 points)