

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: 2009

Date: July 28, 2009

Time: 9.00-12.00

Subject: 237-405 Materials and Process Selection Room: A201

**Instructions**

1. There are 3 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.	20	
2.	40	
3.	15	
Total	75	

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

**Problem 1** Explain the following terms:

1.1 Conceptual design (5 points)

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....

1.2 Embodiment design (5 points)

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....

1.3 Detail design (5 points)

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....

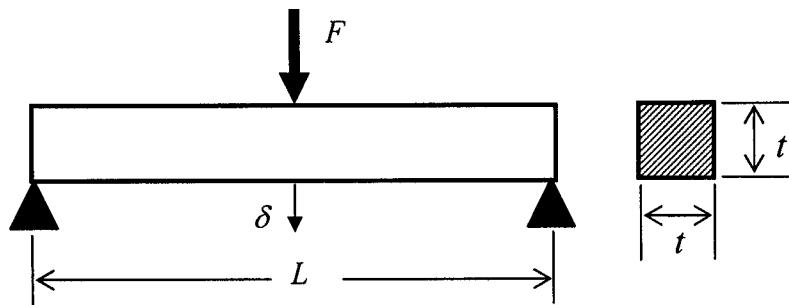
1.4 Material performance index or material index (5 points)

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....

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

**Problem 2** (40 points)

Derive a material index ( $M$ ) for a low cost and stiff beam having length  $L$  and square section area. The length of beam,  $L$  is specified but the cross-section area  $A$  is free. The beam must support a bending load  $F$  without deflecting too much, meaning that the maximum displacement  $\delta_{\max}$  is specified. The material for making the beam is free for selection.



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 square section,  $I = \frac{t^4}{12}$  and  $E$  and  $\sigma_f$  are the Young's modulus and failure stress of the material of the beam.

2.1 Translate the design requirements into a requirement table. (10 points)

2.2 Derive a material index ( $M$ ) for the low cost and stiff beam. (30 points)

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....

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

**Problem 3** (15 points)

Use the Young's modulus-relative cost chart to identify material with

$$M_1 = E > 100 \text{ GPa}$$

$$M_2 = \frac{E}{C_R \rho} = 10 \frac{\text{GPa}}{\text{Mg/m}^3}$$

3.1 Draw the selection lines  $M_1$  and  $M_2$  (10 points)

3.2 Identify the material (5 points)

