

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: 2012

Date: August 1, 2012

Time: 09.00-12.00

Subject: 237-407 Failure Mechanics and Analysis

Room: R201

Instructions

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

Asst. Prof. Dr. Thawatchai Plookphol

Problem no.	Full score	Student's score
1	20	
2	20	
3	20	
4	40	
Total	100	

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Problem 1 (20 points)

Explain the following terms: (please give example and/or draw picture, diagram to support your answer)

1.1 Cleavage (2 points)

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1.2 Slip (2 points)

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1.3 Griffith's fracture theory for brittle materials (2 points)

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1.4 Irwin's concept of stress intensity factor (2 points)

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1.5 Stress concentration factor, k_t (2 points)

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1.6 Fracture toughness (Energy release rate), G_C (2 points)

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1.7 Fracture toughness, K_{IC} (2 points)

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1.8 Mode I loading (2 points)

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1.9 Mode II loading (2 points)

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1.10 Mode III loading (2 points)

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Given Formula

Griffith's equation:
$$\sigma = \sqrt{\frac{2E\gamma_e}{\pi a}}$$

Modified Griffith's equation:
$$\sigma = \sqrt{\frac{2E(\gamma_e + \gamma_p)}{\pi a}}$$

For a central crack:
$$K_I = \sigma\sqrt{\pi a}$$

For an edge crack:
$$K_I = 1.12\sigma\sqrt{\pi a}$$

At fracture:
$$K_I = K_{IC}$$

For cylindrical thin-wall pressure vessel:

$$\sigma_h = \frac{pd}{2t}$$

$$\sigma_l = \frac{pd}{4t}$$

$$\sigma_r = 0$$

where p is the internal pressure,

d is the diameter,

t is the thickness.

Shear stress due to twisting,
$$\tau_{hl} = \frac{Gd\phi}{2}$$

For 2-D state of stress, the principal stresses

$$\sigma_{1,2} = \left(\frac{\sigma_h + \sigma_l}{2} \right) \pm \sqrt{\left(\frac{\sigma_h - \sigma_l}{2} \right)^2 + \tau_{hl}^2}$$