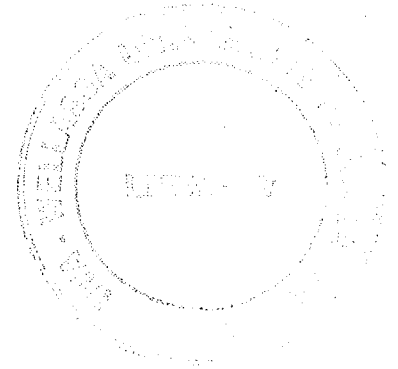


Uva Wellassa University, Sri Lanka
 Btech. Science and Technology
 End Semester Examination- Semester 1
 December-2008



CHE 352-2 – Properties of Materials

Answer both Part A and Part B

Time: Two (02) hours

Part A : Answer two questions only

1. (a). Sketch a typical Engineering Stress-Strain behavior to fracture for a metal and label the followings on it;
 - (i). Proportional limit (P)
 - (ii). Elastic and plastic regions
 - (iii). Maximum (the point corresponding to the tensile strength)
 - (iv). Region of the neck formation
 - (v). Fracture point (F)
- (b). Show how to derive the yield strength from a given stress-strain curve.
- (c). State and give an expression for Hook's law.
- (d). A cylindrical rod 380 mm long, having a diameter of 10 mm, is to be subjected to a tensile load. If the rod is to experience neither plastic deformation nor an elongation of more than 0.9 mm when the applied load is 24,500 N. Which of the four materials listed below are possible candidates? Justify your choice.

Material	Yield strength (MPa)	Modulus of elasticity (GPa)
Copper	250	110
Aluminum alloy	255	70
Brass alloy	345	100
Steel alloy	450	207

(25 marks)

2. (a). Make a rough sketch to show the variation of Force versus Interatomic separation (force-separation curve) for a material having strongly bonded atoms.

- (b). Explain how to derive the modulus of the elasticity, from the curve drawn under (a) above.
- (c). Define and give an expression for Poisson's ratio.
- (d). A tensile stress is to be applied elastically along the long axis of a cylindrical metal rod that has a diameter of 10 mm. A force of 15,000 N produces a 7×10^{-3} mm reduction in diameter. If the modulus of elasticity is 100 GPa, calculate the Poisson's ratio of this metal.

(25 marks)

3. (a). Give a schematic comparison of Engineering and True stress-strain behavior.
- (b). Define and give expressions for True stress and True strain.
 - (c). Briefly explain the terms; *ductility*, *toughness* and *hardness*.
 - (d). A cylindrical metal specimen having an original diameter of 12.8 mm and gauge length of 50.8 mm is pulled in tension until fracture occurs. The diameter at the point of fracture is 6.6 mm and the fractured gauge length is 72.14 mm. Calculate the ductility in terms of percent elongation (%EL) and percent reduction in area (%RA).

(25 marks)

Part B : Answer two questions only

4. (a). With the help of a rough sketch, briefly explain the main stages of a cup-and-cone fracture.
- (b). What are the main features of ductile and brittle fractures?
 - (c). Give an expression showing the relation between the stress concentration factor and the geometrical factors of an internal crack.
 - (d). Determine the stress concentration factor at the tip of an internal crack having crack length of 2.0×10^{-2} mm and a radius of curvature of 3.0×10^{-4} mm?

(25 marks)

5. (a). What is fatigue failure? Name the three distinct steps of fatigue failure.
- (b). With the help of rough sketches of S-N curves, explain the terms Fatigue limit, Fatigue strength and Fatigue life.
- (c). Give a schematic representation showing the stages I and II of fatigue crack propagation in polycrystalline material.
- (d). The mean stress and the stress amplitude reported from a fatigue test were 110 MPa and 270 MPa, respectively. Compute;
- Maximum and minimum stress levels
 - Stress ratio
 - Magnitude of stress range

(25 marks)

6. (a). Define the term *creep*?
- (b). Briefly explain the main stages of creep with the help of a schematic representation.
- (c). Give an expression to show the dependence of the steady-state creep rate on the applied stress and temperature.
- (d). A creep test was conducted for iron under a constant applied stress level at two different temperature levels of 1090 K and 1200 K. The steady-state creep rates were $1.83 \times 10^{-7} \text{ s}^{-1}$ and $2.44 \times 10^{-5} \text{ s}^{-1}$ at 1090 K and 1200 K, respectively. If the gas constant is $8.31 \text{ J mol}^{-1} \text{ K}^{-1}$, calculate the activation energy for creep.

(25 marks)

