Uva Wellassa University of Sri Lanka
Faculty of Science and Technology
Department of Science and Technology
300 level 1st Semester Examination – June/July 2017
SCT 343-2 Structural Properties of Materials

Uva Wellassa University

Instructions to candidates
Duration: 02 hours
Number of questions: 04
Answer all questions
Mark allocation: 80

1. a. Describe briefly the importantce of study of mechanical properties of materials.
(06 marks)

b. Define engineering stress and engineering strain.
(04 marks)

c. Draw typical stress-strain curves (in one diagram) for a brittle material, a ductile material, and a rubbery material. Mark and name the important regions and points in your plot.
(06 marks)

d. A tensile stress, 450 MPa, is applied on a rectangular bar. What will be the magnitude of the shear stress on planes oriented 45° with respect to the axis of the bar?
(04 marks)

2. a. Consider a cylindrical speciman of a metal alloy that has a diameter of 10 mm. A tensile force of 8000 N produces an elastic reduction in diameter of 6.2×10^{-4} mm. Calculate the modulus of elasticity for this alloy, given that Poission's ratio is 0.5.
(04 marks)

b. A cylindrical rod which is 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 24.5 kN, which of the four metals or alloys listed below in Table 01 are possible candidates? Justify your answer(s).
(06 marks)

33

Table 1.

Material	Modulus of Elasticity (GPa)	Yield Strength (MPa)	Tensile Strength (MPa)
Aluminium alloy	70	255	420
Brass alloy	100	345	420
Copper	110	250	290
Steel	207	450	550

c. What is meant by "elastic strain recovery"? (03 marks)

d. From the tensile stress-strain behavior for the brass speciman shown in Figure 1, determine the following.

(i) The modulus of elasticity. (02 marks)

(ii) The yield strength at a strain offset of 0.002. (01 mark)

(iii) The maximum load that can be sustained by a cylindrical specimen having an original diameter of 12.8 mm. (02 marks)

(iv) The change in length of a specimen originally 250 mm long that is subjected to a tensile stress of 345 MPa. (02 marks)

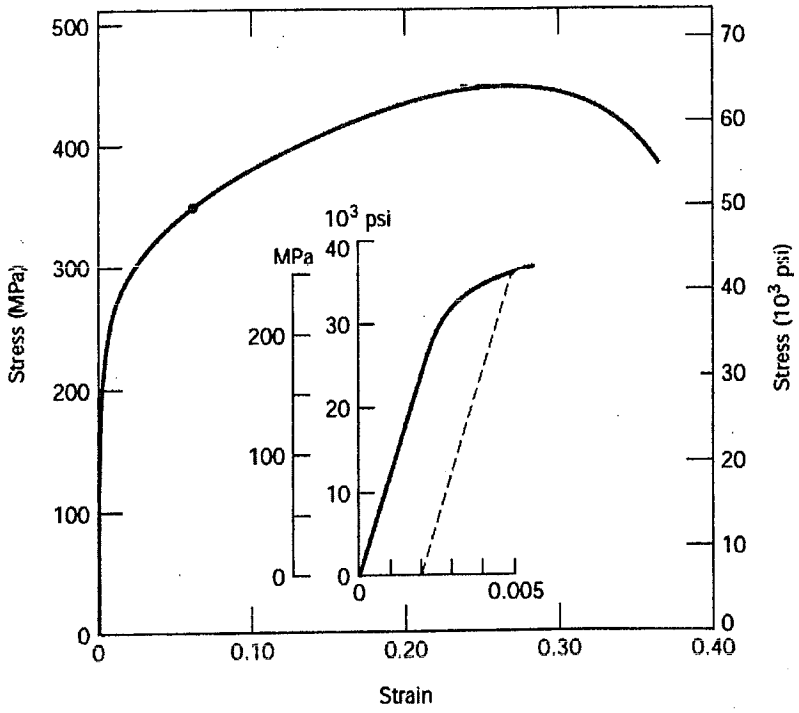

Figure 1

3. a. Briefly describe the following terms using the mathematical expressions where appropriate.

i. Ductility
ii. Resilience

(06 marks)

b. Calculate the moduli of resilience for the material having the stress-strain behavior shown in Figure 1.

(04 marks)

c. Derive expressions for the true stress and true strain using engineering stress and engineering strain.

(04 marks)

d. A bar which is 15 cm long is first elongated by drawing to 20 cm, and then drawing to 25 cm.

i. Calculate the engineering strains for the above two steps, and compare the sum of these with the engineering strain calculated for the overall deformation.

(03 marks)

ii. Repeat the calculation with true strains.

(03 marks)

4. a. Name three (03) hardness tests that are performed in mechanical testing of materials.

(03 marks)

b. Calculate the strain-hardening exponent (n) for an alloy in which a true stress of 625 MPa produces a true strain of 0.2. (Assume a value of 1275 MPa for the constant K)

(05 marks)

c. Briefly describe the following terms.

i. Fracture
ii. Fatigue
iii. Creep

(12 marks)