



Instructions to candidates

Duration: Two (02) hours

Number of questions: Four (04)

Answer all questions

Mark allocation: 100

1. a. In materials science, "study of mechanical properties of solids" has a big potential for construction industry. Briefly describe this statement?

(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.

(10 marks)
 - d. Briefly describe the important characteristic features of elastic and plastic regions in stress-strain diagram of a metal.

(05 marks)
2. a. 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 listed below are possible candidates?

Material	Modulus of Elasticity (GPa)	Yield Strength (MPa)	Tensile Strength (MPa)
A	70	255	420
B	100	345	420
C	110	250	290
D	207	450	550

(10 marks)

b. Draw the potential energy vs distance curves for two materials that have smaller and larger elastic modulus. Both curves should be drawn in a single plot.

(04 marks)

c. Consider a cylindrical specimen of a metal alloy that has a diameter of 5 mm. A tensile force of 2000 N produces an elastic reduction in diameter of 3.2×10^{-4} mm. Calculate the modulus of elasticity for this alloy, given that Poisson's ratio is 0.40.

(06 marks)

d. Obtain the expressions for the true stress and strain using engineering stress and engineering strain.

(05 marks)

3.

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

a. Ductility

b. Resilience

c. Toughness

(12 marks)

b. What is meant by "elastic strain recovery"?

(05 marks)

c. Calculate the strain-hardening exponent (n) for an alloy in which a true stress of 625 MPa produces a true strain of 0.3. (Assume a value of 1075 MPa for the constant K)

(04 marks)

d. Name four (04) hardness tests that are performed in mechanical testing of materials.

(04 marks)

4. a. Figure 01 below shows the tensile stress-strain behavior for a metal alloy.

i. Calculate the modulus of elasticity.

ii. Obtain the proportionality limit.

iii. Estimate the yield strength at a strain offset of 0.002.

iv. Determine the tensile strength.

for this material.

(10 marks)

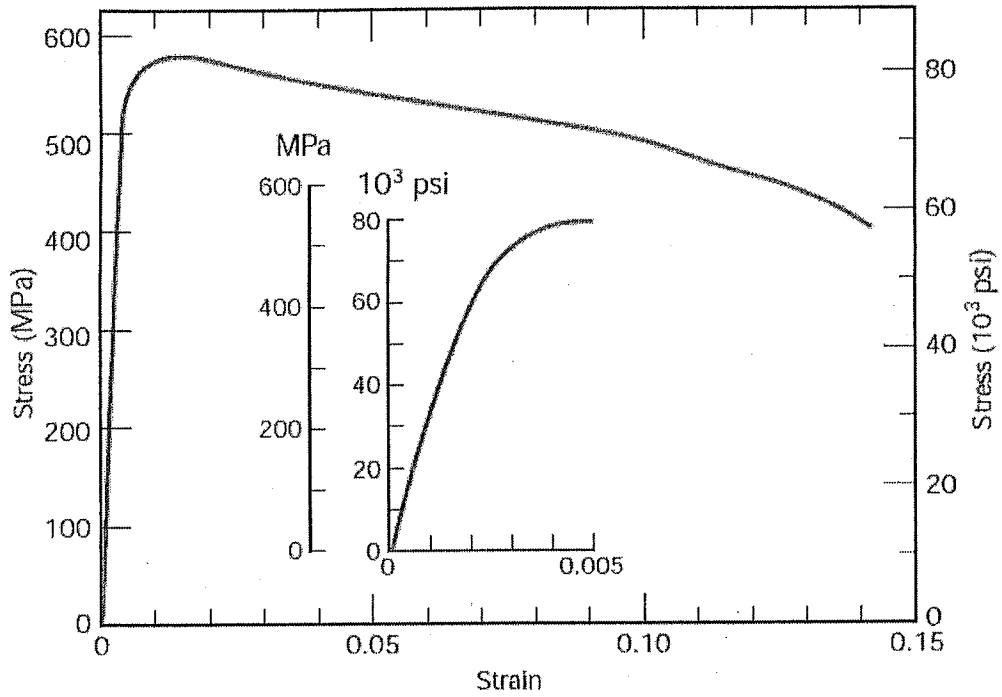


Figure 01

- b. Give a short description about the failure of engineering materials using fracture, fatigue, and creep.

(15marks)

