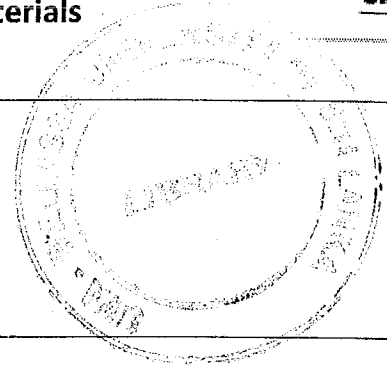


**Uva Wellassa University of Sri Lanka**  
**Faculty of Science and Technology**  
**Department of Science and Technology**  
**300 level 2<sup>nd</sup> Semester Examination – Dec./Jan. 2017**  
**SCT 342-2 Structural Properties of Materials**



**Instructions to candidates**

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

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

(05 marks)
  - b. 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)
  - c. Discuss briefly the differences between elastic and plastic regions in a stress-strain diagram of a metal.  

(05 marks)
  - d. Write down the relationships between normal stress ( $\sigma'$ ) and shear stress ( $\tau'$ ) that act on a plane oriented at an angle  $\theta$  relative to the plane taken perpendicular to the direction along which a pure tensile stress ( $\sigma$ ) is applied.  

(04 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

(08 marks)

(38) ○

- 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. (03 marks)
- c. Consider a solid cylindrical specimen of diameter  $d$  which undergoes an axial load  $F$ . Show that its change in diameter is  $4F\nu/\pi Ed$ . Where  $\nu$  is the Poisson's ratio and  $E$  is the modulus of elasticity of the specimen. (04 marks)
- d. Discuss briefly the atomic scale picture when a metallic material undergoes plastic deformation. (05 marks)
3. a. Figure 01 below shows the tensile stress-strain behavior for a metal alloy. For this material:
- Calculate the modulus of elasticity.
  - Obtain the proportionality limit.
  - Estimate the yield strength at a strain off set of 0.002.
  - Determine the tensile strength.
- (06 marks)

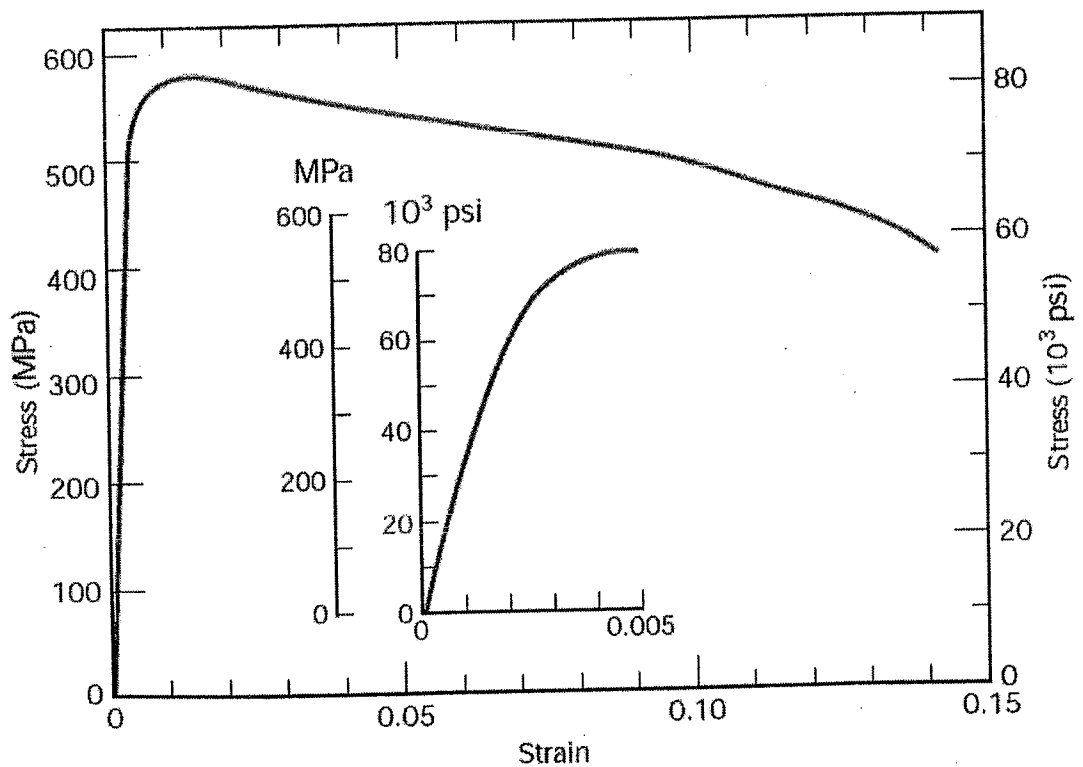


Figure 01

b. i. Define ductility & resilience using the mathematical expressions where appropriate.

(04 marks)

ii. Calculate the moduli of resilience for the material having the stress-strain behavior shown in above Figure 01.

(02 marks)

c. i. Obtain the expressions for the true stress and true strain using engineering stress and engineering strain.

(03 marks)

ii. You are given the following data for brass alloy prior to necking. Using this information, calculate the engineering stress which needs to produce an engineering strain of 0.25.

Engineering Stress (MPa)	Engineering Strain
235	0.194
250	0.296

(05 marks)

4. a. What is meant by "elastic strain recovery"?

(04 marks)

b. i. What is the relationship between hardness and plastic deformation.

(03 marks)

ii. Name three (03) hardness tests that we generally use.

(03 marks)

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

(10 marks)

