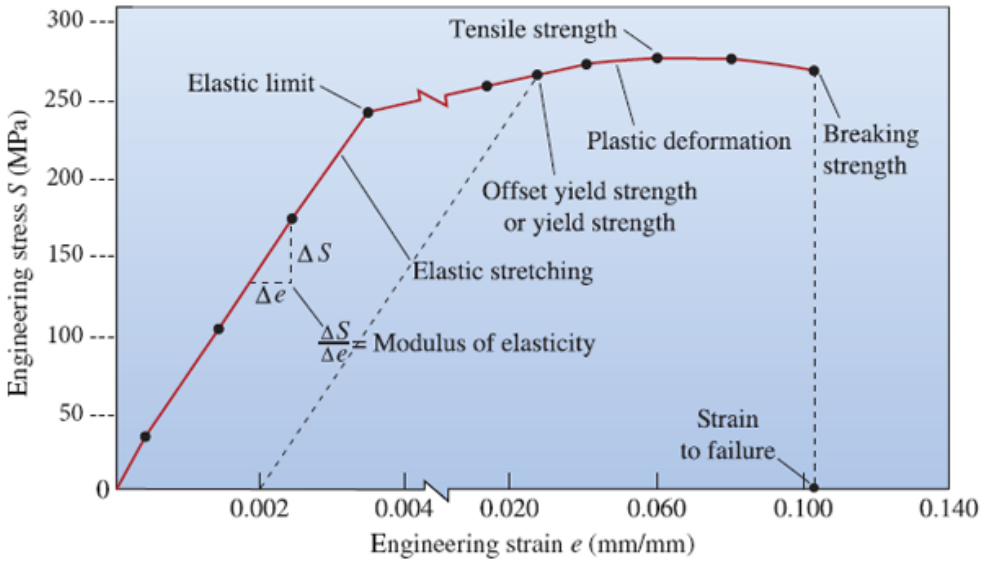
Tutorial 4
Engineering Materials

1. Calculate the Modulus of elasticity of the Aluminum alloy for which the engineering strain strain curve is shown in the figure below. Calculate the length of a bar of initial length 1.27 m when a tensile stress if 206.8 MPa is applied. (Answer: 1.274 m)



The engineering stress strain curve for an aluminum alloy

Reference: The Science and Engineering of Materials (SI Edition) by Donald Askeland and Wendelin J. Wright

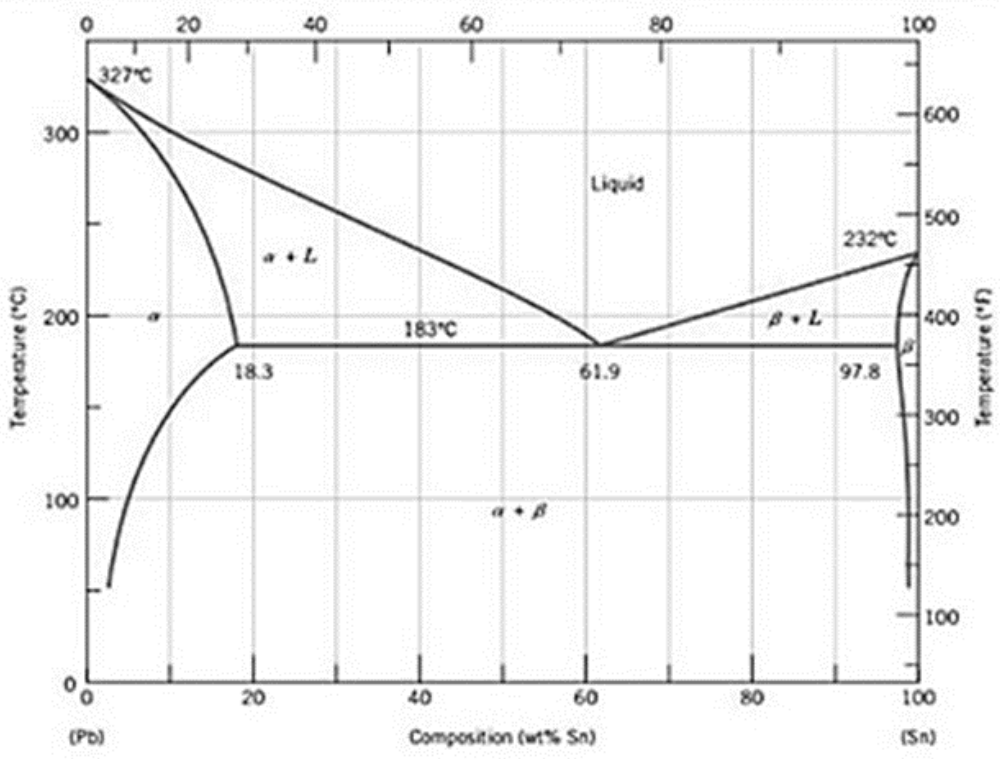
2. Draw the stress vs strain diagram for materials with, High Ductility, Moderate Ductility and Brittle materials.

3. Write the phases for conditions below in Pb-Sn Diagram-
   60% Sn at 300°C -

   40% Sn at 200°C -

   20% Pb at 400°F –

   40% Pb at 100°C –



4. A sculpture weighing 10,000 N rests on a horizontal surface at the top of a 6 m tall vertical pillar. The pillar's cross sectional area is 0.20 m^2 and it is made of granite with a density of 2700 kg/m^3. Find the compressive stress at the cross-section loated 3.0m below the top of the pillar and the value of the compressive strain of the top 3.0 m segment of the pillar. Youngs Modulus for Granite is $Y=4.5 \times 10^{10}$ pa. (Answer: 2.85×10^{-6})

5. The aluminum alloy in Question 1 has a final length after failure of 2.195 (Initial length 2in) in. and a final diameter of 0.398 in. (initial diameter was 0.505 inch) at the fractured surface. Calculate the elongation and reduction of area. (Answer: 37.9%)

6. A short plain concrete column with dimensions of 300 mm × 300 mm × 900 mm is to be constructed. If the compressive strength of the concrete is 34.5 MPa, what is the maximum load that can be applied to this column using a factor of safety of 1.2? (Answer: 2587.5 kN)

7. A nylon string has a diameter of 2 mm, pulled by a force of 100 N. Determine the stress. (Answer: 31.5×10^6 Pa)

8. Brinell Hardness Number of a mild steel specimen is 130. If the indenter diameter is 10 mm and applied load is 3000 kg-f find the indentation diameter on the sample surface. (Answer: 5.21mm)

9. A titanium pipe used to transport a corrosive material at 400°C is found to fail after several months. How would you determine the cause of the failure?

10. A crankshaft in a diesel engine fails. Examination of the crankshaft reveals no plastic deformation. The fracture surface is smooth. In addition, several other cracks appear at other locations in the crankshaft. What type of failure mechanism would you expect?

11. Design a ductile cast iron chain to operate in a furnace used to fire ceramic bricks. The furnace is to operate without rupturing for five years at 600°C, with an applied load of 5000 lbs.