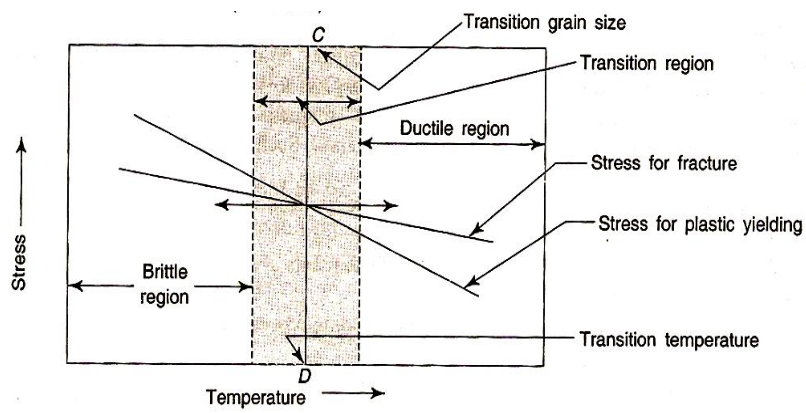
Q1: Give the effect of fraction temperature on the ductile to brittle transition.

Solve:

- The plot of brittle fracture stress (σδ) and the yield stress (σy) as a function of temperature or strain rate can explain the ductile to brittle transition.
- The curve for brittle fracture stress rises slightly because surface energy increases as temperature decreases.
- The yield stress curve shows the strong temperature dependence.
- The brittle fracture stress and the yield stress curves are intersect with each other than a vertical line is drawn at the point of intersection.
- This is called the ductile brittle transition temperature.

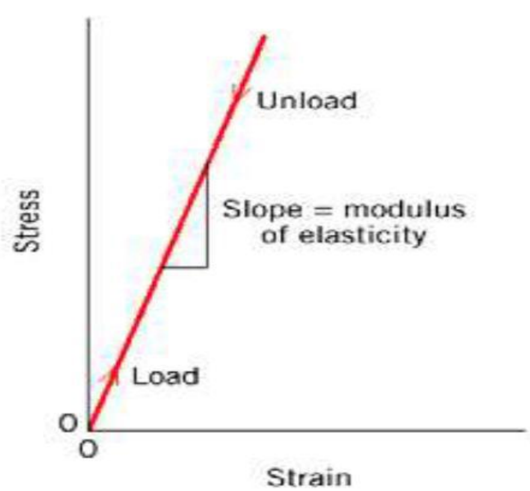


Q2: Describes stress-strain behavior showing linear elastic deformation of some materials.

Solve:

Hooke's Law describes only the initial linear portion of the stress-strain curve for a bar

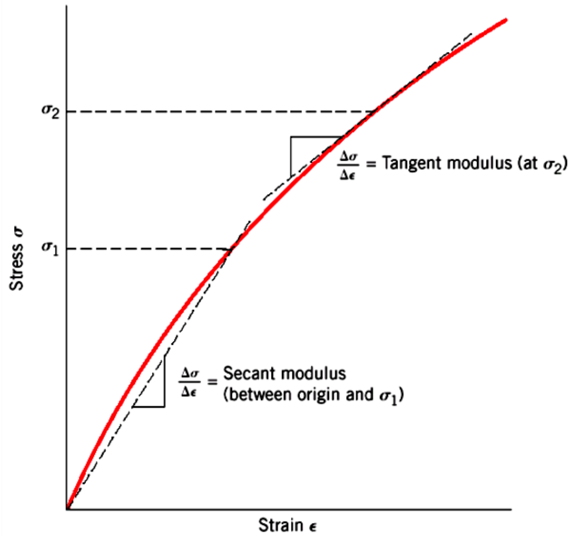
A plot of stress (ordinate) versus strain (abscissa) results in a linear relationship, as shown in Figure below. Elastic deformation is nonpermanent, which means that when the applied load is released, the piece returns to its original shape. As shown in the stress–strain plot.



Q3: Describes stress-strain behavior showing non- linear elastic deformation of some materials

Solve:

There are some materials (e.g., gray cast iron, concrete, and many polymers) for which this elastic portion of the stress–strain curve is not linear (Figure below); hence, it is not possible to determine a modulus of elasticity as described above. For this nonlinear behavior, either ***tangent*** **or** ***secant modulus*** is normally used. **Tangent modulus** is taken as the slope of the stress–strain curve at some specified level of stress, while **secant modulus** represents the slope of a secant drawn from the origin to some given point of the stress– strain curve. The determination of these moduli is illustrated in Figure below



Q4: Explain in details the meaning of plastic deformation in crystalline materials.
Solve:

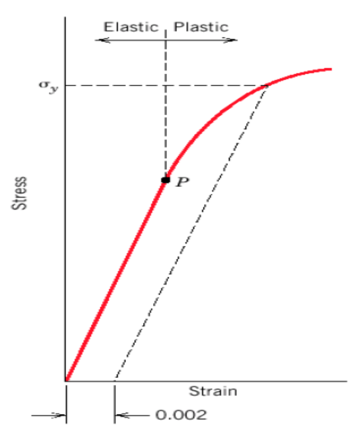
Plastic deformation:

- Stress and strain are not proportional
- The deformation is not reversible
- Deformation occurs by breaking and re-arrangement of atomic bonds (in crystalline materials primarily by motion of dislocations)

Yield strength σ_y - is chosen as that causing a permanent strain of 0.002

Yield point P - the strain deviates from being proportional to the stress (the proportional limit)

The yield stress *is a measure of resistance to plastic deformation*



Q5: Describe (Ductility) by explaining tensile stress–strain behaviors for both ductile and brittle materials schematically.

Solve/

Ductility *is a measure of the degree of plastic deformation at fracture*. A material that experiences very little or no plastic deformation upon fracture is termed *brittle*. Ductility may be expressed quantitatively as either *percent elongation* or *percent reduction in area*. The percent elongation % EL is the percentage of plastic strain at fracture, or

% EL= ($l_f - l_o/l_0$) x 100 or

%EL = ε_{max} x 100 %

Where l_f is the fracture length and l_o is the original gauge lengt

Q6: Explain the elastic deformation (Poisson's ratio)?

Solve:

When a tensile stress is imposed on a metal specimen, an elastic elongation and accompanying strain ϵ_z result in the direction of the applied stress (arbitrarily taken to be the *z* direction), asindicated in Figure below. As a result of this elongation, there will be constrictions in the lateral (*x*and *y*) directions perpendicular to the applied stress. If the applied stress isuniaxial (only in the *z* direction), and the material is isotropic, then $\epsilon_x =$. A parameter termed **Poisson's ratio (ν)** is defined as the ratio of the lateral and axial strains, or

$\nu = \varepsilon_{lateral}/\varepsilon_{axial}$

$\upsilon = -\epsilon_x/\epsilon_z = -\epsilon_y/\epsilon_z$