Registration No. : | | | | | | | | | | |

Total number of printed pages – 2

B. Tech

PCMT 4302

Fifth Semester (Back / Special) Examination – 2013

DEFORMATION BEHAVIOUR OF MATERIALS

BRANCH : MM, MME

QUESTION CODE : D 268

Full Marks – 70

Time : 3 Hours

*Answer Question No. **1** which is compulsory and any **five** from the rest.*
The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2×10

(a) What is Hall-Petch relation ?

(b) What is the phenomenon of strain hardening ?

(c) What is Schmid factor and state the condition when the resolved shear stress is maximum ?

(d) What is a Tresca criterion of yielding ?

(e) Compare the strain energy of an edge dislocation with that of a screw dislocation for a metal having Poisson ratio=1/3.

(f) What are the differences between slip and twinning ?

(g) What is elastic compliance ? Give the relationship between modulus of elasticity and elastic compliance.

(h) How is true stress related with the engineering stress ?

(i) Draw the idealized flow curves of

  (a) rigid ideal plastic material

  (b) Ideal plastic material with elastic region

(j) What is elastic stiffness ?

P.T.O.

2. (a) Estimate the strain energy of an edge dislocation where dislocation outer radius (r) = 10 mm, dislocation core radius (r_o) = 1 nm, G = 50 GPa, b = 0.25 nm and V =1/3. Express the result in electron volts per atomic plane. How much energy (electron volts) is required to produce 1 cm of dislocation line ? 5

(b) Show that more than one-half the strain energy resides outside the core of the dislocation in the region r = 10^{-4} to 1 cm. 5

3. (a) What is the mechanism of precipitation hardening ? Describe the different stages of precipitation during aging time of Al-4.5Cu alloy. 5

(b) Boron fibers having elastic modulus (E_f) = 380 GPa are made into a unidirectional composite with an aluminum matrix, E_m = 60 GPa. What is the modulus parallel to the fibers for 10 and 60 volume percentages ? 5

4. Describe the displacement of points in a continuum may result from rigid body translation, rotation and deformation. 10

5. (a) Describe the generalized stress-strain diagram for FCC single crystal and explain the deformation behaviour in the different stages. 5

(b) How does the above diagram differ for BCC and HCP materials ? 5

6. (a) Explain the Frank – Read mechanism of dislocation generation from the existing dislocation sources. 5

(b) Explain Bauschinger effect. Why the strain hardening in a fine grain size metal will be greater than in a coarse grained polycrystalline aggregate? 5

7. (a) Explain the Von Mises' distortion- energy criterion. 5

(b) If the yield strength of a steel is 50 MPa. Determine whether yielding will occur. If not then what is the safety factor ?

If $\sigma_x = 20$ MPa, $\sigma_y = 10$ MPa, $\sigma_z = -5$ MPa, $\tau_{xy} = 3$ MPa. 5

8. Write short notes on any **two** of the following : 5×2

(a) Yield point phenomenon for mild steel.

(b) Lomer Cottrell barriers

(c) Factors affecting solid solution hardening

(d) Dislocation pile-ups.