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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

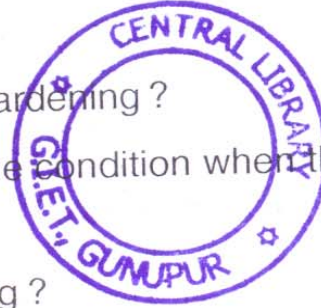
Time : 3 Hours

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

- What is Hall-Petch relation ?
- What is the phenomenon of strain hardening ?
- What is Schmid factor and state the condition when the resolved shear stress is maximum ?
- What is a Tresca criterion of yielding ?
- Compare the strain energy of an edge dislocation with that of a screw dislocation for a metal having Poisson ratio=1/3.
- What are the differences between slip and twinning ?
- What is elastic compliance ? Give the relationship between modulus of elasticity and elastic compliance.
- How is true stress related with the engineering stress ?
- Draw the idealized flow curves of
 - rigid ideal plastic material
 - Ideal plastic material with elastic region
- What is elastic stiffness ?



P.T.O.

2. (a) Estimate the strain energy of an edge dislocation where dislocation outer radius (r) = 10 nm, dislocation core radius (r_0) = 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.