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

Total Number of Pages: 02 **B.TECH**
PCMT4302

5th Semester Regular / Back Examination 2015-16
DEFORMATION BEHAVIOUR OF MATERIALS
BRANCH(S): MM, MME
Max Marks: 70
Q.CODE: T261

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

Q1 Answer the following questions: (2 x 10)

a) Draw the Mohr's Circle for uniaxial compression in two dimensions and identify the principal stresses.

b) Which is more ductile FCC or BCC? and why?

c) The true strain at fracture of a tensile specimen is 0.75. Determine the percentage reduction in cross sectional area.

d) Define offset yield strength.

e) Differentiate between toughness and resilience with the help of stress-strain curves.

f) Determine whether the dislocation reaction $(a/2)[10\bar{1}] \longrightarrow (a/6)[21\bar{1}] + (a/6)[11\bar{2}]$ is feasible.

g) What are partial dislocations? What are the different types of partial dislocations?

h) Explain Portevin-LeChatelier effect?

i) Write the different mechanisms of solute atom and dislocation interactions?

j) If a material has a dislocation density of 10^{12} cm^{-2}. What is the average distance between dislocations?

Q2 a) Explain the effects of strain rate and temperature on flow properties of a material. (5)

b) In a tensile testing following post yield observations were made : (5)

Load	Elongation
45 kN	1 mm
75 kN	4.4 mm

Area of cross section of a sample is $100mm^2$ and the gauge length is 10mm. Determine true tensile strength, U.T.S, and strain hardening exponent of material. Given the flow curve is $\sigma=K\varepsilon^n$.

Q3 a) The state of stress at a point is such that (5)

$\sigma_x=\sigma_y=\sigma_z=\zeta_{xy}=\zeta_{yz}=\zeta_{zx}=\rho$

Determine the principal stresses and their directions.

The state of stress at a point is characterized by the components

$\sigma_x=100MPa$, $\sigma_y=-40MPa$, $\sigma_z=80MPa$, $\zeta_{xy}=\zeta_{yz}=\zeta_{zx}=0$

b) Determine the extremum values of the shear stresses, their associated normal stresses, the octahedral shear stress and its associated normal stress. (5)

Q4 a) Derive the expression for theoretical cohesive strength of metals. Determine the cohesive strength of a silica fiber, if E=95 GPa, $\gamma_s=1Jm^{-2}$, and $a_0=0.16$ nm. (5)

b) Derive the expression for Griffith theory of brittle fracture. A sample of brittle material has a central crack of 4μm. The elastic modulus of the material is 70GPa and the specific surface energy is $1Jm^{-2}$. Estimate the fracture strength of the material. (5)

Q5 a) Derive the expressions for criteria's of yielding in ductile materials. Describe the significance of yield locus. (5)

b) Compare and contrast the mechanisms of slip and twinning. Derive the expression for maximum shear stress at which slip would occur in a perfect lattice. (5)

Q6 a) The following state of strain exists at a point P. (5)

$$[\varepsilon_{ij}]=\left[\begin{bmatrix} 0.02 & -0.04 & 0 \\ -0.04 & 0.06 & -0.02 \\ 0 & -0.02 & 0 \end{bmatrix}\right]$$

Determine the principal strains and the directions of the maximum and minimum principal strains.

b) A cubical element is subjected to the following state of stress. (5)

σ_x=100MPa, σ_y=-20MPa, σ_z=-40MPa, $\zeta_{xy}=\zeta_{yz}=\zeta_{zx}=0$

Assuming the material to be homogenous and isotropic, determine the principal shear strains and the octahedral shear strain, if E=2x 10^3MPa and υ=0.5.

Q7 a) Explain Critical Resolved Shear Stress (CRSS) with suitable diagram. A copper single crystal has a CRSS of 1MPa. It is subjected to a tensile load along [100] direction; determine the tensile yield strength of the crystal. Given slip system is (111), [110]. (5)

b) Draw the Mohrs circle in three dimensions for following state of stress. (5)

i. Uniaxial tension
ii. Uniaxial compression
iii. Biaxial tension
iv. Triaxial tension
v. Uniaxial tension plus biaxial compression.

Q8 Write Short Notes (Any Two) (5 x 2)

a) Strain Aging
b) Strengthening Mechanisms
c) Yield Point Phenomenon
d) Dislocation Pile-up.