VEER SURENDRA SAI UNIVERSITY OF TECHNOLOGY, BURLA
DEPARTMENT OF METALLURGICAL AND MATERIALS ENGINEERING
SESSION 2015 - 16 (Supplementary June ~ July 2016)

B.Tech-5 (M&M)
DBOM
Set-Q_2

Full Marks : 70

Time : 3 hours

Answer **Q. No. 1** and any **five** questions

The figures in the right-hand margin indicate marks

1. Answer *all* questions : 20

(*a*) Define elastic and plastic deformation.

(*b*) Principal stresses on a metal are 100 MPa, 50 MPa and 20 MPa. Use Tresca yield criterion to know the possibility of yielding, if yield strength in uniaxial-tension test is 95 MPa.

(*c*) Derive the relationship between true strain and engineering strain.

(*d*) Prove that $\varepsilon_1 + \varepsilon_2 + \varepsilon_3 = 0$ during plastic deformation of metals.

(*e*) What is work hardening ?

(*f*) What is the main difference between plane stress and plane strain ?

(Turn Over)

(*g*) Why are coarse grained alloys preferred for high temperature applications ?

(*h*) What are dislocation climb ? Explain.

(*i*) What is dislocation density ? What is the value of observed dislocation density in a cold-worked metal ?

(*j*) Differentiate between recovery and recrystallization during annealing of a cold-worked metal.

2. Derive an expression for the theoretical shear strength in a perfect crystal. 10

3. What are different slip systems in fcc and hcp crystals ? Differentiate between edge, screw and mixed dislocations with the help of simple illustrations. 10

4. What are different strengthening mechanisms in metals ? Clearly explain any one strengthening mechanism. 10

5. A 13 mm diameter tensile specimen has a 50 mm gage length. The load corresponding to the 0.2 percent offset is 6800 kg and the maximum load is 8400 kg. Fracture occurs at 7300 kg. The diameter after fracture is 8 mm and gage length at

fracture is 65 mm. Calculate the standard properties of the material from the tension test. 10

6. How does Luders band form during tension test ? What is its role in metal forming operation ? Explain. 10

7. Consider a single crystal of BCC iron oriented such that a tensile stress is applied along a [010] direction.

   (*a*) Compute the resolved shear stress along a (110) plane and in a $[\bar{1}11]$ direction when a tensile stress of 52 MPa is applied.

   (*b*) If slip occurs on a (110) plane and in a $[\bar{1}11]$ direction and the critical resolved shear stress is 30 MPa, calculate the magnitude of the applied tensile stress necessary to initiate yielding. 10

8. What are the differences between deformation by slip and deformation by twinning of metals ? Why does twinning play important role at low temperature ? 10