Code No: 09A51803 **R09** **Set No. 2**

III B.Tech I Semester Examinations,December 2011
MECHANICAL METALLURGY
Metallurgy And Material Technology

Time: 3 hours **Max Marks: 75**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Sketch the transition temperature curves for a plain carbon steel tested in tension, torsion and notched impact.
   (b) What is fracture toughness? Explain its importance. [7+8]

2. Construct and explain a three-dimensional plot showing the relationship between stress, strain and time, for T = Tm/2. [15]

3. The strain hardening of an annealed steel is expressed by $\bar{\sigma} = 200{,}000\ \varepsilon^{-0.5}$, where stress is in psi. A 25 mm diameter bar is drawn down to 20 mm and 15 mm in two steps using tapered cylindrical dies. Determine the plastic work per unit volume for each reduction. [15]

4. (a) Derive the Griffith's equation.
   (b) Explain the Griffith's criterion used for smaller cracks. What is Griffith's crack length? Explain. [7+8]

5. (a) What is plasticity? How the degree of plasticity is expressed? Explain.
   (b) In what type of crystal structure do the more ductile metals exist? Why? Explain.
   (c) Explain about stretcher strains. [5+6+4]

6. (a) What is a dynamic-hardness measurement? What is the working principle of the test?
   (b) Name one hardness method which belongs to the indentation group. Explain its working. Discuss the advantages and limitations of the above method. [6+9]

7. (a) Classify the different kinds of crystal imperfections found in solids.
   (b) Explain about vacancy defect.
   (c) Explain what you mean by stoichiometric crystal defect.
   (d) Explain about surface imperfections. [5+4+3+3]

8. (a) What factors are necessary for fatigue failure? Explain them.
   (b) Draw the typical fatigue curves for ferrous materials and non-ferrous materials. Explain them. [7+8]

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Code No: 09A51803 **R09** **Set No. 4**

III B.Tech I Semester Examinations,December 2011
MECHANICAL METALLURGY
Metallurgy And Material Technology

Time: 3 hours **Max Marks: 75**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Determine the miller indices of slip directions on the (101) plane in BCC unit cell.
   (b) Why does a dislocation of larger Burger's vector try to break itself into smaller dislocation? Discuss. [7+8]

2. (a) The critical impact velocity for steel is 160 ft/s, and the longitudinal sound velocity is 19,500 ft/s. If E = 30 x 10^6 psi and the density is 0.32 lb/in^3, what is the fracture stress under these impulsive-loading conditions?
   (b) What is CTOD test? Explain its importance. [7+8]

3. Explain the following:
   (a) Upper yield point
   (b) Modulus of toughness
   (c) Stiffness
   (d) Modulus of resilience. [15]

4. Write short notes on the following:
   (a) Size effect on fatigue
   (b) Surface effects on fatigue. [15]

5. (a) Distinguish between
      i. crack resistance
      ii. energy release rate.

      Discuss about the two in studying the possibility of crack becoming critical.
   (b) Discuss different types of fractures in brittle materials. [8+7]

6. (a) Explain the purpose of the swivel head commonly used in compression tests. Make a sketch showing the proper arrangement of such a head.
   (b) Explain the possible errors that may arise during compression test. [7+8]

7. Steady-state creep rate can be expressed by $\dot{\varepsilon}_s = Ba^n e^{-Q/kT}$. Apply this relationship to the creep of a steel support rod in a boiler operating at 1000^0F. The rod is stressed in tension to 8,000 psi and its creep elongation must not exceed 10 percent. Using the data given in figure 1, evaluate the constants in the creep equation and estimate the lifetime of the rod. [15]

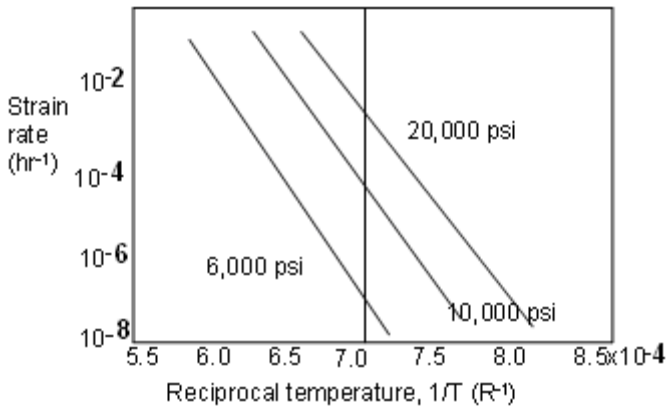

Figure 1:

8. (a) What are the test requirements of hardness test as per BIS Recommendations.
   (b) Distinguish between the terms precision and accuracy. Explain the various factors that influence the accuracy of indentation hardness test. [6+9]

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Code No: 09A51803 **R09** **Set No. 1**

III B.Tech I Semester Examinations,December 2011
MECHANICAL METALLURGY
Metallurgy And Material Technology

Time: 3 hours **Max Marks: 75**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Differentiate between Schottky and Frankel defects.
   (b) Explain the major differences between an edge dislocation and screw dislocation. [7+8]

2. (a) Derive the mathematical expression $BHN = 2P/\prod D(D - \sqrt{(D^2 - \alpha^2)}$
   (b) Is the hardness number expressed with any units or is it just only a Number? Explain. [9+6]

3. A thin-wall pressure vessel of an austenitic alloy has a 1.0" wall thickness and an 18.0" inside diameter. The vessel operates at 1500 ^{0}F. Find the allowable internal pressure if the maximum allowable increase in diameter is 0.2" over a 2-year period. Assume steady-state conditions, and use the value of B and n' from the given data below. [15]

Stress, psi	Minimum creep rate, %/h
10,000	0.00008
15,000	0.0026
20,000	0.025
30,000	2.0
40,000	30.0
50,000	320.0

4. Write short notes on the following:
   (a) Drop-weight test and its significance
   (b) Stress corrosion cracking. [7+8]

5. (a) Why does a brittle material not have stable crack growth?
   (b) Why thin sheets are tougher than thick sheets?
   (c) Explain the factors that effect brittle cleavage type of fracture. [5+5+5]

6. (a) Discuss and contrast the development of a steady-state substructure during creep and during cyclic straining. For example, what parameters are held constant in each kind of test and which ones change? Can the steady-state substructure developed during cyclic straining be related to "recovery" processes as it is in creep? Explain.

(b) Schematically sketch dc/dN vs. ΔK for different values of σ_{max} in the transition region from stage II to stage III fatigue-crack growth. Justify the reasoning you use in constructing the curves. [7+8]

7. Determine p/2k for a 50% extrusion (frictionless) using the upper-bound field given below figure 2. [15]

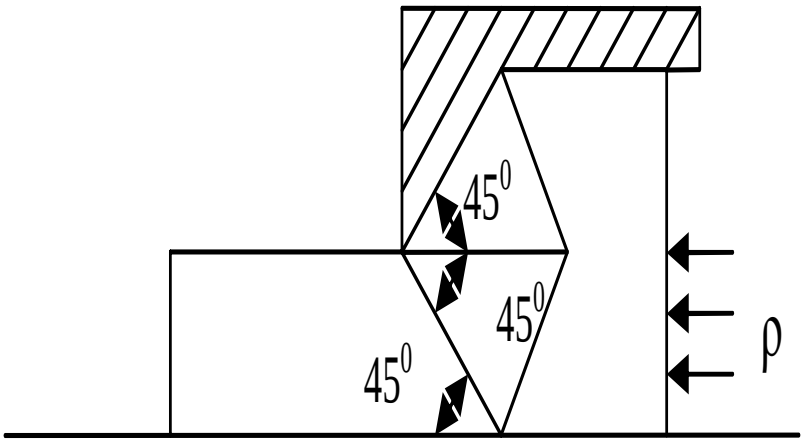

Figure 2:

8. Derive mathematical expressions for True necking strain and True fracture strain. [15]

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Code No: 09A51803 **R09** **Set No. 3**

III B.Tech I Semester Examinations,December 2011
MECHANICAL METALLURGY
Metallurgy And Material Technology

Time: 3 hours **Max Marks: 75**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Develop an expression for the true stress at necking in terms of the material tensile strength and strain hardening coefficient.
   (b) Write down the general form of equation of stress-strain curve.
   (c) Explain about flow curve. Give reasons why it is called so. [7+4+4]

2. Peterson has shown that for an average value of Kt = 2 the notch sensitivity index is given by q = 1/(1+a/r), where 'a' is a "particle size" dependent on the material and r is the notch radius. Kun and Hardrath have related with the tensile strength of the steel.

S, ksi	200	160	100	50
a	0.0004	0.001	0.0042	0.012

   Using these data, plot a curve of q versus r for steels of different strengths. [15]

3. Explain notched-bar impact tests with neat sketches. Explain their advantages and limitations. [15]

4. (a) In Brinell method, would you use same load both for hard and soft materials? Explain. On what factors the load depends? Explain.
   (b) Why tungsten carbide ball indenter is used for testing of hard metals?
   (c) Describe the surface preparation for Brinell hardness test. [7+4+4]

5. (a) What are the possible errors which may arise in compression test? Explain.
   (b) Draw stress-strain diagram for gray cast iron in compression test and compare all corresponding points in tension test. [7+8]

6. Explain the following:
   (a) Idealized adiabatic and isothermal stress-strain curves
   (b) Elastic hysteresis loop
   (c) Anelastic behavior and the elastic after effect. [5+5+5]

7. (a) What will be the difference in fracture between mild steel and cast iron subjected to torsion?
   (b) What is fracture toughness? Explain. What is its significance? What are its units? [6+9]

8. (a) Classify the different kinds of surface imperfections and explain them.

(b) A single crystal of zinc when stressed in tension with the normal to its basal plane (0001) at 60^0 to the tensile axis and the slip direction (1120) at 45^0 to the tensile axis. What is resolved shear stress acting in the slip direction when a tensile stress of 0.7 MPa is applied?

(c) Distinguish between resolved shear stress and critical resolved shear stress.

[4+7+4]

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