Code No: 07A51802 | R07 | Set No. 2

III B.Tech I Semester Examinations,November 2010
MECHANICAL METALLURGY
Metallurgy And Material Technology

Time: 3 hours | Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks
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1. Why are the notched fatigue properties of ordinary gray cast iron about equal to the unnotched properties? [16]

2. (a) Explain about the various types of stresses associated at the crack tip.
   (b) Explain in detail about stress intensity factor and its significance. [8+8]

3. (a) Draw a neat sketch of typical creep curve and explain Andrade's analysis of creep curve.
   (b) Explain the effect of stress on creep curves at constant temperature. [8+8]

4. (a) Why some metals/specimens, during tensile test may neck down to a point size before fractures occur? Explain why .
   (b) Prove that phase instability occurs in a tensile test when the true strain is equal to strain hardening coefficient. [7+9]

5. Compare the advantages and disadvantages of the tension test, the compression test, the plane-strain compression test and the torsion test for determining the flow stress for metal working processes. [16]

6. (a) What is Schmids law.What is its significance. Derive the mathematical expression forthe above law.
   (b) Distinguish between:
      i. Mechanical twins and.
      ii. Annealing twins. [10+6]

7. (a) Explain the importance of projected area of impression rather than surface area of impression during hardness test.
   (b) Which hardness test uses the above principle of that particular hardness method. Describe its advantages and limitations. [4+12]

8. The fracture strength of tungsten at 225 K is 280 MN/m^2 when 5-cm long cracks are present on its surface. The yield strength of tungsten at this temperature is 700 MN/m^2. If G_{lc} increases linearly with temperature, increasing 1.5 MN/m per 5 K, what is the maximum safe operating stress in a welded structure at 200 K if the minimum detectable flaw size is 2.5 cm and a residual tensile stress of 70 MN/m^2 exists within 1.25 cm from the weld? You may assume the residual stress is parallel to the applied tensile stress. Data for tungsten: E = 410 x 10^3 MN/m^2 and $\varepsilon_\nu = 0.3$. [16]

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Code No: 07A51802 **R07** **Set No. 4**

III B.Tech I Semester Examinations,November 2010
MECHANICAL METALLURGY
Metallurgy And Material Technology

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) What are dislocations? What are their uses?Explain.
   (b) Explain with neat sketches interstecial and substitutional impurity defects. [6+10]

2. (a) Why is a surface of a solid is associated with a surface energy? Explain. Also discuss its influence in the crack propagation process.
   (b) Explain with examples the differences between transgranular fracture and intergranular fracture. [8+8]

3. (a) Draw S - N curves for mild steel and aluminum alloy. Explain the significance of those curves.
   (b) Differentiate between Low-cycle fatigue and high-cycle fatigue. [8+8]

4. (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. [8+8]

5. What are the possible mechanisms of creep deformation? Explain them in detail. [16]

6. (a) How the % elongation and % reduction in area of a material are related to its ductility & brittleness.
   (b) Define and explain Hooks law.
   (c) What does the area under stress-strain diagram signify? Explain. [6+4+6]

7. (a) What is Meyers law? Explain
   (b) Explain the 2 types of index tests used in microhardness testing.
   (c) Why Brinells test is preferred for hardness measurement of cast alloys.
   (d) Explain how hardness is related to work hardening characteristics of a metal. [4+4+4+4]

8. Consider a compact tension test for which critical crack propagation takes place at an applied load of 10^5N. Specimen dimensions are w = 10 cm, and t = 5 cm. Calculate K_c for this material. If the materials yield strength is 500 MN/m^2, is K_c equal to K_{lc}? [16]

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Code No: 07A51802 **R07** **Set No. 1**

III B.Tech I Semester Examinations,November 2010
MECHANICAL METALLURGY
Metallurgy And Material Technology

Time: 3 hours **Max Marks: 80**

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 Burgers vector try to break itself into smaller dislocation .Discuss. [8+8]

2. (a) Outline the steps that can be taken to eliminate hydrogen embrittlement.
   (b) What are the basic factors that contribute to a brittle cleavage type of fracture? Explain in detail. [8+8]

3. (a) what are the various Rock well scales used for special purpose? Explain.
   (b) Explain the general precautions to be observed during hardness tests?
   (c) Explain the working principle of rebound hardness test. [6+7+3]

4. (a) Explain why residual stresses are more important in failure analysis.
   (b) Discuss about plane strain fracture toughness.

[8+8]

5. (a) What are the different modes of high temperature fracture? Explain each in detail.
   (b) What is power-law creep? Explain. [8+8]

6. (a) Explain what is meant by the Bauschinger effect?
   (b) Discuss the two main difficulties connected with the compression test and tell how their effects may be minimized. [8+8]

7. A high strength steel has a yield strength of 100 ksi and a fracture toughness (K_{IC}) equal to 150 ksi$\sqrt{in}$. Based on the level of nondestructive inspection, the smallest size flaw that can be detected routinely, a_i, is 0.3". Assume that the most dangerous crack geomentry in the structure is a single-edge notch so that K_{IC} = 1.12s$\sqrt{\Pi a}$. The structure is subjected cyclic fatigue loading in which $\sigma_{\max} = 45\, ksi\, and\, \sigma_{\min} = 25\, ksi$. The fatigue crack growth rate for the steel is given by da/dN = $0.66 \times 10^{-8}(\Delta K)^{2.25}$. With this information, estimate the fatigue life of the structure by
   (a) integrating numerically using an increment of crack growth of 0.1" for each calculation

(b) Using equation $N_f = \frac{a_f^{-(p/2)+1} - a_i^{-(p/2)+1}}{(-(p/2)+1)A\sigma_r^p \pi^{p/2}\alpha^p}$
What changes could be made to increase the fatigue life? Which factor would be the most influential? [16]

8. (a) What do you mean by simple stresses and complex stresses. Describe yielding phenomenon under the influence of complex stresses.
   (b) Explain about 'buckling'.
   (c) Give the units of stress in CGS, MKS and SI systems and briefly explain. [8+4+4]

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Code No: 07A51802 **R07** **Set No. 3**

III B.Tech I Semester Examinations,November 2010
MECHANICAL METALLURGY
Metallurgy And Material Technology

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks
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1. Explain the following:
   (a) Idealized adiabatic and isothermal stress-strain curves.
   (b) Elastic hysteresis loop.
   (c) Anelastic behavior and the elastic after effect. [16]

2. (a) Explain how strain hardening can be observed in a tensile test.
   (b) What is strain hardening & strain hardening coefficient. Explain how Strain hardening can be observed in a tensile test. [6+10]

3. (a) Discuss dislocation mechanism of mechanical twinning.
   (b) Name the different slip systems available in FCC, BCC & CPH crystals. Explain them. [8+8]

4. (a) Explain the type of fractures of brittle materials under compressive loads.
   (b) What is the effect of size and shape of the specimen on the compressive strength? [8+8]

5. (a) Draw and explain the fracture analysis diagram showing influence of various initial flaw sizes.
   (b) Explain the effect of carbon content on the energy-transition temperature curves for steel. [8+8]

6. (a) Explain the relationship between hardness and flow curve.
   (b) Explain the procedure in detail to find out the hardness of a material by Meyer's method. [8+8]

7. (a) 'Triaxial stress condition causes brittle fracture'. Explain. Also discuss with examples what are biaxial and triaxial stresses.
   (b) Explain about:
      i. Notch brittleness and.
      ii. Fracture toughness and notch sensitivity. [8+8]

8. (a) A mild steel plate is subjected to constant amplitude uniaxial fatigue loads to produce stresses varying from s_{max} = 180 MPa to s_{min} = -40 MPa. The static properties of the steel s_0 = 500 MPa, E = 207 GPa and K_c = 100 MPa$\sqrt{m}$. IF the plate contains an initial through thickness edge crack of 0.5 mm, how many fatigue cycles will be required to break the plate?

   (b) What is the effect of stress concentration on fatigue? [8+8]

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