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

III B.Tech I Semester Examinations,May 2011
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) 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. [8+8]

2. Explain the structural changes that occur during creep. [16]

3. Distinguish between engineering stress-strain and true stress-strain curves. Show such curves for glass, cast iron etc. What difference did you observe? Explain [16]

4. (a) Describe the various modes of plastic deformation.
   (b) What are the important results of kink formation.
   (c) If tensile axis lies in a plane,resolved shear stress is zero. Give some physical explanation to explain this. [6+5+5]

5. (a) When a 3000 kg load is applied to a 10 mm diameter ball in a Brinell test of steel, an indentation of 3.0 mm is produced. Estimate the tensile strength of steel.
   (b) What is an indenter? What is its function during hardness tests? Explain About various indenter materials, their sizes and shapes. [8+8]

6. (a) Explain the structural changes that occur when a metal is subjected to cyclic stress.
   (b) Explain the terms: fatigue limit, mean stress, stress ratio and amplitude ratio. [8+8]

7. A weight W falls vertically downward (without friction) along a thin rod of area A and length L until it is brought to rest by striking a flange at the end of the rod. Using energy considerations derive an expression for the maximum stress in the rod produced by the weight falling through a distance h. Assume perfectly elastic impact. Show that the sudden release of load from a height h = 0 produces twice the stress that would result from a gradual application of load. [16]

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

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

III B.Tech I Semester Examinations,May 2011
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) Compare and contrast fracture of any material at low and elevated temperatures.
   (b) Explain how ductility depends on temperature, strain rate and stress rate. [8+8]

2. Show how a value of flow stress independent of friction can be obtained with the compression test using an extrapolation method. [16]

3. (a) What controls the relationship between stress and strain in a material? Discuss.
   (b) What are the three general ways by which a machine element can fail to Perform its intended function? Explain them. [6+10]

4. (a) What is stress-rupture test? Compare and contrast with creep test.
   (b) Describe the typical creep curve. [8+8]

5. (a) Explain how the offset yield strength can be determined by Vicker's hardness measurement.
   (b) Give the mathematical expression that relates BHN and UTS and explain.
   (c) Explain the details of indenter used in Vickers hardness method. [6+4+6]

6. (a) Explain the following terms:
      i. slip lines.
      ii. Slip steps.
      iii. Slip planes.
      iv. Slip- directions.
   (b) Expalin why the slip lines are parallel with in a grain ,but of different orientation in the adjoining grains. [11+5]

7. Suppose a material's tensile yield strength varies with the absolute temperature (T) according to $\sigma_{\mathrm{y}}= (2000 - 4\mathrm{T})\mathrm{MN/m}^2$, and the material's fracture strength varies with T as $\sigma_{\mathrm{F}}= (600 + 2\mathrm{T})\mathrm{MN/m}^2$. Calculate the ductile to brittle transition temperature for an ordinary tensile bar and for a severely notched one for which $\beta = 2.5$. [16]

8. The number of cycles spent in stage II growth (N_u) is often used to estimate a materials fatigue life (N_f). Under what conditions (i.e. high-cycle or low-cycle fatigue) would the above be a reasonable approximation? Is it a reasonable approximation for high-cycle fatigue in structures containing relatively large initial flaws? Explain your reasoning. [16]

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

III B.Tech I Semester Examinations,May 2011
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) Explain the effect of temperature on notch toughness.
   (b) What is the significance of transition-temperature curve? Explain. [8+8]

2. (a) Explain the precautions to be observed in indentation hardness test.
   (b) Explain the working of a rebound hardness test with the help of a neat sketch. Discuss the advantages of this method. [6+10]

3. Define and explain the following terms:
   (a) Yield strength.
   (b) Poisson's ratio.
   (c) Bulk modulus.
   (d) True stress & strain.
   (e) Ultimate tensile strength.
   (f) Yielding. [16]

4. (a) What is notch sensitivity? Explain why cast iron is notch insensitive.
   (b) Explain when crack is said to be stable.
   (c) Between ductile fracture and brittle fracture which is more preferred? Why? Explain. [6+4+6]

5. Discuss the following:
   (a) Fatigue under combined stresses.
   (b) Temperature effect on fatigue. [8+8]

6. (a) The maximum tensile stress for certain ductile steel is 60,000 psi. The corresponding conventional strain is 0.08 in./in. Assuming that the true stress-strain diagrams are identical for tension and compression, compute the conventional stress and strain in compression corresponding to the values given in tension (assume constant volume).
   (b) Without the aid of the text, describe three ways in which a material may fail in compression. [8+8]

7. (a) A structural member has a stress-temperature combination such that the steady-state creep rate is 10^{-10}/s. The material must not extend more than 0.1 percent during its intended lifetime. If this were the only design criterion, estimate how long the structure could remain in service.

(b) Both creep and ductile fracture processes are completed by void coalescence. How does the local strain rate affect the ease of void coalescence at low temperature? How does it affect this process at high temperatures? [8+8]

8. (a) Classify the different kinds of crystal imperfections found in solids.

(b) Explain what is a vacancy defect.

(c) Explain what you mean by stoichiometric crystal defect.

(d) Explain what are surface imperfections. [5+4+3+3]

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

III B.Tech I Semester Examinations,May 2011
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. Write short notes on the following:
   (a) Stress-corrosion cracking.
   (b) Temper embrittlement. [8+8]

2. (a) Differentiate between Schottky and Frankel defects.
   (b) Explain the major differences between an edge dislocation and screw dislocation. [6+10]

3. (a) What are the characteristics of the surface of a ductile fracture of a metal? Discuss.
   (b) Explain the various stages in the ductile fracture of a material. [7+9]

4. (a) Explain why the level of engineering stress-strain curve is lower than that of true stress-strain curve in tensile test, while the opposite is true in the Compression test.
   (b) Explain how the strain hardening coefficient of a material can be determined from true stress-strain curve. [8+8]

5. Consider a smooth bar subject to strain cycling. Calculate the total accumulated strain the material would experience in the 1000 strain cycles (2000 load reversals) it undergoes before failure. State all assumptions. Data: For this material, E = 200 $\times 10^3$ MN/m^2, monotonic tensile true fracture strain = 0.7, cyclic work hardening coefficient (n) 0.15. [16]

6. Discuss the relative ease of hot-work and cold-work for the following metals: Aluminum, zirconium, lead, SAE 4340 steel and molybdenum. Consider the following factors: melting point, flow stress, oxidation behavior and brittleness. [16]

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. (a) Consider a surface crack in a glass rod at a temperature at which viscous flow can takes place. As an approximation, assume that the stress in front of the crack tip scales with the square root of the crack length (this elastic-mechanics

approximation is clearly not valid for a viscous medium). Illustrate how the crack will quickly become blunted via viscous flow. (Recall the relationship between stress and strain rate for viscous materials.)

(b) Consider an isolated void in a material. Let the void grow by mass transfer from its periphery to the surface of the material. Show that the change in surface energy per unit volume of void is $2\gamma/r$, where γ is the surface energy and r is void radius. [8+8]

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