Dr Rifayat Ali 12/12/2022

(M) (248)

National Institute of Technology-Hamirpur
End Term Examination, November 2022
B. Tech. 3rd Semester
MS-214: *Mechanical Behaviour of Materials*

Duration: 180 min **Max. Marks: 50**

Note

- *This question paper consists of 6 questions in two pages*
- *Attempt all questions*
- *Wherever necessary, the diagram drawn should be neat and properly labelled*

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1. **Write a short note on:** **(12)**
   a) Tilt boundaries
   b) Limitation of cold working
   c) Recrystallization temperature
   d) Aging
   e) Orownan model
   f) Brittle to ductile transition
   g) Endurance limit
   h) Defect in the defect in the defect

2. **Answer the following:** **(11)**
   a) For BCC iron, calculate the average distance between dislocations in a small angle grain boundary tilted 0.5°. (Given: a =2.866 Å) (1.5)
   b) What will be the interparticle spacing between the precipitate particles of radius, r = 2 micron? The volume fraction of particles in the matrix is 10% (1.5)
   c) Calculate the fracture stress of brittle material with the following properties. E=200GPa, Surface energy=1.2 Jm^{-2}, a=0.5×10^3nm (1.5)
   d) An aluminium alloy that has plane strain fracture toughness of 25,000 psi$\sqrt{in.}$, fails when a stress of 42,000 psi is applied. Observation of the fracture surface indicates that the fracture began at the surface of the part. Estimate the size of the flaw that initiated the fracture. Assume that Y = 1.1. (1.5)
   e) A Brinell hardness measurement, using a 10 mm diameter indenter and a 500 kg load, produces an indentation of 4.5 mm on an aluminium plate. Determine the Brinell hardness number HB of the metal. (1.5)

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f) Draw qualitative engineering stress-strain curves for ductile polymer, a ductile metal, a ceramic and natural rubber (in a single plot). Label the stress-strain curve carefully. (1.5)

g) The stress required for orownan dislocation bypass is 200 MPa in an alloy when the interparticle spacing is reduced to 500 nm. If the interparticle spacing reduced to 200 nm, what will be the required stress (in MPa) required for the same? (2)

3. a) Driving force for: recovery, recrystallization and grain growth **(3)**

b) What are the characteristic microstructural features associated with a ductile and brittle fracture in a solid? **(4)**

c) What do you understand by creep failure and different stages of creep? **(4)**

d) What is the fatigue mechanism and what are the different factors affecting fatigue failure? **(4)**

4. The flexural modulus of alumina is 45×10^6 psi and its flexural strength is 46,000 psi. A bar of alumina 0.3 in. thick, 1.0 in. wide, and 10 in. long is placed on supports 7 in. apart. Determine the amount of deflection at the moment the bar breaks, assuming that no plastic deformation occurs. **(4)**

5. The strength of titanium is found to be 65,000 psi when the grain size is 17×10^{-6} m and 82,000 psi when the grain size is 0.8×10^{-6} m. Determine (a) the constants in the Hall-Petch equation and (b) the strength of the titanium, when the grain size is reduced to 0.2×10^{-6} m. **(4)**

6. A tensile specimen of 6 mm diameter and gauge length 25 mm reached a maximum load of 45 kN and fractured at 35 kN. The maximum diameter at fracture is 5 mm. Determine the true stress at the fracture point. **(4)**