

M.E. Metallurgical Engineering - First Year -1st Sem

Subject: DEFORMATION & DAMAGE

Time: Three Hours

Full marks: 100

(Answer Question No. 1 and any Four from the rest)

1. Answer any five from the following: 5 x 4 = 20

- (a) Justify whether plastic deformation process is reversible or irreversible?
- (b) "Springs are not made of aluminium" - Justify.
- (c) In the creep range whether would you prefer fine or coarse grained materials? Give reasons in support of your answer.
- (d) "What hardness testing method would you recommend for Grey Cast Iron? Give reason in support of your answer.
- (e) Grey cast iron is brittle but nodular cast iron is ductile – Explain.
- (f) "Griffith's Theory cannot be directly applied to Metals and Alloys" – Justify whether the statement is True or False.
- (g) Find the relationship between true strain and engineering strain in case of uniaxial deformation.
- (h) Whether does Burger's vector depend on crystal size? What are the Burgers vector of Cu and Al?

Q2. (a) Find the relationship for critical resolved shear stress for slip to occur in case of a single crystal.

(b) A tensile stress of 10 MPa is applied along [112] direction of an iron crystal. What is the shear stress in the [010] direction lying on the (001) plane?

(b) Why ornaments are not made of pure gold? What solution would you recommend in this case?

(c) What are the differences between "slip" and "twinning"? 6+6+4+4 = 20

3 (a) A tensile stress of 10 MPa is applied along [112] direction of an iron crystal. What is the shear stress in the [010] direction lying on the (001) plane?

(b) After drawing the stress – strain curve of annealed low carbon steel explain the inhomogeneous yielding phenomenon in terms of dislocation theory.

(c) For a steel with ASTM grain size 3, what reduction in grain size would double the yield stress? Express as both average grain diameter and ASTM number. 6 + 8 + 6 = 20

4 (a) Derive the condition for tensile instability during uniaxial tensile testing of a ductile material. 7

(b) What is "mechanical equation of state? What do you understand by strain rate sensitivity of a material? Give an account for "strain ageing 3 + 4 + 6 = 13

[Turn over

5. Write short notes on the following:

5 x 4 = 20

(a) Goodman Diagram; (b) Corrosion Fatigue; (c) Coffin-Manson behavior; (d) Grain boundary strengthening.

6. (a) On the basis of first approximation find the size of the crack tip plastic zone in case of a thin plate with an edge crack of length "a" loaded below its yield strength. **5**

(b) State the condition for obtaining valid plane strain fracture toughness. Why fracture toughness is called a material property? **4**

(c) Find the relationship between specimen thickness and plastic zone size for obtaining valid plane strain fracture toughness. **4**

(d) Describe the procedure for obtaining valid plane strain fracture toughness of a material. **7**

7. (a) What is known as SIF? Comment on the significance of SIF in Cracked body. **5**

(b) State and explain Griffith's Theory for Brittle Fracture. Find the relationship for Griffith Fracture stress of a material and make comment on Griffith's formulation. **3+5 = 8**

(c) Discuss Wood's model for fatigue crack growth in a specimen under push-pull loading condition. **7**