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B.E / B.Tech (Full Time) DEGREE END SEMESTER EXAMINATIONS, APR / MAY 2014

MATERIAL SCIENCE AND ENGINEERING

Fourth Semester

ML 8403 MECHANICAL METALLURGY
(Regulation 2012)

Time : 3 Hours Answer ALL Questions Max. Marks 100

PART-A (10 x 2 = 20 Marks)

1. Distinguish between yield stress and proof stress
2. Differentiate between Jog and Kink.
3. Differentiate between low angle and high angle grain boundary.
4. Distinguish between particle and fibre.
5. Differentiate between a intergranular and transglanular fracture.
6. A relatively large plate of a glass is subjected to a tensile stress of 40 MPa. If the specific surface energy and modulus of elasticity for this glass are 0.3 J/m^2 and 69 GPa, respectively, determine the maximum length of a surface flaw that is possible without fracture.
7. Distinguish between random and regular fatigue cycle.
8. Define endurance limit.
9. Distinguish between anelasticity and viscoelasticity
10. Differentiate between creep and rupture.

Part – B (5 x 16 = 80 marks)

11. .i).What is a slip system? (2)
    ii) Derive an expression for the theoretical shear strength of a material? Explain why this value is less than the actual value. (10)
    iii Consider a single crystal of BCC iron oriented such that a tensile stress is applied along a [010] direction. Compute the resolved shear stress along a (110) plane and in a direction when a tensile stress of 52 MPa is applied. (4)

12. a) (i) What is a bauschinger effect? Explain in detail. (8)
    (ii) What is solid solution strengthening? Discuss in detail the various factors affecting it. (8)

OR

b) (i) What is precipitation hardening? Discuss in detail the different zones and mechanism involved in Age hardening. (12)

(ii) A continuous and aligned glass fiber–reinforced composite consists of 40 vol% of glass fibers having a modulus of elasticity of 69 GPa and 60 vol% of a polyester resin that, when hardened, displays a modulus of 3.4 GPa).If the cross-

sectional area is 250 mm^2 and a stress of 50 MPa is applied in this longitudinal direction, compute the magnitude of the load carried by each of the fiber and matrix phases. (4)

13. a) a)(i).Distinguish between Brittle and ductile fracture. (6)
(ii). What is the reason for large reduction in experimental fracture stress in comparison with theoretical cohesive strength? State the Griffith's criterion of brittle fracture and obtain an expression for fracture .Discuss the need for a new parameter to quantify the resistance to fracture (10)

OR

b)(i) Define the term stress intensity and state its significance . (4)
(ii) What is ductile -brittle transition in steel? Discuss the factors affecting it (8)
(iii). A steel plate is subjected to a maximum fatigue stress of 200 MPa, the fracture toughness of the steel is 130MPa$\sqrt{m}$ and the geometry factor α is 1.1.The values of Paris equation parameters are A=6.9X10-12 and p=3.0.How many fatigue cycles are required to fracture the plate? (4)

14. a) (i).Define the term fatigue and classify the various fatigue cycles. (4)
ii).Differentiate between high cycle and low cycle fatigue test. (6)
iii).A steel bar is subjected to a fluctuating axial load that varies from a maximum of 330 KN tension to a minimum of 110 KN compression. The mechanical properties of steel are σ_u =1090 MPa σ_o =1010 MPa σ_e=510 MPa. Determine the diameter of the bar to give infinite fatigue life based on a safety factor of 2.5 (6)

OR

b) (i) What are the factors affect the fatigue behavior of material? Discuss their on fatigue. (8)
(ii). Discuss the wood's crack growth mechanism in fatigue in detail. (8)

15. a) (i) Define the term creep? What are the various stages of creep and discuss the factors affecting creep? (10)
(ii).The estimated life of a 100 cm long push rod is 6 months. The maximum permissible elongation is 0.7MPa$\sqrt{m}$ .The ASTM grain size number of the steel is 7.Find out the yield strength of the material. (6)

OR

b) (i).Draw Ashby 's deformation mechanism map and distinguish between the various mechanism of creep. (10)
(ii) A chemical reaction chamber, similar to the one shown below, is made of type 304 stainless steel. The cover bolts of the chamber, which are made of the same steel, are pretensioned at room temperature to a stress of 70 MPa The service temperature of this chamber is 600°C. How long can the chamber be used at this temperature before the stress in the bolts drops below 35 MPa at the operating temperature? (6)