

M.E. Metallurgical - First Year – First Semester Examination 2024**Subject: DEFORMATION & DAMAGE****Time: Three Hours****Full Marks: 100****(Answer any Five from the Following Questions)**

1. (a) What is the need for studying plastic deformation behaviour of metals? 2
 (b) What is responsible for plastic deformation? What kind of stress is responsible for plastic deformation? 2
 (c) Name the mechanisms by which plastic deformation occurs. 2
 (d) Give an account for different types of crystal defects present in a crystal. 8
 (e) What do you understand by the term "critical resolved shear stress"? Derive the relationship for CRSS and what conclusions can be drawn from this relationship. 6
2. (a) What is the necessity to describe the tensile deformation behaviour of a metal in terms of stress and strain instead of load-elongation? 2
 (b) Show that plastic deformation is an irreversible process. 2
 (c) Find the relationship between true strain and engineering strain. 3
 (d) How would you obtain true plastic strain from engineering stress-strain data obtained from a tensile test? 3
 (e) Find the condition at which instability in tension occurs during tensile test. Also express the condition graphically. 5
 (f) What is meant by strain rate sensitivity? How can you determine this? 5
3. (a) What is the reason for dislocation dissociation reaction? Write the conditions for dislocation dissociation reaction and give one example of such reaction satisfying the condition of dissociation. $2 + 2 + 2 = 6$
 (b) What is "cross slip"? Is there any advantage due to the occurrence of cross slip? In which type of metallic system cross slip is easy to occur and why? Between Cu and Mg where cross slip will never occur and why? $3 + 2 + 2 + 2 = 9$
 (c) What is Peierls Stress? On the basis of Peierls Stress how can you justify the role of crystal structure and temperature on yield strength of a material? $2 + 3 = 5$
4. (a) Discuss the shear stress-strain behaviour of Ni - single crystal. How does the nature of shear stress-shear strain curve of Ni – polycrystal vary from that of single crystal and why? $8 + 3 = 11$
 (b) What are the ways to improve the strength of a single-phase material? What is Hall-Petch relationship? Discuss the limitations of this relationship? $3 + 2 + 4 = 9$
5. (a) What is creep? Explain the nature of the constant load creep curve. What are the mechanisms involved in creep deformation? $2 + 4 + 2 = 8$
 (b) How does stress rupture test differ from creep test? What is the utility of doing stress rupture test? $3 + 2 = 5$
 (c) What is Dorn parameter? Derive the Larsen Miller parameter and state the utility of this parameter. $2 + 5 = 7$
6. (a) Discuss the Wood's model for fatigue crack growth.
 (b) What is Paris law?
 (c) What is the difference between ΔK_{th} and K_{Ic} ? Under what situation designing of components will be done based on ΔK_{th} and K_{Ic} and why?
 (d) What is K_{ISCC} ? How does K_{ISCC} differ from K_{Ic} ? $5 + 2 + 3 + 4 + 3 + 3 = 20$
7. (a) Discuss the mechanism of failure during tensile deformation of a ductile material. 5
 (b) State the conditions that promote brittle fracture. 2
 (c) What is known as impact transition temperature? Whether would you recommend for high or low impact transition temperature and why? $2 + 2 = 4$
 (d) What hardness testing method would you recommend for cast material and why? 3
 (e) Why does Brinell hardness depend on load? 3
 (f) Between Al and Mg which one is brittle and why? 3