

**THAPAR INSTITUTE OF ENGINEERING & TECHNOLOGY: PATIALA  
(DEEMED UNIVERSITY)**

Examination: End Semester (1<sup>st</sup> Semester)  
Course: M. Tech. (Materials Science and Engineering)  
Subject: **MECHANICAL BEHAVIOUR OF MATERIALS (MS-103)**

**Total Marks: 36  
Time: 3 Hrs**

**Note: Answer any five of the six questions. Question number one is compulsory. Neatness in writing and clearness in diagrams will be accounted. The answers should be according to question. Extra and unwanted information in answers will not be entertained and marks will be deducted.**

---

---

Q. 1 – State whether the following statements are true or false. Explain and justify your answer.

- a) Tensile strength of material always increases with increase in hardness
- b) Plastic deformation of materials is associated by slip of atomic planes.
- c) Voids are responsible to cause intergranular fracture during secondary creep
- d) Recrystallization is done to relieve stress in annealed materials.

**(4×3 = 12)**

Q. 2 – a) Draw and explain stress-strain curves for brittle and ductile material in a common axis.

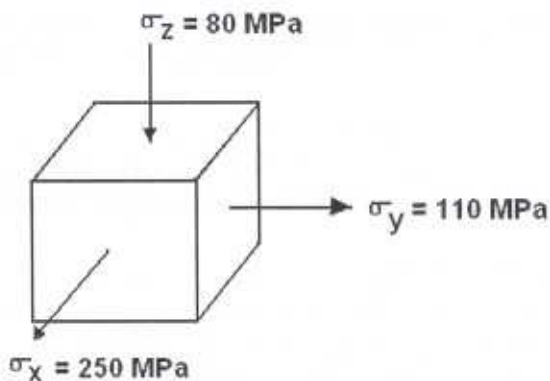
- b) Is it possible to have both slip and twinning occur in the in the same grain? Explain
- c) Which properties would be affected by preferred orientation and why?

**(3+2+1 = 6)**

Q. 3 – a) Explain the reason for the increase in ductility of most metals as the temperature is raised.

- b) Stress analysis of a F16 aircraft wing structure is given in Fig. 1. If 2024 Aluminum alloy with  $\sigma_0 = 700$  MPa is used to manufacture its wings will it exhibit yielding?

Fig. 1



c) What do you understand by dynamic recovery?

(2+3+1 = 6)

Q. 4 – a) Explain the role of coherency of solute atoms in precipitation hardening mechanism.

b) Name and explain the factors responsible for drop in hardness during over ageing.

c) Differentiate precipitation hardening and dispersion hardening. Give examples of each.

(2+2+2 = 6)

Q. 5 – a) Explain why crack propagates easily in brittle materials compared to ductile materials?

b) A crack was responsible for fracturing of a hardened steel shaft under constant load. The half-length of the crack was found  $4 \mu\text{m}$ , and the surface energy of the crack face was estimated  $2 \text{ Jm}^{-2}$ . Calculate the theoretical brittle fracture strength of the steel shaft. [ $Y = 300 \text{ GNm}^{-2}$ ]

c) How dislocations help a crack to grow?

(2+3+1 = 6)

Q. 6 – a) What do you understand by cyclic loading? What are its different types? How fatigue life of materials can be increased?

b) Why in creep resistance materials coherent precipitates are more preferred than