Code No: 5404AD

R17

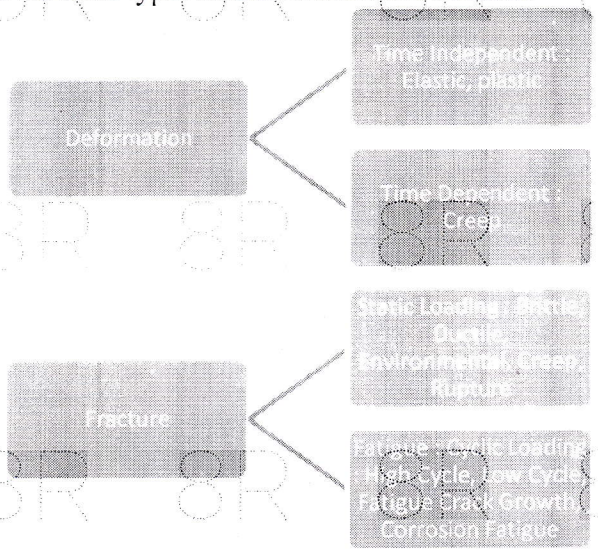
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.Tech I Semester Examinations, July/August - 2021
MECHANICAL BEHAVIOUR OF MATERIALS
(CAD/CAM)

Time: 3 Hours **Max. Marks: 75**

Answer any Five questions
All questions carry equal marks
- - -

1.a) Draw the stress-strain curve for metals, and explain the elastic region, yield point, plastic deformation, necking and fracture.

b) Given below are the basic types of deformation and fracture:



Classify each of the following failures by identifying its category, and explain the reasons for each choice in one or two sentences:
i) The plastic frames on eyeglasses gradually spread and become loose.
ii) A glass bowl with a small crack breaks into two pieces when it is immersed, while still hot, into cold water.
iii) Plastic scissors develop a small crack just in front of one of the finger rings.
iv) A copper water pipe freezes and develops a lengthwise split that causes a leak.
v) The steel radiator fan blades in an automobile develop small cracks near the base of the blades. [7+8]

2.a) An important group of polymers called thermosetting plastics forms a network structure by means of covalent bonds between the chain molecules. How would you expect these to differ from other polymers as to the value of the elastic modulus and the resistance to creep deformation, and why?

b) A plate with a width change is subjected to a tension load as shown in figure 1. The tension load is P = 3800 N, and the dimensions are w_2 = 30, w_1 = 14, and t = 6 mm. It is made of a polycarbonate plastic with yield strength σ_o = 65 MPa. In a tension test, this material exhibits quite ductile behavior, finally breaking at a strain around ε_f = 110 to 150%. What is the safety factor against large amounts of deformation occurring in the plate due to yielding? [7+8]

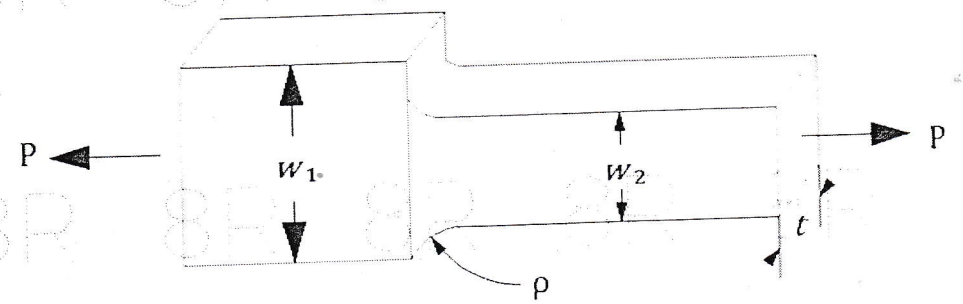


Figure: 1

3.a) The plate shown in figure 2 rotates with a constant angular velocity ω about its axis. The pressures $p = q = 0$. Determine the state of stress and the radial displacement when the boundary conditions alternatively are given by :
Case I: Plate without a hole, a = 0. Outer edge, R = b, of the plate is stress free.
Case II: Plate with a hole, a > 0. Stress free inner and outer edges.

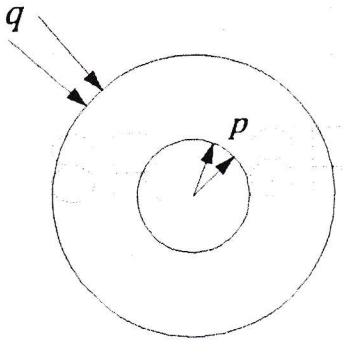


Figure: 2

b) Distinguish between Hydrostatic stress, Deviatoric stress and Octahedral stress. [7+8]

4.a) Distinguish between the mechanical behaviour of isotropic and anisotropic materials.
b) Explain the stress-strain dependence of elastic materials. [7+8]

5.a) Discuss the important interactions with the environment for which the stress field around a dislocation is responsible.
b) What are the different strengthening mechanisms in metals? Explain them. [7+8]

6.a) What is twinning? How is it different from the usual mechanisms where dislocations provide for glide on many glide planes?
b) Explain the interaction between two parallel straight edge dislocations due to the forces between dislocations. [7+8]

7.a) Explain the steps of crack formation and crack propagation in brittle materials.
b) What is the difference between the critical path independent contour integral (J_{IC}) and critical crack tip stress intensity factor (K_{IC})? How do you measure them? [7+8]

8.a) What is cyclic loading and how is it different from static loading?
b) Define creep and discuss its importance in materials engineering. Discuss the design options to minimize creep deformation. [7+8]

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