

1st Semester Regular/Back Examination – 2015-16
SUBJECT NAME- FATIGUE, CREEP AND FRACTURE
BRANCH: MECHANICAL SYSTEM DESIGN
Time: 3 Hours
Max marks: 70
Q.CODE-T1249

Answer Question No.1 which is compulsory and any five from the rest.
The figures in the right hand margin indicate marks.

1. Answer the following questions. 2×10=20
 - a) Mention two important causes for increasing tendency of brittle fracture of metals.
 - b) Describe the phenomenon of fatigue failure in metals. Define “Endurance Limit”.
 - c) What is meant by stress concentration? How do you take it into consideration in case of a component subjected to dynamic loading?
 - d) In $\sigma - N$ Curve show endurance strength for finite life and write down the expression to find out it.
 - e) Discuss some of the technological methods that are adopted to improve fatigue strength.
 - f) Explain the phenomenon of creep in metals.
 - g) Define strain energy release rate.
 - h) Write down the assumptions while considering creep in bending.
 - i) State the basic characteristics of ductile fracture.
 - j) Define fracture toughness. Write down the factors affecting fracture toughness.

1. a) Describe different stages of creep in creep-time curve. [5]
b) Show the methods of representing the rupture stress time and elongation rupture time variation. [5]

2. Derive an expression for angle of twist per unit length considering creep in torsion. Write down the assumptions considered here. [10]

3. Derive the expression for principal strain for a member subjected to triaxial stresses on the basis of uniaxial creep-stress-strain relationship and octahedral shear stress theory. [10]

4. a) Compare Goodman, Soderberg and Gerber fatigue design formulae. Show them on graph. [5]

b) A shaft of 600 mm length is simply supported at its ends. It is subjected to a central concentrated cyclic load that varies from 20 to 40 KN. Determine the diameter of shaft, by taking a factor of safety of 2, size correction factor of 0.8, surface correction factor of 0.9 and fatigue stress concentration factor of 1.5. The material properties of the shaft are given by: ultimate strength of 600 MPa, yield strength of 350 MPa and endurance strength of 300 MPa. [5]

5. a) Explain Griffith theory of brittle fracture. [5]

b) Explain Irwin's theory of fracture. [2]

c) A relatively larger plate of a glass is subjected to a tensile stress of 36 MN/m^2 . If the specific surface energy and modulus of elasticity for this glass are 0.27 J/m^2 and 70 GN/m^2 respectively. Determine the maximum length of a surface flaw that is possible without fracture. [3]

6. a) What is cumulative damage in fatigue? Derive Miner's equation for it. [5]

c) What are the different factors to be considered while designing machine parts to avoid fatigue failure? [5]

7. Write short notes on any two. [5×2=10]

a) Creep stress time relations for simple tension considering different methods for short time and long time.

b) Stress intensity factor

c) Creep stress time relaxation

d) Modes of fracture