Registration no: | | | | | | | | | | |

Total Number of Pages: 02 **M.TECH**
P2MDCC02

2nd Semester Regular Examination 2016-17
FATIGUE, CREEP AND FRACTURE

BRANCH: MACHINE DESIGN, MECH. SYSTEM DESIGN, SYSTEM DESIGN

SYSTEM DESIGN

Time: 3 Hours
Max Marks: 100
Q.CODE :Z486

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

Q1 **Answer the following questions:** **(2×10)**

a) Describe the phenomenon of fatigue failure in metals. Define "Endurance Limit".
b) Describe the effect of size on endurance limit.
c) Define factor of safety for fatigue loading.
d) Define fatigue stress concentration factor
e) Explain the phenomenon of creep in metals.
f) Derive the equation for creep strain using log-log method.
g) Define cumulative damage in fatigue.
h) Distinguish between brittle & ductile fracture.
i) What are the different methods used for detection of fracture.
j) A glass sample has a crack length of 4.2 μm. if the young's modulus of the glass is 70 GN/m2 and the specific energy is 1.1 J/m2. Estimate its fracture strength using Griffith's equation.

Q2 a) Derive and Compare Goodman, Soderberg and Gerber fatigue design formulae. Show them on graph. **(10)**

b) A hot rolled steel shaft is subjected to a torsional moment that varies from 330 N-m clockwise to 110 N-m counterclockwise and an applied bending moment at a critical section varies from 440 N-m to -220 N-m . The shaft is of uniform cross-section and no keyway is present at the critical section. Determine the required shaft diameter. The material has an ultimate strength of 550 MN/m2 and a yield strength of 410 MN/m2. Take the endurance limit as half the ultimate strength, factor of safety of 2, size factor of 0.85 and a surface finish factor of 0.62. **(10)**

Q3 a) Derive the expression showing the ratio of creep bending stress and elastic bending stress (creep stress ratio) considering creep in bending. **(10)**

b) Write down the creep stress time relations for simple tension considering different methods for short time and long time. **(10)**

Q4 a) Derive an expression for angle of twist per unit length considering creep in torsion. **(10)**

b) Derive expresssions for principal strains for a member subjected to tri-axial stresses on the basis of uniaxial creep stress strain relationship and octahedral shear stress theory. **(10)**

Q5 a) State and explain Griffith theory of brittle fracture. Derive an expression for the stress of crack propagation. **(10)**

b) State an expression for Irwin's fracture stress. Derive an expression for stress intensity factor and state of the stress at the end of the crack. **(10)**

Q6 a) Describe the three modes of fracture with appropriate sketches. Write down the methods of protection against fracture. **(10)**

b) Describe different stages of creep in creep-time curve. Define creep stress relaxation with neat curve. **(10)**

Q7 a) Describe the methods of reducing stress concentration. What are the different methods used to improve fatigue strength **(10)**

b) Derive the creep-stress-rupture relations for members subjected to combined stress. Define Fracture toughness. Write down the factors affecting fracture toughness. **(10)**