Registration No : | | | | | | | | | | |

Total Number of Pages : 02 **M.Tech**
MDPE101

1st Semester Back Examination 2019-20
FATIGUE, CREEP AND FRACTURE
BRANCH : DESIGN AND DYNAMICS, MACHINE DESIGN, MECH. ENGG., MECH. SYSTEM DESIGN, MECH. SYSTEMS DESIGN & DYNAMICS, SYSTEM DESIGN
Max Marks : 70
Time : 3 Hours
Q.CODE : HB867
Answer Question No.1 which is compulsory and any FIVE from the rest.
The figures in the right hand margin indicate marks.

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

a) How Low cycle fatigue is different from high cycle fatigue*?*
b) Explain about Endurance strength.
c) Define Notch sensitivity and stress concentration factor?
d) Explain the Miner's concept of cumulative fatigue damage.
e) Distinguish between "Stress Concentration Factor" and "Stress Intensity Factor.
f) State different modes of crack opening.
g) Distinguish between brittle and ductile fracture.
h) Define Finite life and infinite life of fracture?
i) Explain the phenomenon of creep in metals.
j) What is strain hardening effect of creep?

Q2 **a)** Discuss the various mechanical and metallurgical/chemical methods used for improvement of fatigue strength in metals **(5)**

b) Show the σ-N diagrams with natural and log-log scales. Indicate the values of fatigue strength and fatigue life on these curves. **(5)**

Q3 **a)** Compare Goodman, Soderberg and Gerber fatigue design formulae. Show them on a graph. **(5)**

b) A hot rolled steel shaft is subjected to a torsional moment that varies from 330N-m clockwise to 110N-m anticlockwise 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. Find the required rod diameter. Take the ultimate strength of the material of rod as 550NM/m^2 and yield strength of 410 NM/m^2. 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. **(5)**

Q4 **a)** Explain Griffith theory of brittle fracture. Also explain Orwon's modification to Griffith theory **(5)**

b) Using Griffith's equation determine the crack length for steel for the following: **(5)**
$\sigma_{critical}$=1000 MPa, γ=Surface energy per unit area=1.3 J/m^2, E=210 GPa.
What would be the critical crack length according to Griffith- Orwon equation?
Take p = plastic work required to extend the crack wall = 1000 J/m^2.

Q5 **a)** Describe about LEFM and EPFM. How these tare different from each other? **(5)**

b) Discuss the fatigue crack-growth phenomenon through the following relations by graphs **(5)**

i) Instantaneous crack length vrs No. of cycles to failure.

ii) $\frac{dc}{dN}$ vrs Stress Intensity Factor range.

Q6 Describe the three modes of fracture with appropriate sketches. Explain the importance of each mode. Give some example for failure due to each mode. **(10)**

Q7 Derive an expression for angle of twist per unit length considering creep in torsion. Write down the assumptions considered here. **(10)**

Q8 **Write short answer on any TWO :** **(5 x 2)**

a) Describe a standard creep test procedures

b) Discuss creep phenomenon for high temperature bolting design in pressure vessels.

c) Describe the Baily's Power law and its importance.