Sub Code:MME110

Paper Id: 910113 Roll No:

M.TECH
(SEM-I) THEORY EXAMINATION 2019-20
ADVANCED DESIGN OF MECHANICAL SYSTEM

Time: 3 Hours *Total Marks: 100*

Note: Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. 2 x 10 = 20

a. Why it is necessary to use factor of safety?
b. Define concurrent engineering.
c. List at least four failure criteria used for designing machine element.
d. Define elastic and plastic creep behavior.
e. What are the reasons behind the material fracture?
f. Distinguish the difference between high-cycle fatigue and low-cycle fatigue.
g. What isdesign methodologies of totaldesign?
h. What are the three modes of cracking in fracture mechanics?
i. Compare and contrast ductile rupture and brittle fracture.
j. What do you mean by fracture toughness?

SECTION B

2. Attempt any *three* of the following: 10 x 3 = 30

a. Define the term optimum design and briefly explain why it is difficult to achieve an optimum solution to a practical design problem. Also list the several factors that might be used to judge how well a proposed design meets its specified objectives.
b. What is stress concentration factor? What is the influence of stress concentration on fatigue strength?
c. Define design for assembly and also explain the design aspects of design for assembly.
d. What do you understand by term "Theory of failure"? What important point should be considered from theory of failures used in design?
e. Write the short notes on the following:
(i) Stress corrosion cracking
(ii) Pitting of gears

SECTION C

3. Attempt any *one* part of the following: 10 x 1 = 10

(a) What are the factors to be considered for the selection of materials for the design of machine elements? Discuss.
(b) At a section of a mild steel shaft, the maximum torque is 8437.5 Nm and maximum bending moment is 5062.5 Nm. The diameter of shaft is 90 mm and the stress at the elastic limit in simple tension for the material of the shaft is 220 N/mm^2. Determine whether the failure of the material will occur or not according to maximum shear stress theory. If not, then find the factor of safety.

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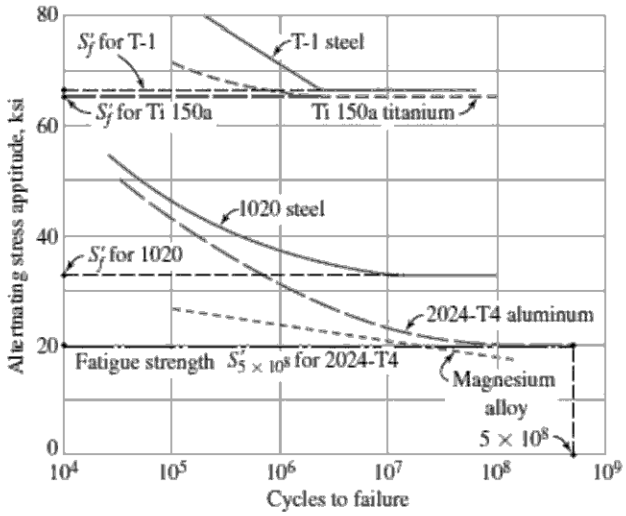
4. Attempt any *one* part of the following: 10 x 1 = 10

(a) What are rolling contact bearings? Discuss their advantages over sliding contact bearings. Explain how the following factors influence the life of a bearing:
(i) Load (ii) Speed (iii) Temperature (iv) Reliability

(b) What do you mean by endurance limit?Discuss the influence of various factors on the endurance limit of ductile material.

5. Attempt any *one* part of the following: 10 x 1 = 10

(a) An axially loaded straight cylindrical bar of diameter $d = 12.5$ mm is to be made of 2024-T4 aluminum with ultimate strength of $Su = 469$ MPa, yield strength $Syp = 331$ MPa, and fatigue properties shown in fig. The bar is to be subjected to a completely reversed axial force of 27 kN, and must for at least 10^7 cycles. Determine (i) What is the governing failure mode? (ii) Is failure predicted to occur?



(b) What do you mean by creep? What are different three stages of creep? Explain briefly about the mechanism of creep deformation.

6. Attempt any *one* part of the following: 10 x 1 = 10

(a) It is desired to design a solid cylindrical tension member 5 feet long, made of 1030 steel, to support a 10000-lb load for 10 years at 750°F without exceeding 0.1-inch creep deformation. What diameter should the bar be made to prevent failure prior to the end of the 10-year design life?

(b) Write the short notes on the following fretting:
(i) Fretting fatigue
(ii) Fretting wear

7. Attempt any *one* part of the following: 10 x 1 = 10

(a) In modern fatigue analysis, three separation phases of fatigue are defined. List the three phases and briefly describe how each one is currently modeled and analyzed?

(b) What do you mean by Linear elastic Fracture Mechanics? Derive an expression for stress intensity factor and state of stress at the end of the crack.