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GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (NEW) EXAMINATION – WINTER 2022

Subject Code:3171925 Date:12-01-2023

Subject Name:Advanced Machine Design

Time:10:30 AM TO 01:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	Give an example of following failure modes: (1) brittle fracture (2) ductile fracture (3) buckling	**03**
	(b)	The aluminum alloy 2024-T4 is subjected to cyclic loading between σ_{min}= 172 and σ_{max} = 430 MPa. What life is expected? Take constants σ_f'= 900 MPa and b = - 0.102 for this material.	**04**
	(c)	A spherical pressure vessel is made of ASTM A517-F steel and operates at room temperature. The inner diameter is 1.5 m, the wall thickness is 10 mm, and the maximum pressure is 6 MPa. Is the leak-before-break condition met? What is the safety factor on *K* relative to K_{IC}, and what is the safety factor against yielding? Take fracture toughness for ASTM A517-F, K_{IC} = 187 MPa $\sqrt{m}$.	**07**
Q.2	**(a)**	Define the terms creep, creep rupture, and stress rupture.	**03**
	(b)	Explain three modes of fracture failure with neat sketch.	**04**
	(c)	A steel plate (Sys = 350 MPa) of width 80 mm and thickness 5 mm has a centre crack 2a = 40 mm length. If the far field stress is 150 MPa, determine the SIF and the length of the effective crack, using Irwin's correction.	**07**
		OR	
	(c)	A center-cracked plate, as in Figure. 1, has dimensions b = 50 mm, t = 5 mm, and large h; a force of P = 50 kN is applied.	**07**

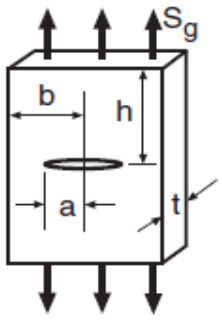

Figure. 1

(a) What is the stress intensity factor K for a crack length of a = 10 mm?
(b) For a = 30 mm?

Q.3	**(a)**	Explain three stages of creep.	**03**
	(b)	Why should we evaluate the SIF for a crack in a component?	**04**

(c) Derive relationship between crack tip opening displacement (CTOD) and stress intensity factor for Mode I (K_I) for small scale yielding. **07**

OR

Q.3 **(a)** Critical SIF of a material depends on many factors? **03**

(b) Discuss three ways for designing to avoid surface failure. **04**

(c) Discuss the Palmgren–Miner rule for life prediction for completely reversed variable amplitude loading. **07**

Q.4 **(a)** What is need of combined seals? **03**

(b) Explain the effects of cracks on brittle versus ductile behaviour. **04**

(c) 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 Figure 2. The bar is to be subjected to a completely reversed axial force of 27 kN, and must last for at least 10^7 cycles. **07**

(1). What is the governing failure mode? (b). Is failure predicted to occur?

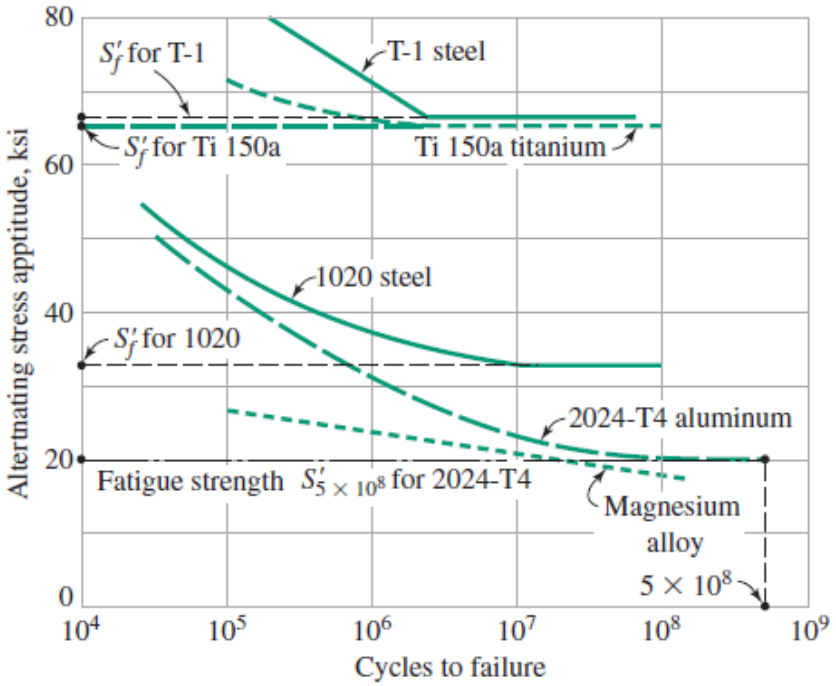

Figure. 2

OR

Q.4 **(a)** Distinguish the difference between high-cycle fatigue and low-cycle fatigue. **03**

(b) Explain rain flow cycle counting method with the help of suitable example. **04**

(c) The ball and socket joint (Figure 3) at the end of a rocker arm has a hardened-steel spherical surface 10 mm in diameter fitting in a hard-bronze bearing alloy spherical seat 10.1 mm in diameter. What maximum contact stress will result from a load of 2000 N? **07**

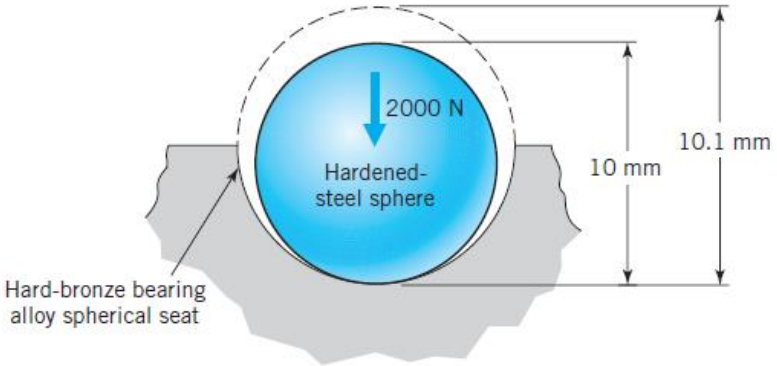

Figure. 3

Take for steel Young's Modulus, E = 207 GPa and Poisson's ratio, ν = 0.30 and for bronze E = 110 GPa and ν = 0.33.

Q.5 **(a)** Describe the usual consequences of surface fatigue. **03**

(b) Give a definition for fretting, and distinguish among the related failure phenomena of fretting fatigue, fretting wear, and fretting corrosion. **04**

(c) Explain contact seals and non-contact seals. **07**

OR

Q.5 **(a)** Enlist the factors that may affect S-N curves. **03**

(b) Explain three-stage gear deformation under load attached with a foundation with neat sketch. **04**

(c) Explain housings split at right angle to the axes of the shafts with suitable example. **07**

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