



P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

First Semester, M.Tech. - Mechanical Engineering (MMDN)

Semester End Examination; April / May - 2021

Advanced Machine Design

Time: 3 hrs

Max. Marks: 100

Course Outcomes

The Students will be able to:

CO1: Explain failure theories and machine elements based on different static failure criteria, describe fatigue concepts and fatigue test methods.

CO2: Describe the S-N behaviour of the machine components, Make use of various techniques for cycle counting and peak counting.

CO3: Define concepts of strain life approach and Apply strain life approach for life estimation of machine elements.

CO4: Explain concepts of LEFM. Analyze the crack growth life of machine elements.

CO5: Describe the influence of notches on fatigue life of machine elements and apply concepts of fracture mechanics determine crack growth at notches.

Note: I) Answer any **FIVE** full questions, selecting **ONE** full question from each unit.

II) Any **THREE** units will have internal choice and remaining **TWO** unit questions are compulsory.

III) Each unit carries 20 marks.

Q. No.	UNIT - I	Marks	BLs	CO	PO
1a.	Derive the design equation for Mohr's theory of failure.	10	L2	CO1	PO1,2
1b.	Find the factor of safety against failure, using modified Mohr's theory, given the material gray cast iron for which, $\sigma_{ut} = 30 \text{ MPa}$, $\sigma_{uc} = 120 \text{ MPa}$, $\sigma_x = -35 \text{ MPa}$, $\sigma_y = 10 \text{ MPa}$ and $\tau_{xy} = 0 \text{ MPa}$.	10	L2	CO1	PO2
OR					
1d.	With a neat sketch, explain any one fatigue testing experiment.	10	L2	CO1	PO2
1e.	Distinguish between failsafe design and safe life design, and explain the concept of inspectability upon which theory both depend?	10	L2	CO1	PO1,3
UNIT - II					
2 a.	Discuss the influence of following factors on S-N behaviour of metals: i) Microstructure ii) Size iii) Surface finish iv) Loading frequency	10	L2	CO2	PO1,2
2 b.	A 40 mm diameter bar has been machined from A1S1-1045 CD bar. The bar will be subjected to a fluctuating tensile load varying from 0-100 kN because of end fillet radius, $k_f = 1.85$ is to be used. Find the critical mean and alternating stresses value σ_a and σ_u and the fatigue factor of safety 'n' according to the modified good man fatigue criterion. Use	10	L4	CO2	PO1,2

$$\sigma_{ut} = 630\text{MPa}, \sigma_y = 530\text{MPa}, \sigma_{cn} = 0.5 \sigma_{ut},$$

$$a = 0.817, b = 1, c = 0.85, k_t = 1$$

UNIT - III

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|------|---|----|----|-----|-------|
| 3 a. | With schematics, explain cyclic hardening and cyclic softening. | 10 | L2 | CO3 | PO1,2 |
| 3 b. | With a neat sketch, explain typical cyclic stress-strain curve. | 10 | L2 | CO3 | PO1,2 |

UNIT - IV

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|------|--|----|----|-----|-------|
| 4 a. | Explain; | 10 | L2 | CO4 | PO1,2 |
| | i) Stress intensity factor ii) Fracture toughness | | | | |
| 4 b. | Explain loading modes and crack tip plastic zone. | 10 | L2 | CO4 | PO1,3 |

OR

4 d. Testing an aluminum alloy has resulted in the following data:

$$\sigma_u = 483\text{MPa}, \sigma_{yp} = 345\text{MPa}, K_{IC} = 28\text{MPa}\sqrt{m},$$

$$e(50\text{mm}) = 22\%, k' = 655\text{MPa}, n' = 0.065, \epsilon_f' = 0.22,$$

$$\sigma_f' = 1100\text{MPa}, b = -0.12, c = -0.60 \text{ and } E = 71\text{GPa}.$$

A direct tension member made of this alloy is to be 50 mm wide, 9 mm thick and have 12 mm diameter hole, through the thickness, at the centre of the tension member. The hole will produce a fatigue stress concentration factor of $k_f = 2.2$. A completely reversed axial force of 28 kN amplitude is to be applied to the member. Estimate the number of cycles required to initiate a fatigue crack at the edge of the hole.

UNIT - V

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|------|---|----|----|-----|-------|
| 5 a. | Illustrate with suitable sketch, the effect of notch root radius on notch sensitivity factor. | 10 | L2 | CO5 | PO1,3 |
| 5 b. | Explain the procedure for life estimation using strain-life approach. | 10 | L2 | CO5 | PO1,2 |

OR

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|------|---|----|----|-----|-------|
| 5 c. | Explain notch sensitivity and notch factor. | 10 | L2 | CO5 | PO1,2 |
| 5 d. | Explain Haigh diagram to estimate its life estimation with SN approach. | 10 | L2 | CO5 | PO2,3 |

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