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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; Jan. - 2020

Advanced Machine Design

Time: 3 hrs *Max. Marks: 100*

Note: *i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.*
ii) Missing data, if any, may be suitably assumed.
iii) Use of Data Hand book is permitted.

UNIT - I

1 a. List any ten mechanical failure modes of metals. 10

b. Explain with neat sketch rotating pure bending testing. 10

2 a. Discuss; (i) Fail-Safe design (ii) Damage-tolerant design. 10

b. Sketch any ten different fatigue test specimens. 10

UNIT - II

3 a. Discuss mean stress effects on S-N behaviour. 10

b. Discuss palmgren-minear linear damage rule. 10

4 a. Explain the following:

(i) Effect of micro structure on S-N behaviour 10

(ii) Rain flow cycle counting method

b. An un-notched circular rod with a diameter of 10 mm is subjected to constant amplitude ending at room temperature, with S_m= 200 MPa, the material is 4340 quenched and tempered alloys steel with S_u = 1240 MPa, S_y = 1170 MPa, and S_y'= 1000 MPa. If the rod is commercially polished, estimate the values of Sa, S_{max}, S_{min} and *R* for a median fatigue life of 50,000 cycles and no yielding. Take; S_f = 540 MPa. 10

UNIT - III

5 a. Substantiate the following statement:

"Cyclic strain-controlled tests can better characterize the fatigue behaviour of material than cyclic stress-controlled tests can". 5

b. Discuss Bauschinger effect. 5

c. Discuss strain based ($\in$-N) approach to life estimation. 10

6 a. Discuss the cyclic hardening and cyclic softening. 5

b. Sketch and explain monotonic and cyclic stress curves for;

(i) Aluminium 2024-T4 (ii) Man-Ten Steel 5

(iii) Ti-811 Titanium aluminium alloy (iv) SAE 4340 steel (v) Waspaloy-A

c. Explain with a schematic representation the effect of surface finish representation the effect of surface finish on strain-life behaviour. 10

Contd….2

UNIT - IV

7 a. Explain with neat sketches, the modes of crack extension. 6

b. Explain the importance of stress intensity factor *K* and energy release rate *G*. 4

c. A very wide SAE 1020 cold–rolled thin plate is subjected to constant amplitude uniaxial cyclic loads that produce nominal stresses varying from S_{max} = 200 MPa to S_{min}= 0 MPa. The monotonic properties for this steel are S_y = 630 MPa, S_u = 670 MPa, E = 207GPa, and K_C = 104 MPa√m. What fatigue life would be attained if an initial through thickness edge crack existed and was 1 mm in length? Take intercept 10

A = 6.9×10^{-12} m/cycle and slope n = 3.0.

8 a. Explain with neat sketches the crack tip plastic zone using Von-Mises Criterion for mode I. 10

b. Discuss Wheeler model used for life estimation with fatigue crack growth. 10

UNIT - V

9. A notched part made from quenched and tempered hot rolled RQC-100 steel is shown in Fig. Q(9)/(10). The elastic stress concentration factor K_t is 3.The nominal stress, $S = P/A + MC/I$ is 11.25P (MPa), where *P* is the load in kN. S_u = 931 MPa, S_y = 883 MPa, σ_f = 1330 MPa, $S'_y = 600\ MPa$, $\sigma'_f = 1240 MPa$, b = –0.07. Construct the S-N lines for,

(i) Completely reversed, constant amplitude loading

(ii) Constant amplitude loading with a minimum nominal stress of 50 MPa 20

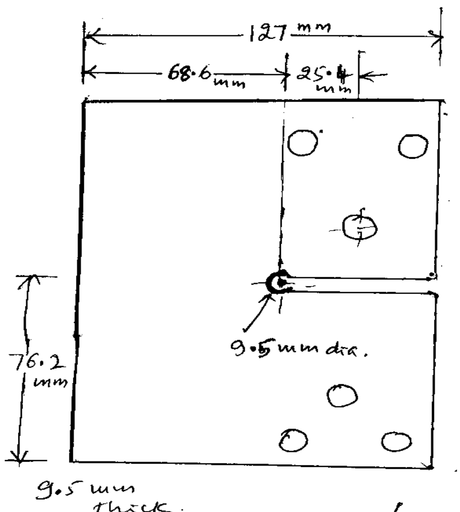

Fig. Q(9)/(10).

10. A notched part made from quenched and tempered hot rolled RQC = 100 steel is shown in Fig. Q(9)/(10). K_t = 3. Using local strain approach, find notch stress and strain amplitudes from constant amplitude alternating loads between 4.45 kN and 44.5 kN. Use $S = P/A + MC/I = 11.25\ P$. Take E = 207 GPa, S_y = 883 MPa, K = 1172 MPa, *n* = 0.06, $S'_y = 600 MPa$, K′ = 1434 MPa, n′ = 0.14, $\sigma^1_f = 1240 MPa$, $\in'_f = 0.66$, b = –0.07, C = –0.69; k_f = 2.82. Any other data may be taken from Q.9. Use Neuber's rule, Strain energy density rule and linear rule for calculation. 20

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