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

(An Autonomous Institution affiliated to VTU, Belgaum)

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

Semester End Examination; Jan - 2017

Advanced Machine Design

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.*
ii) Assume missing data, if any.
iii) Use of Design data hand book/charts is permitted.

UNIT - I

1 a. List at least ten modes of mechanical failure. 5

b. With the help of Mohr's circles, distinguish between even and uneven materials. 7

c. Discuss in detail the fatigue mechanisms and microscopic features. 8

2 a. Discuss the modified Mohr theory with the help of biaxial fracture data of gray cast iron. 10

b. Calculate the safety factor for the bracket shown in Fig. Q2b. Using the Coulomb-Mohr and the modified Mohr effective stress theories. Assume a brittle material strength of $S_{ut} = 350\ MPa$ and $S_{uc} = 1000\ MPa$. 10

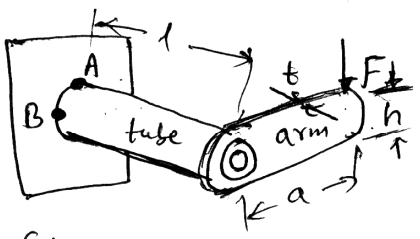

Fig Q2b.

l = 100 mm; a = 400 mm
t = 10 mm; h = 20 mm
F = 50 N; OD = 20 mm (Outer Dia)
ID = 16 mm (Inner Dia)

UNIT - II

3 a. Discuss the influence of the following factors on S-N behavior ;
(i) Microstructure (ii) Size (iii) Surface finish (iv) Frequency. 12

b. Discuss Palmgren-Miner linear damage rule. 8

4 a. An un-notched circular rod with a diameter of 10 mm is subjected to constant amplitude bending at room temperature, with S_m = 200 MPa. The material is 4340 quenched and tempered alloy steel with S_u = 1240 MPa, S_y = 1170 MPa and $S_y^1 = 1000$ MPa. Take $S_f = 0.5\ S_u$ and surface correction factor = 0.87. Estimate the values of S_a, S_{max}, S_{min} and R for a median fatigue life of 50,000 cycles. Verify whether yielding occurs or not. 10

b. Discuss rain flow cycle counting method. 10

Contd….2

UNIT - III

5 a. Explain with a neat sketch, strain-controlled testing conducted on a servo-controlled closed loop testing machine. 10

b. Discuss cyclic stress-strain behavior of Copper subjected to cyclic strain controlled axial loads (fully annealed, partially annealed and cold worked copper). 10

6 a. Discuss strain based approach to life estimation. 10

b. Describe in detail the determination of strain-life fatigue properties. 5

c. Discuss mean stress effects in strain controlled cyclic testing. 5

UNIT - IV

7 a. Sketch and explain modes of crack extension. 6

b. Explain the following : 4

(i) Stress intensity factor (ii) Energy release rate.

c. Sketch and explain crack tip plastic zone for mode I using the von mises criterion and Dugdale plastic zone strip model. 10

8 a. Sketch and explain sigmoidal d_a/d_N-Δk curve. 10

b. A very wide SAE 1020 cold rolled thin plate is subjected to constant amplitude uniaxial cyclic loads that produce nominal stress varying from S_{max} to S_{min} which results in stress range Δs = 200 MPa. The monotonic properties for this steel are S_y = 630 MPa, S_u = 670 MPa, E = 207 GPa, and $K_c = 104\ MPa\sqrt{m}$, S_{max} = 200 MPa. What fatigue life would be attained, if an initial through-thickness edge crack existed and was 3 mm in lengths? Take A = 6.9×10^{-12} m/cycle and n = 3. 10

UNIT - V

9 a. Sketch and explain the construction of Haigh diagrams. 10

b. Describe in detail the notch stresses and strain concentration factors. 10

10. Discuss Neuber's rule and Glinka's rule. 20

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