M.E. First Semester (Mech. Engg. (Adv. Manu. & Mech. Sys. Desig)) (New - CGS)
13459 : Advanced Machine Design : 1 MMD 2

P. Pages : 2

Time : Three Hours

AU - 3379

Max. Marks : 80

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SECTION – A

1. a) Explain importance of theories of failure in mechanical design. 6

   b) Explain 7

      i) Coulomb-Mohr theory and

      ii) Modified Mohr theory of failure for designing with uneven brittle material.

2. a) At a critical point in a stressed body the state of stress is given by $\sigma_x = 60\,MPa$, $\sigma_y = -30\,MPa$. and $\tau_{xy} = 50\,MPa$. If the materials used is cast iron with $\sigma_{ut} = 180\,MPa$, $\sigma_{uc} = 590\,MPa$, determine factor of safety according to modified Mohr's theory. 8

   b) Explain different fatigue design criteria with examples. 6

3. a) Explain Rain-flow method of cycle counting. 4

   b) A very wide SAF 1020 cold rolled thin plate is subjected to constant amplitude uniaxial cyclic load that produce nominal stresses varying from $S_{min} = 250\,MPa$ to $S_{min} = -50$ MPa. Monotonic properties for this steel are $S_Y = 630\,MPa$, $S_D = 670\,MPa$, $E = 207$ GPa and $K_C = 104\,MPa\sqrt{m}$. If an Initial through thickness edge crack of 2mm length existed, what will be the fatigue life of the plate? Take $A = 6.9 \times 10^{-2}\,m|cyc|e$ and $n = 3$. 9

4. a) Explain with neat sketch, rotating bending (Pure) fatigue testing. 7

   b) Explain Palmgren-miner linear damage rule. 6

5. a) Explain HCF and LCF? Compare them. 6

   b) What is Haigh diagram for a notched part? Also sketch a modified Goodman's diagram for a notched part. 7

SECTION – B

6. a) A particular type of ball bearing operating at 3000 rpm has a rated life of 50,000 hrs, 8
6500 hr and 1000 hrs when subjected to constant amplitude loads of 1kN, 2kN and 4kN respectively. During each hour of operation the load is 4kN for 5min, 2kN for 15min and 1kN for 40min.
Determine.
   i) Number of hours the bearing survives.
   ii) Percentage of damage caused by each of load levels.

   b) Explain different wear mechanism? 5

7. a) Briefly explain different measures to be taken to avoid surface failure. 6

   b) Derive an expression for contact pressure distribution in spherical contact. Show the 7
distribution of pressure schematically.

8. a) A ball thrust bearing with 7 balls is loaded axially across its races through the balls. What 8
is the size of the contact patch on a race and what are the stresses developed in balls and race's? What is the depth of maximum shear stress in a ball? The balls are 10mm in diameter and the races are flat. All parts are hardened steel. The axial load is 665N. Assume the seven balls share the load equally. The rotational speed is sufficiently slow. Take Poisson's ratio = 0.28 and $E = 2.1 \times 10^5 \, N/mm^2$.

   b) What do you mean by plane strain fracture toughness? Explain the effect of the following 6
on plane strain fracture toughness.
   i) Temperature   ii) Crack length
   iii) Stress applied.

9. a) What is fatigue damage? Explain different damage summing method's. 7

   b) Explain Weibull distribution for statistical aspect of fatigue life. 6

10. a) What are the important parameters to characterize a given cyclic loading History. 6

   b) Explain the following. 7
   1) Griffith theory.   2) LEFM approach.

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