M.E. First Semester (Mechanical Engineering (Adv. Manu. & Mech. Sys. Desig.)) (New-CGS)

# 13459 : Advanced Machine Design : 1 MMD 2

P. Pages : 2 | **AW - 3548**

Time : Three Hours | Max. Marks : 80

Notes :
1. Answer **three** question from section A and **three** question from section B.
2. Due credit will be given to neatness and adequate dimensions.
3. Assume suitable data wherever necessary.
4. Illustrate your answer necessary with the help of neat sketches.
5. Machine Design Databook is permitted.
6. Use of pen Blue/Black ink/refill only for writing book.

## SECTION – A

**1.** a) Explain different theories of failure for brittle materials? **6**

b) Estimate factor of safety using MSS and DE theory for following stress states. **8**

i) $\sigma_x = 55MPa, \sigma_y = 25MPa, \tau_{xy} = 15MPa$

ii) $\sigma_x = -45MPa, \sigma_y = -65MPa, \tau_{xy} = 10MPa.$

Take $S_{yt} = S_{yc} = 520$ MPa.

**2.** a) Explain different fatigue design criteria's? **5**

b) Determine mean stress, stress amplitude, stress ratio and amplitude ratio for following conditions. **8**

i) $\sigma_{max} = 480\,MPa, \quad \sigma_{min} = -380\,MPa$

ii) $\sigma_{max} = 520\,MPa, \quad \sigma_{min} = 0$

iii) $\sigma_{max} = 580\,MPa, \quad \sigma_{min} = 210\,MPa$

iv) $\sigma_{max} = -120\,MPa, \quad \sigma_{min} = -480\,MPa.$

**3.** a) Which are constant life lines? Explain with neat diagrams. **5**

b) A forged 50mm diameter steel rod has UTS of 700 MPa and YS of 525 MPa. Subjected to constant amplitude cyclic loading. Determine the following using approximate models. **8**
i) Stress amplitude and mean, stress for $10^6$ cycles if R = 0.
ii) Stress amplitude and mean stress for $10^4$ cycles if R = 0.

**4.** a) Derive relation between true stress and strain to engineering stress and strain. **7**

b) Explain strain hardening and strain softening for cyclic stress – strain response of metals? **6**

**5.** a) Explain HCF and LCF? Also compare them. **6**

b) Derive strain-life relation? Explain transition life using strain-life curves. **7**

## SECTION – B

6. a) Explain different modes of loading a crack in a body? 6

   b) Determine plastic zone size and fracture stress for a large Al-plate with a central crack of 5 mm long. Assume plain strain condition and 8
   $\sigma_{ys}$ = 475MPa, $K_{IC}$ = 30MPa $\sqrt{m}$ and E = 70GPa

7. a) What is probability density function? Explain statistical distributions often used in fatigue and durability analysis. 6

   b) Calculate mean, median and standard deviation for fatigue testing of similar components which produced following fatigue lives : 12300, 13500, 12800, 14200, 15600, 16200 and 17500. 7

8. a) What is fatigue damage? Explain different damage summing methods used. 7

   b) A particular ball bearing operating at 3000 rpm has rated life of 40000 hours, 20500 hrs and 5200 hours when subjected to constant amplitude loads of 2kN for 10 minutes, 4kN for 15 minutes and 8kN for 35 minutes respectively. Determine 6
   i) How many hours do you expect the bearings to last?
   ii) What percentage of the damage is caused by each of the load levels?

9. a) Explain following terms related to surface failure with neat sketch. 6
   i) Arithmetic mean Roughness value
   ii) Root mean square Roughness value
   iii) Mean peak Height above mean line

   b) Determine the size of contact path and maximum contact stress for 20mm diameter steel ball rolled against a flat Al-plate with 5kN load. 7

10. a) What is cycle counting? Explain different cycle counting methods. 7

    b) What is plastic zone at crack-tip? Explain plastic zones for monotonic and cyclic loadings for plane stress and plane strain conditions. 6

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