

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

**13459 : Advanced Machine Design : 1 MMD 2**

P. Pages : 2

Time : Three Hours



**AW - 3819**

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. Use of D.A. Lows "Pocket Book for Mechanical Engineers" is permitted.
  6. Use of machine design data book is permitted.
  7. Use of pen Blue/Black ink/refill only for writing the answer book.

**SECTION - A**

1. a) Explain different theories of failure for ductile materials ? 4  
b) Find factor of safety using MNS and BCM theories for following stress states. 9  
i)  $\sigma_x = 140 \text{ MPa}$  ,  $\sigma_y = 50 \text{ MPa}$   
ii)  $\sigma_x = 80 \text{ MPa}$  ,  $\tau_{xy} = -50 \text{ MPa}$   
iii)  $\sigma_x = -100 \text{ MPa}$  ,  $\tau_{xy} = -60 \text{ MPa}$   
Take ultimate strength of 220 MPa in tension and 550 MPa in compression for cast iron.
2. a) What is cyclic loading ? Explain different cyclic loadings ? 5  
b) Compute mean stress, stress amplitude, stress ratio and amplitude ratio for following fatigue stress conditions. 8  
i)  $\sigma_{\max} = 125 \text{ MPa}$  ,  $\sigma_{\min} = -125 \text{ MPa}$   
ii)  $\sigma_{\max} = 150 \text{ MPa}$  ,  $\sigma_{\min} = 0$   
iii)  $\sigma_{\max} = 120 \text{ MPa}$  ,  $\sigma_{\min} = -30 \text{ MPa}$   
iv)  $\sigma_{\max} = 140 \text{ MPa}$  ,  $\sigma_{\min} = 50 \text{ MPa}$
3. a) What is fatigue failure ? Explain stages of fatigue failure mechanism with neat sketches. 6  
b) A component undergoes a cyclic stress with a maximum value of 600 MPa and minimum value of 100 MPa. Using different relations determine fatigue life of the component. Take UTS as 1050 MPa and YS as 730 MPa for material of component. 7
4. a) Show that true stress can be stated as function of engineering stress and strain which is valid upto necking only ? 6  
b) Derive strain life relation ? Explain transition life using strain-life curves. 7
5. a) Explain strain hardening and strain softening of metals for cyclic stress-strain response. 6  
b) Derive relationship between hysteresis stress strain curve and cyclic stress strain curve. 7

## SECTION - B

6. a) Explain which are factors influencing fatigue crack growth ? 6
- b) A large plate ( $2a \ll w$ ) containing a central crack 30 mm long is subjected to tension stress. If the crack growth rate is 5 mm / month and fracture is expected at 12 months from now, determine the fracture stress. Take  $k_{IC} = 30 \text{ MPa } \sqrt{\text{m}}$ . 7
7. a) Explain different modes of loading a crack in a body subjected to load ? 6
- b) What is probability density function ? Explain statistical distributions often used in fatigue and durability analysis. 7
8. a) What is cycle counting ? Explain different cycle counting methods ? 6
- b) What is Palmgren - Miner linear damage rule ? Explain it with the help of example. 7
9. a) Explain following terms related to surface failure with neat sketch. 6
- i) Adhesive wear
- ii) Abrasive wear
- iii) Corrosion wear
- b) Determine size of contact path and contact stresses for 50 mm diameter steel cylinder rolled against a parallel 60 mm diameter copper cylinder with 10 kN radial force and both cylinders are 100 cm long. 7
10. a) Explain crack growth rate diagram with neat sketch. 6
- b) What is surface fatigue ? Explain different precautions made in designing to avoid surface failure. 8

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