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

UNIT - I

1 a. Discuss role of failure prevention analysis in mechanical design. 4

 b. Compare and discuss MNST, MSST, and DET with experimental data. 6

 c. Based upon the distortion energy theory, determine the safety factor for points A and B. The Bar is made of AISI 1006 cold drawn steel (S_y = 280 MPa) and it is loaded by the forces, F = 0.55 kN, P = 8.0 kN and T = 30 N-m. 10

Fig. 81c
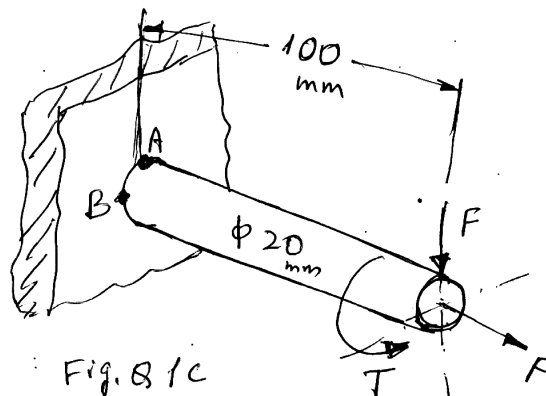
2 a. Explain in detail the following fatigue design criteria : 10
 (i) Safe-life design   (ii) Fail-safe design

 b. With a neat sketch explain how fatigue test is carried out on a rotating pure bending machine. 10

UNIT - II

3 a. Explain compressive and tensile mean stress effect on aluminium alloys and steels. 10

 b. Explain in detail the influence of the following factors on S-N behavior,
 (i) Microstructure   (ii) Size effects 10
 (iii) Surface finish   (iv) Frequency

4 a. Explain fatigue life estimation using S-N approach. 10

 b. Explain the following cycle counting methods : 10
 (i) Peak counting method
 (ii) Rain flow method

UNIT - III

5 a. Explain the following :

   i) True stress and true strain   ii) Cyclic hardening

   iii) Baushinger effect   iv) Stable cyclic stress-strain- hysteresis loop

   v) Monotonic and cyclic stress-strain curve for 2024 - T4 aluminium.   10

   b. Explain with sketches the stress-strain behaviour of fully annealed, partially annealed and cold-worked copper subjected to cyclic strain controlled axial loads.   10

6 a. Explain with a sketch strain based approach to life estimation.   10

   b. Explain with sketches the effect of mean stress and surface finish on strain life behavior.   10

UNIT - IV

7 a. Discuss in detail the effect of the following on fracture toughness,

   i) Specimen thickness

   ii) Temperature

   Draw neat sketches.   14

   b. Write a note on fatigue crank growth, da/dN-ΔK and explain with a sketch, the effect of stress levels as fatigue crack length.   6

8. A very wide SAE 1020 cold-rolled twin plate is subjected to constant amplitude uniaxial cyclic loads that produce nominal stresses varying from S_{max}= 200 MPa to S_{min} = - 50 MPa. The monotonic properties for this steel are S_y = 630 MPa, S_u = 670 MPa. E = 207 GPa, and $K_c = 104 MPa\sqrt{m}$. What fatigue life would be attained if an initial through thickness edge crack existed and was 1mm in length?

   If R = 0.33, S_{max} = 300 MPa, and S_{min} = 100 MPa. What fatigue life is attained given the same initial crack size? Take; A = 6.9x10^{-12} m/cycle and n = 3.   20

UNIT - V

9 a. Explain the effect of stress level on notch factor.   10

   b. Explain mean stress effects and Haigh diagram.   10

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

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