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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/Feb - 2016

Advanced Machine Design

Time: 3 hrs

Max. Marks: 100

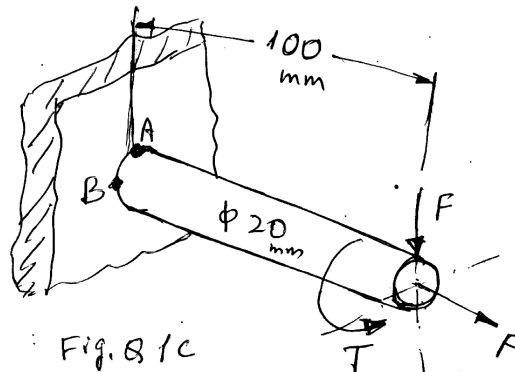
Note: i) Answer **FIVE** full questions, selecting **ONE** full question from each **unit**.

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



- 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, 10
 - (i) Microstructure
 - (ii) Size effects
 - (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.
- b. Explain with sketches the stress-strain behaviour of fully annealed, partially annealed and cold-worked copper subjected to cyclic strain controlled axial loads.
- 6 a. Explain with a sketch strain based approach to life estimation.
- b. Explain with sketches the effect of mean stress and surface finish on strain life behavior.

UNIT - IV

- 7 a. Discuss in detail the effect of the following on fracture toughness,
- i) Specimen thickness
 - ii) Temperature
- Draw neat sketches.
- b. Write a note on fatigue crack growth, $da/dN-\Delta K$ and explain with a sketch, the effect of stress levels as fatigue crack length.
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 $K_c = 104MPa\sqrt{m}$. 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; $A = 6.9 \times 10^{-12}$ m/cycle and $n = 3$.

UNIT - V

- 9 a. Explain the effect of stress level on notch factor.
- b. Explain mean stress effects and Haigh diagram.
10. Explain Neuber's and Glinka's rule.

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