Unit III

5. (a) Explain modified Goodman line diagram for fatigue failure and write down corresponding design equations. Comment on why Goodman's line criterion needed modification.

(b) Clearly define and explain the significance of theoretical stress concentration factor K_t, fatigue stress concentration factor K_f and notch sensitivity q. Derive relation among them.

8+7=15

6. The work cycle of a mechanical component subjected to completely reversed bending stresses comprising of the following three components :

(i) $\pm$350 N/mm^2 for 50% of time

(ii) $\pm$400 N/mm^2 for 30% of time

(iii) $\pm$450 N/mm^2 for 20% of time

The material of the component is 50C8 (S_{ut} = 700 N/mm^2). It is machined and cold drawn with a surface factor of 0.70 and size factor of

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M. Tech. EXAMINATION, May 2019

(First Semester)

(B. Scheme) (Re-appear)

(ME)

MEM507B

ADVANCED DESIGN OF MECHANICAL SYSTEMS

Time : 3 *Hours*] [*Maximum Marks :* 75

Before answering the question-paper candidates should ensure that they have been supplied to correct and complete question-paper. No complaint, in this regard, will be entertained after the examination.

Note : Attempt *Five* questions in all, selecting at least *one* question from each Unit. All questions carry equal marks. Assume any missing data suitably.

Unit I

1. (a) Define stress and explain how it differs from pressure. Explain the state of stress at a point with the help of a 3-D stress element. Also give mathematical representation.

(b) Considering the equilibrium of elementary tetrahedron, derive general formula for stress on an arbitrary plane. Show how you arrive at the classical formula for 2-D stress case on an inclined plane.

5+10=15

2. (a) Draw Mohr's circles for a 2-*d* element under pure shear and under pure tensile load.

(b) Verify whether the following strain field satisfy the compatibility condition :

$\varepsilon_{xx} = py$; $\varepsilon_{yy} = px$; $\varepsilon_{zz} = 2p(x + y)$; $\varepsilon_{xy} = p(x + y)$; $\varepsilon_{yz} = 2pz$; $\varepsilon_{zx} = 2pz$

7+8=15

Unit II

3. (a) Derive constitutive relation between stress field and strain field.

(b) (i) Derive the governing equation for fix-fix column using free body diagrams.

(ii) Determine the expression for Euler's critical load

(iii) Assuming E = 0.2 MPa for steel determine the minimum value of slenderness ratio for which the derived formula is valid. **5+10=15**

4. (a) Write the mathematical statement of Max Shear stress and Von Mises theories in terms of principal stresses and their corresponding design equations.

(b) (i) Define bulk modules (K) and derive the relation among K, μ and G, where μ and G are Poisson ratio and modulus of rigidity. **5+10=15**

0.75, theoretical stress concentration factor K_t = 1.5 and notch sensitivity = 0.7.

(a) Determine the modified endurance strength of the component.

(b) Draw the S-N diagram for the component for high cycle fatigue.

(c) Determine the life of the component. **5×3=15**

Unit IV

7. (a) Explain open-ended and closed-ended problems with illustrations.

(b) Explain feasibility study phase of engineering design with suitable illustrations. **5+10**

8. (a) Explain why there exist more than one solution to a design problem, thus explain the concept of solution field with illustration.

(b) Explain brain storming in terms of its significance, constitution and method of conduction. **8+7=15**

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