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M. TECH.
(SEM-II) THEORY EXAMINATION 2018-19
ADVANCE MECHANICS OF SOLIDS

Time: 3 Hours ***Total Marks: 100***

Note: Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. 2 x 10 = 20

a. Explain principle stress.
b. Define stress concentration?
c. What do you mean by inelastic behavior?
d. Write down the general expressions for stress distribution in a thick cylinder?
e. What is orthotropic lamina?
f. State generalized Hooke's law?
g. State Tresca's principle?
h. Write down boundary condition equations for stress analysis problem?
i. Give a Short note on unidirectional composites
j. List out three basic modes of failure.

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SECTION B

2. Attempt any *three* of the following: 10 x 3 = 30

a. The displacement field for a body is given by $u = (x^2 + y)\, i + (3 + z)\, j + (x^2 + 2y)\, k$, What is the deformed position of a point originally at (3, 1, -2).
b. Show that lame's ellipsoid and the stress –director surface together completely define the state of stress at a point.
c. A cylinder bar of 7 cm diameter is subjected to a torque equal to 3400 Nm, and a bending moment M. If the bar is at the point of failing in accordance with the maximum principle stress theory, determine the maximum bending moment it can support in addition to the torque. The tensile elastic limit for the material is 207 MPa and the factor of safety to be used is 3.
d. What do you mean by Laminates? Explain with various types
e. Briefly describe laminar composites. What is the prime reason for fabricating these materials?

SECTION C

3. Attempt any *one* part of the following: 10 x 1 = 10

(a) Derive an expression for Cauchy's Stress function.
(b) The State of Stress at a point P (x, y, z) in a solid is given by the following state of stress. $\begin{matrix} 6 & 2 & 2 \\ 2 & 0 & 4 \\ 2 & 4 & 0 \end{matrix}$ with respect to another set of x', y', z' the direction of cosine matrix is as $\begin{matrix} 1/\sqrt{2} & 1/\sqrt{2} & 0 \\ 1/\sqrt{2} & 1/\sqrt{2} & 0 \\ 0 & 0 & 1 \end{matrix}$
Determine the stress component with respect to x', y', z' at appoint P.

4. Attempt any *one* part of the following: 10 x 1 = 10

(a) The state of stress at a point is characterized by the components σ_x = 100 MPa, σ_y = - 40 MPa, σ_z = 80 MPa, $\tau_{xy} = \tau_{yz} = \tau_{zx} = 0$. Determine the extreme value of principle stress, associated normal stresses, the octahedral shear stress and its associated normal.

(b) What is S-N curve? Explain with the help of neat sketch.

5. Attempt any *one* part of the following: 10 x 1 = 10

(a) What are the failure criteria of composite material? State any two of them.

(b) Consider graphite–epoxy laminates whose elastic constant along and perpendiculars to the fiber are as follows. E_{xx} =181 GPa, E_{yy} = 10.3 GPa, G_{xy} = 7.17 GPa, v_{yx} = 0.28, v_{xy} = 0.01594.

6. Attempt any *one* part of the following: 10 x 1 = 10

(a) A hollow steel shaft of 5 cm outside diameter is made of miled steel giving a yield point of 3500 kg/cm2 in unidirectional tension. What is the maximum internal diameter of the shaft which would just allow it to transmit, without yielding, torque of (a) 350 kg-m; (b) 700 kg-m. What is the maximum torque transmitted?

(b) What is the distinction between matrix and dispersed phases in a composite material?

7. Attempt any *one* part of the following: 10 x 1 = 10

(a) Describe the mechanisms by which semi crystalline polymers (a) elastically deform and (b) plastically deform, and (c) by which elastomers elastically deform.

(b) In your own words, briefly describe the phenomenon of viscoelasticity.

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