Experimental Stress Analysis (ESA), Autumn 18-19, S C P Assignment # 1/2:

Due on the date of Exam along with MIDSEM answer scripts

<table>
<tr><th>Q No</th><th>Text</th></tr>
<tr><td>1</td><td>Define followings
a. Elasticity, homogeneous,
b. Anisotropy with examples
c. Surface force and body force with examples
d. Plane stress, plane strain cases with example
e. Airy stress function in Cartesian and Polar co-ordinates
f. Strain gage
g. Strain sensitivity
h. Gage factor
i. Gage size
j. Range of strain
k. Precision of readout
l. Eulerian and Natural strain
m. Engineering and tensorial strain
n. Strength of material and elasticity approach
o. Laws of stress and strain transformation in 3D scenario.
p. Compatibility equations and the Physical significance of it.
q. Principal stresses with examples
r. 10 characteristic comments used to Judge a strain gage</td></tr>
<tr><td>2</td><td>Describe various strain measurement techniques each one with maximum 100 words</td></tr>
<tr><td>3</td><td>Sketch the following schematic diagrams.
a. Typical 2D Mohr circles with various special cases examples
b. Typical Mohr circle representation of 3D stresses
c. Cartesian components of stress acting on faces of a small cube element
d. Elemental tetrahedron at a point showing the average stresses which act over its four faces.
e. Arrangement of diffraction type (optical) strain gage and associated diffractogram showing changes in diffraction pattern with increase in strain
f. Showing the light rays which form the two interference pattern
g. Illustration of a capacitor strain gage with variable air gap
h. Illustration of a linear differential transformer (LDF) employed as a strain transducer and its associated schematic circuit diagram and output voltage as a function of core position in a LDF
i. Showing the operation of the Jerrett acoustical strain gage</td></tr>
<tr><td>4</td><td>Prove that $\tau_{xy} = \tau_{yx}, \ \tau_{zy} = \tau_{yz}, \ \tau_{xz} = \tau_{zx}$</td></tr>
<tr><td>5</td><td>$$\begin{vmatrix} \sigma_{xx} - \sigma_n & \tau_{yx} & \tau_{zx} \\ \tau_{yx} & \sigma_{yy} - \sigma_n & \tau_{zy} \\ \tau_{zx} & \tau_{zy} & \sigma_{zz} - \sigma_n \end{vmatrix} = 0$$
Above equation leads to which possible solutions.
Specifically when $\sigma_1 = \sigma_2 = \sigma_3$ what is the state of stress and where is the principal stress</td></tr>
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6	At a point in the stressed body the Cartesian components of stress are $\sigma_{xx} = 60\ MPa,\ \sigma_{yy} = -30\ MPa, \sigma_{zz} = 30\ MPa$ $\tau_{xy} = 40\ MPa, \tau_{yz} = 0\ MPa, \tau_{zx} = 0\ MPa,$ Determine the normal ans shear stresses on a plane whose outer normal has the following direction cosines .cos(n,x)= 6/11; cos(n,y)=6/11 and cos(n,z)=7/11. For the state of stress at the point determine the principal stresses and the maximum shear stress at the point.
7	At a point in the stressed body the Cartesian components of stress are $\sigma_{xx} = 70\ MPa,\ \sigma_{yy} = 60\ MPa, \sigma_{zz} = 50\ MPa\ \tau_{xy} = 20\ MPa, \tau_{yz} = -20\ MPa, \tau_{zx} = 0\ MPa,$ Determine the normal ans shear stresses on a plane whose outer normal has the following direction cosines Cos(n,x)= 12/25; cos(n,y)=15/25 and cos(n,z)=16/25. For the state of stress at the point determine the principal stresses and the maximum shear stress at the point.
8	Using Cartesian Airy stress function determine $\sigma_{xx},\ \sigma_{yy},\ \&\ \tau_{xy},$ for a simply supported beam with uniformly distributed load q with length L, height h and unit width and compare with strength of material solutions
9	Using Cartesian Airy stress function determine $\sigma_{xx},\ \sigma_{yy},\ \&\ \tau_{xy},$ for a cantilever beam with uniformly distributed load q with length L, height h and unit width and compare with strength of material solutions