Kafr El-Sheikh University		2nd Year Mechanical Students
Faculty of Engineering		Final Exam – Jan., 2016
Mechanical Engineering Department	Stress Analysis	Full Marks: 70, Time: 3 Hrs

Solve all FIVE QUESTIONS. Assume reasonable values for any missing data.

Question 1: [10 Marks]

The rosette shown in figure (1) hase been used to determine the following strains at a point on the surface of a crane hook:

$\varepsilon 1 = +420$ $\varepsilon 2 = -45$ $\varepsilon 4 = +160$

(a) What should be the reading of gauge 3?

(b) Determine the principle strains and the maximum in-plane shearing strain.

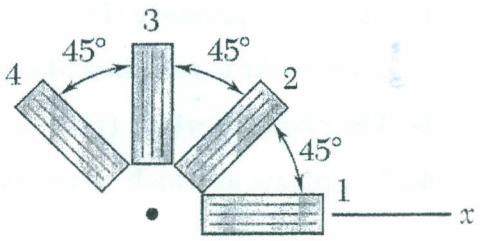

Figure (1)

Question 2: [15 Marks]

At a point in a stressed body, there exists a plane stress condition as shown in figure (2). If σx=200MPa, σy=100MPa, τxy=40MPa, determine:

a) The principle Stresses and the maximum and minimum shear stresses.

b) The planes on which these stresses act

c) If Young's Modulus E=200GPa, and Poisson's Ratio ν=0.3, find the principle strains and the maximum and minimum shear strains.

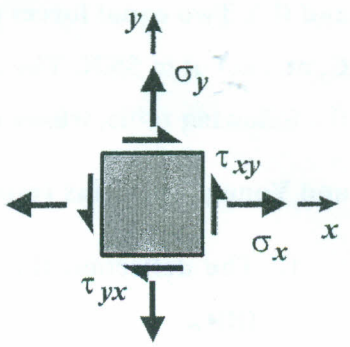

Figure (2)

Question3:(15 Marks)

Prove that:

A) $$\sigma_1 = \frac{(\sigma_x + \sigma_y)}{2} + \sqrt{(\frac{(\sigma_x - \sigma_y)}{2})^2 + \tau_{xy}^{\ 2}}$$

B) $$\sigma_z = \frac{E}{(1+\nu)(1-2\nu)}\left[(1-\nu)\varepsilon_z + \nu(\varepsilon_x + \varepsilon_y)\right]$$

Question4:(15 Marks)

A thin walled cylindrical pressure vessel has a mean diameter D=1000mm, length L=2000mm, and thickness t=2mm, and contains a fluid of pressure (P) MPa. An element on the wall of the vessel as shown in Figure (4), is subjected to a shear stress τ_{xy}=30 MPa. If the yield stress for the vessel material σ_y =100 MPa and using a Safety Factor FS=2, find:

1- Maximum pressure (P).
2- draw Mohr Circle then Maximum shear stress on the element (τ_{max}).
3- The planes at which (τ/σ)=max, and find its values of τ and σ.
4- The planes at which (σ/τ)=max, and find its values of τ and σ.

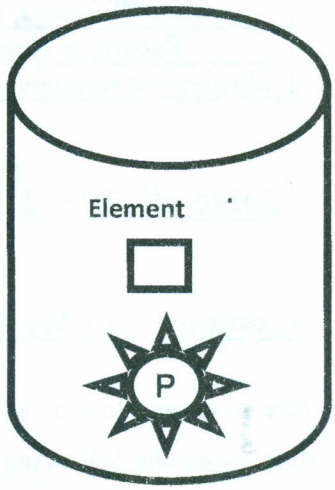

Figure (3)

Question5:(15 Marks)

The stepped shaft (ABCD) at figure (4) is consisting of three steps (AB), (BC), and (CD), and is fixed at its both ends at (A), and (D). Two equal forces (F) act at opposite directions at B, and C, and equal to 5KN. The data of the stepped shaft are given at the following table, where d, L, and E are the diameter, length, and Young's modulus respectively. Find:

1. The deflection (δ) at section (AB) and total deflection of (BD).
2. The normal stress (σ) at sections (BC) and (CD).

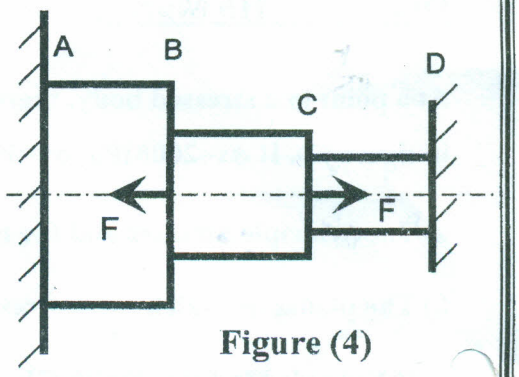

Figure (4)

	d (mm)	L (mm)	E (GPa)
AB	20	300	75
BC	10	300	105
CD	6	300	200

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The END

Good Luck,

Associate Prof. Ahmed Galal