EL-MANSOURA UNIVERSITY   FINAL EXAM., **DEC.** 2010
FACULTY OF ENGINEERING   SYSTEMS OF STRESS ANALYSIS
DEPT. OF PROD. & MECH. DESIGN ENG.   2nd YEAR STUDENTS
TIME ALLOWED: 3 HOURS
               MAXIMUM GRADE: 70 POINTS

SOLVE THE FOLLOWING PROBLEMS; NEAT SKETCHES ARE REQUIRED; ALL PROBLEMS HAVE SAME POINTS;

PROBLEM # 1:

At a point on a stressed body, the Cartesian components of stress are given by:

$$\sigma_{xx}= \sigma_{yy}= \sigma_{zz}=0, \qquad\qquad \tau_{xy}=\tau_{yz}=\tau_{zx}=60 \text{ MPa}$$

Determine: (a) the principal stresses and the maximum shear stress,
                (b) the three stress invariants.

PROBLEM # 2:

A set of Cartesian strain components are:

$$\varepsilon_{xx}= 400 \times 10^{-6}, \qquad \varepsilon_{yy}= 300 \times 10^{-6}, \qquad \varepsilon_{zz}= 200 \times 10^{-6},$$
$$\gamma_{xy}= 100 \times 10^{-6}, \qquad \gamma_{yz}= 200 \times 10^{-6}, \qquad \gamma_{xz}= 0$$

It is required to transform this given set into a new set of strain components relative to the new set of axes: O x'y'z' where $\theta(x, x')= 90°$, $\theta(y, y')= 90°$, and $\theta(z, z')=0$.

If E = 200 GPA & $\upsilon= 0.30$,

a) calculate the Cartesian set of stresses: $\sigma_{xx}, \sigma_{yy}, \sigma_{zz}, \gamma_{xy}, \gamma_{zy}, \gamma_{zx}$ in MPa.
b) calculate the magnitudes of the principal stresses and the maximum shear stress.

PROBLEM # 3:

Outline **the photoelastic coating** technique of stress analysis giving consideration to:
     (a) Theoretical background of the technique.
     (b) The experimental setup showing sketch of the reflection polariscope.
     (c) Method of analysis giving an illustrative example.
     (d) The difference between **isoclinic** and **isochromatic** fringes.

PROBLEM # 4:

Explain the principle on which **the brittle-coating** technique is based. List the advantages and disadvantages of the technique. Sketch the expected cracking pattern for a square plate subjected to a tensile stress in one direction and in two directions.

PROBLEM # 5:

Explain the basic background of the Moiré method of stress analysis. List the advantages and limitations of the method.

BEST WISHES

Examiner : Prof. Dr. M. Shabara