MENOUFIYA UNIVERSITY **Faculty of Engineering, Shebin El-Kom** **Prod. Eng. & Mech. Design Dept.** **1st Semester Examination 2013/1014** **Date : 11/1/2014 M**	جامعة المنوفية كلية الهندسة - شبين الكوم	**Subject; STRESS ANALYSIS** **Code : PRE 508** **Graduate Study: Diploma** **Time Allowed : 3 hours** **Total Mark: 100 Mark**

ANSWER THE FOLLOWING QUESTIONS

QUESTION # 1 (20)

A) Define the following terms; Mean and deviatoric strains, Axi-symmetric problem

B) In a metal forming process, the state of stress is given by; $\sigma_x = \sigma_y = \sigma_z = -80$ MPa, $\tau_{xy} = -- 60$ MPa and $\tau_{xy} = \tau_{xy} = 0.0$.

i) Show that one of the principal stresses equals -80 MPa and find its direction cosines.

ii) Calculate the other two principal stresses.

iii) Obtain the principal stress deviations.

QUESTION # 2 (20)

A closed thin-walled pressure vessel of mean radius of 0.5 meter and length of 2 m is used in chemical processing at 300 ^{0}C. If the vessel wall thickness t is 4 mm, determine the diametral expansion and axial elongation due to operating internal pressure p_i = 2 MPa besides the temperature rise. Knowing that this pressure produces radial stress σ_r= 0.0, circumference stress $\sigma_\theta = p_i r_m/t$ and axial stress $\sigma_a = p_i r_m/2t$. Calculate the final dimensions and the elastic strain energy stored in the vessel wall material. Take room temperature = 20 ^{0}C

QUESTION # 3 (20)

Two thick-walled cylinders have inner and outer diameters of 50 and 75 mm for the first cylinder and of 75 and 100 mm for the second one. If the second is shrunk on the first cylinder and the assembly is then used to transmit torque by means of friction force acting on their common surface. Assuming plane stress condition, determine

i) The torque that can be transmitted by the assembly knowing that, radial interference Δ= 0.375 mm, length of the assembly l =100 mm and the coefficient of friction μ= 0.12.

ii) The maximum tensile stresses induced in the cylinders due to shrink fit, make a sketch showing the stress distribution

QUESTION # 4 (20)

A long thick-walled cylinder of 50 mm and 75 mm inner and outer radii made of steel is used to conduct a hot fluid at temperature t_i = 100 ^{0}C and pressure p_i= 5 MPa, Find the expressions of σ_r σ_θ and σ_z under plane strain condition. The temperature is given as; T= -3000 r + 250 ^{0}C at any radius r (r is measured in meter), Check the safety of the cylinder if the allowable tensile and compression stresses are 100 and 250 MPa.

QUESTION # 5 (20)

A thin annular disc or inner and outer radii 25 and 100 mm is made up of two annuli discs whose radius of separation equals 50 mm. If the outer annulus is not to get loose from the inner one when the disc is rotating with a uniform angular velocity of 500 rpm, determine the minimum value of radial pressure at the radius of separation when the disc at rest. What is the value of radial interference Δ?

With best wishes

This exam measures the following ILOs															
Question number	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
skills	A1	A3	A3	A1	A3	B2	B2	B4	B4	B2	C1	C3	C1	C3	C3
	Knowledge & Understanding					Intellectual					Professional				

P. T. O.

USEFUL INFORMATIONS

For steel; E =200 GPa, υ = 0.3, ρ = 7850 kg/m^3 and α =12x10^{-6}/^{0}C

$$\sigma_r = \frac{p_i}{\lambda^2 - 1}\left[1 - \frac{r_o^2}{r^2}\right], \quad \sigma_\theta = \frac{p_i}{\lambda^2 - 1}\left[1 + \frac{r_o^2}{r^2}\right], \quad \frac{\Delta}{r_c} = \frac{p_c}{E}\left[\frac{\lambda_2^2 + 1}{\lambda_2^2 - 1} + \frac{\lambda_1^2 + 1}{\lambda_1^2 - 1}\right],$$

$$\sigma_r = \frac{-p_o}{\lambda^2 - 1}\left[\lambda^2 - \frac{r_o^2}{r^2}\right], \qquad \sigma_\theta = \frac{-p_o}{\lambda^2 - 1}\left[\lambda^2 + \frac{r_o^2}{r^2}\right]$$

$$\sigma_r = \frac{3+\nu}{8}\rho\omega^2\left[r_o^2 - + r_i^2 - \frac{r_i^2 r_0^2}{r^2} - r^2\right], \qquad U+ V[\int \sigma_x d\varepsilon_x + \sigma_y \varepsilon_y + \sigma_z d\varepsilon_z]$$

$$\sigma_r = \frac{\alpha E}{1-\gamma}\frac{1}{r^2}\left[\frac{(r/r_i)^2 - 1}{\lambda^2 - 1}\int_{r_i}^{r_0} Trdr - \int_{r_i}^{r} Trdr\right] \qquad \sigma_z = \frac{\alpha E}{1-\gamma}\left[\frac{2\nu}{\lambda^2 - 1}\frac{1}{r_i^2}\int_{r_i}^{r_0} Trdr - T\right]$$

$$\sigma_\theta = \frac{\alpha E}{1-\gamma}\frac{1}{r^2}\left[\frac{(r/r_i)^2 + 1}{\lambda^2 - 1}\int_{r_i}^{r_0} Trdr + \int_{r_i}^{r} Trdr \; - Tr^2\right]$$