PS

MENOUFIYA UNIVERSITY
Faculty of Engineering, Shebin El-Kom
Prod. Eng. & Mech. Design Dept.
1st Semester Examination 2013/1014
Date : 15/1/2014 M

Subject; Elasticity& Plasticity
Code : PRE 212
Year: Second
Time Allowed : 3 hours
Total Mark: 70 Mark

ANSWER THE FOLLOWING QUESTIONS

QUESTION # 1 (14 marks)

A) Define the following: Engineering strain, Strain energy, Uniform deformation and Octahedral planes. (4)

B) The state of stress at a point in a loaded element is specified by; σ_x =150 MPa, τ_{xy} =-80 MPa and σ_y is unknown.

1) Calculate the stress invariants interms of σ_y (2)
2) If one of the principal stresses equals -10 MPa, find σ_y (3)
3) Calculate the other principal stresses. (2)
4) Determine the octahedral and maximum shear stresses. (3)

QUESTION # 2 (14 marks)

A plate of dimensions 600x750x10 mm in x, y and z directions respectively is placed between two rigid lubricated walls such that the deformation is constrained in z direction. If the plate is subjected to the uniform stresses of σ_x =60 MPa, σ_y =30 MPa. The plate materials has the following properties E= 200 GPa and ν=0.3, determine

1) The stress in z direction. (4)
2) The values of normal strain component ε_x ε_y. (5)
3) The change in plate dimensions. (5)

QUESTION # 3 (14 marks)

A- Deduce the relation between the mean stress and the mean strain. (6)

B) The stress function for a straight rod of a constant cross section is given by $\Phi = ay^2+by^3$, the rod axis being the x axis. Determine the stresses in the rod and the external loading. Show that the rod cross section remains plane. (8)

QUESTION # 4 (14 marks)

A thin solid disc of radius 600 mm is rotating about its axis with a uniform angular speed. ω. If the increase in its outer radius is not to exceed 0.2 mm, determine the maximum rotating speed and the corresponding maximum stress. The material properties of the disc are; E=200 GPa, υ = 0.3 and ρ = 7800 kg/m^3.

QUESTION # 5 (14 marks)

A) State briefly the assumptions of the plastic deformation analysis. (6)

B) A sleeve of thickness 20 mm is shrunk on a solid shaft of 100 mm radius. If the inside radius of the sleeve before shrink fit is 99.98 mm. Take E = 200 GPa and υ = 0.3.

1) Determine the contact pressure due to shrink fit process. (4)
2) Determine the change in the external radius of the sleeve assuming plane strain state (4)

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	A2	B2	B2	B4	B2	B4	C1	C1	C3	C3	C3
	Knowledge & Understanding					Intellectual					Professional				

USEFUL INFORMATIONS

$$\sigma_\theta = \frac{p_i}{\lambda^2-1}\left(1+\frac{r_0^2}{r^2}\right), \quad \sigma_r = \frac{p_i}{\lambda^2-1}\left(1-\frac{r_0^2}{r^2}\right), \quad \frac{\Delta}{c} = \frac{p_i}{E}\left\{\frac{\lambda_2^2+1}{\lambda_2^2-1}+\frac{\lambda_1^2+1}{\lambda_1^2-1}\right\}$$

$$\sigma_r = \frac{3+\nu}{8}\rho\omega^2\left[r_o^2-r^2\right], \qquad \sigma_\theta = \frac{3+\nu}{8}\rho\omega^2\left[r_o^2-\frac{1+3\nu}{3+\nu}r^2\right], \quad \varepsilon_\theta = \frac{u}{r}$$