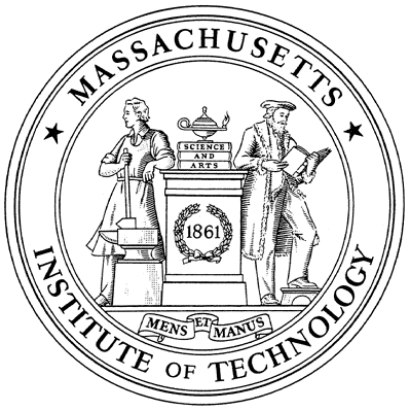

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16.01/16.02 Unified Engineering I, II
Fall 2003

Problem Set 13

Name: _____

Due Date: 12/2/03

	Time Spent (min)
F16	
F17	
M17	
M18	
Study Time	

Announcements:

F16. $\phi_1(x, y)$ and $\phi_2(x, y)$ are known to be physically-possible flows (i.e. satisfy mass conservation), and their corresponding pressure fields $p_1(x, y)$ and $p_2(x, y)$ are known via the Bernoulli equation.

a) A third flow is now defined by $\phi_3(x, y) = \phi_1 + \phi_2$. Explain how you would obtain its corresponding pressure field p_3.

b) Yet another flow $\phi_4 = \partial\phi_1/\partial x$ is defined. Is this a physically-possible flow?

F17. A vortex flow is given by

$$u_1(x, y) = \frac{y}{x^2 + y^2} \qquad v_1(x, y) = \frac{-x}{x^2 + y^2}$$

A uniform flow in the x-direction is given by

$$u_2(x, y) = V_\infty \qquad v_2(x, y) = 0$$

Superimpose these two flows, determine the pressure field, and find the x, y location of the point of maximum pressure.

Problem M17

In question M16. You had a state of strain:

Given a state of plane strain: $\varepsilon_{11} = -0.000200$, $\varepsilon_{22} = +0.000400$, $\varepsilon_{12} = -0.000200$, do the following:

a) If a strain gauge rosette, with three gauges at 60° to each other was placed with one of the gauges orientated along the x_1 direction. What strains would the three gauges read?

b) By representing the strains as a matrix calculate the principal strains and principal directions via the eigenvalue and eigenvectors of the matrix. Show that this is consistent with the values you calculated in M16.

c) If the state of strain was no longer plane strain, and was now $\varepsilon_{11} = -0.000200$, $\varepsilon_{22} = +0.000400$, $\varepsilon_{12} = -0.000200$, $\varepsilon_{33} = 0.000300$, $\varepsilon_{23} = 0$, $\varepsilon_{23} = 0$. What would the principal strains now be?

Problem M18

Read Ashby and Jones Chapters 4, 5 and 6. Answer the following short questions (each answer should be one or two sentences only, the important task is the reading, the questions are to focus your attention):

i) What are the two principal factors that contribute to the Young's modulus of a homogeneous material?

ii) What is the glass transition temperature of a polymer and what is the underlying cause for this?

iii) Why do metals tend to have higher densities than ceramics or polymers?

iv) What is the relationship between the force exerted by an interatomic bond as a function of separation of the atoms and the potential energy associated with the same separation of the atoms?