Solid Mechanics, Recap test 2, February 2, 2021.

Problem 3

a) The constitutive law of a homogeneous and isotropic *Hookean* material is given by

$$\varepsilon_{ij} = 1 / E \, [(1 + v) \, \sigma_{ij} - v \, \sigma_{kk} \, \delta_{ij}],$$

where E is Young's modulus and v Poisson's coefficient.

Define shear modulus G and establish the relationship between G, E and v.

b) An orthotropic material in plane stress has the following flexibility matrix:

$$\begin{pmatrix} e_{11} \\ e_{22} \\ \gamma_{12} \end{pmatrix} = \begin{bmatrix} 1/E_{11} & -v_{21}/E_{22} & 0 \\ -v_{12}/E_{11} & 1/E_{22} & 0 \\ 0 & 0 & 1/G_{12} \end{bmatrix} \begin{pmatrix} \sigma_{11} \\ \sigma_{22} \\ \sigma_{12} \end{pmatrix},$$

The modulus and coefficients of that material are the following in the $x_1 \, x_2$ frame:

	Carbon/Epoxy Bidirectional
E_{11} [GPa]	50.0
E_{22} [GPa]	50.0
G_{12} [GPa]	5.0
v_{12}	0.0

Determine the shear modulus G of that material in a 45° direction with x_1 and x_2. You may use Mohr's circle to represent stresses and deformations.