

Name:

## Homework 2

Due 13 Feb 2019

1. Plot stiffness predictions for a perfectly aligned short-fiber composite with  $E_f = 200$  GPa,  $\nu_f = 0.2$  and  $E_m = 10$  GPa,  $\nu_m = 0.4$ . Assume fibers and matrix are both individually isotropic, and that the fiber aspect ratio is 50. Plot  $E_1$  (stiffness in fiber direction),  $E_2$  (stiffness transverse to fibers) and  $G_{12}$  (shear modulus in fiber direction) vs. volume fraction (between 0 and 50%) for the following methods
  - (a) Eshelby
  - (b) Mori-Tanaka
  - (c) Halpin-Tsai
2. For the Eshelby and Mori-Tanaka methods, compare the stiffness at 50% volume fraction for perfectly aligned fibers with a similar material with random fibers such that

$$a_{ij} = \begin{bmatrix} 0.33 & 0 & 0 \\ 0 & 0.33 & 0 \\ 0 & 0 & 0.33 \end{bmatrix} \quad (1)$$

**Note:** You will need to use a closure approximation to use orientation averaging. You may choose whether to use a linear or quadratic closure.