**Prob. 3.1**

Compute the longitudinal and transverse stiffness $E_1$, $E_2$ of an S-glass epoxy lamina for a fiber volume fraction $V_f = 0.7$, using the constituent properties from Table 1, and matrix properties from the Module on Materials Properties.

Eqs. 3.1 and 3.2 (p. 3-3):

\[ E_1 := V_f E_f + V_m E_m \]
\[ E_2 := \frac{1}{V_f/E_f + V_m/E_m} \]

Define numerical parameters (modulus of epoxy found from other sources):

\[ V_f := 0.7; \quad V_m := 1 - V_f; \quad E_f := 85.5 \text{ GPa}; \quad E_m := 2.4 \text{ GPa}; \]

Evaluate moduli:

\[ \text{evalf}(E_1); \quad \text{evalf}(E_2); \]

\[ E_1 = 60.57 \text{ GPa} \]

**Prob. 3.2**

Plot the longitudinal stiffness $E_1$ of an E-glass/nylon unidirectionally-reinforced composite, as a function of the volume fraction $V_f$.

Rule of mixtures for parallel reinforcement (Eq. 3.1, p. 3-3):

\[ E_{-1} := V_f E_f + (1 - V_f) E_m; \]

Values for fiber and matrix moduli:

\[ E_f := 85.5; \quad E_m := 2; \]

Execute plot:

\[ \text{plot}(E_{-1}, V_f = 0..1); \]