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]:= 1/(V[f]/E[f] + V[m]/E[m]);

$$E_1 := V_f E_f + V_m E_m$$

$$E_2 := \frac{1}{\frac{V_f}{E_f} + \frac{V_m}{E_m}}$$

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

V[f]:=0.7; V[m]:=1-V[f]; E[f]:=85.5*GPa; E[m]:= 2.4*Gpa;

Evaluate moduli:

evalf(E[1]); evalf(E[2]);

$$E_1 = 60.57\ GPa$$

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;

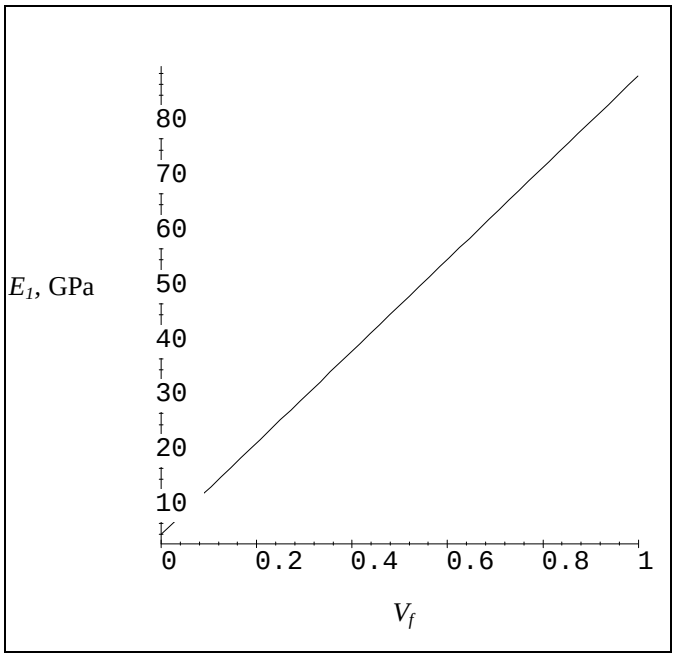
$$E\_1 := V\_f\, E\_f + (1 - V\_f)\, E\_m$$

Values for fiber and matrix moduli:

E_f:=85.5; E_m:= 2;

Execute plot:

plot(E_1,V_f=0..1);


E_1, GPa
80
70
60
50
40
30
20
10
0
0.2
0.4
0.6
0.8
1
V_f