MAIN:

```
clc;clear;close all;

laminate = [140e9,10e9,7e9,0.3,0.0002,0,0,0,0,0,0;...
            140e9,10e9,7e9,0.3,0.0002,45,0,0,0,0,0;...
            140e9,10e9,7e9,0.3,0.0002,-45,0,0,0,0,0;...
            140e9,10e9,7e9,0.3,0.0002,-45,0,0,0,0,0;...
            140e9,10e9,7e9,0.3,0.0002,45,0,0,0,0,0;...
            140e9,10e9,7e9,0.3,0.0002,0,0,0,0,0,0];

[Ex,Ey,Efx,Efy,Gxy,vxy,vyx]=laminateEngineeringConstants(laminate);

fprintf('Ex = %g, Ey = %g, Efx = %g\n',Ex,Ey,Efx)

laminate = [140e9,10e9,7e9,0.3,0.0002,30,1448e6,1172e6,48.3e6,248e6,62.1e6];

Nx=275000;
Ny=0;
Nxy=0;
Mx=0;
My=0;
Mxy=0;

[FSstress]=maximumStressTheory(laminate,Nx,Ny,Nxy,Mx,My,Mxy);
[FSstrain]=maximumStrainTheory(laminate,Nx,Ny,Nxy,Mx,My,Mxy);
[FStsai]=tsaiHillFailure(laminate,Nx,Ny,Nxy,Mx,My,Mxy);
```

Problem 1:

Ex = 6.29859e+10, Ey = 2.76784e+10, Efx = 1.05523e+11

```
function [Ex,Ey,Efx,Efy,Gxy,vxy,vyx]=laminateEngineeringConstants(laminate)
    [~,~,~,~,thicknesses,~] = laminateReader(laminate);
    t=sum(thicknesses);
    ABDmatrixINV = laminateStiffnessMatrixINV(laminate);
    Ex=1/(t*ABDmatrixINV(1,1));
    Ey=1/(t*ABDmatrixINV(2,2));
    Efx=12/(t^3*ABDmatrixINV(4,4));
    Efy=12/(t^3*ABDmatrixINV(5,5));
    Gxy=1/(t*ABDmatrixINV(3,3));
    vxy=-ABDmatrixINV(1,2)/ABDmatrixINV(1,1);
    vyx=-ABDmatrixINV(1,2)/ABDmatrixINV(2,2);
end
```

Problem 2:

```
FSstress = 0.1043
FSstrain = 0.1043
FStsai = 0.1554
```

```
function [FS]=maximumStressTheory(laminate,Nx,Ny,Nxy,Mx,My,Mxy)

[~,~,~,~,~,~,longStrengthTen,longStrengthCom,tranStrengthTen,tranStrengthCom,
strengthLT] = laminateReader(laminate);

[~,~,~,sigma1,sigma2,tau12,~,~,~,~,~,~]=forces2StressStrainLaminateNoPlot(lam
inate,Nx,Ny,Nxy,Mx,My,Mxy);
    FS=zeros(length(longStrengthTen),1);
    for i=2:2:length(sigma1)
        if sigma1(i)>0
            F1=longStrengthTen(i/2)/sigma1(i);
        else
            F1=-longStrengthCom(i/2)/sigma1(i);
        end
        if sigma2>0
            F2=tranStrengthTen(i/2)/sigma2(i);
        else
            F2=-tranStrengthCom(i/2)/sigma2(i);
        end
        F3=strengthLT(i/2)/abs(tau12(i));
        FS(i/2)=min([F1,F2,F3]);
    end
end


function [FS]=maximumStrainTheory(laminate,Nx,Ny,Nxy,Mx,My,Mxy)

[E1s,E2s,~,v12s,~,~,longStrengthTen,longStrengthCom,tranStrengthTen,tranStren
gthCom,strengthLT] = laminateReader(laminate);

[~,~,~,sigma1,sigma2,tau12,~,~,~,~,~,~]=forces2StressStrainLaminateNoPlot(lam
inate,Nx,Ny,Nxy,Mx,My,Mxy);
    FS=zeros(length(longStrengthTen),1);
    for i=2:2:length(sigma1)
        if sigma1(i)>0
            F1=longStrengthTen(i/2)/(sigma1(i)-v12s(i/2)*sigma2(i));
        else
            F1=-longStrengthCom(i/2)/(sigma1(i)-v12s(i/2)*sigma2(i));
        end
        v21=(v12s(i/2)/E1s(i/2))*E2s(i/2);
        if sigma2>0
            F2=tranStrengthTen(i/2)/(sigma2(i)-v21*sigma1(i));
        else
            F2=-tranStrengthCom(i/2)/(sigma2(i)-v21*sigma1(i));
        end
        F3=strengthLT(i/2)/abs(tau12(i));
        FS(i/2)=min([F1,F2,F3]);
    end
end
```

```
function [FS]=tsaiHillFailure(laminate,Nx,Ny,Nxy,Mx,My,Mxy)

[~,~,~,~,~,~,longStrengthTen,longStrengthCom,tranStrengthTen,tranStrengthCom,
strengthLT] = laminateReader(laminate);

[~,~,~,sigma1,sigma2,tau12,~,~,~,~,~,~]=forces2StressStrainLaminateNoPlot(lam
inate,Nx,Ny,Nxy,Mx,My,Mxy);
    FS=zeros(length(longStrengthTen),1);
    for i=2:2:length(sigma1)
        if sigma1(i)>0
            longStrength=longStrengthTen(i/2);
        else
            longStrength=longStrengthCom(i/2);
        end
        if sigma2>0
            transStrength=tranStrengthTen(i/2);
        else
            transStrength=tranStrengthCom(i/2);
        end
        A=(sigma1(i)/longStrength)^2+(sigma2(i)/transStrength)^2-
((sigma1(i)*sigma2(i))/(longStrength)^2)+(tau12(i)/strengthLT);
        FS(i/2)=1/sqrt(A);
    end
end
```