Assignment 1

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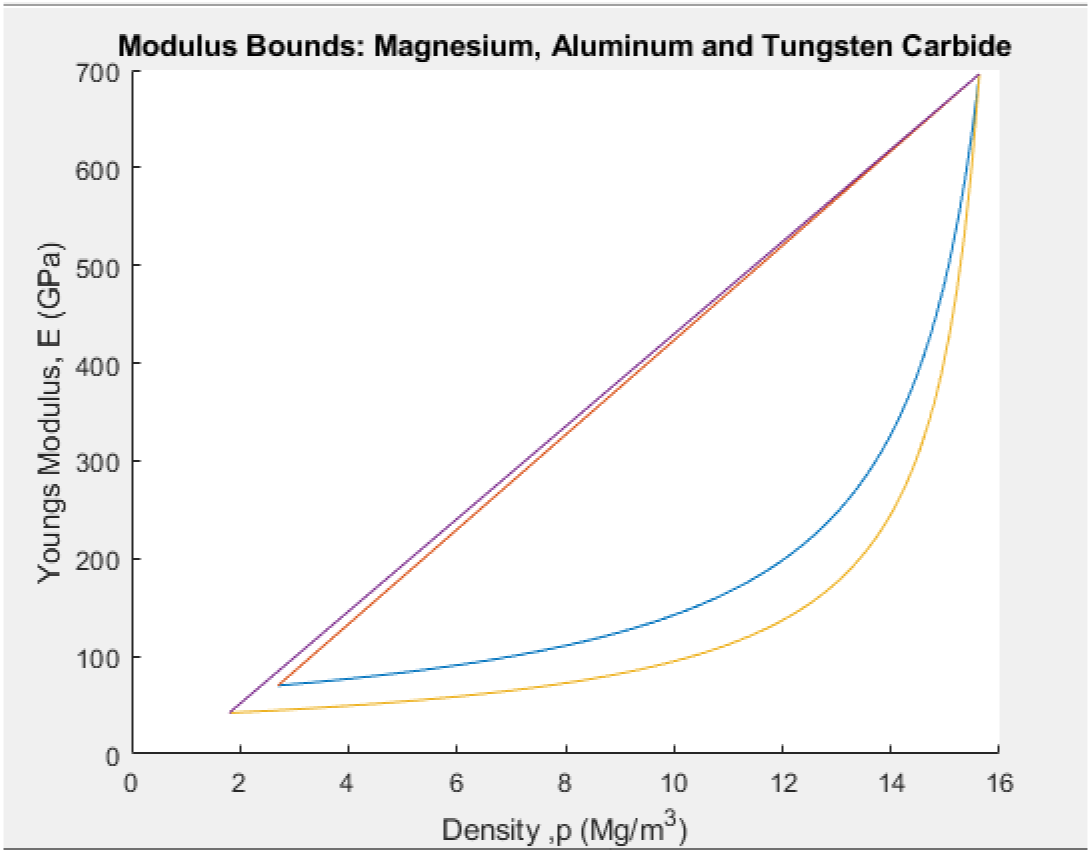
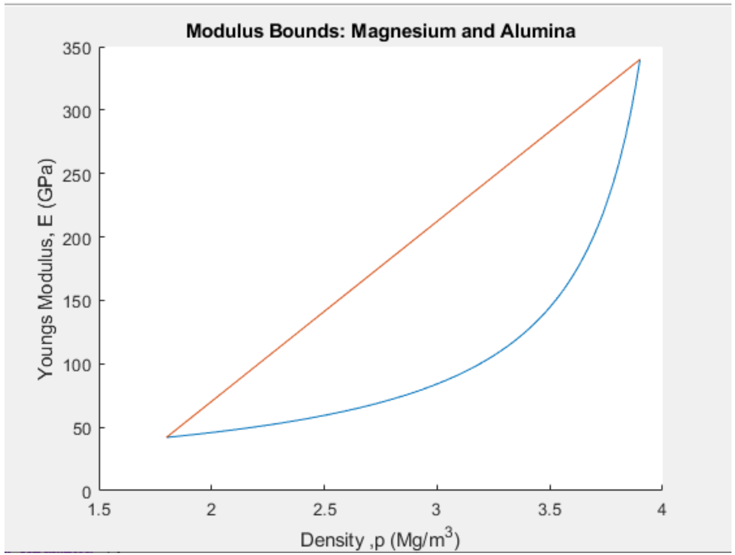
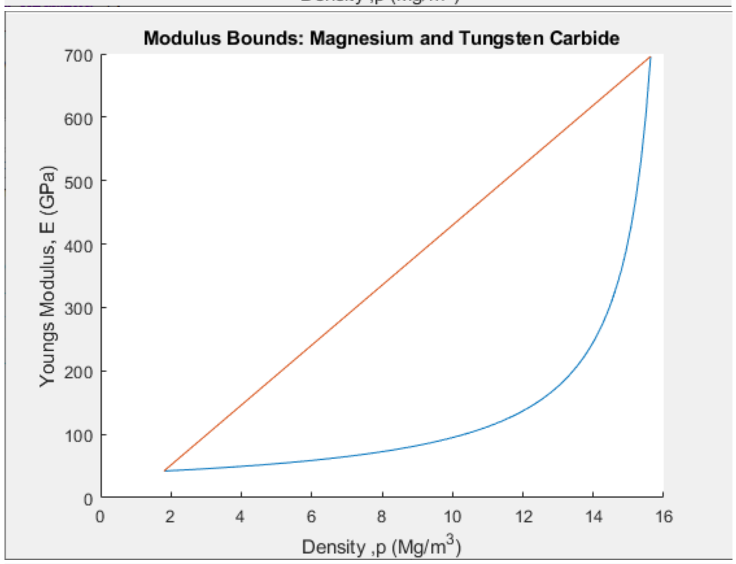
Question 2:

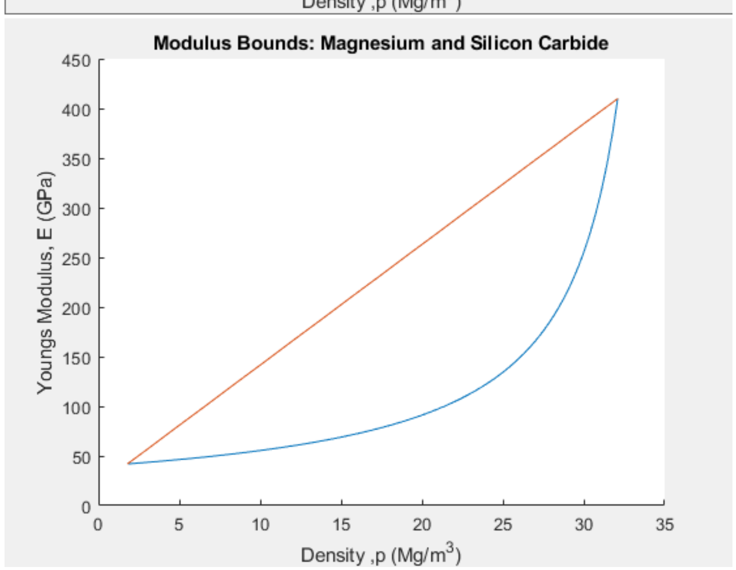


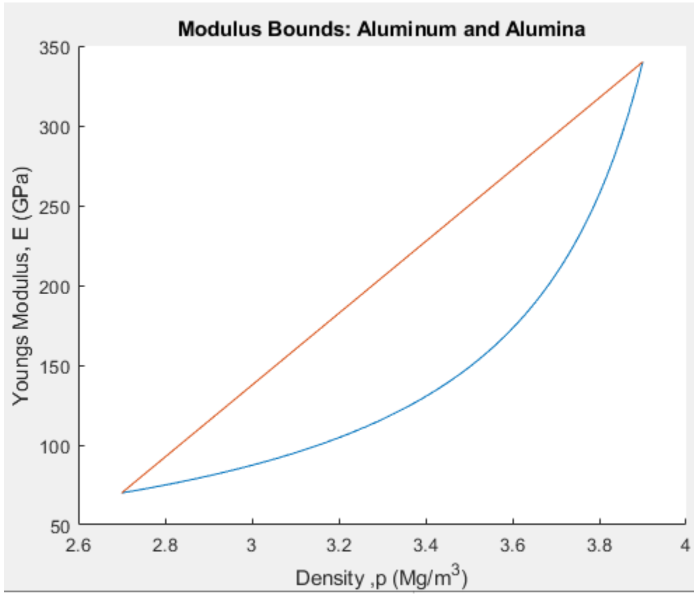
[Orange, Blue: Aluminum/Tungsten Carbide] [Purple, Yellow: Magnesium/Tungsten Carbide]

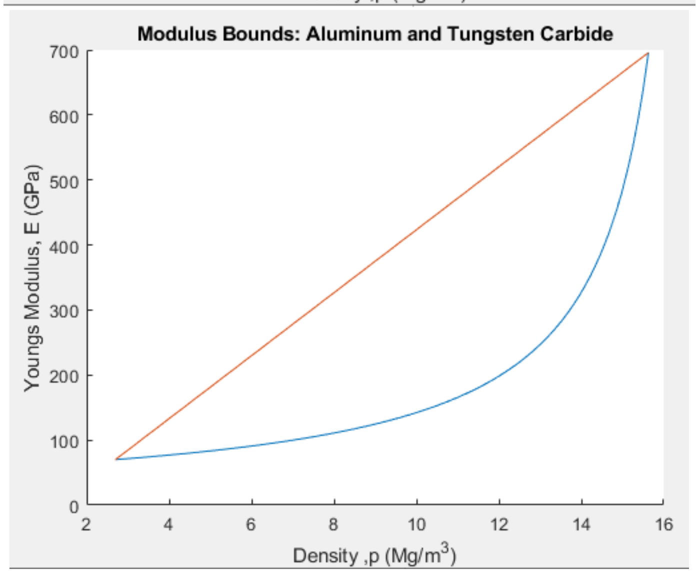
By assessing all the modulus bounds in the following graphs, the best two options were aluminum tungsten carbide and magnesium tungsten carbide. These were the best options because they had the highest young's modulus and the lowest densities meaning they are the lightest options. When comparing these two-options aluminum tungsten carbide is the better option as it has a little higher young's modulus making it stiffer with a little higher density start but with the same higher young's modulus/density point.

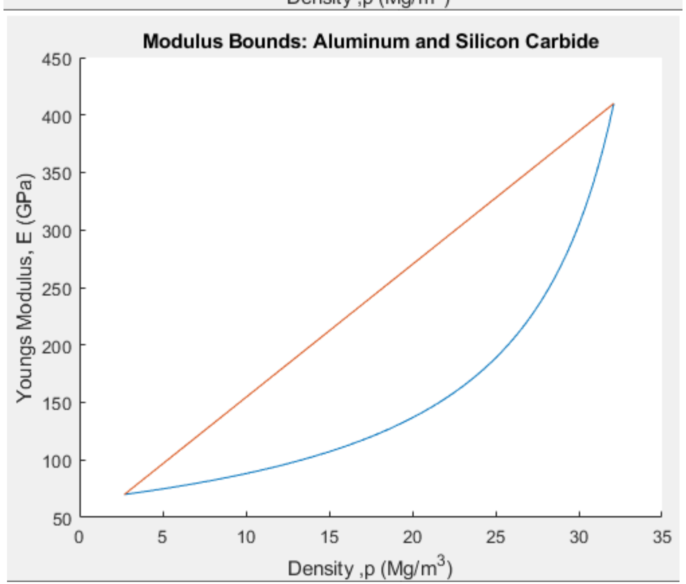

Modulus Bounds: Magnesium and Alumina
Youngs Modulus, E (GPa)
Density ,p (Mg/m^3)
0
50
100
150
200
250
300
350
1.5
2
2.5
3
3.5
4


Modulus Bounds: Magnesium and Tungsten Carbide
Youngs Modulus, E (GPa)
Density ,p (Mg/m^3)
0
100
200
300
400
500
600
700
0
2
4
6
8
10
12
14
16


Modulus Bounds: Magnesium and Silicon Carbide
Youngs Modulus, E (GPa)
Density ,p (Mg/m^3)
0
50
100
150
200
250
300
350
400
450
0
5
10
15
20
25
30
35


Modulus Bounds: Aluminum and Alumina
Youngs Modulus, E (GPa)
50
100
150
200
250
300
350
2.6
2.8
3
3.2
3.4
3.6
3.8
4
Density ,p (Mg/m^3)


Modulus Bounds: Aluminum and Tungsten Carbide
Youngs Modulus, E (GPa)
0
100
200
300
400
500
600
700
2
4
6
8
10
12
14
16
Density ,p (Mg/m^3)


Modulus Bounds: Aluminum and Silicon Carbide
Youngs Modulus, E (GPa)
50
100
150
200
250
300
350
400
450
0
5
10
15
20
25
30
35
Density ,p (Mg/m^3)

MATLAB Code:

```
%%Magnesium and Alumina

vf=[0:0.01:1]; %vf=Volume Fraction of reinforcing material
pf=3.9;        %pf=density of reinforcing material
pm=1.8;        %pm=density of the matrix material
Em=42;         %Em=youngs matrix material
Ef=340;        %Ef=youngs reinforcing material

%Reuss Bound
Er= (((vf/Ef)+((1-vf)/Em)).^-1);

%Voigt Bound
Ev=(vf*Ef)+((1-vf)*Em);

%Density
p=(vf*pf)+((1-vf)*pm);

%Graph
hold on
plot(p,Er)
plot(p,Ev)
title('Modulus Bounds: Magnesium and Alumina');
xlabel('Density ,p (Mg/m^3)')
ylabel('Youngs Modulus, E (GPa)')
hold off
```

```
%%Magnesium and Tungsten Carbide

vf=[0:0.01:1]; %vf=Volume Fraction of reinforcing material
pf=15.63;        %pf=density of reinforcing material
pm=1.8;        %pm=density of the matrix material
Em=42;         %Em=youngs matrix material
Ef=696;        %Ef=youngs reinforcing material

%Reuss Bound
Er= (((vf/Ef)+((1-vf)/Em)).^-1);

%Voigt Bound
Ev=(vf*Ef)+((1-vf)*Em);

%Density
p=(vf*pf)+((1-vf)*pm);

%Graph
hold on
plot(p,Er)
plot(p,Ev)
title('Modulus Bounds: Magnesium and Tungsten Carbide');
xlabel('Density ,p (Mg/m^3)')
ylabel('Youngs Modulus, E (GPa)')
hold off
```

```
%%Magnesium and Silicon Carbide

vf=[0:0.01:1]; %vf=Volume Fraction of reinforcing material
pf=32.1;         %pf=density of reinforcing material
pm=1.8;        %pm=density of the matrix material
Em=42;         %Em=youngs matrix material
Ef=410;        %Ef=youngs reinforcing material

%Reuss Bound
Er= (((vf/Ef)+((1-vf)/Em)).^-1);

%Voigt Bound
Ev=(vf*Ef)+((1-vf)*Em);

%Density
p=(vf*pf)+((1-vf)*pm);

%Graph
hold on
plot(p,Er)
plot(p,Ev)
title('Modulus Bounds: Magnesium and Silicon Carbide');
xlabel('Density ,p (Mg/m^3)')
ylabel('Youngs Modulus, E (GPa)')
hold off
```

```
%%Aluminium and Alumina

vf=[0:0.01:1]; %vf=Volume Fraction of reinforcing material
pf=3.9;        %pf=density of reinforcing material
pm=2.7;        %pm=density of the matrix material
Em=70;         %Em=youngs matrix material
Ef=340;        %Ef=youngs reinforcing material

%Reuss Bound
Er= (((vf/Ef)+((1-vf)/Em)).^-1);

%Voigt Bound
Ev=(vf*Ef)+((1-vf)*Em);

%Density
p=(vf*pf)+((1-vf)*pm);

%Graph
hold on
plot(p,Er)
plot(p,Ev)
title('Modulus Bounds: Aluminium and Alumina');
xlabel('Density ,p (Mg/m^3)')
ylabel('Youngs Modulus, E (GPa)')
hold off
```

```
%%Aluminium and Tungsten Carbide

vf=[0:0.01:1]; %vf=Volume Fraction of reinforcing material
pf=15.63;        %pf=density of reinforcing material
pm=2.7;        %pm=density of the matrix material
Em=70;         %Em=youngs matrix material
Ef=696;        %Ef=youngs reinforcing material

%Reuss Bound
Er= (((vf/Ef)+((1-vf)/Em)).^-1);

%Voigt Bound
Ev=(vf*Ef)+((1-vf)*Em);

%Density
p=(vf*pf)+((1-vf)*pm);

%Graph
hold on
plot(p,Er)
plot(p,Ev)
title('Modulus Bounds: Aluminium and Tungsten Carbide');
xlabel('Density ,p (Mg/m^3)')
ylabel('Youngs Modulus, E (GPa)')
hold off
```

```
%%Aluminium and Silicon Carbide

vf=[0:0.01:1]; %vf=Volume Fraction of reinforcing material
pf=32.1;         %pf=density of reinforcing material
pm=2.7;        %pm=density of the matrix material
Em=70;         %Em=youngs matrix material
Ef=410;        %Ef=youngs reinforcing material

%Reuss Bound
Er= (((vf/Ef)+((1-vf)/Em)).^-1);

%Voigt Bound
Ev=(vf*Ef)+((1-vf)*Em);

%Density
p=(vf*pf)+((1-vf)*pm);

%Graph
hold on
plot(p,Er)
plot(p,Ev)
title('Modulus Bounds: Aluminium and Silicon Carbide');
xlabel('Density ,p (Mg/m^3)')
ylabel('Youngs Modulus, E (GPa)')
hold off
```