

```
In [1]: run MECH530_main.py
```

PLYBOOK (READ FROM EXCEL FILE AND SUMMARIZED HERE)

The laminate is given by the following plybook where the highest ply number '14' indicates the top layer, while the first ply number '1' indicates the bottom layer.

Unique Ply #,	Fiber/Matrix,	Orientation, (degrees)	Thickness (mm)
14	T300/N5208	10	0.125
13	T300/N5208	-10	0.125
12	T300/N5208	90	0.125
11	T300/N5208	0	0.125
10	T300/N5208	0	0.125
9	T300/N5208	50	0.125
8	T300/N5208	-50	0.125
7	T300/N5208	-50	0.125
6	T300/N5208	50	0.125
5	T300/N5208	0	0.125
4	T300/N5208	0	0.125
3	T300/N5208	90	0.125
2	T300/N5208	-10	0.125
1	T300/N5208	10	0.125

PLIES AND THICKNESSES

- Total number of plies in the laminate: 14
- Total thickness of laminate is: 1.750 mm
- There is no core in the laminate ($Z_c = 0$ mm)
- Laminate contains 1 Fiber/Matrix combination. The material properties for this combination shall be listed below.

MATERIALS AND MATERIAL PROPERTIES

RESIN/MATRIX 1 of 1: For T300/N5208, the given material properties are:

-Stiffness and Strength:

$E_x = 181.0000$ GPa, $E_y = 10.3000$ GPa, $E_s = 7.1700$ GPa and $\nu_{x,y} = 0.2800$

$X_t = 1500.0000$ MPa, $X_c = 1500.0000$ MPa, $Y_t = 40.0000$ MPa, $Y_c = 246.0000$ MPa and $S_c = 68.0000$ MPa.

-The 'on-axis' matrices are given by the following:

$S_{on} =$
 $\begin{bmatrix} 0.0055 & -0.0015 & 0.0 \\ -0.0015 & 0.0971 & 0.0 \\ 0.0 & 0.0 & 0.1395 \end{bmatrix} [1/GPa]$

$Q_{on} =$
 $\begin{bmatrix} 181.8111 & 2.8969 & 0.0 \\ 2.8969 & 10.3462 & 0.0 \\ 0.0 & 0.0 & 7.1700 \end{bmatrix} [GPa]$

-The linear combinations of the modulus, independent of ply angle are the following:

```
Us_1 = 0.0555 [1/GPa]
Us_2 = -0.0458 [1/GPa]
Us_3 = -0.0042 [1/GPa]
Us_4 = -0.0058 [1/GPa]
Us_5 = 0.1226 [1/GPa]
```

-The linear combinations of the modulus, dependent on ply angle are the following:

```
Uq_1 = 76.3682 GPa
Uq_2 = 85.7325 GPa
Uq_3 = 19.7104 GPa
Uq_4 = 22.6074 GPa
Uq_5 = 26.8804 GPa
```

-The 'Stiffness' [A] and 'Compliance' [a] matrices are given by the following:

```
A =
[[ 0.2010  0.0265  0.0000]
 [ 0.0265  0.0924  0.0000]
 [ 0.0000  0.0000  0.0340]] [GN/m]
```

```
a =
[[ 5.1708 -1.4817  0.0000]
 [-1.4817 11.2418 -0.0000]
 [ 0.0000 -0.0000 29.4384]] [m/GN]
```

INPUTS:

Would you like to input an applied stress? ON/OFF/NO

OFF

Enter the applied stress resultant vector [N1, N2, N6] [N/m].

N1 = 450000

N2 = -110000

N6 = -130000

OFF-AXIS STRESSES AND STRAINS:

(INPUT) Off-axis Applied stress resultant =

```
[[ 0.00045]
 [-0.00011]
 [-0.00013]] [GN/m]
```

Off-axis stress =

```
[[ 0.25714]
 [-0.06286]
 [-0.07429]] [GPa]
```

Off-axis strain =

```
[[ 0.00249]
 [-0.00190]
 [-0.00383]] [unitless]
```

ON-AXIS STRESSES AND STRAINS:

PLY: 14

ORIENTATION: 10 degrees

Transpose of On-axis stress =

[[0.30637 -0.00662 -0.03656]] [GPa]

Transpose of On-axis strain =

[[0.00170 -0.00112 -0.00510]] [unitless]

PLY: 13

ORIENTATION: -10 degrees

Transpose of On-axis stress =

[[0.54056 -0.01637 -0.01501]] [GPa]

Transpose of On-axis strain =

[[0.00301 -0.00243 -0.00209]] [unitless]

PLY: 12

ORIENTATION: 90 degrees

Transpose of On-axis stress =

[[-0.33884 0.02025 0.02744]] [GPa]

Transpose of On-axis strain =

[[-0.00190 0.00249 0.00383]] [unitless]

PLY: 11

ORIENTATION: 0 degrees

Transpose of On-axis stress =

[[0.44717 -0.01248 -0.02744]] [GPa]

Transpose of On-axis strain =

[[0.00249 -0.00190 -0.00383]] [unitless]

PLY: 10

ORIENTATION: 0 degrees

Transpose of On-axis stress =

[[0.44717 -0.01248 -0.02744]] [GPa]

Transpose of On-axis strain =

[[0.00249 -0.00190 -0.00383]] [unitless]

PLY: 9

ORIENTATION: 50 degrees

Transpose of On-axis stress =

[[-0.35123 0.02076 -0.02626]] [GPa]

Transpose of On-axis strain =

[[-0.00197 0.00256 -0.00366]] [unitless]

PLY: 8

ORIENTATION: -50 degrees

Transpose of On-axis stress =

[[0.32307 -0.00731 0.03579]] [GPa]

Transpose of On-axis strain =

[[0.00180 -0.00121 0.00499]] [unitless]

PLY: 7

ORIENTATION: -50 degrees

Transpose of On-axis stress =

[[0.32307 -0.00731 0.03579]] [GPa]

Transpose of On-axis strain =

[[0.00180 -0.00121 0.00499]] [unitless]

PLY: 6

ORIENTATION: 50 degrees

Transpose of On-axis stress =

[[-0.35123 0.02076 -0.02626]] [GPa]

Transpose of On-axis strain =

[[-0.00197 0.00256 -0.00366]] [unitless]

PLY: 5

ORIENTATION: 0 degrees

Transpose of On-axis stress =

[[0.44717 -0.01248 -0.02744]] [GPa]

Transpose of On-axis strain =

[[0.00249 -0.00190 -0.00383]] [unitless]

PLY: 4

ORIENTATION: 0 degrees

Transpose of On-axis stress =

[[0.44717 -0.01248 -0.02744]] [GPa]

Transpose of On-axis strain =

[[0.00249 -0.00190 -0.00383]] [unitless]

PLY: 3

ORIENTATION: 90 degrees

Transpose of On-axis stress =

[[-0.33884 0.02025 0.02744]] [GPa]

Transpose of On-axis strain =

[[-0.00190 0.00249 0.00383]] [unitless]

PLY: 2

ORIENTATION: -10 degrees

Transpose of On-axis stress =

[[0.54056 -0.01637 -0.01501]] [GPa]

Transpose of On-axis strain =

[[0.00301 -0.00243 -0.00209]] [unitless]

PLY: 1

ORIENTATION: 10 degrees

Transpose of On-axis stress =

[[0.30637 -0.00662 -0.03656]] [GPa]

Transpose of On-axis strain =

[[0.00170 -0.00112 -0.00510]] [unitless]
