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EGR 103L – Fall 2021

# L<sup>A</sup>T<sub>E</sub>X Assignment

NAME (NetID)  
Lab Section N, DAY TIMES  
DATE DUE

I understand and have adhered to all the tenets of the Duke Community Standard in completing every part of this assignment. I understand that a violation of any part of the Standard on any part of this assignment can result in failure of this assignment, failure of this course, and/or suspension from Duke University.

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# 1 Equations

- General second-order system equation[1, p. 221]:

$$\frac{1}{\omega_n^2} \frac{d^2 x(t)}{dt^2} + \frac{2\zeta}{\omega_n} \frac{dx(t)}{dt} + x(t) = K_S f(t)$$

- The Secant Formula for finding maximum stress in a column[2, p. 681]:

$$\sigma_{\max} = \frac{P}{A} \left[ 1 + \frac{ec}{r^2} \sec \left( \frac{L}{2r} \sqrt{\frac{P}{EA}} \right) \right]$$

- Characteristic determinant for a 2x2 system of differential equations[3, p. 152]:

$$\begin{aligned} \det(\mathbf{A} - \lambda \mathbf{I}) &= \begin{vmatrix} a_{11} - \lambda & a_{12} \\ a_{21} & a_{22} - \lambda \end{vmatrix} \\ &= (a_{11} - \lambda)(a_{22} - \lambda) - a_{12}a_{21} \\ &= \lambda^2 - (a_{11} + a_{22})\lambda + a_{11}a_{22} - a_{12}a_{21} = 0 \end{aligned} \quad (1)$$

- Definition of the Lyapunov exponent[4, p. 56]:

$$h = \lim_{T \rightarrow \infty} \frac{1}{T} \ln \left| \frac{dx_T}{dx_0} \right| \quad (2)$$

$$h = \lim_{T \rightarrow \infty} \frac{1}{T} \sum_{n=0}^{T-1} \ln |M'(x_n)| \quad (3)$$

$$h = \int \ln |M'(x)| d\mu(x) \quad (4)$$

## 2 Tables using tabular and array

### 2.1 Using tabular

Converting ammonia into nitric acid - the Ostwald Process[5]:

Description	Chemical equation
Oxidization of Ammonia	$4 \text{NH}_3 (\text{g}) + 5 \text{O}_2 (\text{g}) \rightarrow 4 \text{NO} (\text{g}) + 6 \text{H}_2\text{O} (\text{g})$
Oxidization of Nitric Oxide	$2 \text{NO} (\text{g}) + \text{O}_2 (\text{g}) \rightarrow 2 \text{NO}_2 (\text{g})$
Absorption of Nitrogen Dioxide	$3 \text{NO}_2 (\text{g}) + \text{H}_2\text{O} (\text{l}) \rightarrow 2 \text{HNO}_3 (\text{aq}) + \text{NO} (\text{g})$

### 2.2 Using array

Equation	Description
$\vec{v} = v_x \hat{i} + v_y \hat{j} + v_z \hat{k}$	Resolution into Components
$v^2 = v_0^2 + 2a\Delta x$	Velocity formula

### 3 Comments

Things I learned in this assignment:

- How to use the `align` and `align*` environment to typeset numbered and unnumbered equations and using the `nonumber` command to suppress numbering equations in an `align` environment;
- How to use the `mathrm` command to put super- and subscripts in regular, versus italic, type for things like  $V_{\min}$  instead of  $V_{min}$ ;
- How to change the appearance of fonts to make words **bold**, *italics*, underlined, or **typewriter font**;
- How to use `$` to enter math mode in a line of text to type shorter mathematical expressions like  $10^6$  and  $\nabla u$  or Greek letters like  $\Delta$ ;
- *Add another thing you learned here - your first choice;*
- *Add another thing you learned here - your second choice;* and
- *Add another thing you learned here - your third choice.*

## A Codes

### A.1 Listing of full sample header for original code

```
1 """
2 [Function or Script Name]
3 [Your Name]
4 [Date Written]
5
6 I understand and have adhered to all the tenets of the Duke Community Standard
7 in creating this code. I understand that a violation of any part of the
8 Standard on any part of this assignment can result in failure of this
9 assignment, failure of this course, and/or suspension from Duke University.
10 Signed: [Your NetID]
11 """
```

### A.2 Listing of short sample header for original code

```
1 """
2 [Function or Script Name]
3 [Your Name]
4 [Date Modified]
5
6 I understand and have adhered to all the tenets of the Duke Community Standard
7 in creating this code.
8 Signed: [Your NetID]
9 """
```

### A.3 Listing of full sample header for modified code

```
1 """
2 [Function or Script Name]
3 [Your Name]
4 [Date Modified]
5 Based on: [Original Script or Function]
6 Written by: [Original Author]
7
8 I understand and have adhered to all the tenets of the Duke Community Standard
9 in creating this code. I understand that a violation of any part of the
10 Standard on any part of this assignment can result in failure of this
11 assignment, failure of this course, and/or suspension from Duke University.
12 Signed: [Your NetID]
13 """
```

### A.4 Listing of short sample header for modified code

```
1 """
2 [Function or Script Name]
3 [Your Name]
4 [Date Modified]
5 Based on: [Original Script or Function]
6 Written by: [Original Author]
7
8 I understand and have adhered to all the tenets of the Duke Community Standard
9 in creating this code.
10 Signed: [Your NetID]
11 """
```

## A.5 Listing code for sample graph on following page

```
1 """
2 MakeSample.py
3 Michael R. Gustafson II
4 January 1, 2021
5
6 I understand and have adhered to all the tenets of the Duke Community Standard
7 in creating this code.
8 Signed: mrg
9 """
10
11 # Import modules
12 import matplotlib.pyplot as plt
13 import numpy as np
14
15 # Create linearly spaced array as basis for graphs
16 x = np.linspace(0, 1, 100)
17
18 # Generate x**3 data
19 y = x**3
20
21 # Initialize figure and axes
22 fig, ax = plt.subplots(num=1, clear=True)
23
24 # Plot various lines in different colors and line styles
25 ax.plot(x, y, 'orange')
26 ax.plot(1 - x, y, 'g:')
27 ax.plot(y, x, 'r—')
28 ax.plot(y, 1 - x, 'c-.')
29 ax.plot(x, 1 - y, 'm:')
30 ax.plot(1 - x, 1 - y, 'y-')
31 ax.plot(1 - y, x, 'k-.')
32 ax.plot(1 - y, 1 - x, 'b—')
33
34 # Add text to center
35 ax.text(0.5, 0.5, 'Sample', horizontalalignment='center',
36         verticalalignment='center', size=30)
37
38 # Set properties
39 ax.set(xlabel='x (UNITS)', ylabel='y (UNITS)',
40        title='Different Relationships (NetID)',
41        aspect='equal')
42
43 # Further refine and save plot
44 ax.grid(True)
45 fig.tight_layout()
46 fig.savefig('SamplePyplot.png')
```

## B Figures

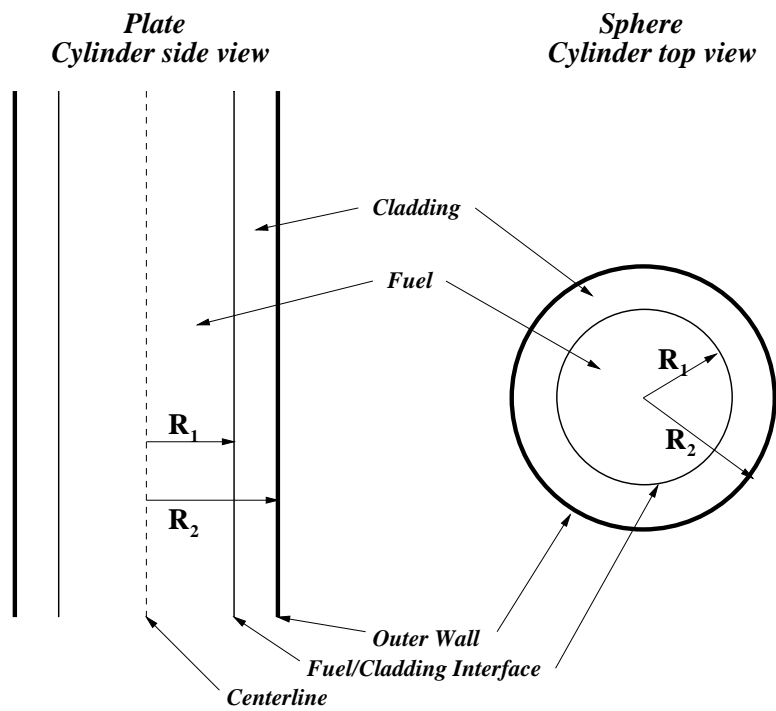


Figure 1: Drawing from ME 431L test.

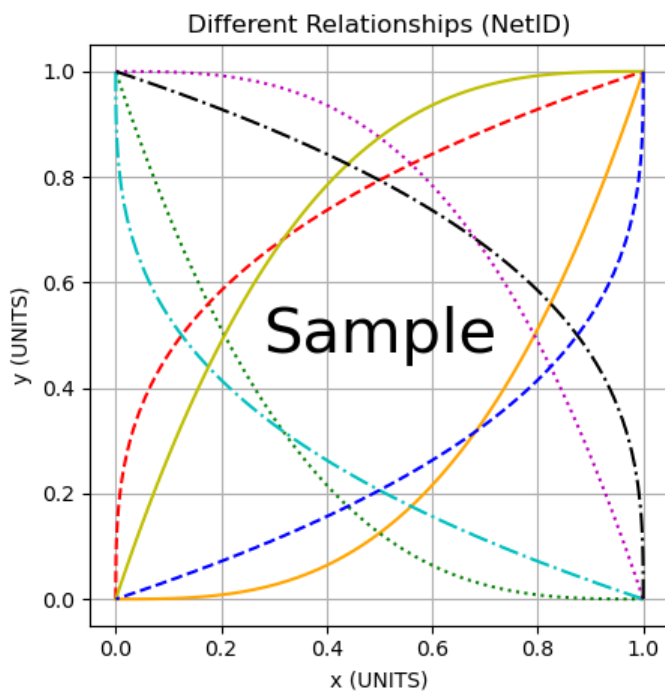


Figure 2: Sample figure.

## References

- [1] Rizzoni, Giorgio, *Principles and Applications of Electrical Engineering*. McGraw-Hill, New York, 5th Edition, 2007.
- [2] Hibbeler, R. C., *Mechanics of Materials*. Pearson Prentice Hall, Upper Saddle River, NJ, 8th Edition, 2011.
- [3] Kreyszig, Erwin, *Advanced Engineering Mathematics*. John Wiley & Sons, New York, 8th Edition, 1999.
- [4] Ott, Edward, *Chaos in Dynamical Systems*. Cambridge University Press, Cambridge, UK, 1st Edition, 1993.
- [5] Wikipedia, *Ostwald process* ([http://en.wikipedia.org/wiki/Ostwald\\_process](http://en.wikipedia.org/wiki/Ostwald_process)). Online; accessed 19-Aug-2012.