ECE 431 Homework 6

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1 ANSWERS

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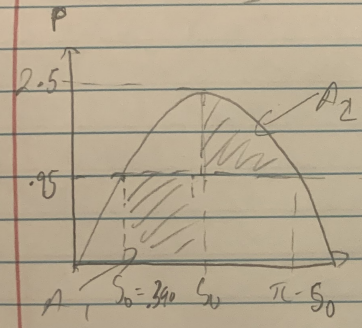
ECE431 HWK 6

6.1) $.5P_u = x_s$

Rated VA $\Rightarrow$ $|P_u| \angle 0° = V_a$, $I_a = |P_u| \angle \cos^{-1}(.95) = 1.0 \angle -18.19°$

$E_a = V_a + I_a j x_s = \boxed{1.25 \angle 22.34° V, \quad \delta = 22.34°}$

b) $P_{out} = \frac{E_a V_a}{x_s} \sin(\delta) = 2.5 \sin\delta \rightarrow \delta = 22.34° = .9505$



$A_1 = A_2$ for Stability

$(\delta_c - .390) .95 = \int_{\delta_c}^{2.75} 2.5 \sin(\delta) - .95 \, d\delta$

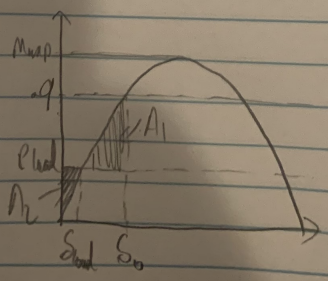
$= [-2.5\cos(\delta) - .95\delta]\Big|_{\delta_c}^{2.75}$

$.95\delta_c - .3705 =$ $\boxed{\delta_c = 1.5983 \text{ rad} = 91.58°}$

c) - If you increase E_a then the curve gets higher and can have more area which would increase δ_c

- You can also reduce x_s to do the same as above

6.2) $.9 P_u$



if $A_1 = A_2$ then Stability can stay

$A_1 = \int_{\delta_{load}}^{\delta_0} (M_{max} \sin(\delta) - P_{load})$

$A_2 = \int_{0}^{\delta_{load}} (P_{load} - M_{max} \sin(\delta))$

6.3)

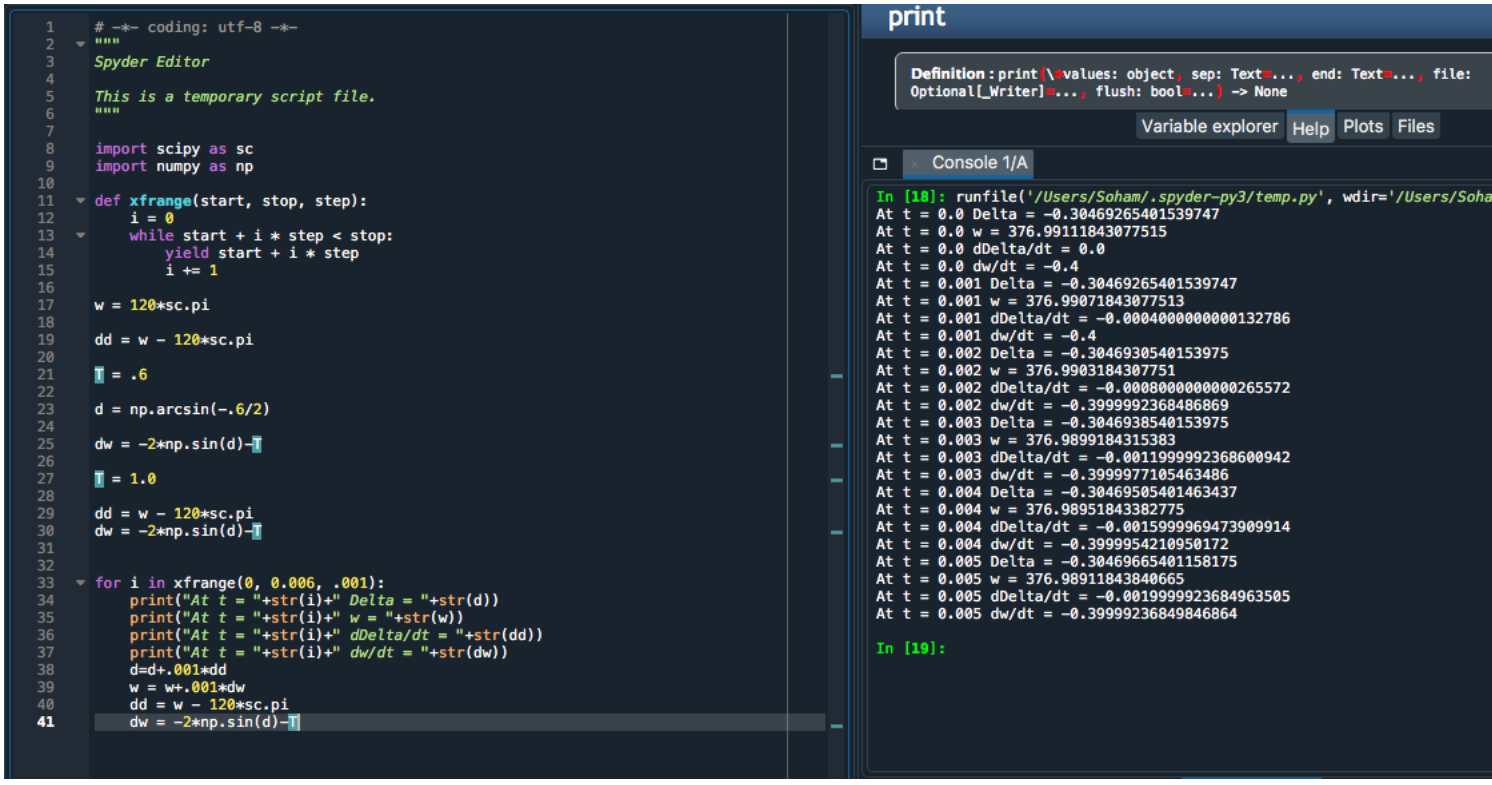
a) $\frac{d\delta}{dt} = \omega - 120\pi$

$\frac{d\omega}{dt} = \frac{d^2\delta}{dt^2} = -2\sin(\delta) - .6$

b) $.6 = -2\sin(\delta) \rightarrow \delta = -.305\text{rad}$

$\omega = 120\pi$

} At equilibrium



```
# -*- coding: utf-8 -*-
"""
Spyder Editor

This is a temporary script file.
"""

import scipy as sc
import numpy as np

def xfrange(start, stop, step):
    i = 0
    while start + i * step < stop:
        yield start + i * step
        i += 1

w = 120*sc.pi

dd = w - 120*sc.pi

T = .6

d = np.arcsin(-.6/2)

dw = -2*np.sin(d)-T

T = 1.0

dd = w - 120*sc.pi
dw = -2*np.sin(d)-T


for i in xfrange(0, 0.006, .001):
    print("At t = "+str(i)+" Delta = "+str(d))
    print("At t = "+str(i)+" w = "+str(w))
    print("At t = "+str(i)+" dDelta/dt = "+str(dd))
    print("At t = "+str(i)+" dw/dt = "+str(dw))
    d=d+.001*dd
    w = w+.001*dw
    dd = w - 120*sc.pi
    dw = -2*np.sin(d)-T
```

```
print

Definition: print(\*values: object, sep: Text=..., end: Text=..., file:
Optional[_Writer]=..., flush: bool=...) -> None

Variable explorer  Help  Plots  Files

Console 1/A

In [18]: runfile('/Users/Soham/.spyder-py3/temp.py', wdir='/Users/Soha
At t = 0.0 Delta = -0.30469265401539747
At t = 0.0 w = 376.99111843077515
At t = 0.0 dDelta/dt = 0.0
At t = 0.0 dw/dt = -0.4
At t = 0.001 Delta = -0.30469265401539747
At t = 0.001 w = 376.99071843077513
At t = 0.001 dDelta/dt = -0.0004000000000132786
At t = 0.001 dw/dt = -0.4
At t = 0.002 Delta = -0.3046930540153975
At t = 0.002 w = 376.9903184307751
At t = 0.002 dDelta/dt = -0.0008000000000265572
At t = 0.002 dw/dt = -0.3999992368486869
At t = 0.003 Delta = -0.3046938540153975
At t = 0.003 w = 376.9899184315383
At t = 0.003 dDelta/dt = -0.0011999992368600942
At t = 0.003 dw/dt = -0.3999977105463486
At t = 0.004 Delta = -0.30469505401463437
At t = 0.004 w = 376.98951843382775
At t = 0.004 dDelta/dt = -0.0015999969473909914
At t = 0.004 dw/dt = -0.3999954210950172
At t = 0.005 Delta = -0.30469665401158175
At t = 0.005 w = 376.98911843840665
At t = 0.005 dDelta/dt = -0.0019999923684963505
At t = 0.005 dw/dt = -0.39999236849846864

In [19]:
```