Name: Shaunak Deshpande

Branch: Instrumentation and Control Engineering

Year: TY

Division: C

Batch: 2

Roll Number: 39

Gr Number: 11911180

Lab Assignment 2

Date: 13-09-2021

**Control Theory Lab 2 dated 13-09-2021.**

**Python Code:**

import control

import numpy as np

import matplotlib.pyplot as plt

sys = control.TransferFunction(np.array([2,3,1]) , np.array([12,7,1]))

control.pzmap(sys, plot=True, grid=None, title='Pole Zero Map')

Rectangle

Description automatically generated with low confidence

#For RC Circuit with Capacitance of 1 mF and resistance of 100k Ohm

num=[1]

den=[100,1]

RC=control.tf(num,den)

print('H(s)=',RC)

control.pzmap(RC, plot=True, grid=None, title='Pole Zero Map')

H(s)=

1

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100 s + 1

# Vout = 0.1 \* np.exp(0.1 \* t)

temp = control.impulse\_response(RC, T=100, X0=0.0, input=None, output=None, T\_num=1000, transpose=False, return\_x=False, squeeze=None)

plt.plot(temp)

plt.show()

A picture containing background pattern

Description automatically generated

#Impulse response of RC Circuit

a0=1

a1=10

b0=1

b1=0

num = np.array([b1, b0])

den = np.array([a1, a0])

H = control.tf(num, den)

print ('H ( s ) = ' , H )

t=np.arange(0,100.1,0.1)

T, yout1 = control.impulse\_response(H, t, X0=0)

plt.plot(T,yout1)

plt.title("Impulse Response of RC Circuit")

plt.xlabel("Time")

plt.ylabel("Vout")

plt.show()

H ( s ) =

1

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10 s + 1

Shape

Description automatically generated

#Step response of RC Circuit

H2= control.tf([1], [1,0.1])

T2, yout2 = control.step\_response(H2, t, X0=0)

plt.plot(T2,yout2)

plt.title("Step Response of RC Circuit")

plt.xlabel("Time")

plt.ylabel("Vout")

plt.show()

**Shape

Description automatically generated**

**Learning outcomes:**

1. Using Control Library in Python
2. Transfer function using control.TransferFunction
3. Finding Pole zero map in Python

**Conclusion:**

By converting the transfer function into a standard second-order equation, we can calculate the values of the natural frequency of oscillations ωn and damping ratio ζ. From the value of the damping ratio, we can differentiate whether a system is underdamped, undamped, overdamped, or critically damped.