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DEPARTMENT: Biomedical Engineering

COURSE CODE: BME312

COURSE TITLE: Biological Systems Control and Modelling

ASSIGNMENT

PID CONTROLLER ASSIGNMENT

QUESTION 1

ZIEGLAR-NICHOLS OPEN-LOOP TUNING RULE

%PID Example 1a

clear all

clc

num=[1]

den=[2 1]

sys=tf(num, den)

H=1 %tf of 1

M=feedback(sys,H) %Open Loop it takes the feedback command as G/1+GH

step(M)

hold on

%% Closed Loop Response

kp=10

ki=0

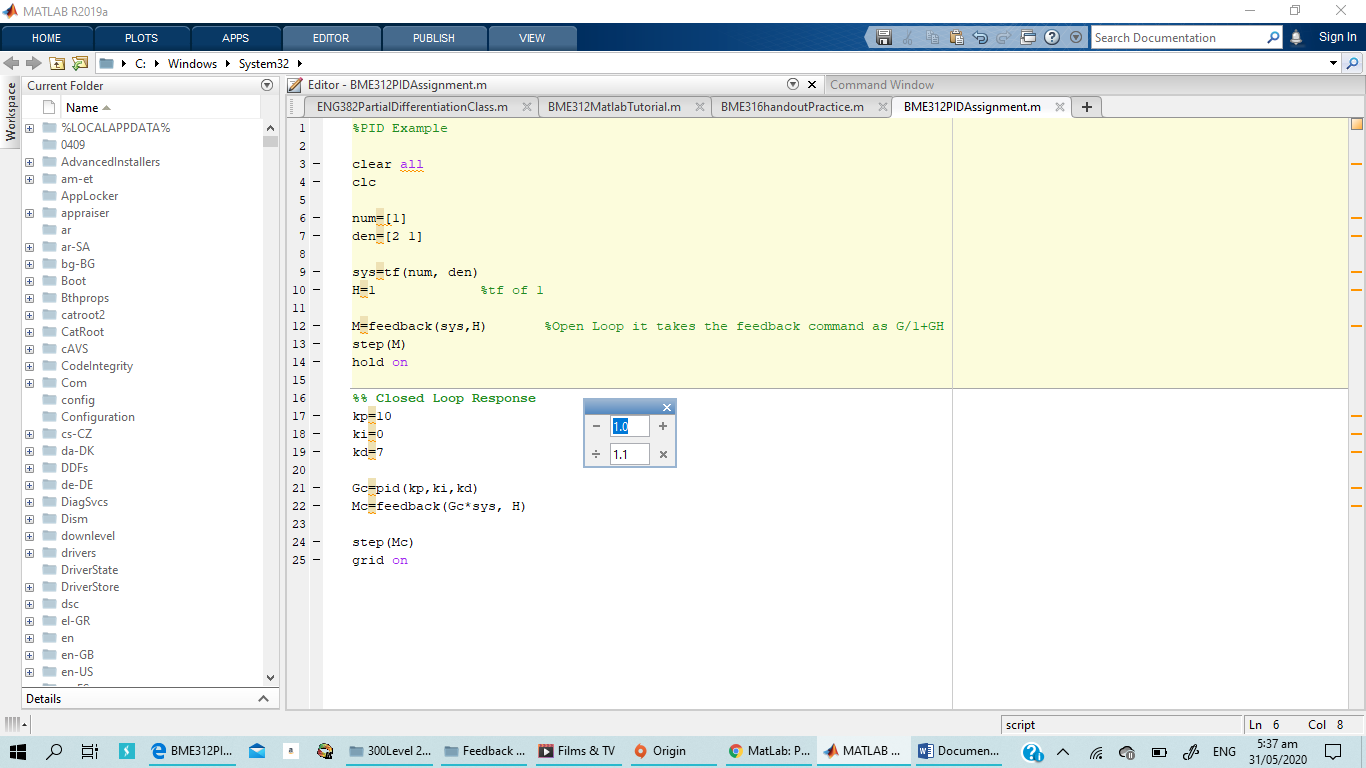
kd=7

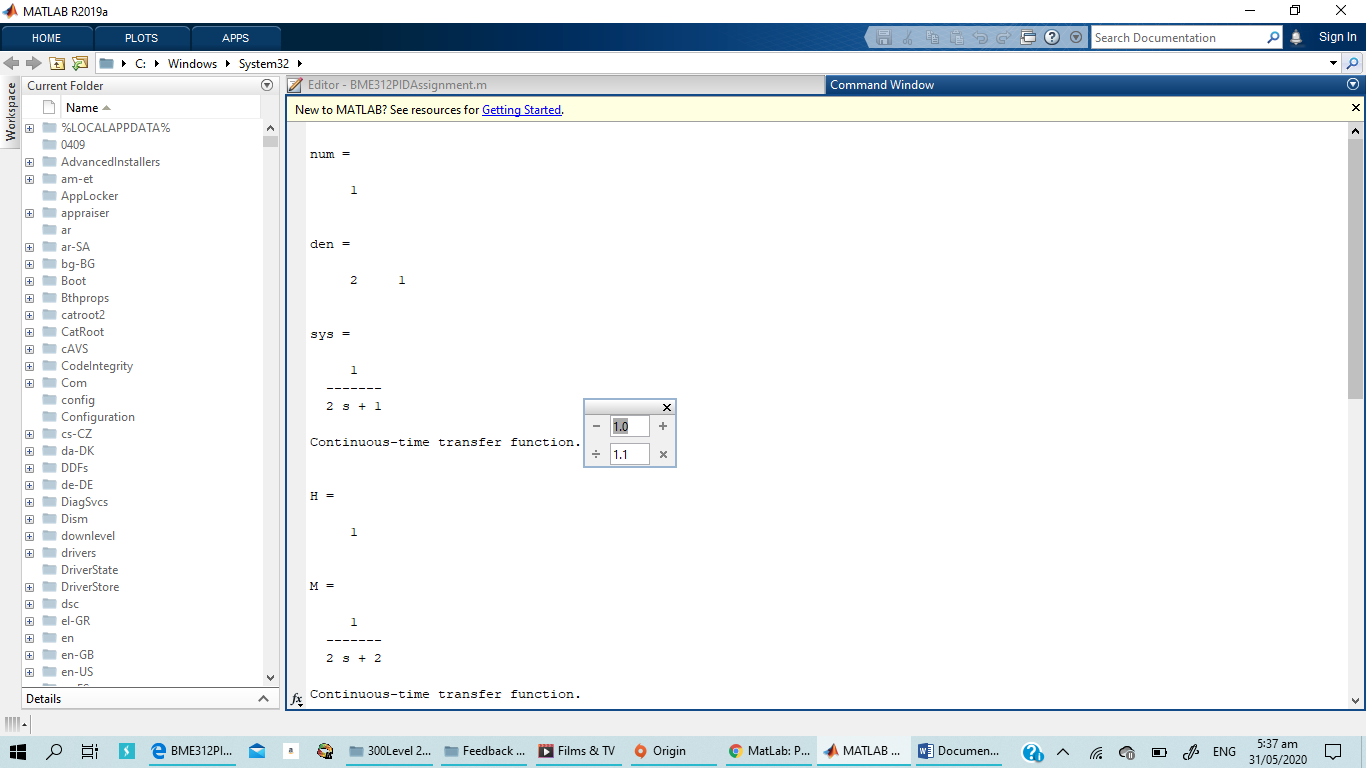
Gc=pid(kp,ki,kd)

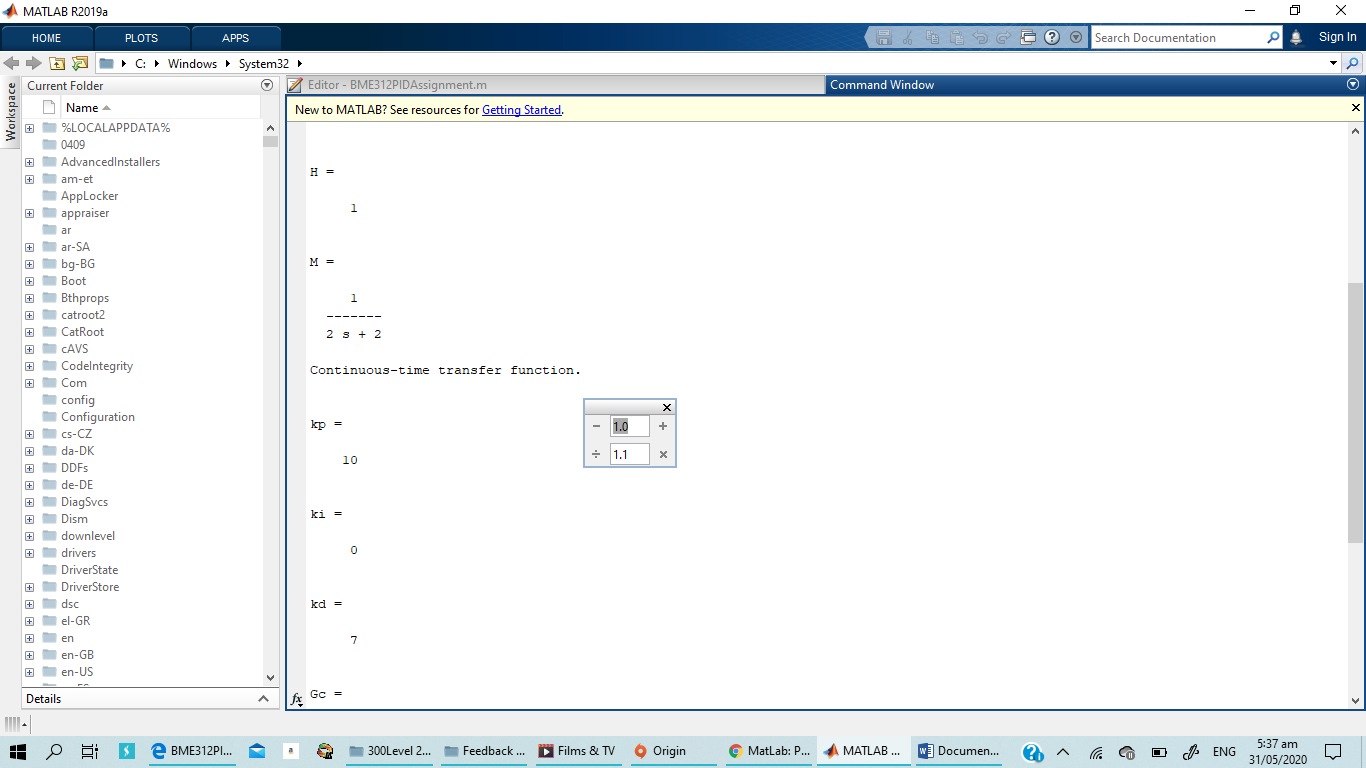
Mc=feedback(Gc\*sys, H)

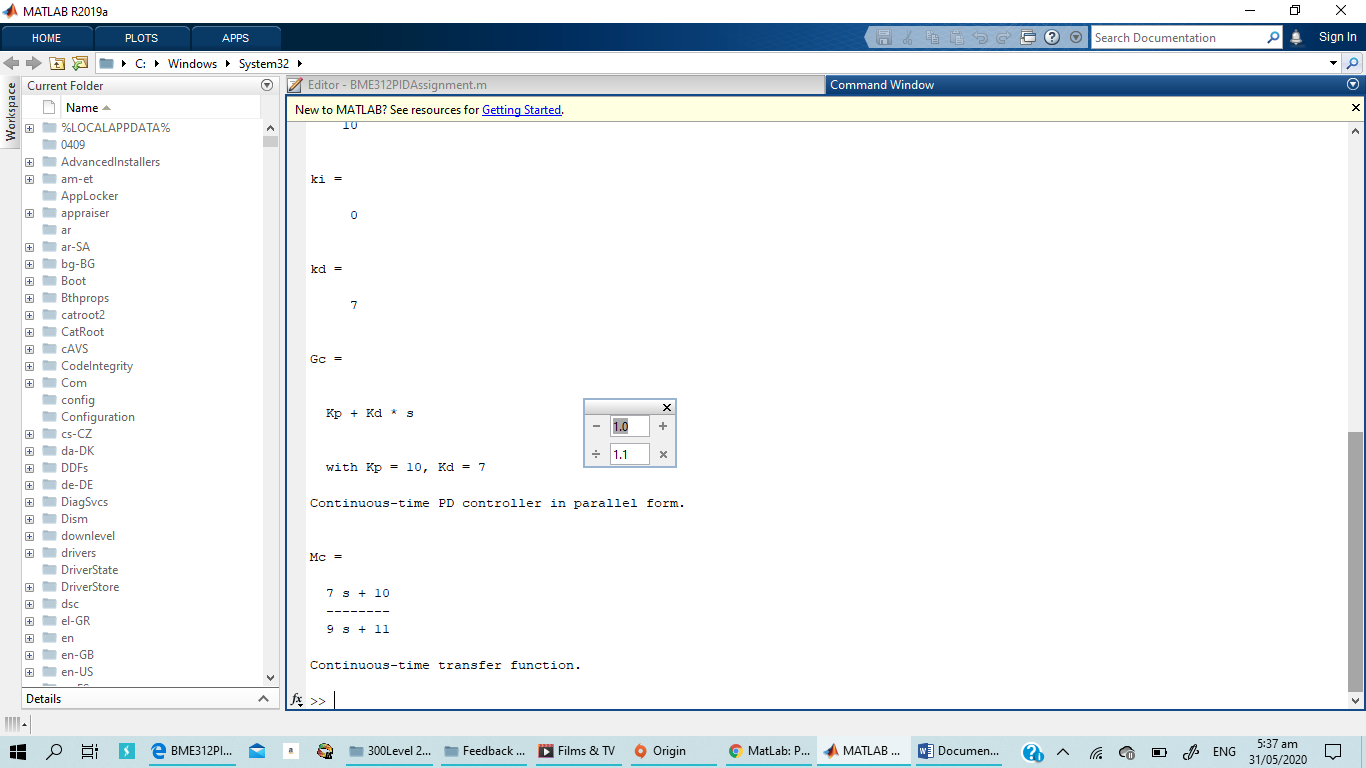
step(Mc)

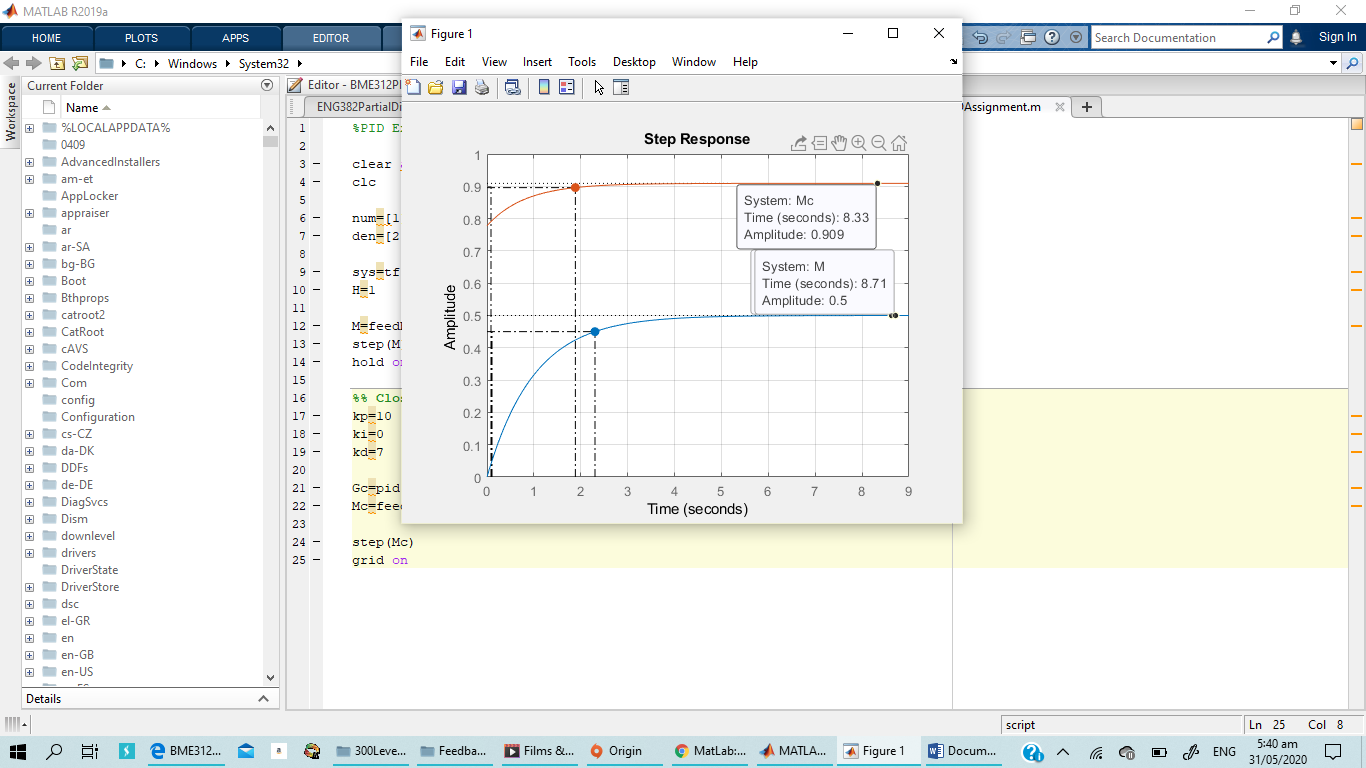
grid on











%Pi Example 1a

clear all

clc

num=[1];

den=[2 1];

sys=tf(num, den)

H=1; %tf of 1

M=feedback(sys,H) %Open Loop it takes the feedback command as G/1+GH

step(M)

hold on

%% Closed Loop Response

kp=30;

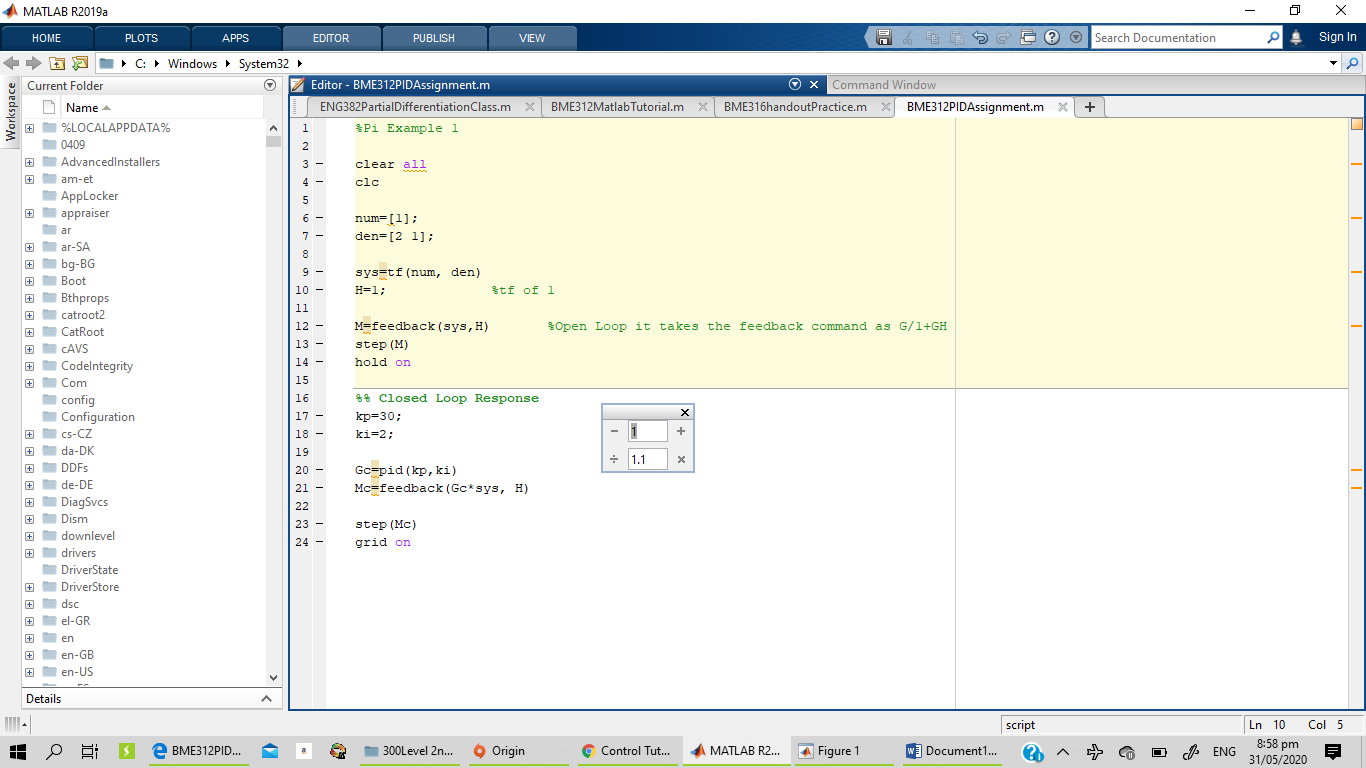
ki=2;

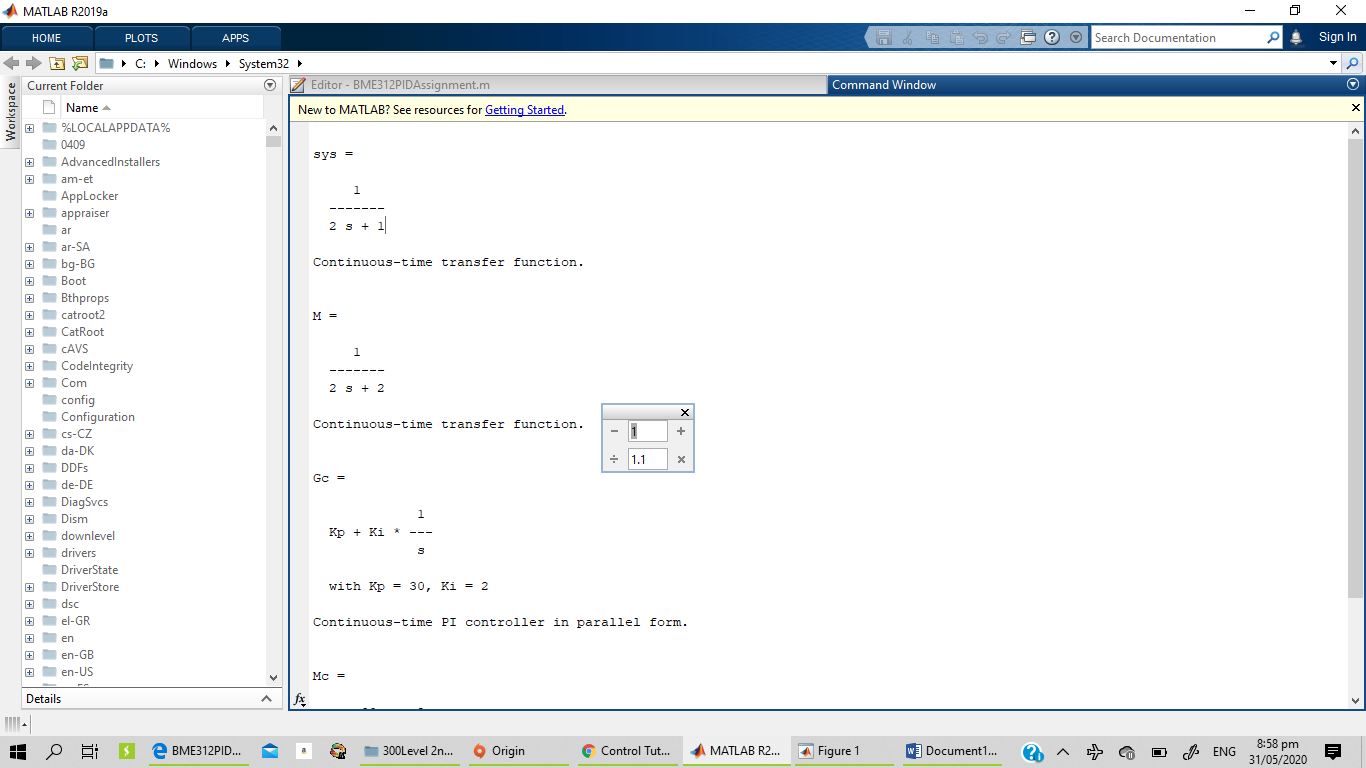
Gc=pid(kp,ki)

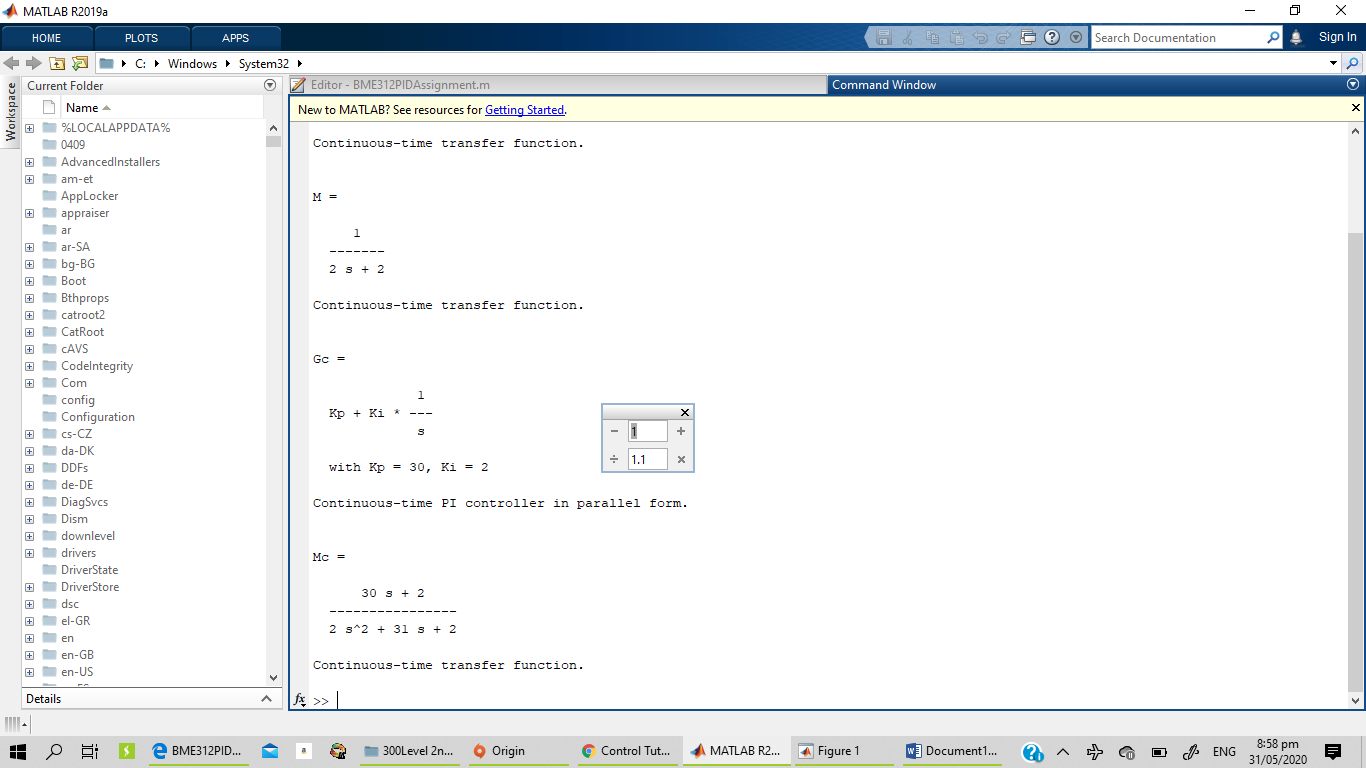
Mc=feedback(Gc\*sys, H)

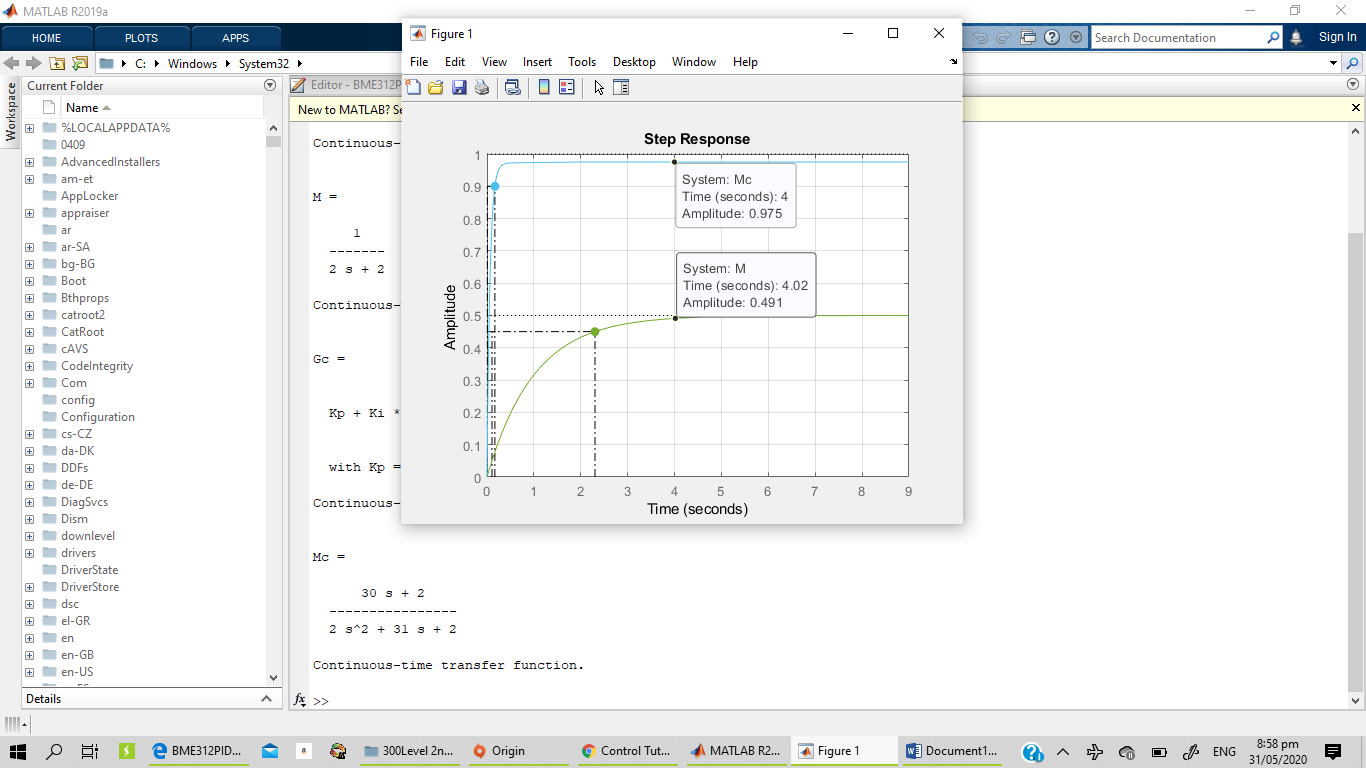
step(Mc)

grid on









%P Example 1a

clear all

clc

num=[1];

den=[2 1];

sys=tf(num, den)

H=1; %tf of 1

M=feedback(sys,H) %Open Loop it takes the feedback command as G/1+GH

step(M)

hold on

%% Closed Loop Response

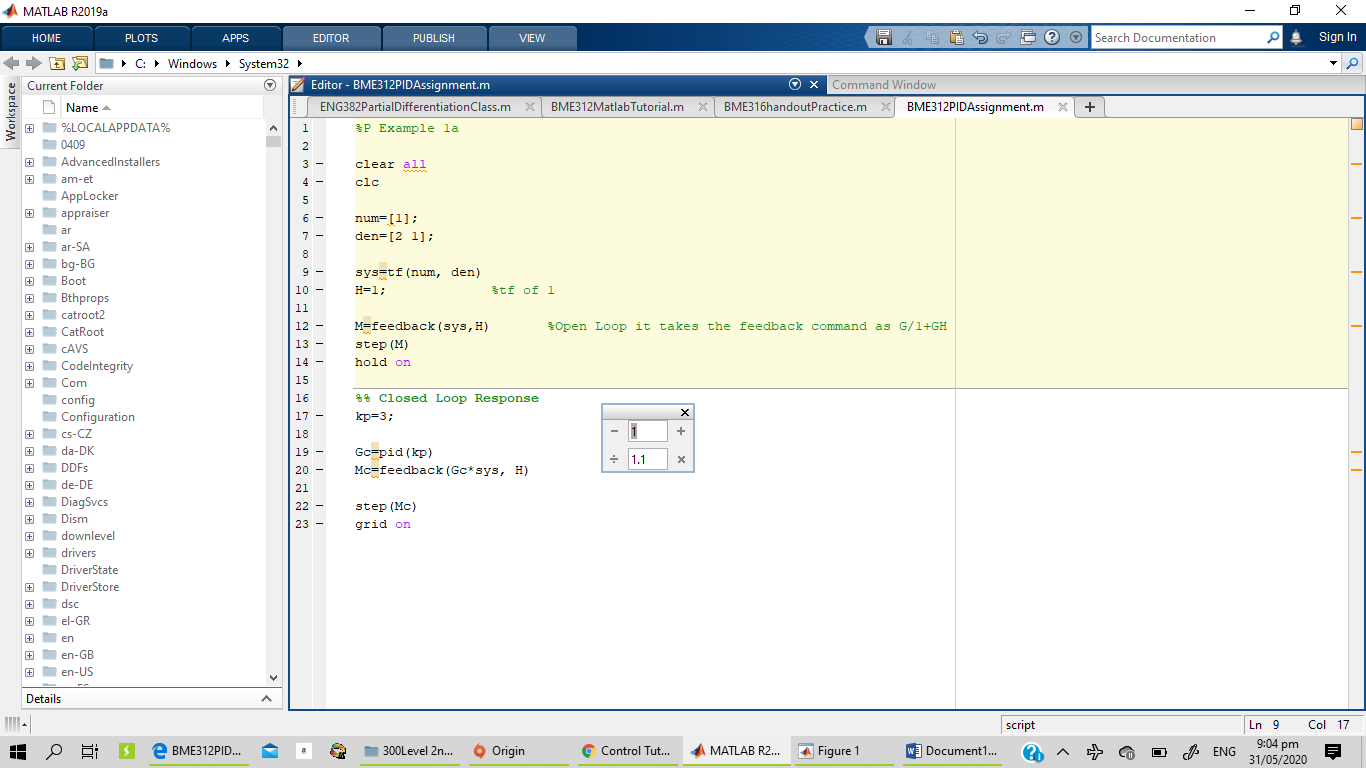
kp=3;

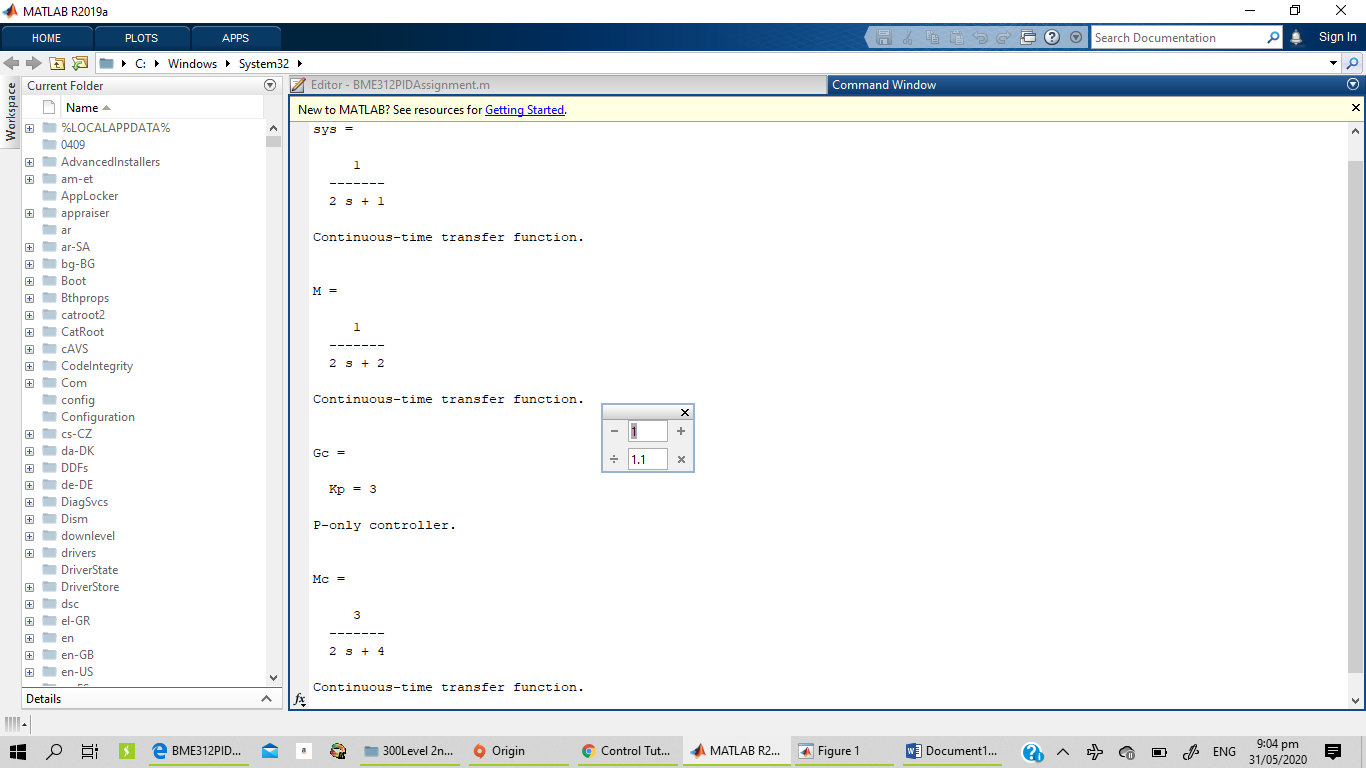
Gc=pid(kp)

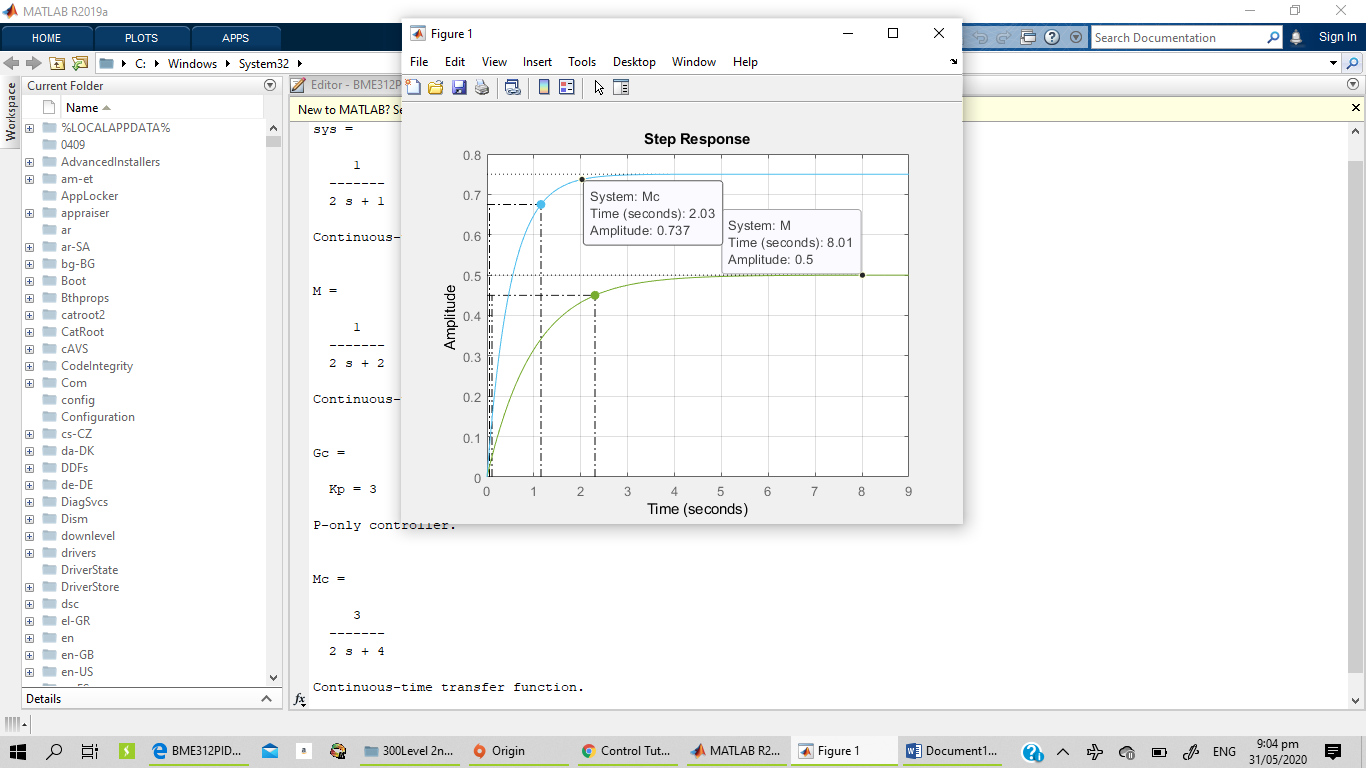
Mc=feedback(Gc\*sys, H)

step(Mc)

grid on







%PID Example 1b

clear all

clc

num=[2]

den=[1 12 9]

sys=tf(num, den)

H=1 %tf of 1

M=feedback(sys,H) %Open Loop it takes the feedback command as G/1+GH

step(M)

hold on

%% Closed Loop Response

kp=11

ki=0

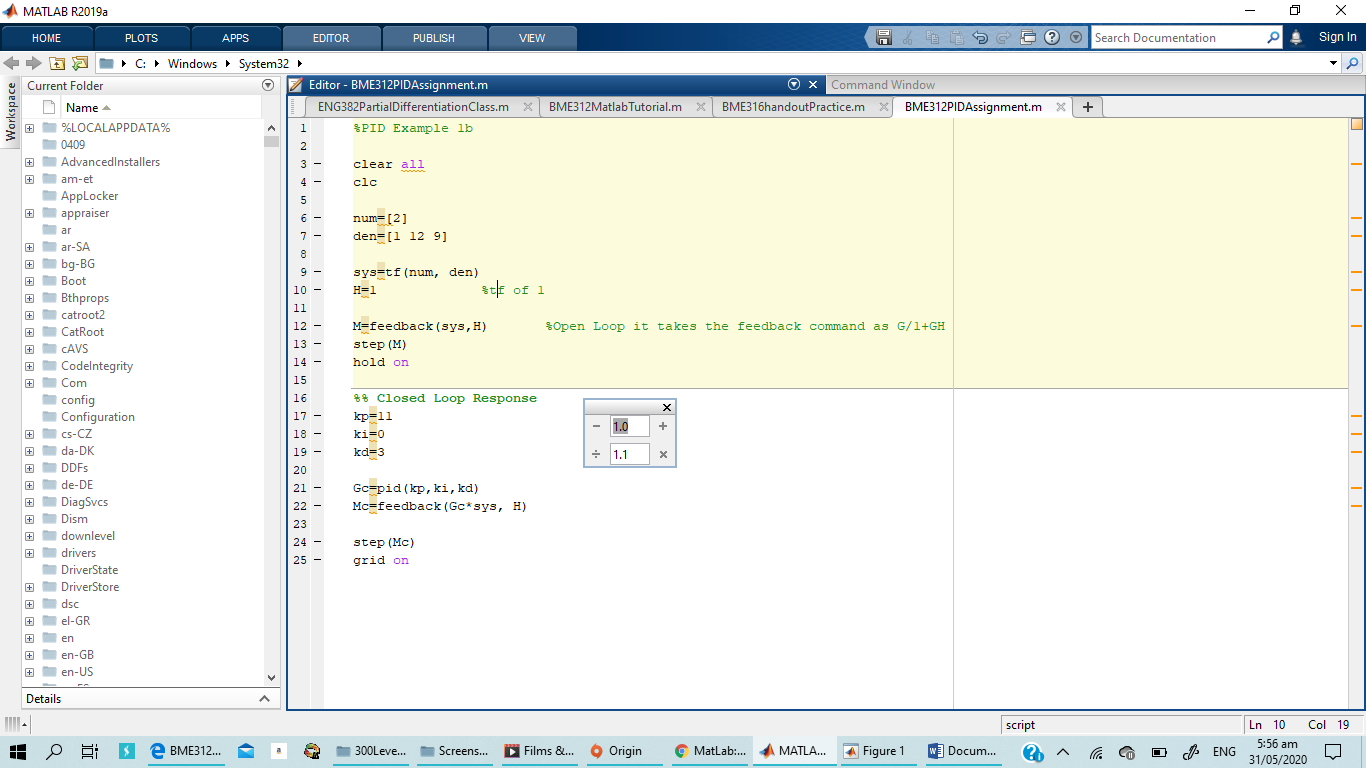
kd=3

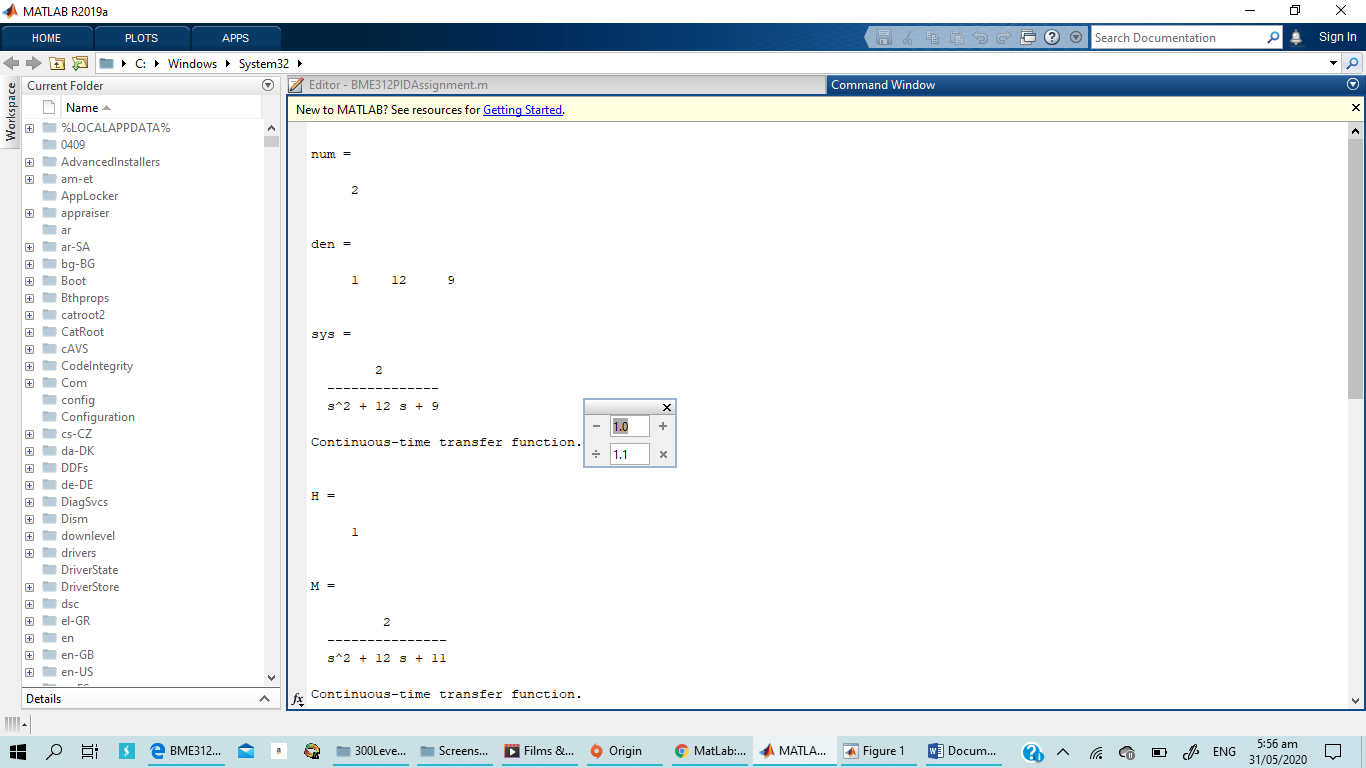
Gc=pid(kp,ki,kd)

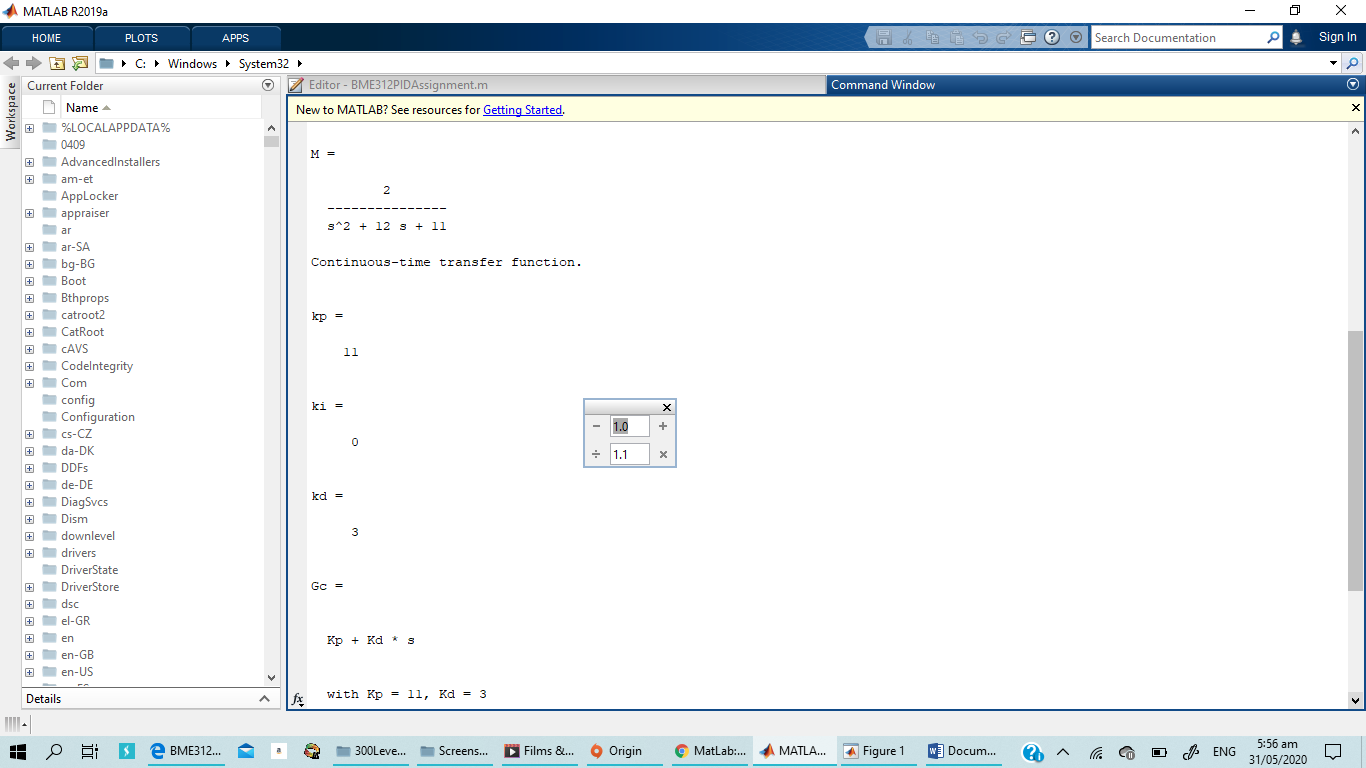
Mc=feedback(Gc\*sys, H)

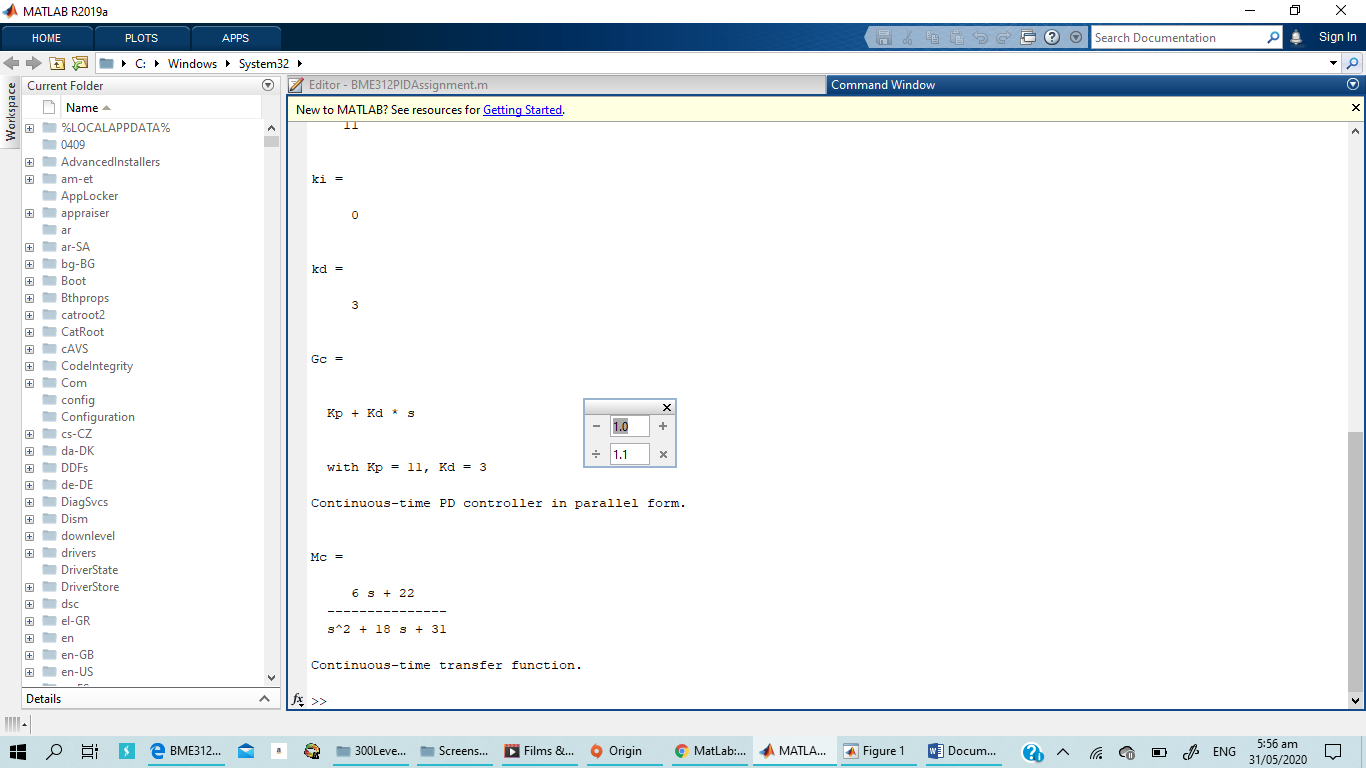
step(Mc)

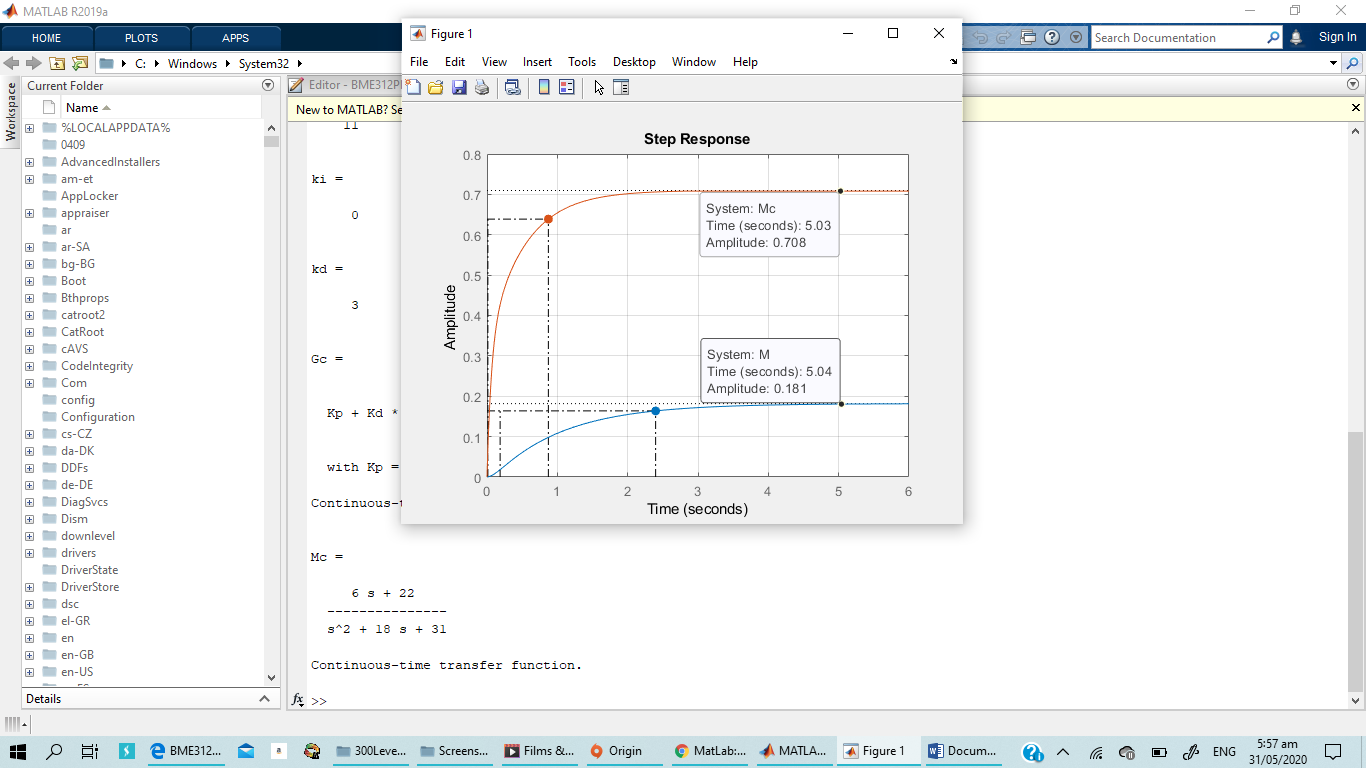
grid on











%Pi Example 1b

clear all

clc

num=[2]

den=[1 12 9]

sys=tf(num, den)

H=1 %tf of 1

M=feedback(sys,H) %Open Loop it takes the feedback command as G/1+GH

step(M)

hold on

%% Closed Loop Response

kp=7

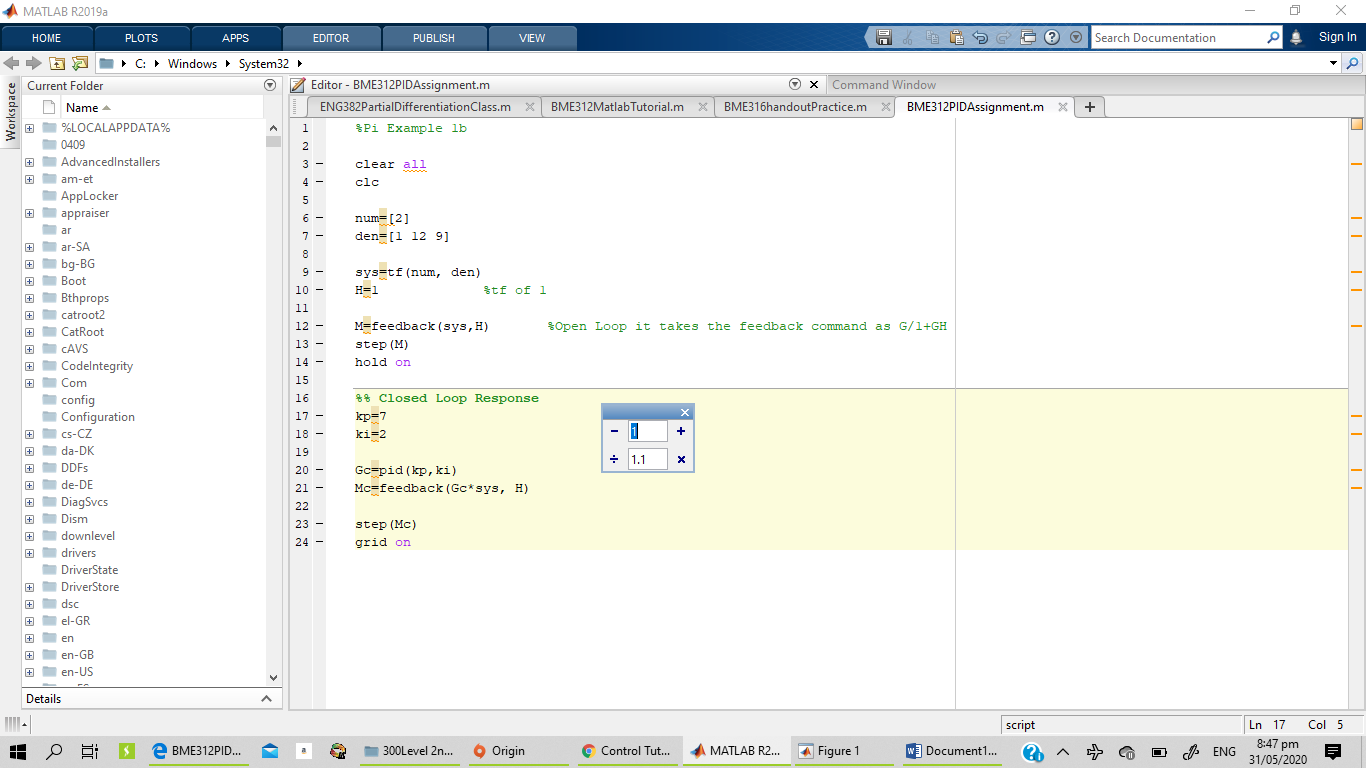
ki=2

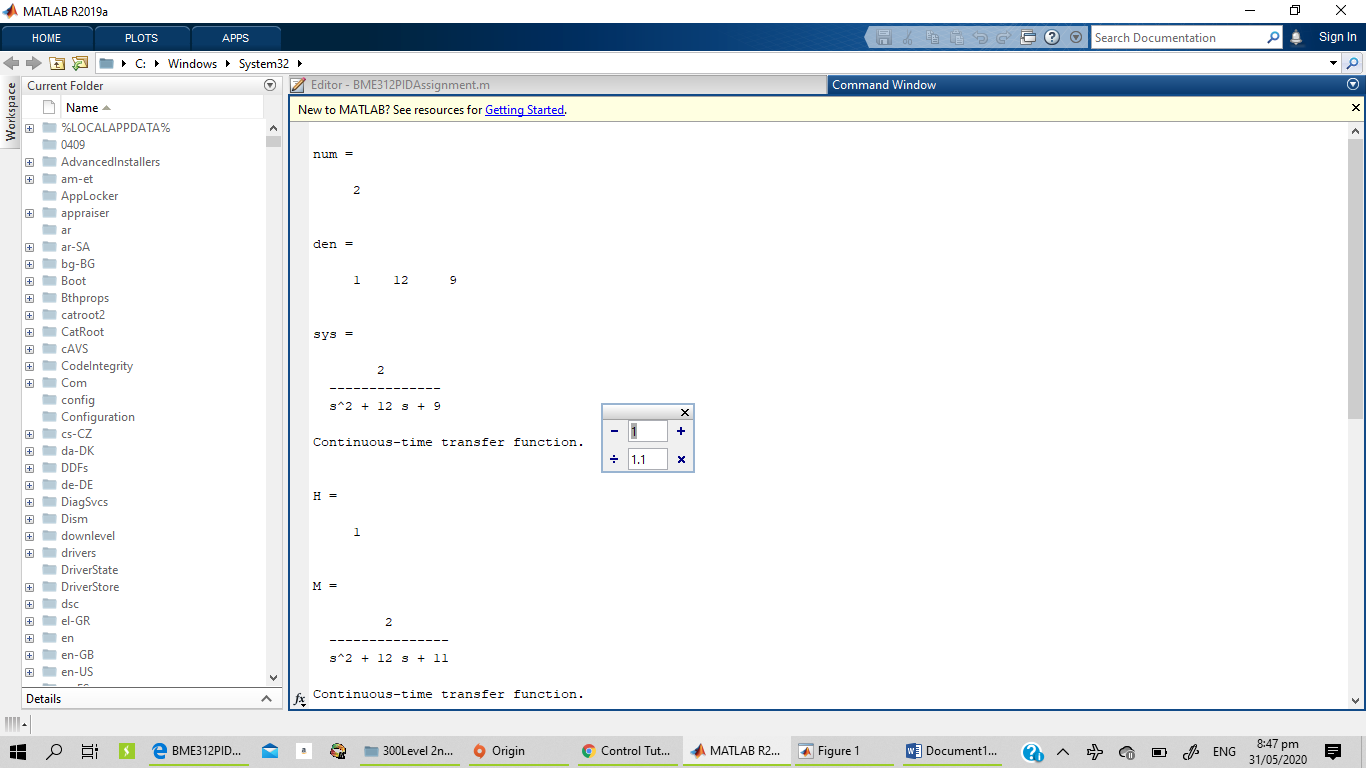
Gc=pid(kp,ki)

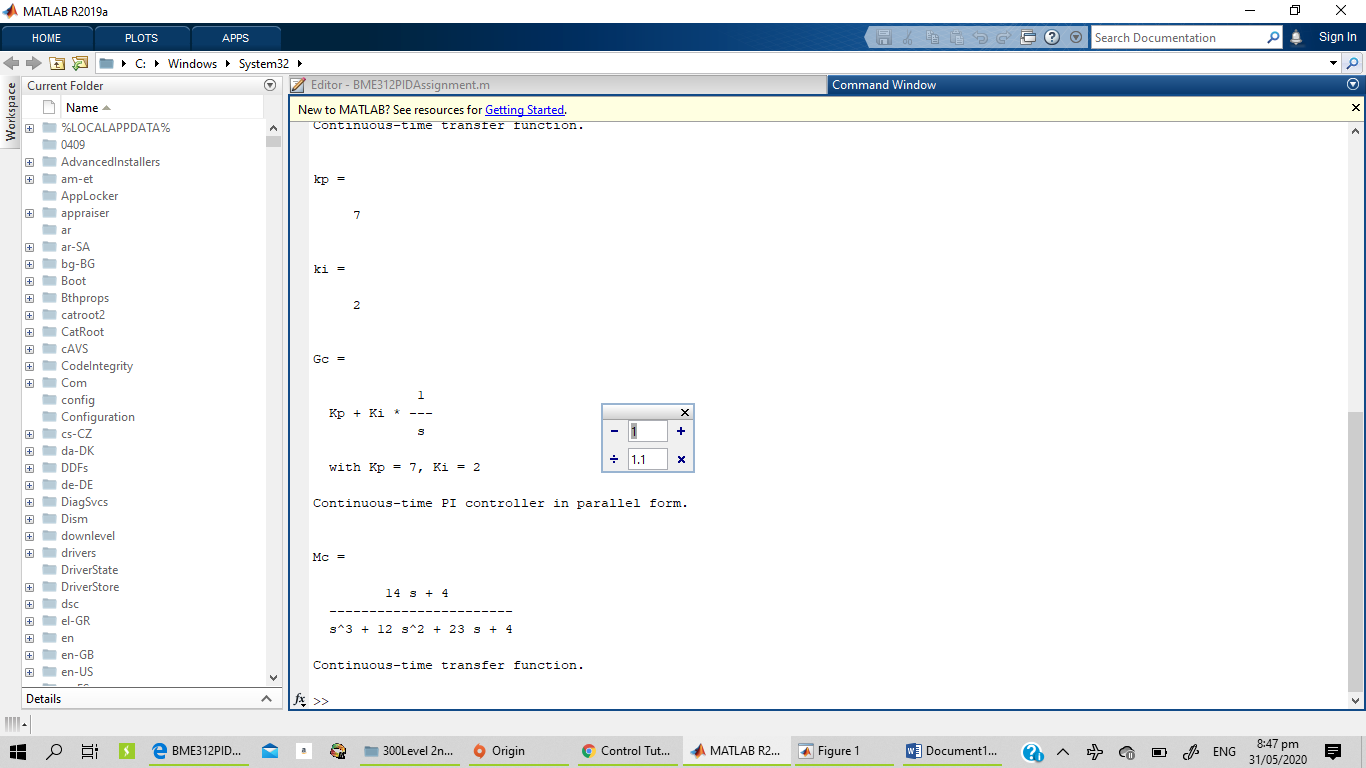
Mc=feedback(Gc\*sys, H)

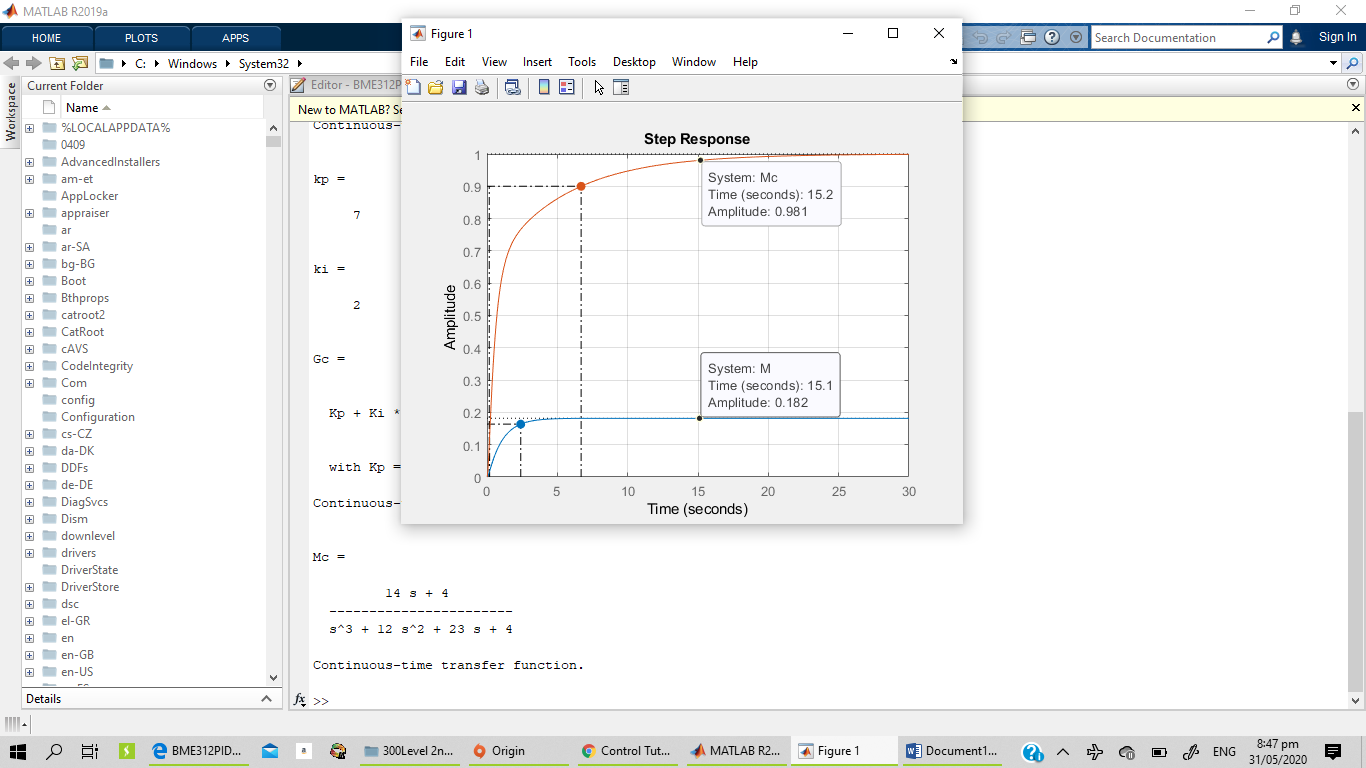
step(Mc)

grid on









%P Example 1b

clear all

clc

num=[2]

den=[1 12 9]

sys=tf(num, den)

H=1 %tf of 1

M=feedback(sys,H) %Open Loop it takes the feedback command as G/1+GH

step(M)

hold on

%% Closed Loop Response

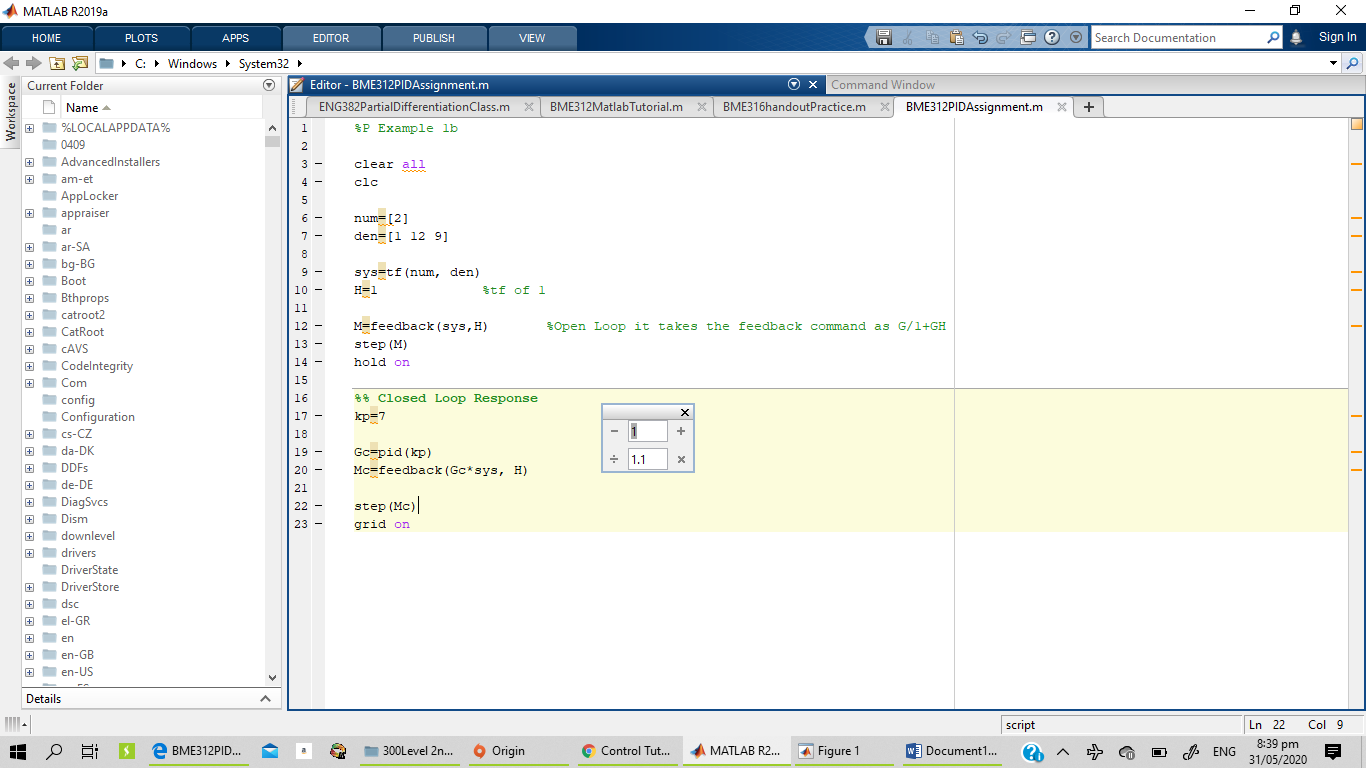
kp=7

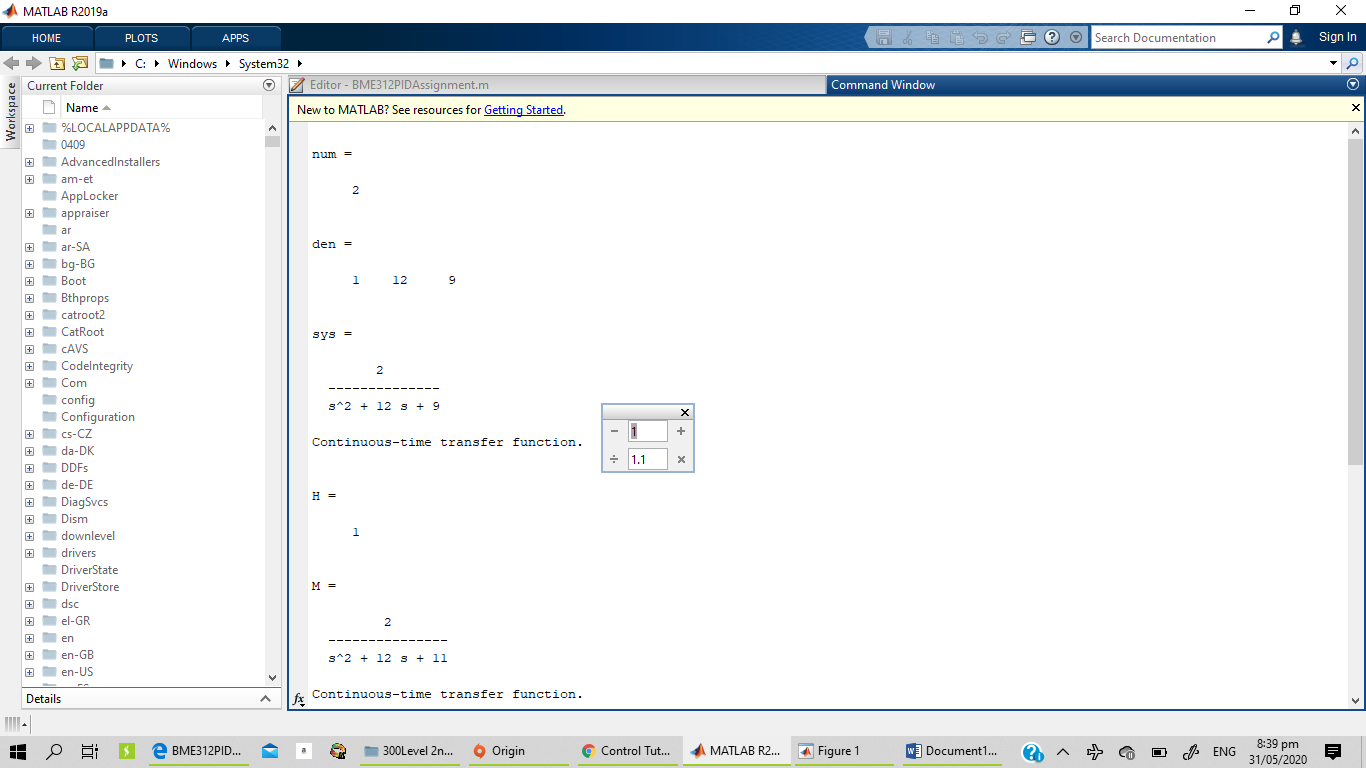
Gc=pid(kp)

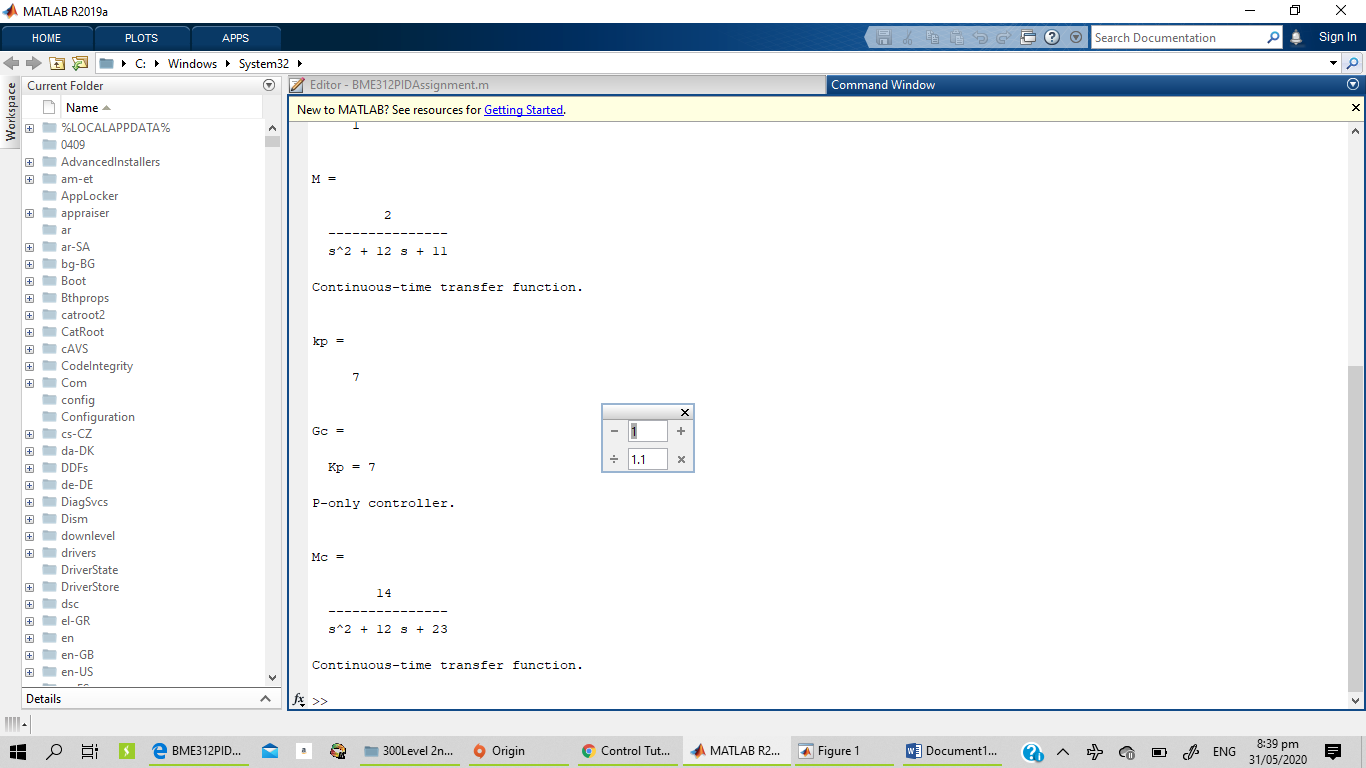
Mc=feedback(Gc\*sys, H)

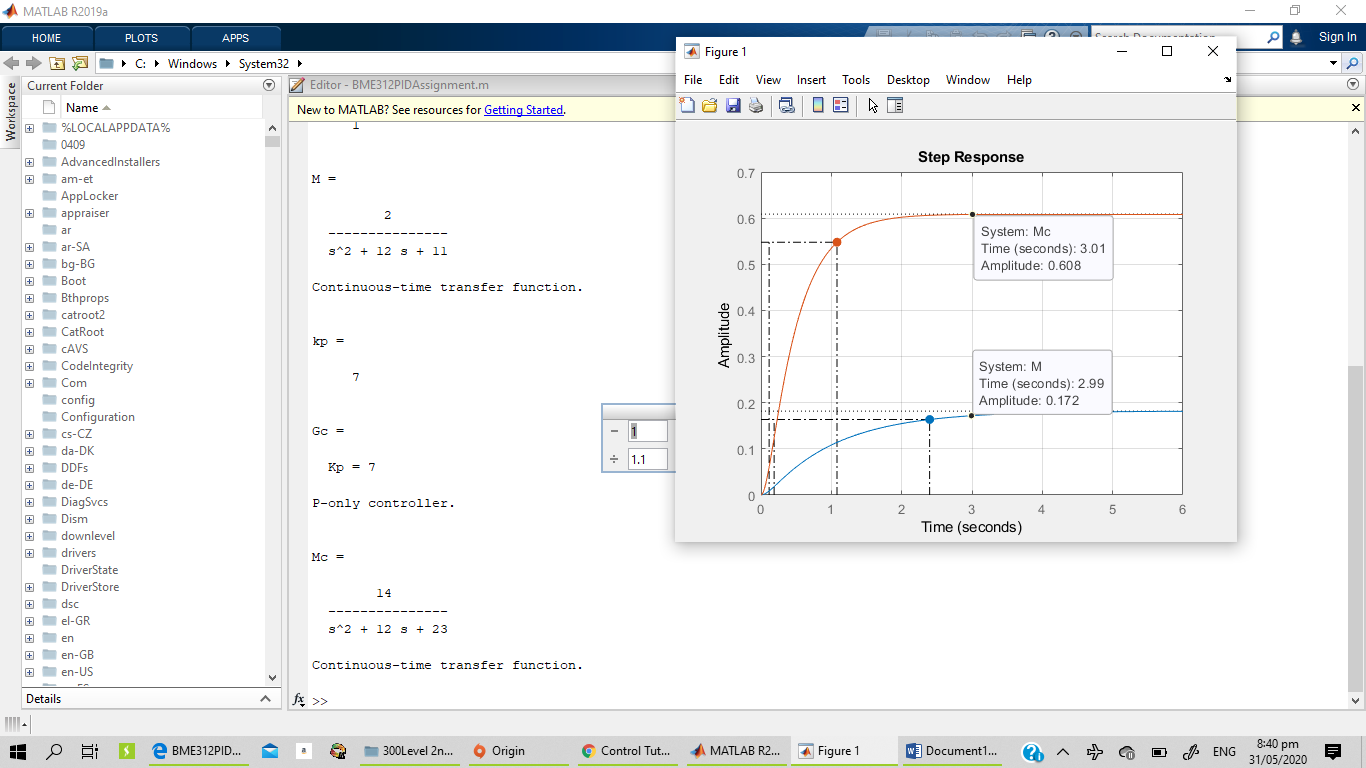
step(Mc)

grid on









%PID Example 1c

clear all

clc

num=[1]

den=[1 14 49]

sys=tf(num, den)

H=1 %tf of 1

M=feedback(sys,H) %Open Loop it takes the feedback command as G/1+GH

step(M)

hold on

%% Closed Loop Response

kp=7

ki=0

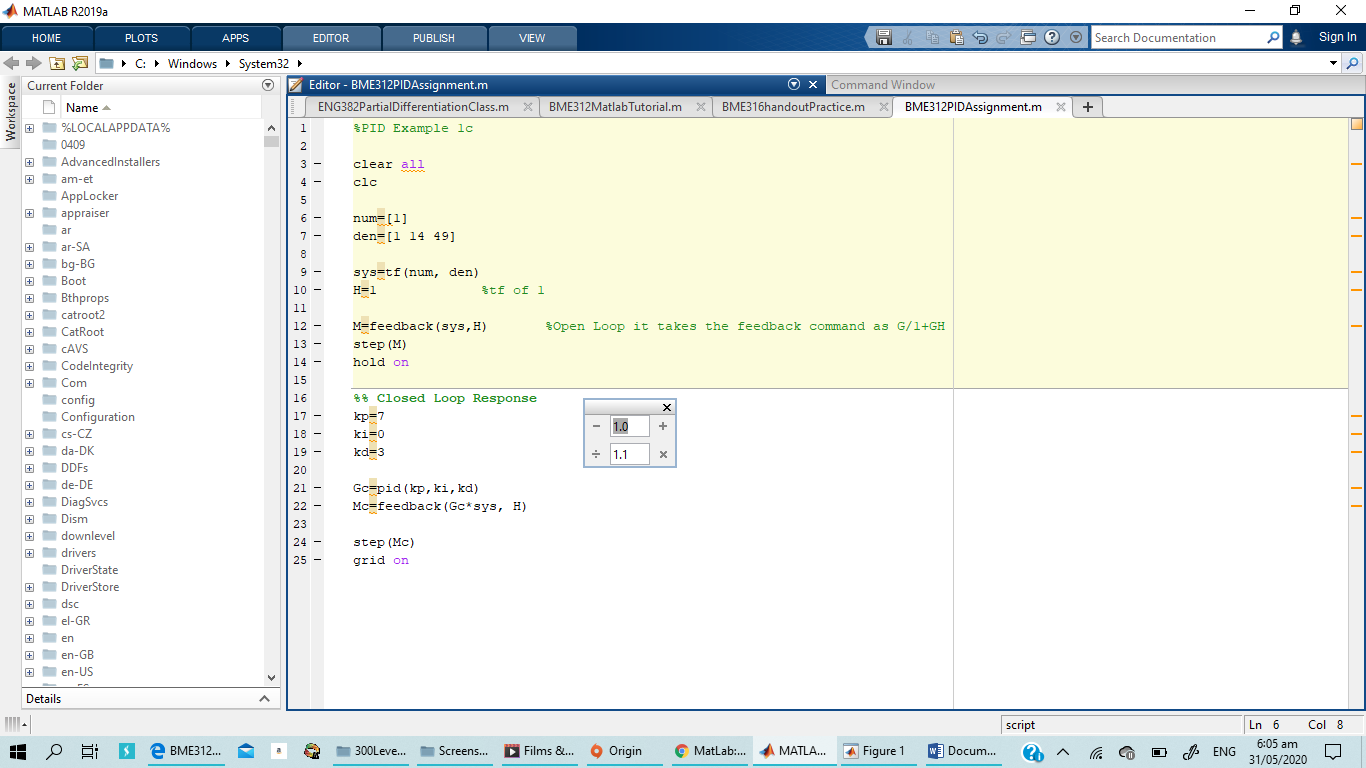
kd=3

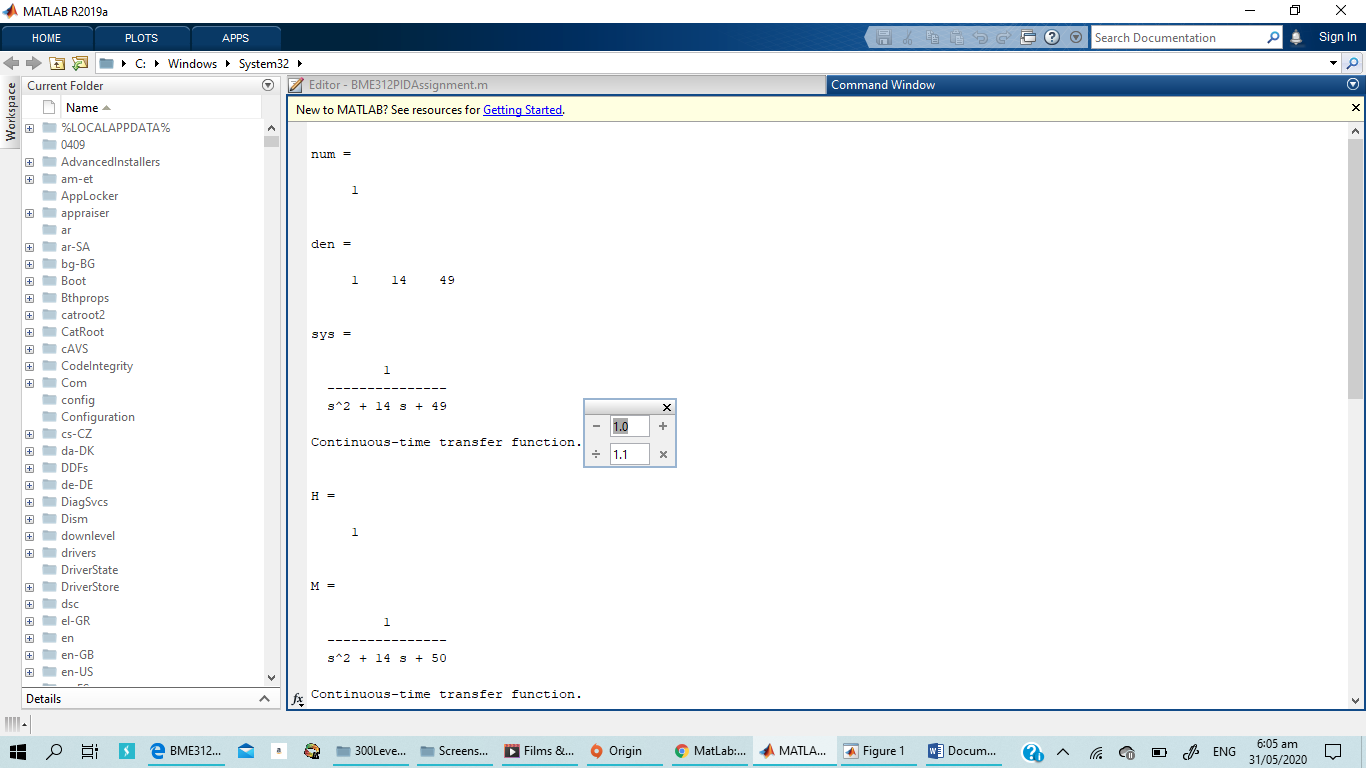
Gc=pid(kp,ki,kd)

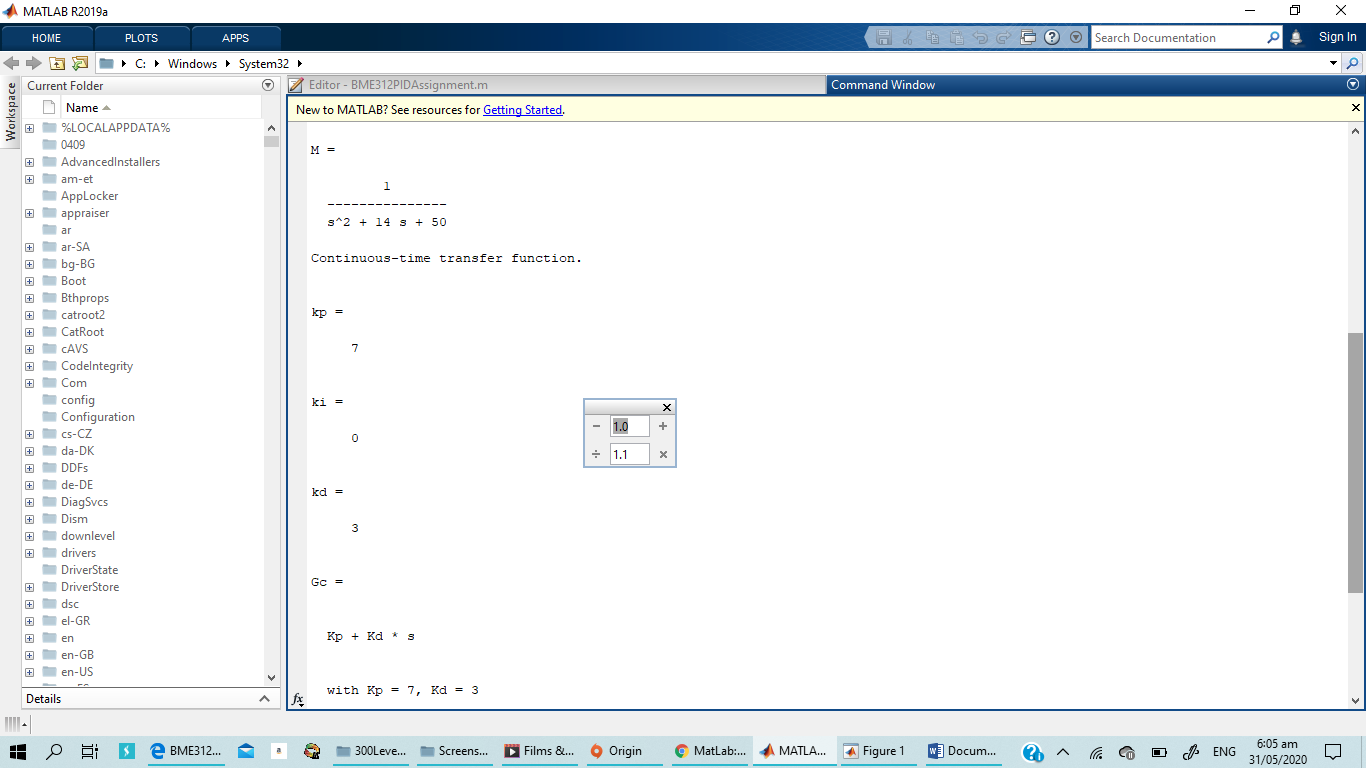
Mc=feedback(Gc\*sys, H)

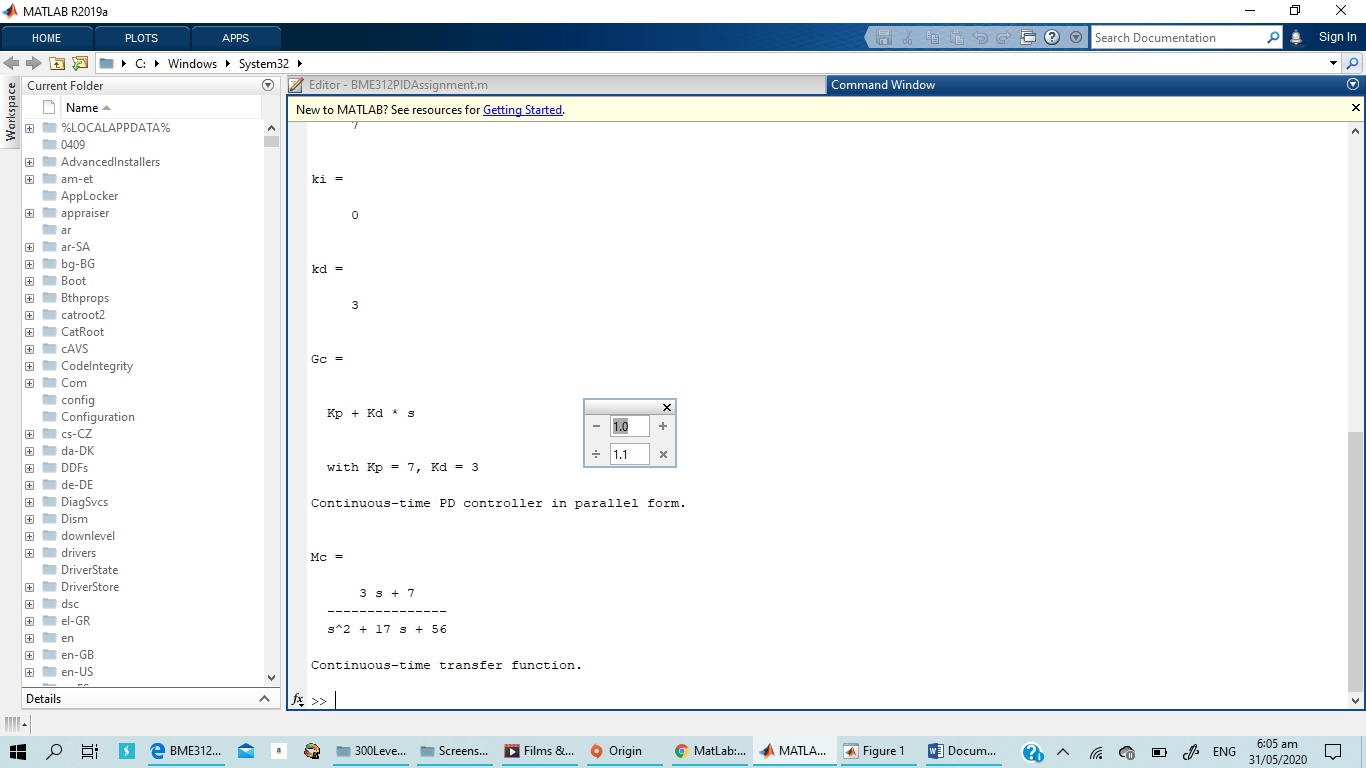
step(Mc)

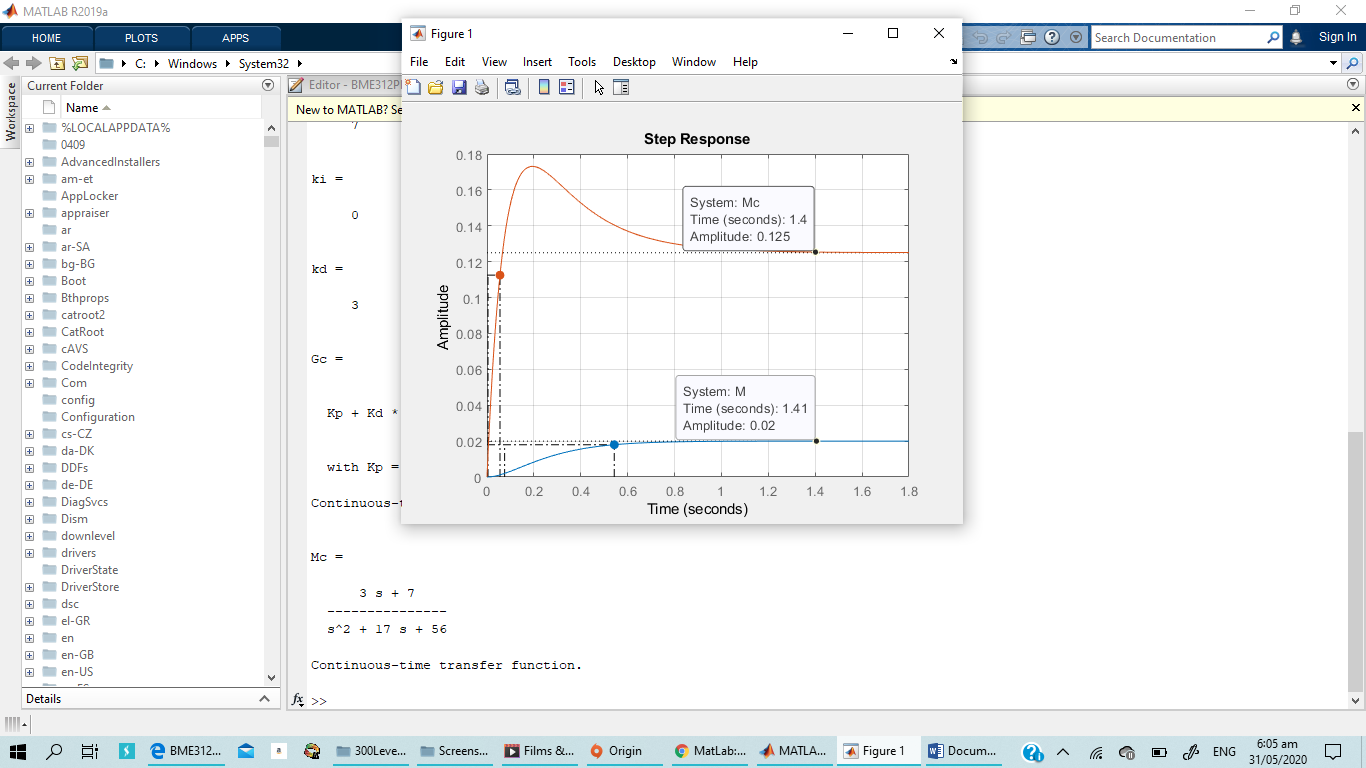
grid on











%PI Example 1c

clear all

clc

num=[1]

den=[1 14 49]

sys=tf(num, den)

H=1 %tf of 1

M=feedback(sys,H) %Open Loop it takes the feedback command as G/1+GH

step(M)

hold on

%% Closed Loop Response

kp=4

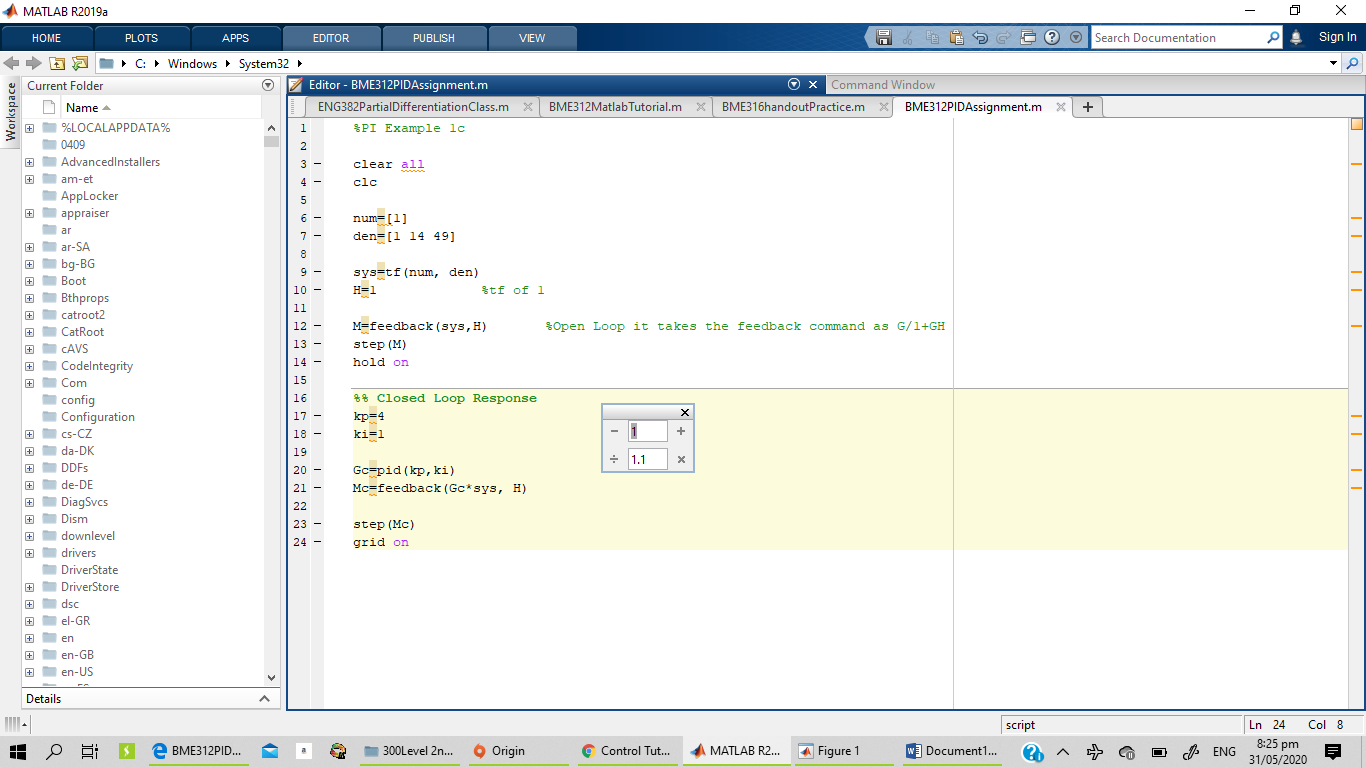
ki=1

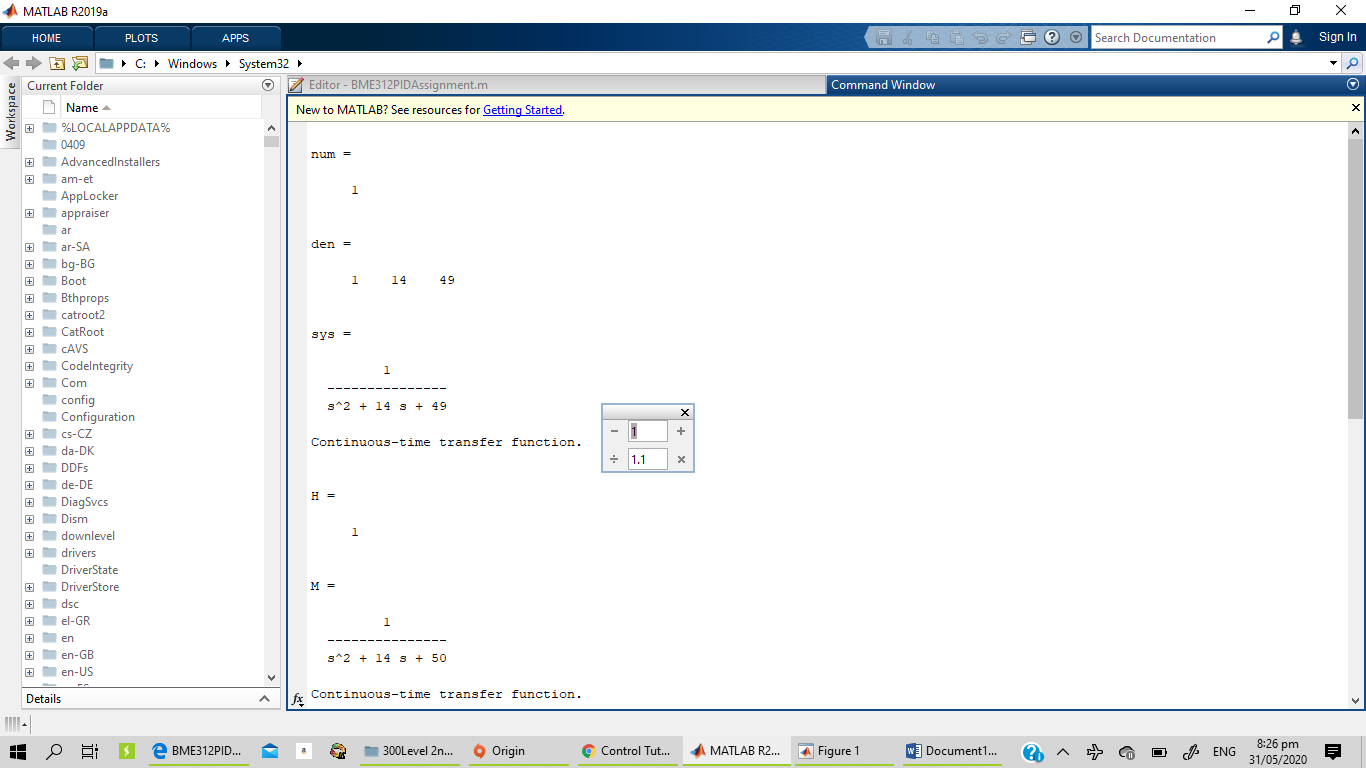
Gc=pid(kp,ki)

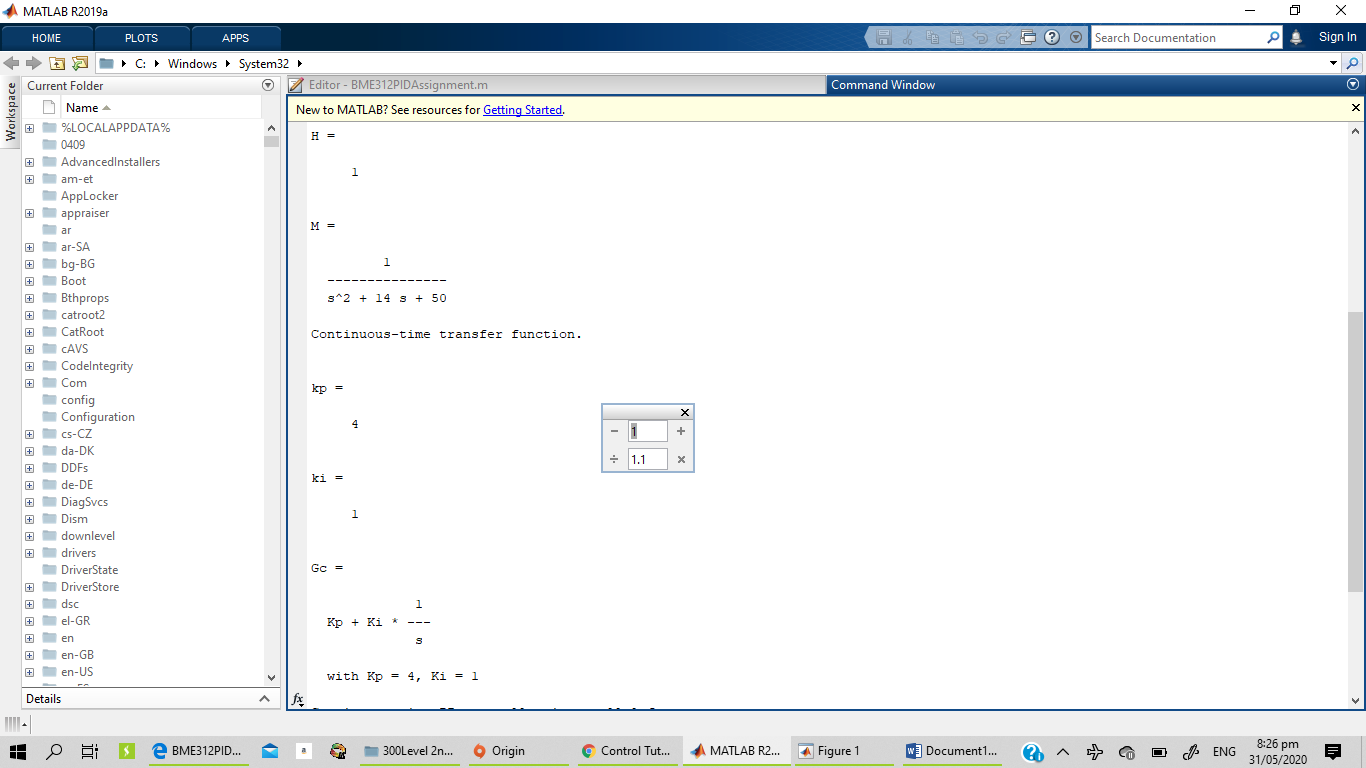
Mc=feedback(Gc\*sys, H)

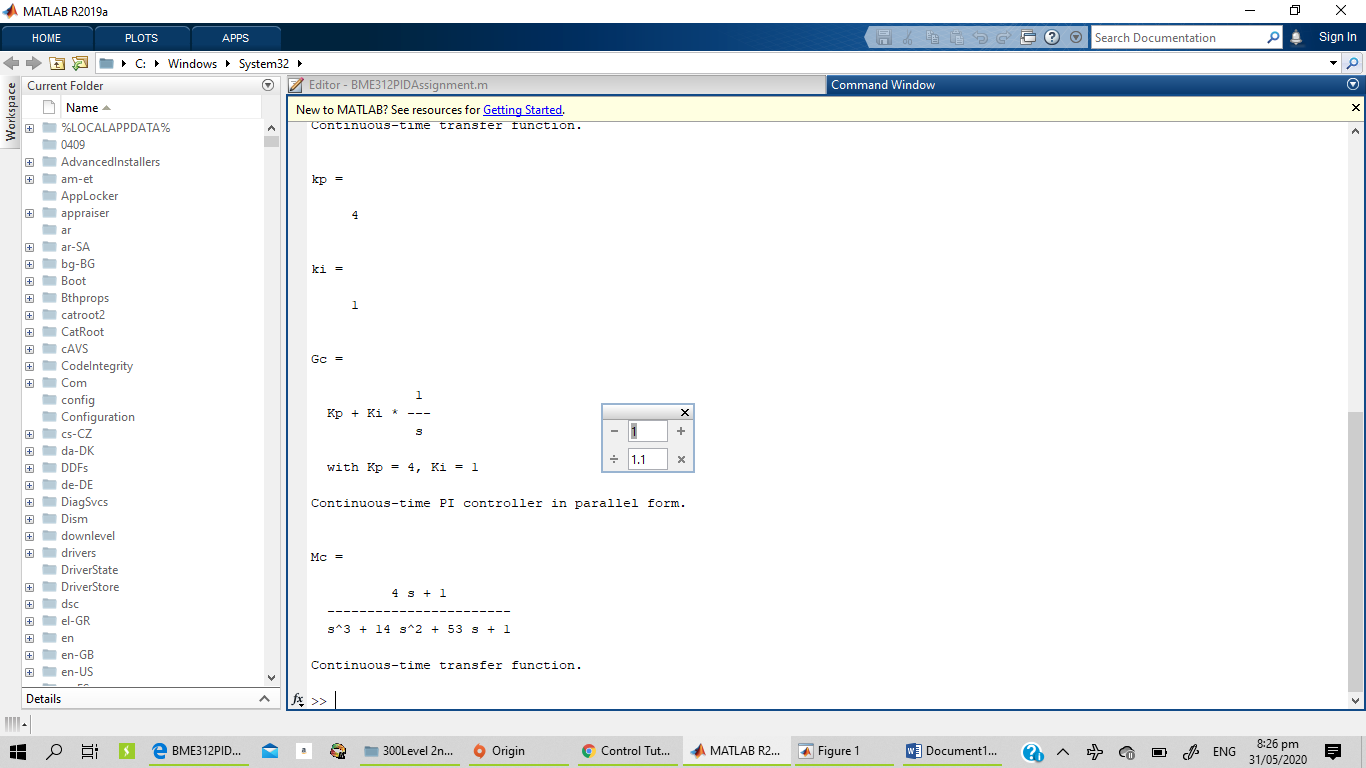
step(Mc)

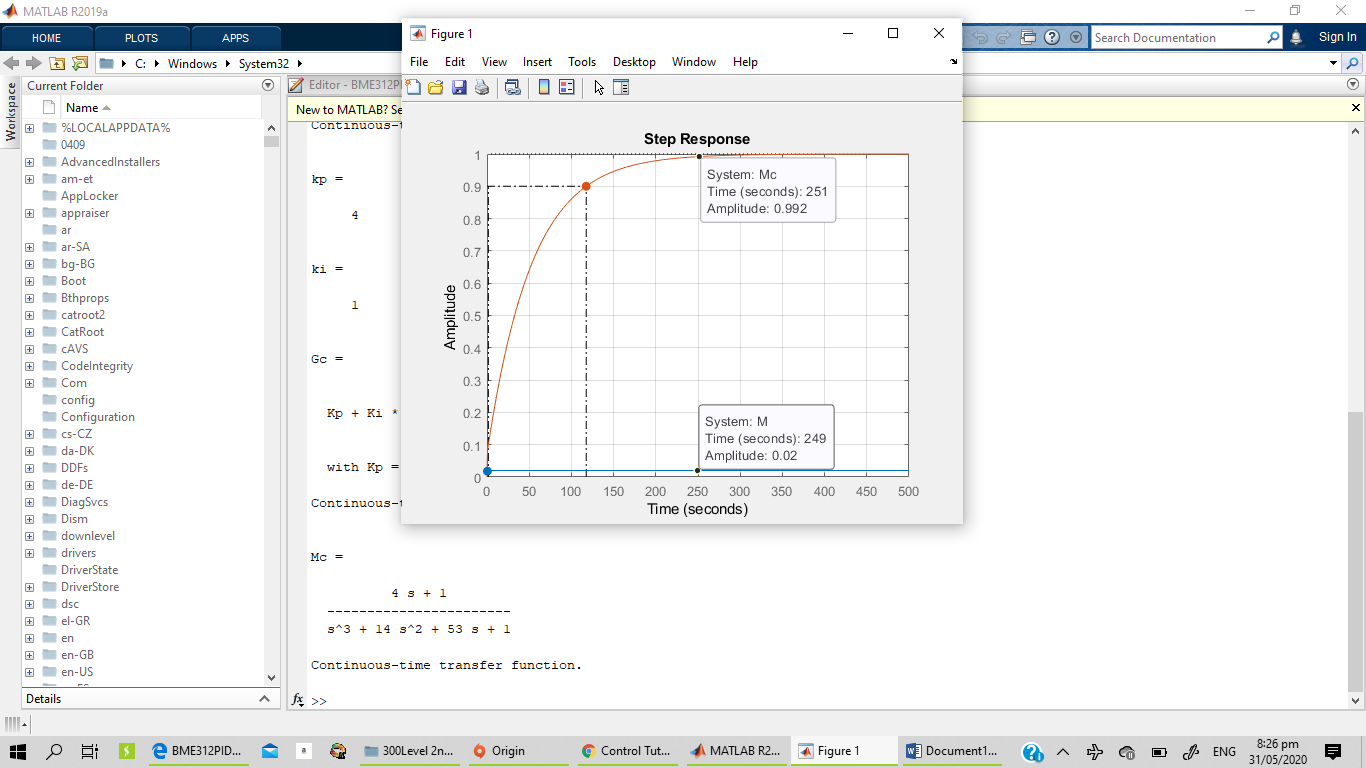
grid on











%P Example 1c

clear all

clc

num=[1]

den=[1 14 49]

sys=tf(num, den)

H=1 %tf of 1

M=feedback(sys,H) %Open Loop it takes the feedback command as G/1+GH

step(M)

hold on

%% Closed Loop Response

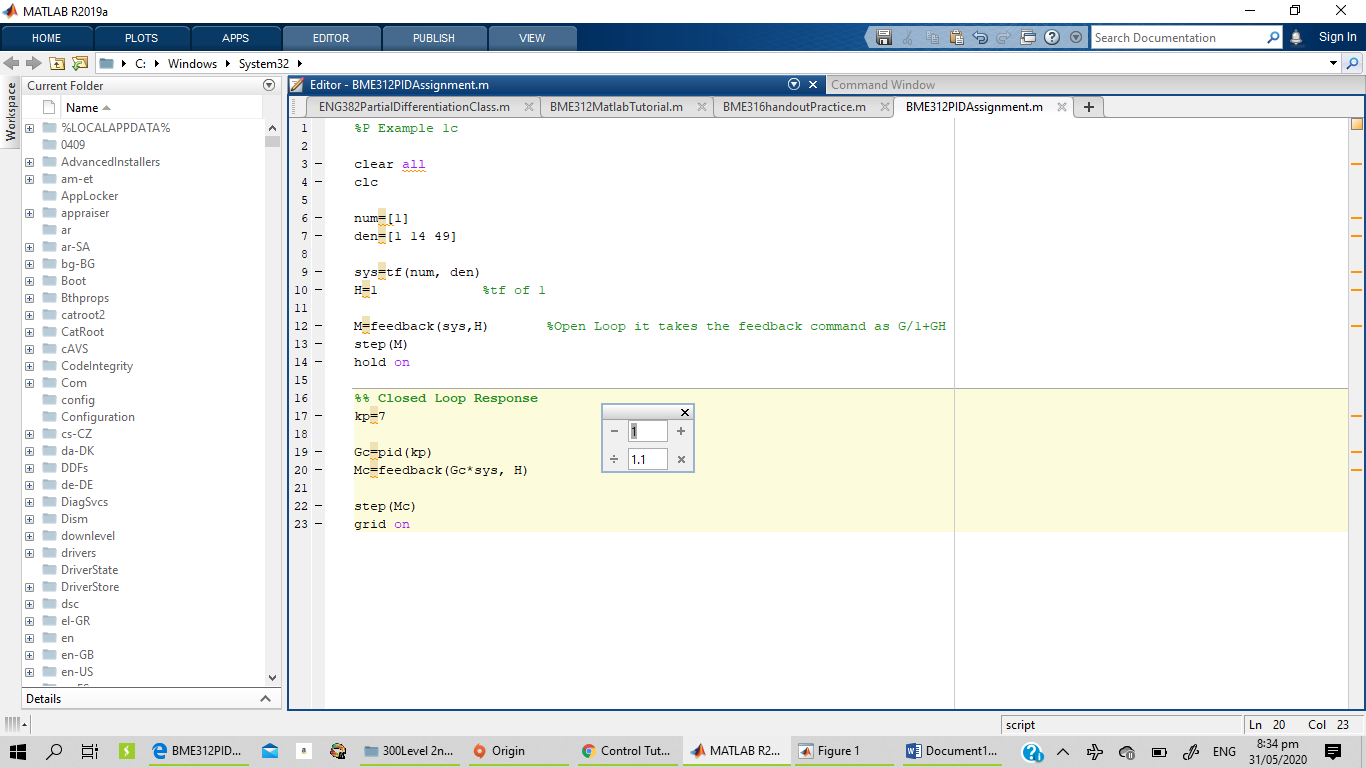
kp=7

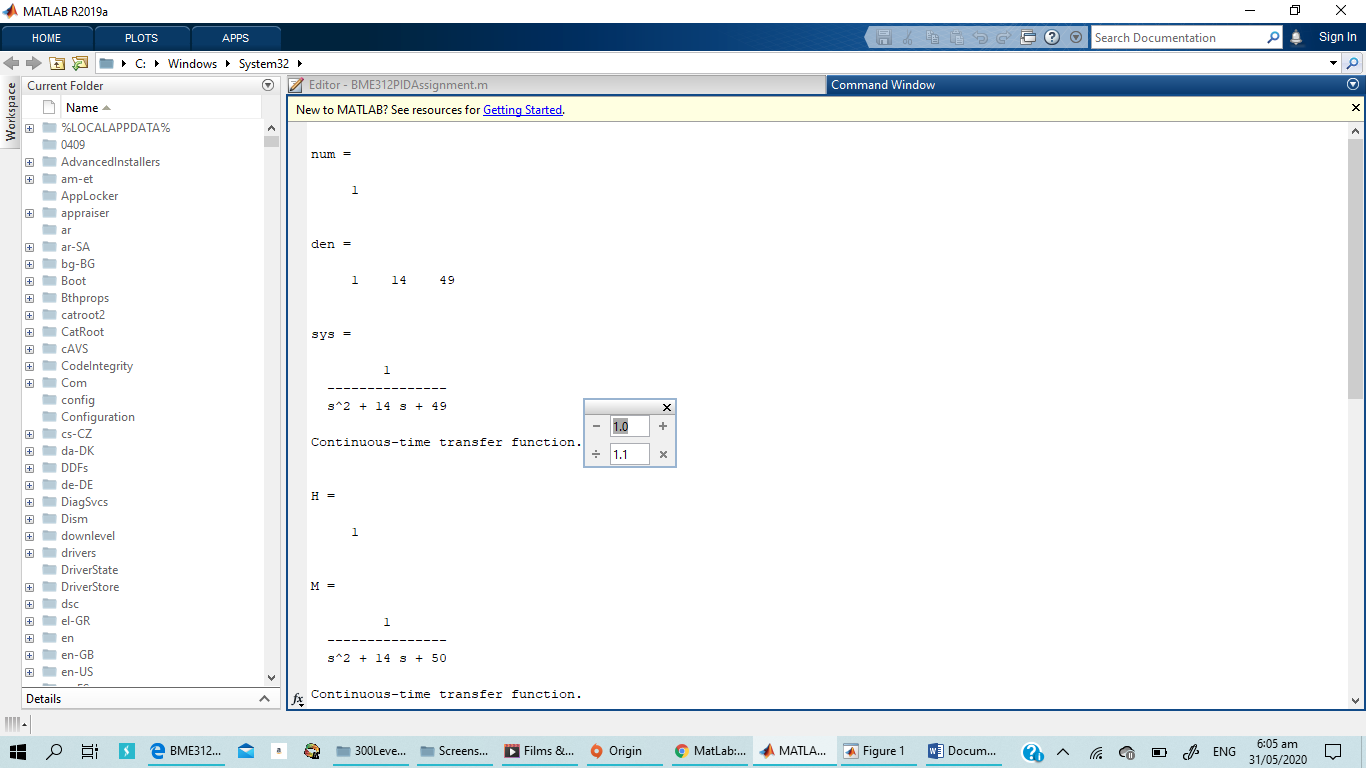
Gc=pid(kp)

Mc=feedback(Gc\*sys, H)

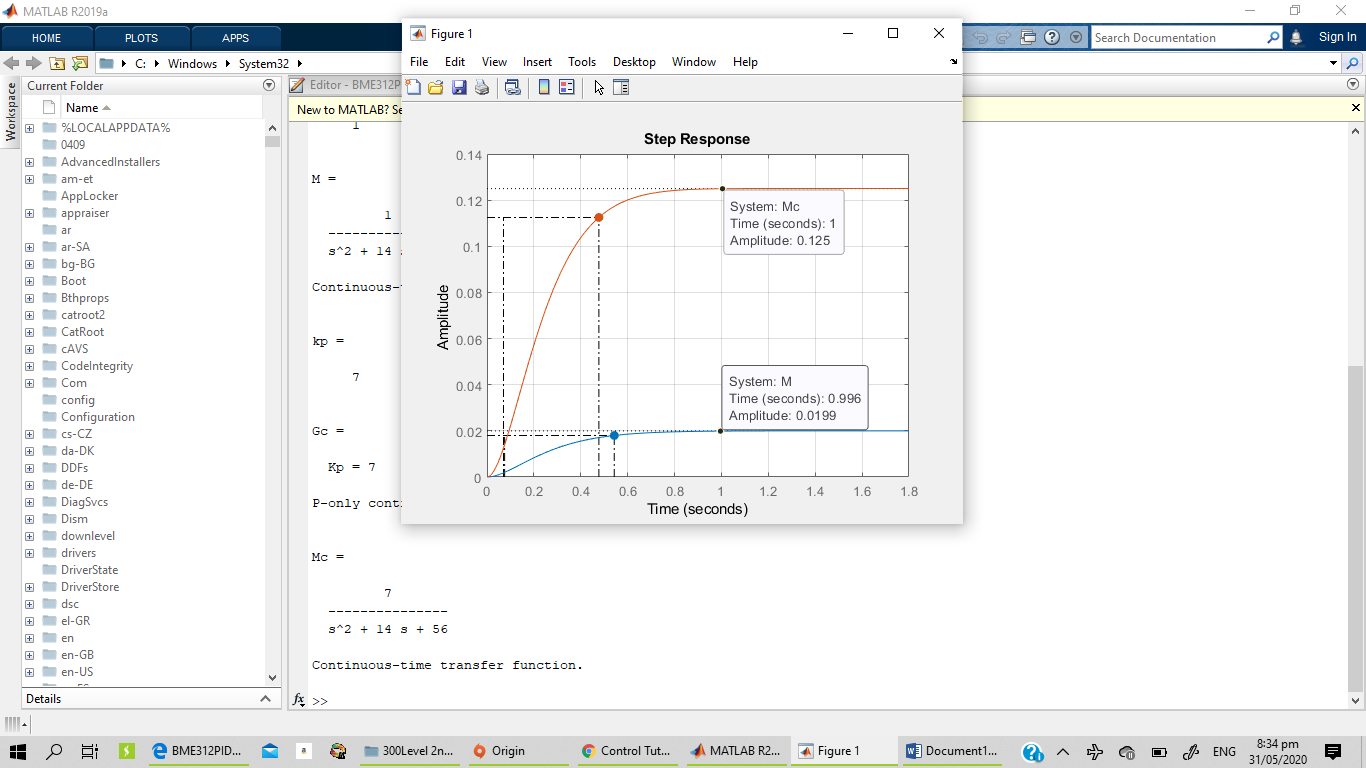
step(Mc)

grid on









OBSERVATION

* I observed that during my simulation the increase of kp, ki, kd in the simulation changes the graph
* During the PID simulation, I observed that increasing in kp can make it get to overshoot

QUESTION 2

SIMC Tuning Method

%SIMC TUNING Question 2a

clear all

clc

num=[1]

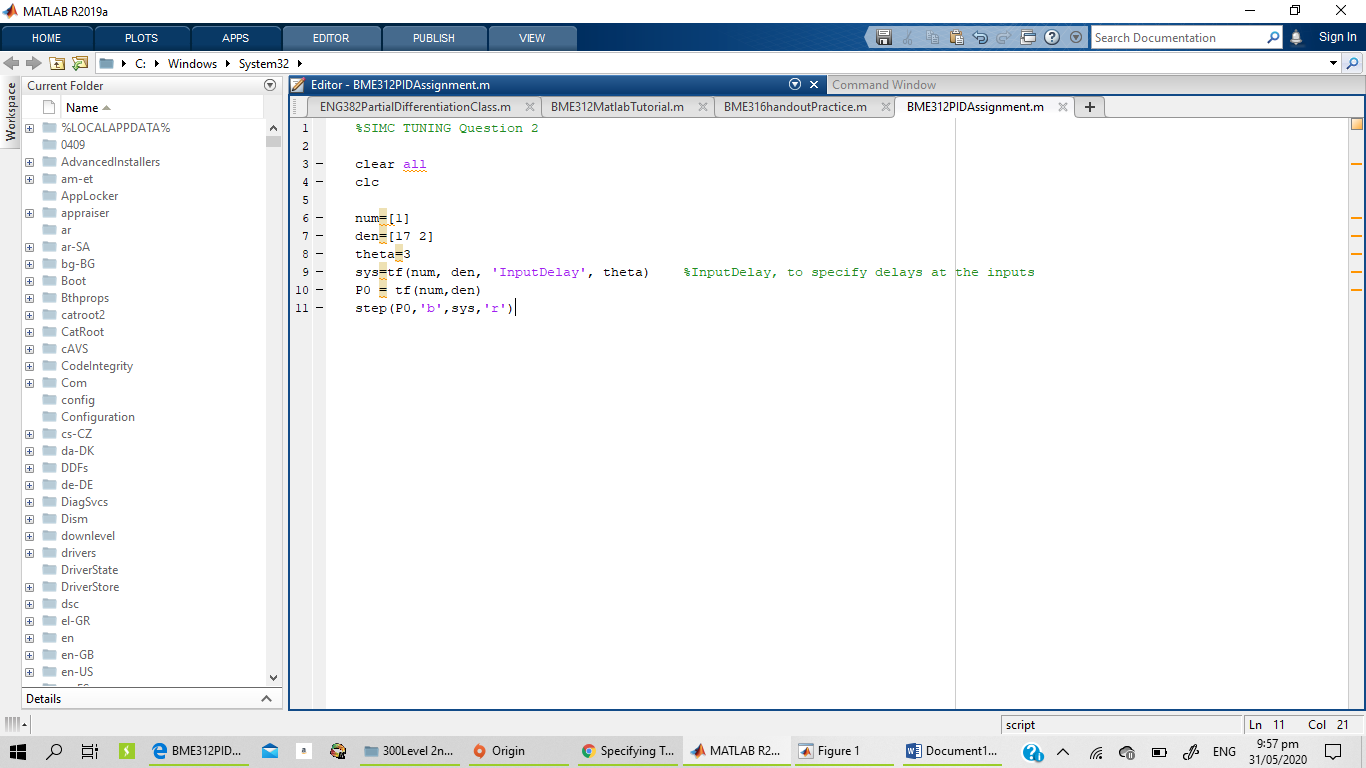
den=[17 2]

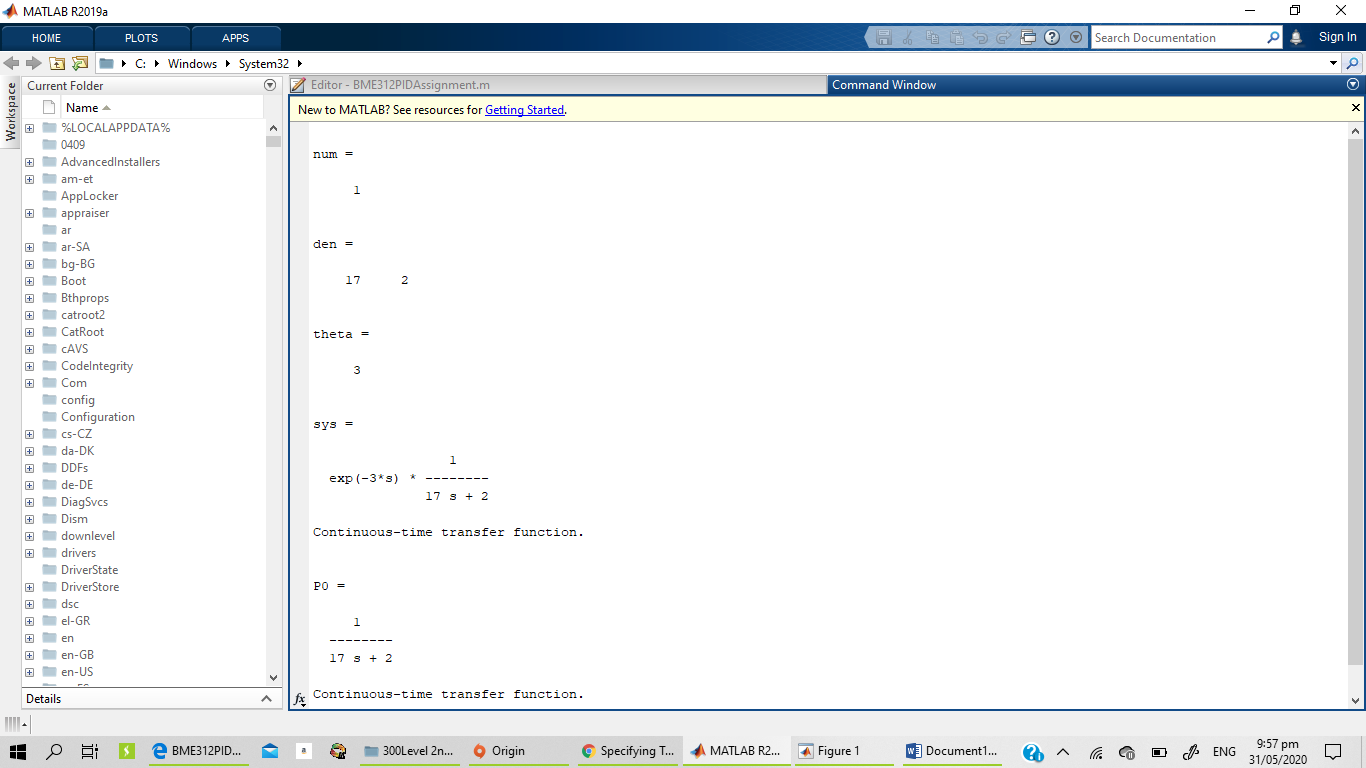
theta=3

sys=tf(num, den, 'InputDelay', theta) %InputDelay, to specify delays at the inputs

P0 = tf(num,den)

step(P0,'b',sys,'r')





%SIMC TUNING Question 2b

clear all

clc

num=[2]

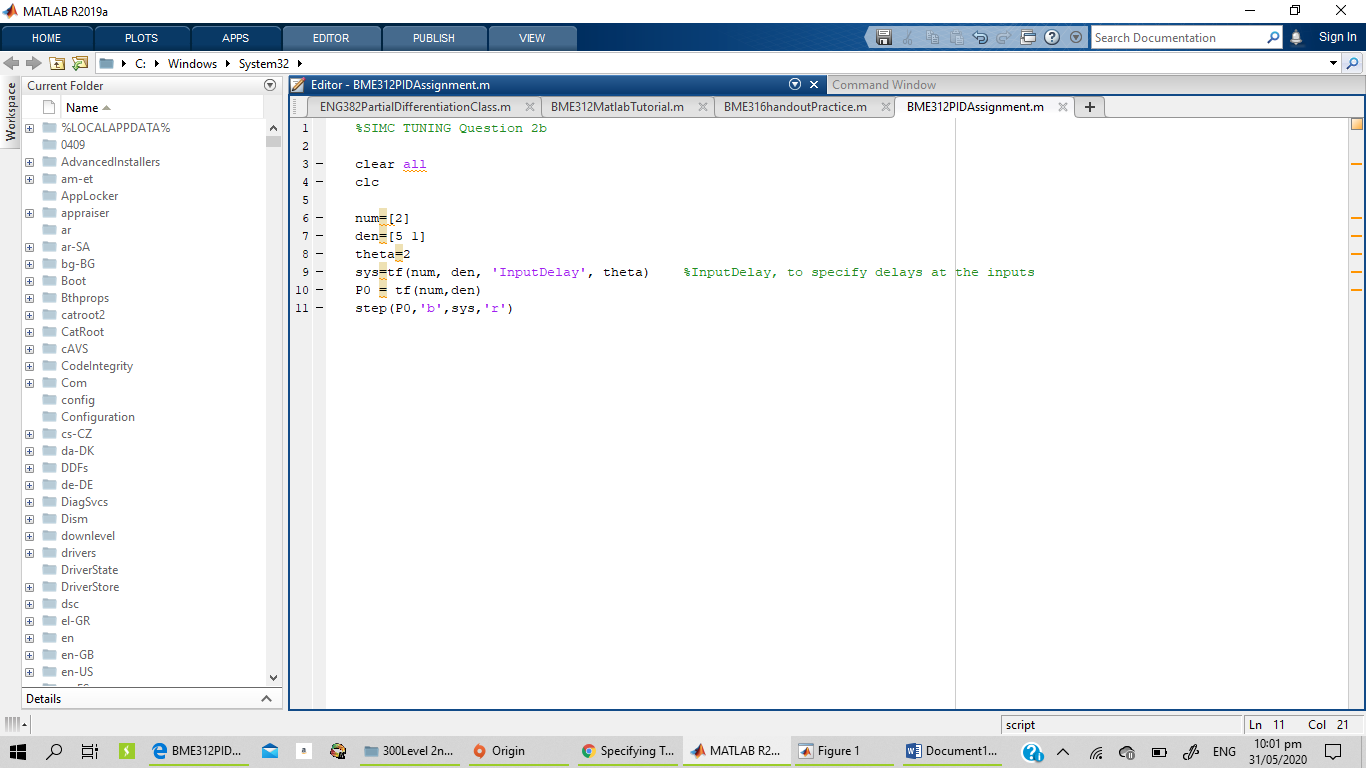
den=[5 1]

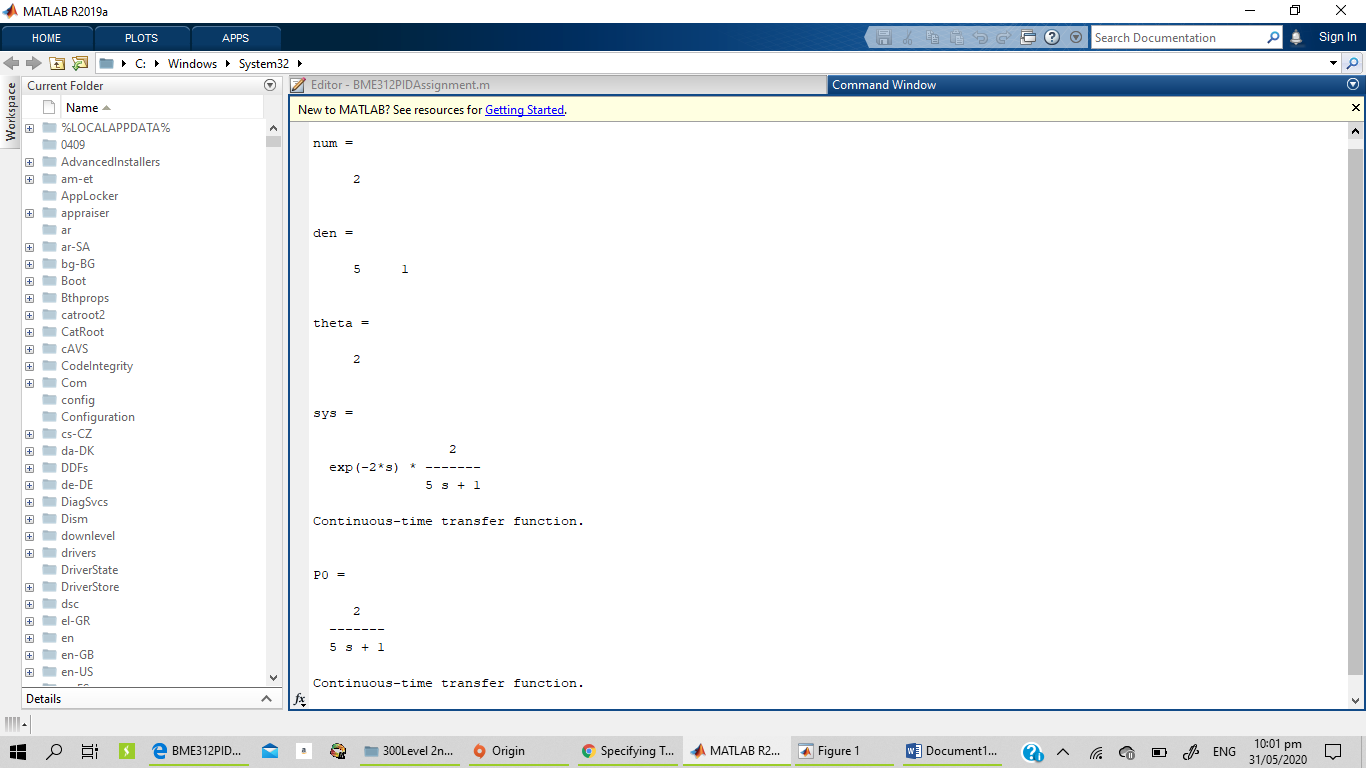
theta=2

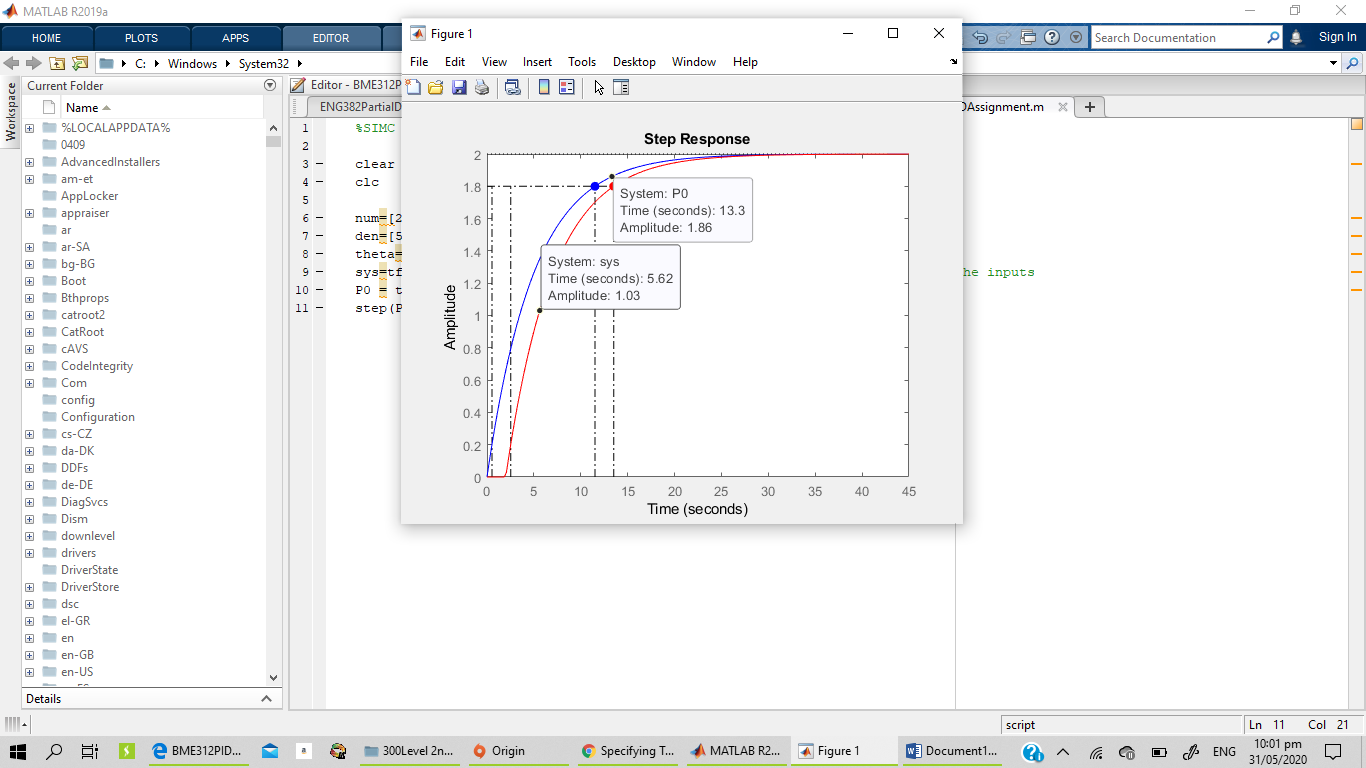
sys=tf(num, den, 'InputDelay', theta) %InputDelay, to specify delays at the inputs

P0 = tf(num,den)

step(P0,'b',sys,'r')







OBSERVATION

* I observed that the rising time between the two are different