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DEPARTMENT: Biomedical Engineering

COURSE CODE: BME312

COURSE TITLE: Biological System of Control and Modelling

**EXERCISE 4.8**

*Question*

(Drug administration) The metabolism of alcohol in the body can be modelled by the nonlinear compartment model

where Vb = 48 L and Vl = 0.6 L are the apparent volumes of distribution of body water and liver water, cb and cl are the concentrations of alcohol in the compartments, qiv and qgi are the injection rates for intravenous and gastrointestinal intake, q = 1.5 L/min is the total hepatic blood ﬂow, qmax = 2.75 mmol/min and c0 = 0.1 mmol/L. Simulate the system and compute the concentration in the blood for oral and intravenous doses of 12 g and 50 g of alcohol.

*Codes*

commandwindow

clear

clc

syms cb(t)

syms ci(t)

q=1.5

vb=48

vi=0.6

c0=0.1

ci= 50 %tried converting it to mmol/L but there is nothing like that

cb= 12

qmax=2.75

qiv=50 %do not know the value to put for it

qgi=12 %do not know the value to put for it

ode=diff(cb,t)==(q\*ci)/vb-(q\*cb)/vb+(qiv/vb)

ode1=diff(cb,t)==(q\*cb)/vi- (ci\*((q/vi)+((qmax\*vi)/(c0-ci)))+(qgi/vi))

plot(ode, ode1) %seriously do not know what to plot against what

*Result*

q =

1.5000

vb =

48

vi =

0.6000

c0 =

0.1000

ci =

50

cb =

12

qmax =

2.7500

qiv =

50

qgi =

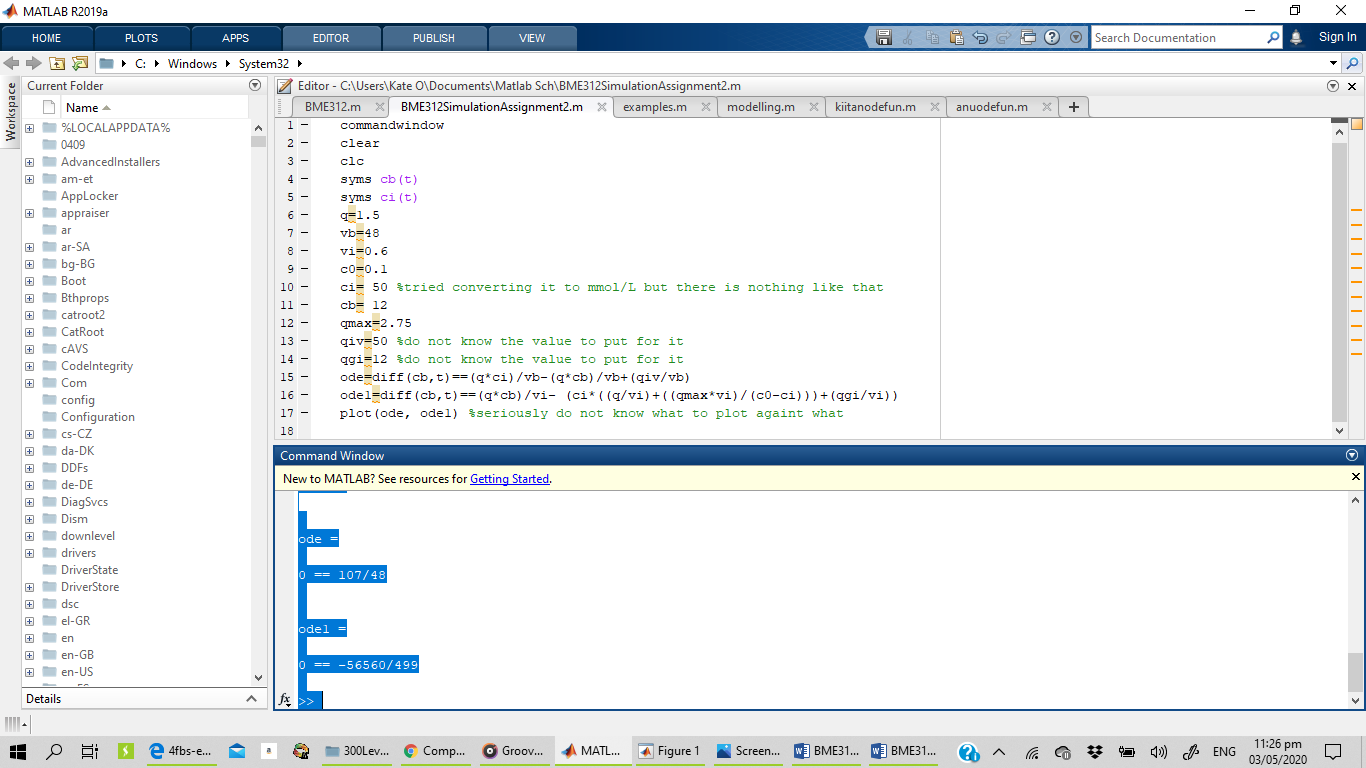
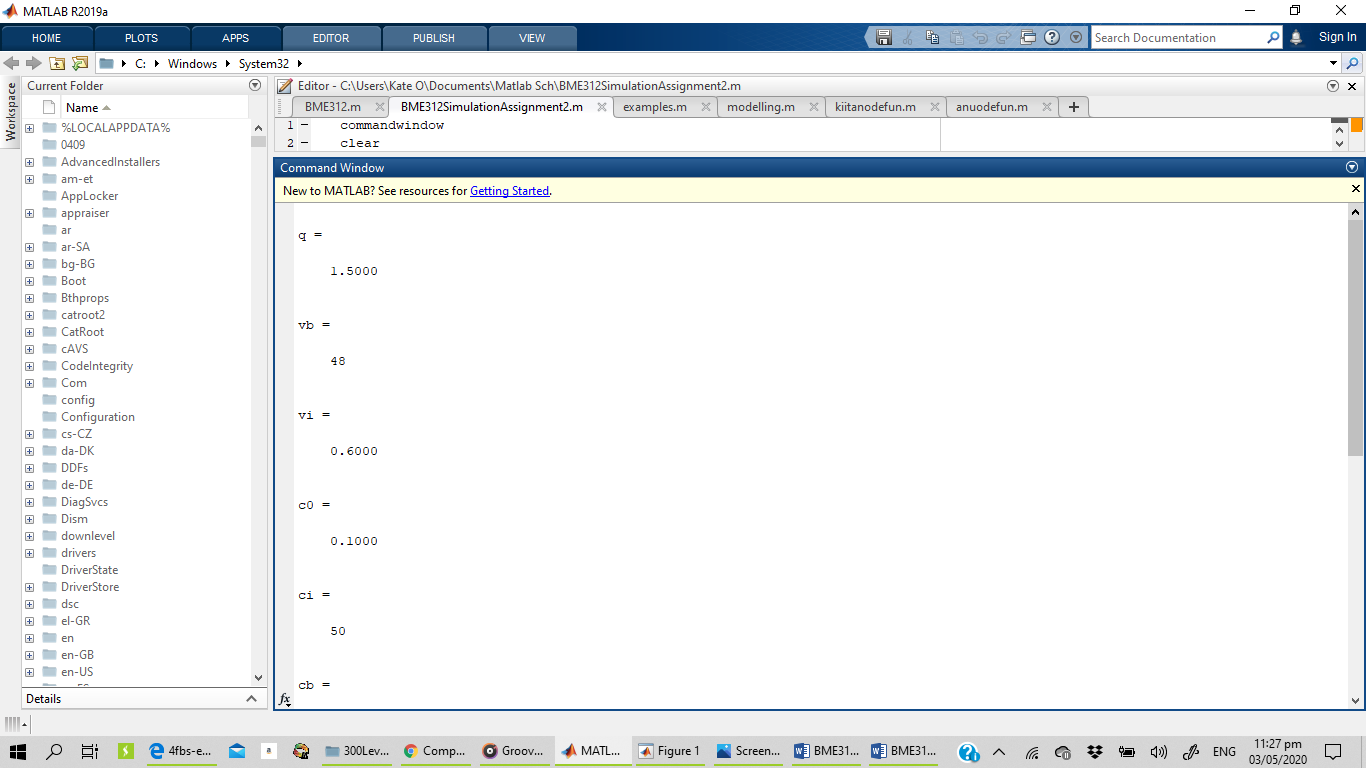
12

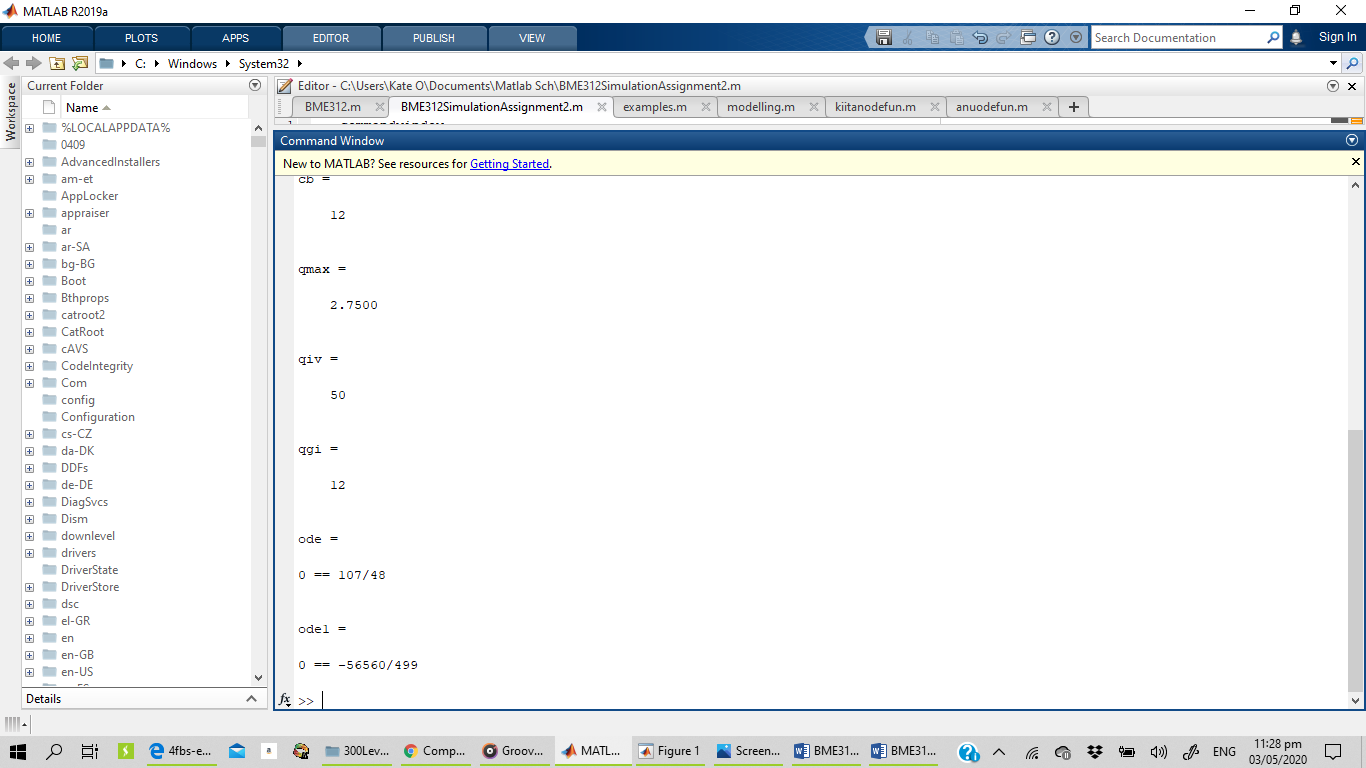
ode =

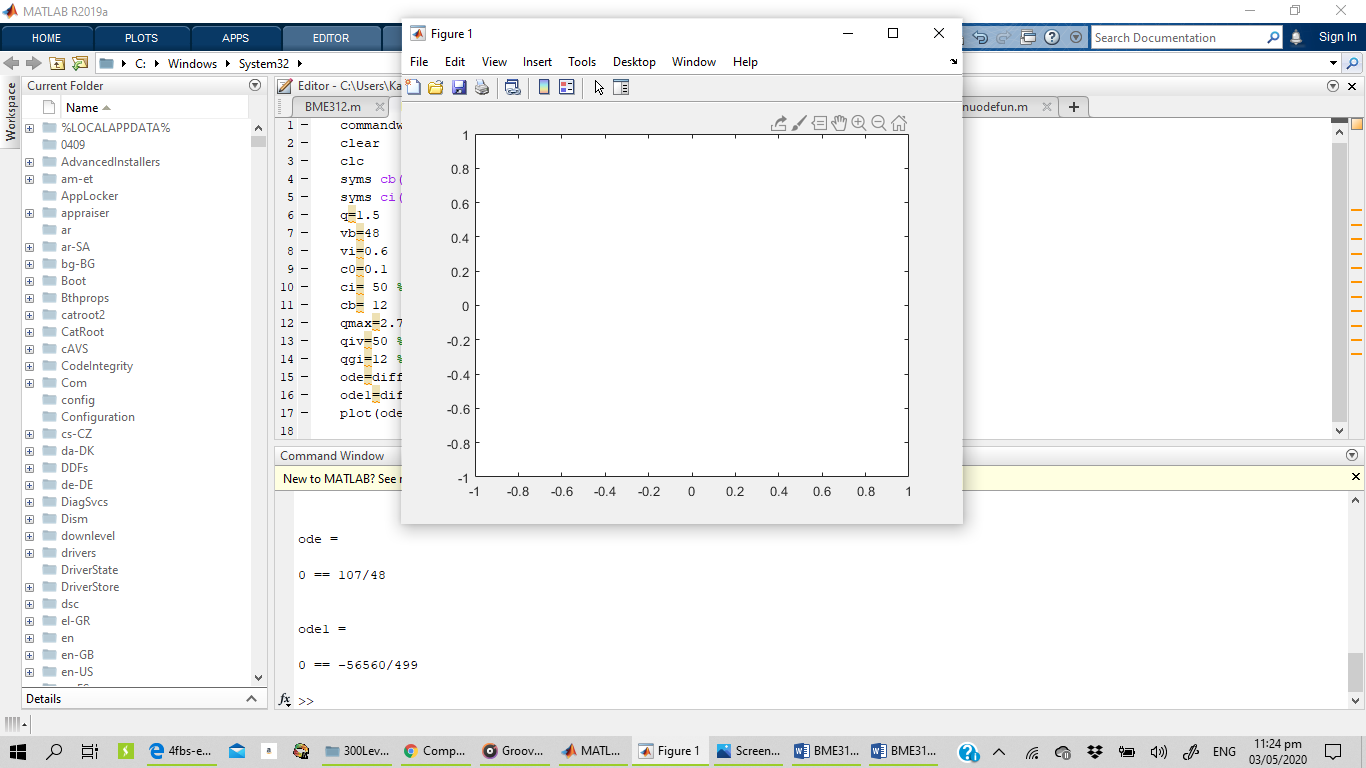
0 == 107/48

ode1 =

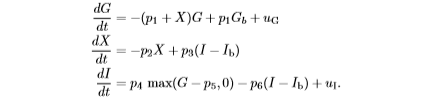
0 == -56560/499







**Exercise 4.9**

(Insulin-glucose dynamics) The following model for insulin glucose dynamics by Gaetano and colleagues [GMGM05] has three states: glucose concentration in the blood plasma G [mg/dL], insulin concentration in the interstitial ﬂuid I [µUI/ml], and X [min−1] that represents the increased removal rate of glucose due to insulin. The state X is proportional to the concentration of interstitial insulin. The dynamics are: dG dt =−(p1 + X)G + p1Gb + uG dX dt =−p2X + p3(I −Ib) dI dt = p4 max(G−p5,0)−p6(I −Ib)+uI. Use the parameters

Simulate the system with the initial conditions G(0) = 300, I(0) = 100 and X(0) = 0. This corresponds to a person having taken a large initial dose of glucose.

*Codes*

commandwindow

clear

clc

syms G(t)

syms X(t)

syms I(t)

Gb=87;

Ib=37.9

P1=0.05

P2=0.5

P3=10^(-4)

P4=10^(-5)

P5=150

P6=0.05

P7=199

G=300

I=100

X=0

Ug=diff(G,t)+((P1+X)\*G)-(P1\*Gb)

ode2=diff(X,t)==(-P2\*X)+(P3\*(I-Ib))

Ui=diff(I,t)-(P4\*(G-P5))-(P6\*(I-Ib))

*Result*

Ib =

37.9000

P1 =

0.0500

P2 =

0.5000

P3 =

1.0000e-04

P4 =

1.0000e-05

P5 =

150

P6 =

0.0500

P7 =

199

G =

300

I =

100

X =

0

Ug =

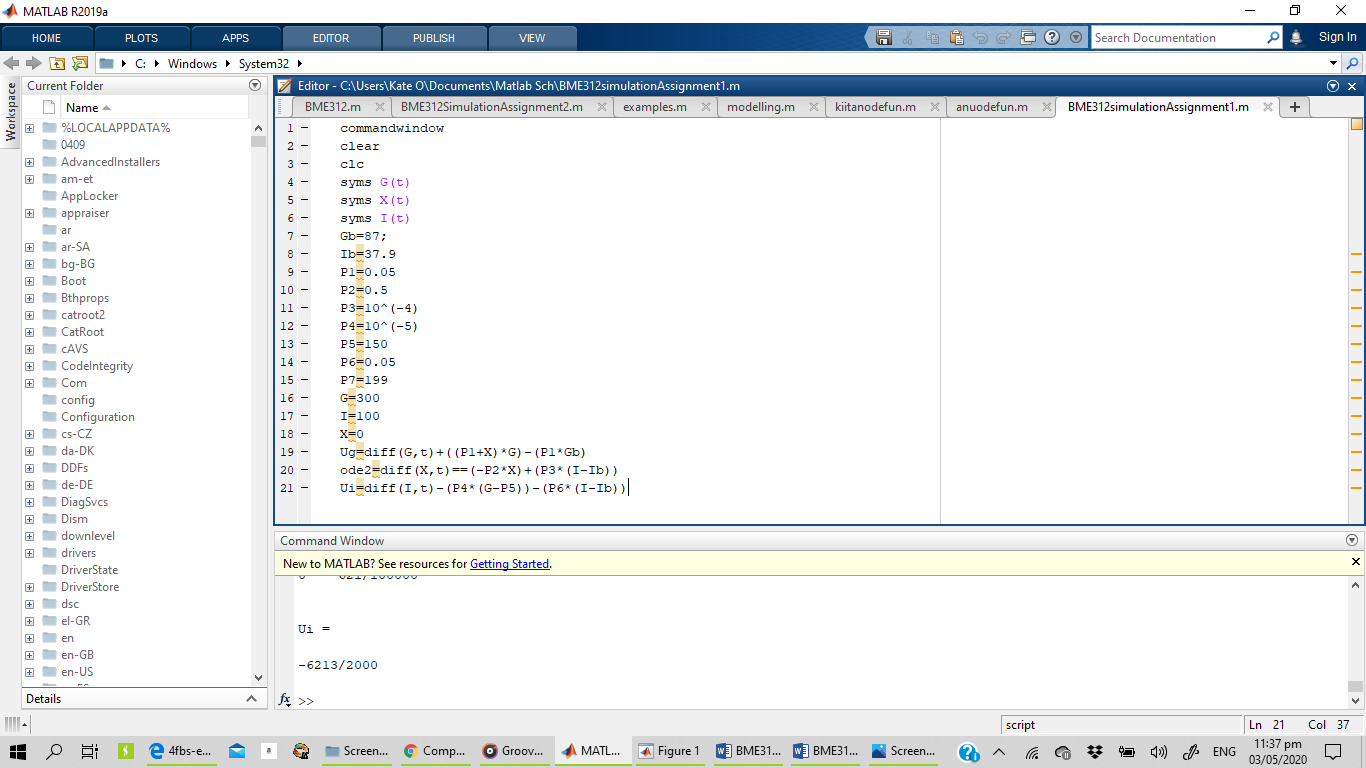
213/20

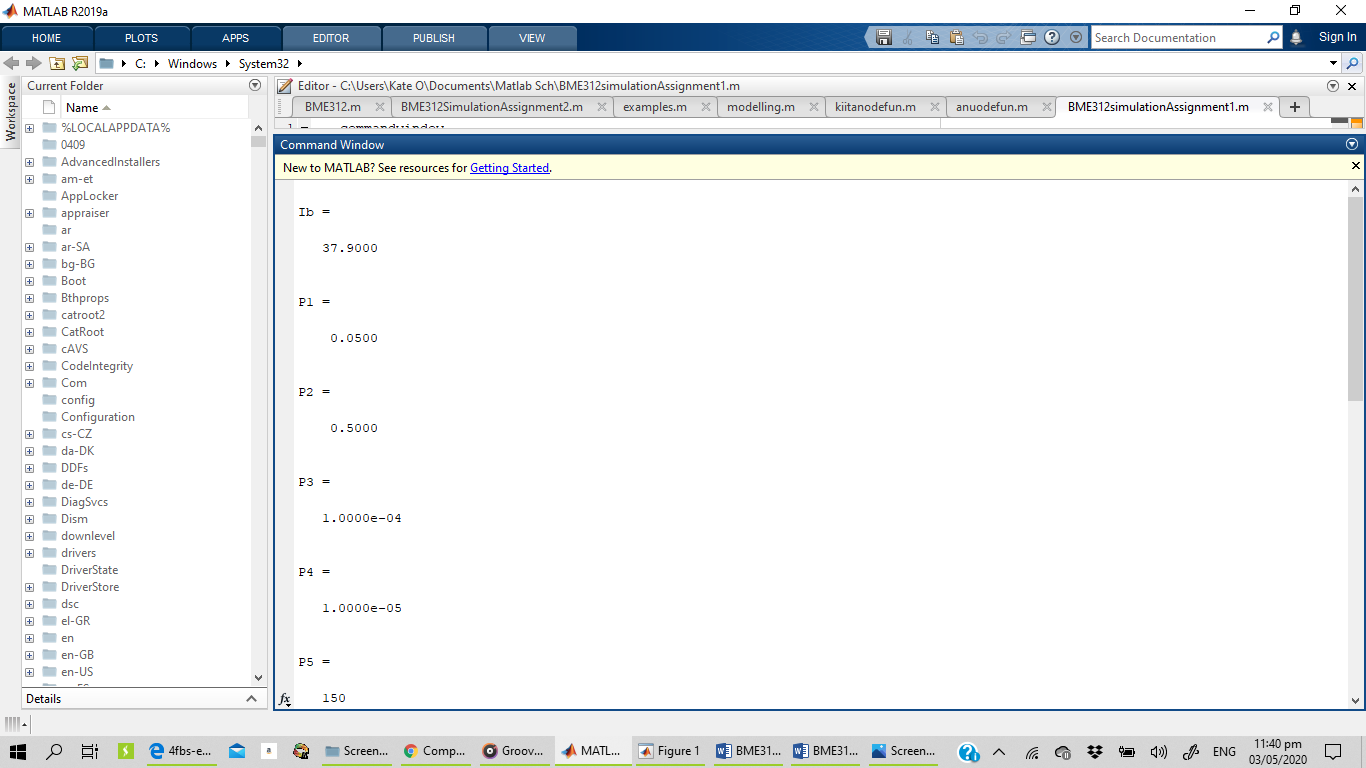
ode2 =

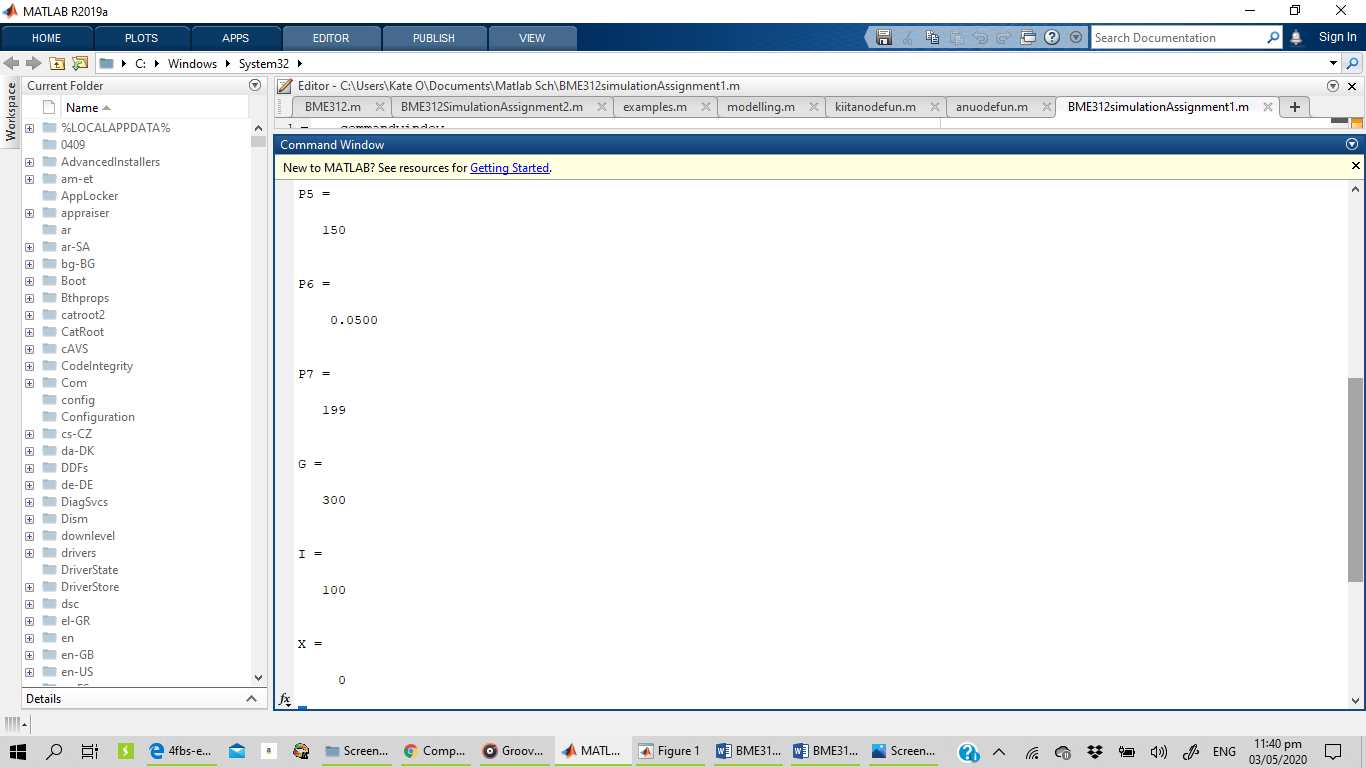
0 == 621/100000

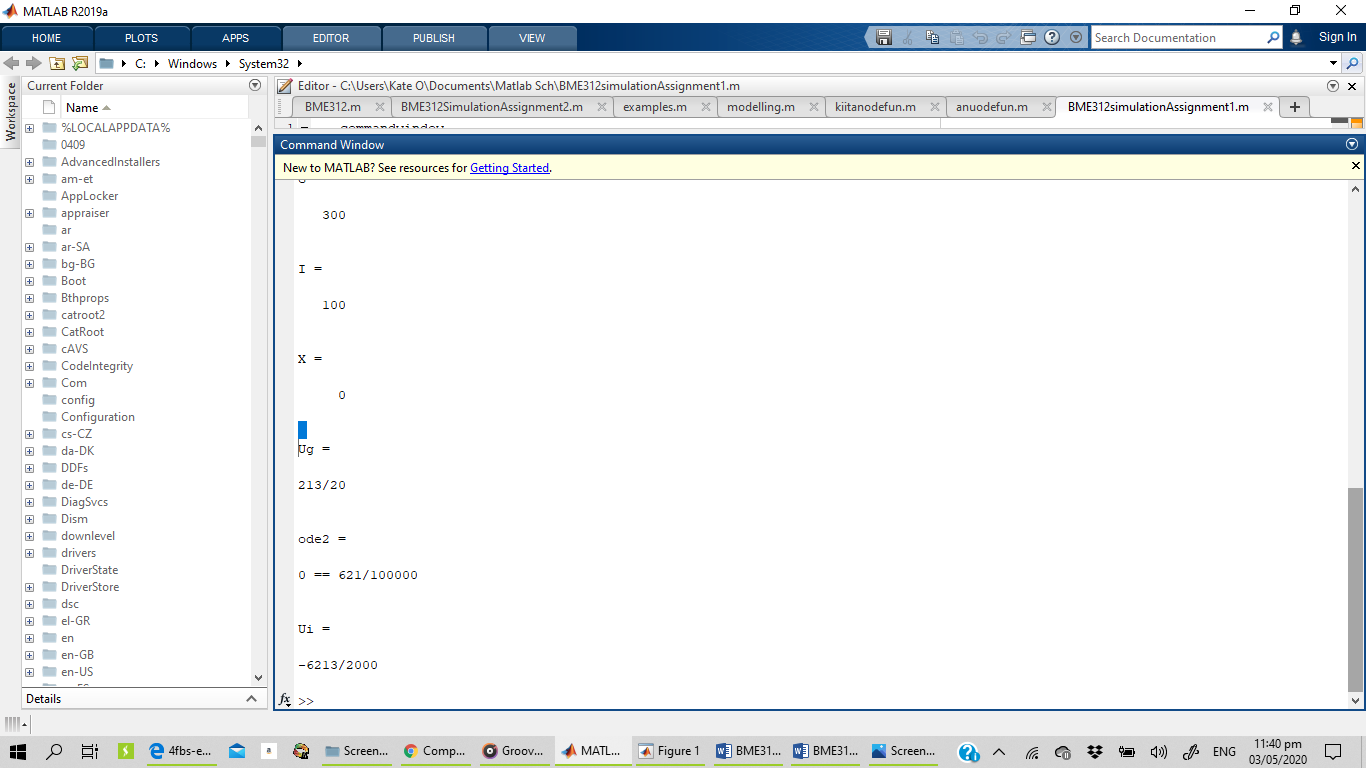
Ui =

-6213/2000









OR USING ODE FUNCTION

*Codes*

function f = anuodefun(c,x)

vb=48

vi=0.6

c0=0.1

ci= 50

cb= 12

qmax=2.75

qiv=50

qgi=12

q=1.5

f(1)= (q\*ci)/vb-(q\*cb)/vb+(qiv/vb);

f(2)= (q\*cb)/vi- (ci\*((q/vi)+((qmax\*vi)/(c0-ci)))+(qgi/vi));

end

*Other code*

close all

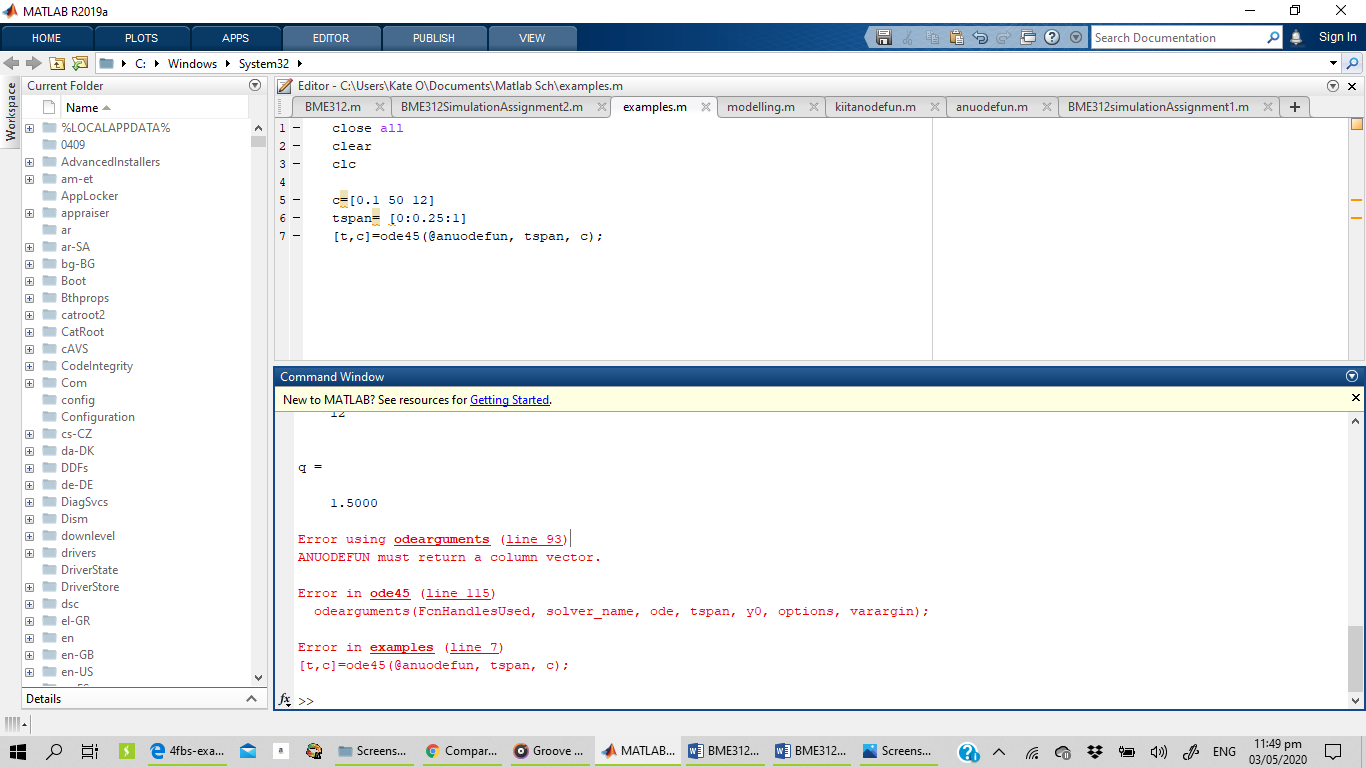
clear

clc

c=[0.1 50 12]

tspan= [0:0.25:1]

[t,c]=ode45(@anuodefun, tspan, c);



%did not run

*Result*

>> anuodefun

vb =

48

vi =

0.6000

c0 =

0.1000

ci =

50

cb =

12

qmax =

2.7500

qiv =

50

qgi =

12

q =

1.5000

ans =

2.2292 -113.3467

