Table of Contents

Q1

```
clear all
close all
clc

% x = [x1;x2]
% Following Constraint equations are written in the form of Ax<=b
% -x1+2x2<=4
% x1+x2<=5
% x1<=3
% -x2<=0
% -x1<=0

A= [ -1 2 ; 1 1 ; 1 0; 0 -1 ;-1 0]
b=[4;5;3;0;0]

x0=[ 0 0 ]; % Initial guess value for x1 and x2 taken 0 0

[x,fval] = fmincon(@fun,x0,A,b)
x1=x(1)
x2=x(2)

% function v = fun(X)
% x1=X(1);
% x2=X(2);
%
% v= (x1-4)^2+(x2-5)^2;
%
% end
```

```
A =

    -1     2
     1     1
     1     0
     0    -1
    -1     0


b =
```

```
     4
     5
     3
     0
     0

Warning: The default trust-region-reflective algorithm does not solve prob
with the constraints you have specified. FMINCON will use the active-set
algorithm instead. For information on applicable algorithms, see Choosing
Algorithm in the documentation.
Warning: Your current settings will run a different algorithm (interior-po
in a future release.

Local minimum found that satisfies the constraints.

Optimization completed because the objective function is non-decreasing in
feasible directions, to within the default value of the function tolerance
and constraints are satisfied to within the default value of the constrain



Active inequalities (to within options.TolCon = 1e-06):
  lower      upper     ineqlin   ineqnonlin
                           1
                           2

x =

    2.0000    3.0000


fval =

    8.0000


x1 =

    2.0000


x2 =

    3.0000
```

Q2.

```
clear all
close all
clc
```

```
g=9.80665;
rhop=1800;
Dp=0.208*10^(-3);
rho=994.6;
mu=8.931*10^(-4);

Re=0.05; % Initial guess value of Reynold's number
    Cd=24/Re;
    v=sqrt(4*g*(rhop-rho)*Dp/(3*Cd*rho));
    Re=rho*v*Dp/mu;
    if(Re<0.1)
         Re
         Vt=v
    end

Cd=(24/Re)*(1+0.14*Re^0.7) ;
v=sqrt(4*g*(rhop-rho)*Dp/(3*Cd*rho));
 Re=rho*v*Dp/mu;
if(Re<=1000 && 0.1<=Re)
    Re
    Vt=v
    end

 Cd=0.44 ;
 v=sqrt(4*g*(rhop-rho)*Dp/(3*Cd*rho));
 Re=rho*v*Dp/mu;
if(Re<=350000 && 1000<Re)
     Re
    Vt=v
end

Cd=0.19-8*(10^4)/Re;
v=sqrt(4*g*(rhop-rho)*Dp/(3*Cd*rho));
Re=rho*v*Dp/mu;
if(Re>350000)
    Re
    Vt=v
    s
end
```

```
Re =

    1.5001


Vt =

    0.0065
```

Q3.

```
clear all
close all
clc

F=70;
```

a.

```
A= 0.01*[ 7 18 15 24 ; 4 24 10 65 ; 54 42 54 10 ; 35 16 21 1 ]

% Rows correspond to
% Xylene
% Styrene
% Toluene
% Benzene

T=F*0.01*[ 15;25;40;20]

% Solving Ax=T where x' = [ D1 B1 D2 B2]

x=A\T
```

```
A =

    0.0700    0.1800    0.1500    0.2400
    0.0400    0.2400    0.1000    0.6500
    0.5400    0.4200    0.5400    0.1000
    0.3500    0.1600    0.2100    0.0100


T =

   10.5000
   17.5000
   28.0000
   14.0000


x =

   26.2500
   17.5000
    8.7500
   17.5000
```

b.

```
D=x(1)+x(2)
```

```
CompD=A(:,1:2)*x(1:2)

B=x(3)+x(4)
CompB=A(:,3:4)*x(3:4)

% Xylene
% Styrene
% Toluene
% Benzene
```

```
D =

   43.7500


CompD =

    4.9875
    5.2500
   21.5250
   11.9875


B =

   26.2500


CompB =

    5.5125
   12.2500
    6.4750
    2.0125
```

Q4

```
clc
clear all
close all

global V k1 k2 v cAin cBin cCin cDin
V=100;
k1=1;
k2=1;
v=1;
cAin=1;
cBin=2;
cCin=0;
cDin=0;
```

```
C=[ cAin cBin cCin cDin ];

[t,c]=ode15s(@cstr,[0 10],C)

plot(t,c)
xlabel('time')
ylabel('conc')
legend('A','B','C','D')


% function conc = cstr(t,C)
% global V k1 k2 v cAin cBin cCin cDin
%
% A=(v/V)*(cAin-C(1))-k1*C(1)*C(2);
% B=(v/V)*(cBin-C(2))-k1*C(1)*C(2)-k2*C(2)*C(3);
% Co=(v/V)*(cCin-C(3))+k1*C(1)*C(2)-k2*C(2)*C(3);
% D=(v/V)*(cDin-C(4))+k2*C(2)*C(3);
%
% conc= [ A ; B ; Co;D];
%
%
% end
```

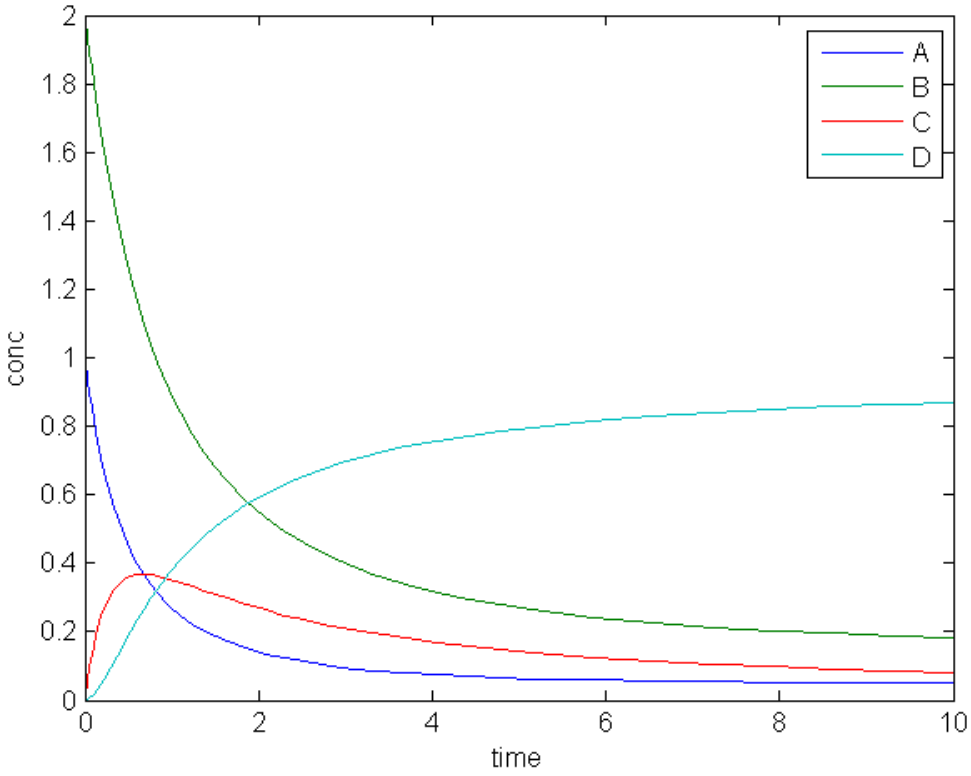
```
t =

         0
    0.0004
    0.0007
    0.0011
    0.0031
    0.0052
    0.0073
    0.0094
    0.0150
    0.0207
    0.0264
    0.0320
    0.0560
    0.0799
    0.1038
    0.1278
    0.1517
    0.1886
    0.2256
    0.2625
    0.2994
    0.3364
    0.3733
    0.4507
    0.5281
    0.6055
    0.6828
    0.7602
```

```
    0.8376
    0.9709
    1.1041
    1.2374
    1.3707
    1.5039
    1.6372
    1.8568
    2.0764
    2.2960
    2.5156
    2.7353
    2.9549
    3.3201
    3.6853
    4.0505
    4.4157
    4.7809
    5.1461
    5.8394
    6.5328
    7.2261
    7.9195
    8.6128
    9.3062
   10.0000
```

```
c =
```

```
    1.0000    2.0000         0         0
    0.9993    1.9993    0.0007    0.0000
    0.9986    1.9986    0.0014    0.0000
    0.9979    1.9979    0.0021    0.0000
    0.9937    1.9937    0.0062    0.0000
    0.9897    1.9896    0.0103    0.0001
    0.9856    1.9855    0.0143    0.0001
    0.9816    1.9814    0.0183    0.0002
    0.9706    1.9702    0.0289    0.0004
    0.9599    1.9590    0.0393    0.0008
    0.9493    1.9480    0.0494    0.0013
    0.9389    1.9370    0.0592    0.0019
    0.8969    1.8914    0.0976    0.0055
    0.8577    1.8470    0.1317    0.0107
    0.8211    1.8040    0.1619    0.0171
    0.7868    1.7622    0.1886    0.0246
    0.7547    1.7218    0.2123    0.0329
    0.7091    1.6619    0.2437    0.0472
    0.6677    1.6051    0.2696    0.0627
    0.6300    1.5510    0.2910    0.0790
    0.5957    1.4998    0.3085    0.0959
    0.5642    1.4512    0.3228    0.1130
    0.5354    1.4051    0.3343    0.1303
    0.4823    1.3160    0.3514    0.1663
```

0.4373	*1.2360*	*0.3613*	*0.2014*
0.3990	*1.1640*	*0.3661*	*0.2350*
0.3660	*1.0991*	*0.3671*	*0.2669*
0.3374	*1.0404*	*0.3656*	*0.2970*
0.3125	*0.9872*	*0.3622*	*0.3253*
0.2763	*0.9064*	*0.3537*	*0.3700*
0.2469	*0.8370*	*0.3432*	*0.4099*
0.2227	*0.7771*	*0.3317*	*0.4456*
0.2025	*0.7249*	*0.3199*	*0.4776*
0.1854	*0.6792*	*0.3083*	*0.5063*
0.1709	*0.6388*	*0.2969*	*0.5322*
0.1512	*0.5817*	*0.2793*	*0.5695*
0.1355	*0.5341*	*0.2630*	*0.6014*
0.1229	*0.4939*	*0.2482*	*0.6290*
0.1125	*0.4597*	*0.2346*	*0.6528*
0.1040	*0.4302*	*0.2223*	*0.6737*
0.0967	*0.4047*	*0.2112*	*0.6921*
0.0871	*0.3690*	*0.1948*	*0.7181*
0.0797	*0.3399*	*0.1806*	*0.7398*
0.0739	*0.3159*	*0.1682*	*0.7580*
0.0693	*0.2960*	*0.1573*	*0.7733*
0.0657	*0.2792*	*0.1478*	*0.7865*
0.0627	*0.2649*	*0.1394*	*0.7979*
0.0586	*0.2430*	*0.1258*	*0.8156*
0.0558	*0.2263*	*0.1148*	*0.8295*
0.0539	*0.2135*	*0.1056*	*0.8405*
0.0528	*0.2035*	*0.0979*	*0.8493*
0.0521	*0.1957*	*0.0914*	*0.8565*
0.0518	*0.1895*	*0.0859*	*0.8623*
0.0517	*0.1845*	*0.0812*	*0.8672*

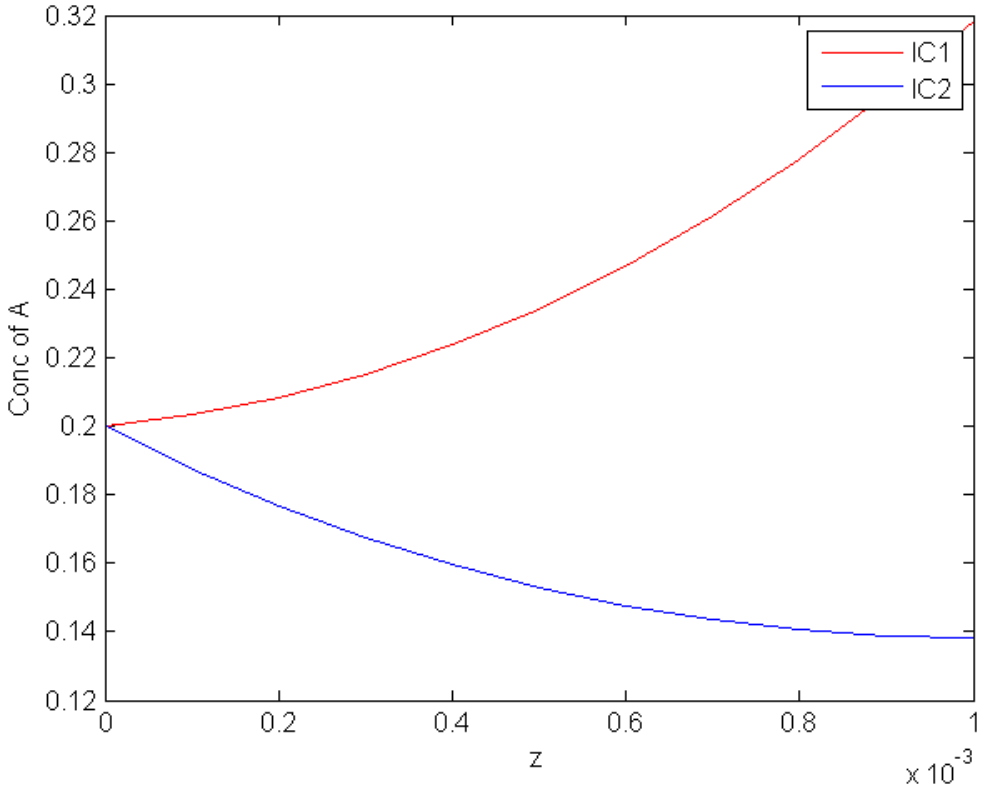


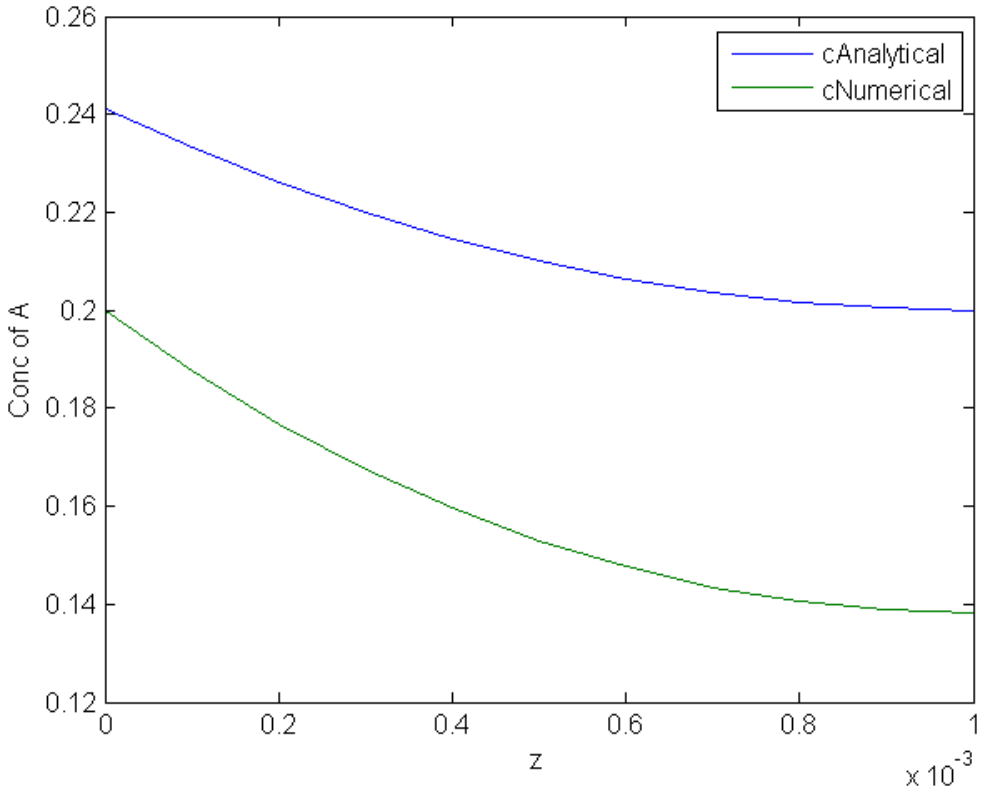
Q.5

```
clear all
close all
clc

cA0=0.2;
k=0.001;
D=1.2*10^(-9);
L=0.001;

syms c(z)

Dc=diff(c);
cA1=dsolve(diff(c,2)==(k/D)*c,'c(0)=cA0','Dc(0)=25.3126');



cA0=0.2;
z=[0:0.0001:0.001];
CA1=eval(cA1);

plot(z,CA1,'r-')
xlabel('z')
ylabel('Conc of A' )
```

```
syms c(z)

Dc=diff(c);
cA2=dsolve(diff(c,2)==(k/D)*c,'c(0)=cA0','Dc(0)=-131.9112');



cA0=0.2;
z=[0:0.0001:0.001];
CA2=eval(cA2);
hold on
plot(z,CA2,'b-')
legend('IC1','IC2');
hold off

% 2nd initial conditions are correct because as we can see from graph,dcA/dz at z=


figure(2)
z=[0:0.0001:0.001];
cAanal= cA0*cosh(L*sqrt(k/D)*(1-z/L)/cosh(L*sqrt(k/D)))

plot(z,cAanal,z,CA2);
legend('cAnalytical','cNumerical')
xlabel('z')
ylabel('Conc of A' )
```

```
cAanal =

  Columns 1 through 7

    0.2412    0.2331    0.2260    0.2198    0.2145    0.2100    0.2064

  Columns 8 through 11

    0.2036    0.2016    0.2004    0.2000
```


IC1
IC2
Conc of A
z
x 10^-3
0.32
0.3
0.28
0.26
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0
0.2
0.4
0.6
0.8
1


cAnalytical
cNumerical
Conc of A
z
x 10^-3
0.26
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0
0.2
0.4
0.6
0.8
1