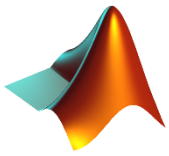
MAT 2002

MATLAB



Lab Assessment – 4

L29+L30

FALL SEMESTER 2020-21

by

SHARADINDU ADHIKARI

19BCE2105

Question 1

Problem:

Solve the following:

(a) $x_1' = 3x_1 - 2x_2;\ x_2' = 2x_1 - 2x_2;\ x_1(0) = 1,\ x_2(0) = -1$

(b) $x_1' = -x_2 + x_3;\ x_2' = 4x_1 - x_2 - 4x_3;\ x_3' = -3x_1 - x_2 + 4x_3$

Solutions:

(a)

Code in MATLAB Editor:

```
clear all
close all
clc
syms t C1 C2
A=input('Enter A: ');
[P,D]=eig(A);
L1=D(1);L2=D(4);
y1=C1*exp(L1*t);y2=C2*exp(L2*t);
Y=[y1;y2];
X=P*Y;
Cond=input('Enter the initial conditions [t0, x10,x20]: ');
t0=Cond(1);x10=Cond(2);x20=Cond(3);
eq1=subs(X(1)-x10,t0);eq2=subs(X(2)-x20,t0);
[C1, C2] = solve(eq1,eq2);
X=subs(X);
disp(X);
```

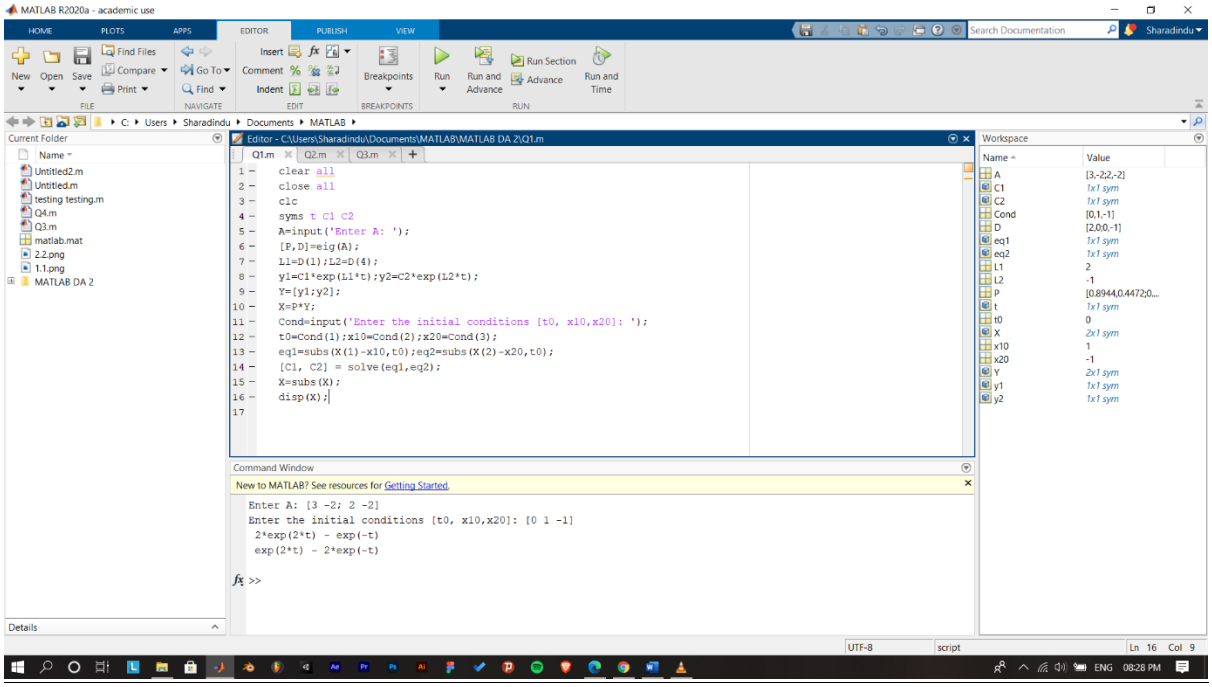
Input in Command Window:

```
Enter A: [3 -2; 2 -2]
Enter the initial conditions [t0, x10,x20]: [0 1 -1]
```

Output in Command Window:

```
2*exp(2*t) - exp(-t)
exp(2*t) - 2*exp(-t)
```

Screenshot:



(b)

Code in MATLAB Editor:

```
clear all
close all
clc
syms t C1 C2 C3
A=input('Enter A: ');
[P,D]=eig(A);
L1=D(1);L2=D(5);L3=D(9)
y1=C1*exp(L1*t);y2=C2*exp(L2*t);y3=C3*exp(L3*t);
Y=[y1;y2;y3];
X=P*Y;
disp(X);
```

Input in Command Window:

```
Enter A: [0 -1 1; 4 -1 -4; -3 -1 4]
```

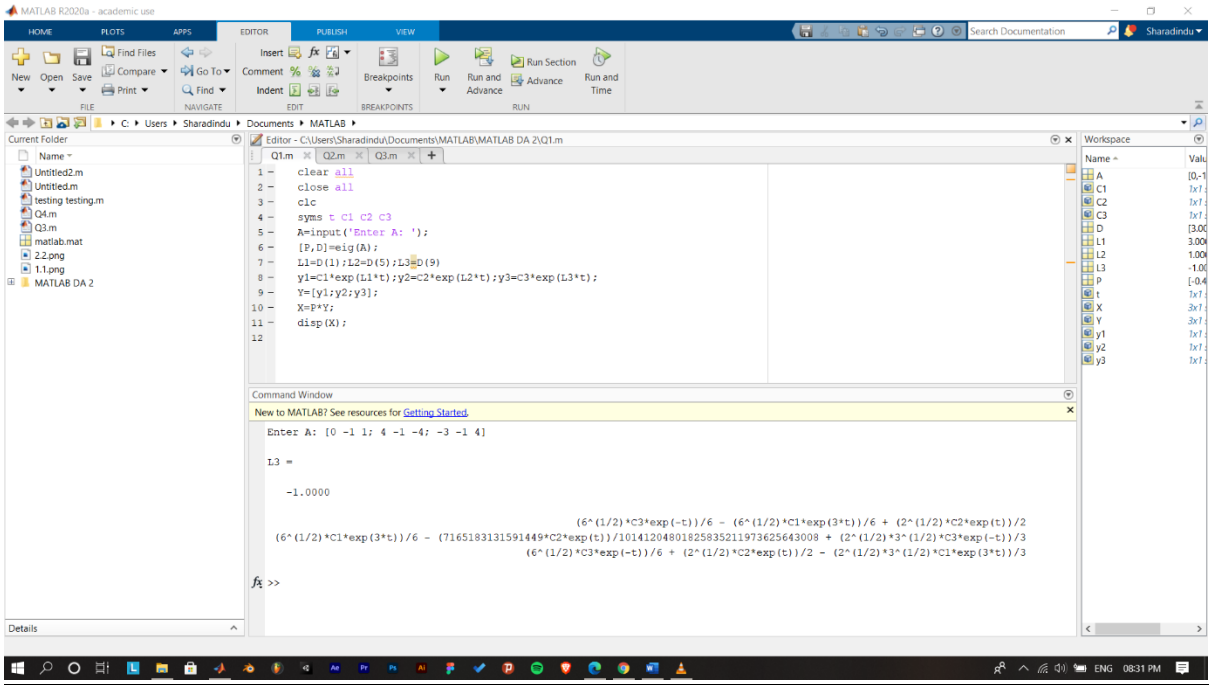
Output in Command Window:

```
L3 =

   -1.0000

                                                          (6^(1/2)*C3*exp(-
t))/6 - (6^(1/2)*C1*exp(3*t))/6 + (2^(1/2)*C2*exp(t))/2
 (6^(1/2)*C1*exp(3*t))/6 -
(7165183131591449*C2*exp(t))/10141204801825835211973625643008 +
(2^(1/2)*3^(1/2)*C3*exp(-t))/3
```

Screenshot:



Question 2

Problem:

Solve the following:

(a) $x_1'' = -5x_1 + 2x_2;\ \ x_2'' = 2x_1 - 2x_2$

(b) $x_1'' + 2x_1 - x_2 = 0;\ \ x_2'' - x_1 + 2x_2 = 0$

Solutions:

(a)

Algorithm:

First, we're reducing the second order ordinary differential equation to first order, and thereafter solve it using the matrix method

Final equation after reduction:

$y_1' = -5y_2 + 2z_2;\ \ z_1' = 2y_2 - 2z_2;$ where $x_1' = y_1$ and $x_2' = z_1$

Code in MATLAB Editor:

```
clear all
close all
clc
syms t C1 C2
A=input('Enter A: ');
[P,D]=eig(A);
L1=D(1);L2=D(4);
y1=C1*exp(L1*t);y2=C2*exp(L2*t);
Y=[y1;y2];
X=P*Y;
disp(X);
integral=int(X,t);
disp(integral)
```

Input in Command Window:

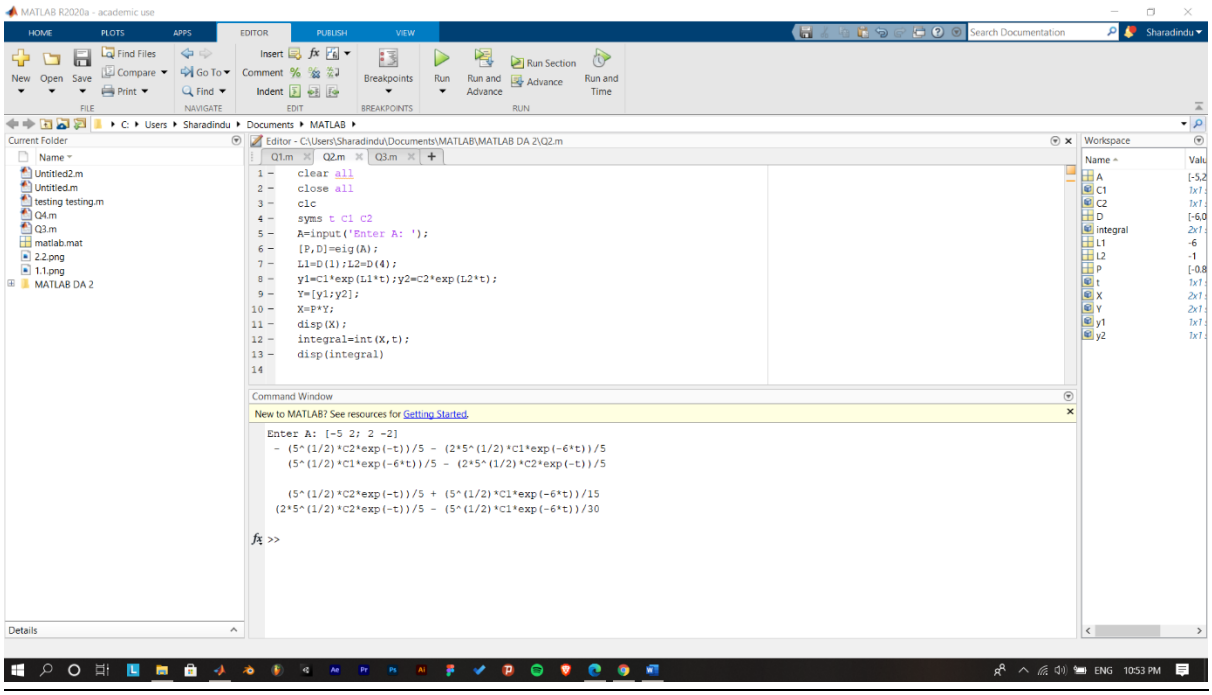
```
Enter A: [-5 2; 2 -2]
```

Output in Command Window:

```
- (5^(1/2)*C2*exp(-t))/5 - (2*5^(1/2)*C1*exp(-6*t))/5
   (5^(1/2)*C1*exp(-6*t))/5 - (2*5^(1/2)*C2*exp(-t))/5

   (5^(1/2)*C2*exp(-t))/5 + (5^(1/2)*C1*exp(-6*t))/15
 (2*5^(1/2)*C2*exp(-t))/5 - (5^(1/2)*C1*exp(-6*t))/30
```

Screenshot:



(b)

Algorithm:

First, we're reducing the second order ordinary differential equation to first order, and thereafter solve it using the matrix method

Final equation after reduction:

$y_1' = -2y_2 + 1z_2;\ \ z_1' = 1y_2 - 2z_2;$ where $x_1' = y_1$ and $x_2' = z_1$

Code in MATLAB Editor:

```
clear all
close all
clc
syms t C1 C2
A=input('Enter A: ');
[P,D]=eig(A);
L1=D(1);L2=D(4);
y1=C1*exp(L1*t);y2=C2*exp(L2*t);
Y=[y1;y2];
X=P*Y;
disp(X);
integral=int(X,t);
disp(integral)
```

Input in Command Window:

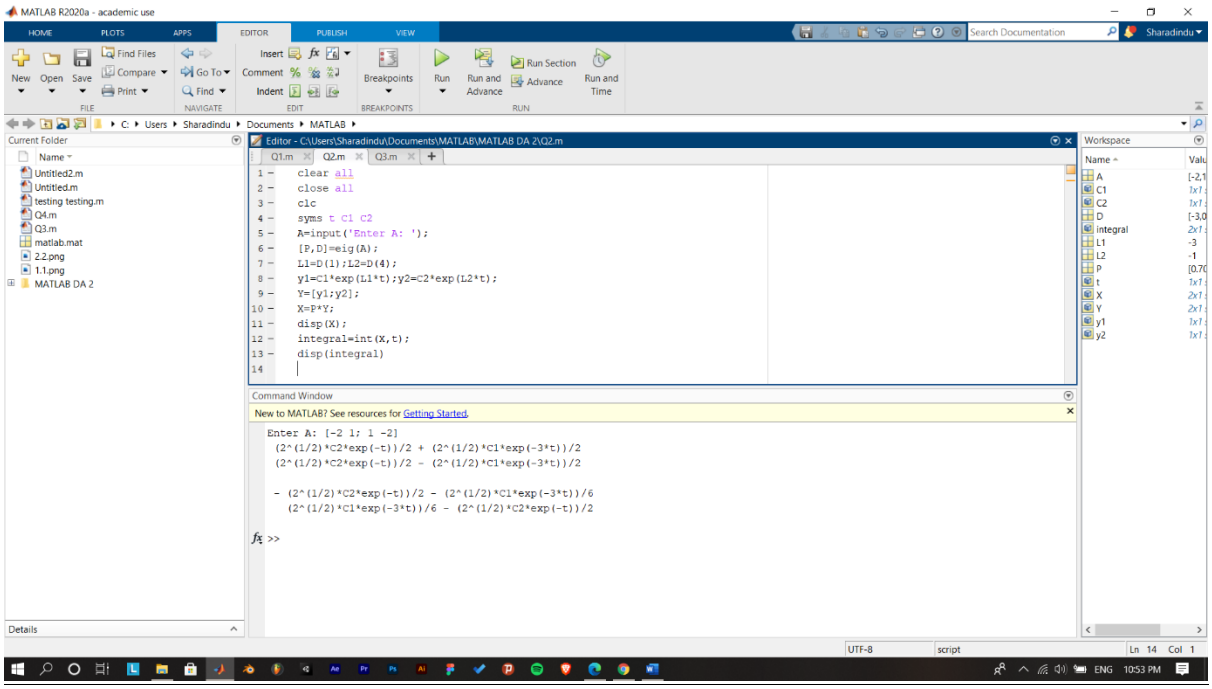
```
Enter A: [-2 1; 1 -2]
```

Output in Command Window:

```
(2^(1/2)*C2*exp(-t))/2 + (2^(1/2)*C1*exp(-3*t))/2
 (2^(1/2)*C2*exp(-t))/2 - (2^(1/2)*C1*exp(-3*t))/2

 - (2^(1/2)*C2*exp(-t))/2 - (2^(1/2)*C1*exp(-3*t))/6
   (2^(1/2)*C1*exp(-3*t))/6 - (2^(1/2)*C2*exp(-t))/2
```

Screenshot:



Question 3

Problem:

Reduce the third order equation $y''' + 2y'' - y' - 2y = 0$ to the system of first order linear equations and solve by matrix method.

Solution:

Reduction of third order ordinary differential equation into first order:
Let $y_1 = y;\ \ y_2 = y_1' = y';\ \ y_3 = y_2' = y'';\ \ y_3' = y'''$

Formed Matrix: $\begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 2 & 1 & -2 \end{bmatrix}$

Code in MATLAB Editor:

```
clear all
clc
syms t C1 C2 C3
A=input('Enter A: ');
[P,D]=eig(A);
L1=D(1);L2=D(5);L3=D(9)
y1=C1*exp(L1*t);y2=C2*exp(L2*t);y3=C3*exp(L3*t);
Y=[y1;y2;y3];
X=P*Y;
disp(X);
```

Input in Command Window:

```
Enter A: [0 1 0; 0 0 1; 2 1 -2]
```

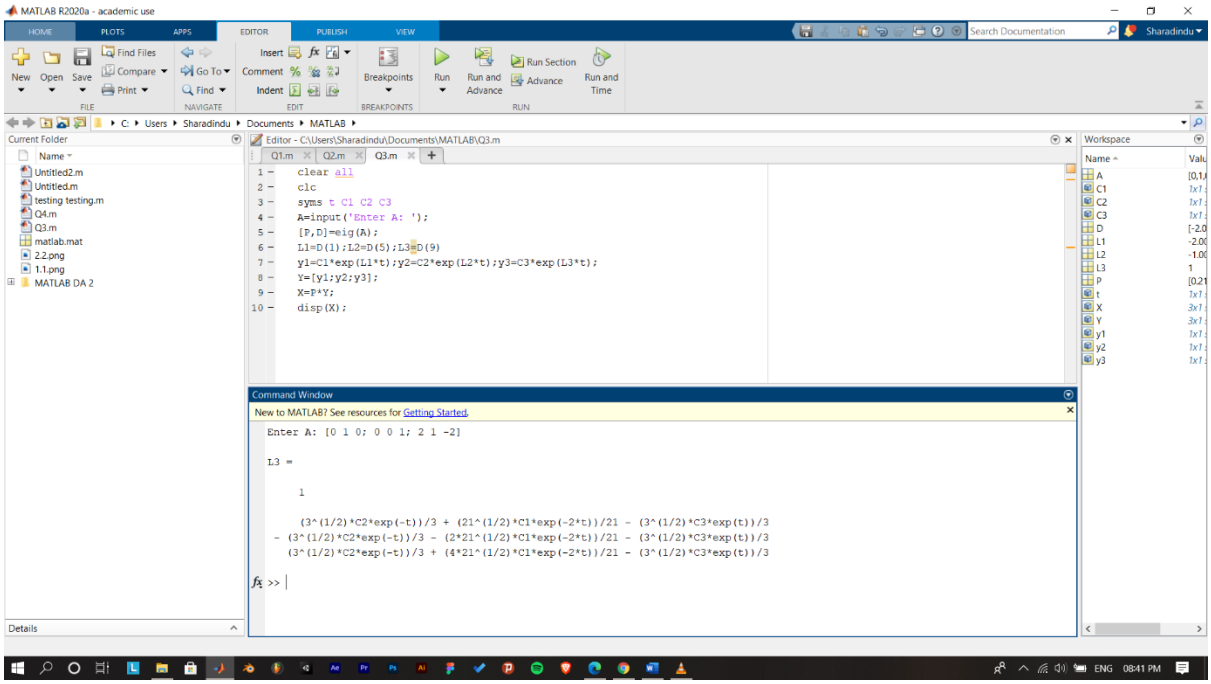
Output in Command Window:

```
L3 =

     1

     (3^(1/2)*C2*exp(-t))/3 + (21^(1/2)*C1*exp(-2*t))/21 -
(3^(1/2)*C3*exp(t))/3
 - (3^(1/2)*C2*exp(-t))/3 - (2*21^(1/2)*C1*exp(-2*t))/21 -
(3^(1/2)*C3*exp(t))/3
   (3^(1/2)*C2*exp(-t))/3 + (4*21^(1/2)*C1*exp(-2*t))/21 -
(3^(1/2)*C3*exp(t))/3
```

Screenshot:


MATLAB R2020a - academic use
Editor - C:\Users\Sharadindu\Documents\MATLAB\Q3.m
Q1.m
Q2.m
Q3.m
clear all
clc
syms t C1 C2 C3
A=input('Enter A: ');
[P,D]=eig(A);
L1=D(1);L2=D(5);L3=D(9)
y1=C1*exp(L1*t);y2=C2*exp(L2*t);y3=C3*exp(L3*t);
Y=[y1;y2;y3];
X=P*Y;
disp(X);
Command Window
Enter A: [0 1 0; 0 0 1; 2 1 -2]
L3 =
1
(3^(1/2)*C2*exp(-t))/3 + (21^(1/2)*C1*exp(-2*t))/21 - (3^(1/2)*C3*exp(t))/3
- (3^(1/2)*C2*exp(-t))/3 - (2*21^(1/2)*C1*exp(-2*t))/21 - (3^(1/2)*C3*exp(t))/3
(3^(1/2)*C2*exp(-t))/3 + (4*21^(1/2)*C1*exp(-2*t))/21 - (3^(1/2)*C3*exp(t))/3