Experiment – 7

1.

Editor - C:\Users\18BIS0043\Documents\MATLAB\E7.m

E7.m

```
clc;
clear all;

syms t C1 C2
A = input('Enter A: ');
[P,D] = eig(A);
L1 = D(1);
L2 = D(4); % Diagonal values

y1 = C1*exp(L1*t);
y2 = C2*exp(L2*t);
Y = [y1;y2];
X = P*Y;

Cn = input('Enter the Initial Conditions [t0,x10,x20]: ');
t0 = Cn(1);
x10 = Cn(2);
x20 = Cn(3);

eq1 = subs(X(1)-x10, t0);
eq2 = subs(X(2)-x20, t0);
[C1,C2] = solve(eq1,eq2);
X = subs(X)
```

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Command Window

New to MATLAB? See resources for Getting Started.

```
Enter A: [1 2
0.5 1]
Enter the Initial Conditions [t0,x10,x20]: [0,16,-2]

X =

 6*exp(2*t) + 10
  3*exp(2*t) - 5

>>
```

2.

Editor - C:\Users\18BIS0043\Documents\MATLAB\E7_2.m

E7.m | E7_2.m

```matlab
clc
clear all;
A = input('Enter A: ');
[P D] = eig(A);

S1 = dsolve(['D2y = ',num2str(D(1)),'*y']);
S2 = dsolve(['D2y = ',num2str(D(4)),'*y']);

X = P*[S1;S2];
disp('x1 = ');disp(X(1));
disp('x2 = ');disp(X(2));
```

Command Window

New to MATLAB? See resources for Getting Started.

```
Enter A: [2 1;9 2]
x1 =
(10^(1/2)*(C3*exp(5^(1/2)*t) + C4*exp(-5^(1/2)*t)))/10 - (10^(1/2)*(C6*cos(t) + C7*sin(t)))/10

x2 =
(3*10^(1/2)*(C6*cos(t) + C7*sin(t)))/10 + (3*10^(1/2)*(C3*exp(5^(1/2)*t) + C4*exp(-5^(1/2)*t)))/10

>>
```

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Experiment - 7

→ System of first order linear differential equations

- $$\begin{cases} x_1' = a_{11}x_1 + a_{12}x_2 + a_{13}x_3 \ldots a_{1n}x_n + g_1(t) \\ x_2' = a_{21}x_1 + a_{22}x_2 + a_{23}x_3 \ldots a_{2n}x_n + g_2(t) \\ \vdots \qquad\qquad \vdots \qquad\qquad \vdots \\ x_n' = a_{n1}x_1 + a_{n2}x_2 + a_{n3}x_3 \ldots a_{nn}x_n + g_n(t) \end{cases}$$

System of 'n' linear first order differential equations in 'n' unknowns (an $n \times n$ system of linear equations.

- If every term $g_i(t)$, where 'i' is from (1 to n), is zero, then the system is said to be <u>homogenous</u>.

- $x' = Ax + G$,

This system will have a general solution,

$$X = c_1 x_1 e^{\lambda_1 t} + c_2 x_2 e^{\lambda_2 t}$$

and $\dot{x} = Ax$ ——— (1)

For a second order system of differential equations,

$$\ddot{x} = AX \text{ ——— } (2)$$

→

→ System of second order linear differential equations

• $$\begin{cases} x_1'' = a_{11}x_1 + a_{12}x_2 + a_{13}x_3 + \dots + a_{1n}x_n \\ x_2'' = a_{21}x_1 + a_{22}x_2 + a_{23}x_3 + \dots + a_{2n}x_n \\ \vdots \qquad\qquad \vdots \qquad\qquad \vdots \qquad\qquad \vdots \\ x_n'' = a_{n1}x_1 + a_{n2}x_2 + a_{n3}x_3 + \dots + a_{nn}x_n \end{cases}$$

System of second order linear differential equations where the coefficients a_{ij}'s are arbitrary constants

---

1. $\dot{x}_1 = x_1 + 2x_2 \qquad x_1(0) = 16$
   $\dot{x}_2 = 0.5x_1 + x_2 \qquad x_2(0) = -2$

Aim: Solve using matrix method in matlab

2. $\ddot{x}_1 = 2x_1 + x_2$
   $\ddot{x}_2 = 9x_1 + 2x_2$

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Aim: Solve using dsolve function.

Experiment – 8

2.

Editor - C:\Users\allen\Documents\MATLAB\E8_1.m

E8_1.m

```
clc
clear all
syms x a0 a1 a2 a3
a = [a0 a1 a2 a3];
y = sum(a.*[x].^[0:3]);
c = input('Enter the initial conditions [y1 y2]: ');
y1 = c(1);
y2 = c(2);
dy = diff(y);
d2y = diff(dy);
gde = collect((1-x^2)*d2y+2*y,x);
cof = coeffs(gde,x);
A2 = solve(cof(1),a2);
A3 = solve(cof(2),a3);
y = subs(y,{a2,a3},{A2,A3});
eq1 = subs(y,x,0);
eq2 = subs(diff(y),x,0);
y = subs(y,{eq1,eq2},{y1,y2})
```

Command Window

```
Enter the initial conditions [y1 y2]: [4 5]

y =

- (5*x^3)/3 - 4*x^2 + 5*x + 4

>>
```

classmate

Date

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Expeiiment - 8

→ Series solutions of oedinary differential equations

- Series solution when $x=0$ is an ordinary point of the equation :

$$P_0 \frac{d^2y}{dx^2} + P_1 \frac{dy}{dx} + P_2 y = 0 \quad \text{— (1)}$$

where P's are polynomial functions of x and $p_0 \neq 0$ at $x=0$.

- Assume its solution to be in the form:

$$y = a_0 + a_1x + a_2x^2 + \ldots + a_nx^n \quad \text{— (2)}$$

- Calculate dy/dx, d^2y/dx^2 and substitute in the values of y, dy/dx, d^2y/dx in (1) from (2)

- Equate to zero the coefficients of the various powers of n and determine $a_2, a_3 \ldots a_n$ in terms of a_0 and a_1

- Substituting the values of $a_2, a_3, a_4 \ldots$ in (2), we get the desired series having a_0 and a_1 as arbitrary constants

1. Solve in series equation

$$\frac{d^2y}{dx^2} + y = 0$$

Output: $dy = 3a_3x^2 + 2a_2x + a_1$

$d^2y = 2a_2 + 6a_2x$

Solution is :

$$y = A\left\{1 - \frac{x^2}{2} + \frac{x^2}{3} + \dots\right\} + B\left\{x - \frac{x^3}{8} + \dots\right\}$$

2. $(1-x)\,y'' + 2y = 0$

$y(0) = 4$

$y'(0) = 5$

Output : $y = -\frac{5x^3}{3} - 4x^2 + 5x + 4$

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