Differential Equations

LAB 4

Yara Hanafi, 194005395

**Question 1**

function [e1, v1, e2, v2] = eigenvectors(A)

I = eye(2);

syms x

eq1 = det(A-I\*x) == 0 ;

eigVal = double(solve(eq1,x));

e1 = eigVal(1);

e2 = eigVal(2);

v1 = [1;1];

Y1 = A-e1\*I;

[~,q1] = max(sum(Y1.^2,1));

C1 = 3-q1;

v1(q1,:) = -Y1(:,q1)\Y1(:,C1);

v2 = [1;1];

Y2 = A-e2\*I;

[~,q2] = max(sum(Y2.^2,1));

C2 = 3-q2;

v2(q2,:) = -Y2(:,q2)\Y2(:,C2);

end

find the eigenvalues and eigenvectors for the matrices

**a =**

**2 1**

**1 0**

**>> [e1,v1,e2,v2] = eigenvectors(a)**

**e1 =**

**-0.4142**

**v1 =**

**-0.4142**

**1.0000**

**e2 =**

**2.4142**

**v2 =**

**1.0000**

**0.4142**

**a =**

**4 3**

**2 -1**

**>> [e1,v1,e2,v2] = eigenvectors(a)**

**e1 =**

**-2**

**v1 =**

**-0.5000**

**1.0000**

**e2 =**

**5**

**v2 =**

**1.0000**

**0.3333**

**>>**

**a =**

**1 2**

**-2 1**

**>> [e1,v1,e2,v2] = eigenvectors(a)**

**e1 =**

**1.0000 - 2.0000i**

**v1 =**

**0.0000 + 1.0000i**

**1.0000 + 0.0000i**

**e2 =**

**1.0000 + 2.0000i**

**v2 =**

**0.0000 - 1.0000i**

**1.0000 + 0.0000i**

**>>**

**Question 2**

**(1)**

**>> a= [2 1; 1 0]**

**a =**

**2 1**

**1 0**

**>> [V,D] = eig(a)**

**V =**

**0.3827 -0.9239**

**-0.9239 -0.3827**

**D =**

**-0.4142 0**

**0 2.4142**

**(2)**

**>> a= [4 3; 2 0-1]**

**a =**

**4 3**

**2 -1**

**>> [V,D] = eig(a)**

**V =**

**0.9487 -0.4472**

**0.3162 0.8944**

**D =**

**5 0**

1. **-2**

**(3)**

**>> a= [1 2; -2 1]**

**a =**

**1 2**

**-2 1**

**>> [V,D] = eig(a)**

**V =**

**0.0000 - 0.7071i 0.0000 + 0.7071i**

**0.7071 + 0.0000i 0.7071 + 0.0000i**

**D =**

**1.0000 + 2.0000i 0.0000 + 0.0000i**

**0.0000 + 0.0000i 1.0000 - 2.0000i**

**Question 3**

function [x, y] = twoDimSolver(A, x0, y0)

[V,D] = eig(A);

e1 = D(1,1);

e2 = D(2,2);

v1=V(:,1);

v2=V(:,2);

x=0;

y=0;

syms x(t) y(t)

syms C1 C2

x(t)= v1(1,1)\*C1\*exp(e1\*t) + v2(1,1)\*C2\*exp(e2\*t);

y(t) = v1(2,1)\*C1\*exp(e1\*t) + v2(2,1)\*C2\*exp(e2\*t);

eq1 = x(0) == x0;

eq2 = y(0) == y0;

[x(t), y(t)] = solve([eq1,eq2],[C1,C2])

(1)

>> a= [4 3; 2 -1]

a =

4 3

2 -1

>> twoDimSolver(a,1,2)

x(t) =

(4\*10^(1/2))/7

y(t) =

(5\*5^(1/2))/7

ans(t) =

(4\*10^(1/2))/7

(2)

a= [1 2; -2 1]

a =

1 2

-2 1

>> twoDimSolver(a,2,2)

x(t) =

2^(1/2)\*(1 + 1i)

y(t) =

2^(1/2)\*(1 - 1i)

ans(t) =

2^(1/2)\*(1 + 1i)

>>

**Question 4**

syms x(t) y(t)

ode1 = diff(x) == 4\*x + 3\*y;

ode2 = diff(y) == 2\*x + -1\*y;

odes = [ode1; ode2];

S = dsolve(odes);

cond1 = x(0) == 1;

cond2 = y(0) == 2;

conds = [cond1; cond2];

[xSol(t), ySol(t)] = dsolve(odes,conds)

>> untitled4

xSol(t) =

(12\*exp(5\*t))/7 - (5\*exp(-2\*t))/7

ySol(t) =

(10\*exp(-2\*t))/7 + (4\*exp(5\*t))/7

syms x(t) y(t)

ode1 = diff(x) == 1\*x + 2\*y;

ode2 = diff(y) == -2\*x + 1\*y;

odes = [ode1; ode2];

S = dsolve(odes);

cond1 = x(0) == 2;

cond2 = y(0) == 2;

conds = [cond1; cond2];

[xSol(t), ySol(t)] = dsolve(odes,conds)

>> untitled4

xSol(t) =

2\*cos(2\*t)\*exp(t) + 2\*sin(2\*t)\*exp(t)

ySol(t) =

2\*cos(2\*t)\*exp(t) - 2\*sin(2\*t)\*exp(t)

>>