Homework 4, Problem 2

```
% David Lim
% A16398479
% 02/21/25
clear
```

Part b.

```
A = [0 1 0 0; -11 -0.2 10 0.1; 0 0 0 1; 10 0.1 -10 -0.1];
[V,D] = eig(A);
D

p1 = (V(:,1)+V(:,2))/2;
p2 = (V(:,1)-V(:,2))/2j;
p3 = (V(:,3)+V(:,4))/2;
p4 = (V(:,3)-V(:,4))/2j;

a1 = real(D(1,1));
b1 = imag(D(1,1));
a2 = real(D(3,3));
b2 = imag(D(3,3));

Vnew = [p1 p2 p3 p4];
Dnew = [a1 b1 0 0; -b1 a1 0 0; 0 0 a2 b2; 0 0 -b2 a2];
% Alternatively, use:
% [Vnew1,Dnew1] = cdf2rdf(V,D)

X = Vnew
Anew = Dnew
```

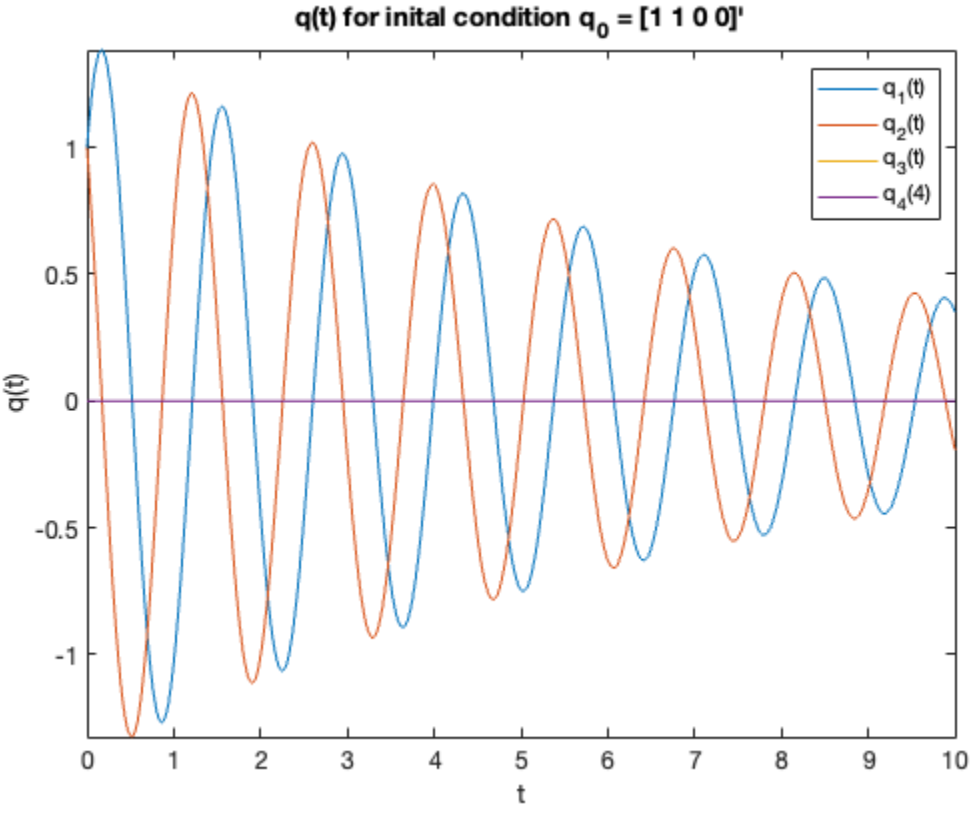
```
D =
  -0.1262 + 4.5271i   0.0000 + 0.0000i   0.0000 + 0.0000i   0.0000 + 0.0000i
   0.0000 + 0.0000i  -0.1262 - 4.5271i   0.0000 + 0.0000i   0.0000 + 0.0000i
   0.0000 + 0.0000i   0.0000 + 0.0000i  -0.0238 + 0.6978i   0.0000 + 0.0000i
   0.0000 + 0.0000i   0.0000 + 0.0000i   0.0000 + 0.0000i  -0.0238 - 0.6978i
X =
   -0.0044   -0.1562   -0.5651    0.0018
    0.7076         0    0.0122   -0.3944
    0.0072    0.1484   -0.5940         0
   -0.6727    0.0137    0.0141   -0.4145
Anew =
   -0.1262    4.5271         0         0
   -4.5271   -0.1262         0         0
         0         0   -0.0238    0.6978
         0         0   -0.6978   -0.0238
```

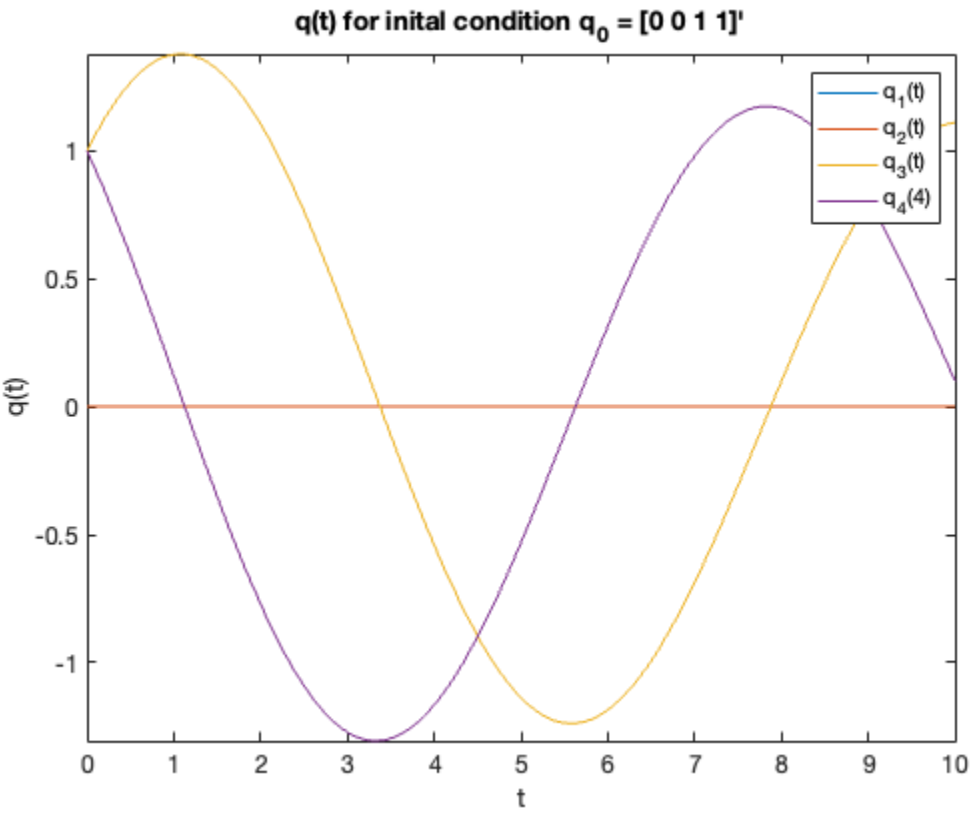
Part c.

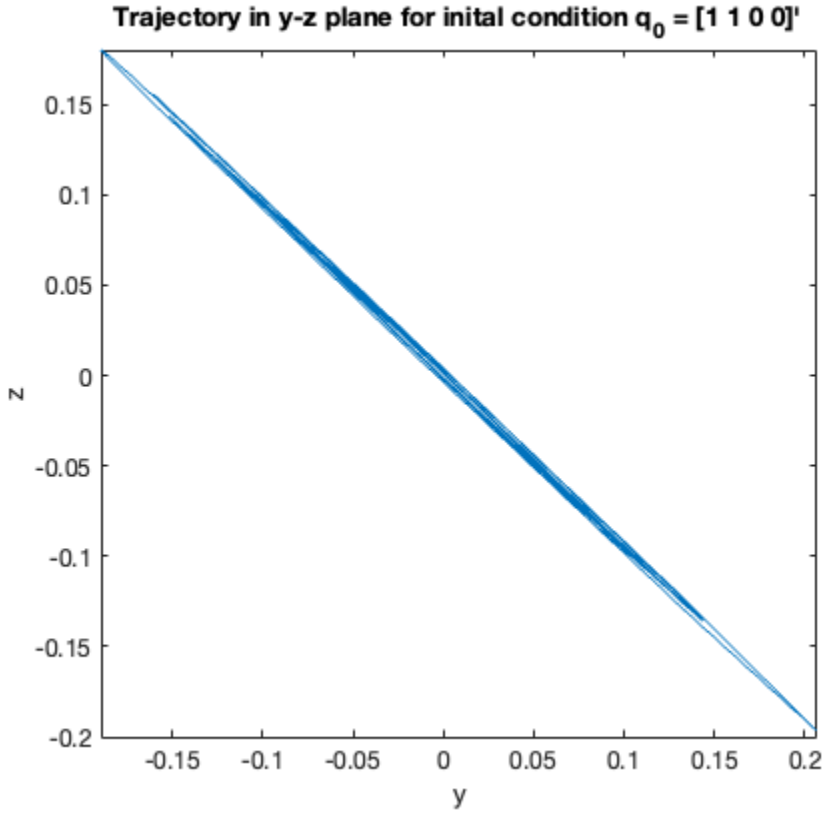
```
syms t
```

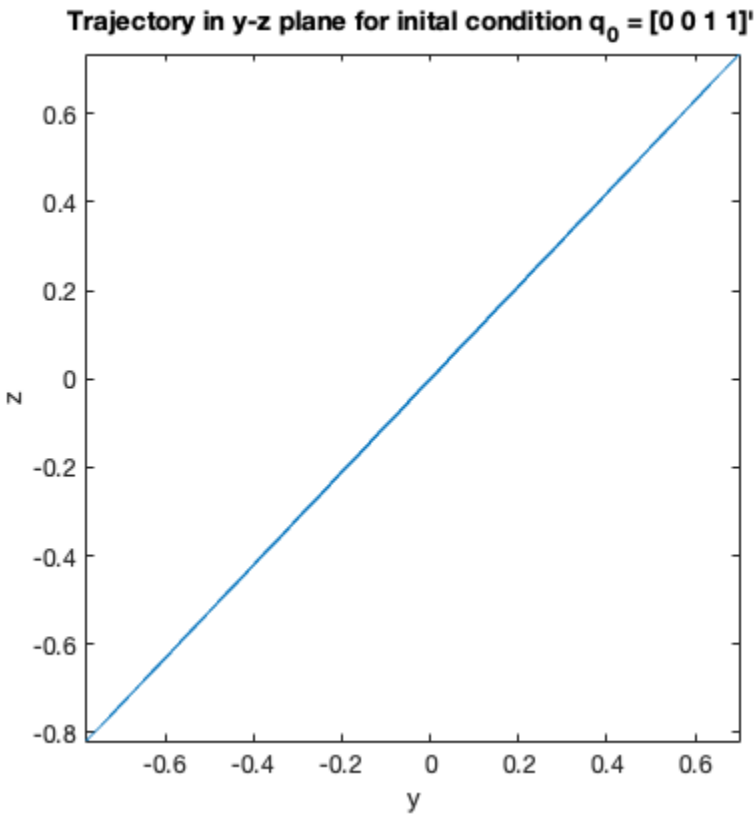
```
q01 = [1 1 0 0]';
q02 = [0 0 1 1]';

q1 = expm(Dnew*t)*q01;
q1 = vpa(simplify(q1,'Steps',9))

figure(1)
fplot(q1,[0,10])
legend('q_1(t)','q_2(t)','q_3(t)','q_4(4)')
xlabel('t')
ylabel('q(t)')
title("q(t) for inital condition q_0 = [1 1 0 0]'")
set(gca,'FontSize',12)

q2 = expm(Dnew*t)*q02;
q2 = vpa(simplify(q2,'Steps',9))

figure(2)
fplot(q2,[0,10])
legend('q_1(t)','q_2(t)','q_3(t)','q_4(4)')
xlabel('t')
ylabel('q(t)')
title("q(t) for inital condition q_0 = [0 0 1 1]'")
set(gca,'FontSize',12)

x1 = X*q1;

figure(3)
fplot(x1(1),x1(3),[0,10])
axis equal
xlabel('y')
ylabel('z')
title("Trajectory in y-z plane for inital condition q_0 = [1 1 0 0]'")
set(gca,'FontSize',12)

x2 = X*q2;

figure(4)
fplot(x2(1),x2(3),[0,10])
axis equal
xlabel('y')
ylabel('z')
title("Trajectory in y-z plane for inital condition q_0 = [0 0 1 1]'")
set(gca,'FontSize',12)

q1 =

exp(-0.126183905476203062079321171040 65*t)*cos(4.527085131272587048556488298 34*t) +
exp(-0.126183905476203062079321171040 65*t)*sin(4.527085131272587048556488298 34*t)
exp(-0.126183905476203062079321171040 65*t)*cos(4.527085131272587048556488298 34*t) -
1.0*exp(-0.126183905476203062079321171040 65*t)*sin(4.527085131272587048556488
```

```
983454*t)

                0

                0
q2 =

                    0

                    0

exp(-0.023816094523797119719699111328737*t)*cos(0.697846543711642008922524382
79684*t) +
exp(-0.023816094523797119719699111328737*t)*sin(0.697846543711642008922524382
79684*t)
exp(-0.023816094523797119719699111328737*t)*cos(0.697846543711642008922524382
79684*t) -
1.0*exp(-0.023816094523797119719699111328737*t)*sin(0.697846543711642008922524
38279684*t)
```




q(t) for inital condition q0 = [0 0 1 1]'
q1(t)
q2(t)
q3(t)
q4(4)
q(t)
t
1
0.5
0
-0.5
-1
0
1
2
3
4
5
6
7
8
9
10


Trajectory in y-z plane for inital condition q0 = [1 1 0 0]'
z
y
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-0.15
-0.1
-0.05
0
0.05
0.1
0.15
0.2



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