

```

interr = 'latex';
% interr = 'none';
set(groot, 'defaulttextinterpreter', interr);
set(groot, 'defaultAxesTickLabelInterpreter', interr);
set(groot, 'defaultLegendInterpreter', interr);

```

Part e)

```

A = [0 0 1 0; 0 0 0 1; 0 1 0 0; 1 0 0 0];
x0 = [1 -1 0 0]';
out = sim('problem2model');
[v,d] = eig(A)

```

```

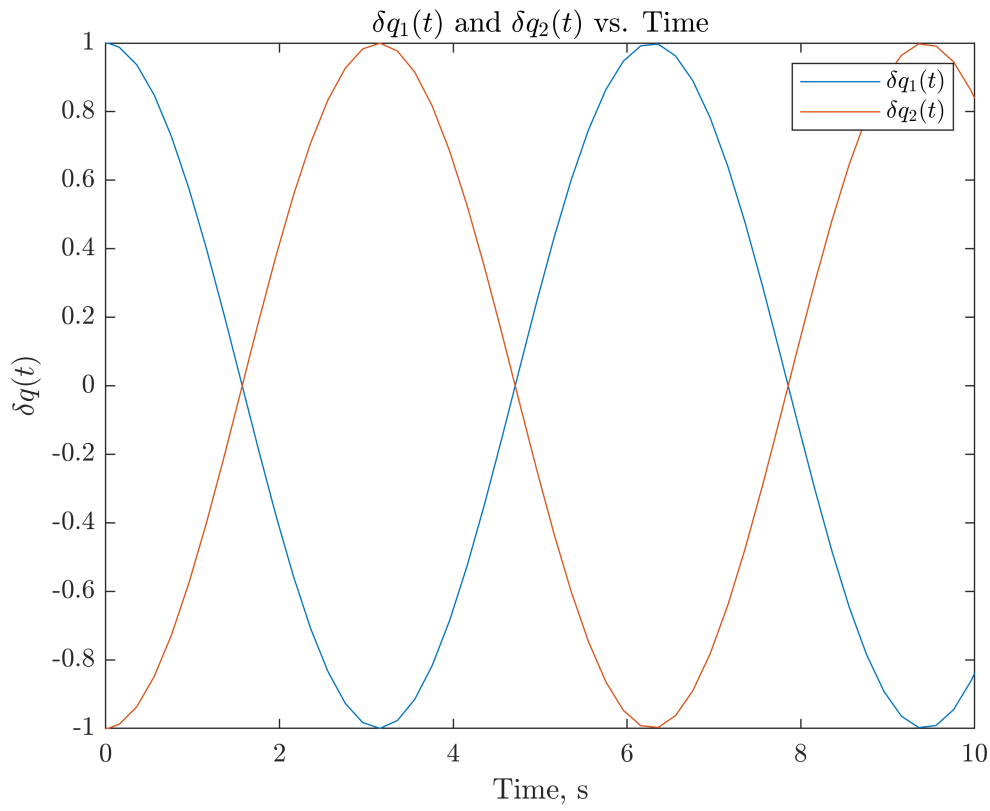
v = 4x4 complex
-0.5000 + 0.0000i    0.0000 - 0.5000i    0.0000 + 0.5000i   -0.5000 + 0.0000i
-0.5000 + 0.0000i   -0.0000 + 0.5000i   -0.0000 - 0.5000i   -0.5000 + 0.0000i
 0.5000 + 0.0000i    0.5000 + 0.0000i    0.5000 - 0.0000i   -0.5000 + 0.0000i
 0.5000 + 0.0000i   -0.5000 + 0.0000i   -0.5000 + 0.0000i   -0.5000 + 0.0000i
d = 4x4 complex
-1.0000 + 0.0000i    0.0000 + 0.0000i    0.0000 + 0.0000i    0.0000 + 0.0000i
 0.0000 + 0.0000i    0.0000 + 1.0000i    0.0000 + 0.0000i    0.0000 + 0.0000i
 0.0000 + 0.0000i    0.0000 + 0.0000i    0.0000 - 1.0000i    0.0000 + 0.0000i
 0.0000 + 0.0000i    0.0000 + 0.0000i    0.0000 + 0.0000i    1.0000 + 0.0000i

```

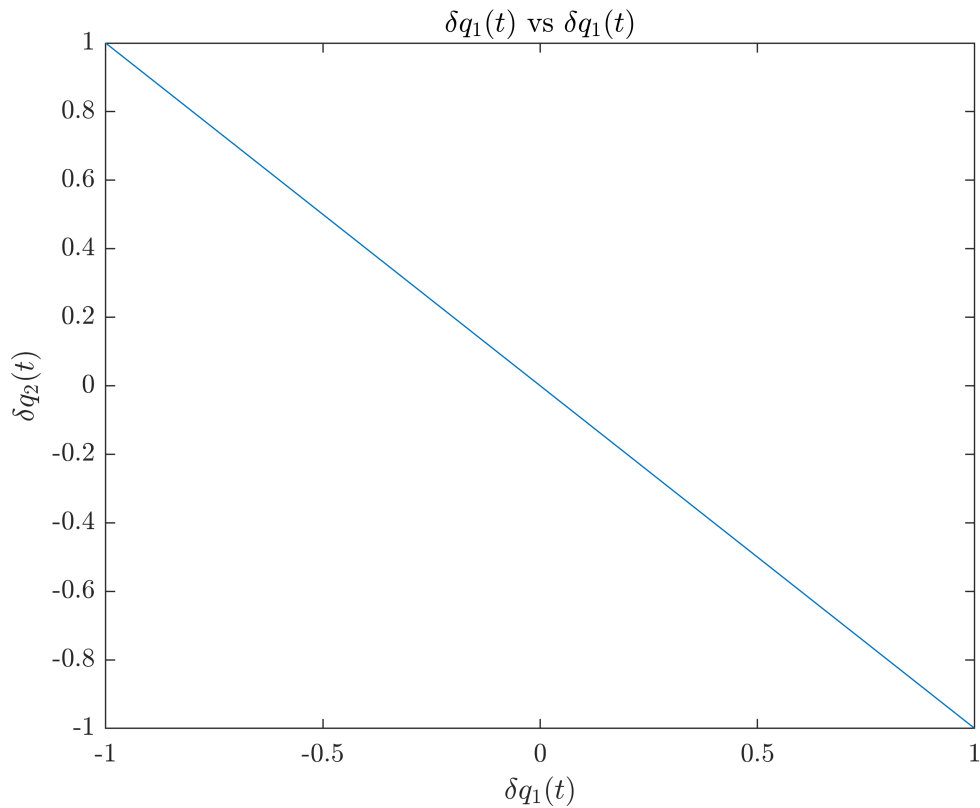
```

t = out.x.Time;
q1 = out.x.Data(:,1);
q2 = out.x.Data(:,2);
figure
plot(t,q1)
title('$\delta q_{1}(t)$ and $\delta q_{2}(t)$ vs. Time')
xlabel('Time, s')
ylabel('$\delta q(t)$')
hold on
plot(t,q2)
legend('$\delta q_{1}(t)$', '$\delta q_{2}(t)$')
hold off

```



```
figure
plot(q1,q2)
title('$\delta q_{1}(t)$ vs $\delta q_{1}(t)$')
xlabel('$\delta q_{1}(t)$')
ylabel('$\delta q_{2}(t)$')
```



```
B = [v(:,1) v(:,2) v(:,3) v(:,4) x0];
C = rref(B);
C = C(:,end)
```

```
C = 4×1 complex
 0.0000 + 0.0000i
 0.0000 + 1.0000i
 0.0000 - 1.0000i
 0.0000 + 0.0000i
```

```
xt = C(1)*exp(d(1,1)*t') .* v(:,1) ...
      + C(2)*exp(d(2,2)*t') .* v(:,2) ...
      + C(3)*exp(d(3,3)*t') .* v(:,3) ...
      + C(4)*exp(d(4,4)*t') .* v(:,4)
```

```
xt = 4×56 complex
 1.0000 - 0.0000i   1.0000 + 0.0000i   1.0000 + 0.0000i   1.0000 + 0.0000i ...
-1.0000 - 0.0000i  -1.0000 + 0.0000i  -1.0000 + 0.0000i  -1.0000 + 0.0000i
 0.0000 + 0.0000i  -0.0002 + 0.0000i  -0.0012 + 0.0000i  -0.0062 + 0.0000i
-0.0000 + 0.0000i   0.0002 + 0.0000i   0.0012 + 0.0000i   0.0062 + 0.0000i
```

```
figure
plot(t,xt(1,:))
```

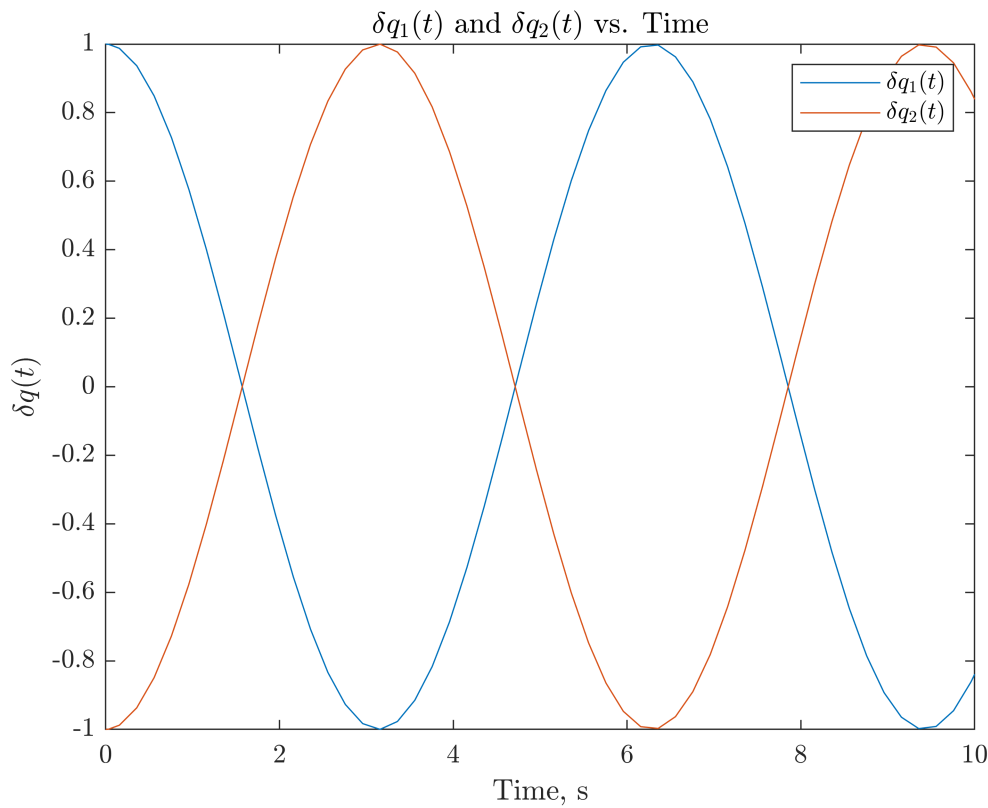
Warning: Imaginary parts of complex X and/or Y arguments ignored.

```
title('$\delta q_{1}(t)$ and $\delta q_{2}(t)$ vs. Time')
xlabel('Time, s')
ylabel('$\delta q(t)$')
hold on
```

```
plot(t,xt(2,:))
```

Warning: Imaginary parts of complex X and/or Y arguments ignored.

```
legend('$\delta q_{1}(t)$','$\delta q_{2}(t)$')
hold off
```



Part f)

```
A = [0 0 1 0; 0 0 0 1; 0 1 0 0; 1 0 0 0]
```

A = 4×4

```
0    0    1    0
0    0    0    1
0    1    0    0
1    0    0    0
```

```
x0 = [1 1 -1 -1]'
```

x0 = 4×1

```
1
1
-1
-1
```

```
out = sim('problem2model');
[v,d] = eig(A)
```

v = 4×4 complex

```
-0.5000 + 0.0000i    0.0000 - 0.5000i    0.0000 + 0.5000i   -0.5000 + 0.0000i
-0.5000 + 0.0000i   -0.0000 + 0.5000i   -0.0000 - 0.5000i   -0.5000 + 0.0000i
```

```

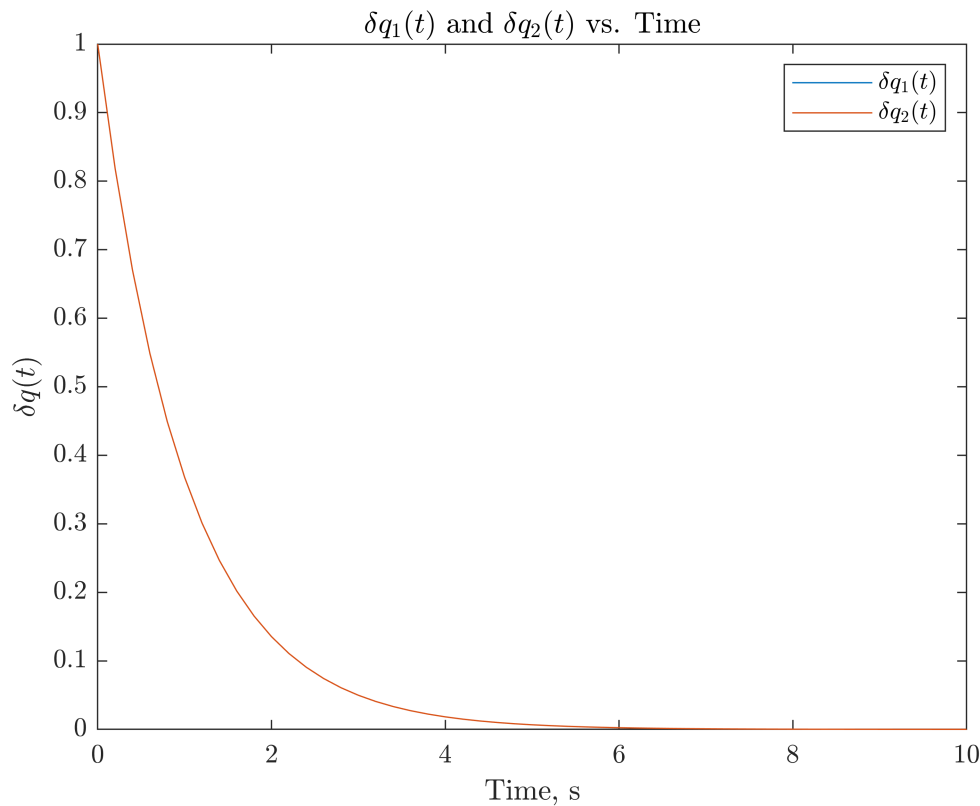
0.5000 + 0.0000i    0.5000 + 0.0000i    0.5000 - 0.0000i   -0.5000 + 0.0000i
0.5000 + 0.0000i   -0.5000 + 0.0000i   -0.5000 + 0.0000i   -0.5000 + 0.0000i
d = 4x4 complex
-1.0000 + 0.0000i    0.0000 + 0.0000i    0.0000 + 0.0000i    0.0000 + 0.0000i
0.0000 + 0.0000i    0.0000 + 1.0000i    0.0000 + 0.0000i    0.0000 + 0.0000i
0.0000 + 0.0000i    0.0000 + 0.0000i    0.0000 - 1.0000i    0.0000 + 0.0000i
0.0000 + 0.0000i    0.0000 + 0.0000i    0.0000 + 0.0000i    1.0000 + 0.0000i

```

```

t = out.x.Time;
q1 = out.x.Data(:,1);
q2 = out.x.Data(:,2);
figure
plot(t,q1)
title('$\delta q_{1}(t)$ and $\delta q_{2}(t)$ vs. Time')
xlabel('Time, s')
ylabel('$\delta q(t)$')
hold on
plot(t,q2)
legend('$\delta q_{1}(t)$', '$\delta q_{2}(t)$')
hold off

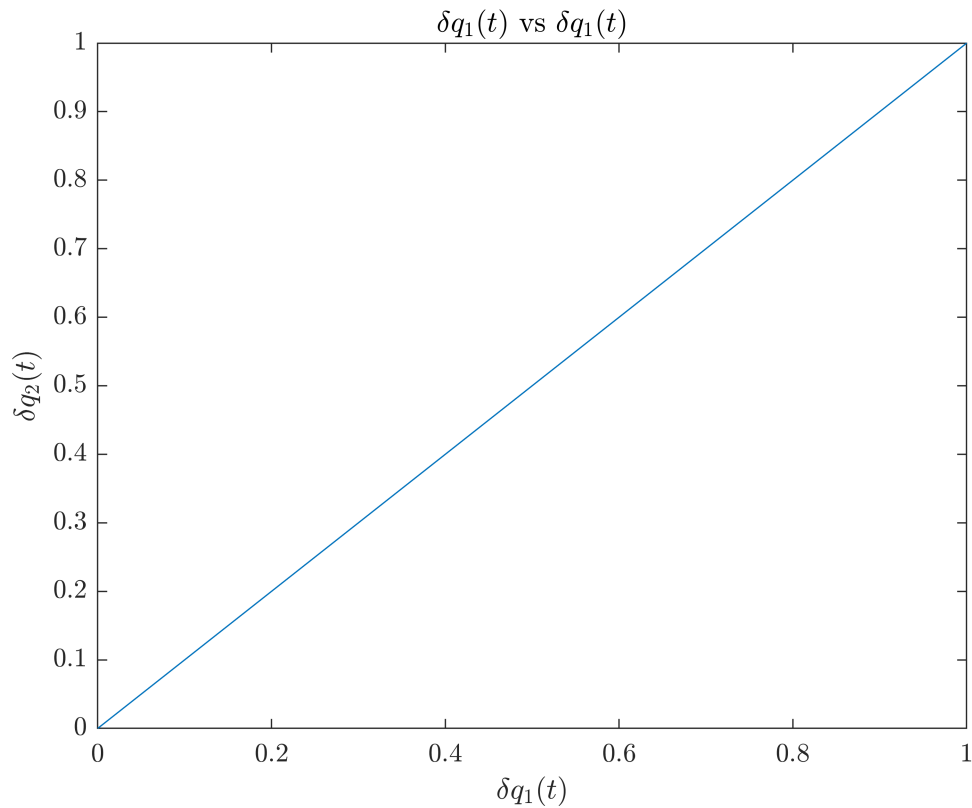
```



```

figure
plot(q1,q2)
title('$\delta q_{1}(t)$ vs $\delta q_{1}(t)$')
xlabel('$\delta q_{1}(t)$')
ylabel('$\delta q_{2}(t)$')

```



```
B = [v(:,1) v(:,2) v(:,3) v(:,4) x0];
C = rref(B);
C = C(:,end)
```

```
C = 4x1 complex
-2.0000 + 0.0000i
-0.0000 - 0.0000i
-0.0000 + 0.0000i
0.0000 + 0.0000i
```

```
xt = C(1)*exp(d(1,1)*t') .* v(:,1) ...
      + C(2)*exp(d(2,2)*t') .* v(:,2) ...
      + C(3)*exp(d(3,3)*t') .* v(:,3) ...
      + C(4)*exp(d(4,4)*t') .* v(:,4)
```

```
xt = 4x51 complex
 1.0000 - 0.0000i   0.8187 - 0.0000i   0.6703 - 0.0000i   0.5488 - 0.0000i ...
 1.0000 - 0.0000i   0.8187 + 0.0000i   0.6703 + 0.0000i   0.5488 + 0.0000i
-1.0000 - 0.0000i  -0.8187 - 0.0000i  -0.6703 - 0.0000i  -0.5488 - 0.0000i
-1.0000 + 0.0000i  -0.8187 - 0.0000i  -0.6703 + 0.0000i  -0.5488 + 0.0000i
```

```
figure
plot(t,xt(1,:))
```

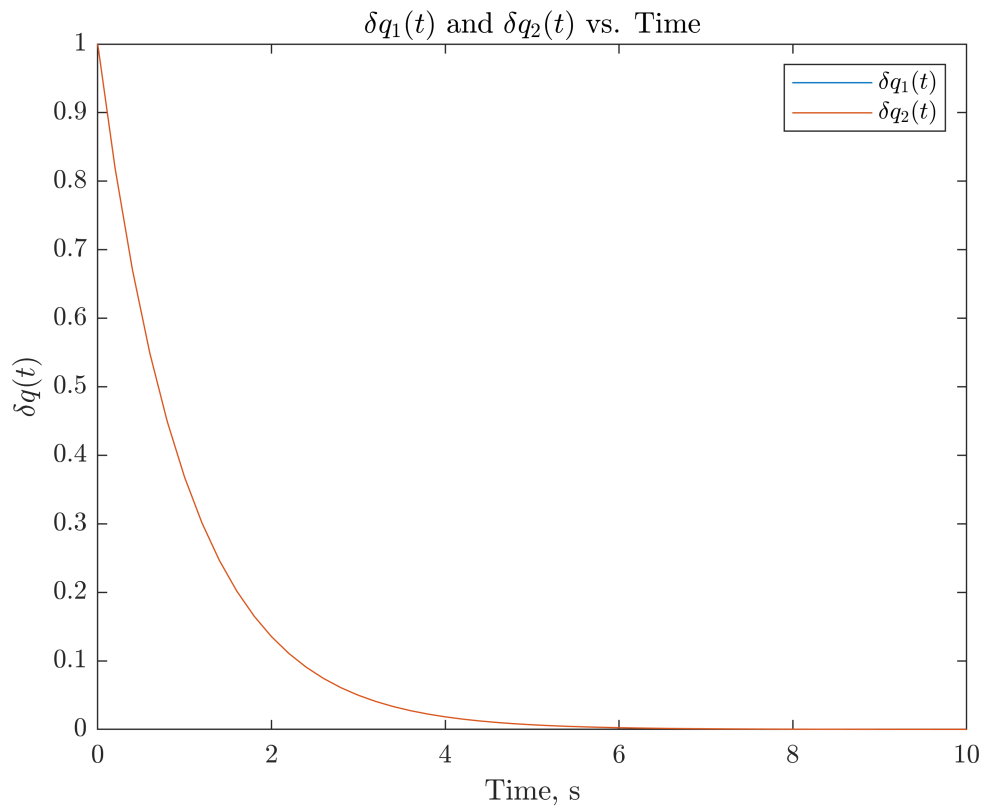
Warning: Imaginary parts of complex X and/or Y arguments ignored.

```
title('$\delta q_{1}(t)$ and $\delta q_{2}(t)$ vs. Time')
xlabel('Time, s')
ylabel('$\delta q(t)$')
hold on
```

```
plot(t,xt(2,:))
```

Warning: Imaginary parts of complex X and/or Y arguments ignored.

```
legend('$\delta q_{1}(t)$','$\delta q_{2}(t)$')
hold off
```



Part g)

```
A = [0 0 1 0; 0 0 0 1; 0 1 0 0; 1 0 0 0]
```

```
A = 4x4
    0    0    1    0
    0    0    0    1
    0    1    0    0
    1    0    0    0
```

```
x0 = [1 1 1 1]'
```

```
x0 = 4x1
    1
    1
    1
    1
```

```
out = sim('problem2model');
[v,d] = eig(A)
```

```
v = 4x4 complex
 -0.5000 + 0.0000i   0.0000 - 0.5000i   0.0000 + 0.5000i  -0.5000 + 0.0000i
 -0.5000 + 0.0000i  -0.0000 + 0.5000i  -0.0000 - 0.5000i  -0.5000 + 0.0000i
```

```

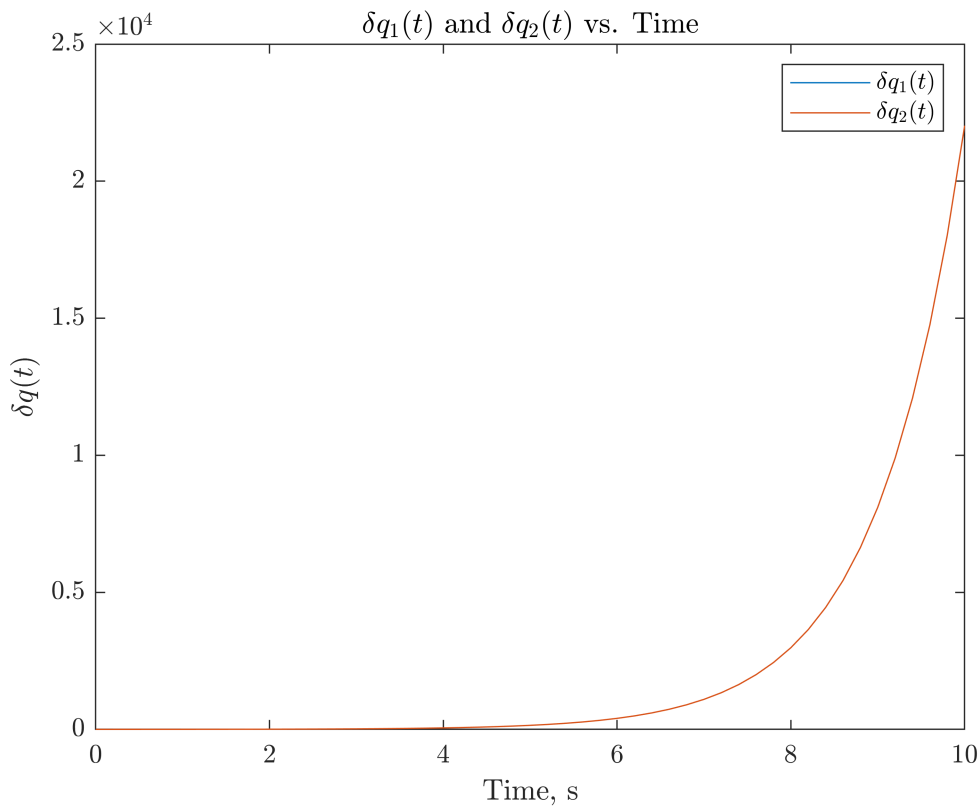
0.5000 + 0.0000i    0.5000 + 0.0000i    0.5000 - 0.0000i   -0.5000 + 0.0000i
0.5000 + 0.0000i   -0.5000 + 0.0000i   -0.5000 + 0.0000i   -0.5000 + 0.0000i
d = 4x4 complex
-1.0000 + 0.0000i    0.0000 + 0.0000i    0.0000 + 0.0000i    0.0000 + 0.0000i
0.0000 + 0.0000i    0.0000 + 1.0000i    0.0000 + 0.0000i    0.0000 + 0.0000i
0.0000 + 0.0000i    0.0000 + 0.0000i    0.0000 - 1.0000i    0.0000 + 0.0000i
0.0000 + 0.0000i    0.0000 + 0.0000i    0.0000 + 0.0000i    1.0000 + 0.0000i

```

```

t = out.x.Time;
q1 = out.x.Data(:,1);
q2 = out.x.Data(:,2);
figure
plot(t,q1)
title('$\delta q_{1}(t)$ and $\delta q_{2}(t)$ vs. Time')
xlabel('Time, s')
ylabel('$\delta q(t)$')
hold on
plot(t,q2)
legend('$\delta q_{1}(t)$', '$\delta q_{2}(t)$')
hold off

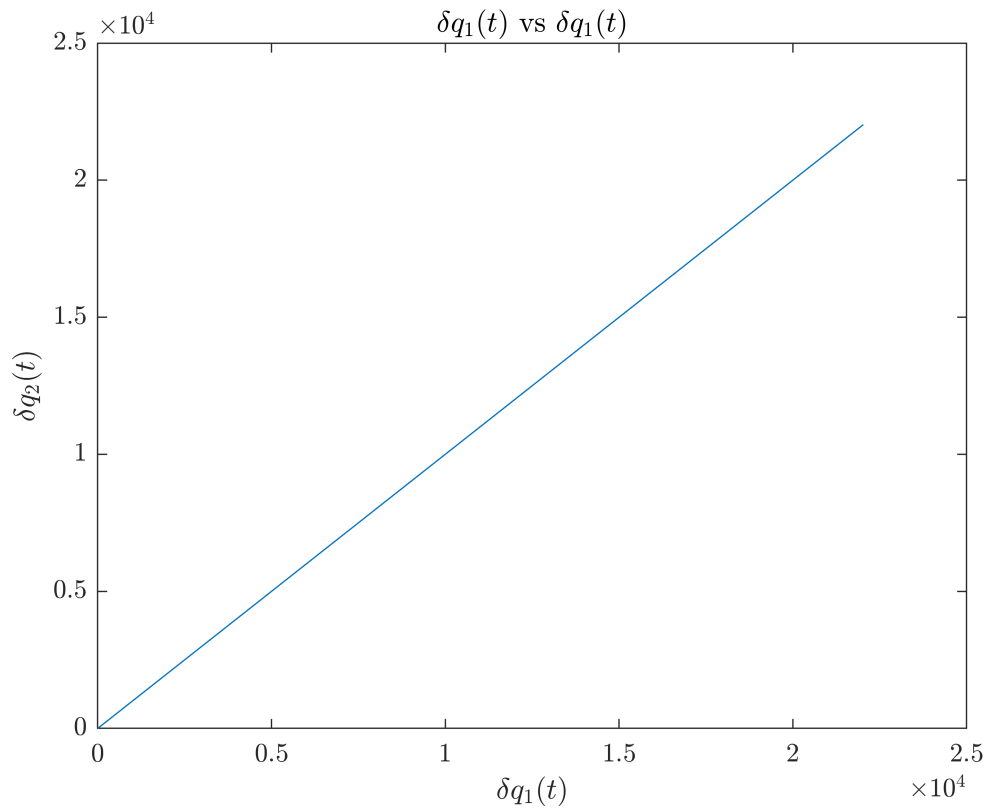
```



```

figure
plot(q1,q2)
title('$\delta q_{1}(t)$ vs $\delta q_{1}(t)$')
xlabel('$\delta q_{1}(t)$')
ylabel('$\delta q_{2}(t)$')

```

```
B = [v(:,1) v(:,2) v(:,3) v(:,4) x0];
C = rref(B);
C = C(:,end)
```

```
C = 4×1 complex
 0.0000 - 0.0000i
-0.0000 + 0.0000i
-0.0000 - 0.0000i
-2.0000 + 0.0000i
```

```
xt = C(1)*exp(d(1,1)*t').*v(:,1) ...
      + C(2)*exp(d(2,2)*t').*v(:,2) ...
      + C(3)*exp(d(3,3)*t').*v(:,3) ...
      + C(4)*exp(d(4,4)*t').*v(:,4)
```

```
xt = 4×51 complex
10⁴ ×
 0.0001 - 0.0000i  0.0001 - 0.0000i  0.0001 - 0.0000i  0.0002 - 0.0000i ...
 0.0001 - 0.0000i  0.0001 + 0.0000i  0.0001 - 0.0000i  0.0002 + 0.0000i
 0.0001 - 0.0000i  0.0001 - 0.0000i  0.0001 - 0.0000i  0.0002 - 0.0000i
 0.0001 + 0.0000i  0.0001 - 0.0000i  0.0001 - 0.0000i  0.0002 - 0.0000i
```

```
figure
plot(t,xt(1,:))
```

Warning: Imaginary parts of complex X and/or Y arguments ignored.

```
title('$\delta q_{1}(t)$ and $\delta q_{2}(t)$ vs. Time')
xlabel('Time, s')
ylabel('$\delta q(t)$')
```

```
hold on
plot(t,xt(2,:))
```

Warning: Imaginary parts of complex X and/or Y arguments ignored.

```
legend('$\delta q_{1}(t)$','$\delta q_{2}(t)$')
hold off
```

