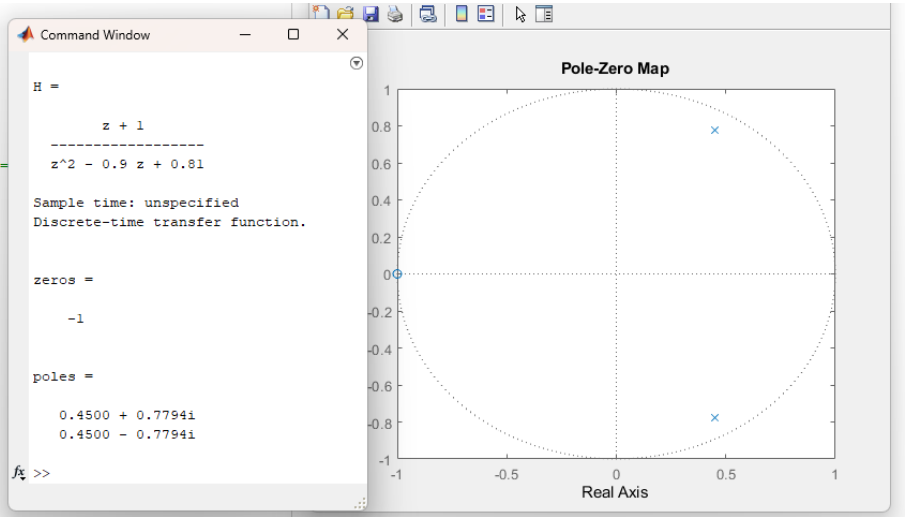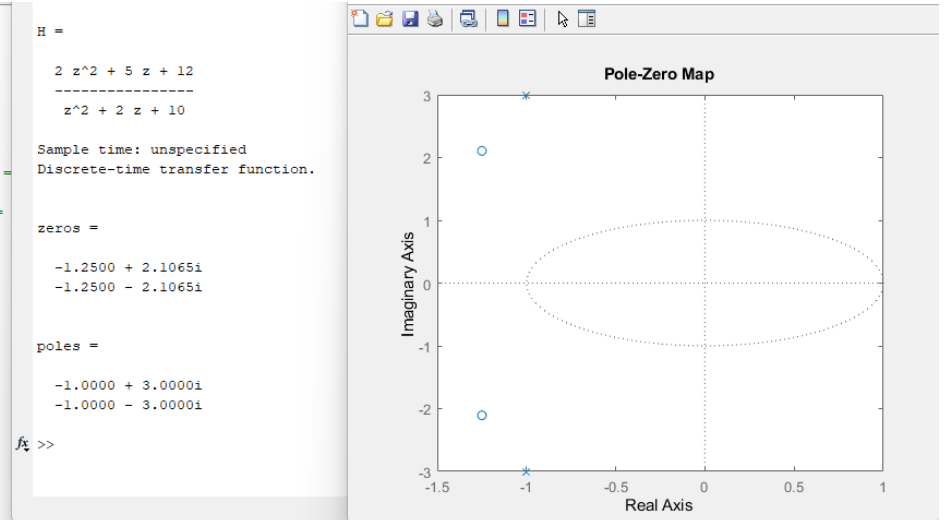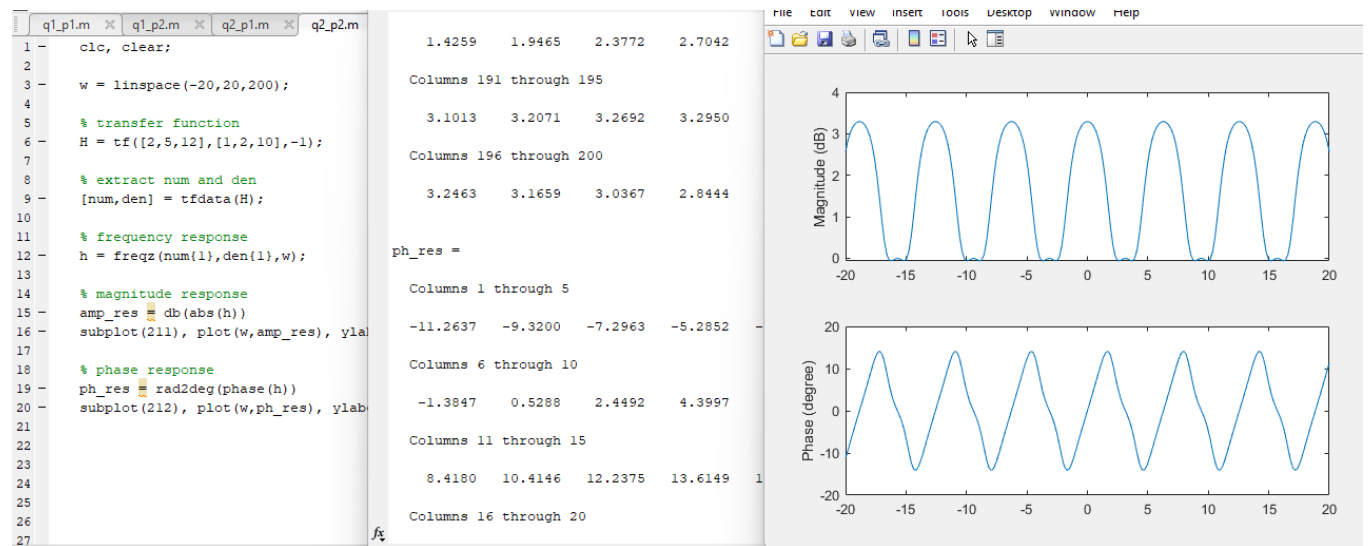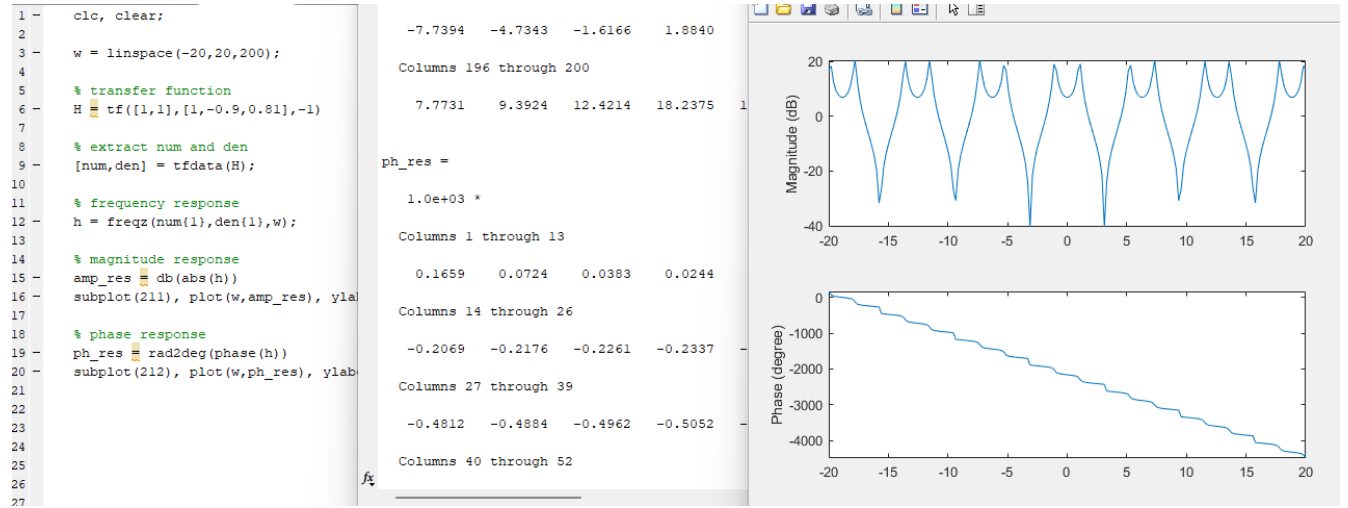# Lab 5

TASK1

```
1 -    clc, clear;
2
3      % transfer function
4 -    H = tf([1,1],[1,-0.9,0.81],ts=-1)
5
6      % extract num and den
7 -    [num,den] = tfdata(H);
8
9      % zeros is the vector when the num of tf =
10 -   zeros = roots(num{1})
11
12     % pole is the vector when the den of tf =
13 -   poles = roots(den{1})
14
15 -   pzmap(H)
16
17
```

Command Window

```
H =

        z + 1
    -------------------
    z^2 - 0.9 z + 0.81

Sample time: unspecified
Discrete-time transfer function.


zeros =

    -1


poles =

    0.4500 + 0.7794i
    0.4500 - 0.7794i

fx >>
```


Pole-Zero Map

```
1 -    clc, clear;
2
3      % transfer function
4 -    H = tf([2,5,12],[1,2,10],ts=-1)
5
6      % extract num and den
7 -    [num,den] = tfdata(H);
8
9      % zeros is the vector when the num of tf =
10 -   zeros = roots(num{1})
11     % pole is the vector when the den of tf =
12 -   poles = roots(den{1})
13
14 -   pzmap(H)
15
16
```

```
H =

    2 z^2 + 5 z + 12
    -----------------
      z^2 + 2 z + 10

Sample time: unspecified
Discrete-time transfer function.


zeros =

    -1.2500 + 2.1065i
    -1.2500 - 2.1065i


poles =

    -1.0000 + 3.0000i
    -1.0000 - 3.0000i

fx >>
```


Pole-Zero Map

Task2 and 3

```matlab
1    clc, clear;
2
3    w = linspace(-20,20,200);
4
5    % transfer function
6    H = tf([1,1],[1,-0.9,0.81],-1)
7
8    % extract num and den
9    [num,den] = tfdata(H);
10
11   % frequency response
12   h = freqz(num{1},den{1},w);
13
14   % magnitude response
15   amp_res = db(abs(h))
16   subplot(211), plot(w,amp_res), yla
17
18   % phase response
19   ph_res = rad2deg(phase(h))
20   subplot(212), plot(w,ph_res), ylab
21
22
23
24
25
26
27
```

```
      -7.7394    -4.7343    -1.6166    1.8840

  Columns 196 through 200

   7.7731     9.3924    12.4214    18.2375   1

ph_res =

   1.0e+03 *

  Columns 1 through 13

   0.1659     0.0724     0.0383     0.0244

  Columns 14 through 26

  -0.2069    -0.2176    -0.2261    -0.2337

  Columns 27 through 39

  -0.4812    -0.4884    -0.4962    -0.5052

  Columns 40 through 52
```



```matlab
q1_p1.m    q1_p2.m    q2_p1.m    q2_p2.m
1    clc, clear;
2
3    w = linspace(-20,20,200);
4
5    % transfer function
6    H = tf([2,5,12],[1,2,10],-1);
7
8    % extract num and den
9    [num,den] = tfdata(H);
10
11   % frequency response
12   h = freqz(num{1},den{1},w);
13
14   % magnitude response
15   amp_res = db(abs(h))
16   subplot(211), plot(w,amp_res), yla
17
18   % phase response
19   ph_res = rad2deg(phase(h))
20   subplot(212), plot(w,ph_res), ylab
21
22
23
24
25
26
27
```

```
   1.4259     1.9465     2.3772    2.7042

  Columns 191 through 195

   3.1013     3.2071     3.2692    3.2950

  Columns 196 through 200

   3.2463     3.1659     3.0367    2.8444

ph_res =

  Columns 1 through 5

 -11.2637    -9.3200    -7.2963   -5.2852

  Columns 6 through 10

  -1.3847     0.5288     2.4492    4.3997

  Columns 11 through 15

   8.4180    10.4146    12.2375   13.6149   1

  Columns 16 through 20
```

Task4

Given the difference equation:

$$y(n) = x(n) + 2x(n-1) - 0.9y(n-1)$$

Applying the Z-transform to the difference equation:

$$Y(z) = X(z) + 2z^{-1}X(z) - 0.9z^{-1}Y(z)$$

Rearrange to solve for $Y(z)$:

$$Y(z) + 0.9z^{-1}Y(z) = X(z) + 2z^{-1}X(z)$$

$$Y(z)(1 + 0.9z^{-1}) = X(z)(1 + 2z^{-1})$$

The transfer function $H(z)$ is given by:

$$H(z) = \frac{Y(z)}{X(z)} = \frac{1 + 2z^{-1}}{1 + 0.9z^{-1}}$$

Multiply both the numerator and the denominator by z:

$$H(z) = \frac{z(1 + 2z^{-1})}{z(1 + 0.9z^{-1})}$$

Thus, the final transfer function is:

$$H(z) = \frac{z + 2}{z + 0.9}$$

```
1    clc, clear;
2
3    num = [1 2];
4    den = [1 0.9];
5
6    disp('Zeros of the system:');
7    roots(num)
8
9    disp('Poles of the system:');
10   roots(den)
11
12
13
```

Command Window

```
Zeros of the system:

ans =

    -2

Poles of the system:

ans =

    -0.9000
```