Report: Signal Processing Lab 2

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Question 1:

ROC, Causality, and Stability (function + script)

Here I have created the function file q1_a.m which houses the function that calculates the required parameters: [N,ROC,C,S]

We call the function with the given inputs in the script and the outputs are received in the format:

```
Output:
for p = 3
     N:
     2

     ROC:
     0     3
     3   Inf

     C:
     0
```

```
1

S:
1
0

for p = 0.1
N:
2

ROC:
    0    0.1000
0.1000       Inf

C:
0
1

S:
0
1

for p = 0
N:
1

ROC:
0   Inf

C:
1

S:
1

for p = 0         0.5
N:
2

ROC:
    0    0.5000
0.5000       Inf

C:
0
1

S:
0
1

for p = 2        -0.5
N:
3

ROC:
    0    0.5000
0.5000    2.0000
```

```
    2.0000       Inf

     C:
     0
     0
     1

     S:
     0
     1
     0

     for p = 0.5        -0.5
     N:
     2

     ROC:
         0    0.5000
    0.5000       Inf

     C:
     0
     1

     S:
     0
     1

     for p = 2  2  2
     N:
     2

     ROC:
     0     2
     2   Inf

     C:
     0
     1

     S:
     1
     0

     for p = 0  1  2
     N:
     3

     ROC:
     0     1
     1     2
     2   Inf

     C:
     0
     0
     1
```

```
S:
0
0
0

for p = -0.5+0i                    0+1i
N:
3

ROC:
    0    0.5000
0.5000    1.0000
1.0000       Inf

C:
0
0
1

S:
0
0
0

for p = 2  2  2
N:
2

ROC:
0     2
2   Inf

C:
0
1

S:
1
0

for p = 0  1  2
N:
3

ROC:
0     1
1     2
2   Inf

C:
0
0
1

S:
0
0
0
```

```
    for p = -0.5+0i                    0+1i
    N:
    3

    ROC:
        0    0.5000
   0.5000    1.0000
   1.0000       Inf

    C:
    0
    0
    1

    S:
    0
    0
    0

    for p = 0+0i   0+1i   0-1i
    N:
    2

    ROC:
    0     1
    1   Inf

    C:
    0
    1

    S:
    0
    0

    for p = 0.5+0i              -0.5+0i                     2+1i
2-1i
    N:
    3

    ROC:
        0    0.5000
   0.5000    2.2361
   2.2361       Inf

    C:
    0
    0
    1

    S:
    0
    1
    0

    for p = 1+1i   1+2i   1+3i   2+1i
    N:
```

```
 4

 ROC:
     0    1.4142
1.4142    2.2361
2.2361    3.1623
3.1623       Inf

 C:
 0
 0
 0
 1

 S:
 1
 0
 0
 0
```

Question 2:

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

We use the function zplane, freqz, impz to calculate the poles, zeroes, frequency/magnitude responses, impulse response for the given system.

The given system represents an FIR filter as the impulse response when plotted can be observed to be of finite duration.

(c) When p is brought down from 0.8 to 0.1, we can see that the number of points in the impulse response reduces.

(e)

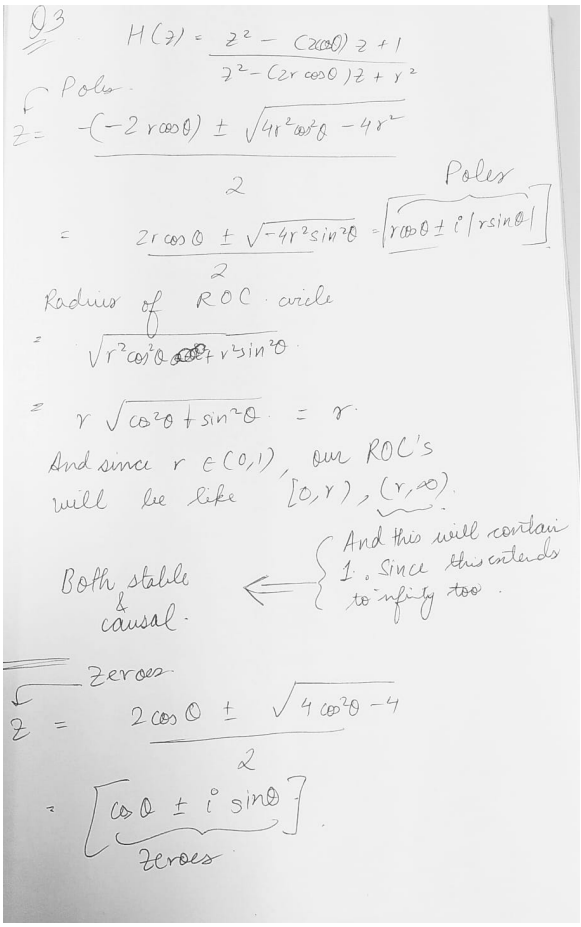
$$H(z) = \frac{z - p^{-1}}{z - p}$$

This also represents an FIR system as in the plot it is observed that the impulse response is of finite duration

Question 3:

$$H(z) = \frac{z^2 - (2cos\theta)z + 1}{z^2 - (2rcos\theta)z + r^2}\ ,\ \ r \in (0,1),\ \theta \in [0,\pi]$$

Poles and Zeroes of the function:



Yes the system can be causal and stable simultaneously, for ROC (r, ∞)
As $r < 1$ this interval contains 1 which makes it stable, and extends to infinity which makes it causal at the same time.

Question 4:

The frequency response and magnitude response have been plotted by using the freqz function and poles of the function have been calculated by using the zplane function.
