DSP UESTC 4005: Homework #chapter 6

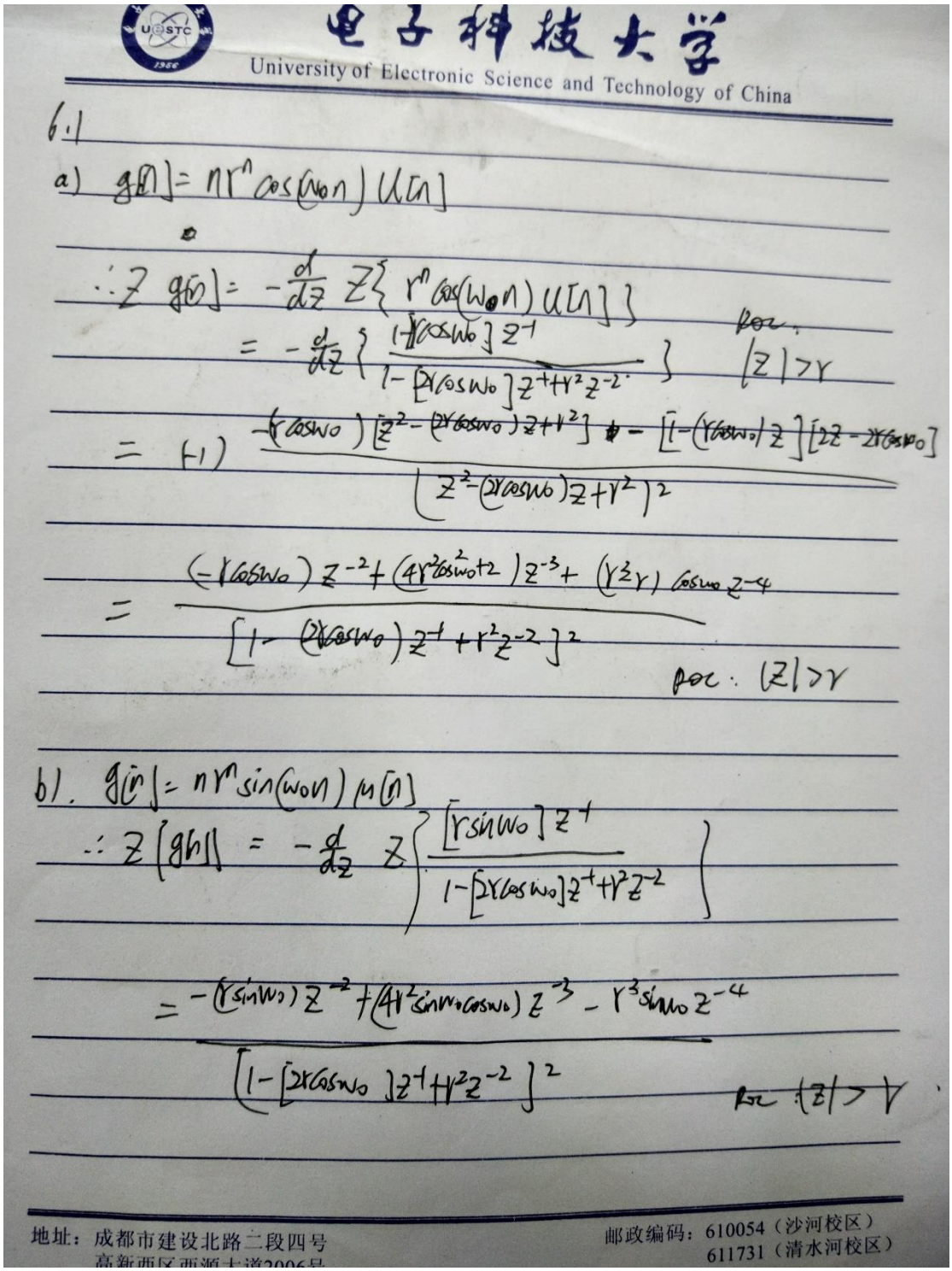
Due on: May 8 2019 at 23:59:59

Instructor: Wenhui Xiong

Jiayi Feng

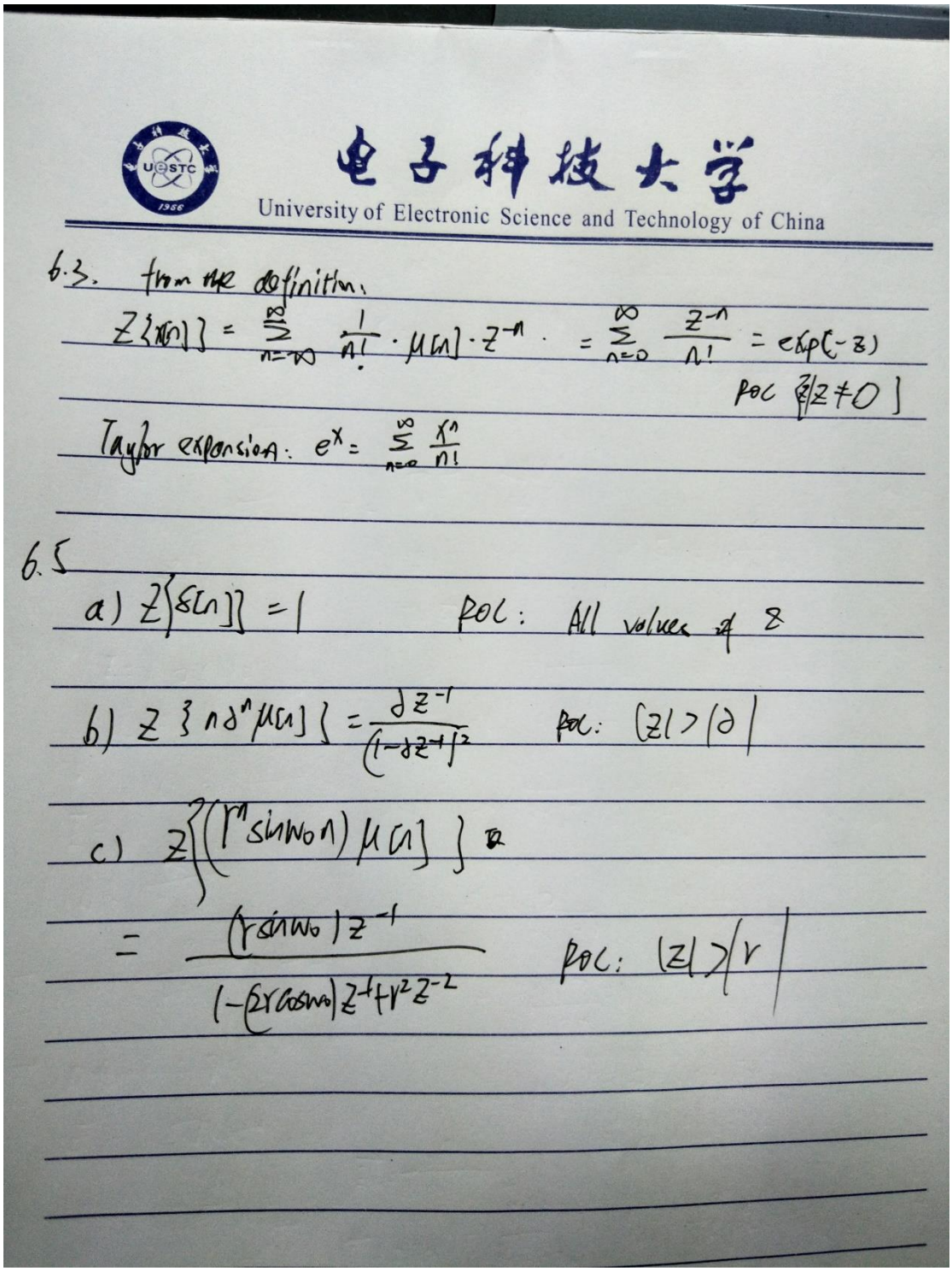
Problem 6.1

Solution:



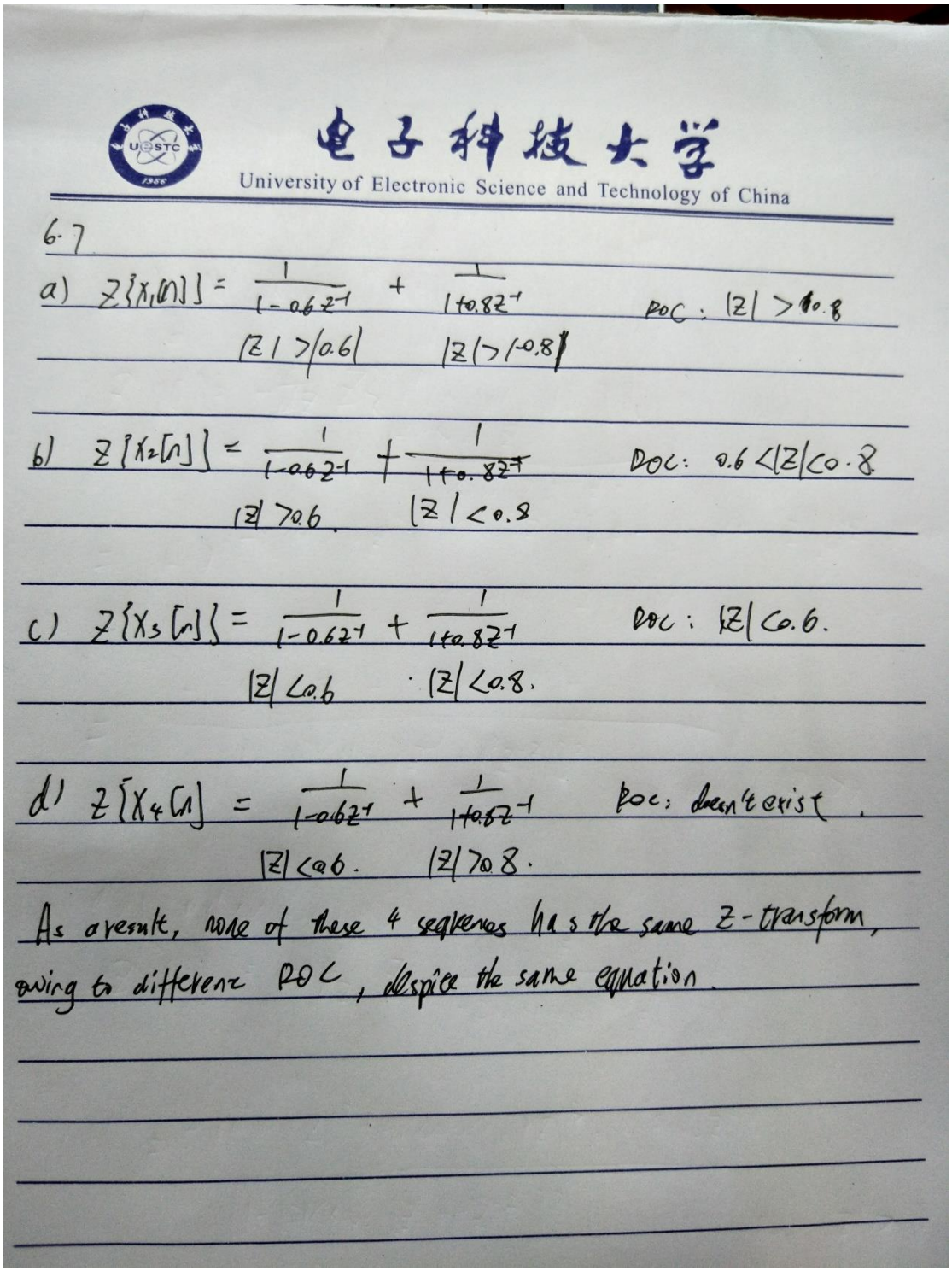
Problem 6.3&6.5

Solution:



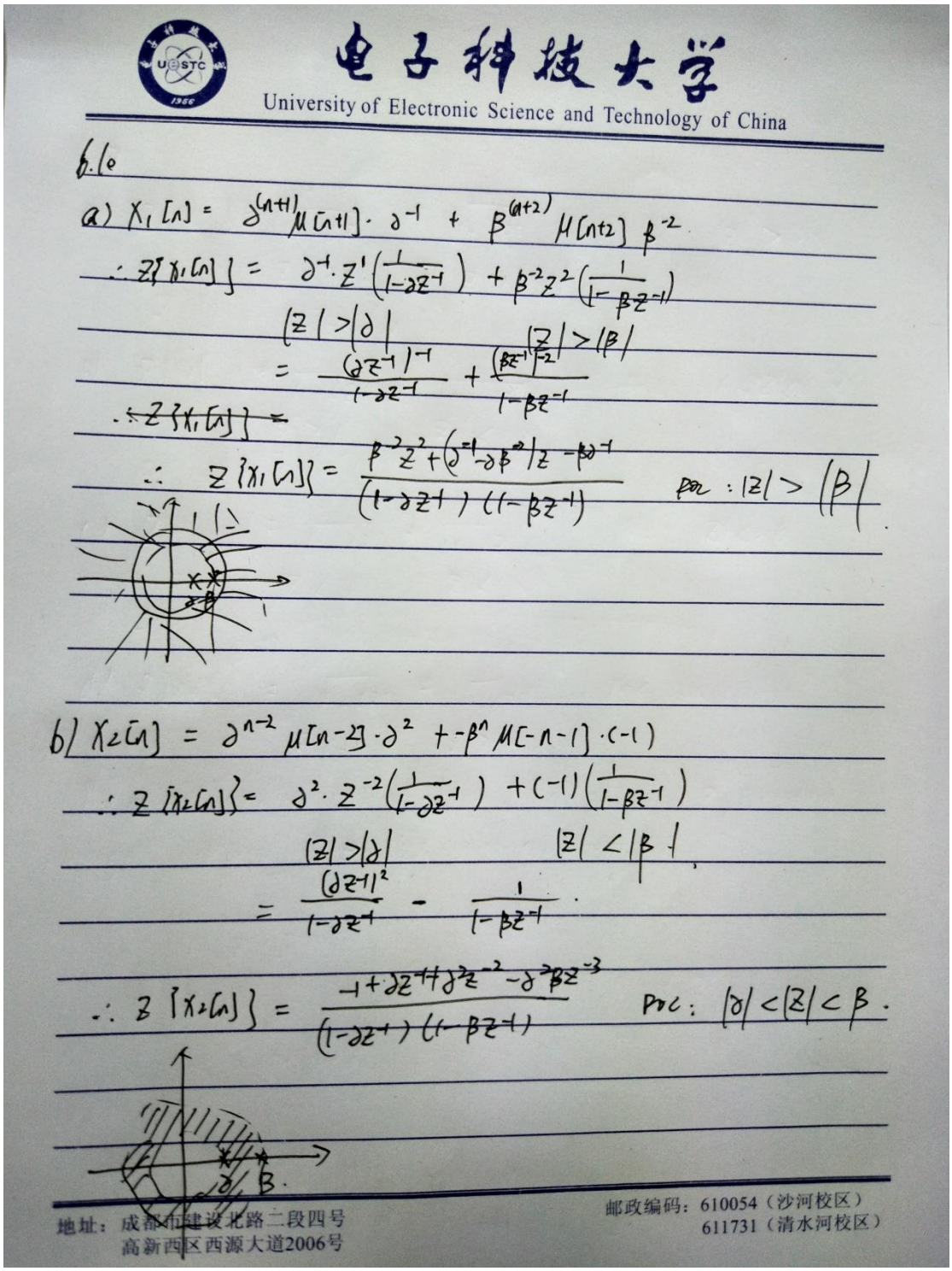
Problem 6.7

Solution:



Problem 6.10&6.13

Solution:



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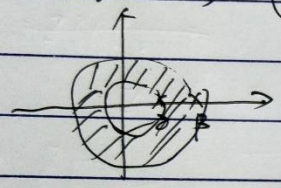
(6). $x_3[n] = \alpha^{n+2}u[n+2]\alpha^{-2} + -\beta^n u[-n-1](-1)$

$\therefore Z\{x_3[n]\} = \alpha^{-2}z^2\left(\frac{1}{1-\alpha z^{-1}}\right) - \left(\frac{1}{1-\beta z^{-1}}\right)$

$|z|>|\alpha| \qquad |z|<|\beta|$

$= \frac{\alpha^{-2}z^2}{1-\alpha z^{-1}} - \frac{1}{1-\beta z^{-1}}$

$Z\{x_3[n]\} = \frac{\alpha^{-2}z^2 \cdot \alpha^{-2}\beta z - 1 + \alpha z^{-1}}{(1-\alpha z^{-1})(1-\beta z^{-1})}$ poc: $|\alpha|<|z|<\beta$.



1.13 a) $X_a(z) = \frac{3.6(z^{-1}+\frac{35}{18})}{(z^{-1}+\frac{10}{3})(z^{-1}+\frac{5}{3})} = \frac{\frac{10}{3}}{z^{-1}+\frac{10}{3}} + \frac{\frac{10}{3}}{z^{-1}+\frac{5}{3}}$

$= \frac{2}{1+0.6z^{-1}} + \frac{5}{1+0.3z^{-1}}$

① poc $|z|<0.3$ then $x_a[n] = (-2)(-0.6)^n u[-n-1] + (-5)(-0.3)^n u[-n-1]$

② poc: $|z|<0.6$ then $x_a[n] = (-2)(-0.6)^n u[-n-1] + 5(-0.3)^n u[n]$.

③ poc: $|z|>0.6$ then $x_a[n] = 2(-0.6)^n u[n] + 5(-0.3)^n u[n]$

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b) $X_b(z) = \frac{3-2z^{-1}}{(1-\frac{2}{5}z^{-1})(1-\frac{1}{5}z^{-1})} = \frac{-4}{1-0.4z^{-1}} + \frac{7}{1-0.2z^{-1}}$

∴ ① ROC: $|z|<0.2$ $x_b[n] = 4(0.4)^n u[-n-1] - 7(0.2)^n u[-n-1]$

② ROC: $0.2<|z|<0.4$ $x_b[n] = 4(0.4)^n u[-n-1] + 7(0.2)^n u[n]$

③ ROC: $|z|>0.4$ $x_b[n] = (-4)(0.4)^n u[n] + 7(0.2)^n u[n]$

c) $X_c(z) = \frac{2}{1+0.6z^{-1}} + \frac{3}{1-0.4z^{-1}} + \frac{-1}{(1-0.4z^{-1})^2}$

∴ ① ROC: $|z|<0.4$. $x_c[n] = [-2)\cdot(-0.6)^n u[-n-1] + (-3)0.4^n u[-n-1]] + (n+1)(0.4)^n u[-n-1]$

② ROC: $0.4<|z|<0.6$ $x_c[n] = (-2)(-0.6)^n u[-n-1] + 3\cdot 0.4^n u[n] + (-1)(n+1)(0.4)^n u[n+1]$

③ ROC: $|z|>0.6$ $x_c[n] = 2(-0.6)^n u[n] + 3\cdot 0.4^n u[n] + (-1)(n+1)(0.4)^n u[n+1]$

Problem 6.81

Solution:

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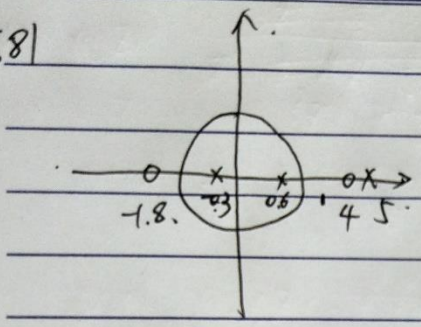
6.8|



a) the frequency response exists if the ROC contains the unit circle.
So. the ROC: $0.6<|z|<5$ would allow the existence of the frequency response

b) The system is stable if the ROC is $0.6<|z|<5$.
However, it cannot be casual since it is two-sided.

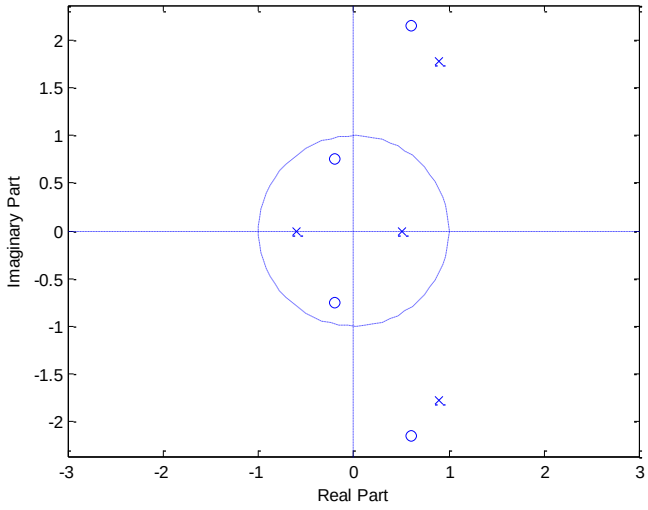
c) $h[n]=A(-0.3)^n u[n]+B(0.6)^n u[n]+C(-5)^n u[n]$

Problem M6.1

Solution:

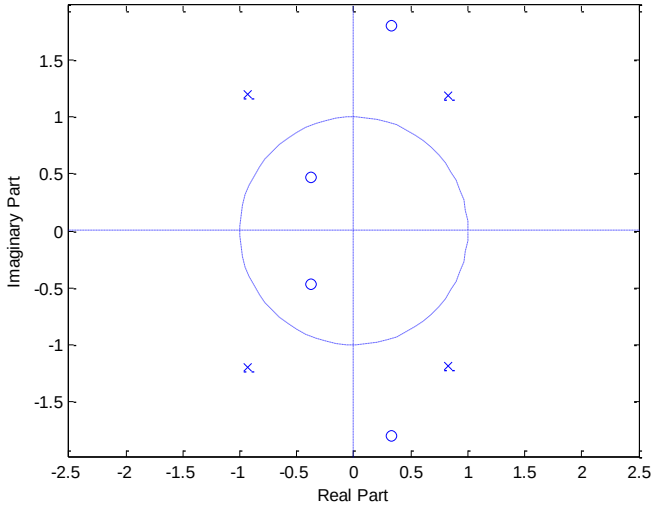
a)

```
>>
Type in the numerator coefficients = [3 -2.4 15.36 3.84 9]
Type in the denominator coefficients = [5 -8.5 17.6 4.7 -6]

Numfactors =

   1.00000000000000  -1.20000000000000   5.00000000000000
   1.00000000000000   0.40000000000000   0.60000000000000


Denfactors =

   1.00000000000000  -1.80000000000000   4.00000000000000
   1.00000000000000   0.60000000000000                   0
   1.00000000000000  -0.50000000000000                   0

Numerator factors
   1.00000000000000  -1.20000000000000   5.00000000000000
   1.00000000000000   0.40000000000000   0.60000000000000

Denominator factors
   1.00000000000000  -1.80000000000000   4.00000000000000
   1.00000000000000   0.60000000000000                   0
   1.00000000000000  -0.50000000000000                   0

Gain constant
   0.60000000000000

>>
```


Imaginary Part
Real Part
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-3
-2
-1
0
1
2
3

b)

```
Type in the numerator coefficients = [2 0.2 6.4 4.6 2.4]
Type in the denominator coefficients = [5 1 6.6 0.42 24]

Numfactors =

   1.00000000000000  -0.65920228694765   3.34132939149340
   1.00000000000000   0.75920228694765   0.35913849231837


Denfactors =

   1.00000000000000   1.85397919923719   2.29431858207741
   1.00000000000000  -1.65397919923719   2.09212444927931

Numerator factors
   1.00000000000000  -0.65920228694765   3.34132939149340
   1.00000000000000   0.75920228694765   0.35913849231837

Denominator factors
   1.00000000000000   1.85397919923719   2.29431858207741
   1.00000000000000  -1.65397919923719   2.09212444927931

Gain constant
   0.40000000000000

>>
```


Imaginary Part
Real Part
1.5
1
0.5
0
-0.5
-1
-1.5
-2.5
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
2.5

Problem M6.2

Solution:

a)

```
Type in numerator coefficients = [7 0 0]
Type in denominator coefficients = [1 0.3 -0.1]
Residues
     5     2

Poles
  -0.500000000000000    0.200000000000000

Constants
     0
```

So, the z-transform will be:

$$X_a(Z) = \frac{5}{1+0.5z^{-1}} + \frac{5}{1-0.2z^{-1}}$$

The inverse z-transform is dependent on the ROC.

b)

```
Type in numerator coefficients = [0 3 1.8 1.28]
Type in denominator coefficients = [1 0.3 -0.24 -0.08]
Residues
   7.23456790123457  15.98765455604055  -7.22222245727512

Poles
   0.500000000000000  -0.400000005880860  -0.399999994119140

Constants
   -16
```

So, the z-transform will be:

$$X_b(Z) = -16 + \frac{7.2346}{1-0.5z^{-1}} + \frac{-7.2222}{1+0.4z^{-1}} + \frac{15.9877}{(1+0.4z^{-1})^2}$$

The inverse z-transform is dependent on the ROC.

Problem M6.4

Solution:

Choose a) as the example.

```
Type in the residues = [6/2 -12.5/2.5]
Type in the poles = [-1/2 0.4]
Type in the constants = [2]
Numerator polynomial coefficients
         0   -3.5000   -0.4000

Denominator polynomial coefficients
    1.0000    0.1000   -0.2000
```

```
Type in the length of output vector = 30
Type in the numerator coefficients = [0 -3.5 -0.4]
Type in the denominator coefficients = [1 0.1 -0.2]
Coefficients of the power series expansion
  Columns 1 through 9

         0   -3.5000   -0.0500   -0.6950    0.0595   -0.1450    0.0264   -0.0316    0.0084

  Columns 10 through 18

   -0.0072    0.0024   -0.0017    0.0006   -0.0004    0.0002   -0.0001    0.0000   -0.0000

  Columns 19 through 27

    0.0000   -0.0000    0.0000   -0.0000    0.0000   -0.0000    0.0000   -0.0000    0.0000

  Columns 28 through 30

   -0.0000    0.0000   -0.0000
```