**Zagazig University**
**Faculty of Engineering**
**Computer and Systems Department**

**Course: CSE 417 – Computer-controlled Systems**
**$4^{th}$ Year Computer & Systems Engineering**
**Mid-term Exam – November 09, 2017**

| No of pages: 1 | Time allowed: 45 min | Total marks: 15 |
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## Question 1 (8 Marks)

**(a) True or false:**

- **The mapping, $z = e^{Ts}$, from continuous to discrete-time system is valid for both poles and zeros.**
- **The transfer function of a system is the same as the z-transform of the impulse response of the system.**
- **With the mapping, $z = e^{Ts}$, the unit circle in s-plane is mapped to the imaginary axis in z-plane.**
- **The pulse response of a first order system having a pole at z = 0.5 will have an alternating sign.**
- **With trapezoidal approximation, continuous-time stable filters are always converted to stable discrete-time filters.**
- **Zero-order hold is a non-causal operation.**

**(b) Consider a signal of frequency 1 Hz, sampled at a rate of fs = 10 Hz. Assume that there is a noise component at 8 Hz.**

1- **What are the first four frequencies appearing at the sampled signal?**
2- **How to eliminate the effect of aliasing?**

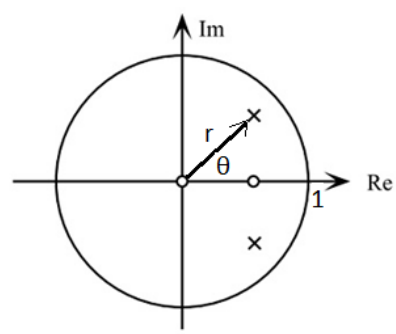
## Question 2 (7 Marks)

**(a) Given the following signal in the z-domain**

$$Y(z) = \frac{(z+1)}{(z-1)(z-2)}$$

1- **What is the final value of $y(k)$?**
2- **Find the inverse z-transform of $Y(z)$.**

**(b) A system has two poles, two zeros and a dc gain of 10. The location of the poles and zeros are shown in the given figure,** $r = 1/\sqrt{2}, \theta = 45°$.




1- **Find the transfer function of the system.**
2- **Find the first four samples of the unit pulse response of the system.**

***----- All best wishes -----***

# Answer

**Question 1**

(a) X √ X X √ X

(b) 1, 2, 8, 9 Hz – use an anti-aliasing filter of cut-off frequency 5 Hz.

**Question 2**

(a) 1- As $Y(z)$ has a pole at $z = 2$ (outside the unit circle), the final value of $y(k)$ has a final value of $\infty$.

2-

$$\frac{Y(z)}{z} = \frac{(z+1)}{z(z-1)(z-2)} = \frac{A}{z} + \frac{B}{(z-1)} + \frac{C}{(z-2)} = \frac{0.5}{z} - \frac{2}{(z-1)} + \frac{1.5}{(z-2)}$$

$$Y(z) = 0.5 - \frac{2z}{(z-1)} + \frac{1.5z}{(z-2)}$$

$$y(k) = 0.5\delta(k) - 2 + 1.5(2)^k$$

Again, we can see that the final value of $y(k)$ is $\infty$.

(b)

1- The zeros are $$z = 0,\ z = \frac{1}{\sqrt{2}}\cos 45° = \frac{1}{2}$$

The poles are $$z = \frac{1}{\sqrt{2}}(\cos 45° \pm j\sin 45°) = \frac{1}{2} \pm j\frac{1}{2}$$

Hence the transfer function is

$$G(z) = \frac{z(z-0.5)}{(z-0.5+j0.5)(z-0.5-j0.5)} = \frac{z(z-0.5)}{z^2 - z + 0.5}$$

The dc gain of G(z) = G(1) = 1. For the transfer function to have a dc gain of 10, the transfer function is:

$$G(z) = 10\frac{z(z-0.5)}{z^2 - z + 0.5}$$

2- Using long division, the pulse response is given by:

$$Y(z) = 10 + 5z^{-1} + 0z^{-2} - 2.5z^{-3} + \ldots$$

That is, y(0) = 10, y(1) = 5, y(2) = 0, y(3) = -2.5.