

<b>Quiz Number:</b> 2	<b>Course Title:</b> Digital Signal and Image Processing	<b>Course Code:</b> ELEC 421	<b>Date:</b> Thursday, November 7, 2024	<b>Duration of Quiz:</b> 15 minutes	<b>Number of Questions:</b> 5	<b>Instructor:</b> Siamak Najarian, Ph.D., P.Eng.	<b>University:</b> UBC	<b>Department:</b> Electrical and Computer Engineering
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**Please carefully read the following instructions and guidelines:**

1. *This quiz is closed books/notes.*
2. *You will not get a negative mark for choosing the incorrect answer.*
3. *Each question carries 1 mark.*

*Best of Luck!*

**Question 1:**

Given the digital signal z-transform  $X(z) = \frac{5z}{2z^2+4z+8}$  and knowing that the signal is right-sided, determine the time-domain signal  $x[n]$ .

A)  $\frac{5 \cdot 2^{n-1} \sin\left(\frac{2\pi n}{3}\right)}{\sqrt{3}}$

B)  $\frac{5 \cdot 2^n \sin\left(\frac{n\pi}{3}\right)}{3}$

C)  $\frac{5 \cdot 2^n \sin\left(\frac{2\pi n}{3}\right)}{3}$

D)  $\frac{5 \cdot 2^{n-2} \sin\left(\frac{\pi n}{3}\right)}{\sqrt{3}}$

Note that:  $a^n \sin(\omega_0 n) u[n] \xleftrightarrow{\mathcal{Z}} \frac{za \sin(\omega_0)}{z^2 - 2a \cos(\omega_0)z + a^2} \quad |z| > a$

**Question 2:**

Which statement best reflects the significance of the unit circle in the context of the z-transform and Fourier transform?

A) The z-transform diverges from the Fourier transform on the unit circle when the region of convergence (ROC) includes it.

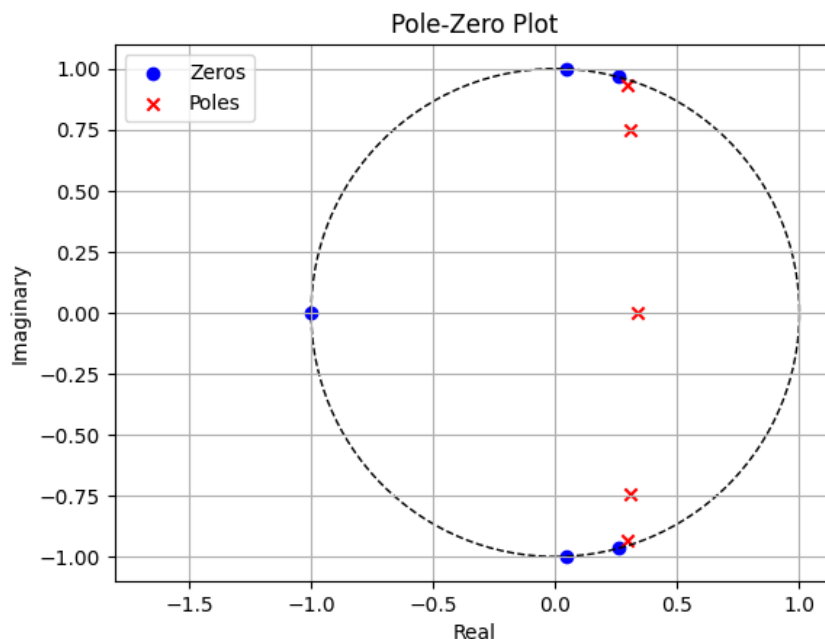
B) The unit circle is fundamental to discrete-time analysis, paralleling the importance of the  $j\omega$ -axis in continuous-time analysis.

C) The Fourier transform can be effectively analyzed without reference to the unit circle in discrete-time systems.

D) The z-transform is primarily concerned with real-valued frequencies, unlike the Fourier transform, which operates on the complex plane.

**Question 3:**

Based on the provided pole-zero plot of a digital filter, which type of filter is most likely represented by the plot?



- A) Highpass
- B) Bandpass
- C) Stopband
- D) Lowpass

**Question 4:**

Which of the following statements accurately describes the relationship between the Discrete Fourier Transform (DFT) and the Discrete-Time Fourier Transform (DTFT)?

- A) The DFT is a continuous representation of the DTFT evaluated at  $\frac{2\pi k}{N}$ .
- B) The DFT,  $X[k]$ , samples the DTFT,  $X(\omega)$ , at  $N$  equally-spaced points.
- C) The DFT can be computed without referencing the DTFT, as they are independent transforms.
- D) The DTFT is derived from the DFT by evaluating it at continuous frequency points.

**Question 5:**

Given  $X[k] = \sum_{n=0}^{N-1} x[n] \cdot e^{-j \cdot k \cdot \frac{2\pi n}{N}}$ , where  $k = 0, 1, \dots, N - 1$  and  $N = 4$ . Suppose  $x[0] = 1$ ,  $x[1] = 1$ ,  $x[2] = 0$ , and  $x[3] = 0$ . What are the values of  $X[1]$  and  $X[3]$ , respectively?

- A) 2, 0
- B)  $1 + j$ ,  $1 - j$
- C)  $1 - j$ ,  $1 + j$
- D) 0, 2

**End of Questions**

**Answer Sheet:**

Question Number	A	B	C	D
1				
2				
3				
4				
5				