

# SOLUTIONS

## Quiz #6 ECEn 380 - Fall 2015

You have 10 minutes to complete the following quiz. Closed book, closed note, and closed neighbor.

1. Find the Discrete Time Fourier Transform (DTFT) of  $x[n] = \{1, 2, 1\}$ . **Simplify your answer until there are no complex exponentials left for full credit.** (5 pts)

$$\begin{aligned} X(e^{j\Omega}) &= \sum_{n=-\infty}^{\infty} x[n] e^{-j\Omega n} = 1 \cdot e^{-j\Omega(-1)} + 2e^{-j\Omega(0)} + 1 \cdot e^{-j\Omega(1)} \\ &= 2 + e^{j\Omega} + e^{-j\Omega} = \boxed{2 + 2\cos(\Omega)} \end{aligned}$$

2. What is the DC component of the signal from the last problem? (3 pts)

Apologies, but it turns out this is an ambiguous question, since I didn't specify whether I meant the DC component of  $x[n]$  or the DC component of  $X(e^{j\Omega})$ .

3. Consider the DTFT of a signal  $x[n]$ . You know that  $X(e^{j2\pi/3}) = 4j$ . What is  $X(e^{j8\pi/3})$ ? (4 pts)

$$\boxed{4j}$$

THE DC COMPONENT OF  $x[n]$  IS 4.  
THE DC COMPONENT OF  $X(e^{j\Omega})$  IS 2.

4. If a signal  $x[n]$  is periodic, real, and even, and you are given that the Fourier Series Coefficient  $x_1 = 3$ , what is the Fourier Series Coefficient  $x_{-1}$ ? (4 pts)

$$\boxed{3}$$

THE FORMER ( $x[n] \Rightarrow 4$ ) IS A MUCH MORE NATURAL INTERPRETATION, BUT I ACCEPTED EITHER.

5. Suppose I sample a continuous-time signal that is band-limited to  $<25\text{kHz}$  at a sampling frequency of  $50\text{kHz}$ , and then take a finite number of those samples and load them into a Matlab vector  $x$ . I then perform the following operation:

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y = fftshift(fft(x));
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What frequency does  $y[1]$  represent in kHz? (4 pts)

$$\boxed{-25\text{ kHz}}$$