# ELEG 305 SIGNALS AND SYSTEMS
# SPRING 2019

- **All Homeworks and Homework Quizzes are worth 25 points.**
- **Homeworks and Solutions from Spring 2018 have been posted on Canvas.**

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## HOMEWORK #7

- *Do not hand in*
- *There will be a Quiz, in Lecture on Tuesday April 30, on a variation of one of the following problems. Solutions will be posted to all of the problems before the Quiz.*
- *Conceptual and Math Review Problems are extra credit here (10 total points) and will not be asked on the Quiz. Please hand them in on Tuesday April 30 in Lecture.*

Read Chapters 5, 7, and 9 in Oppenheim, Willsky, and Nawab (**O&W**)

**O&W:** #5.2, #5.3, #5.21 (a,b,d,g), #5.22 (a,c,e,g), #5.23 (b,c,d,f), #5.33 (a,b(ii)), #5.34(a)

**Additional Problems on Sampling:**

**Problem #1**
Consider the following continuous-time signal (with $W = 100\pi$ rad/sec )

$$x(t) = \left(\frac{\sin(Wt)}{\pi t}\right)^4$$

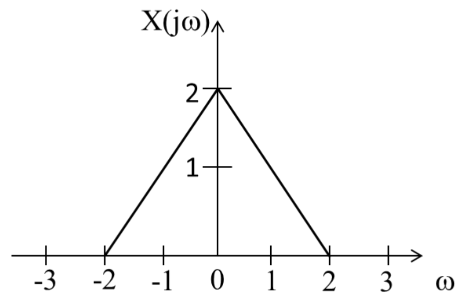
Impulse sampling is performed on $x(t)$. What is the Nyquist rate for this signal?

**Problem #2**
Consider the following continuous-time signal

$$x(t) = e^{-6t}u(t) * \frac{\sin(Wt)}{\pi t}$$

Impulse sampling is performed on $x(t)$; assume $W = 100\pi$ rad/sec. Determine the minimum sampling frequency, $f_s$, which guarantees that the signal $x(t)$ is recoverable from its samples.

**Problem #3**
Consider a continuous-time signal, $x(t)$, with the frequency characteristic shown below.




a.) What is the Nyquist rate?
b.) Suppose $x(t)$ is sampled, at ***twice*** the Nyquist rate, using impulse-train sampling. Draw the spectrum of the resulting sampled signal.
c.) Suppose $x(t)$ is passed through an ideal lowpass filter with a bandwidth of 1 rad/sec. What is the minimum sampling rate for the filtered signal?

**Conceptual:** Violins and flutes might play the exact same notes (e.g., "A" played on a violin or a flute has the same fundamental frequency of 440 Hz,) but you can definitely tell if either a flute or a violin is playing. Using your knowledge of the Fourier transform, explain (in just a 2 or 3 sentences) how this is possible.

**Math Review:** For the following sums of geometric series, determine the values of z (a complex number) for which the sums exist, and then evaluate the sum.

$$\sum_{n=0}^{\infty}\left(\frac{z}{a}\right)^{-n}$$

$$\sum_{n=-\infty}^{-1}(az^{-1})^{n}$$

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**EXAM # 3** Thursday May 9

- Closed everything: no calculators, cellphones, laptops, …
- Chapters 5, 7, and 9
- A formula sheet will be provided with trigonometric identities, and the defining equations and properties for Discrete-Time Fourier Transforms and Laplace Transforms
- Review on Monday May 6