Data Analysis **AE/ME 599 Fall 2020** **Instructor: P. Kreth**
Homework #1 **Due: 09/03/2020**

Note: *Show all necessary steps in determining your solution.* ***Score:*** / 25

[2 pts] 1. B&P - Problem 1.1: Determine the period of the function defined by $x(t) = \sin 11t + \sin 12t$

[4 pts] 2. B&P - Problem 1.2: For the following functions, which are periodic and which are non-periodic?

(a) $x(t) = 3\sin t + 2\sin 2t + \sin 3t$

(b) $x(t) = 3\sin t + 2\sin 2t + \sin \pi t$

(c) $x(t) = 3\sin 4t + 2\sin 5t + \sin 6t$

(d) $x(t) = e^{-t}\sin t$

[3 pts] 3. Determine if $x(t) = \sin\left(\sqrt{50}t\right) + 4\cos\left(\sqrt{98}t - \frac{\pi}{4}\right)$ is periodic and, if so, what is its period?

[6 pts] 4. Calculate the Fourier Transform, $X(\omega)$, of the following function,

$$x(t) = \begin{cases} Ae^{-at}\cos(bt) & t \geq 0 \\ 0 & t < 0 \end{cases}$$

and plot $X(\omega)$ in the complex plane. Graph the magnitude $|X(\omega)|$ and phase $\angle X(\omega)$ with $A = 2$, $a = 1$, and $b = \pi$ for $0 \leq \omega \leq 10$.

[10 pts] 5. Determine the Fourier Series approximation of the following sawtooth wave, and plot the results with n = 1, 3, 5, 15, and 95 (on the same figure). In your graph, show the results from $0 \leq t \leq 2$, and use at least 10,000 points to resolve the edge effects (i.e., t = linspace(0, 2, 10000);). *Hint: find a pattern in the coefficients and write a code to generate the various terms for you.* Based on your observations, what do you think the spectrum of a sawtooth wave would look like, compared to a sine wave at the same frequency?

$x(t) = t - \lfloor t \rfloor$
where $\lfloor t \rfloor$ denotes $floor(t)$