ECE 148 **Signal Processing Applications** **Spring 2025**

Assignment 4: Fourier Series Expansion

Due: Tuesday, May 6

Consider the periodic signal, with period $T = 16$,

$$f(t) = \begin{cases} -5 & -8 \le t < -5 \\ +3 & -5 \le t < +5 \\ -5 & +5 \le t < +8 \end{cases}$$

1. Plot the function $f(t)$ and formulate the Fourier series expansion of the function, in the complex form.

2. For this periodic signal, utilize 7 harmonics, for $n = \pm 1, \pm 2, \ldots \pm 7$, to reconstruct the signal. Plot the result for one period, within the interval $(-8, +8)$.

3. The 15 Fourier coefficients corresponding to the 7 harmonics are grouped into a sequence $\{F_n\}$, where $n = -7, -6, \ldots +5, +6, +7$. Take the *DTFT* of this 15-point sequence and plot the result within the interval $(-\pi, +\pi)$.

4. Take the *32-point DFT* of this 15-point sequence and plot the result.

5. Take the *64-point DFT* of this 15-point sequence and plot the result.

6. Summary: Compare the results from *Problems 2, 3, 4,* and *5,* and describe the relationships.

Note: The input and output sequences of the *DFT* operations need to be organized to provide adequate illustrations.