ECE 453: Wireless Communication Systems **Fall 2026**
Problem Set #1 **Due Date: 5pm, Fri, Sept 11, 2026**

1. A band-limited approximation to a unit-amplitude square wave is

$$m(t) = \frac{4}{\pi} \sum_{m=1,3,5...}^{N} \frac{\sin(n\omega_m t)}{n}$$

   a. Write the corresponding series for the Hilbert transform $\hat{m}(t)$, using the convention that the Hilbert transform of $\sin(\omega t)$ is $-\cos(\omega t)$.
   b. For N = 1, 3, 7, 11, and 15, plot $m(t)$ and $\hat{m}(t)$ over one period of the fundamental.
   c. The message is transmitted using SSB. The RF envelope is proportional to

$$A(t) = \sqrt{m(t)^2 + \hat{m}(t)^2} \ .$$

   For each N, determine the peak-to-average envelope-power ratio

$$PAR = \frac{\max\left|A(t)^2\right|}{\text{average}\left|A(t)^2\right|} .$$

   Comment on the trend as the pulse edges become sharper.

2. DSB-SC is used to transmit a pulse-amplitude-modulated message

$$m(t) = \sum a_n p(t - nT)$$

The symbol interval is $T = 0.80$ μs and $p(t)$ is a raised-cosine pulse with roll-off factor $\beta = 0.35$. Determine the total RF bandwidth occupied by the DSB-SC signal.