Master of Science in Technology Innovation
University of Washington

TECHIN 513, Winter 2025 — *Instructor*: Luyao Niu
Homework 1 — *Due* **on Canvas**

Instructions:

1. If a problem involves plotting/ sketching a graph, please make sure that the **axes of the graph are labeled clearly**. You will lose points for every graph axis that is not clearly labeled.

2. You can discuss the homework assignment with peers in the class. However, your submission must be written in your own words.

3. Show your **thought process** and **intermediate steps**. Simply giving the final answer will not earn points. Incorrect final answer with intermediate steps may earn partial credits.

4. **Submit your results in a pdf file. If you use Python to solve the problem, submit your code in a separate file**.

Problems

1. Consider a discrete-time signal $x[n]$ given as

$$x[n] = \begin{cases} -1 & \text{if } n = -4 \\ -\frac{1}{2} & \text{if } n = -3 \\ \frac{1}{2} & \text{if } n = -2 \\ 1 & \text{if } n = -1, 0, \ldots, 2 \\ \frac{1}{2} & \text{if } n = 3 \\ 0 & \text{otherwise} \end{cases} \tag{1}$$

Sketch the graphs of:

(a) $x[3 - n]$;

(b) $x[(n-1)^2]$.

2. Determine the total energy and average power in the following signals:

   (a) $x[n] = (-1)^n$;

   (b) $x[n] = 0.5^n u[n]$.

3. Determine which of the following sequences is periodic. If the sequence is periodic, determine its fundamental period N.

   (a) $\sin[62\pi n/10]$;

   (b) $\sin[5n]$;

   (c) $\cos[5\pi n/3] + \sin[7\pi n/3]$.

4. **Optional.** Determine the even and odd parts of the signal $x[n] = \alpha^n u[n+2]$, where $u[n]$ is the unit-step sequence.

5. **Optional.**

(a) Let $x_e[n]$ and $x_o[n]$ be the even and odd parts of a DT signal $x[n]$. Prove that:

$$\sum_{n=-\infty}^{\infty} (x[n])^2 = \sum_{n=-\infty}^{\infty} (x_e[n])^2 + \sum_{n=-\infty}^{\infty} (x_o[n])^2$$

(b) Determine the even and odd parts of $x[n] = \alpha^{|n|}$.

Answers

Answers to select problems are provided for your reference.

1b. *Hint*: remember that $(n-1)^2$ is always non-negative.

2a. Infinite energy with average power 1.

2b. Finite energy with average power 0.

3. *Hint*: Determine whether each of the terms is periodic. If both terms are periodic, the period of the signal will be the LCM of the periods of the individual signals.