Weekly Homework 1

Dr. Sameti
CE 40242: Signals and Systems

Problem 1.
Prove the following statements.

(1) All signals with finite average energy, have power average equal to zero.
(2) Signals can have infinite energy and infinite power at the same time.
(3) Let $x_e(t)$ and $x_o(t)$ denote the even and odd parts of $x(t)$ respectively. Energy of $x(t)$
equals to the sum of energies of $x_e(t)$ and $x_o(t)$.

Problem 2.
Signal $x[n]$ is shown below. Sketch the following.

(1) $x[2 - n]$
(2) $x[\frac{3}{4}n - 1]$
Problem 3.
Signal $x(t)$ is given below. Define $x(t)$ in terms of Heaviside step function, and then sketch $\frac{d}{dt}x(t)$

Problem 4.
Determine if the following signals are periodic or not. If so, find their fundamental period.

(1) $x(t) = \sqrt{\cos(5t)}$

(2) $x[n] = \sin(5n)$

(3) $x[n] = e^{j\frac{3\pi}{14}n} + e^{j\frac{5\pi}{14}n}$

(5) $x[n] = |e^{j\sin(\frac{4\pi}{5}n)}|$

Problem 5.
Determine if the following systems are time-invariant, stable and causal.

(1) $y(t) = \int_{t-2}^{t-1} x(\tau)\cos(\tau)d\tau$

(2) $y(t) = x(t)\sin(x(t))$

(3) $y[n] = \cos(n+3)x[n]$

(4) $y[n] = \sin(\frac{n\pi}{4})x[n] + n^2 x[\cos(\frac{n\pi}{2})]$

(5) $y[n] = \sqrt[3]{x[n]}$
Problem 6.
Determine if the following systems are linear.

(1) \( y(t) = \frac{x(t)e^{jx(t)}}{2j} \)
(2) \( y(t) = \text{Re}\{x(t)\} \)
(3) \( y[n] = 2x[n] + 4 \)
(4) \( y[n] = \frac{\sum_{i=1}^{n} x[n-i]}{n} \)
(5) \( y[n] = \sqrt[n]{\prod_{i=1}^{n} x[n-i]} \)

Problem 7.
Please solve these problems from Oppenheim Signals and Systems book, second edition.

- 1.21
- 1.22
- 1.27
- 1.33
- 1.39