

ARIZONA STATE UNIVERSITY
DEPARTMENT OF ELECTRICAL ENGINEERING
EEE 404/591 Spring 2009
Problem Set #1

Assigned: 4 February 2009
Due Date: 18 February 2009

Reading: Finish reading Chapter 1 (except Section 1.7), and Sections 2.1 to 2.4.1 in Kuo & Gan.
Start reading Chapters 1 to 3 of the *DSP56800E 16-bit DSP Core Reference Manual*.

PROBLEM 1.1:

Indicate which of the following input-output relationships represent a linear system (Justify your answer).

- (a) $y(n) = 3x^2(n)$.
- (b) $y(n) = x(2n)$.
- (c) $y(n) = x(n) - 4x(n - 1)$.

PROBLEM 1.2:

Indicate which of the following input-output relationships represent a time-invariant system (Justify your answer).

- (a) $y(n) = x^3(n)$.
- (b) $y(n) = 10x(4n)$.
- (c) $y(n) = x(n) - 4x(n - 1)$.
- (d) $y(n) = e^{x^2(n)}$.

PROBLEM 1.3:

Consider a linear time-invariant system with impulse response $h(n) = \delta(n+2) + 2\delta(n-1)$. Compute and plot the output of the system when the input is:

$$x(n) = \begin{cases} 1, & n = 0 \\ -2, & n = 1 \\ 1, & n = 2 \\ 0, & \text{otherwise} \end{cases}$$

PROBLEM 1.4:

Consider an analog sinusoidal signal $x(t)$ given by:

$$x(t) = 4 \sin(4000\pi t + \pi/3)$$

- Determine the frequency in Hertz of the analog sinusoid $x(t)$.
- Determine the discrete-domain signal $x(n)$ that is obtained by sampling $x(t)$ with a sampling frequency $f_s = 6000$ Hertz.
- For $x(n)$ obtained as in (b), determine the number of instructions that can be performed during the sampling interval (time between two consecutive samples) using the DSP56858.

PROBLEM 1.5:

Consider a system with the following input-output relation:

$$y(n) = 2x(n-1) + x(n)$$

- Determine the impulse response of this system.
- Is this system FIR or IIR? Justify your answer.

PROBLEM 1.6:

Consider the following two signals:

$$x(n) = \begin{cases} 1, & n = 0, 1, 2, 3 \\ 0, & \text{otherwise} \end{cases}$$

and

$$h(n) = \begin{cases} 1, & n = 0, 1, 2 \\ 0, & \text{otherwise} \end{cases}$$

- Compute and plot the convolution $x(n) * h(n)$.
- Compute and plot the 4-point circular convolution of $x(n)$ with $h(n)$ and compare the result to the linear convolution result in (a).
- Determine the minimum size of the circular convolution so that it gives the same result as the linear convolution.
- Using the size determined in (c), compute and plot the circular convolution.

PROBLEM 1.7:

Problem B-2-13, page 88 in Kuo & Gan.

PROBLEM 1.8:

Problem B-2-14, page 88 in Kuo & Gan.

PROBLEM 1.9:

Problem B-2-17, page 88 in Kuo & Gan.