Homework #1

(Due by 15:10, October 12, 2016)

1. Consider a signal $x(t)$ shown in Fig. 1. Sketch and label carefully each of the following signals: (20%)

   (1) (6%) $y(t) = x(20t)$

   (2) (6%) $y(t) = x(0.1t)$

   (3) (8%) $y(t) = x(5t+3)$

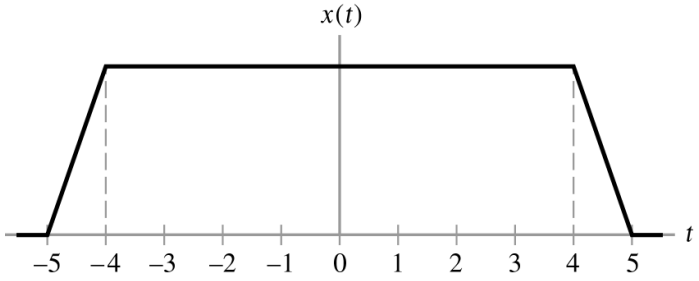

Fig. 1

2. Determine whether or not each of the following signals is periodic; if so, find the fundamental period. (20%)

   (1) $x(t) = \textit{Even part of } \sin(4\pi t)u(t)$;

   (2) $x(t) = \sum_{k=-\infty}^{+\infty} (-0.1)^k \delta(t-2k)$;

   (3) $x[n] = \cos(\frac{\pi}{8} n^2)$;

   (4) $x[n] = \cos(\frac{\pi}{2} n)\cos(\frac{\pi}{4} n)$;

   (5) $x[n] = 2\cos(\frac{\pi}{4} n) + \sin(\frac{\pi}{8} n) - 2\cos(\frac{\pi}{2} n + \frac{\pi}{6})$.

3. A system consists of several subsystems connected as shown in Fig. 2. Express $y(t)$ as a function of $x(t)$. (20%)

$$H_1 : y_1(t) = x_1(t)x_1(t-1);$$
$$H_2 : y_2(t) = |x_2(t)|;$$
$$H_3 : y_3(t) = 1 + 2x_3(t);$$
$$H_4 : y_4(t) = \cos(x_4(t)).$$

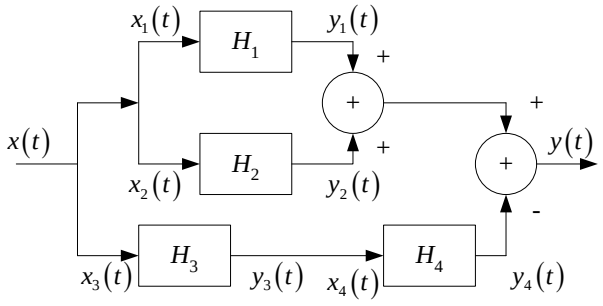

Fig. 2

4. The output of a discrete-time system is related to its input $x[n]$ as follows:

$$y[n] = a \cdot x[n] - b \cdot x[n-1] + c \cdot x^2[n-2]$$

Let the operator S^k denote a system that shifts the input $x[n]$ by k time units to produce $x[n-k]$. Formulate the operator H for the system relating $y[n]$ to $x[n]$. Then develop a block diagram representation for H, using (a) cascade implementation and (b) parallel implementation. (10%)

5. The following systems have input $x(t)$ or $x[n]$ and output $y(t)$ or $y[n]$. For each system, determine whether or not it is (i) memoryless, (ii) invertible, (iii) causal, (iv) bounded-input bounded-output stable, (v) time-invariant, and (vi) linear. Justify your answers briefly. **Also find the inverse system if the system is invertible.** (30%)

(1) (8%) $y[n] = \log_{10}(|x[n]|)$

(2) (7%) $y(t) = \cos(x(t))$

(3) (8%) $y[n] = \sum_{k=-\infty}^{n} x[k+2]$

(4) (7%) $y(t) = x(2-t)$

	Memoryless	Invertible	Causal	Stable	Time-Invariant	Linear
(1)						
(2)						
(3)						
(4)						