Homework No. 1

Due 17:20, October 11, 2012

1. Determine whether the following signals are periodic, and for those which are, find the fundamental period: (20%)

(1) $x[n]=\sin\left(\frac{6\pi}{7}n+1\right)$, (2) $x(t)=\left[\cos\left(2t-\frac{\pi}{3}\right)\right]^2$

(3) $x(t)=\sum_{k=-\infty}^{\infty}(-1)^k\,\delta(t-2k)$, (4) $x[n]=\cos\left(\frac{\pi}{2}n\right)\cos\left(\frac{\pi}{4}n\right)$

2.

(1) The trapezoidal pulse $x(t)$ of Fig. 1 is time scaled, producing the equation $y(t) = x(at)$. Sketch $y(t)$ for $a = 20$ and 0.1. (10%)

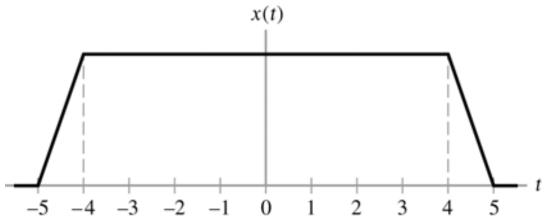

Figure 1

(2) Sketch the trapezoidal pulse $y(t)$ related to that of Fig. 1 as follows

$y(t)=x(5(t-1))$ (10%)

3. A system consists of several subsystems connected as shown in Fig. 2. Express $y(t)$ as a function of $x(t)$. (15%)

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

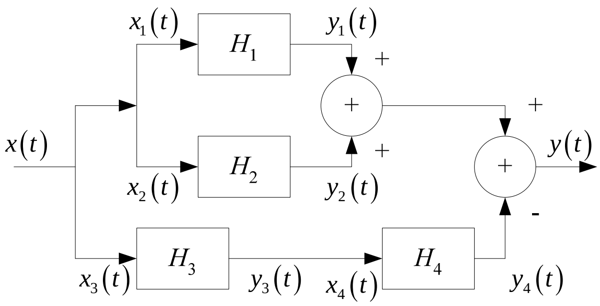

Figure 2

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 $x[n-k]$. Draw the block diagrams representation for this system by using (a) cascade implementation and (b) parallel implementation. (20%)

5. The system that follow have input $x(t)$ or $x[n]$ and output $y(t)$ or $y[n]$. For each system, determine whether it is (i) memoryless, (ii) stable, (iii) causal, (iv) linear, and (v) time invariant. (25%)

(1) $y(t) = \cos\left(x(t)\right)$; (2) $y[n] = 2x[n]u[n]$; (3) $y[n] = \log_{10}\left(\left|x[n]\right|\right)$;

(4) $y(t) = \int_{-\infty}^{t/2} x(\tau)d\tau$; (5) $y[n] = \sum_{k=-\infty}^{n} x[k+2]$.