Tik-61.140 Signal processing systems

1. partial test, mo 1.3.1999 12-15 BC

You can take advantage of

- a mathematical handbook
- graphical calculator. **Remember to erase the memory!**

1. Consider the discrete systems below:

$$y_1[n] = x[-n];$$
$$y_2[n] = x[n-2] - 2y_2[n-8];$$
$$y_3[n] = nx[n],$$

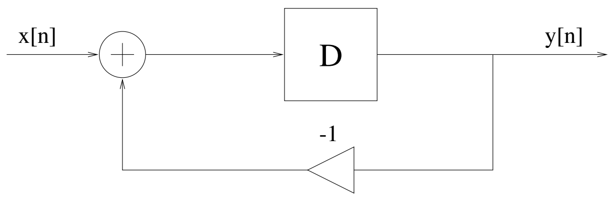
   where $y_i[n]$ is the output of the system to input $x[n]$.

   Are the systems

   i) memoryless,
   ii) timeinvariant,
   iii) linear or
   iv) causal.

   Justify your results shortly!

2. Consider the feedback system given below. Let us assume that the output $y[n] = 0$ when $n < 0$.



   i) Sketch the output, if the input is $x[n] = \delta[n]$;
   ii) Sketch the output, if the input is $x[n] = u[n] - u[n-2]$.
   iii) Is the system stable? Justify!

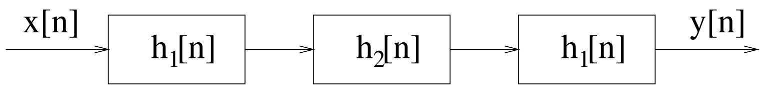
3. Consider the signals given below:

   i) $x_1(t) = 2e^{j(t+\frac{\pi}{4})}$,
   ii) $x_2[n] = \sin(\frac{\pi}{4}n)u[n] - \sin(-\frac{\pi}{4}n)u[-n]$ and
   iii) $x_3[n] = \sum_{k=-\infty}^{\infty} \{\delta[n-4k] - \delta[n-1-4k]\}$.

   Which of the signals are periodic? Justify! Determine the fundamental periods of the periodic signals.

4. **a)** The impulse response of a system is $h_1[n] = u[n] - u[n-2]$. Is the system linear and/or timeinvariant?

   b) The system h_1 is connected in cascade with a causal LTI-system h_2, according to the block diagram shown below:



   Calculate the impulse response of the other system $h_2[n]$, when the impulse response of the *total system* $h[n]$ is the impulse response showm in the table below.

n	<0	0	1	2	3	4	>4
h[n]	0	1	5	9	7	2	0

   c) Calculate the output of the total system, when the input is $x[n] = \delta[n+1] - \delta[n-1]$.

Notice that in all the problems above the unit-impulse is noted by $\delta[n]$ and the unit-step function is noted by $u[n]$.