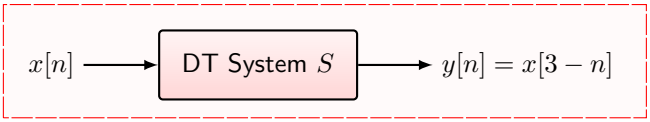
Australian National University
Research School of Engineering
College of Engineering and Computer Science

ENGN2228 Signal Processing

HOMEWORK 5

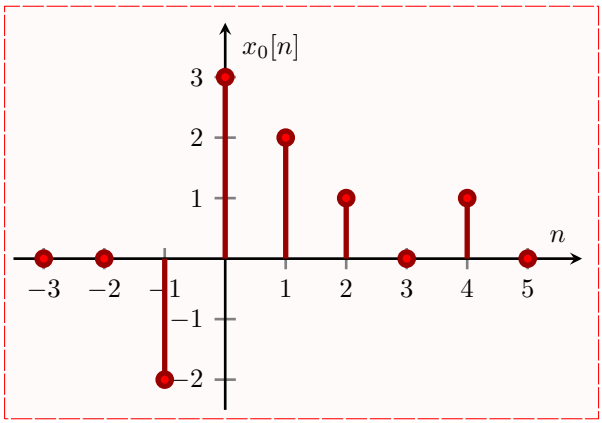
Homework 5-1



Consider the DT system, S, with input signal $x[n]$ and output signal given by

$$S: \quad y[n] = x[3-n]. \tag{1}$$

(a) Write signal $x_0[n]$, shown below, in terms of linear combinations of shifted $\delta[n]$.



(b) Draw the output $y_0[n]$ when the input is given by $x_0[n]$ shown above.

(c) Write this signal $y_0[n]$ in terms of linear combinations of shifted $\delta[n]$.

(d) Shown that the system is linear.

(e) Shown that the system (1) is non-causal.

(f) Shown that the system (1) is time-varying.

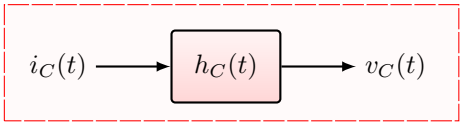
(g) Suppose we have the same system but we don't know its defining relationship (1).
Let $h[n]$ be the output when $\delta[n]$ is applied. We observe $h[n] = \delta[n-3]$.
Can the system be fully characterised by this $h[n]$, that is, if we only know $h[n]$ can we determine the output for any input signal $x[n]$ for such an unknown system?

Homework 5-2

(a) The voltage and current for a capacitor C are related through

$$i_C(t) = C\frac{dv_C(t)}{dt}.$$

Consider the LTI system with input $i_C(t)$ and output $v_C(t)$. What is the impulse response $h_C(t)$ of the system? (You can express the result using the $u_k(t)$ functions defined in Part 7 of the lecture notes, or Section 2.5 of the text.)



(b) The inductor L can be thought of as the dual of the capacitor C where the transformation can be achieved by $L \leftrightarrow C$, $v_L(t) \leftrightarrow i_C(t)$ and $i_L(t) \leftrightarrow v_C(t)$. What is the impulse response $h_L(t)$ for the LTI system with input $i_L(t)$ and output $v_L(t)$