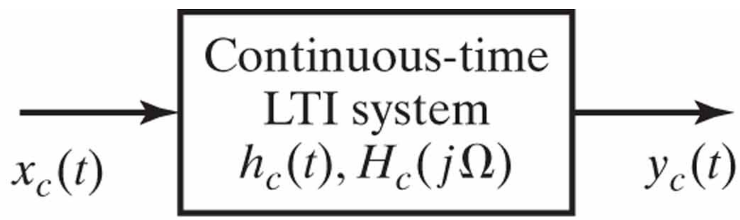
Outline

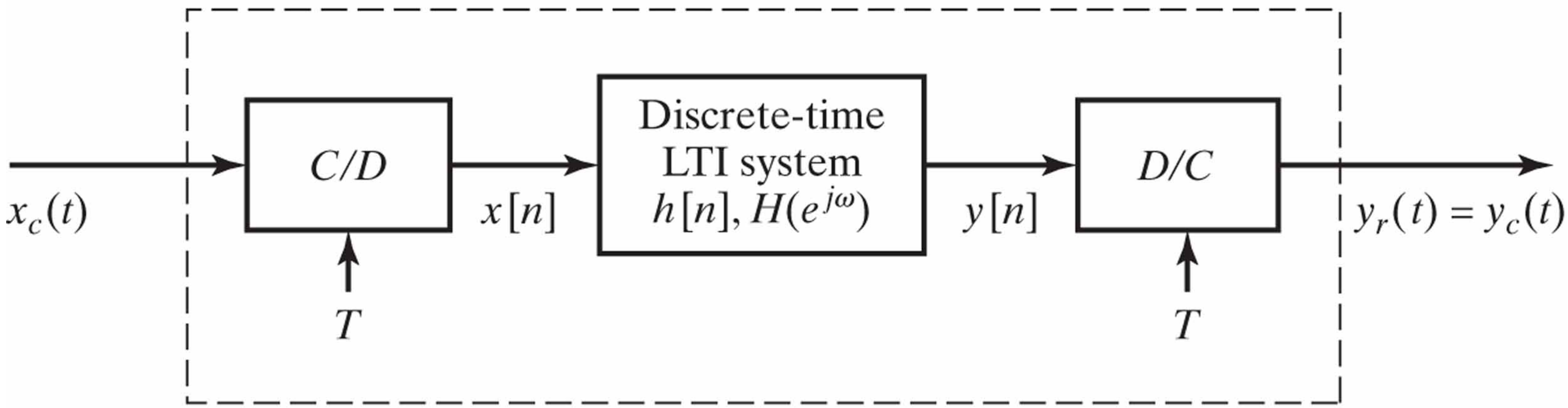
- DT processing of CT signals (cont'd)
  - Summary of the equations discussed yesterday
  - Examples

Assignment 4 to be posted today.

Due date: Wednesday March 24 4:00 pm



(a)



$H_{\text{eff}}(j\Omega) = H_c(j\Omega)$

(b)

Summary of equations describing the DT processing of CT signals

ω = frequency of DT signals Ω = frequency of CT signals

$\omega = \Omega \cdot T$ where T is the sampling period

$$a)\text{C/D convertor } X_d(e^{j\omega}) = \frac{1}{T} X_c\left(j\frac{\omega}{T}\right) \text{ for } -\pi \leq \omega \leq \pi$$

$$b)\text{ DT system } Y_d(e^{j\omega}) = H_d(e^{j\omega}) X_d(e^{j\omega})$$

$$c)\text{ D/C convertor } Y_c(j\Omega) = \begin{cases} TY_d\left(e^{j\Omega T}\right) \text{ for } |\Omega| < \dfrac{\Omega_s}{2} \\ 0 \text{ otherwise} \end{cases}$$

By substitutions (a in b and b in c) we obtain

$$Y_c(j\Omega) = \begin{cases} H_d\left(e^{j\omega}\right) \cdot X_c\left(j\dfrac{\omega}{T}\right) \text{ for } |\Omega| < \dfrac{\Omega_s}{2} \\ 0 \text{ otherwise} \end{cases}$$

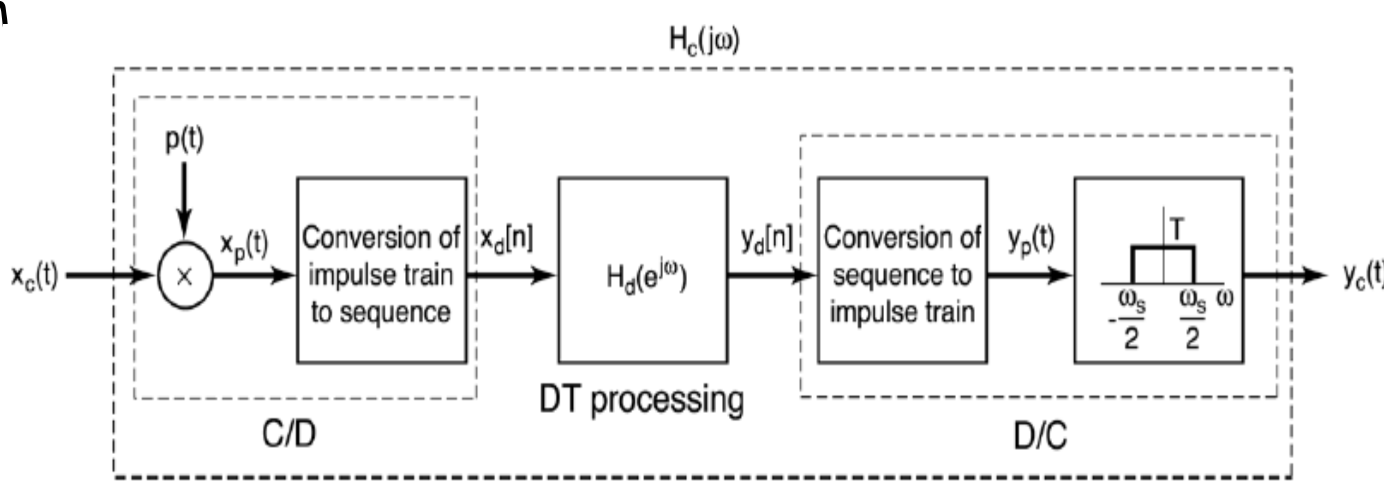
$$H_c(j\Omega) = \begin{cases} H_d\left(e^{j\Omega T}\right) \text{ for } |\Omega| < \dfrac{\Omega_s}{2} \\ 0 \text{ otherwise} \end{cases}$$

Example 1

- The figure below shows a system that processes continuous-time signals using a digital filter h[n] that is linear and causal with difference equation
- y[n]=(1/2)y[n-1]+x[n]
- For band-limited input signals such that $X_c(j\Omega) = 0 \text{ for } |\Omega| > \pi / T$

the system in the figure is equivalent to a continuous-time LTI system.

- Determine the frequency response of the equivalent overall CT system



Example 2.

- Let $x_c(t) = \frac{\sin(75\pi t)}{\pi t}$
- The signal $x_c(t)$ is sampled every T seconds to produce the discrete-time signal $x_d[n]=x_c(nT)$.
- The signal $x_d[n]$ is the input to a discrete-time LTi system with impulse response

$$h_d[n] = \frac{\sin\left(\frac{\pi}{4}n\right)}{\pi n}$$

- The output $y_d[n]$ of the discrete-time system is converted to an impulse train

$$y_p(t) = \sum_{m=-\infty}^{+\infty} y_d(nT)\delta(t - nT)$$

- Finally, the signal $y_p(t)$ is the input of a low-pass filter

$$h_l(t) = \frac{\sin(100\pi t)}{\pi t}$$

- Find $y_c(t)$ for T=1/50.