

## Quiz #6 Solution

1. The system samples signal at 1 KHz and takes 12000 cycles to process each sample using 10 MHz processor clock. Can system run in real time? Explain the difference between hard and soft real-time systems.

Real-time systems perform their operation fast enough to influence the system they control. They are classified according to the consequences of missing a deadline.

Hard real-time systems may generate a total system failure if the deadline is missed.

Soft real-time systems may tolerate missing a processing deadline for a limited period of time that will degrade only the system's quality of service (such as latency)

$$F_s = 1 \text{ KHz}, T_s = 1 \text{ ms}$$

$$\text{Processing time } T_p = 12,000 * 0.1 \mu s = 1.2 \text{ ms} > T_s$$

Therefore, the system CAN NOT work in real time.

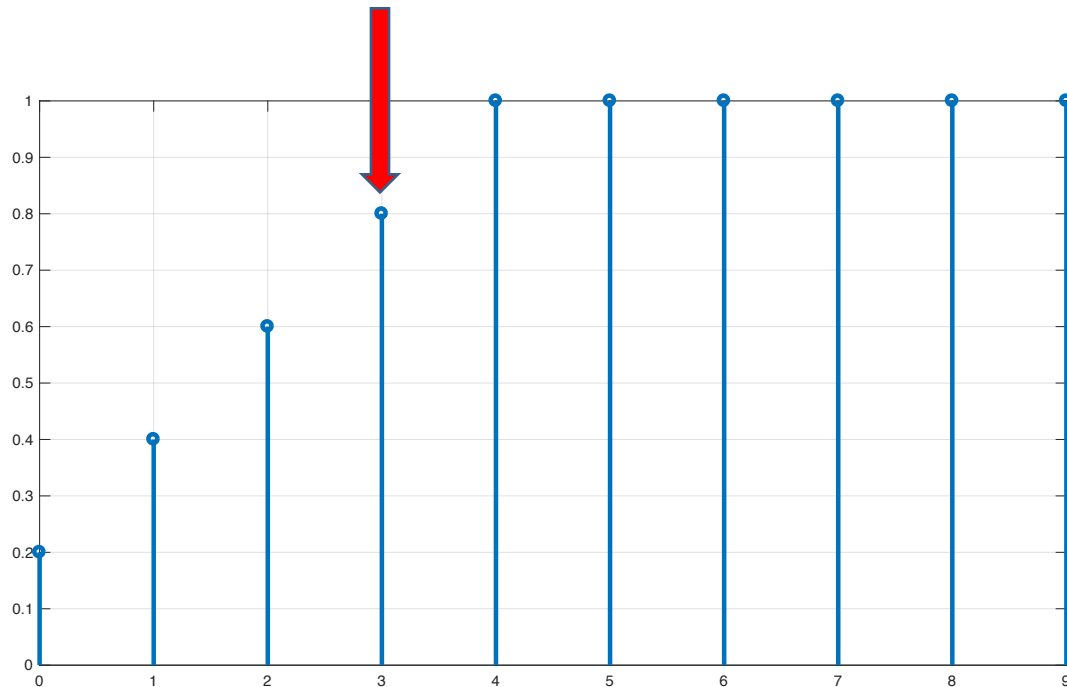
2. Signal is sampled at  $F_s=100$  Hz and processed by FIR filter of length  $NB=80$ . What is the latency of output signal introduced by filtering?

Output latency is

$$T_d = T_s * NB / 2 = 10 \text{ ms} * 80 / 2 = 400 \text{ ms}$$

3. Transfer function of the system is a 5-point averager. Input signal is sampled with sample interval  $T_s$ . What is the value of step response at time  $t=3T_s$ ?

Filter coefficients are  $[0.2 \ 0.2 \ 0.2 \ 0.2 \ 0.2]$ , step response is plotted below and value at time  $3T_s$  is 0.8



4. Amplitude of the output signal is  $A_{out}=0.0001 \cdot A_{in}$ , where  $A_{in}$  is amplitude of the input signal. What is attenuation of the system in [dB]? Evaluate your solution step by step.

$$A = 20 \cdot \log(A_{out}/A_{in}) \quad [\text{dB}]$$

$$A = 20 \cdot \log(0.0001) = 20 \cdot \log_{10}(10^{-4})$$

$$A = -80 \text{ dB}$$