

## Homework Assignment No.2

Digital Signal Processing (module no. 24505)

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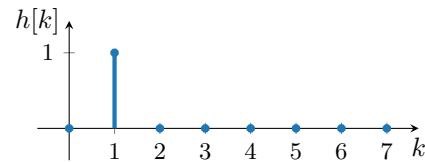
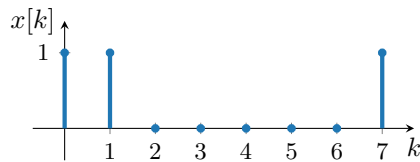
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### Task 1 (6 Points)

#### Discrete Fourier Transform (DFT)

Two 8-point sequences,  $x[k]$  and  $h[k]$  are shown below.



$$\text{DFT} : X[\mu] = \sum_{k=0}^{N-1} x[k] \cdot e^{-j\frac{2\pi}{N}k\mu} \quad (1)$$

- (a) Compute the 8-point DFT of  $x[k]$  using (1) and draw the resulting spectrum.
- (b) Find  $X[\mu]$  by recognizing that it can be obtained by sampling the transform of  $x[k] = \delta[k+1] + \delta[k] + \delta[k-1]$  at eight points.
- (c) Find the sequence  $y[k]$  defined as the inverse DFT of  $Y[\mu] = X[\mu]H[\mu]$ . You do not have to compute  $Y[\mu]$  to solve this problem, why?

### Task 2 (3 Points)

#### Properties of circular convolution

The sequence  $x[k] = [1, 2, 3, 4, 5, 0, 0, 6]$  is given.

Sketch the circular shift  $y[k] = x[(k - k_0)_8]$  for the following values of  $k_0$ :

- (a)  $k_0 = 2$
- (b)  $k_0 = -2$
- (c)  $k_0 = 1068$

### Task 3 (4 Points)

#### Cyclic convolution

Consider the DFT spectra  $X[\mu]$ ,  $H[\mu]$  with a length of  $N = 4$ :

$$\begin{aligned} X[\mu] &= 4\delta[\mu] + 3\delta[\mu-1] - 1\delta[\mu-2] + 3\delta[\mu-3] \\ H[\mu] &= 2j\delta[\mu-1] + 5\delta[\mu-2] - 2j\delta[\mu-3] \end{aligned}$$

Compute the cyclic convolution  $y[k] = x[k] \circledast_N h[k]$ .

### Task 4 (4 Points)

#### Discrete Fourier Transform

A sequence  $x[k]$  of length  $N = 4$  has DFT  $X[\mu] = \delta[\mu] + 2\delta[\mu-1] + 3\delta[\mu-2] + 4\delta[\mu-3]$ .

A new sequence is created,  $y[k] = x[k]e^{-j1.5\pi k}$ . Find  $Y[\mu]$ .