

## ESERCITAZIONE n.4 (Soluzioni)

### Ex. 1

1.  $X(f) = \text{sinc}(f - 2)\exp(-j8\pi f)$ ;
2.  $X(f) = \frac{1}{2(1+j\pi f)}e^{-(j4\pi f+4)}$ ;
3.  $X(f) = T\text{sinc}^2(fT) - T\text{sinc}(fT)e^{j\pi fT}$ ;
4.  $X(f) = e^f u(-f)$ ;
5.  $X(f) = \frac{1}{2} [\text{sinc}(f - f_0) + \text{sinc}(f + f_0)] + \frac{T}{2} [\text{sinc}^2((f - f_0)T) + \text{sinc}^2((f + f_0)T)]$ ;
6.  $X(f) = \frac{1}{2}\text{rect}\left(\frac{f}{2}\right)e^{-j\pi f}$ ;
7.  $X(f) = \frac{T}{2}\text{sinc}(fT) + \frac{T}{4}\text{sinc}(fT - 1) + \frac{T}{4}\text{sinc}(fT + 1)$ ;
8.  $X(f) = \frac{\text{sinc}^2(fT)}{j2\pi f} + \frac{\delta(f)}{2}$ ;
9.  $X(f) = \frac{1}{j\pi f}[1 - \text{sinc}(2fT)]$ .

### Ex. 2

La trasformata di Fourier del segnale è

$$\frac{1}{j\pi f}[\text{sinc}(2fT) - \cos(2\pi fT)]$$

### Ex. 3

1.  $x(t) = \frac{1}{2}[\delta(t - 1) + \delta(t + 1)]e^{j2\pi f_0 t}$ ;
2.  $x(t) = \frac{1}{2}\text{sinc}\left[\frac{t+1}{2}\right] - \frac{1}{2}\text{sinc}\left[\frac{t-1}{2}\right]$ ;
3.  $x(t) = 2\text{sinc}^2\left(\frac{t}{T}\right) - \frac{1}{2}\text{sinc}^2\left(\frac{t}{2T}\right)$ .

### Ex. 4

1.  $x(t) = \text{sinc}(t)$ ;
2.  $x(t) = \frac{1}{2}\text{sinc}(t) + \frac{1}{4}\text{sinc}^2(t/2)$ .
3.  $x(t) = \frac{d}{dt}\left[\frac{1}{\pi}\text{sinc}\left(\frac{t}{\pi}\right)\right]$ ;
4.  $x(t) = 2A^2\Lambda(t) - A^2\Lambda(t - 1) - A^2\Lambda(t + 1)$ .

### Ex. 5

1.  $E_x = 1$
2.  $E_x = 1/2$ .

**Ex. 6**

1.  $X(\nu) = \frac{1-a^2}{1-2a \cos(2\pi\nu)+a^2}$ ;
2.  $X(\nu) = \frac{e^{-j2\pi\nu}}{2-e^{-j2\pi\nu}}$ ;
3.  $X(\nu) = \text{rep}_1\left\{\frac{1}{2j}\left[\delta\left(\nu - \frac{1}{6}\right)e^{j\pi/4} - \delta\left(\nu + \frac{1}{6}\right)e^{-j\pi/4}\right]\right\}$ ;
4.  $X(\nu) = \frac{\sin(4\pi\nu)}{\sin(\pi\nu)} e^{-j11\pi\nu}$ ;

**Ex. 7**

1.  $x(n) = \frac{1}{4} \text{sinc}\left(\frac{n}{4}\right) \cos\left(\frac{\pi n}{2}\right)$ ;
2.  $x(n) = \delta(n) + 3\delta(n-1) + 2\delta(n-2) - 4\delta(n-3) + \delta(n-10)$ ;
3.  $x(n) = \delta(n) + \frac{1}{4}\delta(n-2) + \frac{1}{4}\delta(n+2) - \frac{1}{4}\delta(n-6) - \frac{1}{4}\delta(n+6)$ .

**Ex. 8**

Si ha  $Y(\nu) = X\left(\nu - \frac{1}{2}\right)$ ,  $Z(\nu) = \frac{1}{2}Y\left(\frac{\nu}{2}\right) + \frac{1}{2}Y\left(\frac{\nu-1}{2}\right)$ ,  $V(\nu) = Z(3\nu)$ .