Homework 7-2

Due 15:00, May 21, 2008

1. Use the defining equation for the DTFS coefficients to evaluate the DTFS representation of the following signals:

   (1) $x[n]=\cos^2\left(\frac{6\pi}{17}n+\frac{\pi}{3}\right)$. (8%)

   (2) $x[n] = x[n + 8]$ as depicted in Figure 1. (7%)

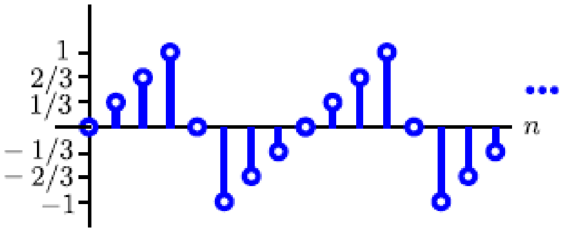

Figure 1

2. Use the definition of the DTFS to determine the time-domain signals represented by the following DTFS coefficients:

   (1) $X[k]=a_k=\cos\left(\frac{8\pi}{21}k\right)$ (7%)

   (2) $X[k]=a_k=\sum_{m=-\infty}^{\infty}(-1)^m\left(\delta[k-2m]-2\delta[k+3m]\right)$ (8%)

3. Use the defining equation for the DTFT to evaluate the frequency-domain representations of the following signals:

   (1) $x[n]=\left(\frac{3}{4}\right)^n u[n-4]$ (5%)

   (2) $x[n]=\frac{1}{2}\delta[4-4n]$ (5%)

4. Use the equation describing the DTFT representation to determine the time-domain signals corresponding to the following DTFTs:

   (1) $X(\Omega)=\cos(\Omega)+j\sin(\Omega)$ (5%)

   (2) $X(\Omega)=\sin\left(\frac{\Omega}{2}\right)+\cos(\Omega)$ (5%)

5. You are given $x[n] = n(3/4)^{|n|} \xleftrightarrow{DTFT} X(\Omega)$. Without evaluating $X(\Omega)$, find $y[n]$ if

(1) $Y(\Omega) = \mathrm{Re}\{X(\Omega)\}$ (5%)

(2) $Y(\Omega) = \dfrac{d}{d\Omega} X(\Omega)$ (5%)

(3) $Y(\Omega) = X(\Omega) \circledast X(\Omega - \pi/2)$ (5%)

(4) $Y(\Omega) = \dfrac{d}{d\Omega}\left\{ e^{-j4\Omega} \left[X\left(e^{-j\left(\Omega + \frac{\pi}{4}\right)} \right) + X\left(e^{-j\left(\Omega - \frac{\pi}{4}\right)} \right) \right] \right\}$ (5%)

6. A linear time-invariant system is described by the input-output relation

$$y[n] = x[n] + 2x[n-1] + x[n-2]$$

(1) Determine $h[n]$, the impulse response of the system and $H(\Omega)$, the frequency response of the system. (10%)

(2) Now consider a new system whose frequency response is $H_1(\Omega) = H(\Omega + \pi)$. Determine $h_1[n]$, the impulse response of the new system. (5%)

7. Determine the difference-equation descriptions for the system with the following impulse and frequency responses:

(1) $h[n] = \delta[n] + 2\left(\dfrac{1}{2}\right)^n u[n] + \left(\dfrac{-1}{2}\right)^n u[n]$. (7%)

(2) $H(\Omega) = 1 + \dfrac{e^{-j\Omega}}{\left(1 - \frac{1}{2}e^{-j\Omega}\right)\left(1 + \frac{1}{4}e^{-j\Omega}\right)}$. (8%)