DSP Assignment 2

28.01.2021

1. Derive the DTFT of u[n] using the odd and even parts of the signal.

2. A particular LTI system is described by difference equation

$$y[n] + \frac{1}{4}\, y[n-1] - \frac{1}{8}\, y[n-2] = x[n] - x[n-1]$$

Find impulse response of the system. Evaluate the magnitude and phase of the system frequency response at $\omega = 0, \pi/4, -\pi/4, 9\pi/4$.

3. Consider the following expression for a signal $x[n]$:

$$c = \frac{\sum_{n=-\infty}^{\infty} n\, x(n)}{\sum_{n=-\infty}^{\infty} x(n)}$$

Express c in terms of $X(\omega)$.

4. Let $x(n) = (1/4)^n u(n)$ and $y(n) = x^2(n)$. $Y(e^{j\omega})$ be the Fourier Transform of $y(n)$. Then $Y(e^{j0})$ *is* ?

5. Consider the signal x(n)={-3, 4, -5, 4, 3}. With X[w] being the DTFT of x(n), find out the following quantities:

A] X[0]

B] $\int_{-\pi}^{\pi} X[w]\, dw$

C] X[π]

D] $\int_{-\pi}^{\pi} |X[w]|^2\, dw$

6. Consider an LTI system with $h[n] = \alpha^n u[n]$, where $|\alpha|<1$. Let, an input is applied to this system with $x[n] = \beta^n u[n]$, where $|\beta|<1$. Find out the DTFT of the output.

7. Compute DTFT of the following signal $r[n] = \begin{cases} 1, & 0 \le n \le M, \\ 0, & \text{otherwise.} \end{cases}$

8. Let, x[n] is real and has DTFT $X[e^{jw}]$. If, the DTFT of y[n] can be expressed as, $Y[e^{jw}] = X[e^{j3w}]$, find out y[n].