Properties of DTFT

Suppose $x[n] \longleftrightarrow X(e^{j\omega})$

$y[n] \longleftrightarrow Y(e^{j\omega})$

1. Linearity $a\,x[n] + b\,y[n] \longleftrightarrow$

2. Time-shift

$y[n] = x[n-n_0] \longleftrightarrow Y(e^{j\omega}) =$

3 Freq-shift.

$y[n] = \qquad \longleftrightarrow Y(e^{j\omega}) = X(e^{j(\omega-\omega_0)})$

4. Time-Reversal

$y[n] = x[-n] \longleftrightarrow Y(e^{j\omega}) =$

5. Difference in time

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

$\longleftrightarrow Y(e^{j\omega}) =$

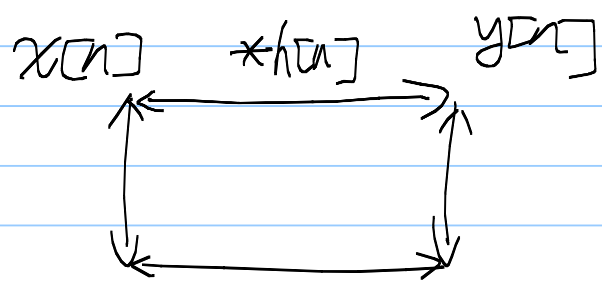
6. Differentiation in freq

$\longleftrightarrow j\frac{d}{d\omega} X(e^{j\omega})$

7. Parseval's relationship

8. Convolution Property

$x[n] * h[n] \longleftrightarrow$



Example: An LTI sys has

$h[n] = \left(\frac{1}{3}\right)^n u[n]$ & input $x[n] = \left(\frac{1}{2}\right)^n u[n]$

Find the output $y[n]$

Ans:

* Ideal discrete-time LPF w. cutoff freq W

$H(e^{j\omega}) =$

Comparison: Ideal Conti-time LPF

Example 5.12: for a DT ideal LPF $H_{LPF}(e^{j\omega})$ with cutoff freq $W = \frac{2}{3}\pi$, find out the DT impulse response $h_{LPF}[n]$.

Ans: By the synthesis formula

9. Multiplication property

$x[n] \cdot y[n] \longleftrightarrow$

Example : 5.15

Q. $x_1[n] = \dfrac{\sin(\frac{3\pi}{4} n)}{\pi n}$, find $X_1(e^{j\omega})$.

Ans :