Assignment - 1

D.S.P. (2171003)

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1. Prove following properties of D.T.F.T:

(i) Linearity:

if $x_1(n) \longleftrightarrow X_1(e^{j\omega})$

$x_2(n) \longleftrightarrow X_2(e^{j\omega})$

then,

$$a\,x_1(n) + b\,x_2(n) \longleftrightarrow a\,X_1(e^{j\omega}) + b\,X_2(e^{j\omega})$$

(ii) Time shifting:

if $x(n) \longleftrightarrow X(e^{j\omega})$

then,

$$x(n-n_d) \longleftrightarrow e^{-j\omega n_d}\,X(e^{j\omega})$$

(iii) Freq^n shifting:

if $x(n) \longleftrightarrow X(e^{j\omega})$

then,

$$e^{j\omega_0 n}\,x(n) \longleftrightarrow X(e^{j(\omega-\omega_0)})$$

(iv) Time Reversal:

if $x(n) \longleftrightarrow X(e^{j\omega})$

then,

$$x(-n) \longleftrightarrow X(e^{-j\omega})$$

(v) Convolution in Time - Domain:

$$x_1(n) * x_2(n) \longleftrightarrow X(e^{j\omega}) \cdot X(e^{j\omega})$$

(vii) Convolution in freq^n domain:

$$x_1(n) \cdot x_2(n) \longleftrightarrow \frac{1}{2\pi}\left[X_1(e^{j\omega}) * X_2(e^{j\omega})\right]$$

(viii) Parsevals Theorem:

if $x(n) \longleftrightarrow X(e^{j\omega})$

then

$$E_x = \sum_{n=-\infty}^{\infty} |x(n)|^2 = \frac{1}{2\pi}\int_{-\pi}^{\pi} |X(e^{j\omega})|^2 \cdot d\omega$$