Class B.Tech 2nd yr (ECE)
Sub: Signal & System
Faculty: Mandeep Singh
Date: 7/5/2020

Topic: Property of Fourier Series / Transform

1. Linearity:

If
$$x_1(t) \xleftrightarrow{F} X_1(f)$$
and
$$x_2(t) \xleftrightarrow{F} X_1(f)$$
then
$$a_1x_1(t) + a_2x_2(t) \xleftrightarrow{F} a_1X(f) + a_2X(f)$$

Class Work Forecast .... to .... Home Work

This follows directly from the definition of the fourier transform (as the integral operator is linear). It is easily extended to a linear combination of an arbitrary number of signals.

(3) Time scaling :-

* Let $x(t)$ and $X(f)$ be fourier Transform pairs and let "α" be a constant. Then time scaling property states that

$$x(\alpha t) \xleftrightarrow{F} \frac{1}{|\alpha|} X\left(\frac{f}{\alpha}\right)$$

$X(\alpha t)$ represents a time scaled signal and $X\left(\frac{f}{\alpha}\right)$ represents frequency scaled signal.

* For $\alpha < 1$, $X(\alpha t)$ represent compressed signal but $X\left(\frac{f}{\alpha}\right)$ represents expanded version of $X(f)$.

* For $\alpha > 1$, $X(\alpha t)$ will be expanded signal in the time domain. But its fourier transform $X(f/\alpha)$ respresents versions of $X(f)$.

Class Work Forecast ... to ... Home Work

time shifting

The time shifting property states that if $x(t)$ and $X(f)$ form a fourier transform pair then

$$x(t-t_d) \xleftrightarrow{F} e^{-j2\pi f t_d} \cdot X(f)$$

It is the same signal $x(t)$ only shifted in time

here the signal $x(t-t_d)$ is time shifted signal

Class Work Forecast

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Class Work Forecast

Planning for		
Days Period	Class Subject	
	4	Duality or Symmetry.

* This property states that

if $x(t) \xleftrightarrow{F} X(-f)$

then

$X(t) \xleftrightarrow{F} x(-f)$

* The duality theorem tells us that the shape of the segnal in the time domain and the shape of the spectrum can be interchanged.

Area under $x(t)$

* This property states that the area under the curve $x(t)$ equals the values of its Fourier transform at $F = 0$

i.e. if $x(t) \xleftrightarrow{F} X(f)$.

then $x(t) = X(0)$

Area under $X(f)$.

* This property states that the area under the curve $X(f)$ equals the values of signal $x(t)$ at $t = 0$

if
$$x(t) \xleftrightarrow{F} X(f).$$

then $x(0) = X(f)$

Frequency shifting

* The frequency shifting characteristics states that if $x(t)$ and $X(f)$ form a fourier transform pair then

$$e^{j2\pi f_c t} x(t) \xleftrightarrow{F} X(f-f_c).$$

* F_c is a real constant