Discussion Session 8

Fourier Transform:
$$\times (jw) = \int_{-\infty}^{\infty} x(t) e^{-jwt} dt$$

$$X(t) = \frac{1}{2\pi} \int_{-\infty}^{\infty} X(jw) e^{jwt} dt$$

If x(+) is periodic signal, you can define the Fourier Transform from Fourier

Series.
$$X(+) \longleftrightarrow \{a_{k}\} \Rightarrow X(j_{w}) = \sum_{k=-\infty}^{\infty} 2\pi a_{k} \delta(w - kw_{\bullet})$$

Fourier Transform

$$\frac{e^{j\omega_{0}t}}{2\pi} \stackrel{F}{\longleftarrow} S(w_{-}w_{0})$$

$$\frac{f}{\sin(w_{0}t)} \frac{f}{\cot(w_{-}w_{0})} \frac{f}$$

$$e^{-at}$$
 $u(t) \longleftrightarrow \frac{1}{a+jw}$

$$\frac{e^{-a|+|}}{Re(a)>0} \stackrel{F}{\longleftrightarrow} \frac{2a}{a^2+w^2}$$

$$\int \operatorname{rect}(t) \longleftrightarrow \operatorname{sinc}(\frac{w}{2\pi}) \qquad \delta(t) \longleftrightarrow 1$$

$$\operatorname{rect}(\frac{t}{2\pi}) \longleftrightarrow 2T_1 \operatorname{sinc}(\frac{wT_1}{\pi}) \qquad u(t) \longleftrightarrow \frac{1}{jw} + \pi \delta(w)$$

$$\begin{cases} \operatorname{sinc}(t) & \longleftarrow \operatorname{Rect}(\frac{w}{2\pi}) \\ \frac{B}{2\pi} \operatorname{sinc}(\frac{Bt}{2\pi}) & \longleftarrow \operatorname{Rect}(\frac{w}{B}) \end{cases}$$

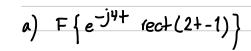
Quality property of fourier transform:

If the fourier transform of x(t) is Y(jw), fourier transform of Y(t)

is
$$2\pi \times (-\omega)$$
: $F(\times(+)) = Y(j\omega) \Rightarrow F(Y(+)) = 2\pi \times (-\omega)$

Fourier transform and signal tranformation. X(+) F X(jw) Y(+) F Y(jw) Linearity: a xct) + by(+) = a x(jw) + b Y(jw) Time Shift: x(+-+.) = F , e-j wt. X(jw) Frequency Shift X(+) ejw.t F X(j(w-w.)) 0 if ferentiation: $\frac{dx(t)}{dt} \in F$, jw X(jw)especial case: Integration: St x(T) dT = 1 x(jw) + 17 x(a) S(jw) Time scaling: $X(at) \stackrel{F}{\longleftarrow} \frac{1}{|a|} X(\frac{jw}{a})$ Time expansion lead to frequency compression and time Frequency scaling: $\frac{1}{|b|} \times (\frac{1}{|b|}) \stackrel{F}{\longleftarrow} \times (jbw)$ compression lead to frequency expansion. Convolution in time. X(+) * Y(+) = F > X(jw) Y(jw) Multiplication in time: X(t) ylt) $\leftarrow F \rightarrow \frac{1}{2} \left(X(j\theta) Y(j(w-\theta)) d\theta \right)$ $= \frac{1}{2} \times (jw) \times (jw)$ $\int_{-\infty}^{\infty} |x(t)|^2 dt = \frac{1}{2n} \int |x(jw)|^2 dw$

Example #1:



c)
$$F\left\{2e^{-j2t} \operatorname{sinc}\left(\frac{t-1}{2}\right)\right\}$$

Example: Find
$$\int_{\infty}^{\infty} |\operatorname{sinc}(2000+)|^2 dt$$

