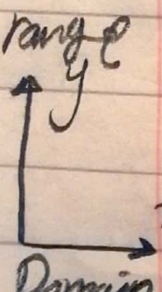
بداية المادة الفعلية :-

المحاضرة الأولى

stream of bits / electrical current → Projector → image

Classify The Signal تصنيفها إلى اثنين

	Cts	Dts
Time 1) Independent Variable	Independent Variable t → Real Value	n → Integer Value
$x(t)$	exacts (form) $x(t)$ real	$x[n]$ real
Signal	Sound	Digital image . Population

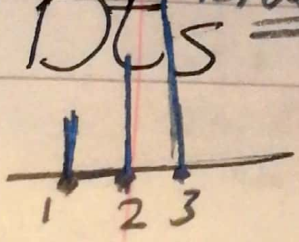


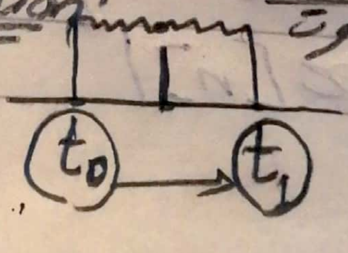
Signal → Discrete Time Signal / Continuous Time Signal

Signal تعريفه Cts دائرة كهربية

Population الصوت

DTs





Second Point :- (Second ~~Specify~~ classify The signals)

الطاقة Energy :- it is the capacity for doing work.
القدرة على بذل شغل

القدرة Power :- it is rate of doing work
معدل ابذل الشغل

Electical Circuit :-

$$P(t) = I(t) \cdot V(t)$$

$$= \frac{V(t)}{R} \cdot V(t) = \cancel{\frac{1}{R}} V^2(t)$$

مؤقتا

V is Voltage

Constant

مؤقتا

$$P(t) = \cancel{k} \cdot V^2(t)$$

Constant

N is the speed of the machine

$$\boxed{P(t) = \text{Constant} \cdot \text{Variable}^2}$$

Cts $\Leftarrow P(t) = x(t)^2 \quad |x(t)|^2$

$| \ | \equiv$ magnitued.

Dts $\Leftarrow P[n] = |x[n]|^2$

$t_0 \longrightarrow t_1$

cts $\Leftarrow$ $E(t_0, t_1) = \int_{t_0}^{t_1} |x(t)|^2 \, dt$ بفرض بسم ما وقفة لي جوه ع طول

t_0 t_1

$t_0 = t_0 + 0.00000000\ldots$

$E(n_0, n_1) = \sum_{n=n_0}^{n_0} |x[n]|^2$ magnitued

Dts

cts $\Leftarrow$ $P(t_0, t_1) = \frac{E(t_0, t_1)}{t_1 - t_0}$

معدل التغير

$P[n_0, n_1] = \frac{E(n_0, n_1)}{n_1 - n_0 + 1}$ Dts

Total Energy ∞

Total average Power

cts $E_\infty \triangleq \lim_{T \to \infty} \int_{-T}^{T} |x(t)|^2 \, dt$

By difinition

$= \int_{-\infty}^{+\infty} |x(t)|^2 \, dt$

$P_\infty \triangleq \lim_{T \to \infty} \frac{1}{2T} \int_{-T}^{T} |x(t)|^2 \, dt$ cts

$= \lim_{T \to \infty} \frac{1}{2T} \int_{-T}^{T} |x(t)|^2 \, dt$

Denomenator

+ve -ve t_0

DisContinuity

Dts $E_\infty \triangleq \lim_{N \to \infty} \sum_{n=-N}^{+N} |x[n]|^2$

$= \sum_{n=-\infty}^{+\infty} |x[n]|^2$

$P_\infty \triangleq \lim_{N \to \infty} \frac{1}{2N+1} \sum_{n=-N}^{+N} |x[n]|^2$

Dts

Simple 1

$-5 < t < +5$ — $|t| < 5$

Q_1: $x(t) = \begin{cases} 8 & -5<t<+5 \\ 0 & o.w. \end{cases}$

E_∞, P_∞

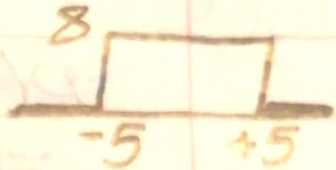
مستحيل الاثنين

$E_\infty < \infty$ — Energy signal

$0 < P_\infty < \infty$ — Power signal

ملاحظة في السلايد

الحل (القانون الأول)



$$E_\infty = \int_{-\infty}^{+\infty} |x(t)|^2 dt = \int_{-\infty}^{+\infty} 8^2 dt$$

$$= \int_{-5}^{+5} 8^2 dt = 64 \int_{-5}^{+5} dt = 64\, t \Big|_{-5}^{5}$$

$$= 64(5-(-5)) = 64(10) = \boxed{640}$$

$\because E_\infty < \infty \quad \therefore P_\infty = 0$

$\therefore$ Signal Is Energy signal.

Simple ②:-

XOR → Energy signal: $E_\infty < \infty$, $\frac{\text{Value}}{\infty} = 0$

XOR → Power Signal: $0 < P_\infty < \infty$

Q2:- $x[n] = j = 0 + j1$

$|x[n]| = \sqrt{(0)^2 + (1)^2} = \sqrt{1} = 1$ // Cannot be (-ve)

$$E_\infty = \sum_{n=-\infty}^{+\infty} |x[n]|^2 = \sum_{n=-\infty}^{+\infty} 1 = \infty$$

$$P_\infty = \lim_{N \to \infty} \frac{1}{2N+1} \sum_{n=-N}^{+N} |x[n]|^2$$

$$= \lim_{N \to \infty} \frac{1}{2N+1} \sum_{n=-N}^{+N} 1 = \lim_{N \to \infty} \frac{1}{\cancel{2N+1}} \cancel{(2N+1)}$$

$$= 1 \quad \begin{matrix} > 0 \\ < \infty \end{matrix} \Big\} \text{:- Power Signal \#}$$

Simple ③ :-

Q_3 :- $x[n] = A\cos(\omega n + \phi)$ $\boxed{\text{Dts}}$

$$|x[n]| = |A \cdot \cos(\omega n + \phi)|$$

Recall !

$$\boxed{|A \cdot B| = |A|\,|B|}$$

لتقويم نصف موجي

$$\therefore |x[n]| = |A|\,|\cos(\omega n + \phi)|$$

$$|x[n]| = |A| \cdot \{0 \leq \text{Value} \leq 1\}$$

$$|x[n]| \leq A$$

$$E_\infty = \sum_{n=-\infty}^{+\infty} |x[n]|^2 = \sum_{n=-\infty}^{+\infty} \{\leq A^2\}$$

$$\leq A^2 \sum_{n=\infty}^{+\infty} 1 = \infty$$

$$P_\infty = \lim_{N\to\infty} \frac{1}{2N+1} \sum_{n=-N}^{+N} |x[n]|^2$$

$$= \lim_{N\to\infty} \frac{1}{2N+1} \sum_{n=-N}^{+N} \{\text{or Value} \leq A^2\}$$

$$\leq A^2 \lim_{N\to\infty} \frac{1}{\cancel{2N+1}} \sum_{n=-N}^{+N} 1 \to \cancel{2N+1}$$

$$\leq A^2 \quad > 0$$

$$< \infty \quad \therefore \text{This Power is Power Signal.}$$

cts $\quad x(t) = A \cos(\omega t + \phi)$ ex.

$$|x(t)| = |A|\,|\cos(\omega t + \phi)|$$

$$E_\infty = \int_{-\infty}^{+\infty} A^2 \cos^2(\omega t + \phi)\, dt$$

$$\cos(\alpha+\beta) = \cos\alpha\cos\beta - \sin\alpha\sin\beta.$$

$$\cos(\omega t + \omega t) = \cos(\omega t)\cos(\omega t) - \sin(\omega t)\sin(\omega t)$$

$$= \cos^2(\omega t) - \sin^2(\omega t)$$

$$\cos^2\theta + \sin^2\theta = 1 \Longrightarrow \sin^2\theta = 1 - \cos^2\theta$$

$$\therefore \cos(2\omega t) = \cos^2(\omega t) - [1 - \cos^2(\omega t)]$$

$$\cos(2\omega t) = \cos^2(\omega t) + \cos^2(\omega t) - 1$$

$$= 2\cos^2(\omega t) - 1$$

Simple ④

$x[n] = e^{j\omega n} = |\xi| e^{j\angle\xi}$

$|x[n]| = 1 \quad e^{j\theta} = \cos\theta + j\sin\theta$

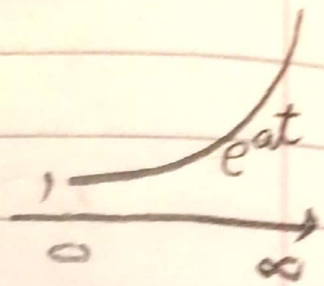
$|x[n]| = \sqrt{\cos^2\theta + \sin^2\theta} = \sqrt{1} = 1$

Contime

Simple ⑤ :

L'Hôpital rule $\Rightarrow x(t) = \begin{cases} e^{at} & t > 0 \\ 0 & \text{O.W.} \end{cases}$

$\rightarrow |x(t)| = \begin{cases} e^{at} & t > 0 \\ 0 & \text{O.W.} \\ & t \le 0 \end{cases}$



$$E_\infty = \int_{-\infty}^{+\infty} |x(t)|^2 dt = \int_0^{\infty} e^{2at} dt = \frac{e^{2at}}{2a}\Big|_0^{\infty}$$

$$= \frac{e^{\infty} - e^{0}}{2a} = \frac{\infty - 1}{2a} = \infty$$

$$P_\infty = \lim_{T \to \infty} \frac{1}{2T} \int_{-T}^{T} e^{2at} dt \quad \int_0^T e^{2at} dt$$

$$= \frac{1}{2a}\left[\lim_{T \to \infty} \frac{1}{2T}\left\{e^{2at} - e^{\cancel{2at}\,0}\right\}\right]$$

$$= \frac{1}{2a}\left[\lim_{T \to \infty} \frac{1}{2T}\left\{e^{2at} - 1\right\}\right] = \frac{\infty}{\infty}$$

Using L'Hospital Rule

$$P_\infty = \frac{1}{\cancel{2a}} \left\{ \lim_{T \to \infty} \frac{1}{2} e^{2at} \cancel{2a} \right]$$

$= \infty$ ∴ This Signal isn't Power signal and isn't Engyer Signal

CamScanner الممسوحة ضوئيا بـ