PRINCIPLES OF COMMUNICATIONS

UNIT-5

LECTURE-4

Appendix: Some Defintions

The energy of a signal $x(t)$ is defined as

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

Energy is defined for a finite duration signal.

Example: The energy of the signal $2e^{-t/2}u(t)$ is given by

$$E_x = \int_{-\infty}^{+\infty} 2e^{-t/2}.2e^{-t/2}\,dt$$

$$= \int_{0}^{+\infty} 4.e^{-t}\,dt$$

$$= -4e^{-t}\Big|_0^{+\infty}$$

$$=4$$

Power of a Signal

The power of a periodic signal x(t) with period T is defined as

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

Power signals are infinite duration signals. Example: The power of the periodic signal x(t) defined by

$$x(t) = \begin{cases} 0, & -\pi \le t < -\frac{\pi}{2} \\ 1, & -\frac{\pi}{2} \le t \le \frac{\pi}{2} \\ 0, & \frac{\pi}{2} < t \le \pi \end{cases}$$

is given by

$$
\begin{aligned}
P_x &= \lim_{T \to +\infty} \frac{1}{2\pi} \int_{-\pi}^{+\pi} x(t) x*(t)\, dt \\
&= \lim_{T \to +\infty} \frac{1}{2\pi} \int_{-\frac{\pi}{2}}^{+\frac{\pi}{2}} 1\, dt \\
&= \lim_{T \to +\infty} \frac{1}{2} \\
&= \frac{1}{2}
\end{aligned}
$$

Root Mean Square Power of Periodic Signals

Root Mean Squre(RMS) power of periodic signals

The RMS value of power signals is defined as the squareroot of the average power.

$$P_{avg} = {V_{RMS}}^2$$

For a sinusoidal signal of amplitude A, the average power is given by

$$P_{avg} = \frac{A^2}{2} = P_{RMS}$$

Now, the RMS voltage is given by