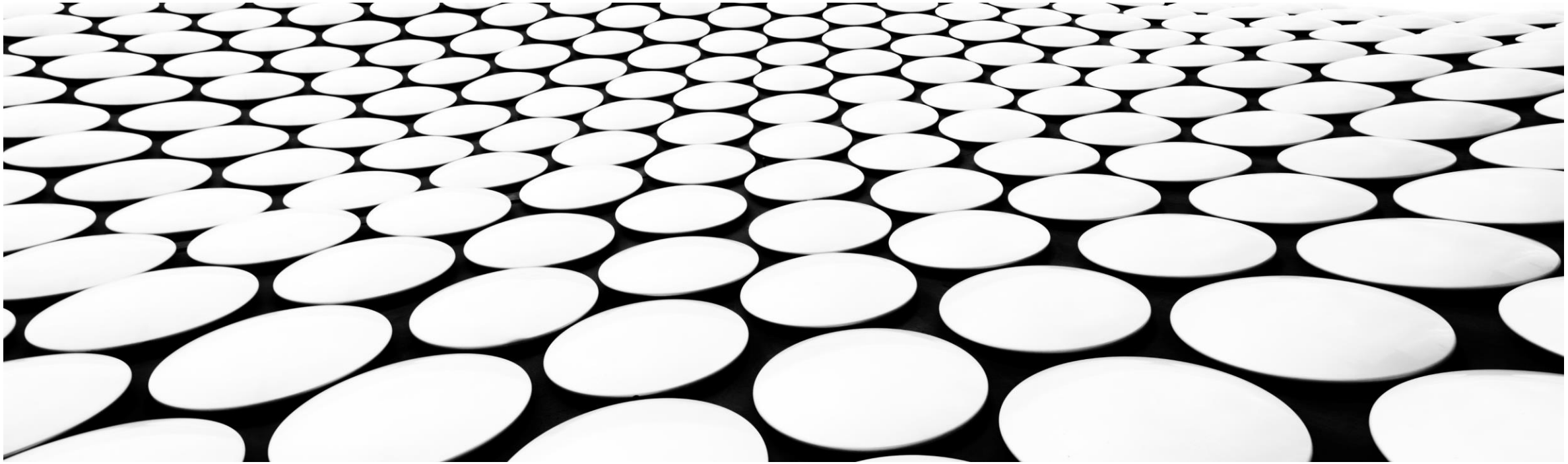
SIGNALS & SYSTEMS

MR. ANKUR JYOTI SARMAH

ASSISTANT PROF., DEPT. OF ELECTRONICS & TELECOM. ENGG.

ASSAM ENGINEERING COLLEGE



1) Find the period of the signals $x(t)$

$$x(t) = \sin(6\pi t) + \sin(10\pi t)$$

$\sin(6\pi t)$ → $\omega_1 t = 6\pi t$

$\Rightarrow \omega_1 = 6\pi$

$\Rightarrow 2\pi f_1 = 6\pi$

$\Rightarrow f_1 = \frac{6\pi}{2\pi} = 3$

$\therefore T_1 = \frac{1}{f_1} = \frac{1}{3}$

or,

$\frac{2\pi}{T_1} = 6\pi$

$\Rightarrow T_1 = \frac{2\pi}{6\pi}$

$\Rightarrow T_1 = 1/3$

$\sin(10\pi t)$ → $\omega_2 t = 10\pi t$

$\Rightarrow \frac{2\pi}{T_2} = 10\pi$

$\Rightarrow T_2 = \frac{2\pi}{10\pi}$

$\Rightarrow T_2 = 1/5$

Find $\frac{T_1}{T_2} = \frac{1/3}{1/5} = \frac{5}{3}$

Rational no.

Hence $x(t)$ is periodic.

To find the period take

$$\frac{\text{LCM of } (T_1, T_2)}{\text{HCF of } (T_1, T_2)} = \frac{\text{LCM}(\frac{1}{3}, \frac{1}{5})}{}$$

$$= \frac{1}{1}$$

$= 1$ sec.

2) Find the condition for $x(t)$ to be periodic, if $x(t) = \sin(at) + \sin\left(\frac{t}{b}\right)$

Soln:-

T_1 = period of $\sin at = \frac{2\pi}{a}$.

T_2 = period of $\sin\left(\frac{t}{b}\right) = \frac{2\pi}{1/b}$

$\Rightarrow T_2 = 2\pi b$.

$\omega t = at$

$\Rightarrow \frac{2\pi}{T} = a$

$\Rightarrow T = \frac{2\pi}{a}$

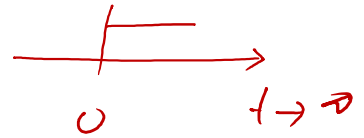
A signal

We know, to become periodic what is the condition ?

$$\frac{T_1}{T_2} = \frac{2\pi/a}{2\pi b} = \frac{2\pi}{a} \times \frac{1}{2\pi b} = \frac{1}{ab}$$ → Must be rational

3) Determine whether $x(t) = u(t)$ → An energy signal ?
→ A power signal ?

$$u(t) = \begin{cases} 1, & t \geq 0 \\ 0 & t < 0 \end{cases}$$



Sol^{n} :-

$$E = \int_{-\infty}^{\infty} |x(t)|^2 dt = \int_{0}^{\infty} 1 \, dt = \infty$$

$$P = \lim_{T \to \infty} \frac{1}{2T} \int_{0}^{T} 1 \cdot dt = \frac{1}{2T} \times T = \frac{1}{2}$$

∴ Here E is infinite and P is finite

⇒ power signal.

4) Find the conjugate symmetric and skew symmetric parts of signals

$$x(t) = t\left(u(t) - u(t-T)\right)$$

Conjugate Symmetric → Even part of $x(t)$

Skew symmetric → odd part of $x(t)$

$\frac{1}{2}\left(x(t) + x(-t)\right)$ → even

$\frac{1}{2}\left(x(t) - x(-t)\right]$ → odd

Sol^{n}:-

$$x(t) = tu(t) - tu(t-T)$$

$$x_e(t) = \frac{1}{2}\left[tu(t) - tu(t-T) + \left[t\,u(-t) - (-t)\,u(-t-T)\right]\right]$$

$$= \frac{1}{2}\left[tu(t) - tu(t-T) - tu(-t) + tu(-t-T)\right]$$

$$x_o(t) = \frac{1}{2}\left[tu(t) - tu(t-T) + tu(-t) - tu(-t-T)\right]$$

3) Find the power of the signal, $x(t) = \underbrace{8\sin(2\pi t) + 4\sin(4\pi t)}_{\text{Composite signals}}$

Sol^n:- power of signal $\underbrace{8\sin(2\pi t)}_{\text{Sinusoidal signal}} = \frac{\text{Amplitude}^2}{2}$ watt

For $8\sin(2\pi t) = \frac{8^2}{2} = \frac{64}{2} = 32$ watt

For $4\sin(4\pi t) = \frac{4^2}{2} = \frac{16}{2} = 8$ watt

$\therefore$ Total power $= 32 + 8 = 40$ watt