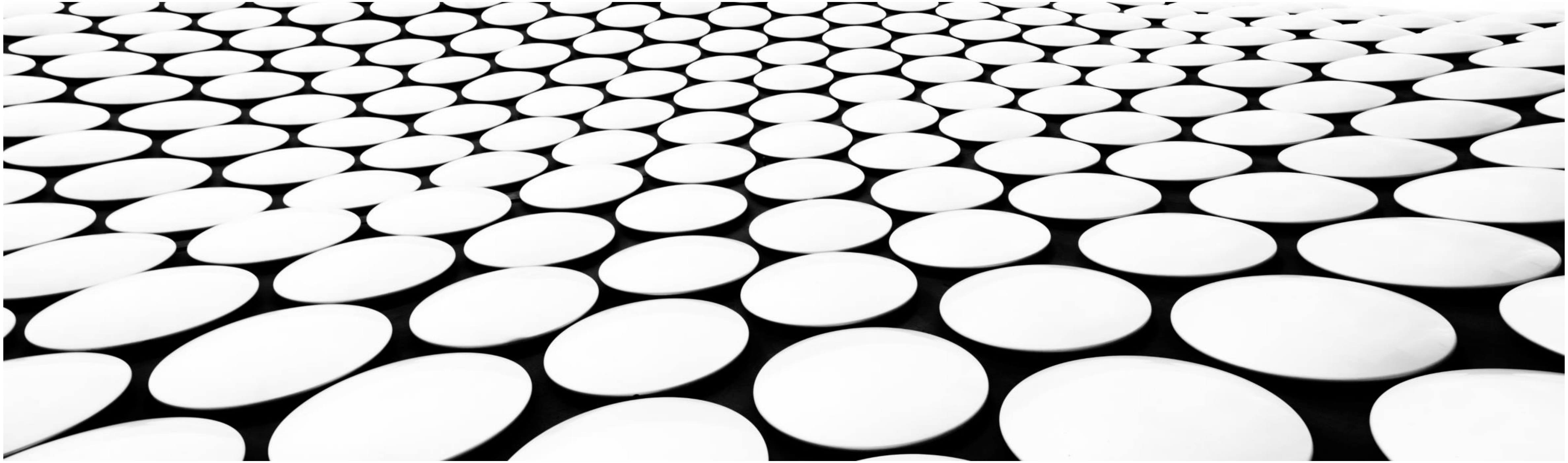
SIGNALS & SYSTEMS

MR. ANKUR JYOTI SARMAH

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

ASSAM ENGINEERING COLLEGE



Convolution

A convolution is an integral that expresses the amount of overlap of one function when it is shifted over another function.

The convolution of two signals in the time domain is equivalent to the multiplication of their representation in frequency domain.

Convolution is actually a type of multiplication.

$x_1(t)$ and $x_2(t)$

$x_3(t)$

$\lambda \rightarrow$ dummy variable

τ

The ***convolution*** of two continuous time signals $x_1(t)$ and $x_2(t)$ is defined as,

$$\boxed{x_3(t) = \int_{-\infty}^{+\infty} x_1(\lambda)\, x_2(t-\lambda)\, d\lambda}$$

where, $x_3(t)$ is the signal obtained by convolving $x_1(t)$ and $x_2(t)$, and λ is a dummy variable used for integration.

The convolution relation of equation (2.21) can be symbolically expressed as,

$$x_3(t) = x_1(t) * x_2(t)$$

convolution operation.

$*$

LTI $\rightarrow$ Linear time invariant system.

$$x(t) \longrightarrow \boxed{h(t)} \longrightarrow y(t)$$

$h(t) \rightarrow$ Impulse response of the system

$$y(t) = x(t) * h(t)$$

$$= \int_{-\infty}^{\infty} x(\tau)\, h(t-\tau)\, d\tau$$

1) Replace $x(t)$ by $x(\tau)$ } introduce dummy variable
$h(t)$ by $h(\tau)$

$$y(t) = \int_{-\infty}^{\infty} x(\tau)\, \underline{\underline{h(t-\tau)}}\, d\tau$$

2) Fix one function $\rightarrow x(\tau)$
shift another function $\rightarrow h(\tau)$

3) perform shifting for $h(\tau) \rightarrow h(-\tau)$

4) Time shifting $h[-(\tau-t)] = h(t-\tau)$

5) Multiplication $x(\tau) \cdot h(t-\tau)$

6) Integration of $x(\tau) \cdot h(t-\tau)$ over $-\infty$ to ∞.