**Lecture 5**

**Title:** Introduction to Systems and Convolution

**Formula:**
\[ y(t) = H_1(x(t)) + H_2(x(t)) = [H_1 + H_2](x(t)) \]

**Diagram:**
- **Convolution Diagram**: Shows the convolution of two signals, with one signal shifted and scaled.
- **Response Equation**: \[ y(x) = H_1(x) + H_2(x) \]

**Notes:**
- Convolution is a fundamental concept in signal processing, used to model the interaction between systems and their inputs.
- Understanding convolution helps in analyzing and designing systems that respond to various inputs.
\[ y(t) = \sum_{k=-\infty}^{\infty} v(k \Delta) h(t - k \Delta) \Delta \]

\[ y(t) = \int_{-\infty}^{\infty} v(t - k \Delta) h(k \Delta) \Delta \]

\[ y(t) = h(t) \ast v(t) \triangleq \text{Convolution} \]

\[ y(t) = h(t) \ast u(t) \triangleq \text{Commutative Property} \]

\[ y(t) = u(t) \ast h(t) \triangleq \text{Commutative Property} \]

\[ y(t) = \int_{-\infty}^{\infty} u(t - k \Delta) h(k \Delta) \Delta \]

\[ y(t) = u(t) \ast h(t) \]

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\[ y(t) = \int_{0}^{t} e^{-\frac{t}{\tau}} dt \]

\[ y(t) = \frac{1}{\tau} \left[ e^{-\frac{t}{\tau}} - 1 \right] = 2 \left[ 1 - e^{-\frac{t}{\tau}} \right] \]