1) using convolution Integral, obtain the res[ponse]
of the ~~using~~ system

$$x(t) = u(t), \quad h(t) = \frac{R}{L} e^{-tR/L} \cdot u(t)$$

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

$$= \int_{-\infty}^{\infty} u(\tau) \cdot \frac{R}{L} e^{-(t-\tau)R/L} \cdot u(t-\tau)\, d\tau$$

$$= \int_{0}^{t} \frac{R}{L} e^{-(t-\tau)R/L}\, d\tau \qquad t-\tau \Rightarrow \tau =$$

$$= \frac{R}{L} \int_{0}^{t} e^{-tR/L} e^{+\tau \frac{R}{L}}\, d\tau$$

$$= \frac{R}{L} e^{-tR/L} \int_{0}^{t} e^{\tau R/L}\, d\tau$$

$$= \frac{R}{L} e^{-t\frac{R}{L}} \left[\frac{e^{\tau R/L}}{R/L} \right]_0^t$$

$$= \cancel{\frac{R}{L}}\, e^{-t\frac{R}{L}} \left[\frac{e^{tR/L} - 1}{\cancel{R/L}} \right]$$

$$\boxed{y(t) = 1 - e^{-tR/L}}$$

properties of convolution Integral

Properties of convolution Integral

1) Commutative Property

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

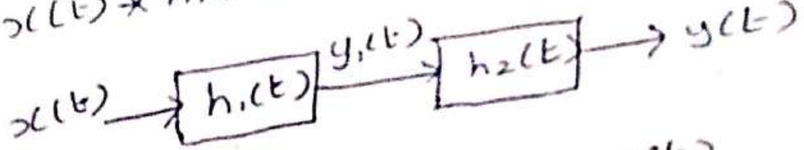
$$= \int_{-\infty}^{\infty} x(\tau)\, h(t-\tau)\, d\tau$$

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

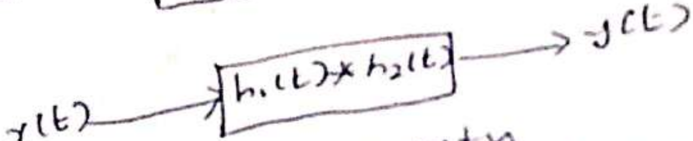
2) Associative Property

$$[x(t) * h_1(t)] * h_2(t) = x(t) * [h_1(t) * h_2(t)]$$

LHS



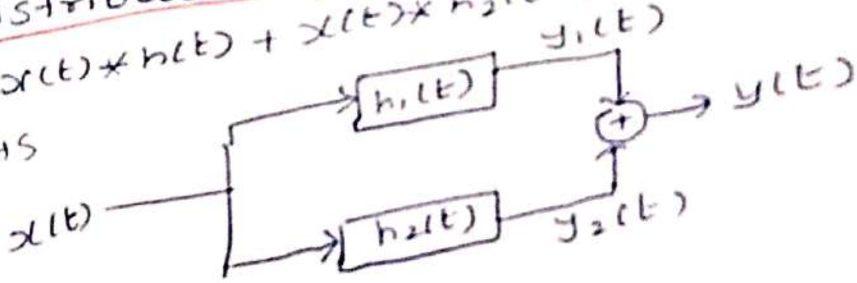
RHS



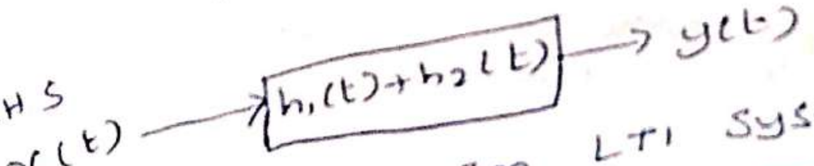
3) Distributive Property

$$x(t) * h(t) + x(t) * h_2(t) = x(t) * [h_1(t) + h_2(t)]$$

LHS



RHS



condition for an LTI system to be causal

$$\boxed{h(t) = 0, \text{ for } t < 0}$$

condition for an LTI system to be stable

$$\boxed{\int_{-\infty}^{\infty} |h(t)|\, dt < \infty.}$$