(A)

$$\begin{cases} \mathcal{L}(f(t)) = F(s) \\ \mathcal{L}^{-1}(F(s)) = f(t) \end{cases}$$

$$\begin{cases} \mathcal{L}(e^{-at} f(t)) = F(s+a) \\ \mathcal{L}^{-1}(F(s+a)) = e^{-at} f(t) \end{cases}$$

1st Shifting Thm.

$$\begin{cases} \mathcal{L}(f(t-a)\, u(t-a)) = e^{-as} F(s) \\ \mathcal{L}^{-1}(e^{-as} F(s)) = f(t-a)\, u(t-a) \end{cases}$$

2nd Shifting Thm

$$\begin{cases} \mathcal{L}(f'(t)) = sF(s) - f(0) \\ \mathcal{L}^{-1}(sF(s) - f(0)) = f'(t) \end{cases}$$

$$\begin{cases} \mathcal{L}\left(\int_0^t f(\tau) g(t-\tau)\, d\tau\right) = F(s) G(s) \\ \mathcal{L}^{-1}(F(s) G(s)) = \int_0^t f(\tau) g(t-\tau)\, d\tau \end{cases}$$

Convolution Thm

$$\begin{cases} \mathcal{L}\left(\int_0^t f(\tau)\, d\tau\right) = \frac{1}{s} F(s) \\ \mathcal{L}^{-1}\left(\frac{1}{s} F(s)\right) = \int_0^t f(\tau)\, d\tau \end{cases}$$

$$\begin{cases} \mathcal{L}(t f(t)) = -F'(s) \\ \mathcal{L}^{-1}(F'(s)) = -t f(t) \end{cases}$$

$$\begin{cases} \mathcal{L}\left(\dfrac{g(t)}{t}\right) = \displaystyle\int_s^\infty G(\sigma)\,d\sigma \\ \mathcal{L}^{-1}\left(\displaystyle\int_s^\infty G(\sigma)\,d\sigma\right) = \dfrac{g(t)}{t} \end{cases}$$

$$\lim_{s\to\infty} sF(s) = \lim_{t\to 0_+} f(t)$$

$$\lim_{s\to 0_+} sF(s) = \lim_{t\to\infty} f(t)$$

when limits all exist

$$\int_0^\infty t^n f(t)\,dt = (-1)^n F^{(n)}(0)$$

If LHS finite

$$n = 0, 1, 2, \ldots$$