Department of Electrical Engineering
School of Science and Engineering

EE310 Signals and Systems

TUTORIAL 11

Information:
We will use the time-shift property, convolution property and differentiation (in s-domain) property of Laplace transform.

- If $\mathcal{L}\{y(t)\} = Y(s)$ with ROC R, the Laplace transform of the time-shifted signal is given by
$$\mathcal{L}\{y(t-t_o\} = e^{-st_o}Y(s), \qquad \text{ROC}: R.$$
- If $\mathcal{L}\{y(t)\} = Y(s)$ with ROC R, the differentiation in s-domain implies
$$\mathcal{L}\{-t\,y(t)\} = \frac{dY(s)}{ds}, \qquad \text{ROC}: R.$$
- If $\mathcal{L}\{y_1(t)\} = Y_1(s)$ with ROC R_1 and $\mathcal{L}\{y_2(t)\} = Y_2(s)$ with ROC R_2, the Laplace transform of the convolution of $y_1(t)$ and $y_2(t)$ is given by
$$\mathcal{L}\{y_1(t) * y_2(t)\} = Y_1(s)Y_2(s), \qquad \text{ROC}: \text{At least } R_1 \cap R_2.$$

Tutorial 11-1

Determine the time-domain function $x(t)$ for each of the following Laplace transforms and their associated regions of convergence:

(a) $\frac{s}{s^2+9}, \quad \Re e\{s\} < 0$

(b) $\frac{s+1}{s^2+5s+6}, \quad -3 < \Re e\{s\} < -2$

Tutorial 11-2

Determine the Laplace transform of the following time-domain functions $x(t)$:

(a) $x(t) = te^{2t}u(-t)$

(b) $x(t) = u(t) - u(t-1)$

Tutorial 11-3

Consider a causal LTI system with impulse response $h(t)$ whose Laplace transform $H(s)$ is given by
$$H(s) = \frac{s-1}{s+1}.$$

(a) Determine the possible inputs to this LTI system such that the output of the system is given by
$$y(t) = e^{-2t}u(t).$$

(b) If the input satisfies $\int_{-\infty}^{\infty} x(t)|dt < \infty$, which of the inputs determined in previous part produces the output $y(t)$.

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