EE1101 Signals and Systems – Tutorial 9

April 16, 2018

1. Find the Laplace transforms and the associated ROC for the following signals

   a. $e^{-2t}\cos(3t)u(t)$

   b. $f(t) = \sin(t), \quad 0 \le t \le 1$ and $f(t) = 0$, elsewhere

   c. $(e^{-4t} + e^{-5t}\sin t)u(t)$

   d. $e^{-2t}u(t-1)$

   e. $e^{-2(t-1)}u(t-1)$

   f. $e^{2t}u(-t) + e^{3t}u(-t)$

   g. $te^{-2|t|}$

2. Find the inverse Laplace transform of the following. Use properties of Laplace transform where necessary.

   (a) $\dfrac{1}{s(s+1)}$, Re{s} > 0

   (b) $\dfrac{1}{s(s+1)}$, Re{s} < -1

   (c) $\dfrac{1}{s(s+1)}$, -1 < Re{s} < 0

   (d) $\dfrac{s+1}{(s+1)^2+9}$, Re{s} < -1

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

   (f) $e^{-s}\frac{10s^2}{(s+1)(s+3)}$, Re{s} > -1

   (g) $\frac{d}{ds}\left(e^{-2s}\frac{1}{(s+2)^2}\right)$, Re{s} > -2

3. The Laplace transform of a function $e(t)$ is $E(s) = \frac{s+1}{(s+1)^2+4}$, Re{s} > -1. Without explicitly finding $e(t)$, evaluate

   a. $\int_{-\infty}^{\infty} e(t)dt$

   b. $\int_{-\infty}^{\infty} te(t)dt$

4. For each of the four signals $x(t)$ given below: (1) Find the Laplace transform $X(s)$ and its ROC, (2) determine if $\{s|s = j\omega, \omega \in R\} \subset ROC$ and calculate the inverse Fourier transform if possible.

   (a) $x(t) = u(t-2)$

   (b) $x(t) = u(t) - u(t-3)$

   (c) $x(t) = e^{3t}u(t)$

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

   (e) $x(t) = \sin t \cdot u(t)$

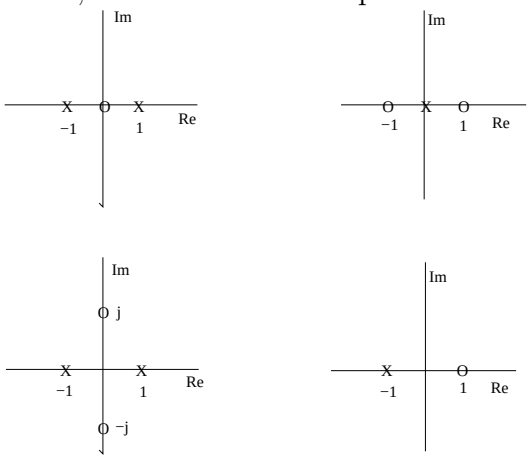
5. Consider a signal $y(t)$ which is related to two signals $x_1(t)$ and $x_2(t)$ by

$$y(t) = x_1(t-2) * x_2(-t+3)$$

   where $x_1(t) = e^{-2t}u(t)$ and $x_2(t) = e^{-3t}u(t)$. Use the properties of Laplace transform to determine the Laplace transform of $y(t)$

6. (a) Show that if $x(t)$ is an even function of time, then $X(s) = X(-s)$.

   (b) Determine which, if any, of the pole-zero plots in the following figure could correspond to an even function of time. For those that could, indicate the required ROC.



7. Let $x(t)$ be a sampled signal specified as

$$x(t) = \sum_{n=0}^{\infty} e^{-nT}\delta(t-nT)$$

   where T > 0

   (a) Determine X(s) and the ROC

   (b) Sketch the pole zero plot for X(s)

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