Signals and Systems ECE 202
Assignment 14

Document and submit your analytic results. Also generate and publish a MATLAB document, where appropriate, for the following exercises. Submit your MATLAB html folder and original MATLAB code (m files).

1. Sketch the pole-zero plot and region of convergence (if it exists) for these signals

   (a) $x(t) = e^{-8t}u(t)$

   (b) $x(t) = e^{3t}\cos(20\pi t)u(-t)$

   (c) $x(t) = e^{2t}u(-t) - e^{-5t}u(t)$

   (d) $x(t) = e^{-t}u(-t) - e^{-4t}u(t)$

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

2. Using the integral definition

$$\mathcal{L}[g(t)] = \int_{0^-}^{\infty} g(t)e^{-st}dt$$

   find the unilateral Laplace transform (and region of convergence) of the following functions

   (a) $x(t) = e^{t}u(t)$

   (b) $x(t) = e^{2t}\cos(200\pi t)u(t)$

   (c) $x(t) = \text{ramp}(t)$

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

   (e) $x(t) = \text{rect}(t)$

3. Using the time-shifting property, find the Laplace transform of these signals.

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

   (b) $x(t) = 3e^{-3(t-2)}u(t-2)$

   (c) $x(t) = 3e^{-3t}u(t-2)$

   (d) $x(t) = 5\sin(\pi(t-1))u(t-1)$

4. Using the complex-frequency-shifting property, find and sketch the inverse Laplace transform of

$$X(s) = \frac{1}{(s+j4)+3} + \frac{1}{(s-j4)+3}$$

5. Using the time-scaling property, find the Laplace transforms of these signals.

   (a) $x(t) = \delta(4t)$

   (b) $x(t) = u(4t)$

6. Using the time-differentiation propery, find the Laplace transforms fo these signals.

   (a) $x(t) = \frac{d}{dt}(u(t))$

   (b) $x(t) = \frac{d}{dt}(e^{-10t}u(t))$

   (c) $x(t) = \frac{d}{dt}(4\sin(10\pi t)u(t))$

   (d) $x(t) = \frac{d}{dt}(10\cos(15\pi t)u(t))$

7. Using multiplication-convolution duality, find the Laplace transforms of these signals and sektch the signals versus time.

   (a) $x(t) = e^{-t}u(t) * u(t)$

   (b) $x(t) = e^{t}\sin(20\pi t)u(t) * u(t)$

   (c) $x(t) = 8\cos\left(\frac{\pi t}{2}\right)u(t) * [u(t) - u(t-1)]$

   (d) $x(t) = 8\cos\left(2\pi t\right)u(t) * [u(t) - u(t-1)]$

8. Using the initial and final value theorems, find the initial and final values (if possible) of the signals with the following Laplace transforms. Note the location of poles.

   (a) $X(s) = \frac{10}{s+8}$

   (b) $X(s) = \frac{s+3}{(s+3)^2+4}$

   (c) $X(s) = \frac{s}{s^2+4}$

   (d) $X(s) = \frac{10s}{s^2+10s+300}$

   (e) $X(s) = \frac{8}{s(s+20))}$

   (f) $X(s) = \frac{8}{s^2(s+20)}$

9. Find the bilateral Laplace transforms (and region of convergence) of these signals

   (a) $x(t) = 3e^{-7t}u(t) - 12e^{4t}u(-t)$

   (b) $x(t) = 50e^{-10|t|}$

10. Find the inverse Laplace transforms of these functions

(a) $X(s) = \frac{24}{s(s+8)}$

(b) $X(s) = \frac{20}{s^2+4s+3}$

(c) $X(s) = \frac{5}{s^2+6s+73}$

(d) $X(s) = \frac{10}{s(s^2+6s+73)}$

(e) $X(s) = \frac{4}{s^2(s^2+6s+73)}$

(f) $X(s) = \frac{2s}{s^2+2s+13}$

(g) $X(s) = \frac{s}{s+3}$

(h) $X(s) = \frac{s}{s^2+4s+4}$

(i) $X(s) = \frac{s^2}{s^2-4s+4}$

(j) $X(s) = \frac{10s}{s^4+4s^2+4}$