### Practice Problem Set #2

1. Determine the unilateral Laplace transform of the following signals:

   (a) \( x(t) = u(t - 2) \)
   (b) \( x(t) = u(t + 2) \)
   (c) \( x(t) = e^{-2t}u(t + 1) \)
   (d) \( x(t) = e^{2t}u(-t + 2) \)
   (e) \( x(t) = \sin(\omega_o t) \)
   (f) \( x(t) = u(t) - u(t - 2) \)
   (g) \( x(t) = \begin{cases} \sin(\pi t), & 0 < t < 1 \\ 0, & \text{otherwise} \end{cases} \)

2. Use the Laplace transform tables and properties to obtain the Laplace transform of the following:

   (a) \( x(t) = \frac{d}{dt}\{te^{-2u(t)}\} \)
   (b) \( x(t) = tu(t) \cdot \cos(2\pi t)u(t) \)
   (c) \( x(t) = t^2u(t) \)
   (d) \( x(t) = u(t - 1) \cdot e^{-2t}u(t - 1) \)
   (e) \( x(t) = \int_0^t e^{-3\tau} \cos(2\tau)d\tau \)
   (f) \( x(t) = \int_0^t \frac{d}{dt}(e^{-t}\cos(t)u(t)) \)

3. Use the tables of transforms and properties to determine the time signals that correspond to the following bilateral Laplace transforms:

   (a) \( X(s) = e^{3s} \cdot \frac{1}{s + 2} \) with ROC \( \text{Re}(s) < -2 \)
   (b) \( X(s) = \frac{d^2}{(s + 3)^2} \) with ROC \( \text{Re}(s) > 3 \)
   (c) \( X(s) = s \left( \frac{1}{s^2} - \frac{e^{-s}}{s^2} - \frac{e^{-2s}}{s} \right) \) with ROC \( \text{Re}(s) < 0 \)
   (d) \( X(s) = s^2 \frac{d}{ds} \left( \frac{e^{-3s}}{s} \right) \) with ROC \( \text{Re}(s) > 0 \)

4. Evaluate the frequency-domain representations of the following signals:

   (a) \( x(t) = e^{-2t}u(t - 3) \)
   (b) \( x(t) = e^{-\alpha t} \)
   (c) \( x(t) = te^{-t}u(t) \)
   (d) \( x(t) = \sum_{m=0}^{\infty} a^m \delta(t - m), \quad |a| < 1 \)
5. Evaluate the frequency-domain representations of the shown signals:

6. Use the Fourier transform tables and properties to obtain the Fourier transform of the following signals:

(a) \( x(t) = \sin(2\pi t)e^{-\omega}u(t) \)
(b) \( x(t) = te^{-3t}u(t-1) \)
(c) \( x(t) = \frac{2 \sin(3\pi t)}{\pi t} \left[ \frac{\sin(2\pi t)}{\pi t} \right] \)
(d) \( x(t) = \frac{d}{dt} \left( te^{-3t} \sin(t) u(t) \right) \)
(e) \( x(t) = \int_{-\infty}^{t} \frac{\sin(2\pi r)}{\pi r} dr \)
(f) \( x(t) = e^{-\pi t^2} u(t - 2) \)
(g) \( x(t) = \left( \frac{\sin(t)}{\pi t} \right) * \frac{d}{dt} \left[ \left( \frac{\sin(2t)}{\pi t} \right) \right] \)

7. Replace the time variable \( t \) with the frequency variable \( \omega \) in all signals in problems 4, 5 and 6 and repeat to obtain the inverse Fourier transform of these signals.