ELEG 4603/5173L Lab # 1
Discrete-Time Signals

1. Use the `stem()` function, plot the following discrete-time signals for `n = [0:40]`. Find if the signals are periodic. If periodic, find the fundamental period and mark one period on the figure.

   (a) $\cos(0.3\pi n + 0.1)$

   (b) $\cos(0.2\pi n + 0.5)$

   (c) $\cos(0.5n + 0.1)$

   (d) $2\cos(0.3\pi n + 0.1) + 3\cos(0.2\pi n + 0.5)$

   (e) $\sum_{m=-\infty}^{\infty}(-1)^m \delta(n - 3m)$

2. Use the `stem()` function to plot the following discrete-time signals (if complex, plot the amplitude and phase). Determine if the signals are power signal or energy signal. Find the corresponding power and energy by using Matlab. (When finding the energy of signal with infinite support, use a large enough N to approximate infinity).

   (a) $\exp(-n)\cos(0.2\pi n)u(n)$

   (b) $\exp(n)u(-n)$

   (c) $\exp(-j0.2\pi n)$

   (d) $\cos(0.3\pi n - pi/4)$

   (e) $\cos(0.3n - \pi/4)$

3. Consider an analog periodic sinusoid $x(t) = \cos(3\pi t + \pi/5)$ being sampled using a sampling period T_s to obtain the discrete-time signal $x(n) = \cos(3\pi T_s n + \pi/5)$.

(a) Choose a value of T_s for which $x(n)$ is periodic. Plot a few periods of $x(n)$ and mark one period on the figure.

(b) Choose a value of T_s for which $x(n)$ is aperiodic. Plot $x(n)$ over an appropriate length to show the signal is not periodic.

(c) Determine under which condition the value of T_s makes $x(n)$ periodic.

4. (Downsampling and upsampling) Consider the discrete-time signal $x(n) = \cos(2\pi n/7)$

(a) Plot $x(n)$

(b) Write a Matlab code to obtain and plot $z(n) = x(2n)$. Compare it with $x(n)$.

(c) Write a Matlab code to obtain and plot $y(n) = x(n/2)$, assume $x(t) = 0$ for t being non-integer values. Compare it with $x(n)$.