ECE 317 Homework 3 **Due March 15th 2025 midnight Saturday**

1) Consider the continuous time signal $x_{c1}(t)= \sin 20\pi t$. This signal is sampled with sampling period T_1 yielding the corresponding discrete time signal $x_1[n]= \sin(\pi n/5)$.
   a) What is the sampling period T_1 so that the given pair of signals are generated?
   b) Sketch the amplitude spectra for the following set of signals:
      i) Original signal $X_{c1}(\Omega)$ vs Ω
      ii) The spectrum of the sampled signal with sampling period T_1 in continuous time: $X_{s1}(\Omega)$ vs Ω
      iii) The discrete sequence amplitude spectrum $X_1(e^{j\omega})$ vs ω
      where Ω and ω are the continuous and discrete time frequency variables, respectively.
   c) Find another sampling period T that generates exact same sequence but is an aliased version (i.e. sampled slower than the Nyquist rate but the replica fills in the right spectral component).Sketch the sampled spected in (ii) for this case.
2) Repeat Q1 for $x_{c2}(t)= \cos 40\pi t$ and $x_2[n]= \cos(2\pi n/5$ and sampling period T_2.
3) Repeat for the sum of the signals, i.e. $x_c(t) = x_{c1}(t) + x_{c2}(t)$ and $x[n]= x_1[n] + x_2[n]$. Use different colors for X_1 and X_2
4) Is the system $y[n]=T(x[n])=x[n]+3\,u[n+1]$ linear? Causal? Time invariant? Stable? Memoryless? Prove or disprove each.
5) Compute the output y[n] of the system with the impuse (unit sample) response h[n]= [….. 0 ½ **<u>1</u>** ½ 0….] to input
   a) x[n]= [….. 0 **<u>3</u>** 2 1 0….] and b) $x[n]=(1/2)^{(n-1)}\,u[n-1]$: