# Homework #1

**Due Mar. 23, 2018 at 9:00 A.M.:**

**Academic Honesty**

Academic honesty is taken seriously in this class during the semester. For homework problems or programming assignments, you are allowed to discuss the problems or assignments verbally with other class members, but under no circumstances can you look at or copy anyone else's written solutions or code relating to homework problems or programming assignments. All problem solutions and code submitted must be material you have personally written during this semester, except for any library or utility functions to be supplied. Failure to adhere to this guideline can result in a student receiving a failing grade in the class. It is the responsibility of each student to follow the course guideline.

1. [20 points] Determine which of the following signals are periodic. If a signal is periodic, determine theirs periods.

   (a) $x(n)=e^{j\frac{2\pi n}{5}}$

   (b) $x(n)=\sin\left(\frac{\pi n}{19}\right)$

   (c) $x(n)=n e^{j\pi n}$

   (d) $x(n)=e^{jn}$

2. [20 points] Show that the following two systems are linear.

   (a) An ideal delay system with $y(n)=T[x(n)]=x(n-n_d)$ where $n_d$ is a fixed positive integer.

   (b) A moving-average system with $y(n)=T[x(n)]=\frac{1}{M_1+M_2+1}\sum_{m=-M_1}^{M_2}x(n-m)$ where $M_1$ and $M_2$ are positive integers.

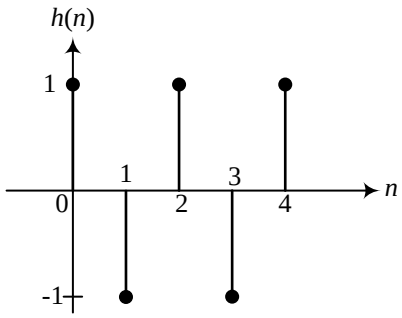
3. [10 points] An LTI system has an impulse response $h(n)=(1/2)^n u(n)$. Find the system output $y(n)$ to the input $x(n)=5u(n-3)$.

4. [20 points] An LTI system has an impulse response $h(n)=a^n u(n)$. Find the system output $y(n)$ to the input $x(n)=u(n)-u(n-N)$.

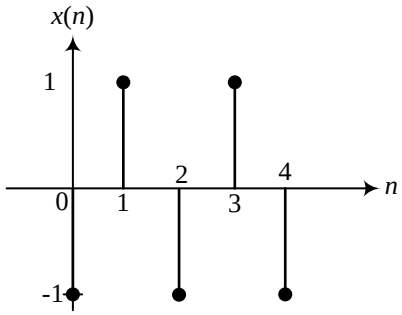
5. [10 points] Determine if the system with unit sample response $h(n)=\frac{1}{n!}u(n)$ is BIBO stable.

6. [10 points] Solve the following problems:

An LTI system has impulse response given by the following plot:




The input to the system, $x(n)$, is plotted below as a function of $n$.




(a) (5 points) Use discrete convolution to determine the output of the system $y(n) = x(n) * h(n)$ for the above input. Sketch $y(n)$ over a range sufficient to define it completely.

(b) (5 points) Implement the convolution using MATLAB and plot $y(n)$.

7. [10 points] Plot the positive and negative complex exponentials using MATLAB as shown in below :