Experiment No: 1 Date: __/__/____

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY

AV331 : DIGITAL SIGNAL PROCESSING LAB

1. Generate standard signals with a single MATLAB command: Use "stem" command to plot them and label and mark values on x- and y- axis.
   a) unit impulse signal with x-axis range -10 to 10
   b) unit step signal with x-axis range -10 to 10
   c) ramp signal with x-axis range 0 to 10
   d) real exponential signal with a = 0.9 and x-axis range 0 to 10
2. Generate and plot the following sinusoidal signals by exploring the MATLAB vector handling capability
   a) $x[n] = 3\sin(2\pi n+\pi/3)$ for $-10 <= n <= 10$
   b) $x[n] = 5\cos(2\pi n/3+\pi/4) + 2.5\sin(\pi n/3+\pi/4)$ for $-10 <= n <= 10$
3. In signal processing it is often needed to find the sum of exponential sequence $x[n] = a^n u[n]$. Find this sum over 0 to 100 for a = 0.9 and verify it by analytically determining the same.
4. In signal processing, it is often needed to deal with complex exponentials.
   a) Plot real and imaginary parts of complex exponential signal: $y[n] = r^n \exp(j\pi n/3)$, where r = 0.8; (and r = 1.2) and $0 <= n <= 20$.
   b) Plot magnitude and phase signals of the above complex exponential using appropriate MATLAB functions
5. **Impulse and Step Sequences**

   Q.5.1) Generate and plot a unit sample sequence for n = -10 to 20 (Program P1),

   Q.5.2) Modify Program P1 to generate a delayed unit sample sequence with a delay of 11 samples.

   Q.5.3) Modify Program P1 to generate a unit step sequence `s[n]`.

   Q.5.4) Modify Program P1 to generate advanced unit step sequence with an advance of 7 samples.
6. **Sinusoidal Sequences**

   Q.6.1) write a program to generate a sinusoidal sequence of length 50, frequency 0.08, amplitude 2.5, and phase shift 90 degrees and display it.

   Q.6.2) Given two sinusoids with the following amplitude and phases:

   $x_1(t) = 5 \cos (2 \pi *500t)$

   $x_2(t) = 5 \cos (2 \pi *1200 t + 0.25 \pi)$

   Create a MATLAB program to sample each sinusoid and generate a sum of sinusoids, that is, $x(n) = x_1(n) + x_2(n)$, using a sampling rate of 8000 Hz, and plot the sum x(n) over a range of time that will exhibit approximately 0.1 second.
7. **Generation of Random Signals:**

   Q.7.1) Write a MATLAB program to generate and display a random signal of length 100 whose elements are uniformly distributed in the interval $[-2, 2]$.

   Q.7.2) Write a MATLAB program to generate and display a Gaussian random signal of length 75 whose elements are normally distributed with zero mean and a variance of 3.

   Q.7.3) Write a MATLAB program to generate and display five sample sequences of a random sinusoidal signal of length 31 $\{X[n]\} = \{A \cdot \cos(\omega_o n + \varphi)\}$ where the amplitude A and the phase φ are statistically independent random variables with uniform probability distribution in the range $0 \leq A \leq 4$ for the amplitude and in the range $0 \leq \varphi \leq 2\pi$ for the phase.