

# National Institute of Technology Calicut

## Department of Electronics and Communication Engineering

### EC 3093D DIGITAL SIGNAL PROCESSING LAB

Sixth Semester B Tech Electronics & Communication Engineering

#### Experiment 1: Generation of basic sequences and random signals, convolution of signals (Matlab and Python Implementation).

Note: All the experiments must be implemented in both Matlab and Python.

#### Generation of Basic Sequences

1. Generate unit impulse, unit step and unit ramp sequences
2. Generate the first few samples of the following real exponential sequences:
  - (a)  $20(0.9)^n$
  - (b)  $0.2(1.2)^n$
  - (c)  $(-0.8)^{n^4}$
  - (d)  $-4(0.8)^n$
3. Generate the complex exponential sequence,  $\mathbf{x} = e^{(-\frac{1}{12} + j\frac{\pi}{6})n}$
4. Generate the following discrete time sequences and display each of them:
  - (a)  $\mathbf{x}_1(n) = \cos(0.2\pi n)$ ,  $\mathbf{x}_2(n) = \cos(1.8\pi n)$  and  $\mathbf{x}_3(n) = \cos(2.2\pi n)$ .  
Compare the plots generated for three cases and comment on your result.
  - (b) Let,  $\mathbf{x}_4(n) = \cos(\frac{4\pi n}{17})$   
 $\mathbf{x}_5(n) = 3\cos(1.3\pi n) - 4\sin(0.5\pi n + 0.5\pi)$   
 $\mathbf{x}_6(n) = 5\cos(1.5\pi n + 0.75\pi) + 4\cos(0.6\pi n) - \sin(.5\pi n)$ .  
In each case, determine the period of the sequence theoretically and verify the results.

- (c)  $\mathbf{x}(n) = 2[n(0.9)^n]$  for  $n = 0 : 50$
- (d)  $\mathbf{x}(n) = (0.95)^n \sin(0.1\pi n)$  for  $n = 0 : 50$
- (e) Generate 10 periods of  $\mathbf{x}(n) = (-4 \ -3 \ -2 \ -1 \ 0 \ 1 \ 2 \ 3 \ 4 \ -4 \ -3 \ \dots)$

### Generation of Random Signals

- 5. Generate and display a random signal of length 100 whose elements are uniformly distributed in the interval  $[-2 \ 2]$ .
- 6. Generate and display a Gaussian random signal of length 75 whose elements are normally distributed with a zero mean and a variance of 3.

### Convolution

- 7. Perform the convolution of  $\mathbf{x}(n) = 0.5(u[n - 5] - u[n - 10])$  and  $\mathbf{h}(n) = u[n] - u[n - 2]$ . Plot  $\mathbf{x}(n)$ ,  $\mathbf{h}(n)$  and  $\mathbf{y}(n)$  with correct time index.
  - 8. Find the step response of the system  $\mathbf{h}(n) = (0.9)^n u[n]$ .
  - 9. Compute the convolution of  $\mathbf{x}(n) = (u[n] - u[n - 10])$  and  $\mathbf{h}(n) = (0.9)^n u[n]$ . Show the first 50 values.
  - 10. Compute the convolution of  $\mathbf{x} = [-1 \ 0.5]$  and  $\mathbf{h} = [2 \ 4 \ -2]$  using functions and display the results.
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