EC3093D Digital Signal Processing Lab
Winter Semester 2023-24

Experiment-3: DTFT and DFT, Magnitude and Phase plots

1. Consider a discrete signal x(n) of length N (from 0 to N-1).
    a) Generate the DFT and IDFT matrices and show the unitary property. (10 pos)
    b) Verify the following properties of DFT using the DFT and IDFT matrices.
        a. Duality. (10 pos)
        b. Time shifting. (10 pos)
        c. Symmetry property. (10 pos)
           Express the signal x(n) as the sum of conjugate symmetric signal $x_e(n)$ and conjugate anti-symmetric signal $x_0(n)$.
           Find the DFT of $x_e(n)$ and $x_0(n)$. Discuss the results. (15 pos)
        d. Parseval's theorem. (10 pos)
2. Let h(n) (of length M≠N, from 0 to M-1) be the impulse response of a discrete LTI system. Write a program to find the system's output when the input signal is x(n). The code must use the DFTs of signals x(n) and h(n) modified suitably. (35 pos)

Quiz topics:

DTFT and DFT: Properties of DTFT and DFT- Time shifting, symmetry in time and frequency domain (odd, even symmetry, conjugate symmetry etc.), duality, orthogonality of the basis functions, Parseval's theorem, periodicity, circular convolution and its relation with DFT, linear convolution using circular convolution (zero padding etc.).

References:

1. Oppenheim, Schafer and Buck, *Discrete-time Signal Processing*, second edition, Prentice Hall Signal Processing Series (Sections 8.5, 8.6 and 8.7)