# EE5130 Digital Signal Processing

Review of Signals and Systems: Discrete time complex exponentials and other basic signals—scaling of the independent axis and differences from its continuous-time counterpart—system properties (linearity, time-invariance, memory, causality, BIBO stability)—LTI systems described by linear constant coefficient difference equations (LCCDE).

Discrete-Time Fourier Transform (DTFT): Complex exponentials as eigensignals of LTI systems—DTFT definition—inversion formula—properties—relationship to continuous-time Fourier series.

Z-Transform: Definition—region of convergence (RoC)—properties of RoC—properties of the z-transform—inverse z-transform methods (partial fraction expansion, power series method, contour integral approach)—pole-zero plots—time-domain responses of simple pole-zero plots—RoC implications of causality and stability.

Frequency Domain Analysis of LTI Systems: Frequency response of systems with rational transfer function—definitions of magnitude and phase response—geometric method of frequency response evaluation from pole-zero plot—frequency response of single complex zero/pole—frequency response of simple configurations—phase response—definition of principal phase—zero-phase response—group delay—phase response of single complex zero/pole—extension to higher order systems—effect of a unit circle zero on the phase response—zero-phase response representation of systems with rational transfer function—minimum phase and allpass systems—constant group delay and its consequences—generalized linear phase—conditions that have to be met for a filter to have generalized linear phase—four types of linear phase FIR filters.

Sampling: Impulse train sampling—relationship between impulse trained sampled continuous-time signal spectrum and the DTFT of its discrete-time counterpart—relationship between true frequency and digital frequency—reconstruction through sinc interpolation—aliasing—effects of oversampling—discrete-time processing of continuous-time signals.

Discrete Fourier Transform (DFT): Definition of the DFT and inverse DFT—matrix representation—DFT as the samples of the DTFT—circular shift of signal and the "index mod N" concept—properties of the DFT—effect of zero padding—Fast Fourier Transform (FFT) algorithm

***Textbook and References:***

*Discrete-Time Signal Processing* by Alan V. Oppenheim and Ronald W. Schafer, 3rd edition, 2010, Prentice Hall, Upper Saddle River, NJ.
*Digital Signal Processing* by John G. Proakis and Dimitris K. Manolakis, 4th edition, 2007, Prentice Hall, Upper Saddle River, NJ.
*Digital Signal Processing* by Sanjit Mitra, 4th edition, 2011, McGraw-Hill, New York, NY.