Instructional Objectives

# Fourier Transform

* Relation between Fourier Transform and Fourier series (limiting form)
* Fourier Transform Definition (Integral Form)
* Performing F.T by integral definition
* Inverse Fourier Transform by definition (Integral Form).Note the differences between F.T and invers F.T.
* Spectrum Property of real signals (even amplitude and odd phase)
* Plotting the spectra (magnitude and phase)
* Spectrum properties i.e. when would the spectrum be real (even *f*(*t*)) .. pure imaginary (odd *f*(*t*))
* Difference between spectrum of periodic and aperiodic signals ( continuous , spectral lines)
* Understanding the Table of F.T pairs…
* Introduce sgn(t) and tri(t) functions
* Table of Fourier Transform properties (linearity, time scaling, time shifting, time transformation, duality, convolution, frequency shifting, Modulation, Time integration and time differentiation, Frequency differentiation)
* Note that integration is not exactly the opposite of integration … for one derivative. There is infinite number of possible integrations… (add constant)
* Given a time domain function, we can perform F.T using tables of pairs and properties.
* Given a frequency domain signal, we can perform inverse F.T. using tables.
* Can use the integration/differentiation property to perform F.T of piecewise linear function
* Familiar with F.T. of Time functions (DC, unit step, switched cosine, pulsed cosine, Exponential pulse)
* Can perform F.T. of periodic functions
* Application of F.T to linear systems (circuit) analysis
* Can solve differential equations using F.T
* Define and evaluate the transfer function
* Explain how to measure (exp. theoretically) the transfer function of a given system (circuit)
* Define relation between energy spectral density and F.T.
* Given the energy spectra, find the energy in a certain spectrum or the total energy
* Parseval’s theorem
* Power spectral density (light coverage)
* Power and energy transmission

# Applications of the F.T

* Ideal filters (4 types, bands)
* Why ideal filters are non-realizable.. show non causality
* Example of RC low-pass filter
* Find and define the 3dB cut off frequency

# Laplace Transform (L.T.)

* Why Laplace transform? Compare Laplace transform with Fourier transform.
* Definition of L.T. Unilateral (one-sided)
* Define inverse L.T integral (hardly used)
* Perform L.T by definition (integral)
* Linearity and differentiation properties
* Laplace transform of important functions (Table of Laplace transform pairs)
* Properties of L.T (Complex shifting, real shifting, Differentiation, Integration,
* Perform L.T by tables
* Partial fraction Expansion (simple, repeated) and the special case: complex poles
* Pole zero plot
* Perform inverse L.T. which might require partial fraction expansion
* LTI characteristics (Causality, Stability (all poles should be in left-half of the plane), invertability ( all poles and zeros should be in the left-half of the plane))
* Frequency response of $H(jω)$ can be found from $H(s)$ byu replacing $s$ with $jω$.