EE5505 : Wave Propegation in Communication(Elective)
September – December 2019

Instructor: Dr. Ananth Krishnan

Course Pre-requisites
None

Format:
2 lectures + 1 Tutorial

Unit - 1 Transmission Lines
1. Circuit model of a lossless transmission line
a) Introducing space coordinate in circuit diagram
b) The notion of delay in a lossless interconnect
c) LC ladder equivalent
d) The spatial derivative in equations for V and I
e) Telegraphers equations
f) Decoupling to wave equation
g) Meaning of the analytical solution to wave equation - The existence of voltage and current waves
2. Programmatic approach to solving partial differential equations - Finite differences
a) Taylor's series approximation to first and second derivatives
b) Partial derivatives
c) Octave/Matlab based solution to voltage in a capacitor (Laplace solver)
d) Meaning of Dirichlet and Neumann boundary conditions and the voltage in parallel plate capacitor
e) Octave/Matlab to solve wave equation
f) Octave/Matlab to solve Telegrapher's equations
g) Implication of short circuit or open circuit in a transmission line
h) The reflection coefficient
i) Time domain reflectometry
j) Time of flight based inferences
k) Bounce diagrams and time evolution of voltage
3. Non-idealities in the transmission line circuit model
a) Resistor and conductor in circuit equivalent
b) Steady state AC in transmission line
c) The propagation constant and characteristic impedance
d) Impedance in the transmission line
e) Standing Wave and Voltage Standing Wave Ratio
f) Power in transmission line
4. Impedance matching
a) Quarter wavelength transformer
b) Stub based matching

Unit -2 Electromagnetic waves (Will be analogous to unit -1 and there will be one to one correspondence in most aspects)

1. Equivalence of Maxwell’s equations and telegraphers equations
2. The electromagnetic wave equation and analogous transmission line wave equation
3. Programmatic solutions to Maxwell’s using Octave/Matlab
4. Characteristic impedance of material media
5. Power and Poynting vector
6. Losses in propagation and propagation constant
7. Polarization (the only difference from transmission lines)
a) Linear, circular, elliptical

Unit-3 EM waves in material media and interfaces (While concepts will be similar to transmission lines, some details will be different)

1. Reflection and transmission at interfaces (analogous to transmission lines)
a) Reflection coefficient and transmission coefficient
b) Standing waves
2. Effect of reflection and transmission on Polarization (different from transmission lines)
3. Dielectric-Dielectric and Dielectric-Metal interfaces
4. Fresnel coefficients
5. Brewsters angle
6. Total internal reflection
7. Parallel plate and rectangular waveguides
8. Modes of parallel plate and rectangular waveguides
9. The cut-off frequency
10. Dispersion