ECE 3065: Master Course Sheet

Georgia Institute of Technology

Maxwell's Equations

$$\nabla \times \vec{H}(\vec{r},t) = \frac{\partial \vec{D}(\vec{r},t)}{\partial t} + \vec{J}(\vec{r},t) \qquad \nabla \cdot \vec{B}(\vec{r},t) = 0$$

$$\nabla \times \vec{E}(\vec{r},t) = -\frac{\partial \vec{B}(\vec{r},t)}{\partial t} \qquad \nabla \cdot \vec{D}(\vec{r},t) = q(\vec{r},t)$$

Vector Magnetic Potential
Near-Field Region
Fresnel Region
Quasi-Static Region

Simple Medium with Current

Vector Magnetic Wave Equation

Far-Field Approximation

Antenna Theory

Polarization
Radiation Resistance
Antenna Vectors

Spherical Waves

Antenna Patterns

Wire Antennas
Horns and Dishes
Helical Antennas
Yagi-Uda Array
Active Arrays

Poynting Vector

Solution Basis

Simple Medium Conditions

Scalar Wave Eq.

$$(\nabla^2 + k^2)\begin{pmatrix}\tilde{H}\\\tilde{E}\end{pmatrix} = 0$$

1D, TEM Propagation

Solution Basis

s-parameter Characterization

Resonator Circuits

Transmission Line

$$v(z) = V^+\exp(-\gamma z) + V^-\exp(+\gamma z)$$

$$i(z) = \frac{V^+}{Z_0}\exp(-\gamma z) - \frac{V^-}{Z_0}\exp(+\gamma z)$$

$$\gamma = \alpha + j\beta = \sqrt{(R+j\omega L)(G+j\omega C)}$$

Impedance Xform & Smith Charts

High Frequency Circuit Matching

/4 Termination
/4 Splice
Series Stub Line
Shunt Stub Line

Plane Waves

Equiphase Fronts

Amplitudes

Plane Wave Interference

Small-Scale Fading
Rayleigh Distribution
Antenna Diversity
Shape Factors

Link Budget Equation

Line-of-Sight Radio
Path Loss
Radio Link Design
PL Exponent Model
Shannon Channel Capacity
Signal-to-Noise Ratio

Multi-Surface Boundary Conditions

Planar Boundary Conditions

RFID and Radar

RFID Interrogator

RF Signal Generator

Receiver Unit

Transmit Antenna

Receive Antenna

RFID tag

Object

Radar Cross Section
Backscatter Modulation
Stealthy Airplanes

Waveguides

Cut-Off
Modes
Dispersion
Signal loss

Planar/Rectangular Waveguides

Circular Waveguides

Dielectric Waveguides

Cavity Resonators

fiber-optic cables
total internal reflection

microwave oven
High-Q filters

Reflection and Refraction

ϵ_1, μ_1

ϵ_2, μ_2

$\hat{e}_i$, $\hat{k}_i$, $\hat{h}_i$, $\hat{z}$, $\hat{x}$, $\hat{k}_r$, $\hat{e}_r$, $\hat{h}_r$

Snell's Laws
Fresnel Coefficients
Polarizers
Brewster Angle
Total Reflection
UHF Radio Propagation
Stealthy Surfaces