Lecture 1

niceguy

January 8, 2024

1 Introduction

1.1 Course Outline

- Theoretical Study and applications of E&M fields and waves
- Electromagnetic wave propagation
- Wave interaction with natural media
- Waveguides (wires but for waves)

This course is not going to be similar to ECE259.

1.2 Deliverables

Weekly online quizzes, labs with lab reports, see syllabus.

2 Transmission Lines

A transmission line is composed of 2 conductors embedded in a dielectric medium. Conductors include Al, Au, Ag, Cu, and dielectrics include air, glass, plastic, etc. Dielectrics are there to prevent short circuits. Arrangements can be coaxial, parallel-plate, microstrip, etc.

Example 2.1 (Analysis of Parallel Plate Transmission)**.** Let the x axis be the normal, and y and z axis be along the sides of the rectangular plates. For the dielectric in between, permittivity is $\varepsilon = \varepsilon_0 \varepsilon_r$, and permeability is

$\mu = \mu_0 \mu_r$.
Consider a "slice" of length Δz. Treating this as a capacitor, capacitance is

$$C = \varepsilon_0 \varepsilon_r \frac{w \Delta z}{h}$$

Per unit length, capacitance is

$$C' = \varepsilon_0 \varepsilon_r \frac{w}{h}$$

If we treat it as an inductor, using our knowledge from ECE259,

$$L = \frac{\mu h \Delta z}{w}$$

and similarly

$$L' = \frac{\mu h}{w}$$

If we consider it as a resistor, current would be constant between z and $z + \Delta z$, which is untrue. Therefore, we cannot solve these by naïvely treating them as resistors.