# ECE 340: Electromagnetics for Computer Engineering

## IN

### Physics and Computer Engineering

- Understand basics of electricity and magnetism
- Compute the terminal voltages and currents as well as the input impedance of transmission lines
- Create a lumped-circuit approximate model of a transmission line
- Understand EM field theory as a foundation of circuit theory
- Understand various computer engineering applications through modelling interconnection conductors

### Mathematics

- Understand calculation with vectors
- Use rectangular, cylindrical, and spherical coordinate systems
- Solve integrals, take derivatives, and solve differential equations using analytical techniques

### EM Field Computation

- Use Coulomb's law to compute electric field
- Use Gauss' law and Ampère's law in integral form to solve simple electric and magnetic static field problems
- Use Maxwell's equations in integral and differential forms, and boundary conditions to solve complex static and low-frequency electromagnetic-field problems

### Pre-requisites

- ECE202 with a minimum grade of C; MATH340 with a minimum grade of C

## Concepts:

- Waves, phasors, and vectors
- Transmission lines and waveguides
- Plane electromagnetic waves
- Wave reflection and transmission
- Static electromagnetic fields and boundary conditions
- Time-varying electromagnetic field
- Maxwell's equations
- Wave propagation and polarization
- Basics in computational electromagnetic modelling

## Applications:

- Computer engineering
- Electronics
- Electromagnetic compatibility
- Silicon photonics circuit design
- Wired and wireless communication
- Modeling of transmission lines
- Computational electromagnetics
- Radar and antennas
- Remote sensing

## Tools:

- Complex Vector algebra
- MATLAB or Python

## OUT

### EM Waves and Phasors

- Understand vector analysis: gradient, divergence, and curl
- Describe static and time-varying EM fields in mathematical forms

### Plane Electromagnetic Waves

- Understand wave propagation through media characterized by different electric and magnetic properties
- Perform propagation analysis of plane EM waves in the presence of arbitrary boundaries
- Compute and analyze potentials and fields in time-invariant and low-frequency EM systems of various shapes and materials

### EM Devices for Engineering Applications

- Relate fundamentals of electromagnetic theory for various computer engineering applications
- Understand and use concepts of transmission line
- Understand the basic performance of antennas and transmission lines in a particular device and relate its influence in VLSI design, silicon photonics, radar, antenna, and communication system
- Understand limitations of circuit theory as an approximation of field theory
- Connect electromagnetic material properties with real-world applications such as circuit design, waveguides, and fiber optics
- Know basics of numerical methods of computational EM to address scientific and engineering problems involving interactions between EM and material structures