# **ELC465b: Advanced Microwave and Antenna Engineering**

## Introduction and Review

* Typical microwave/RF system components
* On-chip, in-package, and on-PCB implementations and limitations.
* New trends and requirements: *5G communication systems*

## Loss Mechanisms in Transmission Lines

* Transmission line/waveguide technologies: Coax, microstrip, stripline, CPW, cylindrical waveguides, substrate integrated waveguides (SIW), other.
* Comparative study between different technologies: loss, isolation, frequency-dependence.
* Simulation using EM tools.

## Introduction to Computational EM

* The Moment Method: Pulse expansion and point matching
* Example 1: Charge distribution on 2D conducting shapes
* Example 2: Electromagnetic scattering by 2D conducting shapes under TM illumination
* Numerical modeling, convergence, and assessment of edge conditions

## Microwave Passive Components

* Review on power division networks
* Microwave attenuators and phase-shifters
* Coupled-line couplers - Theory of coupled lines
* Microwave baluns: high-pass/low-pass, transformer, Marchand, and rat-race
* Microwave duplexers/diplexers
* High-order microwave matching networks
* Circulators and isolators

## Microwave Filter Design

* The insertion loss method.
* Implementation using printed TLs.
* Filters using periodically loaded TLs.
* The coupling matrix method

## Analysis of Microwave Networks Using Signal Flow Graphs

* Source modeling
* Mason’s Rule
* Applications to network analysis

## Phased Arrays: Architectures, Feeding Networks, Tapered Distributions

* Review on antenna arrays and their parameters
* 2D (planar) antenna arrays
* Feeding network design
* Tapered distributions
* Array design considerations: grating lobes, SLL and gain degradation, mutual coupling, beam squinting, scan-blindness, pointing error… etc.