ELC4034: 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.