ECE221: Microwave Engineering

Program: B.Tech. (ECE/CCE) Year: 2nd/3rd Semester: Even
Course: Program Core for ECE Credits: 3 Hours: 42

Course Context and Overview:
The main objective of the course is to familiarize the ECE/CCE students with the various techniques employed in analyzing and designing contemporary Radio Frequency (RF) and Microwave Circuits and Components. The course is a must-do for all Electronics and Communication Engineers.

Prerequisite Courses: ECE0332: Engineering Electromagnetics (or equivalent)

Course outcomes (COs):

On completion of this course, the students will have the ability to:
CO1: Describe and model the performance of various microwave generators
CO2: Design the various types of impedance-matching networks used in RF/microwave frequency bands
CO3: Describe and model the performance of various microwave passive components
CO4: Describe the operation of various microwave active components
CO5: Describe and discuss the methods used for making the various kinds of microwave measurements

Course Topics:

Topics	**Lecture Hours**	
UNIT - I 1. **Microwave Generators** 1.1. Klystrons, Magnetrons, Traveling Wave Tubes, Semiconductor-Based Microwave Generators (Gunn Diode, IMPATT Diode), MASER		10

UNIT - II **2. Microwave Networks and Transmission Lines** 2.1 Two-port and multi-ports networks, scattering matrix for lossless and lossy networks, A recap of coaxial lines, rectangular waveguides, circular waveguides, striplines, microstrips, slot lines, coplanar waveguides, and coplanar strips	4	
3. **Impedance Matching**		12
3.1. Lumped-Component Matching		
3.1.1. The use of L-sections, Analytical Equations for various available topologies	4	
3.2. Distributed-Component Matching		
3.2.1. Stub-Matching (single-stub matching, double-stub matching), Transformer-Matching (maximally-flat designs and equal-ripple designs), Taper-Matching	4	
UNIT – III 4. **Microwave Passive Components (Filters)**		10
4.1. Lumped-Component Designs and Distributed-Component Designs		
4.1.1. Filter Design using Image-Parameter Method, Filter Design using Insertion-Loss Method, Filter Transformations and Scaling, Stepped-Impedance Resonator Filters, Coupled-Line Filters, Edge-Coupled Filters	6	
5. **Microwave Passive Components (Couplers, Power Dividers, Resonators and Isolators)**		
5.1. Coupled-Sections, Branch-Line Couplers, Rat-Race Couplers, Wilkinson Power Dividers. Resonators, Isolators	4	
UNIT – IV 6. **Microwave Active Components and Microwave Measurements**		10
6.1. Intro to Microwave Amplifiers, Low-Noise Amplifiers, Oscillators, Frequency Multipliers, and Mixers	4	
6.2. Intro to various methods of measuring frequency, input impedance, wavelength, power, VSWR, reflection coefficient, return loss, insertion loss, gain, Q, and radiation pattern 6.3. Intro to various commonly used RF/Microwave Test Instruments (Vector Network Analyzer, Spectrum Analyzer, VSWR Meter, Frequency Meter, etc.)	6	

Textbook references (IEEE format):

Text Books:

1. *RF and Microwave Engineering: Fundamentals of Wireless Communications*, Frank Gustrau, First Edition, John Wiley & Sons, 2012.
2. *Microwave Engineering*, David M. Pozar, Fourth Edition, Wiley-India, 2012.
3. *Microwave Devices and Circuits*, Samuel Y. Liao, *Third Edition, Prentice Hall, 1996.*

Reference books:

To Be Decided

Additional Resources (NPTEL, MIT Video Lectures, Web resources etc.):

To BE Decided

Last Update: 10th November 2017