

ECE 402: Microwaves

Course Book

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Prerequisites

The prerequisites of this course include (but not limited to) the following:

- An understanding of electromagnetic theory and propagation principles (Maxwell's equations, plane waves, ..etc.).
- A general knowledge of transmission lines theory.
- An understanding of basic calculus (integration, matrix algebra, differential equations, ..etc.).
- An intermediate level in English so the student can understand the lectures and their handouts.

Learning Objectives

This course aims to help the students understanding the basics of Microwave theory and techniques. It also intends to introduce the applications of Microwave Engineering in the modern communication and radar systems.

By the end of this course, the students should be able to understand basic Microwave electromagnetic structures, analyze Microwave networks, and design simple passive and active Microwave components.

Course Contents

Subject	Details	Duration (Hours)
Introduction to Microwave Engineering	Introducing the concept of Microwave Engineering and its difference from other fields of science. In addition, various applications of devices and systems realized by applying Microwave Engineering principles will be explored.	2
Microwave and RF Transmission Lines	Introduction to transmission lines, equivalent circuit representation of transmission lines, transmission line equation, traveling voltage and current waves, lossless transmission line model, planar transmission lines (microstrip and striplines), terminated lossless transmission lines, special termination conditions.	6
The Smith Chart	The relation between reflection coefficient and load impedance, impedance and admittance transformation, parallel and series connections.	4
Impedance Matching	Matching with lumped elements, single stub tuning, double stub tuning, quarter wave transformer.	6
Review of Microwave Waveguides	Reviewing the already covered theory of the rectangular waveguides and their use in Microwave systems.	2
Microwave Network Analysis	Impedance and equivalent voltages and currents, impedance and admittance matrices, the scattering matrix, ABCD network representation, practical measurements of S-parameters.	8
Microwave Resonators	Series and parallel resonant circuits, transmission line resonators, rectangular and circular waveguide resonators.	4
Microwave and RF Passive Components	One, two, three, and four-port components design using transmission lines and waveguides.	8
Microwave and RF Active Components	RF Diodes, BJTs, RF FETs, High Electron Mobility Transistors (HEMTs).	2
Microwave and RF Amplifier Design	Characteristics of amplifiers, stability considerations, two port power gain, single stage amplifiers, multistage amplifiers.	6
Radar Systems	Introduction to Radar systems, Pulse Radar, Continuous-wave Radar	2

Marks Distribution

Generally speaking, the marking of this course will be distributed as follows:

- **30%** Calculated from different tests and homework assignments given during the course.

- 70% Final Exam.

Contacting the Lecturer

The lecture will take place in the Microwaves laboratory every Monday at 10:30am. Delayed attendance is not accepted. A Google Classroom page has been created with the following registration code: (lcaqdsd)

Textbooks and References

Below is a list of books that will be the base of most lecture notes for this year. A soft copy of the most important books will be available in the google classroom page.

1. Pozar, David M. *Microwave engineering*. John Wiley & Sons, 2009.
2. Pozar, David M. *Microwave and RF design of wireless systems*. Wiley Publishing, 2000.
3. Collin, Robert E. *Foundations for microwave engineering*. John Wiley & Sons, 2007.
4. White, Joseph F. *High Frequency Techniques: An Introduction to RF and Microwave Design and Computer Simulation*. John Wiley & Sons, 2004.
5. Golio, Mike, ed. *The RF and microwave handbook*. CRC press, 2000.
6. Misra, Devendra. *Radio-frequency and microwave communication circuits: analysis and design*. John Wiley & Sons, 2004.
7. Liao, Samuel Y. *Microwave devices and circuits*. Englewood Cliffs: Prentice-Hall, 1985.
8. Barué, Gérard. *Microwave engineering: land & space radiocommunications*. Vol. 9. John Wiley & Sons, 2008.