UNIVERSITY of NICOSIA

Course Syllabus

Course Code	Course Title	ECTS Credits
ECE-440	Microwave Circuits	6
Prerequisites	**Department**	**Semester**
ECE-342	Engineering	Fall or Spring
Type of Course	**Field**	**Language of Instruction**
Elective	Engineering	English
Level of Course	**Lecturer(s)**	**Year of Study**
1st Cycle	Prof. Anastasis Polycarpou	4th
Mode of Delivery	**Work Placement**	**Corequisites**
Face-to-Face	N/A	None

Course Objectives:

The main objectives of the course are to:

- Introduce students to fundamental principles of microwave circuit analysis and design;
- Provide understanding of transmission lines including analytical and graphical tools for analysis and design;
- Introduce main concepts of network analysis and signal flow graphs;
- Introduce impedance matching techniques and tuning including multi-section matching transformers and tapered lines;
- Provide a complete understanding of waveguide propagation, modes, and attenuation;
- Provide the main principles and operation of power dividers, directional couplers, and hybrids;
- Introduce techniques for the design of microwave filters;
- Introduce software and tools for the analysis and design of microwave devices.

Learning Outcomes:

After completion of the course students are expected to be able to:

- Formulate electromagnetic theory to model wave propagation in dielectric/lossy media;
- Use transmission-line theory for the analysis and design of microwave devices including analytical and graphical tools such as the Smith chart;
- Design microstrip lines, striplines, and microwave filters according to certain specifications;
- Explain wave propagation in waveguides and solve related problems for the calculation of wave attenuation, phase velocity, supporting modes, single-mode bandwidth, etc.;

- Design simple and complex matching/tuning networks for different types of loads;
- Design directional couplers, hybrids, and power dividers;
- Use network analysis techniques to design and analyze microwave circuits.

Course Content:

- Introduction to microwaves and relevant applications;
- An overview of electromagnetic theory including Maxwell's equations, fields in different media, boundary conditions, wave equation, polarization, energy and power, lossless and lossy material;
- Introduction to transmission-line theory ranging from transmission-line parameters and the Smith Chart to quarter-wave transformer, generator and load mismatch, loss mechanisms and transient analysis;
- Different types of transmission lines and waveguides including parallel-plate waveguides, rectangular and circular waveguides, coaxial cables, striplines, microstrips, propagating modes, wave velocity, dispersion, and attenuation;
- Microwave network analysis: Impedance and admittance matrices, scattering matrix, and transmission matrix (ABCD). Two-port networks, signal flow graphs (Mason's rules), and modal analysis;
- Impedance matching and tuning using lumped elements, single and double stub matching, quarter-wave transformer, binomial and Chebyshev multi-section matching transformers, and tapered lines;
- Power dividers, directional couplers and hybrids including the T-junction power divider, the Wilkinson power divider, the waveguide directional coupler, the coupled line directional coupler, and the 90- and 180-degree hybrid;
- Microwave filter design and analysis using analytical tools and software packages.

Learning Activities and Teaching Methods:

Lectures, in-class examples and exercises

Assessment Methods:

Homework, project, exams, final exam

Required Textbooks / Readings:

Title	Author(s)	Publisher	Year	ISBN
Microwave Engineering	David M. Pozar	John Wiley & Sons	2011	978-0470631553

Recommended Textbooks / Readings:

Title	Author(s)	Publisher	Year	ISBN
Microwave Devices and Circuits	S. Liao	Prentice Hall	1996	978-0135832042
Foundations for Microwave Engineering	R. E. Collin	Wiley-IEEE Press	2001	978-0780360310