UNIVERSITY of NICOSIA

Course Code	Course Title	Credits (ECTS)
ECE-542	Electromagnetic Waves and Guided Structures	8
Department	**Semester**	**Prerequisites**
Engineering	Fall or Spring	ECE-342
Type of Course	**Field**	**Language of Instruction**
Elective	Engineering	English
Level of Course	**Year of Study**	**Lecturer(s)**
2st Cycle	1st	Dr Anastasis Polycarpou
Mode of Delivery	**Work Placement**	**Co-requisites**
Face-to-face	N/A	None

Objectives of the Course:

The main objectives of the course are to:

- Provide the graduate student with an in-depth understanding of the main principles and laws of Physics governing electromagnetic wave propagation through guided structures and different types of media (isotropic, anisotropic, lossless, or lossy)
- Formulate electromagnetic phenomena, such as wave propagation, reflection, and transmission through single- and multi-layer dielectrics, using vector fields and complex phasors for better understanding of the fundamental concepts
- Explain in detail important concepts related to evanescent waves, surface waves, coupling, attenuation, etc
- Provide a deep understanding of wave polarization and its importance in scattering and antenna technology
- Provide a complete mathematical analysis of wave propagation in rectangular and circular waveguides (and cavities), derivation of governing modes and propagation characteristics, cut-off frequencies, propagating power, etc
- Explain concepts related to dispersion, distortion, phase versus group velocity, dielectric versus conductor loss, etc
- Introduce the graduate student the concept of electromagnetic scattering and diffraction for simple 1-D and 2-D planar or circular structures

Learning Outcomes:

Upon completion of the course students are expected to:

- Interpret the physical meaning of Maxwell's equations
- Solve for the governing electromagnetic fields in different media using solutions of Maxwell's equations and the right boundary conditions at media interfaces
- Formulate electromagnetic wave propagation in lossless, lossy, and anisotropic media using mathematical expressions in order to calculate parameters such as attenuation and propagation constants, phase velocity, power density, etc.
- Determine the polarization of an electromagnetic wave
- Determine the reflection and transmission coefficients of a normally or obliquely incident wave on single- and multiple interfaces for parallel and perpendicular polarizations

- Explain the importance of Critical angle and Brewster angle and their application in optics and photonics
- Differentiate between a surface wave, a reflected wave, a transmitted wave, and an evanescent wave
- Solve problems of electromagnetic wave propagation inside rectangular and circular waveguides with or without dielectric filling
- Solve simple scattering problems for planar and circular 2-D structures

Course Contents:

- Time-varying Maxwell's equations, time-harmonic fields, boundary conditions
- Poynting vector, power and energy of an electromagnetic wave
- Wave propagation in unbounded lossless, lossy, and anisotropic media
- Wave polarization (linear, circular, elliptical)
- Wave interaction with dielectric media (single and multiple layers)
- Reflection and transmission at normal and oblique incidence. Definition of Critical and Brewster angles
- Rectangular and circular waveguides and cavities. Governing modes, propagation characteristics, attenuation, losses
- Introduction to scattering by planar and circular structures
- Project on scattering

Learning Activities and Teaching Methods:

Lectures, in-class examples, exercises, project

Assessment Methods:

Homework, mid-term and final exams, project report.

Required Textbooks/Reading:

Authors	Title	Publisher	Year	ISBN
Constantine A. Balanis	Advanced Engineering Electromagnetics	John Wiley & Sons	1989	0-471-62194-3

Recommended Textbooks/Reading:

Authors	Title	Publisher	Year	ISBN
Roger F. Harrington	Time Harmonic Electromagnetic Fields	McGrow-Hill	1961	07-026745-6
David K. Cheng	Fundamentals of Engineering Electromagnetics	Addison-Wesley	1993	0-201-56611-7