EI2410 Field Theory for Guided Waves 7.5 credits

Fältteori för vågledare

This is a translation of the Swedish, legally binding, course syllabus.

If the course is discontinued, students may request to be examined during the following two academic years

Establishment

Course syllabus for EI2410 valid from Autumn 2011

Grading scale

A, B, C, D, E, FX, F

Education cycle

Second cycle

Main field of study

Electrical Engineering

Specific prerequisites

The courses EI1200 Electromagnetic Field Theory and EI1210 Wave Propagation & Antennas, or the course EI1240 Electromagnetic Theory or equivalent knowledge of Eng B or equivalent. "

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

The course provides knowledge about and skill to analyse the above mentioned waveguides, regarding e.g. wave propagation; dispersion; energy transport; losses; scattering. After completion of the course the student shall be able to

- explain reciprocity and passivity for a material
- apply the decomposition technique on the fields and Maxwell's equations in an isotropic medium
- explain the concept waveguide mode and analyse the TM-, TE- & TEM-modes in metallic waveguides
- describe the modes in metallic waveguides of rectangular and circular cross sections
- use FEM to analyse waveguides with arbitrary cross sections
- explain mode orthogonality and use it when analysing energy transport
- explain the relation between phase velocity and group velocity
- explain chromatic, multi-mode and material dispersion
- compute the modes excited from a current source inside a waveguide
- use the mode matching technique to determine the scattered modes at discontinuties in waveguides
- use the energy conservation method to analyse attenuation of non-degenerate modes
- use perturbation methods to analyse attenuation and coupling between degenerate modes
- analyse cavity resonators, regarding resonance modes, mode othogonality and losses
- explain the quality factor and it's relations to the band width
- use conformal mapping and FEM to determine the parameters in multi-conductor systems
- analyse quasi-TEM modes in multi-conductor transmssion lines: propagation; orthogonality; power transport
- determine the scattering matrices for connected multi-transmission lines
- describe the principle for waves trapped inside a dielectric layer
- analyses TM- & TE-modes in planar dielectric waveguides
- analyse TM-, TE-, EH- & HE-modes in circular dielectric waveguides – optical fibers

Course contents

Electromagnetic fields guided by structures are utilised in several applications. A general name for such a structure is a waveguide. Some examples: cables for electrical power distribution; transmission lines for carrying information between electric/electronic devices and between components on circuit boards; metallic waveguides to distribute high power in antenna systems for radar and telecommunication; cavity resonators as narrow banded filters; optical fibers for high speed communication.

Course literature

M. Norgren Field Theory for Guided Waves (course compendium)

Examination

- TEN1 - Examination, 7.5 credits, grading scale: A, B, C, D, E, FX, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

Other requirements for final grade

Project tasks and written examination (TEN1; 7,5 cr).

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.