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## Guided propagation

### Finalità

The course will provide in-depth technical knowledge regarding functioning and applications of transmission lines as well as base concepts on microwave waveguides and optical fibers. Related design issues will be considered.

### Programma

Farady's and Ampere's laws and integral and differential Maxwell's equations. Differential operators. Wave equation and forward and backward propagating waves. Phase velocity. Ideal and lossy materials. Continuity conditions. Harmonic Maxwell's equations and phasors. Helmholtz's equation.

Active, reactive, instantaneous and average power carried by a wave. Poynting's theorem and its applications.

Introduction to guided propagation. Telegraphers and Telephone equations.

Circuitual line description; lossy lines, propagation constant, phase velocity, characteristic impedance, line parameters and exercises. Smith Chart. Short-circuited and open-circuited transmission lines and standing waves. Exercises on the Smith Chart. Impedance inverter and input impedance. Reflection coefficient.

The problem of matching a line on the input and load sections. Power transferred to the load, transfer function. Single-stub, double-stub and triple-stub matching and quarter-wave matching. Exercises on line matching.

Strip-line and micro-strip. Characteristic parameters, applications, numerical approaches, T and S parameters, exercises.

Transients on transmission lines; transient response, bounce diagrams, time-domain reflectometer and exercises.

Microwave guides; modes, cut-off frequency, phase velocity; rectangular and circular metallic waveguides and applications.

Optical propagation in dielectric waveguides; ray optics. Plastic and glass optical fibers; modes, attenuation and dispersion. Performances and applications. Dielectric waveguides and integrated optics.

### Attività d'esercitazione

Lab activity with numerical codes for the analysis of waves propagation in simple transmission lines.

### Modalità d'esame

Written test

### Propedeuticità

Elettrotecnica AB, Fisica generale C

### Testi consigliati

S. Selleri, A.H. Bouk "Propagazione Guidata", MUP, 2004.

U.S. Inan, A.S. Inan "Engineering Electromagnetics", Addison Wesley, 1999.

F.T. Ulaby "Applied Electromagnetics", Prentice Hall, 1999.