230626 - NMEE - Numerical Methods for Electromagnetic Engineering

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering
Teaching unit: 739 - TSC - Department of Signal Theory and Communications
Academic year: 2017
Degree: MASTER'S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Teaching unit Optional)
ECTS credits: 5
Teaching languages: English

Teaching staff
Coordinator: JUAN-MANUEL RIUS CASALS
Others: ALEXANDER HELDRING - EDUARDO UBEDA FARRE - JOSE MARIA GONZALEZ ARBESU

Prior skills

Requirements
None.

Teaching methodology
Teaching is based on lectures by teachers. Slides and computer simulation software may be used by the teachers to clarify concepts. Students may be asked to solve problems and to write simple programs in MATLAB language.

Learning objectives of the subject
Background in advanced electromagnetics, from an engineering point of view. Understanding of electromagnetic radiation and diffraction, and ability to compute radiated and diffracted fields. Understanding of modern numerical methods for computer simulation. Ability to write simple computer programs for numerical simulation.

Study load

<table>
<thead>
<tr>
<th>Total learning time: 125h</th>
<th>Hours large group:</th>
<th>39h</th>
<th>31.20%</th>
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<tr>
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<td>Self study:</td>
<td>86h</td>
<td>68.80%</td>
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Last update: 30-06-2017
## 1- Fundamentals

**Description:**
- Vector calculus (review)
- Maxwell’s equations and boundary conditions (review)
- Electrical properties of material media
- Conservation of energy
- Time harmonic fields (review)
- Wave equation and its solutions (review)
- Potentials, construction of solutions
- Induced and radiated fields

**Learning time:** 6h
- Theory classes: 6h

## 2- Electromagnetic theorems and principles

**Description:**
- Fundamental theorems and concepts
- Electric and Magnetic Field Integral equations (EFIE and MFIE)
- Practical project: Using the concept of reciprocity and mutual impedances, develop simple software to analyze Yagi-Uda antennas and optimize the design to agree with antenna parameters specification. If possible, the best design will be measured in the AntennaLab anechoic chamber.

**Learning time:** 6h
- Theory classes: 6h

## 3- Radar Cross Section, scattering and high-frequency techniques

**Description:**
- Radar Cross Section
- Analytic solutions for canonical geometries
- Diffraction of 2D TM and TE waves
- High frequency diffraction phenomena
- High frequency methods (from "Antenas", Cardama et al.)

**Learning time:** 6h
- Theory classes: 6h
Students will solve a problem (or a few short exercises) at the end of each chapter (20%). Practical projects will also contribute to final course mark (40%). There will be a final examination (40%).

Final Mark = 0.4*(Final exam) + 0.4*(Practical projects) + 0.2*(Problems)
Bibliography

Basic: