Course guide
230917 - ICAF - Introduction to High Frequency Circuits

Unit in charge: Barcelona School of Telecommunications Engineering
Teaching unit: 739 - TSC - Department of Signal Theory and Communications.
Degree: BACHELOR'S DEGREE IN ELECTRONIC ENGINEERING AND TELECOMMUNICATION (Syllabus 2018).
(Compulsory subject).
Academic year: 2022 ECTS Credits: 6.0 Languages: Catalan

LECTURER
Coordinating lecturer: Consultar aquí / See here:
https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/responsables-assignatura
Others: Consultar aquí / See here:
https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/professorat-assignat-idioma

PRIOR SKILLS
Good capability to operate complex numbers and sinusoidal steady-state circuit analysis. It is important to have achieved the concepts given in the subject "Applied Electromagnetism and Photonics".

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES
Specific:
CE9. (ENG) GEELEC: Capacitat d'anaritzar i especificar els paràmetres fonamentals d'un sistema de comunicacions. (Mòdul comú a la branca de telecomunicació).
CE13. (ENG) GREELEC: Capacitat per comprendre els mecanismes de propagació i transmissió d'ones electromagnètiques i acústiques, i els corresponents dispositius emissors i receptors. (Mòdul comú a la branca de telecomunicació).

Transversal:
CT5. (ENG) GREELEC: ÚS SOLVENT DELS RECURSOS DE LA INFORMACIÓ. Gestionar l'adquisició, l'estructuració, l'anàlisi i la visualització de dades i informació en l'àmbit de l'especialitat i valorar de forma crítica els resultats d'aquesta gestió.

TEACHING METHODOLOGY
Lectures
Laboratory work and exercises
Laboratory reports
Self study (home work)
Short tests: Control exercises, grouped by subject, distributed thought out the course.
Long tests (Mid-term and Final exam)
LEARNING OBJECTIVES OF THE SUBJECT

Based on the knowledge of electromagnetic fields and sinusoidal steady-state lineal circuits theory, the students will learn the fundamentals of transmission media, both, those based on guided and radiated electromagnetic fields.

Learning results:

The student knows the transmission mechanisms of electromagnetic waves and analyzes the transmission lines in temporal domain and in the sinusoidal steady-state. The student knows the theory of waveguides and the operating principle of optical fibers. They be able calculate antenna parameters and, they know the mechanisms of propagation and calculate the fundamental parameters of communication systems. The student understand the concept of signal-to-noise ratio (SNR) and knows how to calculate it.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>52,0</td>
<td>34.67</td>
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<tr>
<td>Hours small group</td>
<td>13,0</td>
<td>8.67</td>
</tr>
<tr>
<td>Self study</td>
<td>85,0</td>
<td>56.67</td>
</tr>
</tbody>
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Total learning time: 150 h

CONTENTS

1. Introduction and basic concepts

Description:
Electric energy and power; Circuits in Sinusoidal Steady-State; Logarithmic magnitudes and cable attenuation (dB and Neper)

Related activities:
Laboratory Work I

Full-or-part-time: 13h 08m
Theory classes: 4h
Laboratory classes: 2h 36m
Self study : 6h 32m

2. Time domain analysis of transmission lines

Description:
Definition, usual configurations and applications. Voltage and current waves, reflection coefficient, transients and pulses.

Related activities:
Laboratory Work II

Full-or-part-time: 18h 24m
Theory classes: 6h
Laboratory classes: 2h 36m
Self study : 9h 48m
### 3. Transmission lines in Sinusoidal Steady-State

**Description:**

**Related activities:**
Laboratory Work III

**Full-or-part-time:** 28h 58m
- Theory classes: 10h
- Laboratory classes: 2h 36m
- Self study: 16h 22m

### 3. Impedance measures and matching networks

**Description:**

**Full-or-part-time:** 15h 48m
- Theory classes: 6h
- Self study: 9h 48m

### 5. Waveguides

**Description:**
Propagation modes. Group and phase velocity. Dispersion. The fundamental mode in the rectangular waveguide, standing waves and the equivalent transmission line.

**Related activities:**
Laboratory Work IV

**Full-or-part-time:** 18h 24m
- Theory classes: 6h
- Laboratory classes: 2h 36m
- Self study: 9h 48m

### 6. Optical Fibers

**Description:**
Fiber optics basics, modal analysis, Multi-mode and single-mode fibers, dispersion, en fibres and maximum bit rate.

**Full-or-part-time:** 15h 48m
- Theory classes: 6h
- Self study: 9h 48m
7. Antenna fundamentals

Description:
Circuit Model. Transmission and reception antenna parameters. Friis transmission equation. Noise in reception: Thermal noise, antenna temperature, equivalent noise temperature, noise to signal ratio (NSR)

Related activities:
Laboratory Work V

Full-or-part-time: 39h 30m
Theory classes: 14h
Laboratory classes: 2h 36m
Self study: 22h 54m

GRADING SYSTEM

- Final exam: 60%
- Continuous assessment: 25%.
- Laboratory work and reports: 15%

EXAMINATION RULES.

Calculator: In order to undertake the tests and exams within this subject, a calculator that operates complex numbers is required. Programmable devices, cameras and any wireless device are strictly forbidden during tests and exams.

BIBLIOGRAPHY

Basic:

Complementary: