

## Faculty of Applied Sciences

**ELEC1755 ELECTRICITY : ADVANCED TOPICS**

[30h+30h exercises] 5 credits

This course is not taught in 2005-2006

This course is taught in the 1st semester

Language: French

Level: First cycle

**Aims**

This course consists of two parts

1. Devices and electronic circuits :

- understand - and predict - the behavior of semi-conductor devices
- develop usable model of these devices

2. Electromagnetism :

- write down the equation and calculate the electrostatic and magnetostatic fields for various conductors and charges topologies,
- solve the Maxwell's equations with their boundary conditions,
- calculate the equivalent circuit (R, L, C) of a 3D structure with electromagnetic fields,
- calculate the fundamental parameters of uniform transmission lines,
- define and use the reflection coefficient and VSWR as well as the Smith Chart,
- calculate transients on lossless transmission lines.

**Main themes**

Identical to the contents of the course

## Content and teaching methods

### 1. Devices and electronic circuits :

#### - Principles of conductivity :

Solids and semi-conductors, doping - effect of potential, temperature, light, Poisson equation and basics of the current equation

#### - Analysis of the PN junction :

Internal potential - static current computation, dynamic behavior, limits of the modeled behavior - models and use (photodiode)

#### - Technology :

Basic material - photo-lithography and basic technologic steps - building circuit elements

#### - Analysis of electronic devices :

Two transistors are analyzed, in order to deduce amplifier and switching properties, the bipolar and the MOS transistors. For each one, the next points are considered :

. physical structure and principles

. static analysis of the various functional modes, limits of approximations

. dynamic behavior

. models and practical examples

#### - Integrated circuits :

Principles of bipolar and MOS technologies, critical parameters and limits, comparison - complexity and verification (tests).

### 2. Electromagnetism

- Electrostatic and magnetostatic equations in vacuum,

- Dielectric and magnetic materials,

- Maxwell's equations,

- Circuit elements (R, L, C 3D structures), skin effect, eddy currents, magnetic circuits

- Fundamental equations of uniform transmission lines in sinusoidal regime, voltage, current, characteristic impedance, reflection coefficient and VSWR,

- Use of the Smith Chart for matching with transmission lines (open or shorted stubs)

- Transients on lossless transmission lines

## Other information (prerequisite, evaluation (assessment methods), course materials recommended readings, ...)

### Prerequisites :

First degree of engineering courses or equivalent

### Supporting material :

#### 1.Devices and electronic circuits :

The copy of the lecture notes and slides used during the course may be found at :

<http://www.icampus.ucl.ac.be/ELEC2755>

#### 2. Electromagnetism

"Electromagnetisme, champs, circuits", A. Vander Vorst, De Boeck

### Assessment :

Written examination (exercises), during the session, with personal documents

### For more information :

<http://www.icampus.ucl.ac.be/ELEC2755>