Faculty of Applied Sciences

## ELEC1755    ELECTRICITY : ADVANCED TOPICS

[30h+30h exercises] 5 credits

This course is taught in the 1st semester

**Teacher(s):**        Anne-Marie Anckaert, Danielle Janvier, Claude Oestges (supplée Danielle Janvier)
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 semci-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 bahavior - podels 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 circucits
- 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 :
BAC11 and BAC12 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

## Other credits in programs

**FSA13BA**         Troisième année de bachelier en sciences de l'ingénieur,         (5 credits)
                    orientation ingénieur civil