UCLouvain

# lelec2541

*2023*

# Advanced Transistors

| 5.00 credits | 30.0 h + 22.5 h | Q2 |
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| Teacher(s) | Flandre Denis ;Hackens Benoît ;Raskin Jean-Pierre ; |
| Language : | English<br>> French-friendly |
| Place of the course | Louvain-la-Neuve |
| Main themes | This training on advanced semiconductor devices follows naturally that of LELEC1330. It is focused on high performance devices in terms of speed, noise and temperature. The course highlights the links between physical phenomena, materials, fabrication and performances. Simulation and characterisation tools will be introduced. Content : Special semiconductors (heterostructures, SOI, III-V), HEMT, JFET, MESFET, Diodes, bipolar transistors, and small scale and high frequency MOS devices. |
| Learning outcomes | **At the end of this learning unit, the student is able to :**<br>1<br>In consideration of the reference table AA of the program "master in electrical engineering ", this course contributes to the development, to the acquisition and to the evaluation of the following experiences of learning:<br>• AA1.1, AA1.2, AA1.3<br>• AA2.1, AA2.2, AA2.5<br>• AA3.1, AA3.2, AA3.3<br>• AA4.1, AA4.2, 4.3, AA4.4<br>• AA5.3, AA5.4, AA5.5, AA5.6,<br>• AA6.1<br>At the end of this course,students will be able to<br>- Describe the physical behavior at play, and use appropriate models, in advanced semiconductor devices and in a wide range of temperature and frequency.<br>- Use simulation and accurate characterization tools of semiconductor devices.<br>- Model new devices in the perspective of forthcoming courses and master projects. |
| Evaluation methods | Written exam on the theoretical background (50%), report and oral presentation of a group project (50%), the 2 parts must be presented.<br>The project marks might be individualized depending on the participation/presence of each student of a group. The project might be represented (and hence improved) in 2nd session.<br>The project must be the own production of the group : plagiarism of sources is obviously forbidden and the use of generative AI (e.g. chatGPT) is strongly not recommended (including to improve the text of the report). Its partial use must be documented as the any other source of information. |
| Teaching methods | • 11 lectures<br>• 2 laboratories<br>• 1 project in small groups, with intermediate presentations and discussions with the teachers. |
| Content | Lectures are given interactively and are based on the themes presented above. They are complementary to the written notes and references below as they give a different perspective and are based on student questions.<br>The project is an extension of the lectures and allows a deeper understanding of advanced devices. It relies on a bibliographic review of a specific subject chosen by the students (groups of 2 to 3), and the analysis of experimental data or their modelling/simulation, depending on ressources available in the lab. |
| Inline resources | https://moodle.uclouvain.be/course/view.php?id=2188 |
| Bibliography | Slides et autres supports proposés par les enseignants sur Moodle.<br>Références disponibles en bibliothèques :<br>- « Physics of low-dimensional semiconconductors », J.H. Davies, Cambridge University Press<br>- « Physique des dispositifs semi-conducteurs », De Boeck Université, J.-P. Colinge et F. Van de Wiele<br>- « Silicon-on-Insulator Technology: Materials to VLSI », 2nd Edition, J.-P. Colinge, Kluwer Academic Publishers<br>- « Operation and modeling of the MOS transistor», Y. P. Tsividis, McGraw-Hill Book Company.<br>- « Quantum semiconductor Structures », C. Weisbuch and B. Vinter, Academic Press Inc. |
| Other infos | Background in physics, including quantum mechanics, physics of semiconductor devices (e.g. LELEC1330) |

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| Faculty or entity in charge | ELEC |

## Programmes containing this learning unit (UE)

| Program title | Acronym | Credits | Prerequisite | Learning outcomes |
|---|---|---|---|---|
| Master [120] in Chemical and Materials Engineering | KIMA2M | 5 | | |
| Master [120] in Electrical Engineering | ELEC2M | 5 | | |
| Master [120] in Physical Engineering | FYAP2M | 5 | | |
| Master [120] in Electro-mechanical Engineering | ELME2M | 5 | | |
| Advanced Master in Nanotechnologies | NANO2MC | 5 | | |