**Universitatea Naţională de Ştiinţă şi Tehnologie Politehnica Bucureşti**
**Facultatea de Electronică, Telecomunicaţii şi**
**Tehnologia Informaţiei**

# COURSE DESCRIPTION

## 1. Program identification information

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|---|---|
| 1.1 Higher education institution | **National University of Science and Technology Politehnica Bucharest** |
| 1.2 Faculty | **Electronics, Telecommunications and Information Technology** |
| 1.3 Department | **Electronic Devices, Circuits and Architectures** |
| 1.4 Domain of studies | Computers and Information Technology |
| 1.5 Cycle of studies | Bachelor/Undergraduate |
| 1.6 Programme of studies | Information Engineering |

## 2. Date despre disciplină

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2.1 Course name (ro)<br>(en) | | | | Modele ale componentelor electronice pentru SPICE | | | |
| 2.2 Course Lecturer | | | | Prof. Dr. Cristian Ravariu | | | |
| 2.3 Instructor for practical activities | | | | Prof. Dr. Cristian Ravariu | | | |
| 2.4 Year of studies | 2 | 2.5 Semester | II | 2.6. Evaluation type | V | 2.7 Course regime | Op |
| 2.8 Course type | | S | 2.9 Course code | 04.S.04.A.722 | | 2.10 Tipul de notare | Nota |

## 3. Total estimated time (hours per semester for academic activities)

| | | | | | |
|---|---|---|---|---|---|
| 3.1 Number of hours per week | 2 | Out of which: 3.2 course | 1.00 | 3.3 seminary/laboratory | 1 |
| 3.4 Total hours in the curricula | 28.00 | Out of which: 3.5 course | 14 | 3.6 seminary/laboratory | 14 |
| Distribution of time: | | | | | hours |
| Study according to the manual, course support, bibliography and hand notes<br>Supplemental documentation (library, electronic access resources, in the field, etc)<br>Preparation for practical activities, homework, essays, portfolios, etc. | | | | | 20 |
| Tutoring | | | | | 10 |
| Examinations | | | | | 10 |
| Other activities (if any): | | | | | 7 |

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|---|---|
| 3.7 Total hours of individual study | 47.00 |
| 3.8 Total hours per semester | 75 |
| 3.9 Number of ECTS credit points | 3 |

## 4. Prerequisites (if applicable) (where applicable)

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|---|---|
| 4.1 Curriculum | The fundamental course of Electronic Devices |
| 4.2 Results of learning | General knowledge of physics, electronic devices and software simulation of electronic circuits |

## 5. Necessary conditions for the optimal development of teaching activities (where applicable)

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|---|---|
| 5.1 Course | The course will take place in a room equipped with a video projector or on the MSTEams platform |
| 5.2 Seminary/ Laboratory/Project | The laboratory will be conducted in a specific room, which must include: computers, Internet connection, SPICE electronic circuit simulator or MSTeams platform, etc, students with computers with a SPICE simulator installed. |

**6. General objective** *(Reffering to the teachers' intentions for students and to what the students will be thought during the course. It offers an idea on the position of course in the scientific domain, as well as the role it has for the study programme. The course topics, the justification of including the course in the currcula of the study programme, etc. will be described in a general manner)*

Familiarizing students with active component models in SPICE simulators based on the acquisition of general theoretical and practical knowledge on the main model parameters. The overall objective is achieved by:

highlighting model parameters and methods of their extraction.

practical application of pattern selection in SPICE simulators for editing and analyzing electronic circuit schemas.

use of parameter extractor sub-programmes necessary to create new models for non-existent active components in libraries or to validate new models

classification and hierarchy of SPICE models;

streamlining the running of simulation programs by ensuring the optimum between the complexity, the number of parameters, the robustness and the precision of the chosen model.

**7. Competences** *(Proven capacity to use knowledge, aptitudes and personal, social and/or methodological abilities in work or study situations and for personal and proffesional growth. They refflect the empolyers requirements.)*

| | |
|---|---|
| **Specific Competences** | C1. Use of fundamental elements relating to electronic devices, circuits, systems, instrumentation and technology<br>C2 Multiple skills to work as an integrated microsystem designer, of medium complexity, or as a process technologist (using state-of-the-art software tools and micro-nanoelectronic technologies<br>C3 . Modeling and processing of integrated devices and circuits using modern micro and nanoelectronic technologies |
| **Transversal (General) Competences** | CT1 Adaptation to new technologies, professional and personal development, through continuous training using printed documentation sources, specialized software and electronic resources in Romanian and at least, in a language of international circulation.<br>CT2 Honorable, responsible, ethical behavior in the spirit of the law to ensure the reputation of the profession<br>CT3 Awareness of the need for continuous training; efficient use of learning resources and techniques for personal and professional development |

**8. Learning outcomes** *(Synthetic descriptions for what a student will be capable of doing or showing at the completion of a course. The learning outcomes reflect the student's acomplishments and to a lesser extent the teachers' intentions. The learning outcomes inform the students of what is expected from them with respect to performance and to obtain the desired grades and ECTS points. They are defined in concise terms, using verbs similar to the examples below and indicate what will be required for evaluation. The learning outcomes will be formulated so that the correlation with the competences defined in section 7 is highlighted.)*

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|---|---|
| **Knowledge** | *The result of knowledge aquisition through learning. The knowledge represents the totality of facts, priciples, theories and practices for a given work or study field. They can be theoretical and/or factual.*<br>List the fundamental models of bipolar alediodes and transistors<br>Define model parameters<br>Describe/classify model parameters<br>Highlights the peculiarities of special constructive solutions |
| **Skills** | *The capacity to apply the knowledge and use the know-how for completing tasks and solving problems. The skills are described as being cognitive (requiring the use of logical, intuitive and creative thinking) or practical (implying manual dexterity and the use of methods, materials, tools and intrumentation).*<br>Selects and groups relevant information about the constructive types of diodes and bipolar transistors.<br>Arguably uses specific principles in order to preserve or neglect some model parameters.<br>Work productively in a team to carry out the laboratory.<br>Elaborates a scientific text in the drafting of laboratory reports.<br>Experimentally check the solutions of model parameter extraction.<br>Solves practical applications within the laboratory, processing datasets from catalog sheets.<br>Adequately interprets causal relationships between extracted values.<br>Analyzes and compares the values of the extracted parameters in the laboratory works.<br>Identifies solutions and elaborates laboratory reports .<br>Conclusions on the experiments carried out.<br>Arguments the solutions identified in the practical applications. |
| **Responsability and autonomy** | *The student's capacity to autonomously and responsably apply their knowledge and skills.*<br>Select appropriate bibliographic sources and analyze them.<br>Respect the principles of academic ethics, correctly quoting the used bibliographic sources.<br>Demonstrate responsiveness for new learning contexts.<br>Demonstrates collaboration with other colleagues and teachers in carrying out teaching activities<br>Demonstrates autonomy in organizing the learning situation/context or problem-solving situation<br>Promotes/contributes through new solutions, related to the specialty field.<br>Awareness of the value of its contribution to the field of engineering in identifying viable/sustainable solutions<br>Apply ethical principles |

**9. Teaching techniques** *(Student centric techniques will be considered. The means for students to participate in defining their own study path, the identification of eventual fallbacks and the remedial measures that will be adopted in those cases will be described.)*

Building on the analysis of students' learning characteristics and their specific needs, the teaching process will explore teaching methods both expository (lecture, exposure) and conversational-interactive, based on learning by discovery models facilitated by direct and indirect exploration of reality (experiment, demonstration, modeling), but also on action-based methods such as exercise, exercise, and, practical activities and problem solving.

Lectures will be used in the teaching activity, based on PowerPoint presentations or different Internet pages that will be made available to students. Each course will start with the recapitulation of the chapters already covered, with an emphasis on the notions taken at the last course.

The presentations use images and schemes so that the information presented is easily understood and assimilated.

This discipline covers information and practical activities designed to support students in their learning efforts and to develop optimal relationships of collaboration and communication in a climate conducive to learning through discovery.

**10. Contents**

| **COURSE** | | |
|---|---|---|
| **Chapter** | **Content** | **No. hours** |
| 1 | 1. Presentation of the SPICE program as an electronic circuit simulator. The problem of modeling in the current software context. Models – Model parameters – Parameter extractors – Extraction algorithms. | 2 |
| 2 | 2. SPICE models of diodes. Declaring a Diode in SPICE. Calling the library with model parameters. Modeling of static diode regime in SPICE. Modeling the dynamic diode regime in SPICE. Applications. | 2 |
| 3 | 3. SPICE models of bipolar transistors. Declaring a TB in SPICE. Start model – Ebers-Moll Fundamental; series resistors, Early Effect, Generation-recombination currents effect, high injection level2 | 2 |
| 4 | 4. Modeling the dynamic regime in SPICE. Capacity for transition. Diffusion capabilities. Extraction of model parameters. The complete circuit of TB | 4 |
| 5 | MOSFETs SOICE Models | 2 |
| 6 | Final revision | 2 |
| | **Total:** | 14 |

**Bibliography:**


- L. Dobrescu, D. Dobrescu Curs Modele SPICE
  Moodle https://archive.curs.upb.ro/2021/course/view.php?id=9649
- L. Dobrescu, D.Dobrescu, "Rezolvarea si simularea in SPICE a circuitelor electronice ", Ed. Politehnica Press, ISBN 978-606-9608-26-5, 2022
- Andrei Vladimirescu, ” SPICE”, Traducere in limba română cu exercitii, Editura Tehnica, 1999.
- A. Rusu, “Modelarea Componentelor Microelectronice Active“, Ed. Academiei Române, 1990.
- D. Dobrescu “ Analiza circuitelor electronice de la functie catre dispozitiv “,Ed. Printech, 2004.
- C. Ravariu, A. Rusu, “Modele SPICE ale componentelor microelectronice ”, Ed. MatrixRom, 2006.
- L.Dobrescu, D. Dobrescu, “Basics of the semiconductor devices physics “, Printech Publishing House, 2005


**LABORATORY**

| Crt. no. | Content | No. hours |
|---|---|---|
| 1 | Simulation in SPICE of multiple circuits with diodes, with emphasis on editing the list of model parameters, in the PSPICE environment from CADENCE ORCAD Cis-LITE 16.6 | 4 |
| 2 | Extraction of parameters for diodes with extraction sub-programme , comparative and advanced simulations (diode as temperature sensor), using PSPICE from CADENCE ORCAD Cis-LITE 16.6 | 4 |
| 3 | Using the LTSpiceIV program to simulate circuits with Bipolar Transistors | 4 |
| 4 | Final revision | 2 |
| | **Total:** | 14 |

**Bibliography:**


- L. Dobrescu, D. Dobrescu Curs Modele SPICE
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- Andrei Vladimirescu, ” SPICE”, Traducere in limba română cu exercitii, Editura Tehnica, 1999
- L. Dobrescu, D.Dobrescu, "Rezolvarea si simularea in SPICE a circuitelor electronice ", Ed. Politehnica Press, ISBN 978-606-9608-26-5, 2022
- A. Rusu “Modelarea Componentelor Microelectronice Active“, Ed. Academiei Române, 1990.
- C. Ravariu, A.Rusu, “Modele SPICE ale componentelor microelectronice “, Ed. MatrixRom, 2006.
- https://www.orcad.com/resources/download-orcad-lite
- https://www.analog.com/en/design-center/design-tools-and-calculators/ltspice-simulator.html


**11. Evaluation**

| Activity type | 11.1 Evaluation criteria | 11.2 Evaluation methods | 11.3 Percentage of final grade |
|---|---|---|---|
| 11.4 Course | | | |

| | | | |
|---|---|---|---|
| 11.5<br>Seminary/laboratory/project | | | |
| 11.6 Passing conditions | | | |
| Obtaining 50% of the laboratory score during the semester.<br>Compliance with UPB regulation on promotion conditions. | | | |

**12. Corroborate the content of the course with the expectations of representatives of employers and representative professional associations in the field of the program, as well as with the current state of knowledge in the scientific field approached and practices in higher education institutions in the European Higher Education Area (EHEA)**

The content of the discipline is largely similar to that of disciplines with the same objectives taught in universities in the European Union. The content of the discipline is continuously updated and adapted following consultations with representatives of the business environment in Bucharest.

| Date | Course lecturer | Instructor(s) for practical activities |
|---|---|---|
| 21.09.2026 | Prof. Dr. Cristian Ravariu | Prof. Dr. Cristian Ravariu |

| Date of department approval | Head of department |
|---|---|

| Date of approval in the Faculty Council | Dean |
|---|---|
| 22.09.2026 | Prof. Dr. Mihnea Udrea |