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

# COURSE DESCRIPTION

## 1. Program identification information

| | |
|---|---|
| 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 | Electronic Engineering, Telecommunications and Information Technology |
| 1.5 Cycle of studies | Bachelor/Undergraduate |
| 1.6 Programme of studies | Microelectronics, Optoelectronics and Nanotechnologies |

## 2. Date despre disciplină

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2.1 Course name (ro)<br>(en) | | | | Grafică asistată de calculator - Tehnici CAD pentru electronică<br>Computer Aided Graphics - CAD Techniques for Electronics | | | |
| 2.2 Course Lecturer | | | | Prof. Dr. Norocel Codreanu | | | |
| 2.3 Instructor for practical activities | | | | Prof. Dr. Norocel Codreanu, Assoc. Prof. Mihaela Pantazica, Assoc. Prof. Irina Bacîş, Lect. Iulian Buşu | | | |
| 2.4 Year of studies | 2 | 2.5 Semester | 1 | 2.6. Evaluation type | V | 2.7 Course regime | Op |
| 2.8 Course type | | F | 2.9 Course code | 04.F.03.A.007 | | 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 | 3.3 seminary/laboratory | 1 |
| 3.4 Total hours in the curricula | 28 | 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 | | | | | 0 |
| Examinations | | | | | 2 |
| Other activities (if any): | | | | | 0 |

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| 3.7 Total hours of individual study | 22.00 |
| 3.8 Total hours per semester | 50 |
| 3.9 Number of ECTS credit points | 2 |

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

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| 4.1 Curriculum | Completion of the following subjects:<br>• Fundamentals of Electrical Engineering;<br>• Physics;<br>• Measurements in Electronics and Telecommunications;<br><br>other courses from the Year I curriculum. |

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| 4.2 Results of learning | General knowledge of analog and digital electronics, electronic technology, signals, electronic circuits and systems |

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

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| 5.1 Course | Room with video projector and screen |
| 5.2 Seminary/ Laboratory/Project | Specific facilities of an electronics laboratory and of a computer-aided design room in electronics; presențce at laboratories (according to the UNSTPB Bachelor's regulations). |

**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)*

The general objective of the subject "Computer-Aided Graphics – CAD Techniques for Electronics" is to offer students in this specialization the opportunity to reach an appropriate level of theoretical and practical knowledge in the field of Electronic Design Automation (EDA), technology engineering, electronic packaging, and the manufacturing of electronic modules.

**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.)*

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|---|---|
| **Specific Competences** | Demonstrates possession of fundamental knowledge in the field of Electronic Design Automation (EDA), computer-aided design in electronics, and technological electronics (electronic packaging).<br>Correlates the accumulated knowledge.<br>Applies knowledge in practice.<br>Applies standardized methods and tools specific to the field to carry out evaluation and diagnosis of a situation according to the identified/reported problems, and identifies engineering solutions.<br>Oral and written communication in Romanian: uses scientific vocabulary specific to the field for effective written and oral communication.<br>Oral and written communication in a foreign language of international circulation (English): demonstrates understanding of the field's vocabulary in a foreign language of international circulation. |
| **Transversal (General) Competences** | Works in a team and communicates effectively, coordinating efforts with others to solve situations with medium complexity problems.<br>Capacity for analysis and synthesis: presents synthetically the knowledge acquired as a result of a systematic analysis process.<br>Respects the principles of academic ethics: correctly cites the bibliographic sources used during documentation and respects intellectual property. |

**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.)*

| | |
|---|---|
| **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>· **Presents** the most important stages of the computer-aided design flow of electronic modules.<br>· **Defines** notions specific to the field of technological electronics and computer-aided design of electronic modules.<br>· **Describes and classifies** the CAE-CAD-CAM processes.<br>• **Highlights consequences and relationships** between the various design stages and the importance of successfully completing all stages. |
| **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 from the field of computer-aided design of electronic modules.<br>· **Works** productively **in a team** through assignments/projects given in the laboratory.<br>· **Checks** by virtual methods (DRC – Design Rules Check) the engineering solutions found.<br>· **Solves** low-complexity applied projects.<br>· **Identifies solutions** for solving the proposed projects.<br>· **Formulates conclusions** for the completed projects.<br>• **Argues** the identified solutions and the ways of solving. |
| **Responsability and autonomy** | *The student's capacity to autonomously and responsably apply their knowledge and skills.*<br>· **Selects** and analyzes bibliographic sources in the field of electronic packaging.<br>· **Respects the principles of academic ethics,** correctly citing the bibliographic sources used.<br>· **Demonstrates receptiveness** to new learning contexts.<br>· **Shows collaboration** with other colleagues and teaching staff in carrying out teaching activities<br>· **Demonstrates autonomy** in organizing the learning situation/context in the field of electronic packaging and computer-aided design of electronic modules.<br>· **Promotes/contributes with new solutions, specific to the field of** electronic packaging to improve the quality of social life.<br>• **Applies principles of ethics/professional deontology in analyzing the technological impact of the proposed solutions** in the field of electronic packaging. |

**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.)*

Teaching is based on expository methods (lecture, presentation) and conversational-interactive methods, based on discovery learning models facilitated by direct and indirect exploration of reality (experiment, demonstration, modeling). In addition, teaching uses action-based methods (exercises, applied activities and solving specific problems in the field of computer-aided design of electronic modules).

In teaching activities, lectures are used based on PowerPoint presentations. The presentations use images, video clips and diagrams so that the information provided to students is easy to understand and assimilate.

This applied subject covers information and engineering activities intended to support students in their learning efforts and in developing optimal collaborative and communication relationships in a climate favorable to discovery learning in the field of computer-aided design of electronic modules.

The course/laboratory holder takes into account practicing active listening and assertive communication skills, as well as deepening the mechanisms of constructing feedback as ways of behavioral regulation in diverse situations and adapting the pedagogical approach to the students' learning needs.

**10. Contents**

| **COURSE** | | |
|---|---|---|
| **Chapter** | **Content** | **No. hours** |
| 1 | Introduction to electronic packaging, interconnection techniques and technologies. Integrated EDA systems for CAE-CAD-CAM design. Fundamental notions related to performing modern electronic projects with the aid of computers. | 2 |
| 2 | Concepts and methods used in the development of electronic modules. Low-complexity projects, high-complexity projects (concatenated, hierarchical). | 2 |
| 3 | Schematic design environments SCH/SCM. Electrical and technological aspects regarding the realization of electronic schematics. Methods for generating SCH/SCM interconnection structures. Generation of virtual components – principles and methods. | 2 |
| 4 | PCB design environments for "on-board" interconnection structures. Manual, interactive and automatic processing. Virtual development of PCB modules. Generation of packages ("PCB Footprints") – principles and methods. Advanced technological aspects related to the design of component packages. Assignment of advanced mechanical models for MCAD - ECAD integration (CAD for mechanics and CAD for electronics). | 4 |
| 5 | Placement, routing, reallocation strategies. Interfacing between EDA system blocks. Design with advanced components in the surface-mount variant (SMT) and high-density interconnections (HDI). Technological and electromagnetic aspects regarding the correct realization of PCB structures. | 2 |
| 6 | Topological and technological optimization of PCB interconnection structures. Finalization of electronic projects developed by CAD methods. Post-processing of CAD projects for manufacturing. Standards and post-processing files intended for manufacturing. Interfacing with electronics manufacturing companies. | 2 |
| | **Total:** | 14 |

**Bibliography:**

1. Norocel Codreanu, Ciprian Ionescu, Mihaela Pantazică, Alina Marcu, "Tehnici CAD de realizare a modulelor electronice", Editura Cavallioti-Editura Pim, Bucureşti-Iaşi, 2017, 147 p., ISBN 978-606-551-092-0, ISBN 978-606-13-4164-1;
2. Ciprian Ionescu, "Tehnici CAD de realizare a modulelor electronice", 274 p., 2013, ISBN 978-606-551-042-5, ISBN 978-606-13-1670-0, Editura Cavallioti, Bucureşti, Editura PIM Iaşi, editură recunoscută CNCSIS, cod CNCSIS 66.
3. Codreanu N. D., „Metode avansate de investigaţie a structurilor PCB”, Editura Cavallioti, Bucureşti, 263 p., 2009, ISBN 978-973-7622-89-1;
4. Jin Y., Wang Z., Chen J., „Introduction to Microsystem Packaging Technology”, CRC Press, Boca Raton, 218 p., 2011, ISBN 978-143981910-4;
5. Harper C. A., „Electronic packaging and interconnection handbook”, McGraw-Hill, 2000;
6. Coombs C. F., Jr., „Printed circuits handbook” – ediţia a VI-a, McGraw Hill Professional, 1000 p., 2007, ISBN 978-0071510790;
7. Svasta P., Codreanu N. D. ş. a., “Proiectarea asistată de calculator a modulelor electronice”, Editura Tehnică, Bucureşti, 1998;
8. J. Lau, C.P.Wong, J. L. Prince, W. Nakayama, „Electronic Packaging – Design, Materials, Process and Reliability”, McGraw-Hill, 1998;
9. Johnson H., Graham M., „High-speed digital design, a handbook of black magic”, Prentice Hall PTR, New Jersey, 1993;
10. www.cetti.ro.

**LABORATORY**

| Crt. no. | Content | No. hours |
|---|---|---|
| 1 | Presentation and consolidation of elements corresponding to CAE-CAD-CAM design activities. Generation of low-complexity schematic structures/projects. | 2 |
| 2 | High-complexity projects/structures (concatenated, hierarchical). The importance of their use within product technical documentation. | 2 |
| 3 | Operations with virtual component libraries (parts). Creating and editing components in accordance with manufacturer data and project requirements. | 2 |
| 4 | Post-processing of schematic projects. SCM/SCH-to-PCB transfer, verification and optimization of the transfer. | 2 |
| 5 | Settings of the PCB design environment for the correct realization of CAD projects. Component placement. Manual, interactive and automatic routing of power and signal traces. | 2 |
| 6 | Design of packages in accordance with manufacturer data, project requirements and real electronic components. Technological criteria related to the design of THT and SMT components. | 2 |
| 7 | Knowledge verification tests | 2 |
| | **Total:** | 14 |

**Bibliography:**

1. Norocel Codreanu, Ciprian Ionescu, Mihaela Pantazică, Alina Marcu, "Tehnici CAD de realizare a modulelor electronice", Editura Cavallioti-Editura Pim, Bucureşti-Iaşi, 2017, 147 p., ISBN 978-606-551-092-0, ISBN 978-606-13-4164-1;
2. Ciprian Ionescu, "Tehnici CAD de realizare a modulelor electronice", 274 p., 2013, ISBN 978-606-551-042-5, ISBN 978-606-13-1670-0, Editura Cavallioti, Bucureşti, Editura PIM Iaşi, editură recunoscută CNCSIS, cod CNCSIS 66.
3. Codreanu N. D., „Metode avansate de investigaţie a structurilor PCB”, Editura Cavallioti, Bucureşti, 263 p., 2009, ISBN 978-973-7622-89-1;
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8. J. Lau, C.P.Wong, J. L. Prince, W. Nakayama, „Electronic Packaging – Design, Materials, Process and Reliability”, McGraw-Hill, 1998;
9. Johnson H., Graham M., „High-speed digital design, a handbook of black magic”, Prentice Hall PTR, New Jersey, 1993;
10. www.cetti.ro.

**11. Evaluation**

| Activity type | 11.1 Evaluation criteria | 11.2 Evaluation methods | 11.3 Percentage of final grade |
|---|---|---|---|
| 11.4 Course | - knowledge of fundamental theoretical notions;<br>- knowledge of how to apply theory to specific problems in CAD techniques associated with technological electronics;<br>- analysis of theoretical aspects in the field of fundamental CAD methods and techniques in electronics. | Ongoing verification tests, held on dates set by the course holder; the topics cover the entire material, achieving a synthesis between the comparative theoretical coverage of the material and the explanation through projects and problems of CAD design methods.<br>The theoretical component may be verified through a multiple-choice test or through computer-based activity; the practical component is evaluated by verifying how the student carries out electronic projects/structures and solves practical problems. | 40% |

| | | | |
|---|---|---|---|
| 11.5<br>Seminary/laboratory/project | - knowledge of the fundamental design of an electronic module;<br>- knowledge of techniques for creating virtual components and their packages;<br>- realization of low-complexity CAD projects;<br>- verification of the integrity of an electronic project through virtual investigation. | Ongoing verification tests, held on dates set by the course holder; the topics cover the entire material, achieving a synthesis between the comparative theoretical coverage of the material and the explanation through projects and problems of CAD design methods.<br>The theoretical component may be verified through a multiple-choice test or through computer-based activity; the practical component is evaluated by verifying how the student carries out electronic projects/structures and solves practical problems. | 60% |
| 11.6 Passing conditions | | | |
| - knowledge of modern CAE-CAD-CAM techniques in the electronics industry;<br>- primary design of a low-complexity electronic module;<br>- knowledge of the development flow of an electronic project through CAD methods;<br>- verification of the integrity of an electronic project through virtual investigation.<br><br>**Minimum passing conditions**<br>Participation in the laboratory in at least 50% of the laboratories;<br>Taking the ongoing verification tests;<br>Obtaining at least 50% of the points allocated to the subject. | | | |

**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 subject "Computer-Aided Graphics – CAD Techniques for Electronics", through its applied nature, is fully correlated with the expectations of employer representatives and representative professional associations in the field of electronics in general, and technological electronics in particular. The collaboration between the team delivering the subject and electronics companies in Bucharest has a tradition of over three decades, having begun immediately after the Revolution. Moreover, the GAC-TCAD subject is also correlated with the current state of knowledge in the addressed scientific field and practices in higher education institutions within the European Higher Education Area (EHEA), through topics that are very similar to those in European universities with which the National University of Science and Technology POLITEHNICA Bucharest has official collaborations.

| Date | Course lecturer | Instructor(s) for practical activities |
|---|---|---|
| 25.09.2025 | Prof. Dr. Norocel Codreanu | Prof. Dr. Norocel Codreanu |

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

Assoc. Prof. Mihaela Pantazica

Assoc. Prof. Irina Bacîş

Lect. Iulian Buşu

| Date of department approval | Head of department |
|---|---|
| 26.09.2025 | Prof. Dr. Claudius Dan |

| Date of approval in the Faculty Council | Dean |
|---|---|
| 26.09.2025 | Prof. Dr. Mihnea Udrea |