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	**Telecommunications**
1.4 Domain of studies	Electronic Engineering, Telecommunications and Information Technology
1.5 Cycle of studies	Bachelor/Undergraduate
1.6 Programme of studies	Networks and Telecommunications Software

2. Date despre disciplină

2.1 Course name (ro) (en)				Grafică asistată de calculator - Tehnici CAD pentru electronică Computer Aided Graphics - CAD Techniques for Electronics			
2.2 Course Lecturer				Lecturer Iulian Busu, Ph.D.			
2.3 Instructor for practical activities				Prof. Norocel Codreanu, Ph.D., Assoc. Prof. Irina Bacîş, Ph.D.			
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 Supplemental documentation (library, electronic access resources, in the field, etc) Preparation for practical activities, homework, essays, portfolios, etc.					20
Tutoring					0
Examinations					2
Other activities (if any):					0

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)

4.1 Curriculum	Attending the following courses: • Fundamentals of electro-techniques; • Physics; • Measurements in electronics and telecommunications; • other courses from the education plan of the 1st year of study.
4.2 Results of learning	General knowledge of analogue and digital electronics, electronics technology, signals, electronic circuits and systems.

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

5.1 Course	Room with video-projector and screen.
5.2 Seminary/ Laboratory/Project	Specific equipment and tools of electronics labs and of rooms for computer-aided-design (CAD) in electronics.

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 "Computer Aided Graphics - CAD Techniques for Electronics" discipline is to offer to students the possibility to reach the proper level of theoretical and practical knowledge in the field of EDA (Electronic Design Automation), technological engineering, electronics 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.)*

Specific Competences	- understanding the multiple aspects of electronic design automation associated with the design and manufacturing of electronic modules; - familiarizing students with the electronic packaging and the development of modules based on various computer-aided engineering and design techniques; - understanding modern electronic engineering assisted by a wide variety of CAE-CAD-CAM (Computer Aided Engineering - Computer Aided Design - Computer Aided Manufacturing) software systems for implementing EDA concepts throughout the design and manufacturing flow; - forming a richer overview of the various aspects of the electronics industry and the current high-performance CAD design systems on the world market.
Transversal (General) Competences	- global understanding of the daily problems that appear “on the workbench” of electronics engineers in the design and development of electronic modules; - understanding of the classic elements specific to electronic projects (for example “milestone” and “time delivery”), familiarity with real engineering projects and the idea of designing/producing electronic products within a short, optimized cycle (according to the phrase “time to market”).

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.* • Presents the most important stages of the computer-aided design flow of electronic modules. • Defines notions specific to the field of technological electronics and computer-aided design of electronic modules. • Describes and classifies CAE-CAD-CAM processes. • 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).* • Selects and groups relevant information in the field of computer-aided design of electronic modules. • Works productively in a team through assignments/projects given in the laboratory. • Verifying the engineering solutions found using virtual methods (DRC – Design Rules Check). • Solves low-complexity application projects. • Identifies solutions to solve proposed projects. • Formulates conclusions on completed projects. • Argues for the identified solutions and ways of solving them.
Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* • Selects and analyzes bibliographic sources in the field of electronic packaging. • Respects the principles of academic ethics, correctly citing the bibliographic sources used. • Demonstrates receptivity to new learning contexts. • Demonstrates collaboration with other colleagues and teachers in carrying out teaching activities. • Demonstrates autonomy in organizing the learning situation/context in the field of electronic packaging and computer-aided design of electronic modules. • Promotes/contributes through new solutions related to the field of electronic packaging to improve the quality of social life. • Applies principles of professional ethics/deontology in analyzing the technological impact of 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 (lecture, exposition) and conversational-interactive methods, based on discovery learning models facilitated by direct and indirect exploration of reality (experiment, demonstration, modeling). In addition, teaching also uses action-based methods (exercises, applied activities and solving specific problems in the field of computer-aided design of electronic modules).

Lectures based on Power Point presentations are used in the teaching activity. The presentations use images, video clips and diagrams, so that the information provided to students is easy to understand and assimilate.

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

The course/laboratory teacher aims to practice active listening and assertive communication skills, as well as deepen the mechanisms for building feedback, as ways to regulate behavior in various situations and adapt the pedagogical approach to the learning needs of students.

10. Contents

COURSE		
Chapter	**Content**	**No. hours**
1	Introduction in electronics packaging, interconnection techniques and technologies. EDA integrated systems for CAE-CAD-CAM design. Fundamentals of designing modern electronic projects using the computer.	2
2	Concepts and methods used in the development of electronic modules. Low complexity projects, high complexity projects (concatenated, hierarchical).	2
3	SCH/SCM schematic design environments. Electrical and technological aspects regarding the implementation of electronic diagrams. Methods for generating SCH/SCM interconnection structures. Creation of virtual components - principles and methods.	2
4	PCB/PWB design environments for design of on-board interconnection structures. Manual, interactive and automatic processing. Development of virtual PCB/PWB modules. PCB/PWB packages/footprints creation - principles and methods. Allocation of STEP mechanical models for MCAD and ECAD integration (CAD for mechanics and CAD for electronics).	4
5	Strategies for placement, routing, reallocation. Interfacing between the blocks of EDA systems. Design with advanced surface mounted components/devices (SMD) and high-density interconnections (HDI). Technological aspects regarding the correct implementation of the PCB/PWB structures. Electromagnetic aspects related to signal integrity and power distribution.	2
6	Topological and technological optimization of the PCB/PWB interconnection structures. Finishing of electronic projects developed using CAD methods. Post-processing of CAD projects for manufacturing.	2
	Total:	14

Bibliography:

1. Course: 04-ETTI-L-A2-S1: Grafică asistată de calculator - Tehnici CAD pentru electronică (Seria D - 2025) | POLITEHNICA Bucureşti Elearning
2. 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;
3. 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.
4. Codreanu N. D., „Metode avansate de investigaţie a structurilor PCB”, Editura Cavallioti, Bucureşti, 263 p., 2009, ISBN 978-973-7622-89-1;
5. Jin Y., Wang Z., Chen J., „Introduction to Microsystem Packaging Technology”, CRC Press, Boca Raton, 218 p., 2011, ISBN 978-143981910-4;
6. Harper C. A., „Electronic packaging and interconnection handbook”, McGraw-Hill, 2000;
7. Coombs C. F., Jr., „Printed circuits handbook” – ediţia a VI-a, McGraw Hill Professional, 1000 p., 2007, ISBN 978-0071510790;
8. Svasta P., Codreanu N. D. ş. a., “Proiectarea asistată de calculator a modulelor electronice”, Editura Tehnică, Bucureşti, 1998;
9. J. Lau, C.P.Wong, J. L. Prince, W. Nakayama, „Electronic Packaging – Design, Materials, Process and Reliability”, McGraw-Hill, 1998;
10. Johnson H., Graham M., „High-speed digital design, a handbook of black magic”, Prentice Hall PTR, New Jersey, 1993;
11. www.cetti.ro.

LABORATORY

Crt. no.	Content	No. hours
1	Presentation and fixing of the elements corresponding to the CAE-CAD-CAM design activities. Creation of low complexity schematic structures/projects.	2
2	High complexity structures/projects (concatenated, hierarchical). The importance of their use in the technical documentation of products.	2
3	Operations with virtual component libraries (parts). Creating and editing components according to the manufacturers’ datasheets and the project requirements.	2
4	Post-processing of schematic projects. SCM/SCH-PCB/PWB transfer, checking and optimization of the transfer.	2
5	Configurations of the PCB/PWB design environment for the correct design of CAD projects. Placement of components. Manual, interactive and automatic routing of power and signal traces.	2
6	Packages/footprints design according to the manufacturers’ datasheets, project requirements, and the real electronic components. Technological criteria related to the design of the THT and SMT components.	2
7	Finishing and optimising of PCB/PWB project. Final technological checking of the virtual electronic module and of the printed circuit board.	2
	Total:	14

Bibliography:

1. Course: 04-ETTI-L-A2-S1: Grafică asistată de calculator - Tehnici CAD pentru electronică (Seria D - 2025) | POLITEHNICA Bucureşti Elearning
2. 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;
3. 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.
4. Codreanu N. D., „Metode avansate de investigaţie a structurilor PCB”, Editura Cavallioti, Bucureşti, 263 p., 2009, ISBN 978-973-7622-89-1;
5. Jin Y., Wang Z., Chen J., „Introduction to Microsystem Packaging Technology”, CRC Press, Boca Raton, 218 p., 2011, ISBN 978-143981910-4;
6. Harper C. A., „Electronic packaging and interconnection handbook”, McGraw-Hill, 2000;
7. Coombs C. F., Jr., „Printed circuits handbook” – ediţia a VI-a, McGraw Hill Professional, 1000 p., 2007, ISBN 978-0071510790;
8. Svasta P., Codreanu N. D. ş. a., “Proiectarea asistată de calculator a modulelor electronice”, Editura Tehnică, Bucureşti, 1998;
9. J. Lau, C.P.Wong, J. L. Prince, W. Nakayama, „Electronic Packaging – Design, Materials, Process and Reliability”, McGraw-Hill, 1998;
10. Johnson H., Graham M., „High-speed digital design, a handbook of black magic”, Prentice Hall PTR, New Jersey, 1993;
11. 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 concepts; - knowledge of how to apply theory to specific problems in CAD techniques associated with technological electronics; - analysis of theoretical aspects in the field of fundamental CAD methods and techniques in electronics.	Evaluation tests during the semester, held on dates set by the course teacher; the subjects cover the entire curricula, creating a synthesis between the comparative theoretical examination of the subject and the explanation of CAD design methods through projects and problems. The theoretical component can be verified through a grid test or through computer activity; the practical component is evaluated by verifying the student's ability to create electronic projects/structures and solve practical problems.	40%

11.5 Seminary/laboratory/project	- knowledge of the fundamental design of an electronic module; - knowledge of the techniques for creating virtual components and their capsules; - checking of the integrity of an electronic project through virtual investigation.	Evaluation tests during the semester, held on dates set by the course teacher; the subjects cover the entire curricula, creating a synthesis between the comparative theoretical examination of the subject and the explanation of CAD design methods through projects and problems. The theoretical component can be verified through a grid test or through computer activity; the practical component is evaluated by verifying the student's ability to create electronic projects/structures and solve practical problems.	40%
	- designing low-complexity CAD projects;	Final evaluation.	20%

11.6 Passing conditions

- knowledge of modern CAE-CAD-CAM techniques in the electronics industry;

- primary design of a low-complexity electronic module;

- knowledge of the development flow of an electronic project using CAD methods;

- checking of the integrity of an electronic project through virtual investigation.

Minimum conditions for promotion:

- Participation in the laboratory and obtaining at least 50% of the laboratory score, according to the regulations of undergraduate studies at POLITEHNICA Bucharest;
- Taking both evaluation tests during the semester;
- Obtaining at least 50% of the final score for this discipline.

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 TCADE discipline is intended to teach the CAE-CAD-CAM principles of designing interconnection structures in electronic modules, as well as to familiarize students with the fundamentals of electronic packaging. This aims to familiarize students with the use of modern components in QFP, CSP, QFN, BGA type capsules specific to surface mount technology (SMT). The course presents a wide thematic area, with an emphasis on CAD techniques and methods of computer-aided electronic engineering. Through its pragmatic side, being strongly oriented towards application, the laboratory of the discipline “Computer Aided Graphics - CAD Techniques for Electronics” highlights the major importance of the aspects of design in electronics using CAD methods, the main target being the design of future real electronic products. The laboratory includes elements of fundamental design of electronic schemes and printed circuits. This ensures

students adequate skills, in line with current qualification needs, and a modern, quality and competitive scientific and technical training, which will allow them to be employed quickly after graduation, being perfectly aligned with the policy of the POLITEHNICA Bucharest, both in terms of content and structure, as well as in terms of skills and international openness offered to students through the professional student competition “Electronic Interconnection Techniques”, a competition that allows the certification of the best students in the field of CAE-CAD-CAM and the development of electronic modules/systems by the industrial environment. The curriculum of the discipline specifically responds to current development and evolution requirements, being connected to the elements of current technological progress in the field. From discussions with representatives of Infineon, Yazaki, Microchip, Continental, Bosch, Siemens, etc. it resulted that they request candidates for employment and appreciate the solid knowledge acquired in this discipline. Also, the president of ARIES - Romanian Association for Electronics and Software Industry, the largest association in Romania, appreciates the knowledge transmitted to students in the discipline "Computer Aided Graphics - CAD Techniques for Electronics". Under these conditions, the discipline is in perfect correlation with the expectations of employers' representatives and representative professional associations in the field related to the program, as well as with the current state of knowledge in the scientific field addressed and practices in higher education institutions in the European Higher Education Area (EHEA), being an applied discipline, with solid links to practical electronic engineering in the Romanian and European industry.

Date	Course lecturer	Instructor(s) for practical activities
21.09.2026	Lecturer Iulian Buşu, Ph.D.	Prof. Norocel Codreanu, Ph.D.
		Assoc. Prof. Irina Bacîş, Ph.D.

Date of department approval	Head of department
22.09.2026	Conf. Dr. Serban Georgica Obreja

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