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) (en)				Tehnici CAD în realizarea modulelor electronice CAD Techniques in the Production of Electronic Modules			
2.2 Course Lecturer				Prof. Dr. Norocel Codreanu			
2.3 Instructor for practical activities				Prof. Dr. Norocel Codreanu, Assoc. Prof. Mihaela Pantazica, PhD Candidate George Florea			
2.4 Year of studies	2	2.5 Semester	II	2.6. Evaluation type	V	2.7 Course regime	Op
2.8 Course type		D	2.9 Course code	04.D.04.A.023		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.					45
Tutoring					0
Examinations					2
Other activities (if any):					0

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)

4.1 Curriculum	Completion of the following subjects: • Electronic devices; • Passive components and circuits; • CAD techniques for electronics; other courses in the curricula of years I and II.

4.2 Results of learning	General knowledge of analog and digital electronics, electronic technology, signals, devices, circuits, and electronic 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 of an electronics laboratory and a computer-aided design room in electronics; attendance at laboratories (according to the UNSTPB undergraduate studies 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 is to deepen knowledge in the field of electronic packaging through chapters on advanced design, post-processing, virtual manufacturing and thermal management, as well as through the chapter dedicated to modern technologies in electronics. The course presents a broad range of topics, with an emphasis on interconnection techniques and technologies in electronic packaging and on CAE-CAD-CAM systems for computer-aided electronic engineering. Through its pragmatic side, being strongly application-oriented, the laboratory of the subject highlights the major importance of advanced design, evaluation, testing and virtual manufacturing of electronic products, the main target being the achievement of real, high-quality electronic products right from the first manufacturing process. In addition, the technological development project of an electronic module allows the student to connect to real engineering specifications and constraints in today’s electronics industry.

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	Demonstrates advanced knowledge in Electronic Design Automation (EDA), computer-aided design in electronics, and technological electronics (electronic packaging), with emphasis on interconnection technologies. Correlates the accumulated knowledge. Applies knowledge in practice. Applies standardized, field-specific methods and tools to carry out the evaluation and diagnosis process of a situation, according to the identified/reported issues, and identifies engineering solutions. Oral and written communication in Romanian: uses the scientific vocabulary specific to the field, for effective written and oral communication. Oral and written communication in a foreign language of international circulation (English): demonstrates understanding of the field-specific 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. Capacity for analysis and synthesis: presents concisely the knowledge acquired as a result of a systematic analysis process. Respects principles of academic ethics: in documentation activity correctly cites the bibliographic sources used 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.* · **Presents** the most important stages of the advanced computer-aided design flow of electronic modules. · **Defines** notions specific to the field of modern technologies in electronics and advanced design. · **Describes and classifies** the advanced CAE-CAD-CAM processes in today's electronics industry. · **Highlights consequences and relationships** between the various design stages and the importance of successfully completing all stages of technological design.
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 from the field of advanced computer-aided design of electronic modules. · **Works** productively **in a team** through assignments/projects given during the laboratory and within the project associated with the subject. · **Verifies** through virtual methods (DRC – Design Rules Check) the engineering solutions found. · **Solves** application projects of medium complexity. · **Identifies solutions** for solving the proposed projects. · **Formulates conclusions** for the completed projects. · **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.* · **Selects** and analyzes bibliographic sources in the field of electronic packaging. · **Respects academic ethics principles,** correctly citing the bibliographic sources used. · **Demonstrates receptiveness** to new learning contexts. · **Shows collaboration** with colleagues and teaching staff in carrying out teaching activities · **Demonstrates autonomy** in organizing the situation/context of studying the field of modern technologies in electronics and advanced computer-aided design. · **Promotes/contributes with new solutions,** related to the field of advanced electronic packaging, to improve the quality of social life. · **Applies principles of professional ethics/deontology in analyzing the technological impact of the proposed solutions** in the field of modern technologies in electronics.

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

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

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

The course/laboratory/project holder considers practicing active listening and assertive communication skills, as well as deepening the mechanisms of constructing feedback, as ways of behavioral regulation in various situations and of adapting the teaching approach to students' learning needs.

10. Contents

COURSE		
Chapter	**Content**	**No. hours**
1	Manufacturing technologies of modern electronic modules and products. Conception, design and production flows	4
2	High-performance CAE-CAD-CAM design principles. Real and virtual electronic components intended for the development of advanced electronic modules and systems	2
3	Optimization and post-processing of CAD projects in electronics	2
4	CAM systems and fundamentals of production preparation. Global standards for printed circuit manufacturing	2
5	Advanced interfacing of design, manufacturing, and assembly technologies in electronics	2
6	Elements of virtual and real thermal management of modern electronic modules and products. The importance of thermal management in today's electronics	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	Development of complex virtual components intended for CAD projects	2
2	SCM/SCH post-processing and communication methods between CAD design blocks	2
3	Advanced design and PCB post-processing	2
4	CAM systems and virtual manufacturing activities	2
5	CAD methods for “pre-layout” investigation of electronic circuits or manufacturing an electronic module with SMD components	2
6	Virtual thermal management of electronic modules	2
7	Technological development project of a low-complexity electronic module based on design specifications and constraints	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;
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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 the fundamental theoretical notions in the field of modern technologies in electronics and advanced computer-aided design; - knowledge of how to apply theory to specific problems in interconnection technologies; - analysis of theoretical techniques and methods in the field of interconnection technologies.	Final test held in the pre-session; the topics cover the entire subject matter, synthesizing between the theoretical coverage of the material and the clarification through exercises and problems of the application aspects in the field of interconnection technologies.	40%

11.5 Seminary/laboratory/project	- knowledge of the design and post-processing of an electronic module; - knowledge of modeling/simulation techniques in the thermal and electrical domains; - completion of a technological development project of a low-complexity electronic module; - demonstration of the operation of an electronic circuit through virtual investigation.	Final laboratory colloquium, comprising a theoretical component and a practical component through computer work. The theoretical component can be checked by a test; the practical component is evaluated by verifying how the student has completed the technological development project of a low-complexity electronic module.	60%
11.6 Passing conditions			
- knowledge of modern technologies in the electronics industry; - technological design of a low-complexity electronic module; - understanding of the virtual and real thermal management of modern electronic modules and products. **Minimum passing conditions:** articipation in the laboratory in at least 50% of the laboratories; aking the final knowledge verification test; ompletion and defense of the technological development project of a low-complexity electronic module; 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 "CAD Techniques in the Production of Electronic Modules", through its application-oriented character, 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 the electronics companies in Bucharest has a tradition of over three decades, beginning immediately after the Revolution. Also, the TCRME subject is correlated with the current state of knowledge in the addressed scientific field and practices in higher education institutions in the European Higher Education Area (EHEA) through a topic very similar to that of European universities with which the National University of Science and Technology POLITEHNICA Bucharest has official collaborations.

Date	Course lecturer	Instructor(s) for practical activities
22.09.2025	Prof. Dr. Norocel Codreanu	Prof. Dr. Norocel Codreanu

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Assoc. Prof. Mihaela Pantazica

PhD Candidate George Florea

Date of department approval

Head of department

Prof. Dr. Claudius Dan

Date of approval in the Faculty Council

Dean

Prof. Dr. Eng. Mihnea Udrea