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 Technology and Reliability**
1.4 Domain of studies	Electronic Engineering, Telecommunications and Information Technology
1.5 Cycle of studies	Masters
1.6 Programme of studies	Advanced Integrated Technologies in Automotive Electronics

2. Date despre disciplină

2.1 Course name (ro) (en)				Laborator interdisciplinar Interdisciplinary Laboratory			
2.2 Course Lecturer							
2.3 Instructor for practical activities				Conf. Dr. Mihaela Pantazică			
2.4 Year of studies	1	2.5 Semester	I	2.6. Evaluation type	V	2.7 Course regime	Ob
2.8 Course type		S	2.9 Course code	2		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	0.00	3.3 seminary/laboratory	2
3.4 Total hours in the curricula	28.00	Out of which: 3.5 course	0	3.6 seminary/laboratory	28
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.					40
Tutoring					4
Examinations					3
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	Attending the following courses: • Passive components and circuits; • Electronic devices and circuits; • Analog integrated circuits and acquisition systems, Physics, Electronic materials; CAD Techniques, Interconnection technologies in electronics.
4.2 Results of learning	General knowledge regarding the analogue and digital electronics, electronic technology, signal processing, electronic circuits and systems.

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

5.1 Course	-
5.2 Seminary/ Laboratory/Project	Specific facilities for electronics CAD laboratory, Specific software:for CAE-CAD-CAM activities. Presence at laboratories (according to university studies rules).

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)*

By its pragmatic side, being strongly oriented on applications, the “Interdisciplinary Laboratory” highlights the major importance of advanced design aspects, evaluation, testing and virtual fabrication of electronic products, the main target being realizing high quality real electronic products even from the first fabrication process. The laboratory contains elements of advanced design, post-processing and fabrication, and, additionally, practical engineering activities in electronics technology laboratories and electronics factories, fundamental knowledge in master engineering activity oriented on conception and development of electronic modules/systems for automotive electronics.

The knowledge gained during the laboratory can be exploited at other master disciplines with applications in the field of development of automotive electronic modules/products, for semester/year projects and especially for the dissertation project. The “Interdisciplinary Laboratory” generates the link between theoretical knowledge gained at the fundamental disciplines and practical engineering activities of design and realization of electronic modules/products functioning in automotive 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	**C4** To use the fundamental elements devices, circuits and electronic instrumentation **C4.5** To design electronic circuits of small/medium complexity and to implement them using CAD techniques
Transversal (General) Competences	**CT1** Methodic analysis of the encountered problems in professional activity, identifying the elements for which there are known solutions, thus assuring the accomplishment of the professional tasks. **CT3** Adaptation to new technologies, professional and personal development through continuous formation, using printed documentation sources, specific software and electronic resources in Romanian and at least one widely used international language.

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.* • Understands the multiple aspects of computer aided design of small/medium/high complexity electronic modules. • Understand the aspects of electronic technology used in the development of electronic modules/systems for the automotive field. • Understanding design aspects for manufacturing high quality electronic systems right from the first manufacturing process. • Lists the most important stages that marked the development of the field. • Defines domain-specific notions. • Describes/classifies notions/processes/phenomena/structures.
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).* • Uses the fundamentals of electronic devices, circuits and instrumentation. • Designs electronic circuits of low/medium complexity and implements them using CAD techniques. • Designs and actually produces electronic modules/systems in the automotive industry. • Selects and groups relevant information in a given context. • Uses specific principles with reason. • Works productively in a team. • Elaborates a scientific text. • Experimentally verifies identified solutions. • Solves practical applications. • Adequately interprets causal relationships. • Analyzes and compares. • Identifies solutions and develops solution/project plans. • Argues the identified solutions/solutions.

Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* • Selects appropriate bibliographic sources and analyze them. • Respects the principles of academic ethics, correctly citing the bibliographic sources used. • Demonstrates responsiveness to new learning contexts. • Demonstrates collaboration with other colleagues and teaching staff in carrying out teaching activities. • Demonstrates autonomy in organizing the learning situation/context or the problem situation to be solved. • Demonstrates social responsibility through active involvement in student social life/involvement in academic community events. • Promotes/contributes through new solutions related to the specialized field to improve the quality of social life. • Realizes the value of his contribution in the field of engineering to the identification of viable/sustainable solutions to solve problems in social and economic life (social responsibility). • Applies principles of professional ethics/deontology in the analysis of the technological impact of the proposed solutions in the specialized field on the environment. • Demonstrates real-life situation management skills (collaborative vs. conflict time management).

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.)*

Starting from the analysis of students' learning characteristics and their specific needs, the teaching process will explore both expository (lecture, exposition) and conversational-interactive teaching methods, based on discovery learning models facilitated by exploration direct and indirect of reality (experiment, demonstration, modeling, simulation, computer-aided design).

In the teaching activity, lectures will be used, based on Power Point presentations or different videos that will be made available to the students.

Presentations use images and diagrams so that the information presented is easy to understand and assimilate.

This discipline covers information and practical activities designed to support students in their learning efforts and the development of optimal collaborative and communicative relationships in a climate conducive to discovery learning.

The practice of active listening and assertive communication skills, as well as feedback construction mechanisms, will be taken into account, as ways of regulating behavior in various situations and adapting the pedagogical approach to the students' learning needs.

Teamwork skills will be practiced to solve different learning tasks.

The presentations at the laboratory are based on the use of the multi-media electronic equipment, video-projector, flip-chart and white table.

The teaching documents/materials are available both in print and in electronic format.

10. Contents

LABORATORY		
Crt. no.	**Content**	**No. hours**
1	Virtual electronic components – concept, design, realization. The importance of working with virtual components in electronic products; advantages. Files for generating virtual components. Methods of design in case of discrete/integrated components; realizing specialized libraries.	4
2	CAD development of complex schematic projects (hierarchical, concatenated). Principles for the generation of complex projects and CAD methods for generation and checking of them.	4
3	Post-processing schematic projects. Post-processing – generalities. Generating files and lists of post-processing. The “ITC / inter-tool communication” principle of real time update of an electronic project.	4
4	Post-processing projects. PCB High precision files for the fabrication of interconnection structures (artwork); inscription, technologic verifications, files and lists of post-processing. Technological aspects regarding the realization of post-processing necessary for obtaining files for equipment for technical and fabrication documentation.	4
5	CAM and virtual fabrication activities. CAM systems destined to special equipment. Files destined to interfacing different CAD-CAM systems. Methods of handling the files destined to fabrication equipment. Soft systems. Principles and professional standards in the area of design and fabrication (IPC, EIPC, EIA, etc.); Development of electronic products according to profile standards.	4
6	Virtual thermal management of electronic products. The role of thermal management in realizing electronic products. Computer aided thermal analysis of electronic components and modules; Thermal maps; Interpretation of thermal maps; Solutions; Comparative studies between virtual electronic products evaluation and measurements of real modules.	4
7	Signal integrity analysis and layout optimization activities. Introduction to signal integrity management. Analysis methods and techniques. Types of signals in interconnection structures; Discontinuities; Methods of evaluation; Integrated systems for pre-layout and post-layout signal integrity analysis.	4
	Total:	28

Bibliography:

Mihaela Pantazică, Norocel-Dragoş Codreanu, Laborator interdisciplinar (LID), suport de laborator electronic, Course: 04-ETTI-M-A1-S1: Laborator interdisciplinar (2024) | POLITEHNICA Bucureşti Elearning (upb.ro)

Norocel Codreanu, Ciprian Ionescu, Mihaela Pantazică, Alina Marcu, "Tehnici CAD de realizare a modulelor electronice - suport de curs şi laborator", Editura Cavallioti, PIM , Iaşi, Decembrie 2017, ISBN: 9-786061-341641, ISBN: 9-786065-510920, CNCSIS 66, nr. pag. 148.

Ionescu, C.. 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.

Codreanu N. D., „Metode avansate de investigaţie a structurilor PCB", Editura Cavallioti, Bucureşti, 263p., 2009, ISBN 978-973-7622-89-1.

Jin Y., Wang Z., Chen J., „Introduction to Microsystem Packaging Technology", CRC Press, Boca Raton, 218 p., 2011, ISBN 978-143981910-4.

Fitzpatrick D., „Analog Design and Simulation using OrCAD Capture and PSpice", Newnes/Elsevier, Oxford, 329 p., 2012, ISBN 978-0-08-097095-0.

Mitzner, K. , Complete PCB design using OrCAD Capture and PCB editor, Newnes, 2009.

Coombs C. F., Jr., „Printed circuits handbook" – ediţia a VI-a, McGraw Hill Professional, 1000 p., 2007, ISBN 978-0071510790.

Herniter M. E., „Schematic Capture with Cadence Pspice", Prentice Hall, 2001.

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Harper C. A., „Electronic packaging and interconnection handbook", McGraw-Hill, 2000.

J. Lau, C.P.Wong, J. L. Prince, W. Nakayama, "Electronic Packaging – Design, Materials, Process and Reliability", McGraw-Hill, 1998.
Rohsenow W.M., Hartnett J.P., Cho Y.I., „Handbook of heat transfer", McGraw-Hill, 1998.

11. Evaluation

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

	- knowledge of techniques for creating virtual components; - knowledge of practical techniques for designing complex electronic circuits/schematics; - knowledge of PCB post-processing activities and virtual fabrication; - knowledge of thermal analysis for electronic modules; - knowledge of signal integrity analysis and layout optimization.	Laboratory activity.	10%
11.5 Seminary/laboratory/project	- knowledge of techniques for creating virtual components; - knowledge of practical techniques for designing complex electronic circuits/schematics; - knowledge of PCB post-processing activities and virtual fabrication; - knowledge of thermal analysis for electronic modules; - knowledge of signal integrity analysis and layout optimization.	Homework/project.	40%
	- knowledge of techniques for creating virtual components; - knowledge of practical techniques for designing complex electronic circuits/schematics; - knowledge of PCB post-processing activities and virtual fabrication; - knowledge of thermal analysis for electronic modules; - knowledge of signal integrity analysis and layout optimization.	Final test on the computer; the topics cover all the approached subjects and evaluates the practical computer aided design skills.	50%
11.6 Passing conditions			

- Knowledge of CAE-CAD-CAM techniques in the modern electronics industry;
- Basic design of a low complexity electronic module;
- Knowledge of the development flow based on CAD methods for an electronic project;
- Checking the integrity of an electronic project through virtual investigation.

Minimum requirements for passing:
Participation to the laboratory activity according to the regulation of university studies of UPB;
Obtaining 50% of the points allocated to the 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 course is developed to familiarize the master students with the electronic packaging activities related to electrical and thermal modeling. During the lectures are used intensively modern packages like QFP, CSP, BGA which are specific for surface mount technology (SMT). The laboratory is focused on CAD methods for electronic engineering and has as target the virtual realization of electronic modules. Laboratory activities also include elements of simulation with programs of type SPICE. This assures to students appropriate competences, as required by the hiring companies. Thermal regime is also studied in the final part of the laboratory. The acquired knowledge is indispensable for those who are connected to automotive electronics, where the thermal regime is very aggressive. The course syllabus meets the current demands for development and evolution, being connected to the elements of the present technological progress in the field. From discussion with representatives of companies like Infineon, Yazaki, Microchip, Continental etc., it has resulted that they ask from candidates and appreciate the solid knowledge gained at this course. Moreover, the president of ARIES – Romanian Association for Electronic Industry and Software, the largest association of its kind in Romania, appreciates the knowledge transferred to students at the discipline “Modeling, Simulation and Thermal Management of Electronic Modules”.

Date	Course lecturer	Instructor(s) for practical activities
25.09.2025		Conf. Dr. Mihaela Pantazică

Date of department approval — Head of department

Date of approval in the Faculty Council — Dean

26.09.2025 — Prof. Dr. Mihnea Udrea

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