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	Technologies and Telecommunications Systems

2. Date despre disciplină

2.1 Course name (ro) (en)				Circuite electronice fundamentale 2 - Proiect Basic Electronic Circuits 2 - Project			
2.2 Course Lecturer				Not necessary.			
2.3 Instructor for practical activities				S.l./Lect. Dr. Laurentiu Teodorescu, S.l./Lect. Dr. Cristina Marghescu			
2.4 Year of studies	3	2.5 Semester	I	2.6. Evaluation type	V	2.7 Course regime	Ob
2.8 Course type		D	2.9 Course code	04.D.05.O.006		2.10 Tipul de notare	Nota

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

3.1 Number of hours per week	1	Out of which: 3.2 course	0.00	3.3 seminary/laboratory	1
3.4 Total hours in the curricula	14.00	Out of which: 3.5 course	0	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.					36
Tutoring					0
Examinations					2
Other activities (if any):					0

3.7 Total hours of individual study	36.00
3.8 Total hours per semester	50
3.9 Number of ECTS credit points	2

4. Prerequisites (if applicable) (where applicable)

4.1 Curriculum	Fundamentals of Electrical Engineering, Electronic Devices, Fundamental Electronic Circuits, Passive Components and Circuits, CAD Techniques, Spice Models

4.2 Results of learning	General principles of electro-technical fundamentals, electronic devices, electronic circuit analysis and simulation, passive components and circuits.

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

5.1 Course	Not necessary.
5.2 Seminary/ Laboratory/Project	Not necessary.

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 the students with specific analogue circuit design techniques. Capitalizing on accumulated knowledge from *Electronic Devices*, *Fundamental Electronic Circuits*, *Passive Components and Circuits*, *Spice Models and CAD Techniques* regarding: diodes and transistors (models and parameters), gain stages, negative feedback, multi-stage amplifiers, regulators, oscillators.

Proposed project assignments consist of medium complexity circuit topologies used in engineering: amplifiers, voltage regulators, oscillators, etc

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	Apply the acquired knowledge in practice, by designing circuits of amplifiers, stabilizers, oscillators, etc., selected based on the design data.: It applies standardized methods and tools, specific to the field, to carry out the design process by using spoke models for active and passive devices, the selection and use of catalog sheets, analog circuit design techniques. It argues and analyzes coherently and correctly the context of application of the basic knowledge of the field, using the verification of the designed circuit through calculations and simulations in compliance with the design data, and the design and realization of the circuit layout in an imposed technology. Oral and written communication in English: demonstrates understanding of subject-related vocabulary in a foreign language.

Transversal (General) Competences	Methodical analysis of the problems encountered in the activity, identifying the elements for which there are established solutions, thus ensuring the fulfillment of professional tasks. Adaptation to new technologies, professional and personal development, through continuous training using printed documentation sources, specialized software and electronic resources in English. Works in a team and communicates effectively, coordinating efforts with others to solve problem situations of medium complexity. Autonomy and critical thinking: the ability to think in scientific terms, search and analyze data independently, and draw and present conclusions / identify solutions. Ability to analyze and synthesize: presents the acquired knowledge in a synthetic way, as a result of a process of systematic analysis. Respect the principles of academic ethics: correctly cite the bibliographic sources used in the documentation activity.

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.* · Designs block diagrams based on the requirements stated in a design specification/topic of low/medium complexity. · Selects a circuit-level implementation variant based on electrical and technological design specifications. · Demonstrates circuit operation and compliance with design requirements through analytical computations. · Implements the design in a CAD environment at the schematic and interconnection structure level. · Simulates the operation of the designed circuit based on the models of the selected electronic components. · Verifies in the CAD environment the correspondence between the simulated schematic diagram and the interconnection structure. · Generates files for manufacturing the interconnection structure on a PCB in an industrial facility. · Documents the design, simulation, assembly and testing activities.

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 a given context. · Appropriately applies specific principles to design electronic modules of low/medium complexity. · Suggests practical applications for the electronic components and circuits studied. · Recognizes the importance of model parameters for the electrical operation of electronic devices and circuits. · Solves practical problems using theoretical knowledge. · Experimentally verifies (through simulation) the solutions determined. · Interprets causal relationships adequately. · Analyzes and compares electronic component specifications for use in a circuit. · Identifies solutions and develops project plans. · Formulates conclusions about experiments conducted. · Justifies the solutions identified. · Works well in a team environment.
Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* · Selects and evaluates appropriate bibliographic sources. · Respects principles of academic ethics and correctly cites bibliographic sources used. · Demonstrates responsiveness to new learning contexts. · Demonstrates collaboration with other colleagues and faculty staff in carrying out educational activities. Demonstrates independence in organizing the learning context or in choosing a solution for a problem-based situation. Contributes to improving the quality of social life through new solutions related to his field of activity. Is aware of the value of his/her contribution in the field of engineering to the identification of viable/sustainable solutions to solve problems in social and economic life (social responsibility). · Applies the principles of professional ethics/deontology in analyzing the technological impact of proposed solutions in his field of activity on the environment. · Analyzes and exploits opportunities for entrepreneurial development in the field. · Demonstrates coping skills in real-life situations.

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.)*

Based on the analysis of the students' learning characteristics and their specific needs, the teaching process uses both expository (lecture, exposition) and conversational-interactive teaching methods based on models of discovery learning facilitated by direct and indirect exploration of reality (experimentation, demonstration, modeling), but also by action-oriented methods such as exercises, practical activities and problem solving.

Instruction is based on both classical methods and multimedia resources and techniques. The complex issues are demonstrated on the blackboard. The materials used are: presentations, assignment collections and course notes, data sheets; most materials are available in electronic form through the project website and Moodle. Pictures and diagrams are used in the presentations so that the information presented is easy to understand and internalize.

The matter "Basic Electronic Circuits 2 - Project" includes information and hands-on activities designed to support students in their learning efforts and to develop optimal collaborative and communicative relationships in a climate conducive to discovery learning. It is also a bridge between theoretical concepts acquired in the various disciplines and engineering practice.

The practice of active listening and assertive communication skills, as well as mechanisms for building feedback, are encouraged to regulate behavior in different situations and to adapt the pedagogical approach to the learning needs of students.

10. Contents

PROJECT		
Crt. no.	**Content**	**No. hours**
1	• Presentation of the project. • Project theme. • Design data. • Systematization of knowledge about electronic devices and circuits.	1
2	Selection criteria of the block diagram of the designed circuit focused on circuit topologies used in engineering practice. Block diagram of the circuit.	1
3	Typical circuits and design algorithms for: bias circuits (voltage references, current sources, etc.), input stages, output stages, etc. Choice of devices. Use of catalog sheets. DC and AC analysis determining the static and dynamic parameters of the circuit.	2
4	Identifying design problems and mistakes. Solving the issues with the circuit design.Drawing the circuit diagram. Circuit simulation. Choosing the SPICE models for components.	2
5	Identification of simulation problems and errors. Solving the issues with the circuit simulation. The (final) choice of components and their packages by looking into the datasheets.	1
6	The layout design (interconnection structure) for the circuit. Dimensioning of interconnection routes. Minimizing the length of the routes and the area occupied by the circuit. Solving heat dissipation problems. Solving layout errors. Bill of Materials (BOM)	6
7	Presentation of the Project activity and its evaluation	1
	Total:	14

Bibliography:

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11. Evaluation

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

11.5 Seminary/laboratory/project	Design and simulation skills. Identification of design omissions and errors. Circuit redesign.	Grading of students at each stage of the project depending on the fulfillment of stage requirements. Assessment of students' abilities to correct errors and omissions in circuit design depending on the fulfillment of design requirements.	50%
	Layout implementation	Evaluation of the design skills of the layout design for a circuit of low complexity	30%
	Project presentation and final report	Final evaluation of the project	20%
11.6 Passing conditions			
Obtaining 50% of the total grade. Obtaining 50% of the grade related to the activity during the semester.			

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 development of analog, digital and mixed circuits is a test of maturity for an engineer. The current achievements of companies in the field of electronics are based on design activities that, together with the new technologies, allow them to offer on the market devices and electronic systems with the smallest dimensions, with the greatest autonomy and number of functions at the lowest prices.
The matter "Basic Electronic Circuits 2 - Project" is an introduction of the future engineer to a specific activity performed in a development company. The activity carried out with the project is exclusively for the application and processing of the knowledge acquired in the specialized courses of the first two years. Knowledge of the fundamentals of electrical engineering, electronic devices and circuits, passive components and computer-aided design (CAD) are used.
Market requirements are met so that the future engineer has an idea of the design and manufacturing process of an electronic circuit/module, which, in this case, uses only discrete components. The student attending the Project- Electronic Circuits 1 is introduced to industrial design, where he/she must find an optimal solution within technological and time limits constraints.
In this way, the student acquires the skills required by the current needs of the market, which will enable him/her to be quickly employed in an electronics company after graduation.
The subject is thus part of the policy of Politehnica University of Bucharest, both in terms of content and structure, and in terms of international openness offered to students.

Date | Course lecturer | Instructor(s) for practical activities

S.l./Lect. Dr. Laurentiu Teodorescu

Universitatea Națională de Știință și Tehnologie Politehnica București

Facultatea de Electronică, Telecomunicații și

Tehnologia Informației

Date of department approval	Head of department prof.dr.ing. Claudius Dan
Date of approval in the Faculty Council	Dean prof.dr.ing. Mihnea Udrea