Universitatea Națională de Știință și Tehnologie Politehnica București
Facultatea de Electronică, Telecomunicații și Tehnologia Informației

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)				Bazele electrotehnicii 2 Fundamentals of Electrical Engineering 2			
2.2 Course Lecturer				Conf. Dr. Ruxandra Liana Costea			
2.3 Instructor for practical activities				Conf. Dr. Ruxandra Liana Costea			
2.4 Year of studies	1	2.5 Semester	II	2.6. Evaluation type	E	2.7 Course regime	Ob
2.8 Course type		D	2.9 Course code	04.D.02.O.012		2.10 Tipul de notare	Nota

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

3.1 Number of hours per week	3	Out of which: 3.2 course	2	3.3 seminary/laboratory	1
3.4 Total hours in the curricula	42	Out of which: 3.5 course	28	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.	48
Tutoring	2
Examinations	8
Other activities (if any):	0

3.7 Total hours of individual study	58.00
3.8 Total hours per semester	100
3.9 Number of ECTS credit points	4

4. Prerequisites (if applicable) (where applicable)

4.1 Curriculum	Mathematics, Physics, Fundamentals of Electrical Engineering 1
4.2 Results of learning	Solid knowledge of algebra, geometry, trigonometry (basic functions) and mathematical analysis (derivatives and integrals), and respectively vector calculus.

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

5.1 Course	The course will take place in a room equipped with a video projector.

5.2 Seminary/ Laboratory/Project	At the seminar, students must be present at the seminar tests which will be announced in advance.

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)*

Concise presentation of electromagnetic field theory, its dynamic and thermal effects, electromagnetic energy, and its transformation and transfer. The field theory is applied to the analysis of effects specific to the quasi-stationary regime (skin effect, eddy currents). In the general time-varying regime, as well as in steady-state sinusoidal regime, the main notions are introduced regarding the electromagnetic radiation of elementary dipoles and the transient regime on transmission lines. The field model of electric circuit theory is highlighted.

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	Analysis of basic problems that admit analytical solutions, and interpretation of these for the design of electrical and magnetic devices or for understanding aspects of electromagnetic compatibility or signal integrity.
Transversal (General) Competences	Honorable, responsible, ethical behavior, in the spirit of the law, to ensure the reputation of the profession Awareness of the need for continuous training;efficient use of learning resources and techniques for personal and professional development

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.* Becoming familiar with mathematical notions applicable to electromagnetic field theory. Defines the quantities and characteristic states of the electromagnetic field (electric/magnetic field). Describes/classifies notions/processes/phenomena specific to each electromagnetic operating regime and becomes familiar with the quantities specific to the electric/magnetic field. Solves simple problems of vector analysis and of electric/magnetic field. Brings together the set of laws of the electric/magnetic field and establishes their connection leading to Electromagnetic Field Theory.

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. Uses specific principles with justification in order to solve an electromagnetic problem. Solves practical problems using appropriate methods. Properly interprets causal relationships between sources and the quantities specific to an electromagnetic system. Identifies solutions and develops plans to solve requirements specific to a particular electromagnetic field problem. Argues the identified solutions/modes of solving for proposed problems. Identifies the operating regime and finds solutions for solving it.
Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* Selects suitable bibliographic sources and analyzes them. Respects principles of academic ethics, correctly citing the bibliographic sources used. Demonstrates receptiveness to new learning contexts specific to the field. Shows collaboration with other colleagues and teaching staff in carrying out didactic activities. Demonstrates autonomy in organizing the learning situation/context or the problem situation to be solved. Shows social responsibility through active involvement in student social life/involvement in events of the academic community. Promotes/contributes with new solutions, specific to the field, to improve the quality of social life. Becomes aware of the value of their contribution in engineering to identifying viable/sustainable solutions to solve problems in social and economic life (social responsibility). Applies principles of professional ethics/deontology in analyzing the technological impact of the proposed solutions in the specialty field on the environment. Analyzes and interprets business/entrepreneurial development opportunities in the specialty field. Demonstrates management skills for real-life situations (time management, collaboration vs. conflict).

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 methods (lecture, presentation) and conversational–interactive methods, based on discovery learning models facilitated by direct and indirect exploration of reality (experiment, demonstration, modeling), as well as action-based methods, such as exercise, practical activities and problem solving.

In teaching activities, lectures will be used, based on PowerPoint presentations or various short films that will be made available to students. Each course will start with a recap of the chapters already covered, with emphasis on the notions covered in the last course.

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

This course covers information and practical activities intended to support students in their learning efforts and in developing optimal collaboration and communication relationships in a learning-friendly climate through discovery. The field of electromagnetic field theory is a fundamental one in the training of engineers in the faculty’s specific domains.

The practice of active listening and assertive communication skills will be considered, as well as mechanisms for constructing feedback, as ways of behavioral regulation in various situations and of adapting the pedagogical approach to students’ learning needs.

Teamwork skills will be practiced to solve various learning tasks and to meet requirements in different contexts.

10. Contents

COURSE		
Chapter	**Content**	**No. hours**
1	Vector analysis. Vector algebra. Differential calculus (Gradient. Curl. Divergence)	3
2	Electrostatics. The electrostatic field. Coulomb’s law. Distributed electric charges. Electric potential. Law of electric flux. Energy and mechanical work. Conductors	6
3	Electrostatic field in materials. Polarization of materials. Law of temporary polarization. Polarization charges. Gauss’s law for polarized bodies. Discontinuity surfaces.	6
4	Magnetic field. Biot–Savart–Laplace law. Ampère’s law. Vector magnetic potential	4
5	Magnetic field in materials. Magnetization. Law of temporary magnetization. Ampère’s theorem	3
6	Law of electromagnetic induction. Self and mutual inductances. The ideal transformer	3
7	Magnetic circuits. Ohm’s law. Kirchhoff theorems for magnetic circuits	3
	Total:	28

Bibliography:

1. Costea Ruxandra - electronic support; Moodle;
2. D. Griffiths, “Introduction to Electrodynamics”, Prentice Hall, 4th Edition, 2012.
3. A. Moraru, “Electromagnetic Field Theory”. Lecture notes 2003, http://www.infocarti.ro/librarie/man_univ.php

4. M. Zahn, “Electromagnetics and Applications”, Massachusetts Institute of Technology http://ocw.mit.edu/OcwWeb/Electrical-Engineering-and-Computer-Science/6-013Fall-2005/CourseHome/index.htm

SEMINARY		
Crt. no.	**Content**	**No. hours**
1	Electrostatic field – calculation of the electric field for concentrated and distributed charges	4
2	Law of electric flux; Capacitances	2

3	Magnetic field. Biot–Savart–Laplace law. Ampère's theorem	2
4	Ampère's theorem	2
5	Inductances	2
6	Magnetic circuits	2
	Total:	14

Bibliography:

1. 1. Costea Ruxandra - electronic support; Moodle.
2. D. Griffiths, "Introduction to Electrodynamics", Prentice Hall, 4th Edition, 2012.
3. A. Moraru, "Electromagnetic Field Theory". Lecture notes 2003, http://www.infocarti.ro/librarie/man_univ.php

4. M. Zahn, "Electromagnetics and Applications", Massachusetts Institute of Technology http://ocw.mit.edu/OcwWeb/Electrical-Engineering-and-Computer-Science/6-013Fall-2005 /CourseHome/index.htm

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; - knowledge of how to apply the theory to specific problems;	Two written tests of equal weight, one during the semester and the other in the exam session, held on dates set at the beginning of the course; the topics cover the entire syllabus, achieving a synthesis between comparative theoretical coverage of the subject and clarification through exercises and problems of the application models.	80%
11.5 Seminary/laboratory/project	application of the theoretical knowledge acquired in the course	Verification tests throughout the semester	20%
11.6 Passing conditions			
According to the university regulations and the decisions of the ETTI faculty council.			

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 Fundamentals of Electrical Engineering 2, as well as Fundamentals of Electrical Engineering 1, is part of the fundamental training domain of students. This course is a precursor to other subjects studied by students in subsequent years, such as:Electronic Devices, Fundamental Electronic Circuits, Signals and Systems, Analysis and Synthesis of Circuits, Project 1 – Electronic Devices and Circuits, etc.

The content of the course is largely similar to that of courses with the same objectives taught in universities of the European Union. The content is updated and continuously adapted following consultations with representatives of the business environment in Bucharest.

Date	Course lecturer	Instructor(s) for practical activities
29.09.2025	Conf. Dr. Ruxandra Liana Costea	Conf. Dr. Ruxandra Liana Costea
Date of department approval	Head of department	
	Prof. Dr. Claudius Dan	
Date of approval in the Faculty Council	Dean	
	Prof. Mihnea UDREA	