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's
1.6 Programme of studies	Microelectronics, Optoelectronics and Nanotechnologies

2. Date despre disciplină

2.1 Course name (ro) (en)				Fizică 1 Physics 1			
2.2 Course Lecturer				Assoc. Prof. Dr. Octavian Dănilă			
2.3 Instructor for practical activities				Assoc. Prof. Dr. Octavian Dănilă			
2.4 Year of studies	1	2.5 Semester	1	2.6. Evaluation type	E	2.7 Course regime	Ob
2.8 Course type		F	2.9 Course code	04.F.01.O.003		2.10 Tipul de notare	Nota

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

3.1 Number of hours per week	4	Out of which: 3.2 course	3	3.3 seminary/laboratory	1
3.4 Total hours in the curricula	56	Out of which: 3.5 course	42	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.					63
Tutoring					3
Examinations					3
Other activities (if any):					0

3.7 Total hours of individual study	69.00
3.8 Total hours per semester	125
3.9 Number of ECTS credit points	5

4. Prerequisites (if applicable) (where applicable)

4.1 Curriculum	General knowledge of algebra and mathematical analysis, programming, and high-school general physics.
4.2 Results of learning	Acquisition of the following knowledge: performing basic mathematical operations, solving first- and second-degree equations, developing simple programs, performing vector operations, basic dimensional analysis.

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, a computer with MS PowerPoint, and a board.
5.2 Seminary/ Laboratory/Project	The laboratory will take place in a room equipped with laboratory works specific to the discipline. Attendance at all laboratory sessions is mandatory.

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)*

Students are introduced to the fundamental laws of nature and their applications in engineering. They gain experience confirming theoretical results through experiment. They learn techniques for solving problems in mechanics, special relativity, electromagnetism, and optics. They become familiar with fundamental notions of the structure of matter.

Students learn to apply mathematical methods in concrete situations. They begin initiation into modern physics methods and the applications of physics in engineering, especially in electronics.
They apply mathematical and physical models in simple but fundamental cases. They are introduced to scientific research methods.

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 methods and results of physics and applying them to concrete situations in the activity of electronics engineers. Ability to build and apply mathematical and physical models. Applying mathematical methods to concrete situations. Developing skills for measuring physical quantities, collecting and processing experimental data, calculating measurement errors, and presenting the results of an experiment.
Transversal (General) Competences	Mastering optimal learning methods, combining theoretical and experimental results, and developing the habit of teamwork. Learning how to support an idea and engage in scientific debate. Honorable, responsible, and ethical behavior, in the spirit of the law, to ensure the profession’s reputation. 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.* · **Defines physical quantities and their units of measurement specific to the chapters studied**. · **Identifies and describes physical phenomena in nature and how they are formulated mathematically**. · **States principles and laws, including in their mathematical form.** · **Formulates and dimensionally checks the mathematical relations that describe physical phenomena.**
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).* · **Identifies and uses the applicable principles and laws for approaching various concrete situations.** · **Works** productively **in a team.** · **Experimentally verifies the link between theory and practical applications.** · **Solves, analytically and numerically,** problems specific to the field. · **Appropriately interprets causal relationships.** · **Formulates conclusions for the experiments performed.** **Argues for the identified solutions/modes of solving.**
Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* · **Selects** appropriate bibliographic sources and analyzes them. **Respects academic ethics,** correctly citing the bibliographic sources used. **Demonstrates receptiveness** to new learning contexts. **Shows 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 management skills** in real-life situations (organizing and managing one's own time and that of the working group; 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 exercises, practical activities, and problem solving. In teaching, lectures will be used based on PowerPoint presentations or various short videos that will be made available to students. Each lecture will start with a recap of the chapters already covered, emphasizing the notions from the last lecture. The 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 in developing optimal collaboration and communication relationships in a climate favorable to discovery learning. Practicing active listening and assertive communication skills will be considered, as well as feedback-building mechanisms as ways to regulate behavior in various situations and to adapt the pedagogical approach to students' learning needs. Teamwork skills will be practiced to solve various learning tasks.

10. Contents

COURSE		
Chapter	**Content**	**No. hours**
1	Physics: subject of study, importance for education in electronic engineering. Physical quantities: definitions, examples, units of measurement.	2
2	Mathematical representation of physical quantities and physical laws: scalars, vectors, higher-rank tensors; physical meaning of differentiation and integration operations.	2
3	Foundations of the kinematics of a material point in the plane and in space in Galilean–Newtonian mechanics.	2
4	Newton’s laws and applications for the material point and systems of material points. Variation theorems and conservation laws.	6
5	Elements of kinematics and dynamics of the rigid body.	2
6	Harmonic, damped, and forced oscillations. Composition of parallel and perpendicular oscillations. Systems of coupled oscillators—normal modes of oscillation.	8
7	Elastic waves: importance, equation, particular types of waves, characteristics. Sound waves, elements of acoustics.	4
8	Special theory of relativity: principles, kinematics and dynamics, applications.	6
9	Principles of thermodynamics and elements of statistical physics; thermal and caloric coefficients; Maxwell–Boltzmann statistics; fundamental transport phenomena (heat, diffusion, viscosity).	8
10	Fundamentals of geometrical optics: image formation in mirrors and lenses. Applications.	2
	Total:	42

Bibliography:

1. Octavian Dănilă, Elemente de Fizică Clasică, Politehnica Press, 2024.
2. Octavian Dănilă, Elemente de Mecanică Teoretică, Editura Bren, 2020.
3. Octavian Dănilă, Elemente de Fizică Modernă şi Contemporană, Editura Matrix Rom, 2025.
4. D. Halliday, R. Resnick, J. Walker, Fundamentals of Physics, Wiley, 2011.
5. R. D. Knight, Physics for Scientists and Engineers, Pearson, 2016.

LABORATORY		
Crt. no.	**Content**	**No. hours**
1	Elements of statistical processing of experimental data.	2
2	Measuring the speed of light.	2
3	Michelson interferometer.	2
4	Study of light dispersion; prism spectroscope.	2
5	Interference and polarization of electromagnetic waves.	2
6	Study of light interference with Young’s device.	2
7	Study of Fresnel diffraction on circular apertures.	2
8	Determining the wavelength of radiation using a diffraction grating.	2

9	Study of polarized light—polarimeter.	2
10	Study of magnetic fields generated by linear conductors. Biot–Savart law.	2
11	Thermistor.	2
12	Study of the velocity distribution of electrons in a metal.	2
13	Study of linearly polarized light. Verification of Malus's law.	2
14	Mechanical oscillations.	2
	Total:	14

Bibliography:

1. Laboratory works, room BN 121, http://www.physics.pub.ro/Cursuri/Cursuri.htm
2. Octavian Dănilă, Elemente de Fizică Clasică, Politehnica Press, 2024.
3. Octavian Dănilă, Elemente de Mecanică Teoretică, Editura Bren, 2020.
4. Octavian Dănilă, Elemente de Fizică Modernă şi Contemporană, Editura Matrix Rom, 2025.
5. D. Halliday, R. Resnick, J. Walker, Fundamentals of Physics, Wiley, 2011.
6. R. D. Knight, Physics for Scientists and Engineers, Pearson, 2016.

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 theory to specific problems	Final exam.	50%
	- knowledge of fundamental theoretical notions - knowledge of how to apply theory to specific problems.	In-semester verification test	20%
11.5 Seminary/laboratory/project	Laboratory: familiarization with the basics of scientific experiments, measurement methods, and processing of experimental data.	- presentation of reports with measured data and calculations of the relevant physical quantities - final laboratory colloquium.	30%
11.6 Passing conditions			
Completion of five laboratory works and obtaining at least 50% of the points allocated to laboratory activity. Sitting the final exam and obtaining at least 50% of the total points by summing the points earned during the semester (laboratory + verification test) and at the final exam.			

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)

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The Physics 1 course is a fundamental discipline that contributes to shaping the student's engineer-researcher mindset. It bridges the material taught in high school and other university courses.

It aims to create a link between mathematical and physical models and methods, both with engineering applications.

It lays the groundwork for understanding topics taught in other subjects, such as oscillations and waves, electromagnetism.

Students begin preparation for pursuing research master's programs. Some perspectives of scientific research are opened.

Students are introduced to some classical theories in physics: special relativity, electromagnetic waves.

It is the first course in which students perform experiments, measure physical quantities, calculate measurement errors, and obtain the final results of the experiments.

Date	Course lecturer	Instructor(s) for practical activities
25.09.2025	Assoc. Prof. Dr. Octavian Dănilă	Assoc. Prof. Dr. Octavian Dănilă

Date of department approval	Head of department
26.09.2025	Prof. Dr. Claudius Dan

Date of approval in the Faculty Council	Dean
26.09.2025	Prof. Dr. Mihnea Udrea