SYLLABUS

1. Program information

1.1 Higher education institution	Technical University of Cluj-Napoca
1.2 Faculty	Faculty of Electronics, Telecommunications and Information Technology
1.3 Department	Bases of Electronics
1.4 Field of study	Electronic engineering, telecommunications and information technologies
1.5 Cycle of study	Bachelor of Science
1.6 Study program / Qualification	Electronic engineering, telecommunications and information technologies/ Engineer
1.7 Form of education	IF – full-time education

2. Course information

2.1 Course title	Physics II					Course code	10.00
2.2 Course coordinator	*Prof. dr. Ioan ARDELEAN; ioan.ardelean@phys.utcluj.ro*						
2.3 Seminar/ laboratory/ project/ practical activity coordinator	*Prof. dr. Ioan ARDELEAN; ioan.ardelean@phys.utcluj.ro* *Asist dr. Mihai Rusu; mihai.rusu@phys.utcluj.ro*						
2.4 Year of study	I	2.5 Semester	2	2.6 Type of assessment			E
2.7 Course status	Formative category						DF
	Optionality						DOB

3. Estimated total time

3.1 Hours per week	3	of which:	3.2 Lecture	2	3.3 Seminar	1	3.3 Laboratory	0	3.3 Project	0	3.3 Practical training	0
3.4 Hours per semester	42	of which:	3.5 Lecture	28	3.6 Seminar	14	3.6 Laboratory	0	3.6 Project	0	3.3 Practical training	0

3.7 Time distribution (hours per semester) for individual study and assessment:	
(a) Assessment	3
(b) Study using textbook, course materials, bibliography, and notes	22
(c) Additional documentation in the library, on specialized electronic platforms, and in the field	7
(d) Preparation for seminars/laboratories, assignments, reports, portfolios and essays	26
(e) Tutoring	
(f) Other activities	
3.8 Total hours of individual study and assessment (sum of (3.7(a)...3.7(f))	58
3.9 Total hours per semester (3.4+3.8)	100
3.10 Number of credits	4.0

4. Prerequisites (where applicable)

4.1 curriculum	Not the case
4.2 competencies	Knowledge of high school physics and mathematics

5. Requirements (where applicable)

5.1. for the development of the lecture	Amphitheater with video projector
5.2. for the development of the seminar/ laboratory/ project	Seminar room

6. Specific competencies acquired

Professional competencies	C1. Use of fundamental elements related to electronic devices, circuits, systems, instrumentation and technology C1.1 Description of the operation of electronic devices and circuits and of the fundamental methods for measuring electrical quantities. C1.2 Analysis of low-/medium-complexity electronic circuits and systems for their design and measurement. C2. Application of basic methods for signal acquisition and processing C2.1 Time-domain, spectral and statistical characterization of signals. C2.4 Use of specific methods and tools for signal analysis. C4. Design and use of low-complexity hardware and software applications specific to applied electronics C4.1 Definition of the concepts, principles and methods used in: computer programming, high-level and specific languages, CAD techniques for creating electronic modules, microcontrollers, computer-system architecture, programmable electronic systems, graphics and reconfigurable hardware architectures. C5. Application of basic knowledge, concepts and methods from: power electronics, automatic systems, electrical energy management and electromagnetic compatibility C5.1 Definition of the specific elements that characterize electronic devices and circuits in the fields of: power electronics, automatic systems, electrical energy management, medical electronics, automotive electronics and consumer goods. C5.2 Qualitative and quantitative interpretation of the operation of circuits in the fields of: power electronics, automatic systems, electrical energy management, medical electronics, automotive electronics and consumer goods; analysis of operation from the standpoint of electromagnetic compatibility. C6. Solving technological problems in the fields of applied electronics C6.1 Definition of the principles and methods underlying the manufacture, adjustment, testing and troubleshooting of devices and equipment in the fields of applied electronics. C6.2 Explanation and interpretation of production processes and maintenance activities for electronic equipment, identifying the test points and electrical quantities to be measured.

Transversal competencie	The physics course will develop students' critical thinking and scientific communication skills, encouraging them to analyze information, interpret data, and express their ideas clearly and concisely.

7. Expected learning outcomes

Knowledge	- The student/graduate identifies and describes basic concepts, principles and methods in mathematics, physics, chemistry, technical drawing, economics and computer science.
Skills	- The student/graduate solves mathematics, physics and chemistry problems with engineering applicability and validates the solution obtained.
Responsibility and autonomy	- The student/graduate applies the values of ethics and professional deontology specific to the engineering profession. - The student/graduate applies logical reasoning, evaluation and self-assessment in decision-making. - The student/graduate communicates effectively about engineering activities with a wide range of audiences. - The student/graduate is engaged in lifelong learning in order to acquire and implement knowledge, as needed, using appropriate learning strategies. - The student/graduate promotes dialogue, cooperation, respect for others and interculturality. - The student/graduate works effectively as a team member or as a team leader. - The student/graduate fluently uses at least one international language in technical communication.

8. Course objectives (based on the grid of specific competencies acquired)

8.1 General objective of the course	Acquiring knowledge of advanced physics to obtain competence in the field of electronics and telecommunications
8.2 Specific objectives	•Knowledge of the main physical phenomena with applications in electronics and their laws. •Developing the ability to apply the knowledge and skills acquired to solve concrete problems. •Forming a rational way of thinking.

9. Contents

9.1 Lecture	No. of hours	Teaching methods	Remarks
Electric charge and electric field. Coulomb interactions. Intensity of the electric field. Electric field lines. The electric potential.	2	Systematic presentation, conversation theoretical and experimental demonstration, observation. Problematization, modeling case study, learning through discovery	Certain phenomena will be illustrated with the help of the video projector
Electric field flux. Gauss law and applications. Energy storage in capacitors and electric field energy. Capacitance of a plane capacitor.	2		
Electric current. Current density. Local form of Ohm's law. Resistivity. Resistance. Electric dipole. Dielectrics in electric fields.	2		
Magnetic field. Biot-Savart's law and applications. The Lorentz force. Magnetic force on a current carrying conductor.	2		
Ampere's law and appplications: infinite wire, infinite plate, uniformly distributed current density.	2		
Magnetic materials. Magnetization. Paramagnetism. Diamagnetism. Ferromagnetism. Antiferromagnetism. Ferrimagnetism.	2		
Galvano-magnetic and thermoelectric effects. Hall effect. Peltier effect. Thermoelectric effect.	2		
Electromagnetic induction. Magnetoelectric induction. Maxwell's equations.	2		
Electromagnetic waves. Ecuation of e.m.w. Transversality in vacuum. Energy density. Intesity and Poynting vector.	2		
Introduction to quantum mechanics. Photoelectric effect. De Broglie hypothesis. Wave function. Postulates of quantum mechanics. The Schrodinger equation.	2		
Particle in a box. Potential well. Potential barriers and tunneling. Tunneling microscope.	2		
Quantum mechanics as basis for atomic physics and solid state electronics. The hydrogen atom: basis of the atomic physics. Quantization of angular momentum and the energy. Quantum numbers.	2		
Electric properties of solids. Energy bands. Metals, insulators and semiconductors.	2		
Intrinsic and extrinsic semiconductors. p-n junction. Electric diode. Electric conduction in semiconductors. Superconductivity.	2		

Bibliography

1. I. Ardelean, Physics -lecture notes (PDF file provided to students) (2023)
2. I. Ardelean, M.M. Rusu, Essential Physics for Engineers, Ed. U.T. PRES, Cluj-Napoca, 2026.
3. I. Ardelean, Fizica pentru ingineri, Ed. U.T. PRES, Cluj-Napoca, 2005.

9.1 Lecture	No. of hours	Teaching methods	Remarks
4. T. I. Cretu, Fizica-curs universitar, Ed. Tehnica, Bucuresti, 1996 5. H. D. Young, R. A. Freedman - Sears and Zemansky's University Physics with Modern Physics Technology Update (lb. engleza), Pearson – 2013			

9.2 Seminar /laboratory /project /practical training	No. of hours	Teaching methods	Remarks
Introduction. Coulomb forces, electric field intensity and electric potential.		Theoretical and experimental demonstration, conversation, observation and analysis.	Students will get involved
Applications of the Gauss law.			
Applications of the Ampere law.			
Applications of the electromagnetic induction and magnetoelectric induction law.			
Photoelectric effect. De Broglie wave lengths of particles and applications.			
Galvano electric and thermoelectric effects			
Electric conductivity in metals and semiconductors.			
Bibliography 1. I. Cosma, Tania Ristoiu, Fizica aplicata - probleme rezolvate, Ed. U.T. PRES, Cluj-Napoca, 2005 2. I. Ardelean, List of seminar problems (PDF file provided to students) (updated 2024)			

10. Alignment of the course contents with the expectations of the epistemic community, professional associations, and representative employers in the field related to the program

The course content and the teaching-learning-assessment methods are aligned with the current requirements of the Electronics, Telecommunications, and Information Technology Engineering field, considering the expectations of the academic and professional community, representative employers, as well as the national quality assurance standards in higher education. The course helps prepare students in line with employer expectations and the quality requirements set for engineering study programs.

11. Assessment

Activity type	11.1 Assessment criteria	11.2 Assessment methods (and type of assessment: continuous/ summative)	11.3 Weight in final grade
11.4 Lecture	The level of acquired theoretical knowledge and practical skills, logical coherence, skills of operating with acquired knowledge in individual complex activities.	Formative evaluation tests (sets of problems solving) -Summative evaluation written exam (theory and problems)	*80%*

11.5 Seminar/ Laboratory/ Project /Practical activity	The level of acquired theoretical knowledge and abilities for problems analysis and solving	- Continuous formative evaluation - Seminary individual work	*20%*

11.6 Minimum performance standard

Quality level:

Minimal knowledge:

- Knowledge of the basic principles of Electricity and Magnetism: phenomena in electrostatics and electro-kinetics
- Knowledge of the phenomenological theory of charge transport, the physical origin of resistance and Joule effect, the classification of materials in metals, insulators, semiconductors.
-Knowledge of main concepts related to the sources of Electric Field and Magnetic Field and the phenomenology of electrostatic and magnetic interactions.
- Knowledge for the basis of electromagnetic field: generation, propagation, energy transport, applications in communications technologies.
-Knowledge of main concept of quantum physics, as basis of modern technologies: wave/particle duality, probabilistic approach of physical phenomena, applications of quantum mechanics in material science and electronic devices.

Minimal competences:

- Be able to calculate electric and magnetic fields generated by their respective sources (charge distributions, currents).
- Calculate electrostatic and magnetic interactions.
- Be able to explain the different properties for the different types of magnetic properties of materials: diamagnetic, ferromagnetic, paramagnetic.
- Be able to solve standard problems in Electricity, Magnetism, Electromagnetic waves, Elementary Quantum Physics.

Quantitative level:

*The final mark for the subject is calculated with the relation: 0.8 * Exam mark + 0.2 * seminar mark*

Completion date:	**Course coordinators**	**teaching rank, title First name LAST NAME**	**Signature**
23.06.2026	Lecture	Prof dr. Ioan ARDELEAN	
	Applications	Prof dr. Ioan ARDELEAN	
		Asist. Dr. Mihai Rusu	

Approval of the Head of the Department coordinating the course, only if this differs from the department organizing the study program	Head of the Physics and Chemistry Department Prof. Petru PĂȘCUȚĂ, Ph.D.

Date of approval by the Council of the Department of Bases of Electronics 26.06.2026	Head of the Bases of Electronics Department Prof. Sorin HINTEA, Ph.D.
Date of approval by the Council of the Faculty of Electronics, Telecommunications and Information Technology 30.06.2026	Dean, Prof. Ovidiu-Aurel POP, Ph.D.