SYLLABUS

1. Data about the program of study

1.1 Institution	Technical University of Cluj-Napoca
1.2 Faculty	Faculty of Electronics, Telecommunications and information Technology
1.3 Department	*Applied Electronics*
1.4 Field of study	Electronic Engineering, Telecommunications and Information Technologies
1.5 Cycle of study	Bachelor of Science
1.6 Program of study / Qualification	Applied Electronics / Engineer
1.7 Form of education	Full time
1.8 Subject code	*10*

2. Data about the subject

2.1 Subject name	Physics II								
2.2 Subject area	Theoretical area Methodological area Analytic area								
2.3 Course responsible	Prof. dr. Ioan ARDELEAN; ioan.ardelean@phys.utcluj.ro								
2.4 Teacher in charge with seminar / laboratory / project	Asist dr. Mihai Rusu; mihai.rusu@phys.utcluj.ro								
2.5 Year of study	I	2.6 Semester	1	2.7 Assessment	Exam	2.8 Subject category	DID/DOB		

3. Estimated total time

3.1 Number of hours per week	14	of which: 3.2 course	2	3.3 seminar / laboratory	1
3.4 To Total hours in the curriculum	42	of which: 3.5 course	28	3.6 seminar / laboratory	14

Distribution of time	hours
Manual, lecture material and notes, bibliography	22
Supplementary study in the library, online specialized platforms and in the field	7
Preparation for seminars / laboratories, homework, reports, portfolios and essays	26
Tutoring	
Exams and tests	3
Other activities:	0

3.7 Total hours of individual study	58
3.8 Total hours per semester	100
3.9 Number of credit points	4

4. Pre-requisites (where appropriate)

4.1 curriculum	Basic background in Physics from High school
4.2 competence	Basic knowledge of Math from High school

5. Requirements (where appropriate)

5.1. for the course	Amphitheatre, Cluj-Napoca

5.2. for the seminars / laboratories / projects	The presence at the seminaries is compulsory.

6. Specific competences

Professional competences	Theoretical	- Basic elements of general physics from high school in the following areas: Mechanics, Thermodynamics and Heat, Electricity and Magnetism, Optics, Atomic and Nuclear Physics. - Specific theoretical knowledge related to fundamental concepts: force, Energy, Conservation laws. - Elementary knowledge in Math: Linear Algebra, Differential an Integral calculus, function representation and analysis.
	Acquired skills (what the student is able to	After completing the discipline, the students will be able to: - Manipulate fundamental concepts in Physics: force, elements of mechanical movement, energy, momentum, conservation laws, periodic motion and periodic phenomena, resonance. - Extrapolate the basic concepts of mechanics for electric phenomena in electronic circuits: transitory regime, oscillating circuits, damped and forced oscillators and specific elements (quality factor, relaxation time, resonance, logarithmic decrement of damping,etc). - Extrapolate the knowledge of Physics, Math, technics of measuring, data analysis in applied electronics area. - Solve problems based on a general algorithm with the following steps: Analyze the formulation and identify the relevant concepts, Set-up the problem (given the concepts identify the known and target quantities and write down the relevant equations, drive the relevanct sketch), Execute the solution, Evaluate and discuss the answer.
Cross competences		They can document t themselves on a specific subject by using the library and the internet

7. Discipline objectives (as results from the key competences gained)

7.1 General objective	Developing the competences and knowledge related to Advanced Physics useful for Electronics and Applied Electronics, underlying physics of some modern devices (sensors, data storage elements, micro and nano-technologies, LASER, microscopes with extreme/atomic resolution).
7.2 Specific objectives	1. Understanding and manipulation of basic concepts in Physics, combined with Math. 2. Developing skills and abilities necessary for solving simple and complex problems of Physics. 3. Developing skills and abilities for the analysis of fundamental phenomena in nature and technics which are transposed as problems in the Engineering domain.

	4. Acquire the advanced physics background of standard and modern electronic devices, micro and nano-technologies.

8. Contents

8.1 Lecture (syllabus)	Teaching methods	Notes
1. Electric charge and electric field. Coulomb interactions. Intensity of the electric field. Electric field lines. The electric potential.	Presentation, heuristic conversation, exemplification, problem presentation, teaching exercise, case study, formative evaluation, learning by discovery	Mainly use the blackboard, the projector used only for presentation of some movies with recorded experiments of physics.
2. Electric field flux. Gauss law and applications. Energy storage in capacitors and electric field energy. Capacitance of a plane capacitor.		
3. Electric current. Current density. Local form of Ohm's law. Resistivity. Resistance. Electric dipole. Dielectrics in electric fields.		
4. Magnetic field. Biot-Savart's law and applications. The Lorentz force. Magnetic force on a current carrying conductor.		
5. Ampere's law and appplications: infinite wire, infinite plate, uniformly distributed current density.		
6. Magnetic materials. Magnetization. Paramagnetism. Diamagnetism. Ferromagnetism. Antiferromagnetism. Ferrimagnetism.		
7. Galvano-magnetic and thermoelectric effects. Hall effect. Peltier effect. Thermoelectric effect.		
8. Electromagnetic induction. Magnetoelectric induction. Maxwell's equations.		
9. Electromagnetic waves. Ecuation of e.m.w. Transversality in vacuum. Energy density. Intesity and Poynting vector.		
10. Introduction to quantum mechanics. Photoelectric effect. De Broglie hypothesis. Wave function. Postulates of quantum mechanics. The Schrodinger equation.		
11. Particle in a box. Potential well. Potential barriers and tunneling. Tunneling microscope.		
12. 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.		
13. Electric properties of solids. Energy bands. Metals, insulators and semiconductors.		
14. Intrinsic and extrinsic semiconductors. p-n junction. Electric diode. Electric conduction in semiconductors. Superconductivity.		

Bibliography

1. H. D. Young, R. A. Freedman - Sears and Zemansky's University Physics with Modern Physics Technology Update (lb. engleza), Pearson - 2013.

2. D. Halliday, R. Resnik, Physics, John Willey et sons (any edition)

3. http://hyperphysics.phy-astr.gsu.edu
4. I.Ardelean, Fizica pentru ingineri, Ed. U.T. PRES, Cluj-Napoca, 2005
5. I. Ardelean, Fizica-note de curs, 2020 (https://utclujnmr.weebly.com/teaching.html)

8.2 Seminar / laboratory / project	Teaching methods	Notes
1. Introduction. Labor protection.Coulomb forces, electric field intensity and electric potential.	Didactic and experimental proof, didactic exercise, conversation, observation and analysis, individual and team work	Use of white/magnetic board, computers and computer programs for data analysis.
2. Applications of the Gauss law.		
3. Applications of the Ampere law.		
4. Applications of the electromagnetic induction and magnetoelectric induction law.		
5. Photoelectric effect. De Broglie wave lengths of particles and applications.		
6. Potential well. Potential barriers and tunneling. Tunneling microscope.		
7. Electric conductivity in metals and semiconductors.		

Bibliography

1. H. D. Young, R. A. Freedman - Sears and Zemansky's University Physics with Modern Physics Technology Update (lb. engleza), Pearson - 2013.
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9. Bridging course contents with the expectations of the representatives of the community, professional associations and employers in the field

The discipline content and the acquired skills agree with the expectations of the professional organizations and the employers in the field, where the students carry out the internship stages and/or occupy a job in the field of *electronics and communications technologies*, and the expectations of the national organization for quality assurance (ARACIS).

10. Evaluation

Activity type	10.1 Assessment criteria	10.2 Assessment methods	10.3 Weight in the final grade
10.4 Course	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%*
10.5 Seminar/ Laboratory	The level of acquired theoretical knowledge and abilities for problems analysis and solving	- Continuous formative evaluation - seminary individual work	*20%*
10.6 Minimum standard of performance			
Minimum 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.

Minimum 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.

-The mark for the subject is calculated with the relation: 0.8 * Exam score + 0.2 * Worker grade (seminary contribution)
The total mark must be at least 5.

Date of filling in:	Responsible	Title Surname NAME	Signature
20.06.2024	Course	Prof. dr. Ioan Ardelean	
	Applications	Asist. dr. Mihai Rusu	

Date of approval in the Department of Applied electronics 26.06.2024	Head of Department Prof. Dorin PETREUȘ, Ph.D.
Date of approval in the Council of Faculty ETTI 11.07.2024	Dean Prof. Ovidiu POP, Ph.D.