SYLLABUS

1. Program Information

1.1 Higher education institution	Technical University of Cluj-Napoca
1.2 Faculty	Faculty of Automation and Computer Science
1.3 Department	Department of Automation
1.4 Field of study	Automation, Applied Informatics and Intelligent Systems
1.5 Cycle of studies	Bachelor
1.6 Study Programme/Qualification	Intelligent Automation Systems (dual, in English language)
1.7 Form of education	IF – full-time education
1.8 Course code	5.00

2. Course information

2.1 Course title	**Physics II**					
2.2 Course lecturer	Lecturer Eng. Boşca Maria, PhD, Maria.Bosca@phys.utcluj.ro					
2.3 Seminar / Laboratory / Project Lecturer	Lecturer Eng. Boşca Maria, PhD, Maria.Bosca@phys.utcluj.ro					
2.4 Year of study	1	2.5 Semester	1	2.6 Type of assessment		E
2.7 Course status	Formative category *(DF, DS, DC)*					DF
	Optionality *(DOB, DOP, DFac)*					DOB

3.Total estimated time

3.1 Number of hours per week	4	of which:	HEI	Lecture	3	Seminar	0	Laboratory	1	Project	0
			CO		0		0		0		0
3.2 Number of hours per semester	56	of which:	HEI	Lecture	42	Seminar	0	Laboratory	14	Project	0
			CO		0		0		0		0

3.3 Distribution of time allocation (hours per semester) for:	HEI	CO
(a) Study based on textbook, course support, bibliography, and notes	18	-
(b) Additional documentation in library, specialized electronic platforms, and fieldwork	10	-
(c) Preparation of seminars/laboratories, assignments, papers, portfolios and essays	10	-
(d) Tutoring	4	-
(e) Examinations	2	-
(f) Other activities:	-	-
3.4 Total individual study hours (sum (3.3(a)... 3.3(f)))	44	-
3.5 Total hours per semester (3.2+3.4)	100	-
3.6 Number of credits per semester	4	-

(HEI = Higher Education Institution, CO = Company)

4. Prerequisites (where applicable)

4.1 Curriculum Prerequisites	Basic background knowledge in Physics from High school
4.2 Competency Prerequisites	Basic physics knowledge and mathematical analysis

5. Conditions (where applicable)

5.1. Course Organization Conditions	Amphitheatre, Technical University of Cluj-Napoca
5.2. Seminar / Laboratory / Project organization conditions	The presence at the laboratory is compulsory.

6. Specific Competencies Acquired

Professional Competencies	• PC02 Analyze test data • PC24 Think abstractly • PC27 Execute analytical mathematical calculations-
Transversal Competencies	• TC02 Think analytically • TC05 Interpret mathematical information

7. Learning outcomes

Knowledge	• Define the main physical quantities and their measurement units. • Acquire the concepts of field (electric, magnetic, electro-magnetic). • Acquire the notions of the main quantities (electric and magnetic) of a solid body. • Identify physical phenomena and explain them. • Operate with physics formulae and demonstrate physics laws. • Compare practical results against theories and draw conclusions. • Identify installations components in the lab and understand how they work. • Identify the components of a laboratory installation and explain its operation based on the laboratory report. • Process the experimental results and determine other physical quantities based on them.
Skills	• Use of integral and differential calculus for the description of physical phenomena. • Graphical representation on various coordinates and obtain relevant information. • Process measurements result in determining other physics quantities. • Measure with different measuring instruments. • To graphically represent experimental results and obtain information from graphical representations. • To estimate the errors that affect the data obtained through measurements or those determined based on experimental results. • To solve problems related to the studied physical phenomena.
Responsibility and autonomy	• Utilize physics fundamentals in electrical engineering domain, proving initiative. • Understand and explain a physical phenomenon with a clear description of it • Understand physics specific laws in correlation with other disciplines.

8. Course Objectives

8.1 General objective of the course	Initiating future engineers in the development and use of physical models, as a practical way of extracting the essential from a complex set of empirical phenomena.
8.2 Specific objectives	Assimilation by students of the quantities and laws that govern the fundamental physical phenomena for the purpose of the intellectual training of the future engineer.

9. Contents

9.1 Lectures	No. of hours	Teaching methods	Obs.
Course 1. Physical quantities and units of measure. Operations with vectors. Material point mechanics.	3		

Cinematics. The fundamental principles of mechanics. Conservation laws in mechanics.		Systematic exposition of physical phenomena, conversations, theoretical and experimental demonstrations, observations and analysis of studied phenomena, learning through discovery.	Exposure and free discussions. Computer, video projector, blackboard.
Course 3. Harmonic oscillations. Composition of parallel and perpendicular harmonic oscillations. Damped and maintained oscillations. Resonance phenomena.	3		
Course 5. Elastic waves. Waves diffraction. Elastic waves reflex and refraction. Waves interference. Stationary waves. Acoustic elements. The Doppler effect.	3		
Course 7. Thermodynamics - principles. Simple transformations of ideal gases. Polytropic transformations. Thermal machine. Carnot cycle. Electric charge. Coulomb's law. The electric field. The intensity of the electric field. Electrical charge distributions. Mechanical work and potential in an electric field. The electric dipole.	3		
Course 8. Electric field flow. Gauss's law for the electric field. Applications of Gauss's Law. Gauss's law in dielectrics. The electric capacitor. Electric current. The intensity of the electric current. Current density. Classical theory of electrical conduction in metals. Ohm's law. Direct current circuits. Energy and electrical power.	3		
Course 9. The magnetic field. Lorentz force. The electromagnetic force. Current loop in uniform magnetic field. Sources of the magnetic field. Biot-Savart's law. Ampere's law. The interaction force between two parallel conductors. Law of electromagnetic induction (Faraday's law). The phenomenon of self-induction. Maxwell's equations. Electromagnetic waves. Propagation of electromagnetic waves.	3		
Course 10. Elements of geometric optics. The plane diopter. Spherical diopter. The plane mirror. Spherical mirror. Thin lenses. Thermoelectric and galvano-magnetic effects. Seebeck effect. Thomson effect. The Peltier effect. Hall effect. Notions of elasticity. Electric field. Electric force. Intensity and potential of an electric field. Electric field flux. Gauss law and applications.	3		
Course 11. Electric dipole. Dielectrics in electric field. Condenser with dielectric. Electric field’s density of energy. Electro-kinetics topics. Electric current. Phenomenon theory of electric conductivity. Magnetism topics. Magnetic field. Biot-Savart law and applications. Lorentz force.	3		
Course 12. Electromagnetism topics. Electromagnetic induction law. Maxwell equations. Inductance, auto-inductance. Magnetic field energy. Magnetic materials. Magnetic momentum. Magnetization. Para-magnetism. Diamagnetism. Electromagnetic waves. Electromagnetic waves equation. Transversality of electromagnetic waves. Energy transported by electromagnetic waves. Vector Poynting.	3		
Course 13. Ferromagnetism. Other magnetic status: antiferromagnetism, ferrimagnetism. Introduction to quantic physics. Photoelectric effect. Stability problem for hydrogen atom. Bohr postulates. Broglie wave. Wave mechanics topics. Schrödinger's equation. Applications:	3		

Free particle. The particle in the infinite potential well. The tunnel effect. The microscope with tunnel effect.			
Course 14. From atom to condensate status. The atom, quantic numbers, energy levels, spin. Electrons' energy bands in solid bodies. Metals, semiconductors, insulators. Geometric optics topics. Plane dioptre. Spheric dioptre. Plane mirror. Spherical mirror. Thin lenses. Galvano-magnetic and thermoelectric effects. Hall normal and abnormal effect. Nernst effect. Seebeck effect. Peltier effect.	3		

Bibliography

- H. D. Young, R. A. Freedman - Sears and Zemansky's University Physics with Modern Physics Technology Update (lb. engleza), Pearson - 2013.
- D. Halliday, R. Resnik, Physics, John Willey et sons (any edition)
- http://hyperphysics.phy-astr.gsu.edu
- Lidia Pop, Maria Boşca, Noţiuni de fizică mecanică, Editura UTPress, 2012
- E. Culea, Fizică – Elemente de fizică pentru ingineri, Risoprint, 2010.
- I. Ardelean, Fizica pentru ingineri, Ed. U.T. PRES, Cluj-Napoca, 2005.
- T. I. Cretu, Fizica-curs universitar, Ed. Tehnica, Bucuresti, 1996.
- Cursul de Fizica Berkeley, Vol. II – Electricitate si Magnetism, Ed. Didactica si Pedagogica, 1981.
- P.W. Sears, M.W. Zemansky, H.D. Young, Fizica, Ed. didactica si pedagogica, 1983.

9.2 Seminar / laboratory / project	Hours HEI	Hours CO	Teaching methods	Obs.
Laboratory 1. Introduction. Labor protection. List of works. Calculation of errors. Graphical representation. Determination of the elastic constant of a spring.	1	-	Theoretical and experimental demonstration, conversation, observation, and analysis.	Laboratory work is performed practically.
Laboratory 2. The study of the thermoelectric effect. The study of electrical conductivity of metals.	1	-		
Laboratory 3. Determination of the viscosity coefficient of liquids (Stokes method). Experimental verification of the Stefan-Boltzmann law.	1	-		
Laboratory 4. Study of the activation energy of a semiconductor. The study of transverse standing waves in vibrating strings.	1	-		
Laboratory 5. The study of the photoelectric effect. Study of a spectroscope and qualitative spectral analysis.	1	-		
Laboratory 6. Hall effect study. The study of polarization of light.	1	-		
Laboratory 7. Applications. Session to cover missed lab works.	1	-		

Bibliography

- 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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- E.Culea, Fizica – elemente de fizica pentru ingineri, Risoprint, 2010, https://biblioteca.utcluj.ro/files/carti-online-cu-coperta/519-0.pdf
- Petru Păşcuţă, Lidia Pop, Maria Boşca, Fizică lucrări practice, Editura UTPress 2013

10. Correlation of course content with the expectations of the epistemic community representatives, professional associations, and major employers in the field related to the program

The acquired skills are necessary for them and will help them to understand other disciplines, especially when they will carry out their activity in engineering fields.

11. Evaluation

Activity Type	**Evaluation criteria**	**Evaluation methods**	**Weight in final grade**
11.1 Lecture	Test with questions from all the taught chapters that consist of solving some problems and theory topics.	Written test (T)	80 %
11.2 Seminar/ Laboratory/Project	Continuous assessment.	Written and oral (L)	20%
11.3 Minimum Performance Standard			
Minimum 5.			

Date of completion:	Lecturers		Signature
11.11.2025	Course	Lect.dr.Eng. Maria Boşca	
		Lect.dr.Eng. Maria Boşca	
	Applications		

Date of approval by the Department of Automation Council 24.11.2025	Director of the Department of Automation Prof.dr.ing. Honoriu VĂLEAN
Date of approval by the Faculty of Automation and Computer Science Council 28.11.2025	Dean Prof.dr.ing. Vlad MUREȘAN