COURSE SYLLABUS

1. Data about the program of study

1.1 Institution	Technical University of Cluj-Napoca
1.2 Faculty	Automotive, Mechatronics and Mechanical Engineering
1.3 Department	Mechatronics and Machine Dynamics
1.4 Field of study	Mechatronics and Robotics
1.5 Cycle of study	Bachelor's degree
1.6 Program of study/Qualification	Mechatronics
1.7 Form of education	Full time

2. Data about the subject

2.1 Subject name	Physics				Subject code	13.00
2.2 Course responsible/lecturer	Ș.l. dr. Mihai Rusu Mihai.Rusu@phys.utcluj.ro					
2.3 Teacher in charge of seminars/labs/projects	Ș.l. dr. Mihai Rusu Mihai.Rusu@phys.utcluj.ro					
2.4 Year of study	I	2.5 Semester	II	2.6 Assessment		E
2.7 Subject category	Formative category					DF
	Optional					DOB

3. Estimated total time

3.1 Number of hours per week	4	of which:	3.2 Course	2	3.3 Seminar	1	3.3 Laboratory	1	3.3 Project	-	3.3 Practical training	-
3.4 Number of hours per semester	56	of which:	3.5 Course	28	3.6 Seminar	14	3.6 Laboratory	14	3.6 Project	-	3.3 Practical training	-

3.7 Distribution of time allocation (hours per semester) for individual study and assessment:	
(a) Assessment	2
(b) Study of textbooks, course materials, bibliography, and lecture notes	20
(c) Additional research in the library, on specialized electronic platforms, and in the field	6
(d) Preparation for seminars/laboratory works, homework, reports, portfolios, essays	10
(e) Tutoring	6
(f) Other activities	-
3.8 Total hours for individual study and evaluation (sum (3.7(a)…3.7(f))	44
3.9 Total hours per semester (3.4+3.8)	100
3.10 Number of credit points	4

4. Pre-requisites (if applicable)

4.1 Curriculum	General knowledge about high school physics General knowledge of the high school mathematics
4.2 Competence	Elements of differential and integral calculus. Vector calculus.

5. Requirements (if applicable)

5.1. for the course	The amphitheater is equipped with a video-projector. During the state of alert/emergency, activities can be carried out online or in a hybrid scenario: onsite/online (through the Teams platform).
5.2. for the seminar/lab/project	Attendance at seminars and laboratory sessions is mandatory.

6. Subject-specific learning outcomes

Professional competencies	• The use of basic concepts, principles, and methods of physics to describe and explain phenomena and processes encountered in engineering. • Modeling and solving applied physics problems and validating the results obtained (dimensional analysis, numerical checks). • Performing basic engineering calculations and associating them with graphical representations (diagrams, characteristics, experimental curves). • Performing basic measurements/experiments, acquiring and processing data, estimating uncertainties and interpreting results.
Transversal competencies	• Applying the values of ethics and academic integrity, observing occupational health and safety norms in experimental activities. • Practicing logical reasoning, critical thinking and self-evaluation in the analysis of problems and results. • Effective communication, oral and written, of reasoning, calculations and theoretical/experimental results (including through graphs). • Effective teamwork within applications/laboratories and assuming role-specific responsibilities. • Developing autonomy in learning and lifelong learning through the use of bibliographic sources and digital resources.

7. Expected learning outcomes

Knowledge	• The student/graduate identifies and describes the concepts, laws, the fundamental principles and theories in physics necessary for engineering training. • The student/graduate describes the physical phenomena and processes relevant to engineering applications, as well as the simplified models used in their analysis. • The student/graduate explains the basic principles of measurement, errors and uncertainties, as well as the interpretation of experimental data.
Skills	• The student/graduate applies the laws of physics for modeling and solving problems with applicability in engineering and verifies the solutions obtained from a dimensional and numerical point of view. • The student/graduate performs calculations and makes graphical representations of functional dependencies, interpreting the curves and characteristics obtained theoretically or experimentally. • The student/graduate acquires and processes experimental data, calculates derived quantities, estimates uncertainties, interprets theoretical and experimental results and writes laboratory reports.

Responsibility and autonomy	• The student/graduate respects the principles of professional ethics and deontology specific to the engineering activity. • The student/graduate uses logical reasoning, critical evaluation and self-evaluation in substantiating decisions. • The student/graduate clearly and efficiently communicates information on engineering activities to various categories of public. • The student/graduate continuously develops his/her knowledge and skills, using learning strategies appropriate to professional needs. • The student/graduate supports dialogue, cooperation, mutual respect and openness to cultural diversity. • The student/graduate works effectively in a team, both as a member and in a coordination role.

8. Discipline objectives (derived from the specific competencies grid)

8.1 General objective of the discipline	Formation of the theoretical and practical basis of physics necessary for understanding, modeling and analyzing the phenomena and processes encountered in specialized disciplines and in engineering activity, by developing the ability to solve problems and interpret theoretical and experimental results.
8.2 Specific objectives	• Correct use of physical quantities, SI units, and dimensional analysis in the formulation and verification of computational relationships. • Applying the fundamental laws of mechanics, oscillations, elastic waves, electricity, magnetism and electromagnetism in solving typical engineering situations and problems. • Development of calculation and graphic representation skills and use of digital tools for analysis and interpretation. • Development of experimental skills: making measurements, acquiring and processing data, estimating errors and formulating conclusions. • Training the capacity for critical interpretation of results and technical communication (oral and written) of solutions and reports. • Cultivating responsibility for safety and work ethics, team collaboration and autonomy in learning.

9. Contents

9.1 Course	**No. of hours**	**Teaching methods**	**Notes**
C1. Introduction. Physical quantities, units of measurement.	2	Systematic exposition of physical phenomena, conversations, theoretical and experimental demonstrations, observations and analysis of the phenomena studied. Video-Projector.	
C2. Translation. Kinematics of material points.	2		
C3. Dynamics. Principles of classical mechanics.	2		
C4. Rotation. Physics of the rigid solid	2		
C5. Oscillations. The harmonic oscillator model	2		
C6. Damped and forced oscillations. Resonance	2		
C7. Mechanic waves and characteristic quantities.	2		
C8. Sound waves and acoustics.	2		
C9. Deformable Solids. Fluid mechanics and characteristic quantities	2		
C10. Fundamental laws and principles in fluid mechanics	2		
C11. Electrostatics. Electric field and characteristic quantities.	2		
C12. Electric current and Ohm's law.	2		
C13. Magnetostatics. Magnetic field and characteristic quantities.	2		

9.1 Course	No. of hours	Teaching methods	Notes
C14. Thermodynamics and heat transport phenomena.	2		

Bibliography

1. I. Ardelean and M.M.Rusu, Essential Physics for Engineers, Ed. U.T. Press, 2026 (free version, available online) https://biblioteca.utcluj.ro/files/carti-online-cu-coperta/831-3.pdf
2. H. D. Young, R. A. Freedman - Sears and Zemansky's University Physics with Modern Physics Technology Update (lb. engleza), Pearson – 2013
3. Lidia Pop, Curs de fizică generală, 2021, https://biblioteca.utcluj.ro/files/carti-online-cu-coperta/520-6.pdf
4. Eugen Culea, Simona Cornelia Nicoară - Fundamentals of Physics, 2007, Risoprint, Cluj-Napoca.

http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html

9.2 Seminar / laboratory / project / practical training	No. of hours	Teaching methods	Notes
S1. Physical quantities. Vectors.	2	Theoretical and experimental demonstration, conversation, observation and analysis. Experimentation	
S2. Kinematics.	2		
S3. Dynamics.	2		
S4. Oscillations.	2		
S5. Waves.	2		
S6. Acoustics.	2		
S7. Thermodynamics and fluid mechanics.	2		
L1. Occupational safety. Measurements. Representing data.	2		
L2. Determination of a spring's elastic constant.	2		
L3. Study of transverse waves in vibrating strings.	2		
L4. Determination of the viscosity coefficient of liquids.	2		
L5. Study of the electrical conductivity of metals.	2		
L6. Experimental verification of the Stefan-Boltzmann law.	2		
L7. Final verification and evaluation of the laboratory activity.	2		

Bibliography

1. Ardelean and M.M.Rusu, Essential Physics for Engineers, Ed. U.T. Press, 2026 (free version, available online) https://biblioteca.utcluj.ro/files/carti-online-cu-coperta/831-3.pdf
2. Radu Fechete, Dumitrița Moldovan, Ramona Chelcea, Lidia Pop and Maria Boșca, Fizică. Îndrumător de lucrări virtuale de laborator, 2021, https://biblioteca.utcluj.ro/files/carti-online-cu-coperta/519-0.pdf
3. H. D. Young, R. A. Freedman - Sears and Zemansky's University Physics with Modern Physics Technology Update (lb. engleza), Pearson – 2013

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

The contents of the discipline and the teaching-learning-assessment methods are correlated with the profile of the Mechatronics and Robotics study program and with the current requirements of the field, taking into account the expectations of the academic and professional community, of representative employers, as well as the national standards of quality assurance in higher education. The discipline contributes to the formation of the physics base necessary for the understanding of mechanical, electrical, actuation and measurement systems specific to mechatronics, as well as to the development of modeling, measuring, processing and interpreting data skills. At the same time, the course and laboratory activities aim to develop critical thinking, comply with safety requirements, communicate results and responsibly carry out individual and team activities, in accordance with the expectations of employers and the quality requirements applicable to engineering study programs.

11. Evaluation

Type of activity	11.1 Assessment criteria	11.2 Assessment methods (and type of assessment: continuous/summative)	11.3 Weight in the final grade
11.4 Course	• Completeness and correctness of knowledge; • The ability to solve problems related to the physical phenomena studied.	Summative written test consisting of topics from theory and applications (grade C)	80%
11.5 Laboratory	• Completeness and correctness of knowledge; • The ability to process and graphically represent the experimental data obtained during laboratory work.	Continuous verification (grade V)	20%
11.6 Minimum performance standard: N = 0,8 C + 0,2 V; N ≥ 5; C ≥ 5; V ≥ 5.			

Completion date:	Faculty members	academic rank, title, First Name SURNAME	Signature
20.05.2026	Course	Ș.l. dr. Mihai Rusu	
	Practical activities	Ș.l. dr. Mihai Rusu	

Approval from the Head of the Department coordinating the course, only if this is different from the department organizing the study program.	Head of Department Physics and Chemistry Prof. dr. Petru PASCUTA

Date of approval by the Department Council 28.05.2026	Head of Department IF Prof. dr. ing. Mircea Viorel BARA
Date of approval by the Faculty Council 16.09.2026	Dean, Prof. dr. ing. Nicolae FILIP