SYLLABUS

1. Data about the program of study

1.1	Institution	Technical University of Cluj-Napoca
1.2	Faculty	Faculty of Automotive, Mechatronics and Mechanical Engineering
1.3	Department	Department of Mechatronics and Machine Dynamics
1.4	Field of study	Mechatronics and Robotics
1.5	Cycle of study	Bachelor of Science
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			Prof. dr. Ioan Ardelean - Ioan.Ardelean@phys.utcluj.ro			
2.3	Teachers in charge of seminars			Prof. dr. Ioan Ardelean - Ioan.Ardelean@phys.utcluj.ro			
2.4 Year of study	1	2.5 Semester	2	2.6 Assessment			E
2.7 Subject category DID DOB	Formative category						DF
	Optionality						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	
3.4 Total hours in the curriculum	56	of which	3.5 Course	28	3.6 Seminar	14	3.6 Laboratory	14	3.6 Project	

3.7 Individual study:	
(a) Manual, lecture material and notes, bibliography	26
(b) Supplementary study in the library, online and in the field	5
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays	5
(d) Tutoring	2
(e) Exams and tests	6
(f) Other activities	

3.8 Total hours of individual study (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 (where appropriate)

4.1	Curriculum	Knowledge of physics and math from high school
4.2	Competence	Elements of differential and integral calculus

5. Requirements (where appropriate)

5.1	For the course	-
5.2	For the applications	Laboratory and seminar attendance is compulsory

6. Specific competences

Professional competences	After completing the subject students will be able to: - Define the main physical quantities and their units of measurement. - Use integral and differential calculus to describe physical phenomena. - Define the concepts of energy, energy conservation, efficiency. - Define the notions of oscillations and waves (mechanical, electromagnetic, acoustic). - To define specific notions of fluid mechanics. - To define the notion of field (gravitational, electric, magnetic, electromagnetic). - Define the main properties (electric and magnetic) of solids. - Identify physical phenomena and explain them - Identify the components of a laboratory installation and explain how it works on the basis of the laboratory report. - Measure with different measuring instruments - Process experimental results and determine other physical quantities from them - Graph experimental results and obtain information from the graphical representations - Estimate errors affecting the data obtained by measurements or those determined from experimental results - Solve problems related to the physical phenomena studied - To appreciate comparatively the theoretical results offered by specialized literature and those of a realized experiment - To measure lengths using specific measuring apparatus: sub-meter, micrometer, comparator. - Use measuring devices such as: frequency generator, galvanometer, multimeter, for determining different physical quantities.
Cross competences	- Responsible performance of professional tasks under conditions of restricted autonomy and qualified assistance - Familiarization with roles and activities specific to teamwork and distribution of tasks to subordinate levels - Awareness of the need for continuous training; efficient use of learning resources and techniques for personal and professional development

7. Expected learning outcomes

Knowledge	• Knowledge of physical concepts, theories, laws, and principles (mechanics, thermodynamics, electricity). • The ability to correctly use the language of physics, units of measurement, and graphical symbols. • Identifying and explaining physical processes in the environment and in technology.
Skills	• Solving problems using mathematical models and physical formulas • Conducting experiments, observing, and interpreting the results. • Processing experimental data, graphing phenomena, and interpreting them. • Analyzing information and phenomena from the perspective of concepts learned in physics.

Responsibility and autonomy	• The ability to collaborate within work groups. • Developing an environmentally conscious attitude and the ethical use of technology. • The ability to independently seek out information and deepen one's knowledge.

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

8.1	General objective	- Acquiring theoretical knowledge and experimental skills in Newtonian mechanics, thermodynamics, fluid mechanics, electromagnetism. - Using integral and differential calculus to describe physical models
8.2	Specific objectives	- Assimilation by the students of the magnitudes and laws governing fundamental physical phenomena in order to train future engineers intellectually - To introduce future engineers to the development and use of physical models as a practical way of extracting the essentials from a complex set of empirical phenomena. - To train the skills to approach complex problems quantitatively through exercises applying the fundamental laws of physics.

9. Contents

9.1. Lecture (syllabus)	Number of hours	Teaching methods	Notes
1. Course 1 Physical quantities and units of measurement.	2	Presentation and discussion	
2. Course 2 Material point mechanics. Kinematics.	2		
3. Course 3 Dynamics. Principles of mechanics. Conservation laws in mechanics.	2		
4. Course 4 Oscillatory motion. Harmonic oscillations. Composition of harmonic oscillations.	2		
5. Course 5 Amortized swings	2		
6. Course 6 Maintained oscillations	2		
7. Course 7 Wave phenomena. Characteristic quantities. Stationary waves	2		
8. Course 8 Elements of acoustics. Doppler effect.	2		
9. Course 9 Thermodynamics. State parameters. Equation of state	2		
10. Course 10 Principles of thermodynamics. Thermodynamic transformations. Thermal transport phenomena	2		

11. Course 11 Fluid Mechanics. Fundamentals.	2		
12. Course 12 Laws and principles of fluid mechanics.	2		
13. Course 13 Electrostatics. Electric field. Characteristic quantities. Coulomb's law. Gauss's law for electric field. Capacitors.	2		
14. Course 14 Electrokinetics. Electric current. Ohm's laws. Kirchhoff's laws.	2		
9.2. Seminars /Laboratory/Project	Number of hours	Teaching methods	Notes
1. Laboratory 1 Labor protection. Elements of error calculation. Graphical representation.	1	Theoretical and experimental demonstration, conversation and analysis	
2. Lab 2 Determining the spring constant of a spring.	1		
3. Lab 3 Study of transverse standing waves in vibrating strings.	1		
4. Lab 4 Determination of the viscosity coefficient of liquids.	1		
5. Laboratory 5 Experimental verification of Stefan-Boltzmann's law	1		
6. Lab 6 Study of the thermoelectric effect.	1		
7. Lab 7 Electrical conductivity of metals.	1		
Seminar 1 Physical quantities. Vectors	1	Discussions and problem solving	
Seminar 2 Cinematics	1		
Seminar 3 Dynamics	1		
Seminar 4 Oscillations	1		
Seminar 5 Waves	1		
Seminar 6 Thermodynamics. Fluid Mechanics	1		
Seminar 7 Electricity	1		

Bibliography

1. L. Pop, Curs de fizică generală, https://biblioteca.utcluj.ro/files/carti-online-cu-coperta/520-6.pdf
2. R. Fechete, D. Moldovan, R. Chelcea, L. Pop, M. Bosca, Fizică. Îndrumător de lucrări virtuale de laborator, https://biblioteca.utcluj.ro/files/carti-online-cu-coperta/519-0.pdf
3. Lidia Pop, Maria Bosca, Notiuni de fizica mecanică. UTPress, 2012
4. Eugen Culea, Fizica – elemente de fizica pentru ingineri, Risoprint, 2010
5. Petru Pascuta, Lidia Pop, Maria Bosca, Fizica: lucrari practice, UTPress, 2013

Ioan Pop, Eugen Culea, Lidia Pop, Fizica aplicată – Indrumator pentru lucrari de laborator, UTPress, 2002

10. Bridging course contents with the expectations of the representatives of the community, professional associations and employers in the field

- The content of the subject and the competences acquired will be necessary for employees working in any engineering field, but with a particular emphasis on mechanical engineering

11. Evaluation

Activity type	11.1 Assessment criteria	11.2 Assessment methods	11.3 Weight in the final grade

11.4 Course	A written paper consisting of solving problems and topics of	Written test	70%
11.5 Seminars /Laboratory/Project	The ability to apply the knowledge gained in practice in different contexts	Check your knowledge as you go	30%
11.6 Minimum standard of performance			
N (final) = 0.3-N(applications)+0.7-N(writing) N(final) ≥ 5			

Date of filling in:	Responsible	Title Surname Name	Signature
11.05.2026	Courses	Prof. dr. Ioan Ardelean	
	Applications	Prof. dr. Ioan Ardelean	

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 Prof.Dr.Abil.Fiz. Petru Păşcuţă

Date of approval in the Department of Mechatronics and Machine Dynamics 28.05.2026	Head of Department Prof.dr.eng. Mircea Bara
Date of approval in the Faculty of Automotive, Mechatronics and Mechanical Engineering 16.09.2026	Dean Prof.dr.eng. Nicolae Filip