

## 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 I                                                                                                                                                                                                 | Course code  | 3.00 |
| 2.2 Course coordinator                                           | Prof. dr. Ioan ARDELEAN; <a href="mailto:ioan.ardelean@phys.utcluj.ro">ioan.ardelean@phys.utcluj.ro</a>                                                                                                   |              |      |
| 2.3 Seminar/ laboratory/ project/ practical activity coordinator | Prof. dr. Ioan ARDELEAN; <a href="mailto:ioan.ardelean@phys.utcluj.ro">ioan.ardelean@phys.utcluj.ro</a><br>Asist dr. Mihai Rusu; <a href="mailto:mihai.rusu@phys.utcluj.ro">mihai.rusu@phys.utcluj.ro</a> |              |      |
| 2.4 Year of study                                                | I                                                                                                                                                                                                         | 2.5 Semester | 1    |
| 2.6 Type of assessment                                           | E                                                                                                                                                                                                         |              |      |
| 2.7 Course status                                                | Formative category                                                                                                                                                                                        |              | DF   |
|                                                                  | Optionality                                                                                                                                                                                               |              | DOB  |

### 3. Estimated total time

|                                                                                                    |    |           |             |    |             |    |                |   |             |   |                        |   |
|----------------------------------------------------------------------------------------------------|----|-----------|-------------|----|-------------|----|----------------|---|-------------|---|------------------------|---|
| 3.1 Hours per week                                                                                 | 4  | of which: | 3.2 Lecture | 2  | 3.3 Seminar | 2  | 3.3 Laboratory | 0 | 3.3 Project | 0 | 3.3 Practical training | 0 |
| 3.4 Hours per semester                                                                             | 56 | of which: | 3.5 Lecture | 28 | 3.6 Seminar | 28 | 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                                                                                     |    |           |             |    |             |    |                |   |             |   | 2                      |   |
| (b) Study using textbook, course materials, bibliography, and notes                                |    |           |             |    |             |    |                |   |             |   | 26                     |   |
| (c) Additional documentation in the library, on specialized electronic platforms, and in the field |    |           |             |    |             |    |                |   |             |   | 5                      |   |
| (d) Preparation for seminars/laboratories, assignments, reports, portfolios and essays             |    |           |             |    |             |    |                |   |             |   | 11                     |   |
| (e) Tutoring                                                                                       |    |           |             |    |             |    |                |   |             |   |                        |   |
| (f) Other activities                                                                               |    |           |             |    |             |    |                |   |             |   |                        |   |
| 3.8 Total hours of individual study and assessment (sum of (3.7(a))...(3.7(f)))                    |    |           |             |    |             |    |                |   | 44          |   |                        |   |
| 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 applicable                                            |
| 4.2 competencies | Knowledge of physics and mathematics at high school level |

#### 5. Requirements (where applicable)

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

#### 6. Specific competencies acquired

|                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Professional competencies | <p>C1. Use of fundamental elements related to electronic devices, circuits, systems, instrumentation and technology</p> <p>C1.1 Description of the operation of electronic devices and circuits and of the fundamental methods for measuring electrical quantities.</p> <p>C1.2 Analysis of low-/medium-complexity electronic circuits and systems for their design and measurement.</p> <p>C2. Application of basic methods for signal acquisition and processing</p> <p>C2.1 Time-domain, spectral and statistical characterization of signals.</p> <p>C2.4 Use of specific methods and tools for signal analysis.</p> <p>C4. Design and use of low-complexity hardware and software applications specific to applied electronics</p> <p>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.</p> <p>C5. Application of basic knowledge, concepts and methods from: power electronics, automatic systems, electrical energy management and electromagnetic compatibility</p> <p>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.</p> <p>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.</p> <p>C6. Solving technological problems in the fields of applied electronics</p> <p>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.</p> <p>C6.2 Explanation and interpretation of production processes and maintenance activities for electronic equipment, identifying the test points and electrical quantities to be measured.</p> |
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|------------------------|-----------------------------------------------------------------------------------|
| Transversal competence | They can document themselves to tackle a topic using the library and the internet |
|------------------------|-----------------------------------------------------------------------------------|

## 7. Expected learning outcomes

|                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Knowledge                   | <ul style="list-style-type: none"> <li>- The student/graduate identifies and describes basic concepts, principles and methods in mathematics, physics, chemistry, technical drawing, economics and computer science.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Skills                      | <ul style="list-style-type: none"> <li>- The student/graduate solves mathematics, physics and chemistry problems with engineering applicability and validates the solution obtained.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Responsibility and autonomy | <ul style="list-style-type: none"> <li>- The student/graduate applies the values of ethics and professional deontology specific to the engineering profession.</li> <li>- The student/graduate applies logical reasoning, evaluation and self-assessment in decision-making.</li> <li>- The student/graduate communicates effectively about engineering activities with a wide range of audiences.</li> <li>- The student/graduate is engaged in lifelong learning in order to acquire and implement knowledge, as needed, using appropriate learning strategies.</li> <li>- The student/graduate promotes dialogue, cooperation, respect for others and interculturality.</li> <li>- The student/graduate works effectively as a team member or as a team leader.</li> <li>- The student/graduate fluently uses at least one international language in technical communication.</li> </ul> |

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

|                                     |                                                                                                                                                                                                                                                                                                   |  |
|-------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| 8.1 General objective of the course | Acquiring knowledge of higher physics to obtain competence in the field of electronics and telecommunications                                                                                                                                                                                     |  |
| 8.2 Specific objectives             | <ul style="list-style-type: none"> <li>• Knowledge of the main physical phenomena with applications in electronics and their laws.</li> <li>• Developing the ability to apply the knowledge and skills acquired to solve concrete problems.</li> </ul> <p>Forming a rational way of thinking.</p> |  |

## 9. Contents

| 9.1 Lecture                                                | No. of hours | Teaching methods     | Remarks                        |
|------------------------------------------------------------|--------------|----------------------|--------------------------------|
| 1. Introduction. Kinematic and dynamic physical quantities | 2            | Systematic exposure, | On site/will be used for video |

| 9.1 Lecture                                                                                                                                                                   | No.<br>of<br>hours | Teaching<br>methods                                                                                                                                                     | Remarks                      |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| 2. Principles of Newtonian mechanics. Mechanical work. Power. Kinetic and potential energy.                                                                                   | 2                  | conversation<br>theoretical and<br>experimental<br>demonstration,<br>observation.<br><br>Problematization,<br>modeling<br>case study,<br>learning through<br>discoverye | projector<br>exemplification |
| 3. Circular motion. Torque. Angular momentum. Conservation of angular momentum.                                                                                               | 2                  |                                                                                                                                                                         |                              |
| 4. Systems of material points. Elements of the kinematics and dynamics of a rigid solid. Inertia. Equilibrium conditions. Rotational energy of a rigid solid.                 | 2                  |                                                                                                                                                                         |                              |
| 5. Periodic motion. Simple Harmonic Motion. Damped Oscillations                                                                                                               | 2                  |                                                                                                                                                                         |                              |
| 6. Forced Oscillations and Resonance. Applications to electronic circuits                                                                                                     | 2                  |                                                                                                                                                                         |                              |
| 7. Overlaped oscillations. Parrallel oscilations of the same frequency but different amplitude. Parrallel oscilations of the same amplitude but different phase.              | 2                  |                                                                                                                                                                         |                              |
| 8. Elastic waves. Equation of an harmonic plane wave. The energy of a harmonic plane wave. Wave intensity. Velocities of waves propagating through gases, liquids and solids. | 2                  |                                                                                                                                                                         |                              |
| 9. Wave interference. Doppler effect. Standing waves. Phase and group velocity. Diffraction of waves.                                                                         | 2                  |                                                                                                                                                                         |                              |
| 10. The principle of Fermat. Reflexion and refraction of waves. Optical fiber.                                                                                                | 2                  |                                                                                                                                                                         |                              |
| 11. Sound waves. Sound pressuse. Sound intensity. Sound intensity level. The energy flux.                                                                                     | 2                  |                                                                                                                                                                         |                              |
| 12. Sound attenuation. Absorbtion of sound. Geometrical attenuation of sound. Reverberation of sound.                                                                         | 2                  |                                                                                                                                                                         |                              |
| 13. Elements of ultra-acoustics. Ultrasound generation. Applications of ultrasounds.                                                                                          | 2                  |                                                                                                                                                                         |                              |
| 14. Heat transport phenomena. Thermal conduction. Thermal convection. Thermal radiation.                                                                                      | 2                  |                                                                                                                                                                         |                              |
| Bibliography                                                                                                                                                                  |                    |                                                                                                                                                                         |                              |
| 1. I. Ardelean, M.M. Rusu, Essential Physics for Engineers, Ed. U.T. PRES, Cluj-Napoca, 2026.                                                                                 |                    |                                                                                                                                                                         |                              |
| 2. I. Ardelean, Physics-lecture notes (PDF file in english, available to students) (2025)                                                                                     |                    |                                                                                                                                                                         |                              |
| 3. I. Ardelean, Fizica pentru ingineri, Ed. U.T. PRES, Cluj-Napoca, 2005.                                                                                                     |                    |                                                                                                                                                                         |                              |
| 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                  |
|------------------------------------------------------------------------------------------------------|--------------|-----------------------------------------------------------------------|--------------------------|
| 1. Scalar and Vector Physical Quantities and Units of Measurement                                    | 2            | Problematizarea, modelarea, studiul de caz, învățare prin descoperire | Se vor implica studentii |
| 2. Laws of One-Dimensional Motion                                                                    | 2            |                                                                       |                          |
| 3. Laws of Three-Dimensional Motion                                                                  | 2            |                                                                       |                          |
| 4. Force, Work, and Energy                                                                           | 2            |                                                                       |                          |
| 5. Conservation of Energy                                                                            | 2            |                                                                       |                          |
| 6. Circular Motion and Rotation of a Rigid Body                                                      | 2            |                                                                       |                          |
| 7. Harmonic Oscillations. Damped Oscillations                                                        | 2            |                                                                       |                          |
| 8. Forced Oscillations. Resonance                                                                    | 2            |                                                                       |                          |
| 9. Superposition of Oscillations                                                                     | 2            |                                                                       |                          |
| 10. Plane Transverse and Longitudinal Waves                                                          | 2            |                                                                       |                          |
| 11. Wave Energy and Pressure                                                                         | 2            |                                                                       |                          |
| 12. Standing Waves                                                                                   | 2            |                                                                       |                          |
| 13. Sound. Sound Level. Attenuation                                                                  | 2            |                                                                       |                          |
| 14. Heat Conduction, Convection, and Thermal Radiation                                               | 2            |                                                                       |                          |
| Bibliografie                                                                                         |              |                                                                       |                          |
| 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 in english, available 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<br>(and type of assessment:<br>continuous/ summative) | 11.3 Weight<br>in final grade |
|-------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|-------------------------------|
| 11.4 Lecture                                                | The completeness and correctness of the accumulated knowledge, the logical coherence and the ability to operate with the assimilated knowledge in complex intellectual activities. | Summative evaluation written exam (theory and problems)                       | 80%                           |
| 11.5 Seminar/<br>Laboratory/ Project<br>/Practical activity | The ability to apply in practice, in different contexts, the accumulated knowledge;                                                                                                | - Continuous formative evaluation<br>- Sets of problems to solve              | 20%                           |

#### 11.6 Minimum performance standard

##### **Quality level:**

##### *Minimal knowledge:*

- Knowledge of the main dynamic and kinematic physical quantities and the principles of dynamics;
- Knowledge of the principles of conservation of energy and momentum;
- Basics of periodic phenomena (harmonic oscillations, elastic waves)
- Basic notions regarding thermal transport phenomena

##### *Minimal competences:*

- Application of the principles of dynamics in various situations;
- Application in various situations of the principles of conservation of energy and momentum;
- Graphical and analytical determination of physical quantities describing harmonic oscillations, harmonic waves;

##### **Quantitative level:**

Complete and correct answers to at least 3 questions in the test and obtaining 2 points for the seminar activity (Grade 5)

The final grade of the subject is calculated with the ratio  $0.8 * \text{Exam grade} + 0.2 * \text{Seminar grade}$

| Completion date: | Course coordinators | teaching rank, title First name<br>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

Head of the Bases of Electronics Department  
Prof. Sorin HINTEA, Ph.D.

26.06.2026

Date of approval by the Council of the Faculty of Electronics, Telecommunications and Information Technology

Dean,  
Prof. Ovidiu-Aurel POP, Ph.D.

30.06.2026