UCLouvain

lphys1112

2021

Mechanics 2 and thermodynamics

10.00 credits	52.5 h + 45.0 h	Q2

Teacher(s)	Fichefet Thierry ;Lemaitre Vincent ;
Language :	French
Place of the course	Louvain-la-Neuve
Main themes	In continuation of the topics addressed in the LPHYS1111 Mechanics 1 teaching unit, wave phenomena such as mechanical waves (coupled springs and pendulums, vibrating string), sound waves and waves on water are studied. The concepts of normal modes of vibration, dispersion, reflection and transmission relationships, wave packets, phase velocity and group velocity, and two- and three-dimensional waves are discussed. Then we talk about the statics and the dynamics of the fluids by insisting on the concepts of pressure and waves on the water. The concept of viscosity and some simple flow examples are presented for incompressible viscous fluids. The basic notions of thermodynamics are then introduced. The concepts of thermodynamic state, pressure and temperature are defined. Internal energy and the first principle of thermodynamics as well as entropy and the second principle of thermodynamics are then presented. Equilibrium conditions and applications (including cycles and thermal machines) are studied. Finally, we describe the kinetic theory of gases, the macroscopic properties of perfect gases and the phase changes of pure bodies. In addition, during the semester and opening up to modern physics, two conferences
Learning outcomes	**At the end of this learning unit, the student is able to :** **a. Contribution of the teaching unit to the learning outcomes of the programme** **AA1 :** 1.1, 1.3, 1.4, 1.5 **AA2 :** 2.1, 2.2, 2.4 **AA3 :** 3.1, 3.2, 3.3, 3.4, 3.5, 3.6 **AA4 :** 4.3 **AA6 :** 6.3, 6.4 **b. Specific learning outcomes of the teaching unit** At the end of this teaching unit, the student will be able to: 1. mathematically describe the mechanical systems with several degrees of freedom and associated wave phenomena; 2. recognize the essential concepts associated with mechanical waves and the relationships they maintain; 3. recognize the power of some mathematical tools to describe physical phenomena; 4. describe and interpret basic notions of incompressible fluids; 5. describe and interpret the basic concepts of thermodynamics, in particular the first and second principles of thermodynamics; 6. apply the basic principles of thermodynamics to simple cases, standard thermodynamic machines and examples of everyday life; 7. interpret transformations involving exchanges of mass and energy through the principles of thermodynamics; 8. link the concepts developed in the field of thermodynamics with those discussed in other teaching units, especially mechanics and chemistry. 9. discuss the main processes associated with phase changes of pure bodies; 10. describe and apply the kinetic theory of gases; 11. manipulate experimental devices, perform measurements and interpret them physically.

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Evaluation methods	The exam is written. It includes various problems similar to those solved in the guided exercise sessions and some questions which aim to check that the concepts and developments presented during the theoretical course have well been mastered (comprehension questions, demonstrations, ...). All the subjects addressed during the theoretical lessons and the guided exercise sessions must be known for the exam. However, for part A, the students have access to a form with the main formulas, which is posted on the LPHYS1112 MoodleUCL site. It is essential to bring a simple scientific calculator to the exam. For students enrolled in the whole teaching unit, the exam takes place for the entire final mark (part A: 11/20; part B: 9/20). However, if the average mark out of 20 obtained in the four tests relating to practical laboratory work is between 10 and 14 (greater than 14), then an average mark of 9/20 (8.5 / 20) obtained in the exam on both parts will be transformed into 10/20. In addition, for part A of the course, a question related to the subjects seen in laboratory sessions will be asked during the exam. For students enrolled only in Part A, the exam takes place for the entire final mark. However, if the average mark out of 20 obtained in the three tests relating to the practical work in the laboratory of partim A is between 10 and 14 (greater than 14), then an average mark of 9/20 (8.5 / 20) obtained in the Partim A exam will be transformed into 10/20. In addition, a question related to the subjects seen in laboratory sessions will be asked during the exam. For students enrolled only in Part B, the exam takes place for the entire final mark. However, if the average mark out of 20 obtained in the test relating to the practical work in the laboratory of partim B is between 10 and 14 (greater than 14), then an average mark of 9/20 (8.5 / 20) obtained in the Partim B exam will be transformed into 10/20. An unjustified absence at conferences will result in a loss of 1 point in the final mark. The modalities mentioned above are valid whatever the exam session.
Teaching methods	The teaching activities include (1) the theoretical course, (2) guided exercise sessions, (3) a practical laboratory work, (4) two conferences on themes related to the teaching unit and (5) the tutorial. It is essential to have a simple scientific calculator for the guided exercise sessions and the practical laboratory work. The different subjects are presented in the theoretical course via slides and blackboard notes. The fundamental concepts are illustrated using applications from modern life, short films or animations, and experiments. The guided exercise sessions play an essential role in the comprehension of the theoretical course and allow the application of the studied theoretical concepts to real problems. Participation in practical laboratory work sessions is not compulsory but is strongly recommended. A test will also be proposed before each laboratory session and this test may have an impact on the success of the course (see the section on the method of evaluation). A laboratory report can be drawn up and submitted at the end of the session. This will be corrected by the assistant for pedagogical purposes but the mark obtained will not have any influence on the final mark of the exam. Participation in conferecnes is compulsory. Tutorials, during which students can ask questions to the teaching team, is organized every week. The golden rule is of course continuous work. In particular, it is essential that the student regularly solves exercises on his own, without just reading their solutions.
Content	Part A 1. Free oscillations of simple systems 2. Free oscillations of systems with a large number of degrees of freedom 3. Forced oscillations 4. Progressive waves 5. Reflection, transmission and interference 6. Modulation, pulse and wave packets 7. Two- and three-dimensional waves, polarization 8. Introduction to statics and dynamics of fluids Part B 1. Fundamental notions 2. Work and heat 3. Internal energy and the first law 4. Perfect and real gases: microscopic approach 5. Entropy and the second law 6. Thermodynamic potentials and functions 7. Phase changes of a pure body 8. Thermal machines
Inline resources	The slides and the short films or animations projected during the theoretical course and conferences, the list of exercises to be solved, the supports for practical laboratory work and other useful documents are made available to students on the MoodleUCLouvain website of LPHYS1112.
Other infos	Following the sanitary conditions, the modalities of the teaching AND the examination could be reassessed according to the situation and the rules in force.

Faculty or entity in charge	PHYS

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Bachelor in Physics	PHYS1BA	10		🔍
Minor in Physics	MINPHYS	10		🔍