UCLouvain

lphys1111

2022

Mechanics 1

9.00 credits	45.0 h + 45.0 h	Q1

Teacher(s)	Bruno Giacomo ;Govaerts Jan ;
Language :	French
Place of the course	Louvain-la-Neuve
Main themes	This teaching unit aims to introduce to the fundamental concepts of physics. In particular the following topics are addressed : The mathematics of classical mechanics, vector calculus, kinematics ; the laws of static equilibrium, forces and torques ; the Principles of Newton's mechanics : dynamics and applications ; conservation laws and applications ; the two body problem, Kepler's laws, universal gravity, Gauss' theorem ; elements of the dynamics of solids, moment of inertia ; elements of Special Relativity, Lorentz transformations and spacetime, relativistic energy and momentum. Furthermore as an opening towards modern physics, two conferences discussing recent developments in physics are organized during the semester, for which the students' participation is compulsory.
Learning outcomes	**At the end of this learning unit, the student is able to :** **a. Contribution of this teaching unit to the learning outcomes of the programme** **AA1 :** 1.1, 1.3, 1.4 **AA2 :** 2.1, 2.2, 2.4 **AA3 :** 3.1, 3.2, 3.3, 3.6 **b. Specific learning outcomes of the teaching unit** At the end of this teaching unit, the student will be able to : 1. apply in a relevant manner the choice of a reference frame for the expression of the laws of motion ; 2. formulate the kinematics of mechanical systems with the use of vector calculus ; 3. establish and solve the conditions for static equilibrium, inclusive of torques, for extended material systems ; 4. properly grasp the primary meaning of Newton's Three Principles, and their formulation relative to a choice of reference frame ; 5. express the laws of motion for the physical observables of total momentum, total angular momentum, and total kinetic energy, as well as the corresponding conservation laws ; 6. apply and develop these laws of motion and conservation laws in the modeling and solution of extended mechanical systems ; 7. describe how the conservation laws allow for the solution of the two body problem, of relevance to the fundamental gravitational interaction ; 8. express the basic principles of Special Relativity ; 9. handle and use experimental equipments, perform measurements, analyze their results, and report on these in a well-structured way.
Evaluation methods	• Compulsory written test during week 7. • Written final exam : resolution of problems, demonstration of theoretical reasoning. • Examples of grading of the laboratory reports. • Participation to the two compulsory conferences organised within this teaching unit. Depending on the evolution of the sanitary situation, tests will possibly be organised during the semester of which the grades will contribute for part to the final grade of the final evaluation of this teaching unit.

Teaching methods	Blackboard teaching and slide projections, experimental demonstrations during lectures, tutored laboratory and exercise practicals. It is deemed crucial to emphasize the importance of the concepts of physics, of their primary meaning, of their rigorous and precise mathematical formulation based on simple experimental facts as well as ordinary everyday observations of point mechanics. The relevance of concepts of invariance and of the conservation of physical observables is emphasized throughout, which by themselves allow already for the partial integration of the equations of motion. The compulsory conferences organised with this teaching unit share in the aims of this very same learning outcome. Presentation during lectures, and tutored practicals of the solutions to « pedagogical » exercises and exercises typical of final examination questions. The necessary methodological tools are developed during lectures and practicals alike. A list of exercises with their solutions is provided.
Content	This teaching unit aims to introduce to the fundamental concepts of physics. In particular the following topics are addressed : The mathematics of classical mechanics, vector calculus, kinematics ; the laws of static equilibrium, forces and torques ; the Principles of Newton's mechanics : dynamics and applications ; conservation laws and applications ; the two body problem, Kepler's laws, universal gravity, Gauss' theorem ; elements of the dynamics of solids, moment of inertia ; elements of Special Relativity, Lorentz transformations and spacetime, relativistic energy and momentum. Furthermore as an opening towards modern physics, two conferences discussing recent developments in physics are organised during the semester, for which the students' participation is compulsory.
Inline resources	Possibly documents of relevance may be made available via the Moodle-UCLouvain web site for the lecture course.
Bibliography	Un syllabus et un recueil de travaux pratiques (exercices et laboratoires) sont mis à disposition des étudiants inscrits à cet enseignement. Bien d'autres documents en soutien à l'étude de cette matière sont encore proposés via une plateforme Moodle en ligne dédicacée à cet enseignement.
Faculty or entity in charge	PHYS

Programmes containing this learning unit (UE)

Program title	Acronym	Credits	Prerequisite	Learning outcomes
Bachelor in Mathematics	MATH1BA	8		🔍
Bachelor in Physics	PHYS1BA	9		🔍