lphys1111
2018

Mechanics 1

9 credits	45.0 h + 45.0 h	Q1

Teacher(s)	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.
Aims	**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. - - - - *The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled "Programmes/courses offering this Teaching Unit".*
Evaluation methods	• Compulsory written test at the end of week 5. • Written final exam : resolution of problems, demonstration of theoretical reasoning. • Grading of the laboratory reports. • Oral presentation of the optional research project based on a written report, all realized by groups of students. • Participation to the two compulsory conferences organized within this teaching unit.

Teaching methods	Blackboard teaching and slide projections, experimental demonstrations during lectures, tutored laboratory and exercise practicals.
	Optional research project, with written report and a final oral group presentation. When feasible this project is coordinated with one of the two compulsory conferences discussing recent developments in physics which are organized within this teaching unit.
	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 organized with this teaching unit share in the aims of this very same learning outcome.
	Presentation during lectures, tutored practicals and tutored sessions 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	The teaching unit is structured in sections organized along the different general themes being addressed :
	1. The mathematics of classical mechanics, vector calculus, kinematics ;
	2. The laws of static equilibrium, forces and torques ;
	3. Newton's Principles : dynamics and applications ;
	4. Conservation laws and applications ;
	5. The two body problem, Kepler's laws, universal gravity, Gauss' theorem ;
	6. Elements of the dynamics of solids, moment of inertia ;
	7. Elements of Special Relativity, Lorentz transformations and space-time, relativistic energy and momentum.
Bibliography	Un syllabus et un recueil de travaux pratiques (exercices et laboratoires) sont mis à disposition des étudiants inscrits à cet enseignement. D'autres documents en soutien à l'étude de cette matière sont proposés via une plateforme en ligne dédicacée à cet enseignement.
Faculty or entity in charge	PHYS

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Aims
Bachelor in Physics	PHYS1BA	9		🔍
Bachelor in Mathematics	MATH1BA	9		🔍