UCLouvain

lphy1223

2017

Special Relativity

4 credits	22.5 h + 15.0 h	Q1

Teacher(s)	Gérard Jean-Marc ;
Language :	French
Place of the course	Louvain-la-Neuve
Prerequisites	LPHY1111 and LPHY1112 *The prerequisite(s) for this Teaching Unit (Unité d'enseignement – UE) for the programmes/courses that offer this Teaching Unit are specified at the end of this sheet.*
Main themes	This course is a basic introduction to Einstein's **special relativity**. The main themes tackled are geometry in space-time, kinematics and relativistic dynamics.
Aims	1 **a. Course contribution to the LO reference framework (programme LO)** **LO1:** 1.1, 1.3, 1.4 **LO2:** 2.1, 2.4 **LO3:** 3.2, 3.5 **b. Specific formulation of programme LOs for this course** At the end of this course, the student will be able: 1. to handle the concepts of metrics and invariants (from Euclid to Minkowski); 2. to go beyond classical prejudices as simultaneity is currently entirely relative and the addition of non-linear velocities (from Galileo to Einstein); 3. to move from an algebraic approach (Lorentz transformation as applied to a four-vector) to a geometric interpretation (in Minkowski's space-time) to describe phenomena such as time dilation and length contraction; 4. to apply relativistic formalism to particle disintegrations (at rest or in motion) and to elastic collision processes (Compton scattering, etc.) and inelastic collision processes (Mossbauer effect, etc.); 5. to apply relativistic formalism to gravitation (starting from a uniform acceleration motion) and to electromagnetism (starting from the Lorentz force); 6. to fully appreciate the impact (in the very long term) of fundamental research that feeds today's applied research. - - - - *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	· Written exam (WE) comprising questions on the development of concepts in physics since Galileo and their experimental confirmation. · Written exam (WE) comprising a kinematics question and (or) a dynamics question referring to tensors. Written exam (WE) comprising questions on the development of concepts in physics (from Euclid to Mikowski, from Galileo to Einstein, from Newton to Einstein) and their coherent mathematical formulation.
Teaching methods	1.4 Apply physics and mathematics theories to resolving a problem. Start from the principle that physics is a coherent representation of reality whose truth value rests upon FACTS to illustrate systematically, through phenomena observed in nature, all concepts inherent to the theory of special relativity. Consequently, we choose: - lecture presentations of theory with, in parallel, many applications in physics; - exercise sessions covering other physics applications. 2.1 Justify the choice of methods and analysis tools used to solve known problems in physics. Incoherence between Newton's mechanics and Maxwell's theory will lead to the development of a covariant theory with respect to the Lorentz transformations. Various exercises on the new mathematical objects that are the tensors will be proposed and solved. 3.2 Construct a physics argument and formalise it. Development of concepts in physics and an introduction to new formalisms: - from space-time geometry to Lorentz transformations; - from relativistic kinematics to tensors; - from relativistic dynamics to interaction fields.

Content	The main themes tackled will be: 1. Geometry in space-time: from rotation in a homogenous space to pseudo-rotation in causal space-time; 2. Relativistic kinematics: from Newton's first law (inertia) to conservation of the four-vector energy-momentum; 3. Relativistic dynamics: from Newton's second law (force) to the existence of electromagnetic (four-vector) and gravitational (tensor) fields.
Faculty or entity in charge	PHYS

Programmes containing this learning unit (UE)

Program title	Acronym	Credits	Prerequisite	Aims
Bachelor in Physics	PHYS1BA	4	LPHYS1111	
Master [120] in Physical Engineering	FYAP2M	4		
Minor in Physics	LPHYS100I	4		
Additionnal module in Mathematics	LMATH100P	4		
Additionnal module in Mathematics	TMATH100P	4		