UCLouvain

lphy1323

2017

General Relativity

5 credits	30.0 h + 22.5 h	Q2

Teacher(s)	Gérard Jean-Marc ;
Language :	French
Place of the course	Louvain-la-Neuve
Prerequisites	LPHY1223 *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 **general relativity**.
Aims	**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** 1 At the end of this course, the student will be able: 1. to think critically about Newton's universal gravitation; 2. to look at familiar phenomena (inertia, free fall, tides, etc.) from a different angle; 3. to understand gravitation as an apparent force that manifests itself through a space-time curvature; 4. to visualise the expansion of the universe on the basis of a Copernican principle; 5. 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 Newton and the observational confirmations collected for more than a century. Written exam (WE) comprising a problem to solve in the context of a metric theory of gravitation. Written exam (WE) comprising questions on the development of concepts in physics in connection to universal gravity (from Newton to Einstein) and their coherent mathematical formulation.
Teaching methods	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 general relativity. Consequently, we choose: - lectures on the theory with, in parallel, many applications in physics; - exercise sessions covering other physics applications. The incoherence between Newton's theory of instantaneous gravity and Einstein's special relativity leads to general relativity. Many exercises will be posed and solved with the Riemannian geometry as a background that underlies this theory. Inductive approach, essentially based upon physical observation, and an introduction to new mathematical formalisms: - from the displacement of Mercury's perihelion to a relativistic theory of gravitation; - free fall of bodies in Riemann's geometry; - recession of galaxies in the Friedmann-Lemaître dynamical models.
Content	1. Difficulties in Newton's theory 2. From Newton's to Einstein's mechanics 3. Einstein's equivalence principle 4. Some features of Riemannian geometry 5. Einstein's equations in the vacuum 6. Classic tests of general relativity 7. Black holes 8. Einstein's equations in the presence of matter

	9. The cosmological principle 10. The Friedmann-Lemaître equations
Faculty or entity in charge	PHYS

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Aims
Bachelor in Physics	PHYS1BA	5	LPHYS1231	🔍