


**PHYS1140** **Eléments de physique théorique et mathématique**

[45h+30h exercices] 8 credits

This course is taught in the 2nd semester

**Teacher(s):** Jean-Pierre Antoine, Philippe Ruelle, Jacques Weyers  
**Language:** french  
**Level:** 1st cycle course

**Aims**

The aim of this course is to outline, through a number of concrete examples, certain mathematical structures which are essential in physics, and to exploit them systematically in these examples. The topics covered are restricted to linear theories and to classical physics.

**Main themes**

- . Mathematical tools : vectorial and differential geometry, Fourier series, Fourier integrals, Lie groups and Lie algebras (basic notions), tensor calculus
- . Special Relativity
- . Classical field theory and conservation laws
- . Theory of the electromagnetic field, including the covariant formalism
- . Linear partial differential equations of classical physics: derivation, classification, solution
- . Rotation group  $SO(3)$ , Lie algebra, representations

**Content and teaching methods**

Part I : Symmetries and Invariance in Relativistic Mechanics

1. Classical mechanics, a reminder

2. Theory of Special Relativity

Part II : Field Theory and Partial Differential Equations

3. Notions of vectorial and differential geometry

4. Field theory and conservation laws

5. Theory of the electromagnetic field

6. Linear partial differential equations of classical physics

Part III: Solution of Linear Partial Differential Equations

7. Fourier series and Fourier integrals

8. Classification of the equations. Uniqueness of solutions

9. Solution of the equations

Part IV: Group Theory and Applications

10. Lie groups and Lie algebras. Representations. Tensors

11. Representations of the groups  $SO(3)$  and  $SU(2)$ 
**Other credits in programs**

<b>PHYS12</b>	Deuxième candidature en sciences physiques	(8 credits)	Mandatory
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