

PHYS-427

**Relativity and cosmology I**

Penedones João Miguel

| Cursus    | Sem.     | Type |
|-----------|----------|------|
| Ing.-phys | MA1, MA3 | Opt. |
| Physicien | MA1, MA3 | Opt. |

|                            |                 |
|----------------------------|-----------------|
| Language of teaching       | English         |
| Credits                    | 6               |
| Session                    | Winter          |
| Semester                   | Fall            |
| Exam                       | Written         |
| Workload                   | 180h            |
| Weeks                      | 14              |
| <b>Hours</b>               | <b>4 weekly</b> |
| Lecture                    | 2 weekly        |
| Exercises                  | 2 weekly        |
| <b>Number of positions</b> |                 |

**Summary**

Introduce the students to general relativity and its classical tests.

**Content****Special Relativity (Review):**

- Lorentz transformations
- Energy-momentum tensor

**General relativity:**

- Equivalence principle
- Tensor analysis and physics in curved space-time
- Einstein's equations
- Schwarzschild solution
- Classical tests of Einstein's theory
- Gravitational waves

**Learning Prerequisites****Required courses**

Analytical mechanics  
Classical Electrodynamics

**Important concepts to start the course**

Special Relativity

**Learning Outcomes**

By the end of the course, the student must be able to:

- Explain the basic concepts of special and general relativity
- Describe physical phenomena in different coordinate systems
- Compute Christoffel symbols and curvatures from a given line element
- Solve Einstein's field equations for static spherically symmetric problems
- Explain the observational effects at the scale of the Solar System that cannot be described by Newtonian gravity

**Teaching methods**

Ex cathedra and exercices in classroom

**Assessment methods**

final written exam

**Supervision**

|              |     |
|--------------|-----|
| Office hours | Yes |
| Assistants   | Yes |
| Forum        | Yes |

**Resources****Bibliography**

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**Ressources en bibliothèque**

- [Gravitation and Cosmology / Weinberg](#)
- [Gravitation / Mizner](#)
- [The classical theory of fields / Landau](#)
- [Spacetime and Geometry: an Introduction to General Relativity / Carroll](#)
- [A First Course in General Relativity / Schutz](#)
- [General relativity / Wald](#)

**Moodle Link**

- <https://go.epfl.ch/PHYS-427>