

COURSE GUIDE

General Relativity

Last updated date: 21/06/2021
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Grado (Bachelor's Degree)	Bachelor's Degree in Physics	Branch	Sciences
Module	Relatividad y Teoría de Campos y Partículas	Subject	Relatividad General
Year of study	4 ^o	Semester	1 ^o
ECTS Credits	6	Course type	Elective course

PREREQUISITES AND RECOMMENDATIONS

- Métodos Matemáticos I, II, III
- Análisis matemático I, II
- Álgebra lineal y Geometría
- Mecánica y Ondas
- Electromagnetismo

BRIEF DESCRIPTION OF COURSE CONTENT (According to the programme's verification report)

- Bases of Differential Geometry
- Einstein equations
- Classical Tests of General Relativity
- Exact solutions: black holes, gravitational waves and cosmological models

SKILLS

GENERAL SKILLS

- CG01 - Capacidad de análisis y síntesis
- CG02 - Capacidad de organización y planificación
- CG05 - Capacidad de gestión de la información
- CG06 - Resolución de problemas
- CG08 - Razonamiento crítico
- CG09 - Aprendizaje autónomo

SUBJECT-SPECIFIC SKILLS

- CE01 - Conocer y comprender los fenómenos y las teorías físicas más importantes.
- CE02 - Estimar órdenes de magnitud para interpretar fenómenos diversos.



- CE03 - Comprender y conocer los métodos matemáticos para describir los fenómenos físicos.
- CE05 - Modelar fenómenos complejos, trasladando un problema físico al lenguaje matemático.
- CE09 - Aplicar los conocimientos matemáticos en el contexto general de la física.

LEARNING OUTCOMES

- Knowledge of General Relativity as the modern theory of gravity
- Comprehend the importance of symmetries in Physics and being able to apply them
- Notions of geometry in curved space
- Knowledge of the Einstein equations and its implications
- Knowledge of black holes, gravitational waves and cosmological models

PLANNED LEARNING ACTIVITIES

THEORY SYLLABUS

1. Special Relativity - Lorentz transformations
2. Minkowski space; four-vectors; Lorentz group
3. Relativistic mechanics and electromagnetism in covariant formulation
4. Manifolds and general coordinate transformations
5. Tensor calculus; affine connections; covariant derivative
6. Curvature tensors; geodesics
7. The Equivalence Principle
8. The energy-momentum tensor
9. The Einstein Equations
10. Physics in curved space
11. Classical tests of General Relativity
12. Schwarzschild black hole: causal structure and interpretation
13. Gravitational waves: linearised theory; gravitational waves as perturbations; detection
14. Cosmological models: FWR metrics; cosmological solutions

PRACTICAL SYLLABUS

1. Problems and exercises of the theory
2. Asistence in specialised seminars

RECOMMENDED READING

ESSENTIAL READING

- Bert Janssen, Teoría de la Relatividad General, Universidad de Granada, 2020
- R. D'Inverno, Introducing Einstein's Relativity, Oxford University Press, 1992.
- S. Carroll, Spacetime and Geometry, Addison-Wesley, 2004.
- S. Weinberg, Gravitation and cosmology, Wiley, 1972.



COMPLEMENTARY READING

- C. Misner, K. Thorn, A. Wheeler, Gravitation, Freeman, 1973
- R. Wald, General Relativity, Chicago University Press, 1984.
- H. Stefani, General Relativity, Cambridge University Press, 1982.
- B.F. Schutz, A first course in General Relativity, Cambridge University Press, 1985.
- J. Hartle, Gravity, Addison-Wesley, 2003.
- E. Poisson, A relativist's Toolkit, Cambridge University Press, 2004.
- T.P. Cheng, Relativity, Gravitation and Cosmology, Oxford University Press, 200

TEACHING METHODS

- MD01 Lección magistral/expositiva
- MD03 Resolución de problemas
- MD07 Seminarios y/o exposición de trabajos
- MD09 Análisis de fuentes y documentos

ASSESSMENT METHODS (Instruments, criteria and percentages)

ORDINARY EXAMINATION DIET

Continuous evaluation:

- Exercises to be handed in & tests (30%)
- Final exam (70%).

In order to succeed for this course, the student must obtain at least 50% of the score of the final exam.

EXTRAORDINARY EXAMINATION DIET

The extraordinary assessment session will consist of the same tests as the Unique Final Evaluation. The student will have the opportunity to obtain 100% of the score.

SINGLE FINAL ASSESSMENT (evaluación única final)

Final exam (100%)

