Bachelor in Physics
(Academic Year 2024-25)

Classical Electrodynamics		Code	800525	Year	4º	Sem.	1º
Module	Fundamental Physics	**Topic**	Compulsory in Fundamental Physics	**Character**	Obligatory		

	Total	Theory	Exercises
ECTS Credits	6	4	2
Semester hours	45	30	15

Learning Objectives (according to the Degree's Verification Document)

- To master concepts as gauge invariance and Lorentz transformation of electromagnetic fields
- To understand the Lagrangian and covariant formulation of electromagnetism
- To understand the movement of relativistic electric charges under Lorentz force and the resultant emission of radiation
- To solve problems of wave propagation and electromagnetic radiation emission

Brief description of contents

Special relativity and Maxwell equations; Lorentz force; potentials and gauge invariance; covariant and Lagrangian formulation of electromagnetism; conservation theorems; radiation of moving charges; multipolar expansion of the electromagnetic field.

Prerequisites

Maxwell equations; Lorentz force; basics of special relativity (space time structure, light cone, invariants, four vectors, Lorentz trasformations); Lagrange and Hamilton mechanics; basic notion of tensors.

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Theory/Exercises – Schedule and Teaching Staff

Group	Lecture Room	Day	Time	Professor	Period/ Dates	Hours	T/E	Dept.
B	1	Tu, Th	14:00-15:30	Ignazio Scimemi Alexey Vladimirov	Whole semester	27 18	T/E	FT

Office hours				
Group	**Professor**	**Schedule**	**E-mail**	**Location**
B	Ignazio Scimemi	Tu, Th: 10:00 -12:00 +3 hours online	ignazios@ucm.es	02.310.0
	Alexey Vladimirov	We, Fr: 10:00-12:00 Th: 10:00-12:00	alexeyvl@ucm.es	03.306.A

yllabus

1. Maxwell equations: definitions, conservation laws, plane waves, electromagnetic pontentials

2. Special relativity and Lorentz transformations: Minkowski space time, Poincaré group and its transformations. Relativistic Dynamics.

3. Classic Field Theory: Transformation laws, variational principle, Noether Theorem, fields and particles, Hamiltonian formalism.

4. Charged particles in electromagnetic fields: particles in electromagnetic fields, point charges in constant electromagnetic fields, dynamics of electromagnetic fields

5. Electromagnetic radiation: radiation of a moving charge, examples of radiation calculations, radiation reaction.

The various topics may be covered in an order different than indicated in this Programme.

Bibliography

Basic:

- J.D. Jackson, “Classical Electrodynamics”, 3rd. ed. Wiley and Sons (1999).
- Landau y E.M. Lifshitz, “Teoría clásica de campos”, Reverté (1986) (“Théorie des Champs”, 4ème éd., Mir, Moscú; “The Classical Theory of Fields”, 4th. ed., Butterworth-Heinemann).
- Lecture notes of prof. I. Scimemi on Classical Field Theory (available on Virtual Campus)

Complementary:

- S. Kruchinin, Problems and Solutions in Special Relativity and electromagnetism, World Scientific (2018)
- F. Scheck Classical Field Theory, Springer (2012)
- Griffiths, D.J.: Introduction to Electrodynamics (3rd. Edition). Prentice Hall International (1999).

Online Resources

Relevant course materials will be made available online through the Virtual Campus

Methodology

Theory and problem classes

Evaluation Criteria		
Exams	**Weight:**	70%
Final Exam		

Other Activities	Weight:	30%
Other activity include: Resolution of problems, participation to classes, seminars, tutorship assistance, oral presentations of homeworks		
Final Mark		
If the mark of the final exam is less or equal to 3.5/10, that will be the final mark. In any case the final mark will not be inferior to the one obtained in the final exam. The final mark is calculated in the same way in all exam sessions.		