



Bachelor in Physics (Academic Year 2022-23)

Classical Electrodynamics			Code	800525	Year	4 ^o	Sem.	1 ^o
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 transformations); 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 14:00-15:30	Ignazio Scimemi	Whole semester	45	T/E	FT

Office hours

Group	Professor	Schedule	E-mail	Location
B	Ignazio Scimemi	Tu, We, Th: 11:00 -12:00	ignazios@ucm.es	02.0310.0

Syllabus
<p>1. Maxwell equations: definitions, conservation laws, plane waves, electromagnetic potentials</p> <p>2. Special relativity and Lorentz transformations: Minkowski space time, Poincaré group and its transformations. Relativistic Dynamics.</p> <p>3. Classic Field Theory: Transformation laws, variational principle, Noether Theorem, fields and particles, Hamiltonian formalism.</p> <p>4. Charged particles in electromagnetic fields: particles in electromagnetic fields, point charges in constant electromagnetic fields, dynamics of electromagnetic fields</p> <p>5. Electromagnetic radiation: radiation of a moving charge, examples of radiation calculations, radiation reaction.</p>

Bibliography
<p>Basic:</p> <ul style="list-style-type: none"> • 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”, 4^{ème} 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) <p>Complementary:</p> <ul style="list-style-type: none"> • 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.		