

SUBJECT TEACHING GUIDE

G2101 - Electromagnetism II

Double Degree in Physics and Mathematics Degree in Physics

Academic year 2025-2026

1. IDENTIFYING DATA					
Degree	Double Degree in Physics and Mathematics Degree in Physics			Type and Year	Compulsory. Year 3 Compulsory. Year 2
Faculty	Faculty of Sciences				
Discipline					
Course unit title and code	G2101 - Electromagnetism II				
Number of ECTS credits allocated	6	Term	Semester based (2)		
Knowledge Field	Physics and astronomy				
Web					
Language of instruction	Spanish	English Friendly	Yes	Mode of delivery	Face-to-face

Department	DPTO. FISICA APLICADA				
Name of lecturer	ERNESTO ANABITARTE CANO				
E-mail	ernesto.anabitarate@unican.es				
Office	Facultad de Ciencias. Planta: + 3. DESPACHO (3031)				
Other lecturers					

4. OBJECTIVES
To know, understand, and be able to apply the fundamentals of electromagnetic theory from a macroscopic point of view in dielectric and magnetic media.
To learn the fundamentals of electromagnetic wave propagation in both infinite and bounded media
To learn the fundamentals of electromagnetic wave generation and the radiation properties of basic sources.

6. SUBJECT PROGRAM	
CONTENTS	
1	ELECTROSTATICS IN THE PRESENCE OF MATTER Dielectrics - The multipole expansion of the scalar potential. -Moments of a charge distribution: monopolar, dipole and quadrupole - The dipole electric field - Linear quadrupole field - Polarization.- Bound charge densities - Electric field inside a dielectric - Displacement vector - Classification of dielectrics - Energy and forces - Electric breakdown field
2	SPECIAL METHODS IN ELECTROSTATICS. - Uniqueness of the solution to Laplace's equation - Method of images - Method of separation of variables: rectangular, cylindrical and spherical coordinates.
3	MAGNETISM IN THE PRESENCE OF MATTER. Multipole expansion of the vector potential.- The dipole magnetic field.- Magnetization.- Magnetization current densities.- Magnetic field H.- Magnetic scalar potential.- Description by means of magnetic poles.- Linear, homogeneous and isotropic magnetic media.- Field equations in material media.- Ferromagnetic materials: Hysteresis cycle.- Energy.- Energy and force on a dipole.- Hysteresis losses
4	PLANE WAVES IN INFINITE MEDIA Plane waves in non-conductive media - Plane waves in conductive media - Density and energy flux - Polarization - Radiation pressure
5	ELECTROMAGNETIC GUIDED WAVES Boundary conditions.-Transmission lines: TEM modes.- Rectangular waveguide: TE and TM modes.- Resonant cavities.
6	RADIATION Retarded potentials - Electric dipole radiation - Magnetic dipole radiation - Half-wave antenna - Characteristic parameters of antennas - Radiation of point charges
7	Written test no. 1 Around week 7 a written test will be given on the contents of lessons 1-3.
8	Written test no. 2 Around week 14 a written test will be given on the contents of lessons 4-6.

7. ASSESSMENT METHODS AND CRITERIA

Description	Type	Final Eval.	Reassessn	%
Exam nº 1 Lessons 1-3 50% Exam nº1 exempts material. A grade equal to or higher than 4 is required.	Written exam	No	Yes	50,00
Exam nº 2 Lessons 4-6 50% Exam #2 exempts material. A grade equal to or higher than 4 is required.	Written exam	No	Yes	50,00
TOTAL				100,00

Observations

ORDINARY EXAM SESSION

The subject can be passed before the final exam.

Exam #1 exempts material. A grade equal to or higher than 4 is required.

Exam #2 exempts material. A grade equal to or higher than 4 is required.

Students who meet the above conditions (grades of 4 or higher on partial exams) must achieve a grade equal to or higher than 5 (averaging partials and proposed problems weighted accordingly) to pass the subject.

Students who do not pass through continuous assessment may take the regular session exam established by the school for the final exam of the subject. There is no minimum grade required for any part of this exam separately, although the subject as a whole is passed with a grade equal to or higher than 5.

Students may take the final exam to improve their grade. The final exam grade will be applied if it improves the continuous assessment grade. If it is lower, the average between the final exam grade and the continuous assessment grade will be applied. In any case, the final grade will not be lower than 5.

EXTRAORDINARY SESSION EXAM.

Students who do not pass the subject in the regular session will have an extraordinary exam similar to the June final exam, which will count 100% of the final grade.

Observations for part-time students

Not applicable in this case

8. BIBLIOGRAPHY AND TEACHING MATERIALS

BASIC

R.K. Wangsness. Campos electromagnéticos.Limusa [1996]

J.R. Reitz, F.J. Milford and R. W. Christy Fundamentos de la Teoría Electromagnética.Addison-Wesley Iberoamericana [1996]

David J. Griffiths. Introduction to Electrodynamics Cambridge University Press [2023]