



Bachelor in Physics (Academic Year 2021-22)

Electromagnetism II		Code	800502	Year	2nd	Sem.	2nd
Module	General Core	Topic	Classical Physics		Character	Obligatory	

	Total	Theory	Exercises
ECTS Credits	6	3.6	2.4
Semester hours	54	29.5	24.5

Learning Objectives (according to the Degree's Verification Document)
<ul style="list-style-type: none"> To get basic knowledge of electromagnetism radiation emission mechanisms. To get knowledge of electromagnetic field energy and momentum concepts. To understand the relation between electromagnetism and theory of relativity.
Brief description of contents
Electromagnetic potentials. Electromagnetic waves. Radiant systems. Relativist formulation.
Prerequisites
Electromagnetism I. Mathematics, Calculus, Algebra.

Coordinator	José Miguel Miranda Pantoja			Dept.	EMFTEL
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Theory/Exercises – Schedule and Teaching Staff								
Group	Lecture Room	Day	Time	Professor	Period/Dates	Hours	T/E	Dept.
B	7	Tu,Th	12:00-14:00	Oscar Rodríguez de la Fuente	Whole semester	54	T&E	FM

T: Theory, E: Exercises

Office hours				
Group	Professor	Schedule	E-mail	Location
B	Oscar Rodríguez de la Fuente	Tu. 14.00 - 15.00	oscar.rodriguez@fis.ucm.es	218.0 2 nd floor, FM

Syllabus
<p>1.- Fundamentals</p> <p>Phasor representation. Differential, integral and phasor formulation of Maxwell equations. Constitutive relationships. Boundary conditions. Electromagnetic potentials. Wave equation. Quasi-static approach.</p>

2.- Boundary problems: static fields

The boundary problem in electrostatics and magnetostatics. Uniqueness theorem. Reciprocity theorem. Method of images. Separation of variables.

3.- Monochromatic plane waves

Harmonic fields. Monochromatic plane waves. Propagation in dielectrics and conductors. Reflection by conductive surfaces. Energy and moment of electromagnetic waves. Radiation pressure.

4.- Guided waves

Confinement in propagating electromagnetic waves. Rectangular waveguides. TE and TM Modes. TEM modes. Resonant cavities.

5.- Radiation

Retarded potentials. Liénard-Wiechert potentials. Velocity and acceleration fields. Accelerated charges in free space: equations of movement, fields and frequency analysis. Radiation generated by currents in conductors: characteristic parameters. Dipole radiation. Radiant systems of practical interest.

6.- Electromagnetism and relativity

Lorentz transformations. Space-time structure: interval, light cone, invariant. Four-vectors (position, velocity, moment...). Relativistic electrodynamics. Four-potential. The magnetic field as a relativistic effect. Transformations of the fields. Electromagnetic tensor.

Bibliography

Basic:

- Wangsness. "Electromagnetic Fields". Wiley.
- D.J. Griffiths. "Introduction to Electrodynamics". Prentice Hall.
- Jackson. "Classical Electrodynamics". Wiley
- Reitz, Milford y Christy. "Foundations of Electromagnetic Theory". Pearson.
- Andrew Zangwill. "Modern Electrodynamics". Cambridge University Press.

Complementary:

- F. Sánchez Quesada, L. L. Sánchez Soto, M. Sancho Ruiz y J. Santamaría. "Fundamentos del Electromagnetismo". Editorial Síntesis.
- Feynman, Leighton y Sands. "Lectures on Physics", Vol. 2: Electromagnetism and Matter. Addison Wesley

Online Resources

Course materials will be provided at the Campus Virtual of the UCM.
 "Fundamentals of Applied EM", <https://www.youtube.com/channel/UCn-0FOjOLbuSZq7PkJUmqg>

Methodology

On-campus teaching 100% (Scenario 0)

The following training activities will be developed:

- Theory lessons (lectures) where most of the main concepts will be explained, including examples and applications.
- Problem-solving practical lessons.

In theory lessons both the board and slides will be used. Sometimes these lessons will be complemented with computer simulations and virtual experiments.

The problems of each lesson will be delivered to the students before their solving in the classroom. Also, briefings and documents of some special subjects will be distributed.

Short tests, solved problems and short classroom seminars will be considered as a part of the continuous assessment.

Semi-online teaching (Scenario 1)
<p>Preferably, we will use mode B.</p> <p>The most basic and theoretical parts of the different subjects will be recorded and uploaded to the Campus Virtual (CV) in the form of presentations with voice and pointer. In this way, the students can visualize and study the contents prior to the practical classes. These will be imparted in the classroom, alternating the subgroups of students every week. These practical classes will be devoted to clarify the ideas studied in the CV and to present examples and exercises.</p>
Online teaching (Scenario 2)
<p>In case all the teaching has to be done online, it will be done in the schedule assigned of the group and using the Microsoft Teams tool of Moodle. In this way the students can participate synchronously and ask questions in real time. The presentations will be done with slides and, at times, with an electronic blackboard.</p> <p>Deliverable hands-on exercises will be done through the CV, using the Tarea tool</p> <p>Tutorships will be available online as well, via Microsoft Teams or Meet.</p>

Evaluation Criteria		
Exams	Weight:	80%
<p>The grade N_{final} of this part (Exams) will be obtained using the following scores:</p> <ul style="list-style-type: none"> ○ $N_{partial}$: Grade of a mid-course and voluntary exam of the first four topics. ○ N_{Ex_final}: Grade of the final exam. <p>If the student doesn't make the mid-course exam or its grade is below 5, $N_{Final} = N_{Ex_final}$. If not, $N_{Final} = N_{EX_final} + 2 \cdot N_{partial} / 10$, up to a maximum grade of 10.</p> <p>The final exam will include all the contents of the course, regardless of the grade of the mid-course exam. The exams will include i) a first part containing qualitative and short problems and/or theoretical questions and ii) a second part with problems.</p>		
Other Activities	Weight:	20%
<p>Regarding continuous assessment, up to 2 points (in a 0-10 scale) can be obtained with the following activities:</p> <ul style="list-style-type: none"> • Short exercises and tests in the Campus Virtual (15%) • Preparation of short classroom presentations about specific issues on electromagnetism (5%) 		
Final Mark		
<p>The final course mark (F) will be the highest of the following:</p> $C_{Final} = 0.2N_{Other_activ} + 0.8N_{Final} \quad \text{and} \quad C_{Final} = N_{Final},$ <p>where N_{Other_activ} is the grade from <i>Other Activities</i> and N_{Final} is the grade obtained from the exams (see the notes above).</p> <p>The July exam (extraordinary examination) will consist in a single test of the whole subject. The grade obtained in this exam will be combined with the grades of the rest of the activities, in the same way as in the ordinary examination.</p>		