Bachelor in Physics
(Academic Year 2021-22)

Physics Fundamentals II	Code	800491	Year	1st	Sem.	2nd
Module	Basic Core	Topic	Physics	Character	Basic	

	Total	Theory	Exercises	Seminars
ECTS Credits	9	4	4	1
Semester hours	82.5	33.5	40	9

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

The student :

- will be able to deal with the basic concepts of Physics: particle, wave, field, reference system, energy, momentum, conservation law, macro and microscopic points of view, etc.
- will understand basic phenomena in Physics, including those related to electromagnetism, wave phenomena, optics and the properties of matter.
- will become familiarized with the formulation and resolution of simple problems in Physics, identifying the relevant principles and making use of estimations of orders of magnitude in them.
- will develop a panoramic vision of the range of problems within nowadays Physics.

Brief description of contents

Electromagnetism, wave phenomena, optics, introduction to modern Physics.

Prerequisites

Phisics Fundamentals I and Mathematics

Coordinators	Mª Amparo Izquierdo Gil & Blanca Ayarzagüena Porras		Dept.	EMFTEL / FTA
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Theory/Problems – Schedule and Teaching Staff

Group	Lecture Room	Day	Time	Professor	Period/ Dates	Hours	T/E	Dept.
B	2	Tu Th Fr	12:00-14:00 11:00-13:00 09:00-11:00	Jesús Fidel González Rouco	01-25-22 / 03-11-22	41.25	T/E	FTA
				Marta Ábalos Álvarez	03-17-22 / 05-10-22	41.25	T/E	FTA

T: Theory, E: Exercises

Office hours

Group	Professor	Schedule	E-mail	Location
B	Jesús Fidel González Rouco	L, X, V: 12.00h-14.00h	fidelgr@ucm.es	Office 4, base floor
	Marta Ábalos Álvarez	L, M, X: 12.30h-14.30h	mabalosa@ucm.es	Dpcho. 234, 4ª Pl. Central

Syllabus

1. **Electric field.** Electric charge. Conductors and insulators. Coulomb's law. Concept of electric field. Superposition of electric fields. Electric field lines. Electric dipole moment. Gauss's law and its applications. Electric fields and charges in conductors. Potential energy and electric potential. Equipotential surfaces. Potential gradient. Compute electric potential. Capacitors. Capacitance. Connection of capacitors. Energy in a capacitor. Dielectrics: electric polarization. Molecular models of dielectrics. Electric current: intensity. Electric resistance: Ohm's law. Electromotive force. Energy and power in circuits.
2. **Magnetic field.** Magnetism. Magnetic field: Lorentz force. Magnetic field lines and flux. Motion in a magnetic field. Magnetic force on a conductor. Magnetic field created by a current. Magnetic field created by a current loop: magnetic dipole and torque. Ampère's law: applications. Hall's effect. Magnetic materials.
3. **Electromagnetic field.** Electromagnetic induction: Faraday's law. Induced motional electromotive force. Induced electric field. Self-inductance. Mutual inductance. Magnetic field energy. Transformers. LRC circuits. Displacement current. Maxwell's equations.
4. **Waves: a general description.** Types of waves. Mechanical waves. Periodic waves and pulses. Speed of propagation. Energy and intensity of a wave. Boundary conditions for waves in a rope: reflection and transmission. Plane and spherical waves. Harmonic waves. Wave interference. Standing waves. Normal modes. Pulses. Dispersion. Waves of particular interest: sound waves, beats, Doppler effect.
5. **Electromagnetic waves and light.** Maxwell equations and electromagnetic waves. Electromagnetic spectrum. Energy and momentum of an electromagnetic wave. Electromagnetic waves in materials and interfaces. Dispersion, reflection and refraction. Geometric optics on the boundaries: rays and wave fronts. Fermat's principle. Polarization. Wave interference: concept of wave coherence. Diffraction. Fraunhofer diffraction by a slit. Diffraction grating. Resolving power.
6. **Quantum Physics.** Planck's quantum hypothesis for emission and absorption of light. Photoelectric effect. Photons. Compton's effect. Energy levels spectra. Bohr's model of the atom. Particles behaving as waves: de Broglie's wave length. Wave-particle duality: diffraction. Heisenberg uncertainty principle. Schrödinger equation.

Bibliography

Basic:

Sears, F. W., M.W. Zemansky, H.D. Young y R.A. Freedman, *University Physics*, 11th Ed., Pearson Education, 2004.

Serway, R. A., *Physics for Scientists and Engineers*, 5th Ed, McGraw-Hill. 2002.

Tipler, P. A. and G. Mosca, *Physics for Scientist and Engineers*. 5th Ed. W. H. Freeman and Company, New York, 2004.

Supplementary:

Alonso, M. and E. J. Finn, *Physics.* Addison-Wesley Iberoamericana. 1992.

Fernández Rañada, A. *Física Básica* (Alianza, Madrid, 2004)

Rex, A and R. Wolfson, Essential College Physics. Pearson Education, 2010.

Lea, S. M. and J.R. Burke, Physics: The Nature of Things, West Publishing Company, College and School Division, 1997.

Mengual, J. I., M.P. Godino y M.Khayet, *Cuestiones y problemas de fundamentos de física*, Ariel, Barcelona, 2004.

Sánchez del Río, C., *Los principios de la física en su evolución histórica*, Ed. Instituto de España, Madrid, 2004.

Seminars Program

February 17th, 1st seminar talk by 'to be determined'

March 13th, 2nd seminar talk by 'to be determined'

March 17th, 3rd seminar talk by 'to be determined'

April 7th, 4th seminar talk by 'to be determined'

April 28th, 5th seminar talk by 'to be determined'

These dates are not absolutely fixed and can suffer changes according to availability of the speaker.

Schedule: Thursdays 11:00-12:30 or 14:30-16:00

Tentative topics of the program: Astrophysics, condensed matter, quantum physics, geophysics, magnetism & superconductivity, biophysics, climate change, etc …

Online Resources

Course materials and tests will be provided through the Virtual Campus.

Other resources:

- Interactive website course by Ángel Franco García http://www.sc.ehu.es/sbweb/fisica_/
- College Physics: http://cnx.org/contents/031da8d3-b525-429c-80cf-6c8ed997733a:1/College_Physics
- Physclips: http://www.animations.physics.unsw.edu.au/
- PHET interactive simulations for Physics: ttps://phet.colorado.edu/es/simulations/category/physics
- OSCAR Physics demonstrations: http://www.ucm.es/theoscarlab
- Feynman Lectures: http://www.feynmanlectures.caltech.edu/
- MIT open courses (course 8.02 and units II and III of course 8.03): http://ocw.mit.edu/OcwWeb/Physics/index.htm
- Hyperphysics: http://hyperphysics.phy-astr.gsu.edu/hbase/HFrame.html
- Caltech, the Mechanical Universe: http://www.acienciasgalilei.com/videos/video0.htm

Methodology

On-campus teaching 100% (Scenario 0)

The course involves the following educational ítems:

- Theoretical lessons (lectures) including explanations for the main concepts of the course, including examples and practical demonstrations of concepts using easy-to-carry laboratory materials (3 hours per week).
- Practical lessons involving the resolution of exercises and coordinated discussion of quiz and frequently asked questions (3 hours per week).
- Five seminar talks about topical subjects at the forefront of present day Physics. The seminars will take place during regular course days and will be repeated in a morning and afternoon slot so that all student groups can attend. The seminar talks will be attended both by students and professors. A 6th seminar will take place in the classroom addressing topics organized by the professors and/or the students.

Theoretical lessons will be developed using the chalkboard and/or slide show presentations. These lectures will be complemented by experimental demonstrations that can be developed in the classroom or in the lab. Ad. Hoc. computer simulations and supporting web interactive demonstrations will additionally be used.

Student cooperation will be encouraged during exercise or tutoring workshops.
Materials will be available for the students beforehand in the Virtual Campus. Students will have to resolve and deliver specifically addressed exercises and/or tests in the Virtual Campus as part of the ongoing evaluation.

Semi-online teaching (Scenario 1)
-Group B. A modality: Classes will be given in the usual way, with only one of the subgroups of students attending, which will rotate weekly. The rest of the students will follow the class remotely with tools such as Moodle's Microsoft Teams, Google Meet, or similar. Additionally, several tools will be used to facilitate the interaction of the subgroup of students that must follow the class online. The classes will be recorded and will be available to students on the Virtual Campus.
Online teaching (Scenario 2)
-Group B. Teaching will be done remotely. This approach includes two types of activities: a) support material available to students on the Virtual Campus, including prerecorded explanatory sessions and b) sessions with student tele-presence. This type of sessions with tele-presence can be used as explanatory classes or as Tutorial sessions to solve students' doubts. The sessions with tele-presence will be held during the official timetable of the course. The number of hours of weekly tele-presence will be less than the number of hours of classroom time assigned to the subject. The sessions with tele-presence will be scheduled and informed sufficiently in advance.

Evaluation Criteria		
Exams	**Weight:**	75%
A mid-course exam will take place. Students obtaining a qualifying grade above 5 (scale 1-10) will not need to be evaluated for this contents in the final course examination. In the final course examination: • Students with a lower grade tan 5 in the mid course exam will have to attend a final examination including all the contents developed during the course. • Students with a qualifying grade above or equal to 5 can select one of the following two alternatives: a) Attending a second examination that addresses only the contents developed in the second part of the course, not included in the mid-course exam. This examination will take place at the same date and time as the final examination. If the student obtains a qualifying grade of 5 in the second examination, the final grade obtained by the student from the exams will be the average of the mid- and final- course examinations. The final grade of the course will also consider the ongoing evaluation activities, provided the exam grade is larger or equal to 5. b) Attending a examination including all the contents addressed during the course. The final grade of the course will also consider the ongoing evaluation activities, provided the exam grade is larger or equal to 5. If the student would not get above the qualifying grade in June, a second examination will be offered in the July call comparable to option b) above. The evaluation of ongoing activities during the course will be considered if the student attains a qualifying grade of at least 5 (scale 1-10) during the examination options described above.		
Other Activities	**Weight:**	25%
The following activities will be developed and evaluated: • Exercises hand outs and/or tests in Virtual Campus. • Assistance to seminar talks and hand out of short reports. • Other coordinated workshop or tutorship activities, classroom presentations, specifically assigned exercises/reports, etc.		
Final Mark		
The final course grade (F) will be the highest value of the following: **F = 0.25 A + 0.75 E F = E** where A is the grade derived from “Otras actividades” and E is the grade obtained from the examinations, both in a 1-10 scale. This weighing is valid both for the evaluation of June or that of July.		