COURSE DATA

DATA SUBJECT

Code: 34262
Name: Atmospheric physics
Cycle: Undergraduate Studies
ECTS Credits: 4.5
Academic year: 2026-27

STUDY (S)

Degree	Center	Acad. year	Period
1105 - Degree in Physics	Facultat de Física	2	Second quarter
1928 - Double Degree Program Physics-Mathematics	Facultat de Ciències Matemàtiques	4	First quarter
1929 - Double Degree Program in Physics and Chemistry	Facultat de Física	3	Second quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1105 - Degree in Physics	Physics of the earth and the cosmos	COMPULSORY
1928 - Double Degree Program Physics-Mathematics	Cuarto Curso (Obligatorio)	COMPULSORY
1929 - Double Degree Program in Physics and Chemistry	Tercer Curso (Obligatorio)	COMPULSORY

COORDINATION

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SUMMARY

This academic guide of the course in "Atmospheric Physics" (compulsory course, 4.5 ECTS, second and third year of the Bachelor's Degree in Physics, Double Degree in Physics and Chemistry, and Double Degree in Physics and Mathematics, respectively) aims to explain the student those basic aspects that are considered most relevant to enhance the knowledge acquisition by the students.

The main objective of the course is the study of the physical processes occurring in the atmosphere, defined as a physical system. It is mainly based on the contents of the core subjects, Physics, Mathematics, Mechanics and Thermodynamics, already introduced during the previous semesters. The

contents of this course are also necessary for later courses such as " Renewable energies and solar radiation" and "Remote Sensing" of the Degree in Physics.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

There are no specified enrollment restrictions with other subjects of the curriculum.

OTHER REQUIREMENTS

Being a second and third year of the Bachelor's Degree in Physics, Double Degree in Physics and Being a second and third year of the Bachelor's Degree in Physics, Double Degree in Physics and Chemistry, and Double Degree in Physics and Mathematics, respectively, the student already has the recommended prior knowledge:

1. Fundamental Concepts of Thermodynamics: ideal gas, equation of state and principles of thermodynamics, etc. acquired during the first semester of the second year of the degree.

2. Mechanics: the fundamental concepts for applying Newton's second law in non-inertial reference frames required for Atmospheric Dynamics are also acquired in the first semester of the second year of the degree (in Mechanics I).

3. The topics covered in Atmosphere and Radiation are related to those covered in freshmen Physics and Chemistry as well as in Thermodynamics course mentioned above. It is necessary to review some concepts already known, such as the black body or the principles of conservation of mass and energy, of relevance to the Physics of the Atmosphere. New concepts, such as magnitudes and observables, of fundamental interest to this subject, will also be introduced.

COMPETENCES / LEARNING OUTCOMES

1105 - Degree in Physics

Basic & applied Research: acquire an understanding of the nature and ways of physics research and of how physics research is applicable to many fields other than physics, e.g. engineering; be able to design experimental and/or theoretical procedures for: (i) solving current problems in academic or industrial research; (ii) improving the existing results.

Be able to understand and master the use of the most commonly used mathematical and numerical methods.

Communication Skills (written and oral): Being able to communicate information, ideas, problems and solutions through argumentation and reasoning which are characteristic of the scientific activity, using basic concepts and tools of physics.

Foreign Language skills: Have improved command of English (or other foreign languages of interest) through: use of the basic literature, written and oral communication (scientific and technical English), participation in courses, study abroad via exchange programmes, and recognition of credits at foreign universities or research centres.

Knowledge and understanding of the fundamentals of physics in theoretical and experimental aspects, and the mathematical background needed for its formulation.

Learning ability: be able to enter new fields through independent study, in physics and science and technology in general.

Modelling & Problem solving skills: be able to identify the essentials of a process / situation and to set up a working model of the same; be able to perform the required approximations so as to reduce a problem to an approachable one. Critical thinking to construct physical models.

Physics general culture: Be familiar with the most important areas of physics and with those approaches which span many areas in physics, or connections of physics with other sciences.

Problem solving: be able to evaluate clearly the orders of magnitude in situations which are physically different, but show analogies, thus allowing the use of known solutions in new problems .

Students must be able to apply their knowledge to their work or vocation in a professional manner and have acquired the competences required for the preparation and defence of arguments and for problem solving in their field of study.

Students must be able to communicate information, ideas, problems and solutions to both expert and lay audiences.

Students must have acquired knowledge and understanding in a specific field of study, on the basis of general secondary education and at a level that includes mainly knowledge drawn from advanced textbooks, but also some cutting-edge knowledge in their field of study.

Students must have developed the learning skills needed to undertake further study with a high degree of autonomy.

Students must have the ability to gather and interpret relevant data (usually in their field of study) to make judgements that take relevant social, scientific or ethical issues into consideration.

Theoretical understanding of physical phenomena: have a good understanding of the most important physical theories (logical and mathematical structure, experimental support, described physical phenomena).

To know how to apply the knowledge acquired to professional activity, to know how to
solve problems and develop and defend arguments, relying on this knowledge.

DESCRIPTION OF CONTENTS

1. Atmospheric Thermodynamics

- The Earth system. The atmosphere: origin, composition, and structure.
- Introduction to atmospheric thermodynamics: equation of state of dry and humid air. Virtual temperature. Air saturation processes. Humidity measurement.
- Adiabatic processes: adiabatic lapse rate of dry and saturated air. Potential temperature. Pseudoadiabatic diagram.
- Stability and convection. Stability criteria.
- Homogeneous and heterogeneous nucleation. Köhler theory. Cloud droplet formation and growth. Ice nucleation.

2. Atmospheric Dynamics

- Real and intertial forces. The equation of motion.
- Steady flows: geostrophic wind, cyclostrophic wind, and inertial wind. Thermal wind equation.
- Global atmospheric circulation.

3. Atmosphere and radiation

- The electromagnetic spectrum. Basic radiometric quantities. Interaction of radiation with matter. The laws of radiation. Natural radiative media (solar radiation and terrestrial radiation).
- Absorption and scattering. Radiative transfer equation. Beer-Bouguer-Lambert law.
- Photodissociation and photoionization.
- Solar radiation at the top of atmosphere. The solar constant. Insolation.
- Planetary radiation balance. Radiation balance on the atmosphere and surface. Global balance: the role of the geofluids.
- Natural climate variability. Anthropogenic climate change.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Tutorials	7,00
Theory	38,00
Total hours	**45,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	0,00
Independent study and work	67,50
Preparation of lessons	0,00

Preparation for assessment activities	0,00
Resolution of case studies	0,00
Total hours	**67,50**

TEACHING METHODOLOGY

The syllabus will be developed in weekly lectures and exercise-solving sessions, with one of the latter sessions about every two weeks. The student can download from Aula Virtual web server pdf files corresponding to:

1. Academic guide: explains the syllabus and temporal development, objectives, bibliography, methodology and criteria of evaluation.

2. Different exercises to be solved during lecturing sessions and for the student's homework.

3. Slides of the lectures.

Lectures makes use of both video projector and blackboard. In the lectures, the topics are presented in a logical and structured sequence, explaining in detail the key concepts, showing illustrative examples. Student participation is continuously encouraged by asking short questions that clarify the more difficult concepts, by classroom demonstrations, etc.

The exercise-solving sessions are centered around the resolution of some exercises by the lecturer and by the students.

On the other hand, the individual tutoring at the lecturer's office allow the lecturer to continuously help, guide and monitor the progress of the students who participate.

EVALUATION

Assessment systems are:

(1) Written examinations: one part (with a weight 60%) will assess the understanding of the conceptual and theoretical formalism of the subject, both through theoretical or conceptual questions and through numerical exercises. Another part (with a weight 40%) will assess the problem-solving skills and the ability to critically analyze the results. In both parts, clarity of presentation and current logical reasoning will be assessed.

(2) Continuous assessment: assessment of solved exercises presented by students, issues proposed and discussed in class, oral presentations of exercises solutions or any other method involving interaction between lecturers and students.

The final mark for the subject will be the highest between the mark obtained in the written exam described in (1) and the weighted average of the marks obtained in the exam (1) and the continuous assessment (2).

In this case, the weight of continuous assessment in the final grade is set equal to 30%. The continuous assessment mark will be kept for the two calls of the academic year.

In order to pass the subject, the minimum mark for (1) must be 3.5/10, and the total minimum mark, 5/10.

REFERENCES

Basic

- J.W. Wallace. P.V. Hobbs, Atmospheric Science. Academic Press, Second Edition, 2006.
- M.L. Salby. Fundamental of Atmospheric Physics. Cambridge University Press, 2012.
- D.G. Andrews. An introduction to atmospheric physics. Cambridge University Press, Cambridge, 2010.

Additional

- J. V. Iribarne & W. L. Godson. Atmospheric Thermodynamics. (2nd edition). Kluwer Academic Publisher B.V., 1981.
- J.R. Holton. Introducción a la meteorología dinámica (2ª edición). Instituto Nacional de Meteorología, Madrid, 1990.
- J. Lenoble. Atmospheric radiative transfer. A. Deepak Publishing, Hampton (Virginia), 1993.
- M. Iqbal. An Introduction to Solar Radiation. Academic Press. 1983.