COURSE PROGRAM

Academic Year: 2024/2025

Identification and characteristics of the course			
Code	500794	ECTS Credits	6
Course name (English)	Physics of the Atmosphere		
Course name (Spanish)	Física de la Atmósfera		
Degree programs	Bachelor Degree in Physics		
Faculty/School	Faculty of Science		
Semester	5º	Type of course	Optional
Module	Optative		
Matter	Advanced Physics		
Lecturer/s			
Name	Office	E-mail	Web page
Antonio Serrano Pérez	A-208	asp@unex.es	https://sites.google.com/view/aspuex https://www.flickr.com/photos/138301188@N06/albums
Subject area	Physics of the Earth		
Departament	Physics		
Coordinating Lecturer (if more than one)			

Competencies
CB1: Students should demonstrate knowledge and understanding in a field of study that is based on Secondary Education and is often at a level that, while supported by advanced textbooks, also includes some aspects that involve cutting-edge knowledge.
CB2: That students should know how to apply their knowledge to their work or vocation in a professional way and have the skills which are usually shown through the elaboration and defense of arguments and solving problems within their area of study.
CB3: Students should have the ability to gather and interpret relevant data (usually within their area of study) to make judgments that include thinking about relevant social, scientific or ethical issues.
CB4: Students should be able to convey information, ideas, problems and solutions to both

specialized and non-specialized audiences.
CB5: Students should have developed those learning skills necessary to undertake further studies with a high degree of autonomy
CG1: To acquire a positive experience of Physics and to maintain an intellectual curiosity in the discipline.
CG2: To know, understand and critically analyze the principles and foundations of Physics, and master the necessary mathematical and numerical methods.
CG3: To observe the physical reality and identify the essential elements of any physical phenomenon being able to build simplified models to describe them with the necessary approximation.
CG4: To know the experimental techniques and methodologies of Physics.
CG5: To know how to evaluate the experimental results, contrast them with the predictions of the theoretical model and introduce the necessary modifications to this model when discrepancies between the two are observed.
CG6: To know how to apply the knowledge acquired during their training to professional practice.
CG7: To develop the imagination and creativity inherent in the advancement of Science.
CG8: To recognize the ethical dimension of problems and research as well as the need for professional ethical commitment.
CT1: To communicate the results of a study by means of elaborating clear and precise scientific reports, as well as by an oral presentation.
CT6: To be able to autonomously learn new techniques and knowledge that allows his/her to undertake further studies with a high degree of autonomy.
CT7: To display sensitivity to environmental issues.
CE1: To demonstrate that they have reached an adequate understanding of the different physical phenomena.
CE2: To have updated or state-of-the-art knowledge in some aspects of Physics.
CE3: To identify the essential elements of a complex physical situation in order to build a simplified model that describes with the necessary approximation the problem to be studied.
CE7: To be able to develop software using programming languages and use software packages in a variety of areas including document development, information search, numerical calculation and data presentation.

CE8: To solve problems in the field of Physics.

Contents
Course outline
Structure and composition of the atmosphere. Atmospheric thermodynamics. Radiative transfer. Cloud Physics. Atmospheric electricity.
Course syllabus
Name of lesson 1: BASIC CONCEPTS Contents of lesson 1: Definition of atmosphere. Structure of the atmosphere. Composition of the atmosphere. Description of practical activities of lesson 1: Modeling pressure, temperature and gas concentration profiles in the atmosphere using a radiative transfer model Photography of clouds, classification and elaboration of a catalogue.
Name of lesson 2: PHYSICAL LAWS OF RADIATION Contents of lesson 2: Radiometric quantities. Fundamental laws. Radiation in the Climate System. Description of practical activities of lesson 2: Plotting and comparing Planck's law with its asymptotic approaches. Application of Wien's law. Plotting and analysing the spectral exitance of the Sun and the Earth.
Name of lesson 3: NON-ATTENUATED SOLAR RADIATION Contents of lesson 3: The sun. Illumination geometry. Instantaneous irradiance. Hourly and daily insolation. Description of practical activities of lesson 3: Modeling the solar emission spectrum. Estimating the solar parameter. Obtaining the colour and effective temperature of the sun. Calculating the daily and annual evolution of the solar position for different latitudes. Calculating and plotting the geographical and temporal distribution of the daily extraterrestrial insolation.
Name of lesson 4: ATTENUATED SOLAR RADIATION Contents of lesson 4: Optical masses. Attenuation mechanisms. Transmissivity. Climate budget. Description of practical activities of lesson 4: Plotting mathematical functions of relative optical masses. Study of Rayleigh scattering by means of a physical model of radiative transfer. Using a radiative transfer code to model the effect of the atmosphere on the irradiance at the Earth's surface. Analysis of the transmittance and identification of atmospheric windows.
Name of lesson 5: TERRESTRIAL RADIATION Contents of lesson 5: Energy transitions. Absorption lines. Radiative transfer. Description of practical activities of lesson 5: Modeling the Earth's emittance spectrum using a radiative transfer model. Simulations with clouds and aerosols and analysis of their effect.
Name of lesson 6: RADIATION BALANCE IN THE ATMOSPHERE

Contents of lesson 6: Global radiation balance. Energy transport mechanisms.

Educational activities								
Student workload in hours by lesson		**Lectures**	**Practical activities**				**Monitoring activity**	**Homework**
Lesson	**Total**	**L**	**HI**	**LAB**	**COM**	**SEM**	**SGT**	**PS**
1	26	9			2			15
2	26	8			3			15
3	29	8			4			17
4	26	8			3			15
5	23	7			3			13
6	8	3						5
Assessment	12	2						10
TOTAL	150	45			15			90

L: Lectures (85 students)
HI: Hospital internships (7 students)
LAB: Lab session or field practice (15 students)
COM: Computer room or language laboratory practice (20 students)
SEM: Problem classes or seminars or case studies (40 students)
SGT: Scheduled group tutorials (educational monitoring, ECTS type tutorials)
PS: Personal study, individual or group work and reading of bibliography

Teaching methodologies

Methodology:

1. Explanation and discussion of the contents.

2. Solving, analysis and discussion of problems. Elaboration, exposition and defense of works/projects.

3. Experimental activities such as practices in laboratories, computer classrooms and field work.

4. Autonomous study of the student.

Recommendations:

It is highly recommended to attend and actively participate in the classes since this subject constitutes the first approach of the students to the discipline of Physics of the Atmosphere in the degree. In the classes the bases of different aspects of this discipline are established, which will be used for the practical work that will be carried out in the computer room. It is also recommended that the students study continuously and ask their teacher any questions they may have, as well as collect current news related to the Physics of the Atmosphere for later discussion in class.

Learning outcomes
Understanding of the theoretical, experimental and simulation foundations of the Physics of the Atmosphere field, being able to make quantitative and qualitative approaches to problems in this field.

Assessment systems

The evaluation will fundamentally value the assimilation, maturity and reflection of the student on the explained subject as well as his capacity of synthesis, global vision and interrelation of the concepts.

Those students who opt for the global evaluation must notify it to the professor by email through the virtual campus during the period established by the regulation for this purpose.

A) Continuous evaluation: It will be carried out by means of the following assessment instruments, with their percentage contribution to the final mark:

- A1. Performance of lab exercises and elaboration of a final report. This activity is graded by means of an report that each student must deliver at the end of the lab, which may also include the oral exposition and defense of the report. It is a non-recoverable activity whose mark will be extended to all the examinations of the course. Its mark has a weight of 25% in the final mark.
- A2. Study of a topic and its oral presentation. This activity is assessed by grading the exposition of the topic and its defense to questions asked subsequently. It is an non-recoverable activity whose mark is extended to all the examinations of the course. Its mark has a weight of 15 % in the final mark.
- A3. Final exam. This activity has a weight of 60 % in the final mark.

B) Global evaluation: It will be carried out by means of a final exam that will include:

- B1. Questions on the knowledge taught in class (with a weight of 60% in the final mark).
- B2. Questions on the expositions given in class by the students (with a weight of 15 % in the final mark).
- B3. A practical exercise to be solved corresponding to one of the lab exercises practiced during the course (with a weight of 25 % in the final mark).

Bibliography (basic and complementary)

Bibliography

- Rogers, R. R. (2008). *Física de las nubes*, Ed. Reverte, 264 pp.
- Goody, R. M., and Young, Y. L. (1995). *Atmospheric radiation (Theoretical basis)*, 2nd Edition, Oxford University Press, Inc., ISBN 0-19-505134-3, 519 pp.
- Liou, K-N. (1980). *An introduction to atmospheric radiation*, 2nd Edition, Academic Press, 392 pp.
- Ricchiazzi, P., S. Yang, C. Gautier and D. Sowle (1988). SBDART: A research and teaching software tool for plane-parallel radiative transfer in the earth's atmosphere. *Bulletin of the American Meteorological Society*, Vol. 79, No. 10, 2101-2114.
- Chalmers, J. A. (1967). *Atmospheric electricity*, Pergamon Press, Oxford, 515 pp.

Other resources and complementary materials

On-line resources

- Cloud album of the course: https://www.flickr.com/photos/138301188@N06/albums
- On-line Campus of the couse: https://campusvirtual.unex.es/zonauex/avuex/course/view.php?id=18725
- Spanish National Weather Service: www.aemet.es
- Cloud Appreciation Society: https://cloudappreciationsociety.org