ANEXO I

Faculty Experimental Sciences

GENERAL SPECIFICATIONS

Subject Data

Name:
METEOROLOGÍA Y CLIMATOLOGÍA

English name:
METEOROLOGY AND CLIMATOLOGY

Code:	Type:
757709221	OBLIGATORIA

Hours:

	Total	In class	Out class
Time distribution	60	45	15

ECTS:

Standard group	Small groups			
	Classroom	Lab	Practices	Computer classroom
	45	15	0	0

Departments:	Knowledge areas:
CIENCIAS INTEGRADAS	FÍSICA APLICADA
Year:	**Semester**
SECOND	FIRST

TEACHING STAFF

Name:	E-mail:	Telephone
FRANCISCO PÉREZ BERNAL	FRANCISCO.PEREZ@DFAIE.UHU.ES	959219789
ÁNGEL MIGUEL SÁNCHEZ BENÍTEZ	ANGEL.SANCHEZ@DFAIE.UHU.ES	959219799

ANEXO I

Others Data (Tutoring, schedule...)		
Schedule: Classes in the Physics Seminar Room (4th floor Experimental Sciences building) Tuesday 12.00 – 14.00 11 weeks Thursday 10.00 – 12.00 12 weeks Laboratory Sessions in Physics I Laboratory (Ground floor Experimental Sciences building) Tuesday 16.00 – 19.30 5 weeks Office Hours Tuesday 10.00 – 12.00 and 16.00 – 18.00 Thursday 12.00 – 14.00 Students can arrange by mail office hours at other times and dates.		

ANEXO I

SPECIFIC INFORMATION OF THE COURSE

1. Contents description:

1.1 In English:

The course is organized in four main blocks. Block number 1 introduces the subject to the student (Chapter I) and present radiation heat transfer, energy budget, and temperature in the Earth. The second Block, Block number 2, explains the main concepts of atmospheric thermodynamics for non-saturated (Chapter IV), and saturated (Chapter V) air. Block number 3 presents the basics of atmospheric dynamics and synoptic analysis, with two chapters: Chapter VI presents winds, the forces that cause the wind and different local wind systems and Chapter VII contains an introduction to the main concepts of synoptic meteorology: high and low pressure areas, air masses, fronts, and mid-latitudes cyclogenesis. The last block, Block 4, is devoted to Climatology, with two chapters, Chapter VII presents global circulation patterns in the atmosphere, teleconnection indexes, and the Knöppen-Geiger climate classification; finally, Chapter VIII is a basic introduction to climate change and global warming. The course includes five lab sessions, two of them are devoted to different aspects of atmospheric thermodynamics, and three of them to the Synop code and to the Skew T-Log P diagram.

1.2 In Spanish:

El curso se organiza en cuatro bloques. El bloque 1 contiene una introducción a la tiempo atmosférico y al clima, presenta el balance de radiación en el sistema climático y la distribución de temperaturas en la tierra. El bloque 2 se centra en la termodinámica atmosférica para aire seco, no saturado y saturado. El bloque 3 introduce la dinámica atmosférica y el análisis sinóptico. Por último, el bloque 4 se centra en el estudio del clima, presentando la circulación en la atmósfera a nivel global y los principios físicos que explican el cambio climático. El curso incluye cinco prácticas de laboratorio dos de ellas dedicadas a termodinámica atmosférica, una al código SYNOP y dos al diagrama oblicuo de temperatura.

2. Background:

2.1 Situation within the Degree:

Environmental Science students need precise a basic knowledge of the atmosphere, and the physical laws governing its behaviour at short (Meteorology) and long (Climatology) terms. These opens to them interesting professional venues as well as a possible research field that has been considered of the utmost importance in recent times.

2.2 Recommendations

No formal prerequisites are required. A knowledge of basic mathematics (calculus) and thermodynamics are of great help to the understanding of the subject. Students are expected to attend classes regularly. In-class participation is highly encouraged as well as the solution of the problems given as homework. This can make a difference to the final grade.

3. Objectives (as result of teaching):

At the end of the course students should be able to demonstrate an understanding of

- how the interplay of solar radiation, Earth characteristics, and astronomical factors determines the surface-atmosphere energy balance and Earth climate distribution.
- how dry air thermodynamics explains the concept of atmospheric stability and its consequences.
- condensation phenomena and their implications in the atmospheric energy balance.
- the forces that guide the direction and speed of winds in local and global scales.
- the physical aspects that drive climate change.

4. Skills to be acquired

4.1 Specific Skills:

E1 - Ability to apply the basic principles of Physics and Mathematics to the knowledge of the Environment.
E2 - Ability to analyze the environment as a system, identifying the factors, behaviors, and interactions that configure the system.
E10 - Ability to carry out environmental impact assessments.
E19 - Capacity in the elaboration and interpretation of thematic cartographies.

4.2 General, Basic or Transversal Skills:

BC1 - That students have demonstrated to possess knowledge and understand an area of study that starts from the base of general secondary education, and is usually found at a level that, while supported by advanced textbooks, it also includes some aspects that involve knowledge from the forefront of your field of study.
BC2 - That students know how to apply their knowledge to their work in a professional way and possess the competences that are usually demonstrated through the elaboration and defense of arguments and the resolution of problems within their area of study.
BC3 - That students have the ability to collect and interpret relevant data (normally within their area of study) to make judgments that include a reflection on relevant issues of a social, scientific, or ethical nature.
BC4 - That students can transmit information, ideas, problems and solutions to a public, specialized or not.
BC5 - That students have developed the learning skills necessary to undertake studies with a high degree of autonomy.

GC1 - Capacity for analysis and synthesis.
GC3 - Oral and written communication.
GC6 - Information management capacity.
GC7 - Problem solving.
GC9 - Teamwork.
GC12 - Autonomous learning.
GC14 - Critical reasoning.
GC18 - Sensitivity towards environmental issues.
GC20 - Use of the Internet as a means of communication and as a source of information.

TC1 - That students have developed and demonstrated learning skills and knowledge from their field of study, being able to apply them in their work, assessing relevant data to make judgments of topics of various kinds, being able to transmit them to both a specialized and non-specialized audience.

5. Training Activities and Teaching Methods

5.1 Training Activities:

- Expository method (lecture).
- Exercise, rehearse and put into practice in the laboratory previous knowledge and apply the methods characteristic of the discipline.
- Autonomous Learning.
- Cooperative learning.
- Personalized attention to students.

5.2 Teaching Methods::

- Expository method (lectures).
- Audiovisual exhibitions.
- invited conferences.
- Organization of seminars, workshops or debates.
- Resolution of exercises and problems.
- Self-assessment of exercises.
- Autonomous Learning.
- Cooperative learning.
- Personalized attention to students.

5.3 Development and Justification:

This module is based on the understanding of a set of physical principles that will be introduced at the beginning of the course, followed by more descriptive contents. The course ends introducing a complex and interesting subject, climate change, whose understanding requires an adequate knowledge of the introduced physical principles. The lab session will be used to reinforce the understanding of the aforementioned physical principles in the laboratory with the student's hands on work. Students' seminars will be given at the end of the course, once that the students are acquainted enough with the subject.

6. Detailed Contents

ANEXO I

1. Introduction. Weather and Climate. Atmospheric variables. The climatic system: the structure of the atmosphere. (2T)

2. Energy: Solar warming of the Earth. Electromagnetic radiation. Temperature and radiation heat transfer. The black body. The solar and earth spectra. The greenhouse effect. Geometric effects. (4.5TP)

3. Seasonal and Daily Temperatures in the Earth. Terrestrial distribution of temperature. Natural temperature controls. Daily and seasonal oscillations. Atmospheric thermometry. (2T)

4. Dry and non saturated air. Air as an ideal gas. Water vapor, humidity indexes. Thermodynamics of dry and non-saturated air. Adiabatic processes in the atmosphere. Atmospheric stability and vertical movement of air parcels. (4TP)

5. Condensation and precipitation. Saturation vapor pressure dependence with temperature. Adiabatic lifting of air parcels. Condensation mechanisms in the atmosphere. Precipitation types. Fogs and cloud classification. (4.5TP)

6. Local winds. Atmospheric pressure variation. Pressure maps. Wind measure. Forces that determine wind direction and speed. Geostrophic and gradient winds. (3T)

7. Air masses and fronts. High and low pressure areas. Classification of air masses. Synoptic meteorology. Cyclogenesis and weather forecasting. (3T)

8. Global climate. Global wind and current systems. Global Circulation Patterns and Teleconnection Indexes. The Monsoons. World climate classification. (3T)

9. Climate change. History and evolution of the climate. Feedback mechanisms. Climatic models. Natural and anthropogenic causes of global warming. (4T)

Note.- Numbers in parentheses indicate the number of hours allocated to each topic and whether these consist only of (T)heory or also include (P)roblems.

7. Bibliography

7.1 Basic Bibliography:

- Meteorology Today. An introduction to weather, climate, and the environment, by C. Donald Ahrens. Cengage Learning; 13th edition (January 1, 2021)

7.2 Additional Bibliography:

- Practical Meteorology: An Algebra-based Survey of Atmospheric Science, by R. Stull 2018 Ed. Univ. of British Columbia. 940 pages. isbn 978-0-88865-283-6 .
- The atmosphere, an introduction to meteorology, by F.K. Lutgens and E.J. Tarbuck, Ed. Prentice Hall (New Jersey). 1998.
- Global Physical Climatology, by D.L. Hartmann, Ed. Academic Press (New York). 1994.
- Principles of meteorological analysis, by W.J. Saucier, Ed. Dover (New York). 1989.
- Fundamentals of Atmospheric Physics, by Murry L. Salby. Ed. Academic Press (San Diego, CA) 1996.

8. Systems and Assessment Criteria

8.1 System for Assessment:

- Theory exam: The exam will contain multiple choice and/or short essay questions.
- Problem exam: The exam will consist of two or more problems.
- Lab sessions: In the lab sessions, students will work in groups in the lab and each group should hand over or upload to Moodle a resume of the session with the data, results, and details on the performed calculations after each session.
- Student seminar: A 15-20 minutes seminar on a scientific paper or a subject of interest for the course. The students will preferably work on small (2-3 students) groups and the professor will evaluate the quality of the slides and the student's skills presenting the problem to his classmates and to the professor.

8.2 Assessment Criteria and Marks:

8.2.1 Examinations Convocatory I

30% Theory exam. In a total of 10 points, up to an extra 0.5 points can be obtained from an active class participation and a minimum grade of 3.75/10 should be obtained in this item in order that the final average grade can be computed.
30% Problem exam. In a total of 10 points, up to an extra 0.5 points can be obtained from the problems sent as a homework and handed over or solved in the classroom by the students. A minimum grade of 3.75/10 should be obtained in this item in order that the final average grade can be computed.
20% Lab sessions: Failing to accomplish the secheduled deadline will convey a penalty in the grade. The professor will also take into account how the group has performed in the Laboratory. If the student's grade in this item is less than 5/10, he will be offered the chance of sitting -the same day of the final exam- a short exam about the lab sessions.
20% Student seminar.

8.2.2 Examinations Convocatory II

30% Theory exam. In a total of 10 points, up to an extra 0.5 points can be obtained from an active class participation and a minimum grade of 3.75/10 should be obtained in this item in order that the final average grade can be computed.
30% Problem exam. In a total of 10 points, up to an extra 0.5 points can be obtained from the problems sent as a homework and handed over or solved in the classroom by the students. A minimum grade of 3.75/10 should be obtained in this item in order that the final average grade can be computed.
20% Lab sessions: The grade obtained in the lab assessment will be used. If the alumn has failed in the lab grade, he will be offered the chance of sitting -the same day of the final exam- a short exam about the lab sessions.
20% Student seminar. In case that the student has not passed the student's seminar item he will be offered to be graded using mode (b) in Single final evaluation.

8.2.3 Examinations Convocatory III

30% Theory exam. In a total of 10 points, up to an extra 0.5 points can be obtained from an active class participation and a minimum grade of 3.75/10 should be obtained in this item in order that the final average grade can be computed.
30% Problem exam. In a total of 10 points, up to an extra 0.5 points can be obtained from the problems sent as a homework and handed over or solved in the classroom by the students. A minimum grade of 3.75/10 should be obtained in this item in order that the final average grade can be computed.
20% Lab sessions: The grade obtained in the lab assessment will be used. If the alumn has failed in the lab grade, he will be offered the chance of sitting -the same day of the final exam- a short exam about the lab sessions.
20% Student seminar. In case that the student has not passed the student's seminar item he will be offered to be graded using mode (b) in Single final evaluation.

ANEXO I

8.2.4 Extraordinary Convocatory

30% Theory exam. In a total of 10 points, up to an extra 0.5 points can be obtained from an active class participation and a minimum grade of 3.75/10 should be obtained in this item in order that the final average grade can be computed.
30% Problem exam. In a total of 10 points, up to an extra 0.5 points can be obtained from the problems sent as a homework and handed over or solved in the classroom by the students. A minimum grade of 3.75/10 should be obtained in this item in order that the final average grade can be computed.
20% Lab sessions: The grade obtained in the lab assessment will be used. If the alumn has failed in the lab grade, he will be offered the chance of sitting -the same day of the final exam- a short exam about the lab sessions.
20% Student seminar. In case that the student has not passed the student's seminar item he will be offered to be graded using mode (b) in Single final evaluation.

8.3 Single Final Evaluation:

The single assessment will consist of a single exam with contain multiple choice and/or short essay questions (40% of the exam grade), problems (40% of the exam grade) plus an exam on the laboratory sessions (20% of the exam grade). In the lab exam the student will be provided with a set of experimental data and should work with them to extract the relevant information. In order to compute the total exam average the student should get 50% of the possible grade in the three exam items considered.

There are two possible ways of assessing the student work:

(a) A single assessment procedure consisting of a written exam that will contain multiple choice and/or short essay questions (40% of the grade), problems (40% of the grade), and questions on the laboratory sessions (20% of the grade). In the lab exam the student will be provided with a set of experimental data and should work with them to extract the relevant information. In order to compute the total exam average the student should get 50% of the possible grade in the three exam items considered.

(b) In case that the students have obtained previous grades on laboratory sessions and seminar presentation in the present term; his final mark will be computed as 60% final exam + 20% lab sessions + 20% student's seminar; unless the student chooses the aforementioned evaluation mode. In this second case the student should get a minimum 37.5/100 mark in the exam to compute the final grade as a thtee-component average. Students can renounce their previous marks on lab sessions or/and problem assignments and seminar presentation to take this part of the subject in the written exam.