



Bachelor in Physics (Academic Year 2022-23)

Physics of the Atmosphere			Code	800511	Year	3rd	Sem.	2nd
Module	Applied Physics	Topic	Compulsory for Applied Physics			Character	Optional	

	Total	Theory	Pract./Semin.	Lab.
ECTS Credits	6	4.2	1.8	
Semester hours	45	31	8	6

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

- To acquire knowledge on the main physical characteristics and processes regulating the atmosphere's behavior.
- To identify the physical laws (radiation, thermodynamics, dynamics) regulating the main atmospheric processes.
- To acknowledge the atmosphere's role as one of the main components of the climate system, and to identify the basic aspects of the Physics of climate change.
- To apply the acquired knowledge to practical cases through problem solving and practical training

Brief description of contents

Atmospheric composition; solar and terrestrial radiation; energy balance; water vapor and cloud formation; air motion equation; weather analysis and prediction; climate changes.

Prerequisites

Coordinator	Carlos Yagüe Anguís			Dept.	FTA
	Office	110, 4 th floor, east	e-mail	carlos@ucm.es	

Theory/Exercises – Schedule and Teaching Staff

Group	Lecture Room	Day	Time	Professor	Period/Dates	Hours	T/E	Dept.
B	10	Mo We	17:00-18:30 16:30-18:00	Elsa Mohino Harris	Entire semester	39	T/E	FTA

T: Theory, E: Exercises

Group	Computer Lab	Day - hours	Professor	Hours	Dept.
LB1	A1	2 marzo, y 12, 19 y 26 de abril, de 16.30 a 18.00	Elsa Mohino Harris	6	FTA

Office hours

Group	Professor	Schedule	E-mail	Location
B	Elsa Mohino Harris	L: 15.30h-17.00h X: 15.00h-16.30h Resto on line	emohino@ucm.es	105, 4 th floor, east

Syllabus

Theory

1. Introduction. Physics of the atmosphere. Air composition. Origin of Earth's atmosphere. Vertical distribution of atmospheric mass. Vertical distribution of temperature.
2. Fundamental thermodynamic processes in the atmosphere. Equation of state for air. Virtual temperature. Hydrostatic equation. Adiabatic processes. Potential temperature.
3. Water vapor in air. Phases of water in the atmosphere. Saturation. Moisture parameters. Formation of fog and clouds.
4. Atmospheric stability and cloud formation. Ascent of air parcels: temperature variation. Dry adiabatic and saturated adiabatic lapse rates. Adiabatic and pseudoadiabatic ascent. Static stability. Convection and cloud formation. Thermodynamic diagrams.
5. Energy balance. Heat transfer in the atmosphere. Solar and terrestrial radiation. Fundamental radiation laws. Absorption, emission and equilibrium. Greenhouse effect. Total energy balance. Implications for climate change studies. Latitudinal variations of energy balance.
6. Temperature. Hemispheric seasonal variations in temperature: causes and effects. Local seasonal variations in temperature. Daily temperature variations. Measuring air temperature.
7. Air pressure and winds. Atmospheric pressure. Variation with height. Forces that influence the winds. The geostrophic wind. The gradient wind. Effect of surface friction.
8. Weather analysis and prediction. Global observing system. Meteorological maps. Weather forecasting methods using meteorological maps. Current weather forecasting. Numerical models. Weather predictability.

Practice:

Four practice sessions will be held in the computer lab.

Bibliography

BASIC

- C.D. Ahrens and R. Henson (2019). *Meteorology Today*, 12th edition. Cengage. Also online resource from the library: <https://ucm.on.worldcat.org/oclc/1227788986>
- J.M. Wallace and P.V. Hobbs (1977, 1st edition; 2006, 2nd edition). *Atmospheric Science: An Introductory Survey*. Academic Press. Elsevier

COMPLEMENTARY

- R.B. Stull (2000). *Meteorology for Scientists and Engineers*, 2nd ed. Brooks/Cole Thomson Learning.
- Sendiña Nadal and V. Pérez Muñuziri (2006). *Fundamentos de Meteorología*. Academic Press. Universidad de Santiago de Compostela (Servicio Publicaciones).
- M. Ledesma Jimeno (2011). *Principios de Meteorología y Climatología*. Ediciones Paraninfo S.A.
- Zúñiga López, Ignacio; Crespo del Arco, Emilia; Fernández Sánchez, Julio; Santos Burquete, Carlos (2016). *Problemas de meteorología y climatología*. UNED.

Online Resources

Virtual campus

Meteorology and Climate virtual laboratory: <http://meteolab.fis.ucm.es/>

Methodology
<p>The following training activities will be conducted:</p> <ul style="list-style-type: none"> • Theory lessons where the main concepts of Physics of the Atmosphere will be explained, including examples and applications. • Problem solving classes will be combined with theory lessons to provide an adequate complement. • Questionnaires and/or practical exercises will be proposed through the use of Virtual Campus. • Practice sessions in the Computer Lab. Four practice sessions will be conducted (90 minutes each) to reinforce the explained theoretical concepts. <p>For the theory lessons, projected computer presentations and explanations with the blackboard will be used. Occasionally, the lessons can be complemented with real cases of particular meteorological situations.</p> <p>The computer presentations and proposed exercises will be provided to the students through the virtual campus in advance.</p> <p>As part of the continuous evaluation, students will have to hand in the proposed exercises and practice reports in due time, as specified.</p>

Evaluation Criteria		
Exams	Weight:	70%
<p>A Final Exam will be performed, which can consist of multiple-choice questions, short questions with theoretical and/or practical argumentation and/or problem solving. No reference material will be allowed.</p> <p>The Final Exam (Nexam) will be marked over 10.</p>		
Other Activities	Weight:	30%
<p>Throughout the course, as part of the continuous evaluation, students will hand in the proposed exercises in due time, as specified.</p> <p>A partial test can be proposed in class time. It can include multiple-choice questions and/or exercises. The test will be announced in advance in class and through the Virtual Campus.</p> <p>Lab practices, to which attendance is compulsory, will be held as programmed. Students will hand in a report for each of them.</p> <p>The overall mark for Other Activities (NOtherActiv) will be provided over 10.</p>		
Final Mark		
<p>The final mark will be the result of the following equation:</p> $C_{Final} = 0.7 \times N_{Exam} + 0.3 \times N_{OtherActiv},$ <p>where NOther is the mark for Other Activities and NExam the one obtained in the Final Exam.</p> <p>The mark for the June-July resit will be obtained following the same evaluation procedure.</p>		