COURSE DATA

Data Subject	
Code	33085
Name	Meteorology and climatology
Cycle	Grade
ECTS Credits	4.5
Academic year	2020 - 2021

Study (s)

Degree	Center	Acad. year	Period
1104 - Degree in Environmental Sciences	Faculty of Biological Sciences	2	First term

Subject-matter

Degree	Subject-matter	Character
1104 - Degree in Environmental Sciences	123 - Meteorology and climatology	Obligatory

Coordination

Name	Department
LOPEZ BAEZA, ERNESTO	345 - Earth Physics and Thermodynamics

SUMMARY

Introduction

The subject **Meteorology and Climatology** is taught, as a compulsory subject, in the first quarter of the second year of the **Degree in Environmental Sciences**.

Meteorology and **Climatology** are key disciplines in the training of future graduates in **Environmental Sciences**. The course develops a basic theme area that is a great help in planning, understanding, analyzing and solving problems related to phenomena and natural processes and anthropogenic actions that shape and affect the Environment. The subject of **Meteorology and Climatology** relates on the one hand, with some specific matters of first-year courses such as Physics, Chemistry and Geology, mainly. In fact, these subjects along with Mathematics, are essential for its better understanding and use. On the other hand, in subsequent courses, **Meteorology and Climatology** provides a knowledge base and is related to other subjects such as Soil Science and Continental and Marine Hydrology, Contamination Assessment, Geographic Information Systems and Fundamentals of Environmental Engineering, among

others

- ***General Objectives***

The general objectives of the **Meteorology and Climatology** course, as a subject of general education and complementary to other subjects of the Grade include:

(i) Enhance the capacity of analysis and synthesis of the students

(ii) Develop the ability to access and evaluate information sources, taking their reliability into account

(iii) Exercise the ability to interpret both qualitative and quantitative weather and climate information

(iv) Develop the ability to integrate and make connections between theoretical and practical knowledge

(v) Encourage independent work of students in terms of information search and data processing

(vi) Hand in reports and memoranda both orally and in writing

(vii)Promote teamwork

- ***Specific Objectives***

(i) Acquire an overview of the atmosphere and the processes occurring in it and their relationships with the other components of the climate system

(ii) Understand the concepts of climate and climate system and the mechanisms and processes that shape them

(iii) Analyze and explore the various parameters that define weather and climate, their role played in the climate system and their measurement and observation techniques. Acquire knowledge of their typical values as well as of their associated errors and uncertainties

(iv) Know the basic aspects concerning the interaction of radiation with the atmosphere and the radiation balance of the Earth – Atmosphere System

(v) Analyze and interpret the basic meteorological and climatological processes. Know the characteristics of the most significant weather phenomena at different scales, from local to synoptic and global, and understand their dynamic and thermodynamic fundamental aspects

(vi) Know the basics of thermodynamics of the atmosphere necessary for understanding the processes associated with cloud formation and precipitation

(vii)Understand the processes related to atmospheric dynamics

(viii) Understand the role of atmospheric and oceanic circulation in shaping global climat

(ix) Know the origins of climate variability and its relation to climate change

(x) Know how to assess the anthropogenic effect on climate

(xi) Introductory knowledge on Numerical Weather Prediction Models and Climate Simulation Models

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

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

Other requirements

It is essential that in this subject students have the basic knowledge provided by the other Mathematics and Physics courses, the latter as well as basic knowledge for the measurement of meteorological parameters. It is also desirable that the students know spreadsheet programs and conventional statistical analysis such as Excel or Kaleidagragh.

OUTCOMES

1104 - Degree in Environmental Sciences

- Conocer las características de los diferentes climas.
- Analizar e interpretar procesos meteorológicos.
- Comprender y manejar diferentes escalas espaciales y temporales en la interpretación de los sistemas naturales.
- Conocer los principales impactos humanos sobre los sistemas naturales.

LEARNING OUTCOMES

- Carrying out practical work involving problem solving, data analysis and critical interpretation
- Preparation and presentation of short seminars, both individually and in small groups, involving literature searches, information integration in Spanish and English, analysis and synthesis of that information, public oral presentation and defense of it. At least one of the presentations should be held in English
- Use of bibliographic electronic databases, access to scientific journals and other publications both printed and in electronic format, and using at least one presentation software (eg Power Point)
- Solving problems involving the acquisition of qualitative and quantitative data in the laboratory or the field, data analysis and interpretation in a theoretical context
- Knowledge of the different climate types and of their main characteristics
- Analysis and interpretation of the main meteorological processes
- Knowledge of the components and processes of the climate system and of its features at different spatial and temporal scales

Knowledge of the major human impacts on the climate system

DESCRIPTION OF CONTENTS

1. Introduction

Weather and Climate. Scales in Meteorology and Climatology

2. The Climate System

The Climate System. Components and Processes. Feedback Processes

3. Physical Properties of the Atmosphere

Composition of the Atmosphere. Aerosols. Structure of the Atmosphere. The Standard Atmosphere. Radiosonding Ascents

4. Radiative Balance (I)

The Solar Constant and its Variability. Energy Balance of the Earth. The Greenhouse Effect. Effect of Clouds on the Radiation Balance.

5. Radiative Balance (II)

Geographical Distribution of Radiation. Measurement of Solar and Thermal Radiation

6. Temperature

Insolation and Temperature. Temperature Cycles. Determining Factors of Temperature. Temperature Measurement

7. Atmospheric Pressure

Definition, Units and Meaning of Atmospheric Pressure. Variation of Pressure and Density with Altitude. Atmosphere Models. Hydrostatic Atmosphere. Measurement of Atmospheric Pressure

8. Atmospheric Humidity

Role of Water in Climate. Water Circulation in the Atmosphere. Moisture and Humidity. Dew Point. Humidity Measurement

9. Clouds and Precipitation (I)

Clouds and Cloud Types. Observation and Identification of Clouds.

10. Clouds and Precipitation (II)

Precipitación y tipos de Precipitaciones. Distribución y Variación Periódica de las Precipitaciones. Medida de la Precipitación. El Radar Meteorológico.

11. Wind

Involved Forces: Gravity, Pressure Gradient, Coriolis and Centripetal Effects, Friction. Geostrophic Wind, Gradient and Heat. Wind Measurement

12. Stability and Equilibrium in the Atmosphere (I)

Adiabatic Processes in Hydrostatic atmosphere. Adiabatic Cooling of Dry Air and of Moist Air.

13. Stability and Equilibrium in the Atmosphere (II)

Procesos Adiabáticos en Atmósferas Hidrostáticas. Enfriamiento Adiabático del Aire Seco y del Aire Húmedo. Convective Motions. Consequences of Stability

14. Atmospheric Dynamics (I)

Atmospheric Forces: Real and Apparent Forces. Approximation of geostrophic, gradient and termal winds.

15. General Circulation and Climatic Zones (I)

Global Motion System and Global Solar Heating Distribution. Components of the Global Circulation: Southern Circulation and Western Trade Winds, Jet Streams and Climate Belts. Effect of Mountains and the Land-Ocean Distribution.

16. General Circulation and Climatic Zones (II)

Climatic Zones and Global Distribution of Temperature and Rainfall

17. Planetary Boundary Layer (I)

Characteristics. Viscosity and Turbulence. Origins of Turbulence. Turbulent Viscosity. Vertical Profile of Wind. Zonal Winds, Breezes, Storms, Hurricanes

18. Planetary boundary layer (II)

Energy balance

19. Main Meteorological Systems

High Pressure and Low Pressure Systems. Warm, Cold and Occluded Frontal Systems. Systems Originating Precipitation. High Level Winds, Jet Stream

20. Characteristics of the Different Types of Climas (I)

Factors that Determine the Distribution of Climates on the Planet. Classifications and Climate Indices.

21. Characteristics of the Different Types of Climas (II)

Warm, Temperate, Cold, Desert and Mountain Climates

22. Urban Climate

Meteorological Measurements in Urban Areas. Urban Energy Flows. Urban Heat Island. Urban Vegetation and Climate. Megacities

23. Climate Change (I)

Enhanced Greenhouse Effect by Anthropogenic Causes. Factors of Climate Change.

24. Climate Change (II)

Observation of Climate Change and its Agents. Climate Models. Climate Scenarios.

25. Climate Change (III)

Projections of Climate Change

26. Paleoclimatology

Past Climate. Instrumental Measurement Record over Land and over Sea. Climate in the Past 1000 Years, Proxy Climatic Indicators. Climate Change of the Past Several Hundred Thousand Years. Climate Change over the History of the Earth, Milankovitchs Theory

27. Laboratory practices

Lab 1: Automatic Weather Stations
Configuration of the Weather Station
Download Weather Data
Analysis and Interpretation of Meteorological Measurements

Lab 2: Soil Profile Temperatures
Measurement of the Temperature Profile in Different Soil Types
Homogeneity Study of the Thermal Properties of Soil
Thermal Waves in Soil

Lab 3: Measurement of Atmospheric Humidity
Getting Acquainted to the Various Parameters that Express Atmospheric Humidity
Different Measuring Methods of Atmospheric Humidity (Psychrometers, Hygrometers, Electrical Methods, Condensation Methods, ...)

Lab 4: Measurement of Solar Radiation
Measurement of the Different Components of Solar Radiation. Influence of the Inclination Angle
Surface Albedo
Thermal Radiation
Net Radiation. Factors of Which it Depends

28. Tutoring

Tut I y II: Territorial Delegation of AEMet in theValentian Community
Visit to the Territorial Delegation of AEMet at the Valencian Community to learn about the activities of a completeMeteorological Center:
- measurements and observations at a meteorological shelter
- assimilation of meteorological stations data
- meteorological radar and remote sensing
- Use of the Numerical Prediction Model
- continuous analysis of meteorological information and climatological data bases
- meteorological warning systemPreviMetand wildfire risk PreviFoc

Exercises on
- instrumentation
- climatology
- operationsof thePreviMetand PreviFocsystems

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	28,00	100
Laboratory practices	15,00	100
Tutorials	2,00	100
Development of group work	10,00	0
Study and independent work	13,00	0
Readings supplementary material	2,50	0
Preparation of evaluation activities	26,00	0
Preparing lectures	13,00	0
Preparation of practical classes and problem	3,00	0
TOTAL	**112,50**	

TEACHING METHODOLOGY

The subject consists of several parts, with different and distinct methodology. For each part a specific development and methodology follows:

• ***Theoretical-Practical Lectures***

Two classes a week, of theoretical - practical content (theory and conceptual exercises and problems), in varying proportions depending on the subject, according to the schedule developed in section 6 above **Description of the Contents** that is divided into three Units

• **Unit I Introduction of Basic Concepts. Meteorological and climatological variables** (**Items 1 to 11**, 11 hours)

• **Unit II. Meteorology** (**Items 12 to 19**, 8 hours)

• **Unit III. Climatology** (**Items 20 to 26**, 7 hours)

In these lectures, the lecturerimparts the theoretical topicsleaning on materials (books, notes, slides, figures and diagrams) to be provided to students through the *Aula Virtual*. This material is only for guidance and at no time should be seen as the only material to be used by the student. In each of the theoretical topics, practical exercises will be developedthat help students to understand the matter explained. In many cases, the theoretical topics will beintroducedindicating the content scope, hoping that the student complete the details of the matter in their individual study.

In these classes, the teacher presents the theoretical basis of materials (books, notes, slides, figures and diagrams) that are provided to students through the Virtual Classroom.

• ***Laboratory Classes (Practicals)***

Four laboratory sessions are taught in small subgroups, with a teacher assigned to each subgroup. In the sessions, students in pairs, perform the four practicals that are described in section 6 on **Description of Contents(Lab I** to **Lab IV)**. For each practical, each pair of students must submit a report for the collection of experimental data and their treatment (errors, graphs, mathematical fittings and correlations), the results obtained and the conclusions reached. Emphasis is placed on the use of data processing software, for which suitable computer equipment is provided in the laboratory. Attendance to this activity is compulsory for the student.

• ***Supervised Working Tasks***

We propose a scientific visit to the **Territorial Delegation of AEMet in the Valencian Community** to understand how a complete Meteorological Center works. In the visit, the students will have the opportunityto see the instrumentation, measurements and observations of the weather station, the assimilation of data from meteorological stations in the region, the operation of the numerical prediction model and the meteorological warning systems *PreviMet*and of wildfire risks*PreviFoc*. The students will be proposed to carry out some practical work related to the contents of the visit. Attendance to this activity is compulsory for the student.

• ***Tutorials***

The student can clarify or solvedoubts on any matter of the course in Tutoring hours of the lecturer or by email (*virtual tutoring*) if the query can be resolved reasonably well by this system.

EVALUATION

The evaluation of the subject is made taking into account its various different parts which are separately evaluated according to the criteria detailed below:

• **Assessment of the Theoretical and Practical Knowledge**: The evaluation of this part of the course will be based on a written exam

• **Evaluation of the Laboratory**: The laboratory work is evaluated based on the laboratory reports (and oral presentations) made by the students for each of the practicals performed during the course. **It is compulsory to carry out all the laboratory practicals**

• **Assessment of Supervised Work**: This work is evaluated based on the reports made by the students. **To be evaluated, it is required to attend this class-scientific visit.**

The evaluation of the subject will be made with the following criteria:

(i) **60 points**: theoretical and practical knowledge through the written final exam

(ii) **30 points**: work performed in the laboratory through evaluation of laboratory reports and eventual questionnaires

(iii) **10 points**: supervised work through the assessment of reports and exercises proposed in the lectures

The final mark will be obtained from the sum of the scores of the preceding paragraphs, provided in paragraph (i) obtain a minimum of **25** points and in (ii) a minimum of **12** points. The final score needed to pass the course will be **50** points.

In order to apply for advancement of the examination session of this subject, students should be awaere that mandatory activities outlined in the teaching guide should have previously been carried out. See also section on *Teaching methodology, laboratory classes (Practicals), and supervised working tasks.*

REFERENCES

Basic

- Manuel Ledesma Jimeno (2011): Principios de Meteorología y Climatología. Paraninfo
- María Carmen Casas Castillo y Marta Alarcón Jordán (1999): Meteorología y Clima. Volumen 79 de Politext Series, Ediciones UPC, S.L.
- Hartmann, D.L. (1994): Global Physical Climatology. Academic Press
- J.M. Wallace & P. Hobbs (2006): Atmospheric Science. An Introductory Survey. Academic Press, 2nd Edition

Additional

- María Fernanda Pita y José María Cuadrat (2006): Climatología. Ediciones Cátedra
- Javier Martín Vide (2005): Los Mapas del Tiempo. Editorial Davinci, Mataró
- Javier Martín Vide (1991): Fundamentos de Climatología Analítica. Editorial Síntesis. Madrid
- Felipe Fernández García (1995): Manual de Climatología Aplicada. Editorial Síntesis. Madrid

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

1. Contenidos

Se mantienen los contenidos inicialmente programados

Si la Visita Científica a la Delegación de AEMet en la Comunidad Valenciana no pudiera realizarse como Tutoría y Trabajo Tutelado, se programaría una tarea virtual equivalente.

2. Volumen de trabajo y planificación temporal de la docencia

Se mantendría el volumen de trabajo aumentando ligeramente el peso relativo de los trabajos voluntarios en relación al peso del examen de teoría.

En principio, se mantendrían los horarios (días y horas) de las sesiones presenciales en el caso de que estas se sustituyeran por sesiones de videoconferencia

3. Metodología docente

Clases de teoría

• Se continuaría subiendo al Aula Virtual las presentaciones de las clases correspondientes a los diferentes temas

• Se programarían videoconferencias en los días y a las horas convencionales de la asignatura utilizando BBC

Tutorías y Seminarios

• La tutoría presencial obligatoria, consistente en una Visita Científica a la Delegación de AEMet en la Comunidad Valenciana, se sustituiría por un ejercicio virtual equivalente que el propio estudiante seleccionaría entre los centros meteorológicos disponibles en internet. Se mantendría el cuestionario que habitualmente se utiliza en esta actividad y que el/la estudiante adaptaría adecuadamente

• A lo largo del curso, se programarán tareas sobre trabajos tutelados o cuestionarios on-line a través del Aula Virtual para repasar conceptos significativos de algunos temas de especial interés

• Para las tutorías o dudas que pueden surgir a lo largo del curso se utilizará el correo electrónico, chat del Aula Virtual o incluso podría programarse una sesión por videoconferencia BBC si fuera necesario

• Para los seminarios se invitará a algún conferenciante adecuado de prestigio, como se ha hecho habitualmente, que lo impartirla por videoconferencia BBC

Laboratorio

• La presencialidad será al 100% en el laboratorio, donde estudiantado y profesorado seguirán las normas de seguridad (uso de máscara obligatorio, limpieza de manos con gel hidroalcohólico, limpieza del material usado al final de cada sesión, etc)

• En caso de emergencia sanitaria y no ser posible la presencialidad, el profesorado facilitaría vídeos explicativos de las 4 prácticas a desarrollar en el laboratorio y, a continuación, datos experimentales (tomados en el propio laboratorio) a trabajar por parte del alumnado de forma no presencial, con el fin de desarrollar las memorias asociadas a dichas prácticas que sirven para evaluar esta parte de la asignatura.

4. Evaluación

El peso relativo de cada actividad se cambiaría de acuerdo con la siguiente distribución:

- Examen de Teoría: 50%
- Laboratorio: Memorias 30%
- Tutorías y Trabajos Tutelados
    - Visita científica virtual a centro meteorológico: 10%
    - Trabajos tutelados: 10%