COURSE INFORMATION

Meteorology and Climatology

Code number: 757709221(T2)
Degree in Environmental Sciences
Academic Year: 2016-2017
Compulsory course. 2nd year
First semester: 6 credits

Course schedule:

Classes: Tu 16.00-18.00. Common room iI. 4th floor Experimental Sciences
Problem sessions: We 11.30-12.30 (Same classroom. Ten problem sessions during the semester).
Lab sessions: Tu 11.00-14.00 (Four lab sessions during the semester)

Check for the final dates or any change in the Moodle module site.

TEACHING STAFF

Prof.: Francisco Pérez Bernal
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Office hours:

First Semester: Tu 16.00-18.00, We 12:00-14.00, Th 12:00-14:00

Second Semester: Tu 16.00-18.00, We 12:00-14.00, Th 12:00-14:00

Students are invited to come to my office to discuss a homework problem or any aspect of the course. during office hours or at other times after a previous email appointment.

SYLLABUS

1. Description

The present subject aim is to introduce the students to the basic physical processes that create our weather in the very different time and length scales involved, making special emphasis in the usage of problem solving techniques. Also the student is provided with simple tools to understand basic principles of weather forecasting, the different Earth climates, and an introduction to climate change.

2. Prerequisites

No formal prerequisites are demanded. 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. I highly encourage in-class participation and the solution of the problems proposed as homework as it can make a difference in the final grade.

3. Objectives/Learning Outcomes

At the end of the course student should be able to

- Understand how the interplay of solar radiation together with Earth characteristics and astronomical factors determines the surface-atmosphere energy balance and Earth climate distribution.
- Understand how dry air thermodynamics explains the concept of atmospheric stability and its consequences.
- Understand what are condensation phenomena and their implications in the atmospheric energy balance.
- Understand the forces that guide the direction and speed of winds in local and global scales.
- Understand the physical aspects that drive climate change.
- In addition to the previous items, students should have further developed critical thinking and problem solving skills after the course.

4. Teaching Methodology

The bulk of the subject will be presented in the classroom, with support from Moodle where students can find the class material slides as well as complementary material to facilitate their understanding of the subject. The reduced group sessions will be devoted to improve the comprehension of the subject, in particular, students will solve in the blackboard some of the problems included as homework assignments. This problems will substantially overlap with the lecture material and they will have an increasing difficulty.

Students working in groups of two or three are expected to give a short talk or seminar (15 minutes) before the end of the semester about a scientific paper, or they will expand upon a subject, covering some topics not discussed in the classroom.

There will be four laboratory sessions (3h each) covering different aspects of the subject and each group of 3-4 students will have approx. ten days to complete a lab report with the main results after each session. This report will be used to grade their lab skills. A lab handout for each lab session will be at your disposal in Moodle. You may discuss lab assignments with each other and work together towards solutions, but every group must write up their own solutions using the data obtained in the lab (one for all the members of the 3-4 students group).

5. Contents

1. Introduction. Weather and Climate. Atmospheric variables. The climatic system: the structure of the atmosphere. (1.5T)

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. (3TP)

3. Seasonal and Daily Temperatures in the Earth. Terrestrial distribution of temperature. Natural temperature controls. Daily and seasonal oscillations. Atmospheric thermometry. (1.5T)

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. (4TP)

6. Local winds. Atmospheric pressure variation. Pressure maps. Wind measure. Forces that determine wind direction and speed. Geostrophic and gradient winds. (2T)

7. Air masses and fronts. High and low pressure areas. Classification of air masses. Synoptic meteorology. Cyclogenesis and weather forecasting. (2T)

8. Global climate. Global wind and current systems. Global Circulation Patterns and Teleconnection Indexes. The Monsoons. World climate classification. (2.5T)

9. Climate change. History and evolution of the climate. Feedback mechanisms. Climatic models. Natural and anthropogenic causes of global warming. (2.5T)

Note.- Numbers between parentheses indicate the number of hours dedicated to each topic and if it consists only of (T)heory or also (P)roblems are included.

Laboratory sessions:

Session 1. Measuring air adiabatic index.
Session 2. Air density and humidity.
Session 3. Scalar fields and the synop code.
Session 4. The skew T/log p diagram.

6. BIBLIOGRAPHY

Basic textbook:

Meteorology Today. An introduction to weather, climate, and the environment, by C. Donald Ahrens. Ed. Brooks Cole. 2008.

Other references of interest:

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.

Students can find in the Moodle site for this module many links to documents and other material of interest for the different topics treated.

7. ASSESSMENT/GRADING

Grading breakdown is as follows:

20% lab sessions + 20% problem assignments and student's seminar + 60% final exam

The exam will contain multiple choice, and short essay questions (60% of the exam grade) and two problems (40% of the exam grade). A student is required to obtain a minimum of 35/100 grade in the exam to obtain the final grade average.