Course guide
2500237 - GEA0237 - Climate Change and Natural Risks

Last modified: 21/06/2024

Unit in charge: Barcelona School of Civil Engineering
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering.

Degree: BACHELOR'S DEGREE IN ENVIRONMENTAL ENGINEERING (Syllabus 2020). (Optional subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: OCTAVIO CESAR MÖSSO ARANDA

Others: JOSE ANTONIO JIMENEZ QUINTANA, OCTAVIO CESAR MÖSSO ARANDA, DANIEL SEMPERE TORRES

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
14458. Apply the methodologies of studies and evaluations of environmental impact and, in general, of environmental technologies, sustainability and waste treatment and of the management of international standards of environmental quality. Life cycle analysis, carbon footprint and water footprint and assess natural hazards (river, coastal floods, droughts, fires, soil erosion and landslides).
14465. Identify renewable energy generation techniques and energy transition concept.

Generical:
14440. Identify, formulate and solve problems related to environmental engineering.
14441. Apply the functions of consulting, analysis, design, calculation, project, construction, maintenance, conservation and exploitation of any action in the territory in the field of environmental engineering.
14442. To use in any action in the territory proven methods and accredited technologies, in order to achieve the greatest efficiency respect for the environment and the protection of the safety and health of workers and users.
14443. Apply the necessary legislation during the professional practice of environmental engineering.
14444. Apply business management techniques and labor legislation.

TEACHING METHODOLOGY

The course consists of 2.3 hours per week of classroom activity (large size group) and 1.2 hours weekly with half the students (medium size group).

The 2.3 hours in the large size groups are devoted to theoretical lectures, in which the teacher presents the basic concepts and topics of the subject, shows examples and solves exercises.

The 1.2 hours in the medium size groups is devoted to solving practical problems with greater interaction with the students. The objective of these practical exercises is to consolidate the general and specific learning objectives.

The rest of weekly hours devoted to laboratory practice.

Support material in the form of a detailed teaching plan is provided using the virtual campus ATENEA: content, program of learning and assessment activities conducted and literature.

Although most of the sessions will be given in the language indicated, sessions supported by other occasional guest experts may be held in other languages.

LEARNING OBJECTIVES OF THE SUBJECT

In this subject the causes and impacts of climate change and global and regional climate models will be studied. Next, the bases will be established for the evaluation, prediction and prevention of the impacts of hydrometeorological processes (river floods and "flash floods"), geological (stability of slopes, landslides and soil erosion), marine (coastal flooding due to the effects of storms of sea and change in the wave climate) and droughts, fires, heat waves and others.

1. Evaluate, predict and prevent impacts caused by hydrometeorological and geological processes, droughts, fires, heat waves and others.
2. Understand the causes and impacts of climate change from global and regional climate models.

Climate Change and Natural Risks. In this subject the causes and impacts of climate change and global and regional climate models will be studied.
Next, the bases for evaluation, prediction and prevention of the impacts of hydrometeorological processes (fluvial floods and "flash floods"), geological (slope stability, landslides and soil erosion), marine (coastal flooding due to storms) will be established. waves and change in wave climate) and droughts, fires, heat waves and others.

STUDY LOAD

Type	Hours	Percentage
Hours medium group	15,0	10.00
Hours small group	15,0	10.00
Self study	90,0	60.00
Hours large group	30,0	20.00

Total learning time: 150 h

CONTENTS

01.- Introduction. Climate System Review

Description:
Students will be introduced to the terrestrial climate system, showing the relationships between the ocean, the atmosphere and the continents. A comparison will be made between the physical properties of the sea and the atmosphere. The role of the ocean as a climate regulator and the role of the cryosphere will be shown.

Specific objectives:
Describe the Climate System from an Oceanographic Perspective and the relationship of the Ocean with the Atmosphere and the Continents. The role of the Cryosphere will be discussed.

Full-or-part-time: 14h 23m
Theory classes: 6h
Self study : 8h 23m

02.- Oceanic and Atmospheric Circulation

Description:
The most relevant aspects of ocean circulation at a global level will be shown
To show the general aspects of atmospheric general circulation. Distributions of high and low pressure centers and their relation to terrestrial climate.
To define the concept of atmospheric teleconnections and their relation to climate. Emphasis will be made on the ENSO, NAO, MOI indices.
There will be a review of the Thermal Balance on Earth and the effect of the atmosphere and greenhouse gases in the configuration of the Earth's climate.

Specific objectives:
Thermohaline Circulation and Wind Drag
Show the general aspects of the general atmospheric circulation. Distributions of high and low pressure centers and their relationship with the terrestrial climate. Define the concept of Atmospheric Teleconnections and its relationship with the weather.
Fundamentals of Thermal Balance Concept of Greenhouse Effect

Full-or-part-time: 19h 12m
Theory classes: 8h
Self study : 11h 12m

03.- Evolution of the Earth's Climate

Description:
A review of the fossil and geological climate records will be made.

Specific objectives:
The fossil records of the terrestrial climate will be shown. The climatic changes will be shown on a geological scale, the interglacial cycles of the Pleistocene and the climatic oscillations. The role of the industrial revolution in the current and future climate will be shown.

Full-or-part-time: 9h 36m
Theory classes: 4h
Self study : 5h 36m

04.- Climate Data Analysis

Description:
Two climatic data analysis techniques will be shown. One based on the time domain (trend analysis) and the other based on the frequency domain (spectral analysis).
Two climatic data analysis techniques will be shown. One based on the time domain (trend analysis) and the other based on the frequency domain (spectral analysis).

Specific objectives:
Basic aspects of Trend analysis (linear and flexible) will be shown. Basic aspects of Spectral analysis will be shown.
Basic aspects of Trend analysis (linear and flexible) will be shown. Basic aspects of Spectral analysis will be shown.

Full-or-part-time: 14h 23m
Theory classes: 2h
Practical classes: 4h
Self study : 8h 23m

06.- Climate Projections and Scenarios

Description:
Students will be shown which are the main climate models used and climate projections in different scenarios of greenhouse gas emissions
The main effects of the different emission scenarios and global warming on the European climate will be shown.
Students will be introduced to the concepts of Policies and routes for adaptation to climate change and natural risk management.

Specific objectives:
Show Climate Models and Projections
Show the effect of global warming on the European climate
Show the concepts of adaptation policies and routes. Show the concept of natural risk management

Full-or-part-time: 14h 23m
Theory classes: 6h
Self study : 8h 23m

07.- Climate Related Risks

Description:
Risks of Climatic Origin (Coastal, Meteorological, Continental and Socionatural) Observed and Projected
The main coastal and port risks associated with climate change will be shown. Special attention will be paid to the rise in the average sea level, the frequency and intensity of storms and the impact on the coasts and ports.
Students will be introduced to the concept of meteorological risk, paying special attention to changes in the frequency and intensity of storms, heat waves and extreme weather events in general.
Students will be introduced to the concept of Continental risk, paying special attention to floods, landslides, droughts and forest fires.
Students will be introduced to the concept of risk on ecosystems (continental, terrestrial and marine aquatics), emphasizing the concept of tropicalization, invasion of invasive species, introduction of infectious vectors.

Specific objectives:
Introduction to the concept of risk. Description of the different types of Natural and Socionatural Risks
Introduction to Coastal Risks
Introduction to Port Risks
Introduction to Weather Hazards
Introduction to Continental Risks.
Introduction to the concept of Risk on ecosystems

Full-or-part-time: 28h 47m
Theory classes: 12h
Self study : 16h 47m

08.- Sectoral Impacts of Climate Change

Description:
The student will be introduced to the main sectoral impacts derived from climate change
Students will be shown the main sectoral impacts derived from climate change, particularly on soils, agri-food systems, energy production and consumption, in industry, tourism, the insurance sector and human health.

Specific objectives:
Introduction of the concept of Seasonal Shift
The main effects of climate change on the productive sectors will be shown

Full-or-part-time: 14h 23m
Theory classes: 6h
Self study : 8h 23m

09.- Risk Assessment Methodologies Associated with Climate Change

Description:
Various methodologies for assessing the risk associated with climate change will be shown. Special attention will be paid to

Specific objectives:
Different methodologies will be shown for the evaluation of the risk associated with climate change

Full-or-part-time: 9h 36m
Theory classes: 4h
Self study : 5h 36m

10.- Analysis of Impacts Associated to Climate Change at a Local Scale

Description:
An introduction will be made on different methodologies for the analysis of impacts associated with climate change.
An introduction will be made on different methodologies for the analysis of impacts associated with climate change, emphasizing practical examples and Team work.

Specific objectives:
Introduction to impact analysis
Introduction to impact analysis

Full-or-part-time: 14h 23m
Theory classes: 2h
Practical classes: 4h
Self study : 8h 23m

11.- Measures for Adaptation and Mitigation of Natural Risks

Description:
Students will be introduced to the concepts of adaptation and mitigation of natural risks

Specific objectives:
Introduction to the concepts of adaptation and mitigation to climate change

Full-or-part-time: 4h 48m
Theory classes: 2h
Self study : 2h 48m

GRADING SYSTEM

Ordinary Evaluation (EO) The qualification of the continuous evaluation is the weighted arithmetic mean of the exercises/problems (Pr) carried out during the course, of the directed activities such as assignments or reports (Tr) and of the partial exams (Ex, which will have the same value). There will be two partial exams and they will count for 70% of the grade. Problems will count 15% and directed activities will count 15%. The final mark will be EO=0.7*(average of Ex1 and Ex2)+0.15*(average of Pr) +0.15*(average of Tr). To pass, the EO grade must be greater than or equal to 5. Re-evaluation (RE) Qualification and admission criteria for re-evaluation (Re): Students who have failed the ordinary evaluation and who have regularly attended the assessment tests of the failed subject will have the option to take a reassessment test in the period set in the academic calendar. Students who have already passed or students who have not been submitted or who have not handed in all the exercises/problems (Pr) and the papers and reports (Tr) may not take the reassessment test of a subject. The reassessment (RE) will consist of a single exam that covers all the content of the course. The maximum grade for the reassessment will be five (5.0) and the final grade for the course will be the maximum grade between the continuous assessment and the reassessment exam, that is, MAX(EO/RE). The non-attendance of a student summoned to the re-evaluation test, held in the set period, may not lead to another test at a later date. Extraordinary evaluations will be carried out for those students who, due to accredited force majeure, have not been able to take any of the continuous evaluation tests. These tests must be authorized by the corresponding head of studies, at the request of the professor responsible for the subject, and will be carried out within the corresponding school period.

EXAMINATION RULES.

If any of the laboratory or continuous assessment activities are not carried out in the scheduled period, it will be considered a zero score. The tests will be carried out individually, with multiple choice questions that can be theoretical or problem type questions. The exams can include short questions to be developed by the students and exercises to be solved.

BIBLIOGRAPHY

Basic:

- Keller, Edward A.; Blodgett, Robert H.. Riesgos naturales : procesos de la tierra como riesgos, desastres y catástrofes. Madrid: Pearson Prentice Hall, 2007. ISBN 9788483223369.