Course guide
2500217 - GEA0217 - Atmospheric Processes and Hydrology

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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). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: DANIEL SEMPERE TORRES

Others: GONZALO JAVIER OLIVARES CERPA, SHINJU PARK, BENIAMINO RUSSO, DANIEL SEMPERE TORRES

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
14445. Recognize the biological bases and foundations of the plant and animal field in engineering: notions of genetics, biochemistry and metabolism, physiology, organisms and environment, population dynamics, flows of matter and energy and changes in ecosystems, biodiversity, principles of the kinetics of microbial growth and reactor theory.
14447. Obtain basic knowledge about the use and programming of computers, operating systems, databases and basic numerical calculation and applied to engineering.
14451. Apply the fundamental concepts of statistics and randomness of physical, social and economic phenomena, as well as uncertainty and decision-making techniques.
14452. Enhance the capacity of spatial vision and identify the techniques of graphic representation, topography, photogrammetry, cartography, remote sensing and Geographic Information systems.
14453. Describe and apply the techniques of analysis of physical, chemical and biological parameters; Integrate the experimental evidence found in field and / or laboratory data with the theoretical knowledge and interpret its results.
14454. Formulate the principles of fluid mechanics and the fundamentals of continuous medium mechanics.
14455. Identify the concepts and technical aspects linked to the conduit systems, both in pressure and in free sheet and apply them to the water supply transport networks; pumping systems; unit networks; separative networks; Avenues prevention systems in urban areas and analysis of tools for the recovery of altered river and coastal spaces.
14456. Describe the processes linked to the water cycle: atmospheric circulation and rain formation; rain transformation into runoff; and apply them to surface and underground hydrology associated with avenues risk, surface water pollution, aquifer management and groundwater pollution.

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.

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

The water cycle in its atmospheric and surface component will be studied. Thus, the bases of atmospheric circulation, its relationship with the formation of waves and currents in the sea, as well as the relationship of the climate with extreme events (droughts and flood risk) will be raised. The processes and methods of transforming rain into runoff will be analyzed. Finally, the main processes of surface water contamination will be considered, thus giving an overview of surface hydrology in general and providing the capacity for its application to engineering problems.

1. Understand the fundamentals of atmospheric circulation and the relationships of climate with extreme events (droughts and flood risk).
2. Apply methods associated with the atmospheric and surface water cycle for surface hydrological modeling: transformation methods of rain in runoff and flood propagation methods.
3. Know the main processes of surface water contamination by anthropic origin, by degradation of organic matter (hypoxia, anoxia) or eutrophication.

Atmospheric Processes and Hydrology. The water cycle in its atmospheric and surface component will be studied. Thus the bases of atmospheric circulation will be raised, its relation with the formation of waves and currents in the sea, as well as the relation of the climate with extreme episodes (droughts and flood risk). I know they will analyze the processes and methods of transforming rain into runoff. Finally, the main processes of surface water contamination will be considered.

The specific objectives are: 1.- to identify the main phenomena of the hydrological cycle, the main associated physical processes, as well as their quantification through mathematical modelling. 2.- Acquire the necessary knowledge to be able to interpret the maps and products provided by observations and forecasts of meteorological models usually available. In particular to be able to interpret various meteorological situations and their relationship with the generation of precipitation. 3.- Acquire the necessary knowledge to carry out a basic hydrological quantification study in a basin, including the quantification of the expected rain with a certain probability threshold, the characterization of the associated hydrograph and the flow towards, in the saturated zone . Emphasis will be placed on the notion of risk, with application to the management of water resources to the understanding of the phenomenon of high tides and floods and the implications of knowing the quality of the resource. 4.- Understand the transport phenomena that occur in the atmosphere, aquifers and rivers and their interaction with the coastal zone. The focus of the subject is to be able to provide not only a basic description of these processes, but also the methods to estimate the key variables in the hydrological cycle.

STUDY LOAD

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

Type	Hours	Percentage
Hours small group	15,0	10.00

Total learning time: 150 h

CONTENTS

Introduction to hydrological processes and basin analysis

Description:
Introduce the student to general concepts of surface hydrology and basins analysis

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

Design storms

Description:
Present the IDF or DDF curves and propose exercises with their information
Introduce the student to the typical types of project rains and compare results for the various types

Full-or-part-time: 12h
Theory classes: 2h 30m
Practical classes: 2h 30m
Self study : 7h

Net Rain: Precipitation Losses

Description:
Present to the student the common loss processes in a basin
ET estimation procedures. ETo and actual ET. infiltration Concept and models
Show the student the model of the curve number, based on the SCS proposal
Exercises to obtain net rain from NC and other loss models

Full-or-part-time: 16h 48m
Theory classes: 6h
Practical classes: 1h
Self study : 9h 48m

Rain - flow transformation

Description:
runoff calculation: unit hydrograph, reservoir model and kinematic wave models
Concept of unit hydrograph, real and synthetic. Obtaining from field measurements
Excercises on Unit Hydrograph

Full-or-part-time: 12h
Theory classes: 4h
Practical classes: 1h
Self study : 7h

Propagation in natural channels

Description:
Propagation in channels and lamination effect produced by reservoirs as a protection solution against floods
Hydrological methods of propagation: Muskingum. Formulation, time steps, subreaches,

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

Water quality in fluvial environments

Description:
Introduce basic concepts on water quality in fluvial environments.

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

Introduction to the HEC-HMS code

Description:
HMS hydrological model Public domain model
Course work with HMS. Dam design and its associated reservoir

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

Exam Surface Hidrology

Full-or-part-time: 2h 24m
Laboratory classes: 1h
Self study : 1h 24m

The hydrological cycle

Description:
Introduction to the subject. Evaluation system. The hydrological cycle. Hydrometeorological processes.

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

Atmospheric Processes

Description:
Atmospheric pressure. Hydrostatic balance, hypsometric curve. Layers of the atmosphere. Pressure gradients. winds geostrophic wind Surface wind. Solar radiation, differential heating on a planetary scale, temperature distribution. thermal imbalance

Full-or-part-time: 9h 36m
Theory classes: 2h
Laboratory classes: 2h
Self study : 5h 36m

Spatial analysis of rainfall, IDF curves

Description:
Planetary-scale mass and energy transport processes: thermal imbalance and planetary-scale winds.
Precipitation generation processes. Convective and stratiform processes.

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

Atmospheric thermodynamics

Description:
Atmospheric thermodynamics: Thermodynamics of dry air and moist air. Adiabatic and pseudoadiabatic processes.
Thermodynamic diagrams. radiosondes
Interpretation of radio soundings and anticipation of phenomena based on pressure, temperature and humidity profiles.
Atmospheric stability. Cloud and precipitation generation processes. Analysis in thermodynamic diagrams. LCC, CAPE and CIN
Exercises with thermodynamic diagrams

Full-or-part-time: 19h 12m
Theory classes: 6h
Practical classes: 2h
Self study : 11h 12m

Precipitation generation processes

Description:
Air masses fronts Jet stream and main atmospheric oscillations. Cyclogenesis.
12. Observation and measurement of precipitation.

Full-or-part-time: 9h 36m
Theory classes: 2h
Practical classes: 2h
Self study : 5h 36m

Meteorological Models

Description:
Meteorological forecast.
Practice with meteorological models
Practice with meteorological models

Full-or-part-time: 19h 12m
Theory classes: 2h
Practical classes: 2h
Laboratory classes: 4h
Self study : 11h 12m

GRADING SYSTEM

The subject's grade is obtained from the continuous assessment grades of the two parts in which it is composed. Each has a partial exam and an evaluable assignment or practice, in addition to class exercises. The exams are not cumulative in the subject. The course grade is obtained as the average of the following activities:
-First partial exam 40%
-Class exercises and report on meteorological model practices: 10%
-Second partial exam: 30%
-Hydrology practices: 7 .5%
- Hydrology work: 12.5%
If you do not pass the continuous assessment, or if you do not attend any of the assessable activities, you may take a revaluation exam in which the weight of each of them will be 50%.

BIBLIOGRAPHY

Basic:
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- Stull, R. Practical meteorology: an algebra-based survey of atmospheric science. Vancouver: University of British Columbia, 2015. ISBN 9780888651761.
- Nanía Escobar, L.S.; Gómez Valentín, M. Ingeniería hidrológica. 2a ed. Granada: Grupo Editorial Universitario, 2006. ISBN 8484916367.
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Complementary:
- Maidment, D. Handbook of hydrology. New York: McGraw-Hill, 1993. ISBN 0070397325.
- Viessman, W. Introduction to hydrology. 5th ed. Upper Saddle River: Prentice Hall, 2003. ISBN 067399337X.
- Shaw, E.M. Hydrology in practice. 4th ed. Londres: Spon Press, 2011. ISBN 9780415370424.
- Davie, T. Fundamentals of hydrology. 3rd ed. London: Routledge, [2019]. ISBN 9780415858700.
- Bedient, P.B.; Huber, W.C.; Vieux, B.E. Hydrology and floodplain analysis. 4th ed. Upper Saddle River, NJ: Prentice Hall, 2008. ISBN 9780131745896.
- Subramanya, K. Engineering hydrology. 4a ed. New Delhi: McGraw Hill, 2013. ISBN 9789383286539.
- Chow,, V.T.; Maidment, D.R.; Mays, L.W. Applied hydrology. New York: McGraw-Hill, 1988. ISBN 0070108102.