Course guide
250430 - HIDURB - Urban Hydrology

Last modified: 30/06/2025

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

Degree: MASTER'S DEGREE IN CIVIL ENGINEERING (PROFESSIONAL TRACK) (Syllabus 2012). (Optional subject).
MASTER'S DEGREE IN WATER ENGINEERING (Syllabus 2025). (Optional subject).

Academic year: 2025 **ECTS Credits:** 5.0 **Languages:** English

LECTURER

Coordinating lecturer: BENIAMINO RUSSO

Others: BENIAMINO RUSSO

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
8230. The ability to plan, dimension, construct and maintain hydraulic works.
8231. The ability to plan, evaluate and regulate the use of surface water and groundwater resources.

Transversal:
8559. ENTREPRENEURSHIP AND INNOVATION: Being aware of and understanding the mechanisms on which scientific research is based, as well as the mechanisms and instruments for transferring results among socio-economic agents involved in research, development and innovation processes.
8560. SUSTAINABILITY AND SOCIAL COMMITMENT: Being aware of and understanding the complexity of the economic and social phenomena typical of a welfare society, and being able to relate social welfare to globalisation and sustainability and to use technique, technology, economics and sustainability in a balanced and compatible manner.

8561. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

TEACHING METHODOLOGY

The course consists of 1,8 hours per week of classroom activity (large size group) and 0,8 hours weekly with half the students (medium size group).

The 1,8 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 0,8 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 courseworks

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

General objectives
Specialization subject in which knowledge on specific competences is intensified.
Knowledge and high specialized skills that permit the development and application of techniques and methodologies at advanced level.
Contents of specialization at master level related to research or innovation in the field of engineering.

Specific objectives
Provide a detailed knowledge about the main hydrological processes in urban areas during rain events, design storms, hydrological losses in urban areas, inlet systems, hydraulics of sewers, sustainable urban drainage systems, combined sewer overflows (CSO), most common softwares to simulate hydrological and hydraulic response of urban catchments.

STUDY LOAD

Type	Hours	Percentage
Self study	80,0	63.95
Hours medium group	9,8	7.83
Hours small group	9,8	7.83
Hours large group	25,5	20.38

Total learning time: 125.1 h

CONTENTS

Urban Drainage: Introduction

Description:
Introduction of the general concept of Urban Drainage and the objectives associated to the drainage system: rainfall data, urban basins, sewer system, flooding, overflows to receiving waters and related impacts.

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

Design criteria and flood risk assessment framework

Description:
In this session we introduce the main design criteria used in drainage systems: type of sections, maximum and minimum velocities, etc.
Flood risk assessment framework. Definition of the concept of hazard, exposure, vulnerability and risk. Socio-economic and environmental impacts. Return period.

Full-or-part-time: 7h 11m
Theory classes: 3h
Self study : 4h 11m

Rainfall data: design storms and rainfall patterns

Description:
In this sessions, rainfall data needed to perform a detailed hydrologic study in urban areas is presented. Real and synthetic Intensity-Duration-Frequency and design storms used in the professional practice are introduced.
Design Storms Examples and applications

Full-or-part-time: 11h
Theory classes: 2h 30m
Practical classes: 1h 30m
Self study : 7h

Precipitation losses in urban areas

Description:
Description of the theoretical concepts of the most common loss models used in urban drainage.
Examples and applications of the different loss processes in urban environment.

Specific objectives:
Learn to estimate hydrological losses in different urban contexts.

Full-or-part-time: 5h 48m
Theory classes: 1h 30m
Practical classes: 1h 30m
Self study : 2h 48m

Rainfall – Runoff transformation in urban catchments

Description:
Description of the most common techniques (reservoir model, kinematic wave model, rational method) for the simulation of the rainfall-runoff transformation process. Examples and applications

Full-or-part-time: 4h 48m
Theory classes: 1h
Practical classes: 1h
Self study : 2h 48m

Inlet systems: hydraulic behavior

Description:
Hydraulic analysis of grate inlets. Experimental procedures. Concept of efficiency and captured flow.

Specific objectives:
Provide to the student the concepts of the hydraulic behaviour of a grated inlet. Characterization of hydraulic efficiency and estimation of captured flows.

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

Street flow: flood hazard criteria

Description:
Street network and street flow. Maximum flow in a street. Flood hazard criteria in terms of maximum flow, water level, velocity, etc.
Calculation of the optimum distance between consecutive inlets.

Specific objectives:
Provide to the student the concept of surface flow along the street network during a rain event. Estimation of the maximum acceptable flow in a street. Definition of flood hazard criteria associated to street flow. Apply the concepts of flood hazard, street flow and inlet hydraulics to define the spacing between two inlets. Simulations through hydrological tool.

Related activities:
Coursework 1: design of optimal inlets spacing.

Full-or-part-time: 12h
Theory classes: 2h
Laboratory classes: 3h
Self study : 7h

Detention tanks. Design and maintenance

Description:
Description and classification of storm tanks with hydraulic (anti-flooding) and environmental (anti-pollution) functions. Design and maintenance criteria.

Specific objectives:
Introduce to the student the concept of a detention basin. Advantages and disadvantages. Dimensions and other elements for inlet and outlet. Cleaning and maintenance criteria.
Observe through a real case the main characteristics of a detention basin.

Related activities:
Field visit to a storm storage tank in the Barcelona Metropolitan Area.

Full-or-part-time: 10h 55m
Theory classes: 2h 30m
Practical classes: 3h 05m
Self study : 5h 20m

SUDS: Sustainable Urban Drainage Systems

Description:
Description and classification of the most common urban sustainable drainage systems. Design and maintenance criteria.

Specific objectives:
Provide to the student the vision of the "soft" techniques, trying to reduce runoff and water quality pollution during rain events.

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

Hydraulic behaviour of sewer systems

Description:
Hydraulic behaviour of sewer systems. Steady and unsteady flow approaches.

Specific objectives:
Introduce to the specific aspects of the hydraulic behaviour of sewer networks: free surface and pressure flow.

Full-or-part-time: 6h 48m
Theory classes: 2h
Self study : 4h 48m

Monitoring of sewer networks

Description:
Description of the most used monitoring equipment in the field of urban drainage. Selection, location and maintenance criteria.

Full-or-part-time: 5h 04m
Theory classes: 1h
Practical classes: 2h
Self study : 2h 04m

Assessment

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

Quality aspects of receiving waters

Description:
Water quality aspects and sewer system overflows. Simulation and real measurements.

Specific objectives:
Introduce the CSO and SSO concepts and the risk to receiving waters during wet weather conditions.

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

Available commercial codes

Description:
Mos common commercial codes: SWMM5, InfoWorks, Mike-Urban and others
Introduction on modelling and and test case through SWMM5 code.

Specific objectives:
Present to the student the main commercial coeds available to the practitioner to use in urban drainage
Introduce the public domain code SWMM5 developed by the EPA and its main capabilities.

Related activities:
Coursework 2: Sewer system analysis. Model calibration. Simulation and rehabilitation of a network with SWMM5.

Full-or-part-time: 22h 50m
Theory classes: 1h
Laboratory classes: 8h 30m
Self study : 13h 20m

GRADING SYSTEM

The mark of the course is obtained from the ratings of continuous assessment (courseworks developed during the semester and a final exam).

The final exam consits of questions about concepts associated with the learning objectives of the course.

Final mark (from 0 to 10): 70% rank of the final exam and 30% of the courseworks.

The professor may call the student to validate the grades through an oral examination of the answers provided in the evaluable activities.

EXAMINATION RULES.

Failure to perform a laboratory or continuous assessment activity in the scheduled period will result in a mark of zero in that activity.

BIBLIOGRAPHY

Basic:
- Butler, D.; Digman, C.; Makropoulos, C.; Davies, J. Urban drainage. 4th ed. Boca Raton: CRC Press, Taylor & Francis, 2018. ISBN 9781498750585.
- Gómez Valentín, M. Curso de hidrología urbana. Barcelona: Escola Tècnica Superior d'Enginyers de Camins, Canals i Ports. Universitat Politècnica de Catalunya (UPC), 2008. ISBN 978-84-612-1514-0.
- Mays, L.W. (ed.). Stormwater collection systems design handbook. New York: McGraw-Hill, 2001. ISBN 0071354719.
- Gómez Valentín, M. Curso de depósitos de retención de aguas pluviales. Barcelona: Mcharly, 2009. ISBN 9788461371013.
- Gómez Valentín, M. Curso de análisis y rehabilitación de redes de alcantarillado mediante el código SWMM 5.0. Barcelona: Escola Tècnica Superior d'Enginyers de Camins, Canals i Ports. Universitat Politècnica de Catalunya (UPC), 2007. ISBN 9788461178179.

Complementary:
- Pazwash, H. Urban storm water management [on line]. Boca Raton: CRC Press, 2011 [Consultation: 29/01/2020]. Available on: https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=688520. ISBN 9781439810361.
- Akan, A.O.; Houghtalen, R.J. Urban hydrology, hydraulics, and stormwater quality: engineering applications and computer modeling. Hoboken: J. Wiley & Sons, 2003. ISBN 0471431583.
- Tota-Maharaj, K. Permeable pavements for urban stormwater runoff enhancement and reuse. Saarbrücken: VDM Dr. Müller, 2011. ISBN 9783639365061.
- Wanielista, M.P.; Yousef, Y.A. Stormwater management. New York: J. Wiley, 1993. ISBN 0471571350.
- Centro de Estudios Hidrográficos. Guía técnica sobre redes de saneamiento y drenaje urbano. 3a ed. Madrid: Ministerio de Fomento. Secretaría General Técnica. Centro de Publicaciones : CEDEX, 2009. ISBN 9788477904915.