

Course guides

250430 - HIDURB - Urban Hydrology

Last modified: 06/10/2020

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 CIVIL ENGINEERING (PROFESSIONAL TRACK) (Syllabus 2012). (Optional subject).	
Academic year: 2020	ECTS Credits: 5.0	Languages: English

LECTURER

Coordinating lecturer:	MANUEL GOMEZ VALENTIN
Others:	MANUEL GOMEZ VALENTIN, 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.

LEARNING OBJECTIVES OF THE SUBJECT

Specialization subject in which knowledge on specific competences is intensified.

Knowledge and skills at specialization level 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.

Provide a detailed knowledge of the main processes in urban areas during rain events, design storms, losses, inlet systems, hydraulic calculus and CSO problems, and the tools to develop a project of a sewer system emphasizing the hydrologic and hydraulic behaviour

STUDY LOAD

Type	Hours	Percentage
Laboratory classes	9,8	7.83
Theory classes	19,5	15.59
Practical classes	9,8	7.83
Guided activities	6,0	4.80
Self study	80,0	63.95

Total learning time: 125.1 h

CONTENTS

Urban Drainage: Introduction

Description:

To introduce the concept of Urban Drainage and the objectives associated to the drainage system: the rainfall data, the urban environments, a sewer system, a collecting system and the overflows to receiving waters and the impacts associated.

Full-or-part-time: 2h 24m

Theory classes: 1h

Self study : 1h 24m

Design Criteria

Description:

In this session we introduce the main design criteria used in drainage systems: type of sections, maximum and minimum velocities, etc

Risk criteria in sewer systems: hazard and risk. Return period. Concept of hazard and risk. Economic assessment

Design rainfall in different cities around the world: Exercise

Specific objectives:

Provide to the students the concepts of return period associated to the sewer design, and the concepts of hazard and risk, and the use in new sewer systems or rehabilitation of existing sewers

To compare the design criteria of different cities, differences and similarities

Full-or-part-time: 14h 23m

Theory classes: 4h

Practical classes: 2h

Self study : 8h 23m

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. IDF real or synthetic are presented. Design storms used in the professional practice are introduced
Design Storms Examples and applications

Full-or-part-time: 7h 11m

Theory classes: 2h

Practical classes: 1h

Self study : 4h 11m

Losses in urban areas

Description:

Description of the different loss processes in urban environment

Full-or-part-time: 2h 24m

Practical classes: 1h

Self study : 1h 24m

Street flow: risk criteria

Description:

Hydraulic analysis of grate inlets. Experimental procedures. Concept of efficiency. Carry over flow.
Street network and street flow. Maximum flow in a street. Risk criteria in terms of maximum flow, water level, velocity, etc.
Calculation of the best distance between consecutive inlets
Test case: design of optimal location of inlets. Visit to the laboratory to observe a hydraulic test of a single inlet

Specific objectives:

Provide to the student the concepts of the hydraulic behaviour of a single grate inlet. Explain how to characterize with a power function the efficiency values of any inlet

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 risk criteria associated to street flow

Apply the concepts of risk flow, hydraulic parameters of an inlet, to define the best location for inlets at any street

Full-or-part-time: 14h 23m

Theory classes: 3h

Practical classes: 3h

Self study : 8h 23m

SUDS Sustainable Urban Drainage Systems

Description:

SUDS. Retention and infiltration. Porous pavements. Infiltration trench. Other techniques

Specific objectives:

Provide to the student the vision of the "soft" techniques, trying to reduce the runoff during rain events

Full-or-part-time: 4h 48m

Theory classes: 2h

Self study : 2h 48m



Assessment

Full-or-part-time: 9h 36m

Laboratory classes: 4h

Self study : 5h 36m

Hydraulic behaviour of sewer systems

Description:

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

Detention basins. Hydraulic behaviour. Inlet and outlet. Design criteria. Maintenance and operation

Visit to the detention basins located in Cornellá

Specific objectives:

Introduce to the specific aspects of the hydraulic behaviour of sewer networks: free surface and pressure flow, front waves, hydraulic jumps, trapped air, etc

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 two different examples the benefits and operation and maintenance of real detention basins

Full-or-part-time: 14h 23m

Theory classes: 3h

Laboratory classes: 3h

Self study : 8h 23m

CSO problems. Quality aspects of receiving waters

Description:

Concept of CSO and SSO. Water quality aspects. Organic and inorganic matter. CSO components. Simulation and real measurements

CSO test case

Specific objectives:

Introduce the CSO concepts and the risk to receiving waters in wet weather conditions

To show an example of CSO problem

Full-or-part-time: 7h 11m

Theory classes: 3h

Self study : 4h 11m

Commercial codes available

Description:

Commercial codes most used: SWMM5, InfoWorks, Mike-Urban and others

SWMM5 code. Introduction and test cases

Coursework on sewer system analysis. Rehabilitation of a network with SWMM5

Specific objectives:

Present to the student the main commercial codes available to the practitioner to use in urban drainage

Introduce a public domain code SWMM5 developed by the EPA, and their possibilities

Full-or-part-time: 14h 23m

Theory classes: 1h

Practical classes: 5h

Self study : 8h 23m



Pilot catchments

Description:

Concept of pilot catchment. Selection criteria. Rain gages. Flow gauges. Measurements of pollutants

Full-or-part-time: 2h 24m

Laboratory classes: 1h

Self study : 1h 24m

GRADING SYSTEM

The mark of the course is obtained from the ratings of continuous assessment and their corresponding laboratories and/or classroom computers.

Continuous assessment consist in several activities, both individually and in group, of additive and training characteristics, carried out during the year (both in and out of the classroom).

The teachings of the laboratory grade is the average in such activities.

The evaluation tests consist of a part with questions about concepts associated with the learning objectives of the course with regard to knowledge or understanding, and a part with a set of application exercises.

Final Test and Courseworks, mark from 0 to 10

Nota final: 0.5 Final Test + 0.5 Courseworks

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.