250430 - HIDURB - Urban Hydrology

Coordinating unit: 250 - ETSECCPB - Barcelona School of Civil Engineering
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering
Academic year: 2015
Degree: MASTER'S DEGREE IN CIVIL ENGINEERING (PROFESSIONAL TRACK) (Syllabus 2012). (Teaching unit Optional)
MASTER'S DEGREE IN CIVIL ENGINEERING (RESEARCH TRACK) (Syllabus 2009). (Teaching unit Optional)
ECTS credits: 5  Teaching languages: English

Teaching staff
Coordinator: MANUEL GOMEZ VALENTIN
Others: JORGE CABOT PLE, MANUEL GOMEZ VALENTIN

Opening hours
Timetable: Friday afternoon, from 16 to 20 h
Building D1, room 205

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.

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 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.

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.
250430 - HIDURB - Urban Hydrology

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.

<table>
<thead>
<tr>
<th>Study load</th>
<th>Time (h)</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td><strong>Total learning time:</strong> 125h</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theory classes:</td>
<td>19h 30m</td>
<td>15.60%</td>
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<tr>
<td>Practical classes:</td>
<td>9h 45m</td>
<td>7.80%</td>
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<tr>
<td>Laboratory classes:</td>
<td>9h 45m</td>
<td>7.80%</td>
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<tr>
<td>Guided activities:</td>
<td>6h</td>
<td>4.80%</td>
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<tr>
<td>Self study:</td>
<td>80h</td>
<td>64.00%</td>
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</table>
# Content

<table>
<thead>
<tr>
<th>Urban Drainage: Introduction</th>
<th>Learning time: 2h 24m</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Theory classes: 1h</td>
</tr>
<tr>
<td></td>
<td>Self study : 1h 24m</td>
</tr>
<tr>
<td>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.</td>
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<table>
<thead>
<tr>
<th>Design Criteria</th>
<th>Learning time: 14h 23m</th>
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</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Theory classes: 4h</td>
</tr>
<tr>
<td></td>
<td>Practical classes: 2h</td>
</tr>
<tr>
<td></td>
<td>Self study : 8h 23m</td>
</tr>
<tr>
<td>In this session we introduce the main design criteria used in drainage systems: type of sections, maximum and minimum velocities, etc.</td>
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<tr>
<td><strong>Specific objectives:</strong></td>
<td>Design rainfall in different cities around the world: Exercise</td>
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<tr>
<td>Provision 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</td>
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<tr>
<td>To compare the design criteria of different cities, differences and similarities</td>
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<table>
<thead>
<tr>
<th>Rainfall data: design storms and rainfall patterns</th>
<th>Learning time: 7h 11m</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Theory classes: 2h</td>
</tr>
<tr>
<td>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.</td>
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<tr>
<td><strong>Specific objectives:</strong></td>
<td>Practical classes: 1h</td>
</tr>
<tr>
<td>Design Storms Examples and applications</td>
<td>Self study : 4h 11m</td>
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</tbody>
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<thead>
<tr>
<th>Losses in urban areas</th>
<th>Learning time: 2h 24m</th>
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<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Practical classes: 1h</td>
</tr>
<tr>
<td>Description of the different loss processes in urban environment</td>
<td>Self study : 1h 24m</td>
</tr>
</tbody>
</table>
# Street flow: risk criteria

**Learning time:** 14h 23m  
Theory classes: 3h  
Practical classes: 3h  
Self study : 8h 23m

### Description:
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

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# SUDS Sustainable Urban Drainage Systems

**Learning time:** 4h 48m  
Theory classes: 2h  
Self study : 2h 48m

### 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

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# Assessment

**Learning time:** 9h 36m  
Laboratory classes: 4h  
Self study : 5h 36m
## Hydraulic behaviour of sewer systems

**Learning time:** 14h 23m

- **Theory classes:** 3h
- **Laboratory classes:** 3h
- **Self study:** 8h 23m

### 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

## CSO problems. Quality aspects of receiving waters

**Learning time:** 7h 11m

- **Theory classes:** 3h
- **Self study:** 4h 11m

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

### Specific objectives:
- Introduce the CSO concepts and the risk to receiving waters in wet weather conditions
- To show and example of CSO problem

## Commercial codes available

**Learning time:** 14h 23m

- **Theory classes:** 1h
- **Practical classes:** 5h
- **Self study:** 8h 23m

### 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 coeds available to the practitioner to use in urban drainage
- Introduce a public domain code SWMM5 developed by the EPA, and their possibilities
**Pilot catchments**

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<th>Description:</th>
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**Learning time:** 2h 24m
- Laboratory classes: 1h
- Self study: 1h 24m

### Qualification 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.

Test1, Test2 and Courseworks, mark from 0 to 10
Nota final: 0.5(0.5*Test1+0.5Test2) + 0.5 Courseworks

### Regulations for carrying out activities

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:


Complementary:


