820013 - MF - Fluid Mechanics

Coordinating unit: 295 - EEBE - Barcelona East School of Engineering
Teaching unit: 729 - MF - Department of Fluid Mechanics
Academic year: 2017
Degree: BACHELOR'S DEGREE IN BIOMEDICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN ENERGY ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN MATERIALS ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
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BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)

ECTS credits: 6 Teaching languages: Catalan, Spanish

Teaching staff
Coordinator: CARLOS RUIZ MOYA - JOSEP XERCAVINS VALLS
Others: VICENTE BITRIAN - ALBERT CARBÓ - ALFRED FONTANALS - CARLOS RUÍZ - JOSEP XERCAVINS

Requirements
Co-requisites: Mathematics II, Physics II

Degree competences to which the subject contributes

Specific:
2. Understand the basic principles of fluid mechanics and its application to problems in the field of engineering.
   Calculate the parameters of ducts, channels and fluid systems.

Transversal:
1. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to
   favor communication, task assignment and cohesion.

Teaching methodology

The subject will be developed using master classes to present the contents to the students. The students will have to do
individual work for problem solving and test preparing, and also team work for lab experiences and complex problem
solving.

Learning objectives of the subject

Giving the students the knowledge and basic skills on this subject in order to prepare him for professional tasks related to
the contents of it, and at the same time encouraging the training and learning processes in the field of fluid mechanics
engineering.

Co-requisites: Mathematics II, Physics II

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### Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group:</th>
<th>45h</th>
<th>30.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours medium group:</td>
<td>0h</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>Hours small group:</td>
<td>15h</td>
<td>10.00%</td>
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<td></td>
<td>Guided activities:</td>
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<tr>
<td></td>
<td>Self study:</td>
<td>90h</td>
<td>60.00%</td>
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</table>
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## Content

| 1. Fundamentals concepts. Fluid Properties. | **Learning time:** 21h 30m  
Theory classes: 7h 30m  
Laboratory classes: 1h  
Self study: 13h |
|---|---|
| **Description:**  
**Specific objectives:**  
Understanding the basic concepts of fluid mechanics. Identifying different kinds of problems in fluid mechanics. Applied knowledge of basic fluid properties and the influence of viscosity on friction in fluid flow. |

| 2. Hydrostatics. | **Learning time:** 18h 30m  
Theory classes: 6h 30m  
Laboratory classes: 1h  
Self study: 11h |
|---|---|
| **Description:**  
**Specific objectives:**  
Achieving the capacity to determine the pressure distribution in a still fluid, to calculate hydrostatic forces over flat and curved submerged surfaces and to determine the pressure distribution in fluids in motion as rigid solids. |

| 3. Basic concepts for flow analysis. | **Learning time:** 10h 30m  
Theory classes: 3h 30m  
Laboratory classes: 1h  
Self study: 6h |
|---|---|
| **Description:**  
**Specific objectives:**  
Understanding the use of the material derivative for connecting the Eulerian and the Lagrangian approach, identifying different flow visualization techniques, understanding the use of Reynolds' transport theorem and knowing the differential, integral, experimental and computational techniques used for flow analysis. |
### 4. Basic integral equations in fluid mechanics (I).

<table>
<thead>
<tr>
<th>Learning time: 40h 30m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes: 14h 30m</td>
</tr>
<tr>
<td>Laboratory classes: 1h</td>
</tr>
<tr>
<td>Self study: 25h</td>
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</tbody>
</table>

**Description:**
- Continuity equation: massic and volumetric flow.
- Energy equation.
- Bernoulli equation.
- Scope and limitations.
- Velocity and flow rate meters.

**Specific objectives:**
- Correctly applying the concepts of compressibility and steadiness in flow determination.
- Identifying and correctly estimating the different forms of mechanical energy together with the efficiency in their transformations.
- Correctly using Bernoulli’s equation in solving basic hydraulic problems and in velocity and flow rate meters.

### 5. Basic integral equations in fluid mechanics (II).

<table>
<thead>
<tr>
<th>Learning time: 25h</th>
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</thead>
<tbody>
<tr>
<td>Theory classes: 9h</td>
</tr>
<tr>
<td>Laboratory classes: 1h</td>
</tr>
<tr>
<td>Self study: 15h</td>
</tr>
</tbody>
</table>

**Description:**
- Newton's laws and momentum conservation.
- Forces over a control volume.
- Angular momentum equation.
- Application to turbomachines: characteristic curves.

**Specific objectives:**
- Identifying forces and torques over a control volume.
- Determine resulting forces due to flow streams.
- Estimating torques generated by flow streams.

### 6. Pipe flow

<table>
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<tr>
<th>Learning time: 17h 30m</th>
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<tbody>
<tr>
<td>Theory classes: 6h</td>
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<tr>
<td>Laboratory classes: 1h 30m</td>
</tr>
<tr>
<td>Self study: 10h</td>
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</tbody>
</table>

**Description:**
- Developed flows. Laminar and turbulent flow.
- Main and secondary losses.
- Flow in non-circular ducts.
- Hydraulic radius and equivalent diameter.
- Pipe systems: serial-parallel arrange.
- Steady state basic hydraulics, installation resistant curve.
- Operation point of a pumping installation.

**Specific objectives:**
- Solving basic steady state hydraulic problems.
- Developing basic design tasks for fluid distribution installations and determining the operating point in pumps.
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7. Free surface flows

Learning time: 16h 30m
- Theory classes: 5h 30m
- Laboratory classes: 1h
- Self study: 10h

Description:

Specific objectives:
Solving slow problems in steady state open canals. Using pouring systems for flow control and measurement.

Qualification system

Evaluation will be done by means of written tests both for mid-terms and final exams. Exercises and problems will be evaluated from the material submitted by the student. Lab experiences will be evaluated based on previous test, assistance, developed tasks in the lab and lab reports.

Mid-terms: 40 %
Exercises/Problems: 5 %
Lab experiences: 15 %
Team work: 5 %
Final exam: 35 %

This course will re-evaluation test as established by the rules of the school.

Regulations for carrying out activities

Lab experiences are mandatory.

Bibliography

Basic:

Complementary: