340039 - MFLU-F3O29 - Fluid Mechanics

Coordinating unit: 340 - EPSEVG - Vilanova i la Geltrú School of Engineering
Teaching unit: 729 - MF - Department of Fluid Mechanics
Academic year: 2019
Degree: BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
ECTS credits: 6
Teaching languages: Catalan

Teaching staff

Coordinator: Carbonell Ventura, Montserrat
Others: Pons Segalà, Jordi
Nieto Reina, Iván

Degree competences to which the subject contributes

Specific:
1. CE8. Knowledge of basic principals of fluid mechanic and its application to resolve problems in engineering area. Calculus of channels, canals and fluids.

Transversal:
07 AAT N2. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.
04 COE N2. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.
05 TEQ N2. 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

- Lectures and participatory classes, consisting of explanation and development of the theory and, if necessary in the resolution of problems. The material user will be available to the student in the Digital Campus section of the subject.
- Practical lessons in problem-solving, where it will seek the maximum involvement of students through their direct involvement in solving the problems. Students must solve in class / outside of class, individually or in groups, problems that are assigned. In the Digital Campus section of the subject, the student can look up the list of problems before they are done in class.
- Hand in resolved problems by students. Submittals will consist on individual or group solution, in class or outside class, of some problems of the list or similar, the student will have in the Digital Campus. This activity will be evaluated. The student feed-back can made from the submission of the revised problems.
- Laboratory practical classes, made directly by students, guided by the teacher, allowing them to directly observe relevant aspects of the theory. The student can look up the explanatory text of the practices to develop in the Digital Campus. The students will give the theacher a copy of the experimental extracted data. Later, students must make a report of the practices carried out. This report will be evaluated and will be delivered before the date set by the professor.
- Tutorial classes in group or individual.
- Students will make two exams of all theoretical and practical knowledge developed in the subject.

Learning objectives of the subject
When the student finishes the subject, he/she has to be capable of:
- Understanding the basic principles of the behavior of fluids, when static and in movement, as well as the principles of applied thermodynamics and heat transfer.
- Knowing the principles of fluid mechanics in fluidodynamics systems.
- Solving problems of pipelines and simple fluid systems.
- Analyzing and solving problems in the area of fluid engineering.
- Interpreting, analyzing, synthesizing and extracting conclusions of results of measurements and tests.
- Writing texts with the structure adapted to the aims of communication.
- Knowing and putting into practice the dynamics teamwork.
- Carrying out assignments from basic directions given by the teacher.

### Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group: 52h 30m (35.00%)</th>
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<tbody>
<tr>
<td>Hours medium group:</td>
<td>0h</td>
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<tr>
<td>Hours small group:</td>
<td>7h 30m (5.00%)</td>
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<tr>
<td>Guided activities:</td>
<td>0h</td>
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<tr>
<td>Self study:</td>
<td>90h (60.00%)</td>
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1. INTRODUCTION TO FLUID MECHANICS.
FLUID'S MECHANICAL PROPERTIES.

Description:
1.1 Fluid's definition.
1.2 Forces acting on a fluid.
1.3 Continuum media. Non-Slip condition
1.4 Mechanical Properties of Fluids
1.5 Dimensions and systems of units.

Related activities:
A1. Applied exercises
A7. Laboratory: Determination of density and viscosity of liquids.
A12. Individual exam.

Specific objectives:
- Define the concept of a fluid.
- Interpret the continuous medium and non-slip condition hypothesis.
- Formulate the principal mechanical properties of fluids.
- Have an applied knowledge of the fluid's mechanical properties.
- Understand the influence of viscosity on friction in fluid flow.

Learning time: 18h 30m
- Theory classes: 7h
- Laboratory classes: 1h 30m
- Self study: 10h

2. FLUIDS STATICS

Description:
2.1 Fundamental equation of hydrostatics. Applications.
2.2 Pressure measurement.
2.3 Pressure forces on flat and curved surfaces.
2.4 Stability of total or partially submerged bodies

Related activities:
A2. Applied exercises
A12. Individual exam.

Specific objectives:
- Interpret the fundamentals for the fluid static equation.
- Interpret the equation of hydrostatic in the gravity field.
- Describe the methods and instruments for the measurement of the pressure.
- Calculate the pressure read on a gauge.
- Determine the pressure distribution in a static fluid and its effects on solid surfaces.
- Calculate the hydrostatic forces acting on a flat or curved surface.
- Interpret the Archimedes' principle.
- Calculate the buoyancy force acting on total or partially submerged bodies.

Learning time: 21h
- Theory classes: 7h
- Laboratory classes: 0h
- Self study: 14h
### 3. PRINCIPLE OF CONSERVATION OF MASS

**Learning time:** 21h 30m  
Theory classes: 6h 30m  
Self study: 15h

<table>
<thead>
<tr>
<th>Description</th>
<th>Related activities</th>
<th>Specific objectives</th>
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</thead>
<tbody>
<tr>
<td>3.1 Control systems and volumes.</td>
<td>A3. Applied exercises</td>
<td>- Know the Eulerian and Lagrangian descriptions of fluid flow.</td>
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<tr>
<td>3.3 Viewing the speed field. Flow lines.</td>
<td></td>
<td>- Understand the meaning of the material derivative.</td>
</tr>
<tr>
<td>3.4 Material derivative.</td>
<td></td>
<td>- Calculate volumetric and mass flow rates, and average velocity.</td>
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<tr>
<td>3.5 Volumetric and mass flow rate. Average speed.</td>
<td></td>
<td>- Interpret the principle of the conservation of mass using the Reynolds transport theorem.</td>
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<tr>
<td>3.6 Reynolds Transportation Theorem.</td>
<td></td>
<td>- Calculate mass balances in stationary and non-stationary flows.</td>
</tr>
<tr>
<td>3.7 Principle of Conservation of Mass.</td>
<td></td>
<td>- Apply the equation of conservation of the massa per the resolution of problems of fluids.</td>
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</tbody>
</table>
4. PRINCIPLE OF CONSERVATION OF ENERGY

<table>
<thead>
<tr>
<th>Description:</th>
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<tbody>
<tr>
<td>4.1 Mechanical energy equation</td>
</tr>
<tr>
<td>4.2 Applications of Bernoulli's equation for an ideal fluid. Velocity and flow rate meters.</td>
</tr>
<tr>
<td>4.3 Generalized Bernoulli’s equation.</td>
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<td>4.4 Flow regimes in pipes.</td>
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<td>4.5 Head losses in pipes: linear and secondary.</td>
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<td>4.6 Energy grade line and the hydraulic grade line.</td>
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<th>Related activities:</th>
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<tr>
<td>A13. Individual exam.</td>
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<th>Specific objectives:</th>
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<tr>
<td>- Identify and correctly evaluate the different forms of mechanical energy.</td>
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<tr>
<td>- Understand l’ús i limitacions de l'equació de Bernoulli.</td>
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<tr>
<td>- Apply the Bernoulli's equation in solving basic hydraulic problems, in velocity and flow rate meters.</td>
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<tr>
<td>- Apply the Bernoulli's equation in velocity and flow rate meters.</td>
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5. PRINCIPLE OF CONSERVATION OF MOMENTUM

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<tbody>
<tr>
<td>5.1 Principle of the conservation of the quantity of movement.</td>
</tr>
<tr>
<td>5.2 Action and reaction forces due to fluid movement.</td>
</tr>
<tr>
<td>5.3 Angular momentum equation.</td>
</tr>
<tr>
<td>5.4 Application to Turbomachines: characteristic curves.</td>
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<tr>
<th>Related activities:</th>
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<tr>
<td>A5. Applied exercises.</td>
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<tr>
<td>A13. Individual exam.</td>
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<tr>
<td>- Identify the forces and torques over a control volume.</td>
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<tr>
<td>- Determine resulting forces due to flow streams.</td>
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<tr>
<td>- Determine torques generated by flow streams.</td>
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<tr>
<td>- Apply angular momentum equation to turbomachines.</td>
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### 6. FLOW SYSTEM ANALYSIS

**Description:**
- 6.1 Installation resistant curve.
- 6.3 Operating point of a pumping installation.
- 6.4 Pipe systems: serial-parallel arranges.
- 6.5 Open-channel flow.

**Related activities:**
- A10. Laboratory: Measurement of flow rates and head loss in laminar and turbulent flow.
- A13. Individual exam.

**Specific objectives:**
- Apply mechanical energy equation in piping systems.
- Calculate main and minor head losses in piping systems.
- Calculate system-head curve of a basic installation in steady state.
- Calculate the operating point of a pumping installation.
- Interpret the operating point of a pump.
- Calculate installations consist of pipes arranged in series, parallel, or some complicated combination.
- Calculate flow rates by flow weir.
- Calculate flow rates on a given channel geometry.
- Hydraulic jump definition.

### 7. FUNDAMENTAL PNEUMATIC PRINCIPLES

**Description:**
- 7.1 Introduction to pneumatics.
- 7.2 Working pneumatic components.
- 7.3 Pneumatic control elements. Valves.
- 7.4 Basic pneumatic circuits.

**Related activities:**
- A11: Laboratory: Elemental pneumatic circuits with double-acting cylinder. Festo panel-mounting valves and actuating attachments.
- A13. Individual exam.

**Specific objectives:**
- Know the fundamentals of the production of compressed air.
- Know the elements of a pneumatic system.
- Know the actuators and distributors. Pneumatic symbols and design of basic circuits.
The different concepts that make up the continuous assessment are:
- Written individual examinations (75%)
- Laboratory practical and reports (10%)
- Submission of resolved problems (15%)

The re-evaluation will consist of a Global Exam of the subject corresponding to the theory and problems of CP1 and CP2, independent of the grade obtained in each of the partial controls (be less than, equal to or greater than 5.0). The Global Exam will weigh 75% of the final reevaluation grade.

**Qualification system**

**Regulations for carrying out activities**

Each of the two individual exams will consist of two parts:
- Part 1: a theory test (maximum 20% of the exam).
- Part 2: with a number of problems that will contemplate the score until completing the 100% of the exam.

**Bibliography**

**Basic:**


**Complementary:**
