820425 - EFM - Fluid Engineering

Coordinating unit: 295 - EEBE - Barcelona East School of Engineering
Teaching unit: 729 - MF - Department of Fluid Mechanics
Academic year: 2019
Degree: BACHELOR’S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
ECTS credits: 6
Teaching languages: Catalan, Spanish

Teaching staff
Coordinator: Ricardo Torres Cámara
Fontanals Garcia, Alfred
Others: Ricardo Torres Cámara
Alfred Fontanals
Alfredo Guardo-Zabaleta

Requirements
TERMODINÀMICA ITRANSFERÈNCIA DE CALOR - Prerequisite

Degree competences to which the subject contributes

Specific:
CEMEC-24. Understand and apply the fundamentals of fluid mechanics systems and machines.

Transversal:
1. TEAMWORK - Level 1. Working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.

Learning objectives of the subject

Study load

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

<table>
<thead>
<tr>
<th>(ENG) Chapter 1: Fonamental Equacions in differential form</th>
<th>Learning time: 3h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description: Kinematics of a fluid particle. Navier-Stokes equations: continuity, momentum and energy. Exact and approximate solutions of the Navier-Stokes equations. Euler equation. Bernoulli equation.</td>
<td>Theory classes: 3h</td>
</tr>
<tr>
<td>Specific objectives: An understanding of the deduction of the equations of mass, momentum and energy in differential form including how to calculate the pressure field for a known velocity field and to obtain approximate and analytical solutions for simple flow fields.</td>
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<table>
<thead>
<tr>
<th>(ENG) Chapter 2: Dimensional and similarity. Modeling.</th>
<th>Learning time: 2h</th>
</tr>
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<tbody>
<tr>
<td>Description: The need for dimensional analysis. Dimensional homogeneity. The PI theorem. Nondimensionalization of the basic equations. Relevant dimensionless parameters in mass transport, momentum and energy and their physical meaning. Similarity: geometric, kinematic and dynamic similarities. Partial and incomplete similarities.</td>
<td>Theory classes: 2h</td>
</tr>
<tr>
<td>Specific objectives: A knowledge of the scope of dimensional analysis in the study of fluid flow and its limitations. To identify characteristics scales correctly and to distinguish between different types of similarity. An ability to determine dimensionless groups and to know the physical meaning of the most important in the flow of fluids and fluid machinery. An ability to obtain partial similarity from simplifications.</td>
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<table>
<thead>
<tr>
<th>(ENG) Chapter 3: Lift and drag. External flow</th>
<th>Learning time: 3h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific objectives: An understanding of the effects of friction and pressure on drag and lift. An ability to know how to determine the fluid forces on common geometries and to describe the flow patterns around cylinders and spheres. An understanding of the models of the boundary layer and how to calculate their properties. An exposure to the difficulties of the turbulence: essential aspects of the turbulent phenomena and classification of the turbulence models.</td>
<td></td>
</tr>
</tbody>
</table>
### (ENG) Chapter 4: Fluid systems

**Description:**

**Specific objectives:**
An ability to solve multiple-pipe systems and to determine fluid systems characteristics. An understanding of essential problems in stationary fluid systems. Combinations in series / parallel of pumps and fluid systems. An ability to matching pumps to system characteristics. An ability to avoid abnormal operating conditions like cavitation as well as to assess the effects of a water hammer.

### (ENG) Tema 5: Turbomàquines i màquines volumètriques

**Description:**

**Specific objectives:**
A knowledge of the classification of fluid machinery. An understanding of the dynamics in the impeller of the turbomachinery and its influence on the energy transfer. A knowledge of the different types of turbomàquines, of the essential functional elements and their areas of operation. An ability to use the similarity rules to re-design new turbomachinery. An understanding of the performance parameters of positive-displacement machines. A knowledge of the mechanical designs of PDM, of the selection criteria an of the use as power transmission systems.
To pass the course will have completed and passed the practice. There will test reassessment. The students will be able to access the re-assessment test that meets the requirements set by the EEBE in its Assessment and Permanence Regulations (https://eebe.upc.edu/ca/estudis/normatives-academiques/documents/eebe-normativa-avaluacio-i-permanencia-18-19-aprovat-je-2018-06-13.pdf)

**Qualification system**

Continous assesment: 35 %
Final assessment: 35 %
Exercises/problems: 10 %
Laboratory: 15 %
Generical competence: 5%

**(ENG) Tema 6: Principles of numeric and computational analysis in fluid systems engineering**

<table>
<thead>
<tr>
<th>Description:</th>
<th>Learning time: 2h</th>
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<tbody>
<tr>
<td>Background of computational simulations and the numerical methods in engineering nowadays. Basic steps: problem definition, discretization of space and model, analysis, resolution and assessment of results. Numerical techniques of discretization: DF, VF and EF. The importance of the network calculation (grid/mesh). Initial and boundary conditions specifications.</td>
<td>Theory classes: 2h</td>
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**Specific objectives:**
Valorar les aportacions dels mètodes numèrics a l'estudi del flux de fluids en enginyeria. Conèixer les etapes fonamentals de les simulacions i les eines i arquitectures disponibles. Conèixer les diferents tècniques de discretització. Valorar la importància de la xarxa de discretització. Aplicar correctament les condicions de contorn i inicials. Adquirir criteri per tal de valorar adequadament els resultats de les simulacions i inferir correctament a partir d'ells.

**Chapter 7. Compressible flow**

<table>
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<tr>
<th>Description:</th>
<th>Learning time: 2h</th>
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</table>

**Description:**
Bibliography

Basic:


Others resources:

Hyperlink

How wings work Smoke streamlines around an airfoil
https://www.google.es/url?sa=t&rct=j&q=&esrc=s&source=video&cd=1&ved=0ahUKEwi8pLys4uDNaHVFLeAKHd1BKAQtwIHDAA&url=https%3A%2F%2Fwww.youtube.com%2Fwatch%3Fv%3D6UlsArvbTeo&usg=AFQjCNHWUA5oQhKGStRYYgpepZrlMIZJO5w&bvm=bv.126130881,d.ZGg

Aerodynamic Stall - Wing Profile
https://youtu.be/Ti5zUD08w5s

Mercedes-Benz E-Class Coupe Aerodynamics
https://youtu.be/jd71qpfUfEg

New BMW Aerodynamic Test Center Model, Wind Tunnel, Aerolab
https://youtu.be/eszhVxE_9-8

The Aerodynamics of Flight
https://youtu.be/SljtFEei3AI

Audiovisual material

Nom recurs
Resource