820425 - EFM - Fluid Engineering

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 MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
ECTS credits: 6

Teaching languages: Catalan, Spanish

Coordinator: Ricardo Torres Cámara
Fontanals Garcia, Alfred

Others: Ricardo Torres Cámara
Alfred Fontanals
Alfredo Guardo-Zabaleta

Requirements
Fluid Mechanics (FM)
Thermodynamics and Heat Transfer (THT)

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.

Study load

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

<table>
<thead>
<tr>
<th>(ENG) Chapter 1: Fonamental Equacions in differential form</th>
<th>Learning time: 3h</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 3h</td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td>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>
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<tr>
<td><strong>Specific objectives:</strong></td>
<td>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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<tr>
<th>(ENG) Chapter 2: Dimensional and similarity. Modeling.</th>
<th>Learning time: 2h</th>
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<td></td>
<td>Theory classes: 2h</td>
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<tr>
<td><strong>Description:</strong></td>
<td>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>
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<tr>
<td><strong>Specific objectives:</strong></td>
<td>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>
</tr>
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<thead>
<tr>
<th>(ENG) Chapter 3: Lift and drag. External flow</th>
<th>Learning time: 3h</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 3h</td>
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<tr>
<td><strong>Specific objectives:</strong></td>
<td>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>
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</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.

**Learning time:** 2h
- Theory classes: 2h

### (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.

**Learning time:** 3h
- Theory classes: 3h
(ENG) Tema 6: Principles of numeric and computational analysis in fluid systems engineering

Description:

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

Description:

Qualification system

To pass the course will have completed and passed the practice. There will test reassessment.

Continuous assessment: 35 %
Final assessment: 35 %
Exercises/problems: 10 %
Laboratory: 15 %
Generic competence: 5%
Bibliography

Basic:


Others resources:

Hyperlink

How wings work Smoke streamlines around an airfoil
https://www.google.es/url?sa=t&rct=j&q=&e=UTF-7&source=video&cd=1&cad=rja&uact=8&ved=0ahUKEwi8pLYs4uDNAhVFLcAKHdi8BKAQtwIHDAA&url=https%3A%2F%2Fwww.youtube.com%2Fwatch%3Fv%3D6UlsArvbTeo&usg=AFQjCNRWUA5oQhKGStRYYgpepZrIMIZJO5w&bvm=bv.126130881,d.ZGg

Mercedes-Benz E-Class Coupe Aerodynamics
https://youtu.be/Ti5zUD08w5s

New BMW Aerodynamic Test Center Model, Wind Tunnel, Aerolab
https://youtu.be/jd71qpfufEg

The Aerodynamics of Flight
https://youtu.be/5ltjFEei3AI

Audiovisual material

Nom recurss

Resource