340208 - MATH-M7P29 - Heat and Hydraulic Engines I

<table>
<thead>
<tr>
<th>Coordinating unit:</th>
<th>340 - EPSEVG - Vilanova i la Geltrú School of Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching unit:</td>
<td>729 - MF - Department of Fluid Mechanics</td>
</tr>
<tr>
<td>Academic year:</td>
<td>2018</td>
</tr>
<tr>
<td>Degree:</td>
<td>BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Optional)</td>
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<tr>
<td></td>
<td>BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)</td>
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<td>ECTS credits:</td>
<td>6</td>
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<tr>
<td>Teaching languages:</td>
<td>Catalan</td>
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</tbody>
</table>

**Teaching staff**

- Coordinator: JAUME MIQUEL MASALLES
- Others: JAUME MIQUEL MASALLES
           MONTSERRAT CARBONELL VENTURA
           CARLOS PRUDENCIO DE GRACIA

**Prior skills**

- Knowledge of Fundamentals of Thermal Engineering
- Knowledge of Fluid Mechanics
- Knowledge of Thermal Engineering
- Knowledge of Fluid Engineering

**Requirements**

- 340032 - Thermal Engineering and Fluid Mechanics (in case you have not completed 340038 and 340039)
- 340038 - Fundamentals of Thermal Engineering
- 340039 - Fluid Mechanics
- 340056 - Thermal Engineering
- 340058 - Fluid Engineering

**Degree competences to which the subject contributes**

**Specific:**


**Transversal:**

3. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.

4. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.

6. TEAMWORK - Level 3. Managing and making work groups effective. Resolving possible conflicts, valuing working with others, assessing the effectiveness of a team and presenting the final results.

7. EFFECTIVE USE OF INFORMATION RESOURCES - Level 3. Planning and using the information necessary for an academic assignment (a final thesis, for example) based on a critical appraisal of the information resources used.
At the end of the course students should be able to:

1. Identify and evaluate the variables that characterize the thermal and hydraulic machines.
# Study load

<table>
<thead>
<tr>
<th>Study load</th>
<th>Time (h)</th>
<th>Percentage</th>
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<tbody>
<tr>
<td><strong>Total learning time:</strong> 151h</td>
<td></td>
<td></td>
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<tr>
<td>Hours large group:</td>
<td>53</td>
<td>35.10%</td>
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<tr>
<td>Hours medium group:</td>
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<td>Hours small group:</td>
<td>8</td>
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<tr>
<td>Guided activities:</td>
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<tr>
<td>Self study:</td>
<td>90</td>
<td>59.60%</td>
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</table>
1. HEAT ENGINES: INTERNAL COMBUSTION ENGINES

**Description:**
1.1. General classification of thermal machines and heat engines (external and internal combustion engines). Basic components of an internal combustion engine (ICE). Main fields of application of the ICE.

**Related activities:**

**Specific objectives:**
At the end of this teaching unit, the student should be able to:

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2. COMPRESSORS

**Description:**
2.1. Introduction. General classification of the compressors. Scope of various types of compressors. Practical applications of compressors.

**Related activities:**
A2. Problems of compressors.

**Specific objectives:**
At the end of this teaching unit, the student should be able to:

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3. STEAM TURBINES AND GAS TURBINES

**Description:**
3.1. Power cycles with steam turbines:

**Related activities:**

**Specific objectives:**
At the end of this teaching unit, the student should be able to:
### 4. FUNDAMENTALS OF HYDRAULIC MACHINES

<table>
<thead>
<tr>
<th>Description</th>
<th>Learning time: 22h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 8h 30m</td>
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<tr>
<td></td>
<td>Self study: 13h 30m</td>
</tr>
</tbody>
</table>

#### Description:
- 4.1. Definición y clasificaciones de Máquinas Hidráulicas
- 4.2. Teoría general de las Turbomáquinas Hidráulicas
  - 4.2.1. Triángulos de velocidad.
  - 4.2.2. Ecuación fundamental de las turbomáquinas hidráulicas.
  - 4.2.3. Grado de reacción
  - 4.2.4. Pérdidas en las turbomáquinas.
  - 4.2.5. Comportamiento real de las turbomáquinas hidráulicas.
- 4.3. Semejanza en Turbomáquinas Hidráulicas.

#### Related activities:

#### Specific objectives:
At the end of this teaching unit, the student must be able to:
5. PUMPS AND FANS

Description:
5.1. Bombas Hidráulicas: Introducción y Clasificación
   5.1.1. Turbobombas (bombas rotodinámicas).
       5.1.1.1. Clasificaciones y elementos constitutivos. Equipamiento hidráulico.
       5.1.1.2. Curvas características.
       5.1.1.3. Forma y número de álabes del rodete.
       5.1.1.4. Funcionamiento a velocidad angular variable.
       5.1.1.5. Recorte del rodete
       5.1.1.6. Cavación.
       5.1.1.7. Selección de una bomba. Influencia de la viscosidad del fluido.
       5.1.1.8. Golpe de Ariete.
   5.1.2. Bombas de Desplazamiento Positivo.
       5.1.2.1. Fundamentos. Clasificación.
       5.1.2.2. Bombas alternativas.
       5.1.2.3. Bombas rotoestáticas.

5.2. Ventiladores.
   5.2.1. Definición y clasificaciones de ventiladores.
   5.2.2. Fórmulas fundamentales de ventiladores.
   5.2.3. Efecto de la compresibilidad del gas en el diseño de ventiladores.
   5.2.4. Acoplamiento de ventiladores.

5.3. Regulación de bombas y ventiladores.

Related activities:

Specific objectives:
At the end of this teaching unit, the student must be able to:
- Identify the different types of pumps, understand how it works and know its scope of application.
6. HYDRAULIC TURBINES

Learning time: 23h
Theory classes: 8h
Self study: 15h

Description:
6.2. Generalidades de Turbinas Hidráulicas.
6.3. Turbinas Hidráulicas de Acción.
   6.3.1. Elementos de una Turbina Pelton.
   6.3.2. Triángulos de velocidades de una Turbina Pelton.
   6.3.3. Velocidad Específica en una Turbina Pelton.
   6.3.4. Selección de una Turbina Pelton.
6.4. Turbinas Hidráulicas de Reacción.
   6.4.1. Diagrama de transformación de energía de una Turbina Hidráulica de Reacción.
   6.4.2. Elementos de una Turbina Hidráulica de Reacción
   6.4.3. Tipos de Turbinas Hidráulicas de Reacción.
   6.4.4. Velocidad Específica en una Turbina Francis.
   6.4.5. Cavitación en Turbinas Hidráulicas.

Related activities:
A11. Problems of Hydraulic Turbines

Specific objectives:
At the end of this teaching unit, the student should be able to:
Qualification system

The evaluation weight of the different concepts involved in the qualification of the subject are:
- INDIVIDUAL WRITING TESTS: 65 %
- DELIVERY OF SOLVED PROBLEMS: 18 %
- PRACTICES REPORTS (WORKS, LABORATORY AND SIMULATION): 17 %

To obtain the final grade of MATH the following equation of the evaluation will be applied:

\[1\] Final Note of MATH = Note CP1*0.325 + Note CP2*0.325 + Note Delivery Problems*0.18 + Note Practices*0.17

Students who have obtained a grade lower than 3.5 in the Note of CP1, may be presented as an optional to a Final Control (CFinal) instead of CP2. This CFinal will be held on the same day and time as the CP2, within the Final Evaluation Period. The equation of the evaluation, to obtain the final grade of MATH, in this case is:

\[2\] Final Note of MATH = Note CFinal*0.65 + Note Delivery of Problems*0.18 + Note Practices*0.17

There are no minimum notes in any of the previous evaluative acts at the time of applying equations [1] or [2].

RE-EVALUATION:
The student who has: 3.0 <= Final Note of MATH <= 4.9, has the right to take the re-evaluation of the subject of MATH. The re-evaluation will consist of a Global Control of theory and problems of the subject that will have a weight of 65%. Once the Global Control (CGlobal) of re-evaluation is done, the final grade of Reevaluation is obtained by the following expression:

Final Note of Reevaluation = Note CGlobal*0.65 + Note Delivery of Problems*0.18 + Note Practices*0.17

The Final Note of MATH after the re-evaluation will be:
a) If the Final Note of Reevaluation is equal to or greater than 5.0: Final Note of MATH = 5.0
b) If the Final Note of Reevaluation is less than 5.0: the highest grade between the Final Note of Reevaluation and the Final Note of MATH prior to re-evaluation will be taken as the Final Note of MATH.
Regulations for carrying out activities

- Each of the two individual written tests (Partial Controls), will consist of two parts: a theory test (which will constitute 30% of the grade of the 1st test and 20% of the grade of the 2nd test) and a certain number of problems (until completing 100% of the test grade). Both tests have the same evaluative weight (32.5%). A minimum grade of the partial controls is not required.

- The Final Control (CFinal) will consist of two parts: the first part of Thermal Machines will be worth 5 points and will consist of a theory test (which may constitute up to 30% of the note of this part) and a certain number of problems (until completing 100% of the note of this part). The second part of Hydraulic Machines will be worth 5 points and will consist of a theory test (which may constitute up to 20% of the grade of this part) and a certain number of problems (until completing 100% of the grade of this part). A minimum grade of the Final Control is not required.

- Deliveries of problems solved individually, will be evaluated following the rubric for the delivery of problems, which the student will have in advance. The problems solved must be delivered by the Digital Campus within the time period assigned by the teacher.

- The practices reports (works, laboratory and simulation) will be evaluated according to the rubric established for the realization of the same and that the students will have previously. To have a note of a certain laboratory practice (or simulation) it is essential to have done the practice in person and present the report with the group with which the practice was carried out in the laboratory (or in the computer room).

- If a student does not show up to any of the two partial controls (or the final control), but presents problems and / or practices delivery, at the end he / she will have a note of the subject.

RE-EVALUATION:

- When the Final Note of MATH is lower than 5.0 but equal to or higher than 3.0, the Reevaluation is eligible. In this case, the theory and problems contents of CP1 (Thermal Machines) and CP2 (Hydraulic Machines) are reappraised. In the Reevaluation there will be a Global Control of the subject (CGlobal) that will include the part of Thermal Machines and the part of Hydraulic Machines, and this will have a weight of 65%.

- The Global Control (CGlobal) of the re-evaluation will consist of two parts: the first part of Thermal Machines will be worth 5 points and will consist of a theory test (normally of 5 questions, which may constitute up to 30% of the note of this part) and a certain number of problems (usually 2 problems, until completing 100% of the note of this part). The second part of Hydraulic Machines will be worth 5 points and will consist of a theory test (normally of 5 questions, which may constitute up to 20% of the grade of this part) and a certain number of problems (normally 2 problems, until completing the 100% of the note of this part).
Bibliography

Basic:


Complementary:


