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340208 - MATH-M7P29 - Heat and Hydraulic Engines I

Coordinating unit: 340 - EPSEVG - Vilanova i la Geltrú School of Engineering

Teaching unit: 729 - MF - Department of Fluid Mechanics

Academic year: 2018

Degree: BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)

ECTS credits: 6 Teaching languages: Catalan

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:

1. CE21. Applied thermal engineering knowledge.

2. CE24. Applied basic knowledge of fluid mechanical systems and machines.

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.

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Teaching methodology

- IMPARTITION OF KNOWLEDGE: 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.
- APPLIED APPRENTICESHIP OF KNOWLEDGE: Practical sessions of resolution of problems where the maximum participation of the student will be tried, through his direct implication in the resolution of exercises. This will give rise to the activity of "Delivery of Exercises". The student will have in advance in the section of the Digital Campus enabled for the subject of the collection of problems to be carried out.
- DELIVERY OF EXERCISES: Delivery of problems solved by students. The deliveries will consist of the individual resolution, to be done in class and/or out of class, of any problem/s of the list of problems, or similar to those of the list, that the student will have the Digital Campus. This activity will have evaluative weight and for its realization a rubric will be available. Efforts will be made to give the note of the delivery of the problems in a reasonable time so that the student can reorient their work in case it is not satisfactory.
- LEARNING FROM EXPERIMENTATION AND SIMULATION: Practical laboratory sessions and simulation practices, carried out directly by the students, guided by the teacher, which will allow them to observe directly relevant aspects of the theory developed. The scripts of the practices to be developed will be available, before their realization, in the section of the Digital Campus enabled for the subject. The students will give the teacher a copy of the experimental data obtained. Subsequently, students must make a report, by group, of the practice carried out. For its realization the students will have a rubric in the Digital Campus referring to the preparation of the internship reports. These reports will have an evaluative weight and must be submitted, by groups, before the date indicated by the professor through the digital campus.
- SELF-DIRECTED LEARNING GUIDES: Preparation and written presentation of two (or three) sections of Topic 1 and Topic 6 of the subject respectively. This constitutes Practice 1 and Practice 5 of the subject. The student must work in groups of 2 or 3 students two (or three) sections of Topic 1 and Topic 6 of the subject assigned by the teacher. You will have the objectives, the sections to develop and a reference bibliography to consult. The group must be able to decide how it should be organized and know how to identify the sources of information. The presentation of the activity will be done in writing (as the report of Practice 1 and Practice 5 respectively) and will have an evaluative weight.
- TUTORIALS: Individual tutorials (or collective where appropriate) that will allow the student to solve any doubts that may have on the subject for an effective follow-up of the subject.
- INDIVIDUAL WRITTEN TESTS: The students will perform two partial controls of all the knowledge of theory and problems developed in the subject. The first partial control (CP1) will be done halfway through the semester and will be related to Thermal Machines, and the second partial control (CP2) will be carried out at the end of the semester (Final Evaluation period) and will be related with the Hydraulic Machines. There will be a Final Control of the subject (CFinal) in the Final Evaluation period. Students with a grade of CP1 lower than 3.5 can be presented in an optional way to this Final Control, which will replace CP2. There will also be a Global Control (CGlobal) of Reevaluation at the Reevaluation period.

Learning objectives of the subject

At the end of the course students should be able to:

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

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Study load

Total learning time: 151h	Hours large group:	53h	35.10%
	Hours medium group:	0h	0.00%
	Hours small group:	8h	5.30%
	Guided activities:	0h	0.00%
	Self study:	90h	59.60%

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Content

1. HEAT ENGINES: INTERNAL COMBUSTION ENGINES

Learning time: 30h 15m

Theory classes: 10h 30m
Laboratory classes: 1h 45m
Self study : 18h

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:
A1. Problems of internal combustion engines (ICE).

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

2. COMPRESSORS

Learning time: 20h 30m

Theory classes: 7h 30m
Self study : 13h

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:

3. STEAM TURBINES AND GAS TURBINES

Learning time: 25h 15m

Theory classes: 8h 45m
Laboratory classes: 2h 30m
Self study : 14h

Description:
3.1. Power cycles with steam turbines:

Related activities:
A3. Problems of steam turbines and gas turbines.

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

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4. FUNDAMENTALS OF HYDRAULIC MACHINES

Learning time: 22h

Theory classes: 8h 30m
Self study : 13h 30m

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:
A9. Problems of fundamentals of Hydraulic Machines.

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

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5. PUMPS AND FANS

Learning time: 29h

Theory classes: 10h 45m
Laboratory classes: 1h 45m
Self study : 16h 30m

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. Cavitación.
  - 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:

A6. Practice 3. "Study of the performance of a centrifugal fan with different impellers. Study of instabilities of a fan."

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.

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6. HYDRAULIC TURBINES

Learning time: 23h

Theory classes: 8h
Self study : 15h

Description:
6.1. Centrales Hidroeléctricas. Elementos constitutivos.
6.2. Generalidades de Turbinas Hidráulicas.
6.3. Turbinas Hidráulicas de Acción.
6.3.1. Elementos de una Turbina Pelton.
6.3.2. Triangulos 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:

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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.

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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).

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