Course guide
220208 - 220208 - Engineering of Thermal and Fluids Systems

Last modified: 26/06/2023

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 724 - MMT - Department of Heat Engines.
729 - MF - Department of Fluid Mechanics.

Degree: MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2013). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 7.5 **Languages:** Catalan

LECTURER

Coordinating lecturer: JORDI VENTOSA - SALVADOR DE LAS HERAS

Others: OSCAR RIBE TORIJANO - JORDI CADAFALCH - RICARD CONSUL - HIPOLIT MORENO - DAIBEL DE ARMAS

PRIOR SKILLS

Chemistry, Thermodynamics, Heat Transfer, Fluid Mechanics

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Knowledge and skills for the design and analysis of heat engines and machines, hydraulic machines and installations of heating and cooling industry.

TEACHING METHODOLOGY

The course is divided into three parts:
1. Sessions to present content.
2. Sessions for practice (exercises, problems and laboratory).
3. Self study, exercises and activities.

In the content of the sessions, teachers will introduce the theoretical foundations of the subject, concepts and methods, using appropriate examples to facilitate understanding.
In the practical sessions, teachers will guide students in applying theoretical concepts and using critical reasoning. We propose that students solve exercises in the classroom and outside the classroom, to promote contact and use the basic tools needed to solve the problems.
Students, independently, will work with material provided by the teacher to fix and assimilate concepts. The teachers provide a curriculum and monitoring activities (ATENEA).

LEARNING OBJECTIVES OF THE SUBJECT

The course is divided into three modules or themes:
1) Fluid Engineering: Hydraulic machines and systems (2.5 ECTS)
2) Thermal Engineering: Industrial heating and cooling systems (2.5 ECTS)
3) Thermal Engineering: Heat engines (2.5 ECTS)

Hydraulic systems and machines
Study of operating principles, technology and applications of basic hydraulic machines, as well as various equipment and facilities of hydraulic systems.
Students should know the types of machines studied, scope and operation, and the basic criteria used in engineering selection. Students should also dominate the interaction between the machine and the system to which is connected, and how to act to change the operating point. Finally, students should be aware of the common operation problems and how to avoid them.

Industrial heating and cooling systems
Study of operating principles, technology and applications of the main equipment and systems used for industrial heating and cooling. The student must know how to use the energy balances to determine the efficiency and performance of the equipment and systems studied. At the same time should know the types of applications and limitations of use of each system, focusing especially on the environmental impact that its use may produce.

Heat engines
Study of operating principles, technology and applications of heat engines. The heat engine can generate mechanical energy, based on the energy content of a fluid (usually heat generated by combustion). The main applications of this equipment focus on transport, the operation of machinery and the generation of electrical energy.
In a similar way to the heating and cooling systems, the student must know how to use the energy balances to determine the efficiency and performance of the equipment studied. At the same time should know the types of applications and limitations of use of each equipment, focusing especially on the environmental impact that its use may produce.

STUDY LOAD

Type	Hours	Percentage
Hours small group	22,5	12.00
Hours large group	45,0	24.00
Self study	120,0	64.00

Total learning time: 187.5 h

CONTENTS

Module 1: Hydraulic machines and systems

Description:
Previous concepts.
Pumps and fans. Curves. Selection. Scope and applications.
Systems with turbomachinery. Operating point.
Dimensionless groups and similarity theory models.
Regulation. Control valves. Types and selection
Unstable operation. Water hammer. Cavitation.

Full-or-part-time: 62h 30m
Theory classes: 15h
Laboratory classes: 7h 30m
Self study : 40h

Module 2 : Industrial heating and cooling systems

Description:
Heat exchangers
Fuels and combustion
Refrigeration equipment
Heat generators

Full-or-part-time: 62h 30m
Theory classes: 15h
Laboratory classes: 7h 30m
Self study : 40h

Module 3 : Heat engines

Description:
Internal combustion engines
Steam turbines
Gas turbines
Combined heat and power systems

Full-or-part-time: 62h 30m
Theory classes: 15h
Laboratory classes: 7h 30m
Self study : 40h

GRADING SYSTEM

The final grade of the course will be the weighted grade of the three modules, according to the following criteria:
- Module 1 : 1/3
- Module 2 : 1/3
- Module 3 : 1/3

The final grade for Module 1 depends on the following activities:
-1 : First partial exam (1st Evaluation) 30 %.
-2 : Second partial exam (2nd Evaluation) 40 %
-3 : Laboratory 20 %
-4 : Works 10

The final grade of Module 2 depends on the following activities:
-1 : Exam 100% module (1st Evaluation) 80 %.
-2 : Laboratory / Work 20 %.

The final grade for Module 3 depends on the following activities:
-1 : Examination 100% module (2nd Evaluation) 80 %
-2 : Laboratory / Work 20 %.

The evaluation system will follow the following schedule:
- 1st Evaluation : Module 1 (first partial examination)
Module 2
- 2nd Evaluation : Module 1 (second partial exam)
Module 3

For the students who do not pass the 1st Evaluation, it is foreseen to take a recovery exam which will be held on the day of the 2nd Evaluation exam.

Rules of the recovery exam:
-Only students who have failed the 1st evaluation can take the exam.
-Maximum grade limited to 6.0 out of 10.0.

The final grade of the 1st Evaluation will be the highest grade obtained by the student between the two exams (regular exam and recovery exam).

BIBLIOGRAPHY

Basic:
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- McBirnie, Samuel C. Marine steam engines and turbines. 4th ed. London: Butterworths, 1980. ISBN 0408003871.
- ASHRAE handbook: refrigeration. Atlanta: American Society of Heating, Ventilating and Air-Condtioning Engineers, 2014. ISBN 9781936504725.
- Heras, Salvador de las. Fluidos, bombas e instalaciones hidráulicas [on line]. 2a ed. Barcelona: Iniciativa Digital Politècnica, 2018 [Consultation: 10/03/2023]. Available on: http://hdl.handle.net/2117/127556. ISBN 9788498807288.
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- Çencel, Y. A.; Boles, M. A. Termodinámica [on line]. 9ª ed. México: McGraw-Hill, 2019 [Consultation: 03/10/2022]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=5808940. ISBN 9781456269166.
- Kays, W.M.; London, A.L. Compact heat exchangers. 3rd ed. Malabar: Krieger Publishing, 1984. ISBN 1575240602.
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- Pita, Edward G. Principios y sistemas de refrigeración. México: Limusa, 1991. ISBN 9681839692.
- Carreras, R.; Comas, A.; Calvo, A. Motores de combustión interna: fundamentos. Barcelona: Edicions UPC, 1993. ISBN 8476533543.
- Saravanamuttoo,H.I.H. [et al.]. Gas turbine theory. 6th ed. Harlow; New York: Pearson Prentice Hall, 2009. ISBN 9780132224376.