Course guide
3200501 - ST1 - Thermal Systems I

Last modified: 02/04/2024

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

Degree: BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Compulsory subject).

Academic year: 2024 **ECTS Credits:** 4.5 **Languages:** Catalan

LECTURER

Coordinating lecturer: Núria Garrido Soriano

Others: Núria Garrido
Roser Capdevila

PRIOR SKILLS

Students will be expected to have passed Thermal Engineering.

REQUIREMENTS

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. MEC: Skills for the calculation, design and testing of machines.

TEACHING METHODOLOGY

- Face-to-face lecture sessions.
- Face-to-face guided exercise sessions.
- Independent study and small-group exercises.

In the face-to-face lecture sessions, the lecturer will introduce the basic theory, concepts, methods and results for the subject and use examples to facilitate students' understanding.
In the face-to-face practical class work sessions, the lecturer will help students to understand problem statements, analyse the information provided, and solve and check the problems.
Students will be expected to study in their own time so that they are familiar with concepts and are able to solve the exercises set.

LEARNING OBJECTIVES OF THE SUBJECT

In this subject, students gain an understanding of the basic theoretical concepts of heat transfer and how they relate to technical thermodynamics, as well as the ability to design, analyse and use basic thermal equipment and systems.
Build on the specific transversal competencies associated with coursework, as described below.
Specific competencies
· An understanding of the principles of heat transfer, and the ability to apply those principles to the design of thermal equipment and systems.
· The ability to analyse and solve problems in heat transfer.
Generic competencies:
· Independent learning.

STUDY LOAD

Type	Hours	Percentage
Hours medium group	15,0	13.33
Hours large group	30,0	26.67
Self study	67,5	60.00

Total learning time: 112.5 h

CONTENTS

BLOC1: FURTHER HEAT TRANSFER

(ENG) TEMA 0: Conceptes bàsics

Description:
(ENG) 1 CONCEPTES BÀSICS
1.1 OBJECTIUS
1.2 TERMODINÀMICA VS TRANSFERÈNCIA DE CALOR
1.3 FORMES D'ENERGIA I TRANSFERÈNCIA D'ENERGIA
1.3.1 Formes d'energia
1.3.2 Transferència d'energia
1.4 BALANÇOS D'ENERGIA
1.4.1 Primera llei de la termodinàmica
1.4.2 Balanç per sistemes tancats i estacionaris
1.4.3 Balanç per sistemes oberts (de flux estacionari)
1.4.4 Balanç d'energia en la superfície
1.5 MECANISMES DE TRANSMISSIÓ DE CALOR
1.5.1 Transmissió de calor per conducció.
1.5.2 Transmissió de calor per convecció.
1.5.3 Transmissió de calor per radiació.
1.6 SISTEMES DE TRANSMISSIÓ DE CALOR COMBINATS
1.6.1 Conducció i convecció en sèrie
1.6.2 Convecció i radiació en paral·lel

Specific objectives:
(ENG) 1. Explicar com estan relacionades entre si la termodinàmica i la transferència de calor
2. Diferenciar l'energia tèrmica de les altres formes d'energia, així com la transferència de calor de les altres formes de transferència d'energia
3. Realitzar balanços generals d'energia i balanços d'energia superficial
4. Definir els mecanismes bàsics de transferència de calor: conducció, convecció i radiació així com la llei de Fourier de la transferència de calor per cunducció, la llei de Newton del refredament i la llei de Stefan-Boltzman de la radiació
5. Identificar els mecansismes de transferència de calor que en la pràctica tenen lloc de forma simultània.

Full-or-part-time: 7h 30m
Theory classes: 2h
Practical classes: 1h
Self study : 4h 30m

TOPIC 1: Heat transfer by conduction

Description:
- Introduction
- Differential equation for conduction. Levels of resolution.
- Stationary conduction and one-dimensional flow in simple geometries.
- Intensification of heat transfer.

Full-or-part-time: 45h
Theory classes: 13h
Practical classes: 5h
Self study : 27h

TOPIC 2: Heat transfer by convection

Description:
- Introduction
- Equations of basic concepts. Levels of resolution.
- Boundary layer basics.
- Dimensional analysis and model theory. Physical significance of dimensionless groups.
- Analysis of convective heat transfer coefficients. Empirical relationships.

Full-or-part-time: 30h
Theory classes: 8h
Practical classes: 4h
Self study : 18h

TOPIC 3: Heat transfer by radiation

Description:
- The nature of thermal radiation.
- Transparent and participating media.
- Black body radiation. Fundamental laws.
- Radiation properties of real bodies.
- Radiation exchange between black surfaces. View factor. Calculation methods.

Full-or-part-time: 30h
Theory classes: 9h
Practical classes: 3h
Self study : 18h

GRADING SYSTEM

- First examination: 30%
- Second examination: 35%
- Questionnaires: 20%
- Simulation practice: 25%

Students who do not pass the partial assessment (grade less than 5 out of 10) may return the result in the final assessment. (See evaluation rules section)

For those students who meet the requirements and submit to the reevaluation examination, the grade of the reevaluation exam will replace the grades of all the on-site written evaluation acts (tests, midterm and final exams) and the grades obtained during the course for lab practices, works, projects and presentations will be kept.
If the final grade after reevaluation is lower than 5.0, it will replace the initial one only if it is higher. If the final grade after reevaluation is greater or equal to 5.0, the final grade of the subject will be pass 5.0.
The subject is evaluated continuously. Nevertheless, the second evaluation of the subject allows a reconduction of the mark of those students who have suspended the first evaluation, based on a double score of a series of questions of problems (clearly identified) that will allow to obtain 5 points (on 10) if answered correctly. This mark will replace the problem mark of the first assessment and, in any case, the final mark will be the highest of those obtained. All students who have obtained a grade of less than 5 (out of 10) in the partial assessment will be eligible.

EXAMINATION RULES.

The assessment test will contain theory, with test and / or short development questions, and problems. For each test, the weights of the theory and problem part will be 30% and 70% respectively.

The theory part of the assessment test will be done without any resources other than paper and pen. The problem part of the assessment test can also be done with a calculator and a form provided by the teachers of the subject and available at Atenea.
The tests will be performed in a maximum time of 180 minutes. The theory part of the assessment test will last 25 minutes. Then there will be a 5 minute break. The problem part of the assessment test will last 150 minutes.

BIBLIOGRAPHY

Basic:
- Çengel, Yunus A. Transferencia de calor y de masa: fundamentos y aplicaciones [on line]. 6ª ed. México: McGraw-Hill, 2020 [Consultation: 23/11/2021]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=10213. ISBN 9781456277215.
- Kreith, Frank [et al.]. Principios de transferencia de calor. 6a ed. Madrid: International Thomson, 2002. ISBN 8497320611.

Complementary:
- Incropera, Frank P. Fundamentos de transferencia de calor. 4a ed. México: Prentice Hall, 1999. ISBN 9701701704.
- Mills, Anthony F. Transferencia de calor. México: Irwin, 1995. ISBN 8480861940.