30012 - Technical Thermodynamics and Heat Transfer Basics

Información del Plan Docente

Academic Year	2018/19
Subject	30012 - Technical Thermodynamics and Heat Transfer Basics
Faculty / School	110 - Escuela de Ingeniería y Arquitectura
Degree	436 - Bachelor's Degree in Industrial Engineering Technology
ECTS	6.0
Year	2
Semester	First semester
Subject Type	Compulsory
Module	---

1.General information

1.1.Aims of the course

1.2.Context and importance of this course in the degree

1.3.Recommendations to take this course

2.Learning goals

2.1.Competences

2.2.Learning goals

2.3.Importance of learning goals

3.Assessment (1st and 2nd call)

3.1.Assessment tasks (description of tasks, marking system and assessment criteria)

4.Methodology, learning tasks, syllabus and resources

4.1.Methodological overview

The methodology followed in this course is oriented towards achievement of the learning objectives. It is based on participation and the active role of the student favors the development of communication and decision-making skills. A wide range of teaching and learning tasks are implemented, such as lectures, guided assignments, laboratory sessions, autonomous work, and tutorials.

Students are expected to participate actively in the class throughout the semester.

Classroom materials will be available via Moodle. These include a repository of the lecture notes used in class, the course syllabus, as well as other course-specific learning materials.

Further information regarding the course will be provided on the first day of class.

4.2.Learning tasks

The course includes 6.0 ECTS organized according to:

- Lectures (1.8 ECTS): 45 hours.

- Laboratory sessions (0.6 ECTS): 15 hours.

- Guided assignments (1.6 ECTS): 40 hours.

- Autonomous work (1.6 ECTS): 40 hours.

- Tutorials (0.5 ECTS): 10 hours.

Notes:

Lectures: the professor will explain the theoretical contents of the course and solve illustrative applied problems. These problems and exercises can be found in the problem set provided at the beginning of the semester. Lectures run for 3 weekly hours. Although it is not a mandatory activity, regular attendance is highly recommended.

Laboratory sessions: sessions will take place every 2 weeks aprox. (5 sessions in total) and last 3 hours each. Students will work together in groups actively doing tasks such as practical demonstrations, measurements, calculations, and the use of graphical and analytical methods.

Guided assignments: students will complete assignments, problems and exercises related to concepts seen in laboratory sessions and lectures. They will be submitted at the beginning of every laboratory sessions to be discussed and analyzed. If assignments are submitted later, students will not be able to take the assessment test.

Autonomous work: students are expected to spend about 75 hours to study theory, solve problems, prepare lab sessions, and take exams.

Tutorials: the professor's office hours will be posted on Moodle and the degree website to assist students with questions and doubts. It is beneficial for the student to come with clear and specific questions.

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4.3.Syllabus

The course will address the following topics:

Theory sessions

Topic 1. Introduction to Engineering Thermodynamics. Introductory concepts. Definitions. System and processes. (2 hours)

Topic 2. Empirical behavior of matter and calculation of thermodynamic properties. Phase change. Diagrams: T-v, P-v, P-T. Superheated steam. Two phase mixtures. Subcooled liquid. Real gas. Ideal gas. (6 hours)

Topic 3. First Law of Thermodynamics. Mathematical formulations. Mass and energy balances for closed and open systems (control volume). Application to industrial processes and equipment. Transient analysis. (8 hours)

Topic 4. Second Law of Thermodynamics. Reversible and irreversible processes. Formulations of Second Law of Thermodynamics. Carnot Cycle. Entropy: definition and calculation. T-s and h-s diagrams. Entropy balance. Isentropic processes. Isentropic efficiency. Heat transfer and work in quasi-static (isentropic) processes. (8 hours)

Topic 5. Gas power cycles. Otto, Diesel and Dual cycles. Joule-Brayton cycle. Air standard analysis. Effect of pressure ratio and irreversibilities on energy efficiency. Regenerative gas turbine. Regenerative gas turbine with reheat and intercooling. (4 hours)

Topic 6. Vapor power cycles. Ideal Rankine cycle. Effect of the boiler and condenser pressures on the energy efficiency. Comparisson with Carnot cycle. Irreversibilities and losses. Superheating and reheating. Regenerative cycles. (4 hours)

Topic 7. Refrigeration cycles. Applications. Thermophysical properties of refrigerants. Vapor compression refrigeration cycle. Cascade and multi-stage refrigeration cycles. Heat pump. Irreversibilities. Gas refrigeration cycle. (4 hours)

Topic 8. Psychrometrics and psychrometric processes. Psychrometric principles. Mass and energy conservation in psychrometric processes. Psychrometric diagram. Psychrometric processes. (5 hours)

Topic 9. Fundamentals of Heat Transfer. Relationship of heat transfer with engineering thermodynamics. Relevance of heat transfer. Physical origins and rate equations: conduction, convection radiation. (4 hours)

Laboratory sessions (tentative program)

Session 1. Thermodynamic properties of P-V-T substances

Session 2. Energy balances to different pieces of equipment

Session 3. Gas or Vapor power cycle

Session 4. Refrigeration cycle

Session 5. Psychrometric processes

4.4.Course planning and calendar

For further details concerning the timetable, classroom and further information regarding this course, please refer to the Escuela de Ingeniería y Arquitectura de la Universidad de Zaragoza (EINA), website, https://eina.unizar.es/ .

4.5.Bibliography and recommended resources