Course Unit	Thermodynamics II			Field of study	Thermodynamics and Thermal Processes		
Bachelor in	Mechanical Engineering			School	School of Technology and Management		
Academic Year	2023/2024	Year of study	2	Level	1-2	ECTS credits	6.0
Type	Semestral	Semester	2	Code	9123-759-2205-00-23		

Workload (hours)	162	Contact hours	T	TP	PL	TC	S	E	OT	O
			-	60	-	-	-	-	-	-

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s): Manuel Luís Pires Clara

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. Understand the importance of the second law of thermodynamics in the characterization of the processes.
2. Recognize the importance of entropy in the performance of the devices.
3. Know characterize the different thermodynamic power cycles identifying the conditions of application of each one.
4. Recognize the importance and knowing the effects of the changes and modifications in the cycles such as the reheat and regeneration.
5. Identify the different thermodynamic refrigeration cycles and systems.

Prerequisites

Before the course unit the learner is expected to be able to:
1. Apply the basic concepts of thermodynamics: units and thermodynamic properties;
2. Use the tables of the thermodynamic properties of pure substances and ideal gases;
3. Distinguish heat and work and apply the 1st law of thermodynamics to closed and open systems;

Course contents

Introduction (brief review on the second law and entropy). Gas power cycles. Steam and combined power cycles. Refrigeration cycles.

Course contents (extended version)

1. Second Law of Thermodynamics (Review)
   - Heat Engines, Refrigerators and Heat Pumps; Cycle, Heat Engine, Refrigerator and Carnot Principles.
2. Entropia (Review)
   - Entropy; Entropy Increase Principle; Entropy Change; Isentropic Efficiencies.
3. Gas Power Cycles
   - Otto and Diesel Cycles; Brayton Cycle with Ideal Regeneration, Cooling and Intermediate Reheat.
4. Steam and Combined Power Cycles
   - Rankine Cycle with Regeneration and Reheat; Cogeneration; Binary Cycles; Gas-Steam Combined Cycles.
5. Refrigeration Cycles
   - Ideal Vapor Compression Refrigeration Cycle; Absorption Refrigeration Systems.

Recommended reading

1. Y. Çengel, M. A. Boles and M. Kanolu. Thermodynamics: An Engineering Approach. Ninth edition. | New York, NY : McGraw-Hill Education, [2019].
2. M. J. Moran and H. N. Shapiro. Fundamentals of Engineering Thermodynamics. 8th ed. New York: John Wiley & Sons, 2014.

Teaching and learning methods

In the lecture classes, the contents will be presented with the help of simple examples and in the practice classes more complex examples will be developed. The use of software will be implemented whenever it is available.

Assessment methods

1. Alternative 1 - (Regular, Student Worker) (Final)
   - Intermediate Written Test - 50% (Mid term exam.)
   - Intermediate Written Test - 50% (Final term exam.)
2. Alternative 2 - (Regular, Student Worker) (Final, Supplementary, Special)
   - Final Written Exam - 100%

Language of instruction

Portuguese, with additional English support for foreign students.

Electronic validation

Manuel Luís Pires Clara	João Eduardo Pinto Castro Ribeiro	João da Rocha e Silva	José Carlos Rufino Amaro
12-02-2024	15-02-2024	16-02-2024	25-02-2024