Course Unit	Design of Thermal Systems			Field of study	Thermodynamics and Thermal Processes		
Master in	Mechanical Engineering			School	School of Technology and Management		
Academic Year	2023/2024	Year of study	1	Level	2-1	ECTS credits	6.0
Type	Semestral	Semester	1	Code	5071-793-1103-00-23		

Workload (hours)	162	Contact hours	T	TP	PL	TC	S	E	OT	O
			-	20	40	-	-	-	-	-

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): Luís Manuel Frolen Ribeiro

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. Identify and design thermofluid systems, including heating, drying, boiling, refrigeration, air conditioning, compression, expansion, combustion and also for the production of heat and electricity;
2. Analyze and size a thermal system design and equip their intellectual toolbox with a variety of techniques for applying a functional and successful thermal design;
3. Communicate, written and orally, the critical issues of thermal fluid systems, their strengths, characteristics and limitations.

Prerequisites

Before the course unit the learner is expected to be able to:
Basic knowledge of thermodynamics, fluid mechanics and heat transfer.

Course contents

Design analysis process; Types of systems; Selection of fluid flow equipment; Heat exchange design options; Economic evaluation and preliminary cost estimation; Availability analysis; System flow sheeting; Equipment sizing and selecting (boilers, burners, heat exchangers, pumps, condensers, evaporators, compressors, gas and vapour turbines); Process safety and maintenance; Monitorization and control.

Course contents (extended version)

1. Thermodynamics, Heat Transfer and Combustion Review;
2. The design analysis process;
3. Process flow diagrams;
4. Thermodynamics complements;
5. Burners and heat recovery;
6. Boilers and energy cycles;
7. Combustion turbines;
8. Refrigeration and heat Pumps;
9. Other thermal systems;
10. Analysis of fluid and piping movers;
11. Thermal protection;
12. Piping and instrumentation diagrams;
13. Control of thermal systems;
14. Process safety;
15. Process quality assurance and evaluation methods;
16. Acquisition, Operation and Maintenance.

Recommended reading

1. Design of Thermal Energy Systems; Pradip Majumdar; 2021; ISBN:9781118956939
2. Heating, ventilating and air conditioning - ASHRAE Handbook of Fundamentals, McQuinston, Faye C.; 2005
3. Thermal Systems Design - Fundamentals and Projects –Martin, R. J. - 2nd Edition – 2022 - John Wiley & Sons, Inc. - ISBN: 9781119803478
4. Design of thermal systems, Stoecker, W. F., McGraw-Hill Book Company, 1989 ISBN:0-07-100610-9

Teaching and learning methods

The course is structured in the Project Based Learning methodology and is developed in parallel with ongoing research projects. The class is organized into groups with specific tasks for the success of the whole, with group members rotating through different sub-themes and roles. The work is carried out in the classroom, with assessment of oral and written communication in each class.

Assessment methods

- Unified project - (Regular, Student Worker) (Final, Supplementary, Special)

Language of instruction

Portuguese, with additional English support for foreign students.

Electronic validation

Luís Manuel Frolen Ribeiro	João Eduardo Pinto Castro Ribeiro	Paulo Alexandre Gonçalves Piloto	José Carlos Rufino Amaro
12-10-2023	12-10-2023	12-10-2023	20-10-2023