# Curricular Unit Form (FUC)

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| Course: | **FIRST CYCLE IN MECHANICAL ENGINEERING** | | | | | |
| Curricular Unit (UC) | **Applied Thermodynamics** | | | Mandatory | **X** | |
| | | | | Optional | | |
| Scientific Area: | **Termofluids and Energy** | | | | | |
| Year: 2nd | Semester: 2nd | ECTS: 5,5 | | Total Hours: 148,5 | | |
| Contact Hours: | T: 22,5 | TP:45,0 | PL: | S: | OT: | TT: 67,5 |
| Professor in charge | | Academic Degree /Title | | Position | | |
| Cláudia S. Séneca L. Casaca | | PhD | | Assistant Professor | | |

T- Theoretical ; TP – Theory and practice ; PL – Laboratory ; S – Seminar ; OT –Tutorial ; TT – Total of contact hours

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| Entry into Force | Semester: Winter | Academic Year: 2019/2020 |

**Objectives of the curricular unit and competences** (max. 1000 characters)

The fundamental goal of this Curricular Unit is to provide the student with the theoretical and practical bases necessary for understanding the subjects. Identification, classification and understanding of real systems based on learning of ideal systems. Comparison between different systems and analysis of results.

The students should know thermal and work producing thermodynamic cycles and their practical applications in power plants based on steam turbines, gas turbines, combined cycle, cogeneration, heat pumps and refrigeration plants. Capability to deal with engineering problems well-structured and coherent in order to be able to infer, through them, the behavior of real systems. The students should be able to write a report according to universally accepted and used rules and with the resource of computer software.

**Syllabus** (max. 1000 characters)

INTRODUCTION: Definition of energy. Energy conversion. Renewable and non-renewable energy sources. The process of combustion and fuels. 1st and 2nd Principles of Thermodynamics. Definition of exergy. Energy and exergy analysis. Load Diagrams: Sankey and Grassman.

WORK PRODUCING THERMODYNAMIC CYCLES AND THEIR APPLICATIONS: Rankine - steam turbine plants based on simple Cycle, with reheating and with regenerative heating (closed and open heaters). Joule (Brayton) - gas turbines plants in open and closed circuits. Combined cycles and combined heat and power production (Cogeneration).

THERMAL PRODUCING THERMODYNAMIC CYCLES AND THEIR APPLICATIONS: Vapour-compression, gas refrigeration systems and Absorption refrigeration Cycles – heat pumps and refrigeration plants. Coefficients of performance. The desired thermodynamic properties for the refrigerant fluid.

**Demonstration of the syllabus coherence with curricular unit's objectives** (max. 1000 characters)

With the themes explained in the introduction the thermodynamic concepts to be developed on the main core of the study for several cycles are introduced, and later applied to real energy-producing plants. At the end of this course, the students will not only be able to solve typical textbook problems involving thermodynamic cycles, but also problems involving real thermodynamic cycles of existing thermal power plants, having a first contact with the reality of a power plant.

This course intends to give continuity to the matters exposed in the course Thermodynamics of the previous semester, developing exergy analysis as a complement to traditional energy analysis.

**Teaching methodologies (including evaluation)** (max. 1000 characters)

The course is organized in theoretical, theoretical/practical, laboratory classes and field trips. In the theoretical and theoretical/practical classes the topics covered in the course will be explained and discussed and applied problems are solved. In laboratory practice sessions, students work with computer programs simulating facilities functioning. In the study visits they will get acquainted with real plants.

The evaluation of the course is conducted through an exam and a practical component, pedagogically fundamental, based on the resolution (individual or group) of the problems proposed in the classes, and in the presentations developed within the scope of the case study.

Final Assessment: 70% Exam + 30% practical works.

**Demonstration of the teaching methodologies coherence with the curricular unit's objectives** (max. 3000 characters)

The teaching of the theoretical-practical classes consists on the explanation and discussion of the topics covered in the syllabus and on the resolution of applied problems. Audiovisual techniques and appropriate software are used as a support to the presentation and visualization of the examples given.

The learning begins with the interest stimulated on students about the topics discussed in the classroom. It would be accomplished via practical works (research or laboratory) realized by the students organized in small groups (3/4 persons). The work reports and an exam, which is individual, evaluates the acquisition of theoretical and practical skills of the matters taught.

The teaching/learning process is complemented in the Moodle platform where relevant information is made available by the teacher and can be accessed by the students.

**Main Bibliography** (max. 1000 characters)

Çengel, Y. A. and Boles, M. A. Thermodynamics: an engineering approach. McGraw-Hill.

Haywood, R. W. Analysis of Engineering Cycles. Pergamon Press.

Moran, M. J. and Shapiro, H. N. Fundamentals of Engineering Thermodynamics. John Wiley & Sons Publishers.

Mota, O. Exercícios Resolvidos de Termodinâmica. LIDEL.

Oliveira, P. P. Fundamentos de Termodinâmica Aplicada. Análise Energética e Exergética. LIDEL.

Coelho, P. Tabelas de Termodinâmica. LIDEL