Curricular Unit Form (FUC)

Course:	**FIRST CYCLE IN MECHANICAL ENGINEERING**						
Curricular Unit (UC)	**Thermal Equipments**					Mandatory	
						Optional	**X**
Scientific Area:	**Energy and Control Systems**						
Year: **3º**	Semester: **2º**	ECTS:**4,0**		Total Hours: **3,0**			
Contact Hours:	T:	TP:**45,0**	PL:	S:	OT:	TT: **45,0**	
Professor in charge		Academic Degree /Title		Position			
Paulo Santamaria Gouveia		**Mestre/Especialista IPL**		**Professor Adjunto**			

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

Entry into Force	Semester: **Winter**	Academic Year: **2012/2013**

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

To address the theoretical and practical aspects essential in the transmission of heat in thermal equipment, introducing components, materials, technical language and methodologies inherent to the design, project and construction of heat exchange bodies.

Development of critical skills in the establishment of the phenomena relevant to the operation of complex thermal equipment, and the project analysis to establish the principle of operation from the fundamental knowledge acquired in the applicable base disciplines.

It is intended to guide the student in establishing working models of equipment analyzed from the fundamental knowledge gained in basic disciplines: Thermodynamics, Fluid Mechanics, Heat Transfer, etc.. And its interconnection with the more traditional Eng. Mechanics: Technologies and materials, machinery and organs of mechanical design, design and design of the equipment.

The student will be encouraged to find, select and process information relevant to the monitoring of the discipline and fundamental to value and meet the demands of theoretical work provided

Syllabus (max. 1000 characters)

BASIC THEORY OF HEAT EXCHANGE

1. Heat Transfer Global Coefficient;
2. Temperature distribution through Heat Exchangers;
3. General Method for Heat Exchange Area calculus;
4. Special solutions for Heat Exchange Coefficient: Stationary and Heat Exchange Capacity;
5. Maximum heat exchange flux and heat exchange efficiency;
6. NTU- Number of Thermal Units;
7. Alternatives for the analysis of Heat Exchangers behavior;

HEAT EXCHANGERS SELECTION

1. Primary configurations for Heat Exchangers;
2. Main Selection;
3. Secondary selection of the configuration characteristics.

HEAT EXCHANGERS DESIGN

1. Simpler design of double pipe heat exchangers;
2. Heat Exchangers based on Pipe arrangements;
3. Heat Exchangers based on Plate arrangements;
4. Simple Plates heat exchangers;
5. Heat Exchangers cooled by Air.

BI-PHASIC FLOW HEAT EXCHANGERS.

BOILING HEAT TRANSFER.

STEAM GENERATORS.

HEAT EXCHANGERS COMBINED WITH STEAM GENERATORS.

EVAPORATORS.

HEAT EXCHANGERS WITH STEAM CONDENSATION.

COOLING TOWERS

FURNACES AND BOILERS

HEAT TRANSFER WITHIN THERMODINAMICAL CYCLES.

Basics: ECEMEI - European Centre for the Economics and Management of Energy for Industry Ltd

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

The syllabus coincides with high accuracy with defined objectives, namely:

i. Deepening and practical application the knowledge acquired in the basic specialty disciplines (Heat Transfer, Fluid Mechanics and Thermodynamics, essentially).

ii. Development of the Theory on applied heat exchange equipment, in general, focusing on the physical phenomena associated.

iii. More sophisticated and thorough treatment of the central issues of the discipline program, including physically different types of heat exchange.

iv. Introduction and theoretical development of the most important classes of equipment.

v. Development of calculation abilities and introduction to the draft industrial equipment, prioritizing the phenomenological understanding of the processes involved.

vi. Integration of knowledge central to Mechanical Engineering, promoting the interconnection of knowledge, through the quantification of interrelated impacts (eg. Mechanical consequences of thermal requests)

The theoretical work evaluation is aimed specifically at achieving the objectives of the discipline, through the development of the know-how acquired applied to the design of specific industrial equipment.

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

In the methodology followed, the priority is the phenomenological explanation of the issues, easing up the use of more complex mathematical models and deepening the physical depth approach, but without compromising the effective calculation (and complete) of equipments and practical applications studied, including the development of relevant inherent conclusions.

Evaluation.

An written final Examination (EXM) and one theoretical work (pedagogically) fundamental (TRB).

• TRB-Work Theory: like the calculation of a thermodynamic features studied
aims to enhance the development of competencies in the discipline main areas;

• EXM-Final Exam: are acceptable ratings higher (or equal) to 8.0 pints (in 20.0),
intended to ensure that the minimum acceptable level of knowledge has been attained;

• **Final Note**: Weighted partial average ratings = 0.5 x TRB + 0.5 x EXM.

Approval -will be in chair approved students with Endnote equal or higher than 9.5

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

The teaching methodologies and assessment used are the most appropriate, taking into account the constraints of the resources of the School and the objectives pursued:

- The theoretical and practical classes are being taught in the classroom, using up to some laboratory demonstrations possible.
- The content of the lessons is essentially theoretical (due to the length of the program) with a few practical lessons (problems, calculations, design) to consolidate knowledge.
- After introducing the basic concepts and their practical application to calculate the equipments, are performed problems that promote the structuring of the reasoning for the application of scientific knowledge to the development of technological applications.
- The theoretical Work allows students to work in teams to develop the calculations of complex equipments: problem analysis, survey of known information, research data and parameters required, structuring of calculations sequence, characterization of decision algorithms, evaluation of results, development of final conclusions, suggestions for future improvement, etc..
- The exam consists of an individual assessment of the fundamental knowledge whose acquisition is considered mandatory for the successful approval in the discipline.

Main Bibliography (max. 1000 characters)

Bibliography:

- **Notes & Texts compiled and selected by the Head of the discipline.**
- Process Heat Transfer - D.Q. Kern - McGraw - Hill KogaKusha Ltd.
- Process Heat Transfer - Geoffrey Frederick Hewitt, G. L. Shires, T. R. Bott
- Compact Heat Exchangers - W. Kays & A.L. London, McGraw-Hill Book Company.
- Parallel-Tube Exchangers Shell counterflow - CCWright-Stanford University Report.
- Heat Exchangers Design - A.P. Fraas & M.N. Ozisik - John Wiley & Sons Inc.
- Evaporative Cooling of Circulating Water - LD Berman - Pergamon Press Ltd.

Additional:

- Plate Heat Characteristics in Refrigerant Systems - Mats Strömblad
- Transmission et échangeurs de chaleur - G. Rigot ; Les Editions Parisiennes
- Power Plant System Design - Kaw W. Li & A. Paul Priddy - John Wiley & Sons, inc.
- Fundamentos de Transferência de Calor e de Massa (tradução brasileira) – Frank P. Incropera & David P. DeWitt – LTC: Livros Técnicos e Científicos Editora S.A.
- Handbook of Heat Transfer - WM Rohsenow & Hartnett JP (editors) - McGraw-Hill Book Co.
- Analysis of Heat and Mass Transfer - E.R.G. Eckert & R. M. Drake Jr. - McGraw-Hill Kogakusha Ld
- Thermal Radiation Heat Transfer - Robert Siegel, John R. Howell - McGraw - Hill Kogakusha Ld
- Heat Transfer Engineering - JR Simonson - The MacMillan Press Ltd.
- Heat Transfer Engineering - James R. Welty - John Wiley & Sons, Inc.
- Geradores de Calor - Filipe José Mendes Juanico ; ECEMEI