COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Engineering		
ACADEMIC UNIT	Department of Mechanical Engineering		
LEVEL OF STUDIES	*Undergraduate*		
COURSE CODE	EN1200	**SEMESTER**	9th
COURSE TITLE	Thermal Process Equipment		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
	5	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialized general knowledge, skills development*	Specialized general knowledge
PREREQUISITE COURSES:	There are no prerequisite courses. It is recommended that students who are interested in attending the course have completed successfully Thermodynamics I & II, Fluid Mechanics I & II, Heat Transfer, Transport Processes.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Όχι
COURSE WEBSITE (URL)	https://www.mie.uth.gr/?page_id=18444&lang=en

the following courses:

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

This course aims to provide the necessary knowledge that will enable students to analyze and design the most popular heat exchangers under conditions of single-phase and multi-phase heat transfer.
Thus, the fundamentals of gas/liquid multiphase flow, film condensation and pool and flow boiing are also covered.
Upon successful completion of this course, the student will be able to:

- select among different types of heat exchangers based on the thermo-physical properties and process characteristics of the streams,
- perform preliminary calculations of heat transfer area, taking into account scale formation,
- perform detailed calculations of shell-and-tube exchangers, selecting among alternative TEMA designs,
- perform detailed calculations of the most popular compact exchangers (tube-and-fin, plate-and-fin, plate-and-frame),
- calculate pressure drop and heat transfer coefficients in gas/liquid two-phase flow,
- design various types of condensers and evaporators/reboilers,
- understand the construction details and operational characteristics of fire-tube and water-tube boilers and perform energy calculations for boiler rating.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project planning and management with
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking
……
Others…
…….

- Search for, analysis and synthesis of data and information with the use of the necessary technology Decision making
- Team work
- Project planning and management

(3) SYLLABUS

Preliminary thermal design of heat exchangers. Fouling and scaling problems. Basic exchanger types. Design of double-pipe exchangers. Construction details, TEMA classification and design of shell-and-tube exchangers. Design of compact heat exchangers, tube-and-fin, plate-and-fin and plate-and-frame. Twophase pressure drop and heat transfer computations. Physics of condensation and design of condensers. Nucleate and film boiling. Critical heat flux in pool and flow boiling. Design of evaporators and reboilers. Steam and energy economy. Fire-tube and water-tube boilers. Construction details, operational characteristics and energy calculations of boilers. Water-steam and fuel-exhaust circuits. Design considerations for the combustion/radiation chamber.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	- Retrieval of constructor information on heat exchangers - Use of physico-chemical property databases - Design optimization by preadsheet calculations

TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non- directed study according to the principles of the ECTS*	*Activity*	*Semester workload*
	Lectures	56
	Application exercises Design project	34 35
	Independent study	25
	Course total	*150*
STUDENT PERFORMANCE EVALUATION ***Description of the evaluation procedure*** *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, shortanswer questions, open- ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Heat exchanger design projects (20%) Final written exam (80%) undertaken with open books and notes. The exam involves problem solving, detailed design calculations and open-ended questions.	

(5) **ATTACHED BIBLIOGRAPHY**

-Suggested bibliography:

- Lecture notes
- Kakac "Boilers, Evaporators and Condensers"
- Hesselgreaves “Compact Heat Exchangers”
- Wallis “One-Dimensional Two-Phase Flow”
- Tong, Tang “Boiling Heat Transfer and Two-Phase Flow”

- Related academic journals:

- International Journal of Multiphase Flow
- International Journal of Heat and Mass Transfer Applied Thermal Engineering