COURSE OUTLINE

(1) GENERAL

SCHOOL	Engineering		
ACADEMIC UNIT	Mechanical Engineering		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	EN1600	**SEMESTER**	9th
COURSE TITLE	HEATING – REFRIGERATION –AIR CONDITIONING ENGINEERING		

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 thecourse, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures, Lab exercises, Case study	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*	Special background, Specialized general knowledge, Skills development
PREREQUISITE COURSES:	There are no prerequisite courses. It is recommended that students who are interested in attending the course have completed successfully the following courses: Thermodynamics I & II, Fluid Mechanics I & II, Heat Transfer.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	https://www.mie.uth.gr/?page_id=18486&lang=en

(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*

After completing this course the student should be able to:

- Calculate heating and cooling loads in buildings
- Understand and specify the use of insulation materials for the building envelope in engineering studies
- Design an air-conditioning process (cooling or heating) in the psychrometric chart
- Design and dimensioning (pressure losses) of piping and duct networks
- Understanding the selection of boilers, chillers, pumps, fans, radiators and fan coils, air handling units and economizers
- Use Technical Guidelines, Standards and Handbooks in the design process

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, with 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
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
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- Technical data and information search, analysis and synthesis
- Understanding and design HVAC installations
- Decision - making
- Working independently
- Team work
- Design and calculation of HVAC installations

(3) SYLLABUS

1. Introduction to heating and cooling processes. Thermal comfort.
2. Design conditions: indoor – outdoor. Thermal insulation codes. Heat transfer coefficients of building materials.
3. Energy consumption estimation methodologies
4. Introduction to building heating: heating system equipment and devices, heat load calculation (ISO12831).
5. Hydronic systems. Design of single- and double- pipe systems.
6. Heating equipment. Boilers, pumps, radiators, fan coils. Selection and dimensioning of components, valves, expansion vessel.
7. Psychometrics principles. Sensible – latent load. Basic psychrometric calculations – software. Heating, cooling, humidifying – dehumidifying, mixing.
8. Air conditioning systems. All air, air-water and all water systems. Suitability of air conditioning systems for various applications – selection process.
9. Thermodynamics of heating and cooling. Heat pump cycles. Heat pumps with mechanical compression. Absorption heat pumps.
10. Heat recovery. Economizers. Regenerators. Energy saving in air conditioning - heating systems.
11. Pipe and duct sizing. Duct systems, fans, fittings. Hydronic heating and cooling systems design. Control systems. Fan-coil selection, piping system design.
12. Central air conditioning. Air distribution systems, single and double duct. Multi-zone systems.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY ***Face-to-face, Distance learning, etc.***	Face –to- face, e-class.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	e-class communication with students, Lab. exercises.

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.

Activity	*Semester workload*
Lectures	50
laboratory	20
Study and analysis	20
Projects and exercises	45
Software application	5
Practice in classroom	10

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	Course total	*150*
STUDENT PERFORMANCE EVALUATION ***Description of the evaluation procedure*** *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer 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.*	Language of evaluation: Greek Method of evaluation: summative Final exam: 2-3 problems with shorter questions Problem solving, written work	

(5) **ATTACHED BIBLIOGRAPHY**

-Suggested bibliography:

- Ronald H. Howell, Harry J. Sauer, Willima J. Coad: Principles of Heating, Ventilating and Air Conditioning. ASHRAE Inc, 1998, ISBN 1-883413-56-7
- William C. Whitman and William M. Johnson: Ψυκτικές Μηχανές και Εγκαταστάσεις. Εκδόσεις ΙΩΝ, 1997 ISBN 960-405-753-7
- Paul Lang: Αρχές Κλιματισμού. Εκδόσεις ΙΩΝ 1997. ISBN 960-405-7
- ASHRAE Handbook 1997 Fundamentals. ASHRAE Inc 1997, SI Edition, ISBN 1-883413-45-1
- ASHRAE Handbook 1995 HVAC Applications. ASHRAE Inc 1995, SI Edition, ISBN 1-883413-
- ASHRAE Handbook 1996 HVAC Systems and Equipment. ASHRAE Inc 1996, SI Edition, ISBN 1-883413-
- Recknagel-Sprenger-Schramek: Taschenbuch fuer Heizung + Klimatechnik. Oldenbourg 1997. ISBN 3-486-26213-0

- Related academic journals:

- ASHRAE Transactions