COURSE OUTLINE

(1) GENERAL

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF FINANCIAL AND MANAGEMENT ENGINEERING		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	MH0105	SEMESTER	3rd
COURSE TITLE	THERMODYNAMICS		

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
Courses	3	4,5
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, specialised general knowledge, skills development*	General background
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	http://www.fme.aegean.gr/en/c/thermodynamics

(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*

The main objective of this course is to present to the undergraduate students with an easy and logical way the basic concepts and principles of thermodynamics and furthermore to assist them to understand deeper those principles as well. To achieve the above-mentioned objectives, an emphasis in the analysis of the correct scientific way of thinking is primarily given, as well as in the methodology and the problem-solving techniques. Very important objective is also the challenge to cause the interest of the undergraduate students, through a big variety of examples and applications of thermodynamics in the modern life.

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
……
Others…
…….

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations , decision-making,
Production of new research ideas, Project planning and management, Criticism and self-criticism
Production of free, creative and inductive thinking

(3) SYLLABUS

The courses cover all the basic topics of the Thermodynamics including: Introduction to Thermodynamics and the thermodynamic properties of matter. The concept of work and heat. First law of Thermodynamics (closed and open systems). Internal energy. Enthalpy and Specific Heats of Ideal gases, solids and liquids. Second law of Thermodynamics. Irreversible processes and the Carnot cycles. The Carnot Heat Engine. The Carnot Refrigerator and Heat Pump. Entropy. Cycles analysis: Otto, Sterling, Brayton and Rankine cycles. Mixtures of ideal gases. Wet air analysis.

Courses:

COURCES	OUTLINE AND LEARNING OBJECTIVES
1	➢ Basic concepts of Thermodynamics. Thermodynamics and Energy. Closed and open systems. Processes and Cycles. Temperature and the Zeroth Law of Thermodynamics. Pressure.
2	➢ Introduce the concept of a pure substance. Phases of a pure substance. Phase-change processes of pure substances.

3	➢ Property diagrams for phase-change processes. The Ideal-Gas equation of state. Other equations of state. Property Tables.
4	➢ Heat transfer. Energy transfer by work. Mechanical and no-mechanical forms of work. Conservation of mass principle, The First Law of Thermodynamics.
5	➢ Energy balance for closed systems. Energy balance for steady-flow systems. Some steady-flow engineering devices.
6	➢ Internal energy. Enthalpy and Specific Heats of Ideal gases, solids and liquids.
7	➢ Introduction to the Second Law of Thermodynamics. Thermal energy reservoirs. Heat engines. Energy conversion efficiencies.
8	➢ Refrigerators and Heat pumps. Heat pump systems. Perpetual-motion machines. Reversible and irreversible processes.
9	➢ Entropy. The increase of Entropy Principle. Entropy change of pure substances. Isentropic processes.
10	➢ Property diagrams involving entropy. The *T- ds* relations. Entropy change of Ideal Gases. Liquids and Solids. Reversible steady-flow work. Entropy Balance.
11	➢ The Carnot cycle. The Carnot principles. The Thermodynamic temperature scale. The Carnot Heat Engine. The Carnot Refrigerator and Heat Pump.
12	➢ Basic considerations in the analysis of power cycles. ➢ Overview of reciprocating engines Otto Cycle: The ideal cycle for spark-ignition engines Diesel Cycle: The ideal cycle for compression-ignition engines: Stirling and Ericsson cycles. Brayton cycle: The ideal cycle for gas-turbine engines.
13	➢ The Carnot vapor cycle. Rankine cycle: The ideal cycle for vapor power cycles.

(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*	Use of ICT in teaching
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*	
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.*	One final examination (100%) in writing at the end of the semester in Greek, which include questions (development), knowledge and understanding of the content of the course, and problem solving.

Activity	*Semester workload*
Lectures	39
Seminars	13
Study of bibliography	90
Examinations	3
Course total	***145***

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

The courses in THERMODYNAMICS are based on the books:

(1) "**THERMODYNAMICS AND ADVANCED THERMODYNAMICS**", Apostolos Polyzakis

(2) "**Thermodynamics for engineering's**", 8th Edition, Cengel Yunus A., Boles Michael A.

- Related academic journals:

Other useful books:

(1) ***J.M. Smith, H.C. Van Ness, M.M. Abbott, ¨Introduction to Thermodynamics¨***

(2) ***Sonntag R., Borgnake C., Van Wylen, "Fundamentals of Thermodynamics"***