COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**41**	**SEMESTER**	**4**
COURSE TITLE	Thermodynamics and laboratories in Heat		

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	7
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 backrgound
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	http://ecourse.uoi.gr/course/view.php?id=786 http://ecourse.uoi.gr/course/view.php?id=444

(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 course provides the students with basic knowledge concerning the principles and the phenomena of Heat and Thermodynamics. It also trains the students several mathematical procedures for solving a variety of problems. More specifically after the successful attendance of the course, the student will be able:

- to explain and extract conclusions about the measurement of the temperature, to distinguish the physical meaning of temperature, heat, internal (thermal) energy and entropy, to understand the thermal equilibrium, the transport of heat, the generalized principle of the energy conservation, the energy conversions, the principles of thermal engines and the thermodynamic laws,
- to apply mathematical procedures in order to calculate analytically the production of work and heat, the efficiency of the thermal machines and entropy changes,
- to formulate problems in Thermodynamics and to use appropriate mathematical methods for solving them,
- to calculate the change of the internal energy of a system, the energy transport by heat and mechanical work and the entropy change of the system,

- to use the definitions of the thermodynamic functions, such as the enthalpy, the Helmholtz energy and the free energy of Gibbs, during the energy changes of a system.
- to apply the theoretical knowledge to laboratory experiments in heat and in this way to confirm the laws of Thermodynamics.

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

Search for analysis and synthesis of data and information, with the use of the necessary technology.
Working independently.
Production of free, creative and inductive thinking.

(3) SYLLABUS

The definitions of heat, temperature and internal thermal energy. The thermal equilibrium and the zeroth law of Thermodynamics. Thermometers and measurement of temperature. The transport of heat. Work, heat, internal thermal energy, the first law of Thermodynamics. Thermal and cooling engines and their efficiencies, Carnot's theorem, the second law of Thermodynamics, entropy. Low temperatures and the third law of Thermodynamics. General methods for calculation of the thermal energy changes and transport. Entropy change in reversible and irreversible processes. Thermodynamic functions of enthalpy, Helmholtz energy and Gibbs energy.

Laboratory part: Conducting laboratory experiments in groups of students. The experiments concern the thermal expansion of solids, the specific heat measurement of materials, the confirmation of gas laws, the calculation of the adiabatic constant of air and the measurement of the performance of a thermal engine.

(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 the e-courses learning system, with uploaded notes and exercises for practice and communication with students

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	42
Tutorials	13
Laboratory	10
Study of bibliography	80
Non-directed study	25
Exams	5
Course total	**175**

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.*	Homework for solving exercises and their evaluation in a weekly base (20%). The corrected homework is returned to students. Intermediate examination (30%). Final writing examination in the end of the semester (50%).

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
- Heat and Thermodynamics, M. Zemansky, R. Dittman, Copyright © 1997, The Mc Graw-Hill Companies, Inc, ISBN 0-07-114816-7.
- Θερμότητα και Θερμοδυναμική, M. Zemansky, Εκδόσεις Α. Γ. Πνευματικός, Αθήνα (2015), ISBN 978-960-72585-0-2.
- Εισαγωγή στη Θερμότητα και τη Θερμοδυναμική, Ι. Γραμματικάκης, Εκδόσεις Leader Books, Αθήνα, (2012), ISBN 978-960-99459-4-3.
- Θερμοδυναμική και Προχωρημένη Θερμοδυναμική, Α. Πολυζάκης, Εκδόσεις Τσότρας, Αθήνα, (2013), ISBN 978-960-98311-3-0