COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Agricultural Sciences		
ACADEMIC UNIT	Biosystems & Agricultural Engineering		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	BAE_610	**SEMESTER**	6th
COURSE TITLE	**APPLIED 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**
Lectures	3	
Tutorials	2	
Laboratory		
TOTAL	**5**	**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*	Scientific area, background and skills development
PREREQUISITE COURSES:	There are no prerequisite courses.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek .-For Erasmus students in English
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	

(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*

At completion of the course students will have acquired knowledge and familiarity with the laws of thermodynamics and their practical engineering applications. They will also:

- Have developed ability to perform thermodynamic calculations
- Application of the principles of electrochemistry and the Nernst equation to the prediction by calculations of the spontaneous or non-spontaneous redox reaction.
- Use of ionic power, coefficients of activity and Debye Huckel Theory. in approximate solutions and applications in environmental systems

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
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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Working in an interdisciplinary environment	*Others…*
Production of new research ideas	*…….*

In general, upon completion of this course the student will have further developed the following general skills (from the list above):
Search, analysis and synthesis of data and information, using the necessary technologies
Adaptation to new situations
Decision making
Autonomous work
Teamwork
Respect for the natural environment
Exercise criticism and self-criticism

(3) SYLLABUS

• Intermolecular forces. Kinetic theory of dilute gases. Ideal gases. Real gases: static equation virial, static equation van der Waals and its predictions for phase equilibrium and criticality. Joule-Thomson factor. • Liquids: vapor pressure, viscosity, surface tension, capillary effects. • Solids: Crystalline systems and grids. Amorphous solids. Heat capacities of solids. • Laws of Thermodynamics. First Law of Thermodynamics. • The Second Law of Thermodynamics in its application. Calculations of entropic changes. Thermodynamic analysis of simple cycles of substances. Calculation of thermodynamic properties. • Principles of operation of thermal and refrigeration cycles. Carnot cycle. • Thermochemistry. Reaction heats. Standard situations. • Status changes. The chemical potential. Law of phases. One component systems. Two component systems. Solid-liquid phase diagrams of binary systems. Three component systems. • Physical systems: Some molecular properties. Ideal and real solutions. Volatility. Addition properties (decrease in vapor pressure, increase in boiling point, lowering of freezing point, osmosis). Vapor-liquid balances, azeotropes. Partially miscible liquids. • Chemical kinetics. Reaction class. • Ionic power effects. Activity factors. Debye Huckel Theory. Approximate solutions. Applications in environmental systems. • Oxidation. Basic principles. Standard dynamics. Solution dynamics. Electrode dynamics. The electrical potential at interfaces. Standard electrodes. • Electrochemical elements. Standard electrode dynamics. Thermodynamic data from electrochemical measurements.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face deliveries.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Use of ICT (power point) in Teaching • Use of ICT (power point) in Laboratory Training • Use of ICT in Communication with students (Learning process support through the electronic platform e-class).
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*	

Activity	***Semester workload***
Lectures	39
Tutorials	26
Final Exams	26
Study hours and preparation for tutorials and the final examination	44
Course total	**125**

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.* 1	1. The main assessment criteria focus on understanding and correlating the knowledge that students gain from the course with other knowledge. Particular emphasis is placed on whether they have developed the ability to apply this knowledge to crop selection and to assess the impact of these changes on the environment. Emphasis is also placed on demonstrating critical ability and justifying the choices they make in each problem. 2. Evaluation is dynamic. It mainly involves problem solving. is done orally or in writing or with a combination of the two, with or without pre-examination on the basic principles of the course, with or without exculpatory advances and with other test or inventive methods, depending on the composition of the dynamics and the needs of the audience. 3. The above are done in the Greek language. For foreign language students (eg Erasmus students) conducted in English

(5) RECOMMENDED LITERATURE

- *Α.Πολυζάκης, ΘΕΡΜΟΔΥΝΑΜΙΚΗ ΚΑΙ ΠΡΟΧΩΡΗΜΕΝΗ ΘΕΡΜΟΔΥΝΑΜΙΚΗ Έκδοση: 1η/2013,Εκδ. Α.ΠΟΛΥΖΑΚΗΣ, Κωδικός Βιβλίου στον Εύδοξο: 33155128, ISBN: 978-960-99122-2-8*
- *Enrico Fermi, Thermodynamics, Dover*
- *Ν.Κατσάνος, Φυσικοχημεία. Βασική θεώρηση, Έκδοση Τρίτη, Εκδ. Παπαζήση, Αθήνα, 1999, ISBN13: 9789600204483*
- *Robert J. Silbey, Robert A. Alberty, Moungi G. Bawendi, Physical Chemistry, 4th Ed., Wiley, 2004, ISBN: 978-0-471-21504-2 or 978-0-471-65897-9:*
- https://ocw.mit.edu/courses/chemistry/5-61-physical-chemistry-fall-2007/
- *https://www.google.gr/url?sa=t&rct=j&q=&esrc=s&source=web&cd=5&cad=rja&uact=8&ved=0ahUKEwiTxJ_QuJXWAhVCtRoKHWfvAAUQFghKMAQ&url=https%3A%2F%2Fwww.coursera.org%2Flearn%2Fphysical-chemistry&usg=AFQjCNFUC9AV6WEysaUbmtl2PlhzrHYY6A*
- *https://www.coursera.org/learn/physical-chemistry*
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