COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Agricultural Sciences		
ACADEMIC UNIT	Biosystems & Agricultural Engineering		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	BAE 520	**SEMESTER**	5th
COURSE TITLE	**PHYSICAL CHEMISTRY**		
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	0	
	Laboratory	2	
	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*	Background (Fundamental Principles of Physical Chemistry) Skills Development (Experimental Physical Chemistry)		
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*

Physical chemistry aims to understand the structure, properties and transformations of matter, from bulk behavior down to mechanisms at the molecular level. It is the role of the physical chemist to collect, collate and analyze experimental data from all branches of chemistry and to construct predictive models. As such, physical chemistry underlies much of modern science and is a motor driving advances in a very wide range of fields. Building on information and concepts from chemistry, physics and mathematics, physical chemistry contributes to and is stimulated by areas as diverse as medicine, molecular biology, biochemistry, molecular engineering, chemical engineering, materials science and earth sciences and Agricultural Sciences

Upon successful completion, students will have the knowledge and skills to:

1. Predict and measure/analyse bulk properties of gases and liquids using equilibrium thermodynamics.
2. Understand and assess the fundamental operation of a machine driven by chemical processes, using the Second Law.

3. Predict equilibrium transitions and recognise/analyse these transitions in both natural and engineered systems, using equilibrium free energies. These transitions include gas-liquid-solid transitions in single component systems, as well as in multiple component systems, and the partition of components between co-existing phases.
4. Understand the limit of classical descriptions of light and matter and the subsequent role of quantum mechanical descriptions in physical chemistry.
5. Calculate and analyse the translational, rotational and vibrational motion of microscopic particles using simple quantum mechanical models.
6. Predict, using models of simple atoms and molecules, the arrangement of electrons and their motion as revealed in experimental spectroscopy.
7. Use quantitative, predictive models for diffusion, viscosity, and thermal conductivity, and verify with measurement. Understand the role of physical transport of mass, heat, and momentum in a chemical context.
8. Quantitatively analyse kinetics of reactions involving mechanisms which are consecutive and competitive, as well as more complex mechanisms.

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…*
	…….

The course will provide the foundations of physical chemistry, with a strong focus on developing a skill base necessary for the construction, analysis, and interpretation of experimental data, as well as a practical understanding and use of predictive models.
At the end of this course the student will have further developed the following skills (general skills):
• Ability to identify and name utensils and instruments of a physical chemical laboratory
• Ability to record and keep a proper laboratory diary
• Ability to process experimental measurements and yield results in the correct format
• Ability to find information from any book of physical chemical as well as from sources on the internet

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

The course involves study of:
Quantum Mechanics and Structure (3 Lectures) :
•Principles of quantum mechanics
•Atomic structure
•Molecular structure and bonding
Chemical Thermodynamics (3 Lectures)
•First and second laws
•Gibbs free energy
•Chemical potentials
•Chemical equilibria
Phase Changes (3 Lectures):
•Phases and components
•Degrees of freedom

•Electrochemical systems
•Ions in solution
•Electrical phenomena – application to clay-water systems
Chemical Kinetics (4 Lectures):
•First and second order reactions
•Integrated rate laws
•Reaction rate theories
•Steady state approximation
•Chain reactions (Polymer Chemistry)
•Catalysis
Laboratory Exercises

1. Introduction to the Laboratory-Safety and hygiene rules
2. Quantum Mechanics and Structure (models)
3. Chemical Thermodynamics Part I (First and second laws)
4. Chemical Thermodynamics Part II (Chemical equilibria)
5. Phase Changes Part I (First law)
6. Phase Changes Part II (second law)
7. Phase Changes Part III (Electrochemical systems, redox reactions)
8. Chemical Kinetics Part I (First and second order reactions)
9. Chemical Kinetics Part II (Chain reactions Polymerization)
10. Chemical Kinetics Part III (Catalysis)

(1) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face deliveries. Laboratory exercises in Physical Chemistry
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 the hours of non directed study according to the principles of the ECTS*	

Activity	***Semester workload***
Lectures	39
Laboratory	26
Writing short reports of laboratory exercises	13
Final Exams	3
Study hours and preparation for the laboratory exercises and the final examination	44
Course total	**125**

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,*	1. The laboratories participate by 30% in the final grade. In order to be examined in theory, the student must have completed all the laboratories and have been successfully examined in them. 2. 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. 3. 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

other *Specifically-defined evaluation criteria are* *given, and if and where they are accessible to* *students.*	inventive methods, depending on the composition of the dynamics and the needs of the audience. 4. The above are done in the Greek language. For foreign language students (eg Erasmus students) conducted in English

(2) RECOMMENDED LITERATURE

-Προτεινόμενη Βιβλιογραφία :

1. Atkins Peter, Paula Julio. De, Keeler James, ATKINS ΦΥΣΙΚΟΧΗΜΕΙΑ (ΕΠΙΤΟΜΟ, ΣΚΛΗΡΟΔΕΤΗ ΕΚΔΟΣΗ) (11η ΕΚΔΟΣΗ), Εκδ. ΠΕΚ (ΠΑΝΕΠΙΣΤΗΜΙΑΚΕΣ ΕΚΔΟΣΕΙΣ ΚΡΗΤΗΣ), 2020, ISBN139789605245917

2. Gordon G. Hammes, Φυσικοχημεία για τις Βιολογικές Επιστήμες, Εκδ. ΚΩΣΤΑΡΑΚΗ, ISBN: 978-960-99858-3-3

3. Λάζου Ανδριάνα Ε., Φυσικές ιδιότητες τροφίμων Εκδόσεις Παπαζήση, 2019,ISBN: 9789600234978

-Εκδ. Κάλλιπος 2015

Κούτσελος, Α., 2015. Στατιστική θερμοδυναμική. [ηλεκτρ. βιβλ.] Αθήνα: Σύνδεσμος Ελληνικών Ακαδημαϊκών Βιβλιοθηκών. Διαθέσιμο στο: http://hdl.handle.net/11419/5053, Εκδ. Κάλλιπος 2015

Σιγάλας, Μ., Αντώνογλου, Λ., Χαριστός, Ν., 2015. Μοριακή συμμετρία και θεωρία ομάδων. [ηλεκτρ. βιβλ.] Αθήνα:Σύνδεσμος Ελληνικών Ακαδημαϊκών Βιβλιοθηκών. Διαθέσιμο στο: http://hdl.handle.net/11419/4019, Εκδ. Κάλλιπος 2015

Κουή, Μ., Αβδελίδης, Ν., Θεοδωρακέας, Π., Χειλάκου, Ε. 2015. Μη καταστρεπτικές και φασματοσκοπικές μέθοδοι εξέτασης των υλικών. [ηλεκτρ. βιβλ.] Αθήνα: Σύνδεσμος Ελληνικών Ακαδημαϊκών Βιβλιοθηκών. Διαθέσιμο στο: http://hdl.handle.net/11419/6168

-Συναφείς επιστημονικές πηγές και περιοδικά:

https://peerj.com/physical-chemistry/
https://www.hindawi.com/journals/apc/
https://pubs.acs.org/journal/jpcafh
https://pubs.acs.org/journal/jpccck
https://www.rsc.org/journals-books-databases/about-journals/pccp/