Physical Chemistry-3

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XA 434**	**SEMESTER**	**4th**
COURSE TITLE	PHYSICAL CHEMISTRY-3		

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	10
Seminars	1	
Laboratory work	3	
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*	Field of Science and Skills Development
PREREQUISITE COURSES:	Typically, there are not prerequisite course. Essentially, the students should possess knowledge provided through the previously taught theoretical course ''Physical Chemistry – 1''
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.
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*

By the end of this course the student will be able to:

1. Define the chemical equilibrium constant of a reaction and derive its relation to temperature and pressure.
2. Answer the following questions:
   a) How fast does a chemical reaction occur?
   b) What factors affect the rate of chemical reactions?
   c) What is the mechanism that follows chemical reactions?
3. Define the factors that influence the rate of enzyme reactions.

4. Define parameters such as activity, activity coefficient, mean activity coefficient of ions in solution and describe the interactions between the different species in electrolyte solutions.

5. a) Describe the electrode-electrolyte interface.
   b) Represent electrochemical cells.
   c) Predict when electrochemical reactions become spontaneous.
   d) Define the electrochemical equilibrium.
   e) Define the dependence of the ionic potential on the activities of the ions.

6. Define the rate of electrochemical reactions and describe its relationship to the potential difference of electrodes.

7. Prepare and execute laboratory experiments related to the contents of the course.

8. Prepare technical reports after numerical calculations based on experimental data and carry out scientific conclusions.

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	*Others*
Production of new research ideas	

By the end of this course the student will further develop the following skills:

1. Ability to exhibit knowledge and understanding of the essential facts, concepts, theories and applications which related to Physical Chemistry and especially of Chemical Equilibrium, Chemical Kinetics and Electrochemistry.

2. Ability to apply this knowledge and understanding to the solution of problems related to Material Science, Environment, Food Science, Biology, Pharmacy and Medicine.

3. Study skills needed for continuing professional development.

4. Ability to prepare and execute laboratory experiments related to Physical Chemistry.

5. Ability to interact with others in chemical or of interdisciplinary problems.

Generally, by the end of this course the student will, furthermore, have develop the following general abilities:

Searching, analysis and synthesis of facts and information, as well as using the necessary technologies

Adaptation to new situations

Decision making

Autonomous (Independent) work

Group work

Exercise of criticism and self-criticism

Promotion of free, creative and inductive thinking

Respect to natural environment

Work design and management

3. SYLLABUS

1. *Chemical Equilibrium*

   Chemical equilibrium constants and their dependence on temperature and pressure. Representative examples of chemical equilibrium. Chemical equilibrium in biological reactions.

2. *Chemical Reaction Kinetics*
   Kinetic equations. Define reaction order and rate constant of chemical reactions. Kinetic equations from the mechanism of the reaction. Steady state approximation. Kinetic equations for consecutive reactions. The kinetics of complex reactions.
3. *Kinetic of enzyme actions*
   Effect of concentration, pH and temperature on the rate of enzyme action. Michaelis-Menten mechanism of enzyme action.
4. *Conductivity and Ionic Equilibrium*
   Conductivity. Transport numbers. Conductivity and electrical mobility of ionic species. Ionic equilibrium. Buffer solutions. Indicator solutions.
5. *Electrochemical cells*
   Electrodes and electrochemical cells. Electrochemical reactions. Thermodynamics of electrodes and electrochemical potential. Membrane potentials. Definition of *pK* of an acid or base and the pH of a solution. Potentiometric titrations.
6. *Electrochemical Kinetics*
   Electric double layer. Rate of electrochemical reactions. Overpotential. Polarography. Corrosion.
7. *Experimental physical chemistry.*
   Laboratory work dealing with subjects of Chemical Thermodynamics, Chemical Equilibrium, Chemical Kinetics and Electrochemistry.

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures, seminars and laboratory work face to face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Information and Communication Technologies (ICTs) (e.g. power point) 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*	

Activity	***Semester workload***
Lectures (3 contact hours per week x 13 weeks)	39
Seminars (1 contact hour per week x 13 weeks) - solving of representative problems	13
Laboratory work (4 contact hours per week x 13 weeks)	52
Final examination (3 contact hours)	3
Hours for private study of the student and preparation of technical reports for each laboratory experiment.	143
Course total	***250***

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.*	The course is consisted of theoretical (lecture and seminars) and laboratory sessions. *Theoretical session* 1. Optionally two (2) written examinations during the semester. 2. Written examination after the end of the semester. Minimum passing grade for the theoretical session: 5 *Laboratory session* 1. a. Oral examination at the beginning of each new laboratory period (experiment). The mean mark from these examinations consists the 50% of the final grade of the laboratory session.

	a. Written report for each laboratory experiment. The mean mark of the reports consists the 50% of the final grade of the laboratory session. Minimum passing grade for the experimental session: 5 The final course grade is calculated as follows: Grade of the theoretical session (70%) and grade of the laboratory session (30%). Compulsory passing grade for both theoretical and laboratory sessions.

5. ATTACHED BIBLIOGRAPHY

1. G. Karaiskakis, "*Physical Chemistry*", in Greek language only, Travlos Publications, 1998.
2. P. Atkins, J. De Paula, "*Physical Chemistry*», 8th Edition, Oxford University Press, 2006.
3. N. Katsanos "*Physical Chemistry: Basic Consideration*", 3rd Edition, in Greek language only, Papazisis Publications, 1999.
4. N. Katsanos, "*Physical Chemistry Laboratory Textbook*", PartsI&II, in Greek language only, University of Patras Publications, 2006.
5. G. Karaiskakis, N. Klouras, E. Manesi-Zoupa, "*Chemistry Laboratory Textbook*", in Greek language only, Hellenic Open University Publications, 2003.
6. R.J. Sime, "*Physical Chemistry: Methods-Techniques-Experiments*", (Saunders Golden Sunburst Series), Saunders College Publishing, 1998.
7. A.D. Mc Quarrie, J.D. Simon, ''*Physical Chemistry. A Molecular Approach*''. University Science Book, 1997.