COURSE SYLLABUS

1. COURSE DESCRIPTION

Degree:	**Biotecnología**
Double Degree:	
Course:	**General Chemistry**
Module:	**BLOQUE 1 MATERIAS BÁSICAS**
Department:	**Sistemas Físicos, Químicos y Naturales**
Academic Year:	**2016-17**
Term:	**First Term (Fall)**
Total Credits :	**6**
Year:	**1**
Type of Course:	**Basic**
Course Language:	**English**

Modelo de docencia:	**B1**
a. Enseñanzas Básicas (EB):	**60%**
b. Enseñanzas de Prácticas y Desarrollo (EPD):	**40%**
c. Actividades Dirigidas (AD):	
d.	

COURSE SYLLABUS

2. TEACHING TEAM INFORMATION

Course Coordinator: Patrick Merkling **Professors**	
Name:	Patrick Merkling
Faculty:	**Facultad de Ciencias Experimentales**
Department:	Sistemas Físicos, Químicos y Naturales
Academic Area:	Química Física
Category:	Prof. Contr. Dr.
Office Hours:	TBD and by appointment (e-mail me to arrange a time)
Office Number:	**E22, 3.11**
E-mail:	**pjmerx@upo.es**
Telephone:	**954348643**

COURSE SYLLABUS

3. ACADEMIC CONTEXT

3.1. Course Description and Objectives

Note: This document is also available in spanish (Química General) with identical contents. I would recommend anybody go back to that document if you do not understand clearly this version.

The main purpose of this course is to provide the student with fundamentals in chemistry to build upon in future courses, and to enable him to apply them to solve practical problems both during his studies and in his future as a professional.

3.2. Contribution to the training plan

The assignment of General Chemistry belongs to the module "Chemistry in Molecular Biosciences". General Chemistry provides the students with the fundamentals and capabilities needed to understand the mechanisms underlying biological processes.

The general and specific skills achieved in this course are essential for understanding further advanced matters that they will study in their degree, such as Organic Chemistry, Thermodynamics and Kinetics, Instrumental Analysis Techniques, Bioanalytical Chemistry, Biochemistry, etc.

3.3. Recommendations or prerequisites

Recommendation: possess a background in chemistry, physics and maths from high school/secondary school.

4. SKILLS

4.1 Degree skills developed during this course

Biotechnology can be defined as a technique that uses living organisms or compounds obtained from living organisms to produce products of economical, medical or social value to humans. Therefore learning about Biotechnology at the level of the Degree requires a biological and chemical knowledge base to enable students to understand the technological processes that involve living organisms.

The Report for the verification request of the graduate degree in Biotechnology from the University Pablo de Olavide referred (among others) the following competencies:
• Understand the scientific method. Know, understand and apply the tools, techniques and experimental protocols in the laboratory and acquire the skills of observation and interpretation of the results.
• Acquire basic experimental skills appropriate to each of the subjects taught, by the description, quantification, analysis and critical evaluation of the experimental results obtained independently.
• Work properly in a biological, chemical or biochemical laboratory, know and apply standards and techniques related to health and safety, handling of laboratory animals and waste management.
• Demonstrate proper integrated view of the R + D + i be able to interrelate and connect the areas of biotechnology encompassing knowledge from biological and physicochemical principles to new scientific knowledge for practical application development and introduction in the market for new biotech products of interest

4.2. Module skills developed during this course

The Degree Report includes the following module-specific skills:

1. Know the origin of the atomic/molecular properties of matter, including pure substances, mixtures and solutions.
2. Know the principles of thermodynamics and their practical application to thermochemical and thermodynamic study of a reaction and dominate the thermodynamic concept of chemical equilibrium and equilibrium constant, and be able to identify the factors on which it depends.
3. Learn the common characteristics of physicochemical transport processes: diffusion, osmosis, electrophoresis, etc ...
4. Master the concept of reaction rate and rate constant and be able to identify the factors on which it depends and know how to describe proton transfer reactions and electronical and thermodynamical concepts applied to their behavior.
5. Know the basis of spectroscopical methods for quantitative chemical analysis and structural elucidation of organic compounds.

4.3. Course-specific skills

1. Understand the atomic/molecular origin of the properties of matter, either pure substances, mixtures or solutions
2. Apply the principles of thermodynamics to thermochemical and thermodynamic study of a chemical reaction
3. Master the concept of chemical equilibrium and equilibrium constant, and be able to identify the factors on which it depends
4. Master the concept of reaction rate and rate constant and be able to identify the factors on which it depends
5. Be able to describe the proton transfer reactions and electronic and thermodynamic concepts involved in their description

5. COURSE CONTENTS (COURSE TOPICS)

Succinctly, the topics of the course are:

• Introduction and basic concepts, Topic 0

• Atomic and molecular structure, Topic 1

• Introduction to Thermodynamics, Topic 2

• Introduction to the fundamentals of chemical kinetics and chemical equilibrium, Topic 3

• Proton transfer reactions, Topic 4

• Electron transfer reactions, Topic 5

Description of lab sessions:

Practice 1: Spectrophotometry

Practice 2: Calorimetry

Practice 3: Acid-base and buffer solution

Practice 4: Determination of vitamin C contained in a shake or fruit juice

Teaching program (EB):

COURSE SYLLABUS

	Contents	Nº Classes*
Topic 0: Introduction and basic concepts	Review of basic chemistry concepts and introduction to modern chemical language: stoichiometry, preparation of solutions, …	2
Topic 1: Atomic and molecular structure	Electromagnetic spectrum. Basics of quantum mechanics for the electronic structure of atoms. Quantum numbers and orbitals. Relationship between electronic configuration and chemical properties of the elements. Periodic classification of elements. Periodic properties: atomic radii, ionization energy,electronic affinity and electronegativity. Chemical bond: ionic and covalent bonds. Molecular geometry VSEPR theory. Hybridization of atomic orbitals. Localized and delocalized molecular orbitals. Intermolecular forces and states of matter.	7
Topic 2: Introduction to chemical thermodynamics	First law of thermodynamics and fundamentals of calorimetry. Thermochemistry and Hess' law. Second law of thermodynamics. Entropy, free energy and spontaneous processes. Phase changes and phase diagrams. Vapour pressure. Mixtures and principle of distillation. Physical properties of solutions.	3
Topic 3: Introduction to chemical kinetics and fundamentals of chemical equilibrium	Chemical reaction rates. Rate laws and reaction order. Activation energy. Factors that affect reaction rates. Catalysis. Equilibrium constants. Factors that affect chemical equilibrium and Le Chatelier's principle.	5
Topic 4: Proton transfer reactions	Concepts of acids and bases. Calculation of pH in aqueous solution. Hydrolysis. Buffer solutions. Amphoteric substances and isoelectric point. Acid-base titrations.	5
Topic 5: Electron transfer reactions	Oxidation-reduction reactions Relation between free energy and electrode potentials. Nernst equation.	5
	TOTAL	**27**

*This is a tentative scheme and is intended as a guideline but will depend on the progress of the class

"Practices and Development" Sessions (EPD): They consist of 2-hour problem-solving seminars and 3-hour laboratory sessions. 3 seminars and 4 laboratory sessions are scheduled in the weekly calendar application available through the "Facultad de Ciencias

Experimentales" under section horario. Exam dates for non-official exams are also marked in the calendar. I will intend to keep the information in the weekly calendar up to date throughout the course.

	Lab session/Seminar	Nº hours
Topic 0: Introduction and fundamental concepts	None associated	
Topic 1: Atomic and molecular structure	**Laboratory Session 1** *Spectrophotometry*	**3**
	Seminar 1 *Structure*	**2**
Topic 2: Introduction to chemical thermodynamics	**Laboratory session 2** *Calorimetry*	**3**
Topic 3: Introduction to chemical kinetics and fundamentals of chemical equilibrium	**Seminar 2** *Thermodynamics, equilibrium and kinetics, Precipitation and proton transfer*	**2**
Topic 4: Proton transfer reactions	**Laboratory session 3** *Acid-Base titration and buffer solution*	**3**
	Seminar 3 *Proton and electron transfer*	**2**
Topic 5: Electron transfer reactions	**Laboratory session 4** *Redox titration for vitamin C determination in fruit juice*	**3**
	TOTAL	**18**

6. METHODOLOGY AND RESOURCES

Classes are of two general types "basic teaching" (EB) and "practices and development" (EPD). The EPD in this course are either 3-hour lab sessions or 2-hour seminars. For more details, a table in the expanded teaching guide will be made available through the virtual platform.

Methodologically, transparencies will be used, seminars, private or small-group tutoring, laboratory sessions, and, if technology allows, use of the virtual platform.

7. ASSESSMENT

Up to 15 hours of student time for assessment
1. EPD Exams covering the problem set classes: 3@1 hour (spread throughout the course, usually a week after the EPD class)
2. EPD exam review: 3@20 minutes (throughout the course)
3. Final EB + EPD exam: 3 hours, split into two same-day exams (February Examination Period)
4. Final EB + EPD exam (recovery): 3 hours, split into two same-day exams (July Examination Period)
5. EPD exams (at the beginning of the laboratory sessions): 4@15 minutes
6. EB February Exam Review: 1 hour
7. EPD February Exam Review: 1 hour
8. EB July Exam Review: 1 hour
9. EPD July exam review: 1 hour

It is strongly recommended that you use your hand-written lab book in the EPD lab exam. Your lab book may be collected by the examiner at the end of the exam. This will help the teacher in assessing the exam.

Continuous assessment consists in (1) EPD practices and seminars, (2) exams at the beginning of the seminars and (3) an optional work (EV) to be delivered through the virtual platform. Works are due on the date indicated in the Detailed Assessment Table (at the end of this section).
EB examinations, EPD and EV are weighted according to the table. In this way the student will obtain a total score as shown in Detailed Assessment Table (at the end of this section).
The final grade for the course will be drawn from the following formula:
RAW FINAL GRADE = 0.5 x (EB) + 0.5 × (EPD)

Regardless of the numerical value obtained in the above formula, the final score that appears in the records shall be subject to the following restrictions:
a) To pass the course you need to get at least 5 out of 10 and **a minimum in each of the parts** specified in the Detailed Assessment Table (at the end of this section).
b) To get a B-grade (**Notable**) in the course you must achieve at least **55% of the maximum grade in the theory exam**.
c) To get an A-grade (**Sobresaliente**) in the course you must achieve at least **70% of the maximum score in the theory exam**.
A voluntary delivery will be proposed (EV) through the virtual platform. This EV is scored out of 10 and will not affect the final grade. However, it is a prerequisite to be eligible for honors (Matrícula de Honor).

Attendance at EPD (Seminars and laboratory) sessions is mandatory. An unjustified

absence at a lab session will lead to a 20% reduction of the lab EPD grade. A single absence will be tolerated without penalty if supported by a valid medical certificate. In that case, and if the absence is at one of the seminars, the student must take the exam at a later time.

Nature of optional work:

The EV work consists in writing an article on a subject of your choice of up to 3 pages that complies with the format of the journal MoleQla (http://www.upo.es/moleqla). The topic must be related to the course and may be further narrowed by the lecturer. Should the virtual platform forum be available, you will propose the topic or a self-explanatory title of your article in it to avoid overlapping topics. You will deliver your work through an application of the virtual platform that checks automatically for plagiarism. If plagiarism is obvious, the work will entail a negative EV grade of -10 points. Plagiarism is considered a **very serious offense**. The maximum attainable grade in the course would be in this case an 8 out of 10. The finest papers will be selected for publication in the journal. If you do not wish your article to be published, you may specify it at the end of the work itself or communicate your decision at any subsequent time in the editorial process in written form or by e-mail to the lecturer. Obviously, this will neither affect the grade of the work nor the requirements on plagiarism.

RAW FINAL GRADE = 0.5 x (EB) + 0.2 ×(EPD) + 0.3 ×(3 EPD & EV, drop 1))
If plagiarism is manifest, the formula used is:
RAW FINAL GRADE = 0.5 ×(EB) + 0.4 ×(EPD)+0.1×(EV)

Assessment system for July exams:

The assessment system of the EBs and lab EPDs in July will be exactly the same as in February. Due to the highly experimental nature of the course, no unique exam can cover all of the skills developed in this course. The student will take those modules in which he failed to obtain the minimum grade required to pass the course (see detailed assessment table).

Detailed assessment table

Activity	Minimum grade[1]	Maximum grade[2]	Weighting factor	Assessment duration (hours)	Exam or due date
EB	4.0	10	50%	7	Official examination dates scheduled by Faculty Board
EPD (lab)	4.0	10	20%	4	Official examination dates scheduled by Faculty Board
EPD (seminars)	0	10	20 or 30%	4	In every seminar
EV	-	10	0 or10%		Last lecturing week of december. Compulsory work for aiming at the highest grade (MH)
TOTAL	**5**	**10**	**100%**	15	

[1]Minimum grade for each part to pass the course
[2]Maximum achievable grade for each part

8. BIBLIOGRAPHY

The general chemistry textbooks are quite similar to each other. The main differences are the relative importance given to the different parts, the choice of examples and style of the authors.

• P. Atkins and L. Jones. "Chemical Principles - The quest for insight", 3rd ed., W.H. Freeman and Company, 2005
• R. H. Petrucci, W. S. Hardwood and F.G. Herring "General Chemistry", Eighth Edition, Prentice Hall. 2003

Complementary texts

• K. Timberlake, "Chemistry, An Introduction to General, Organic and Biological

Chemistry", 10th edition, Pearson, 2011
• K.W. Whitten et al., "General Chemistry", Fifth Edition, McGraw-Hill, 1998
• J. Crowe, T. Bradshaw, "Chemistry for the Biosciences, The essential concepts", 2nd edition, Oxford University Press, 2010
• M. Paraira, "Introducción a la formulación y nomenclatura química inorgánica-orgánica" Vicens-Vives, 1995