1. Course description

Degree:	**Biotechnology**
Course:	**Thermodynamics and Chemical Kinetics**
Module:	**Chemistry for the Biomolecular Sciences**
Department:	**Physical, Chemical and Natural Systems**
Academic Year:	**2017-2018**
Term:	**First**
ECTS credits:	**6**
Year:	**2nd year**
Type:	**Compulsory**
Language:	**Spanish**

Course Model:	B1
a. Basic learning (EB):	27 hours
b. Practical learning (EPD):	18 hours

2. Lecturers

Coordinator	
Name:	**Alejandro Cuetos Menéndez**
School:	**School of Experimental Sciences**
Department:	**Physical, Chemical and Natural Systems**
Area:	**Physical Chemistry**
Office Hours:	**Tuesdays and Thursdays: 10.00 -13.00 (please, contact previously through e-mail)**
Office:	**22-3-15**
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3. Topics

In order to accomplish the aforementioned goals, the contents of this course are distributed in 10 Units, as described in the table below. Each Unit has a number of EB and EPD hours which depend on their relative importance for the learning of Chemical Kinetics and Thermodynamics for Biotechnology students. There will four 3-hour laboratory exercises and three slots of 2-hour seminars.

Part A: Introduction and Chemical Thermodynamics

	Contents	Hours EB	Hours EPD
Unit 1: Introduction	*Course organization and general concepts*	1	
Unit 2: Basic definitions and the First Law	***pt of "system" and "variable" in Thermodynamics. Thermodynamic Equilibrium. Response functions. Equations of State: The ideal gas equation and the virial equation. Heat and Work. Mechanical Work, electric Work, surface Work and chemical Work. Equivalence betwen Heat and Work. Internal energy and the First Law. Enthalpy. Thermochemistry and Hess Law.***	4	**Seminar 1:** *Solving Exercises of mid-term exam 1 (Units 2 and 3)* (2 hours)
Unit 3: The Second and the Third Laws	*Spontaneity and directionality of the physicochemical processes. Entropy and the Second Law. Fundamental Equation of Thermodynamics. The concept of Thermodynamic Potential and Free Energy. Calculations involving variables and thermodynamic derivatives. The Third Law and Absolute Entropies. The Microscopic Basis of Thermodynamics: an introduction to Statistical Thermodynamics.*	3	
Unit 4: Phase Equilibria	*Mass as a thermodynamic variable. Chemical Potential. Gibbs-Duhem equation. The relationship between activity and chemical potential. Reference states. Phase transitions and Phase Diagrams in pure substances. Clapeyron and Clausius-Clapeyron Equations. Phase diagrams for binary mixtures. Raoult 's Law and Henry's*	4	**Laboratory Exercise 1:** *Determination of the partition coefficient of Acetic Acid in the water/organic system* (3 hours)

	Law. Colligative properties.		
Unit 5: Chemical Equilibrium	*Determination of the reaction free energy. Thermodynamic Description of Chemical Equilibrium.* *Definition of Equilibrium Constant. Factors affecting the Chemical Equilibrium: composition and temperature. Van't Hoff's Law.*	3	**Seminar 2:** *Solving Exercises of mid-term exam 2 (Units 4 and 5)* (2 hours)
	TOTAL	15	7

Part B: Kinetics and Complex Systems

	Contents	Horas EB	Horas EPD
Unit 6: Transport processes	*Introduction of the time variable in physicochemical processes. Concept of thermodynamic gradient and flux. Continuity equation. Diffusion, viscosity, thermal conductivity and electrical conductivity. Fick's Laws. Equations of Stokes-Einstein and Einstein-Smoluchowski.*	3	**Lab exercise 2:** *Measurement of the Isoelectric point of Casein.* **(3 hours)** **Lab Exercise 3:** *Kinetic study of the hydrolysis of the methyl acetate in acid medium* (3 hours) **Seminar 3:** *Solving Exercises of mid-term exam 3* (2 hours)
Unit 7: Physical chemistry of electrolytic solutions and electron-transfer reactions.	*Ions in solution. Debye-Hückel law. Relationship between free energy and electric potential. Ion transport and electrochemical potential. Membrane potential. Electron-transfer chemical reactions: Nernst equation. Colloidals systems. Stability and aggregation of macromolecules and colloids.*	3	
Unit 8: Formal Chemical Kinetics	*Concept of reaction rate. Rate equation and reaction orders. Integrated rate equation. First order and Second order chemical reactions. Concept of lifetime.*	3	
Unit 9: Molecular Chemical Kinetics	*Concept of molecularity and reaction mechanism. Concept of steady state and rate-limiting step. Temperature effect and*	3	**Lab Exercise 4:** *Numerical study of enzymatic kinetics*

	Arrhenius Equation. Catalysis. Types of Catalysis: homogenous, heterogenous and enzymatic. Michaelis-Menten mechanism.		(3 hours)
	TOTAL	12	11