

## Physics and Physical Chemistry applied to the Pharmacy

MODULE	CONTENT	YEAR	TERM	CREDITS	TYPE
Physics and Mathematics	Physics and Physical Chemistry applied to the Pharmacy	1st	1st	6	Compulsory
<b>LECTURER(S)</b>			<b>Postal address, telephone nº, e-mail address</b>		
Jiménez Durán, Manuel Martínez Martínez, Fernando Miguel Álvarez, Delia Talavera Rodríguez, Eva M <sup>a</sup>			Departamento de Físicoquímica. Facultad de Farmacia. Campus Universitario de Cartuja. 18071-Granada. Telf.:958-243823. <a href="mailto:mjduran@ugr.es">mjduran@ugr.es</a> , <a href="mailto:femartin@ugr.es">femartin@ugr.es</a> , <a href="mailto:dmalvarez@ugr.es">dmalvarez@ugr.es</a> , <a href="mailto:etalaver@ugr.es">etalaver@ugr.es</a>		
			<b>TUTORING HOURS</b>		
			<p><b>Jiménez Durán, Manuel</b> <i>First term:</i> Martes: 10-13 h (Despacho 309) Jueves: 10-13 h (Despacho 309) <i>Second term:</i> Miércoles: 08:30h-14:30h (Despacho 309)</p> <p><b>Martínez Martínez, Fernando</b> <i>First and second terms:</i> Lunes: 8:30- 11:30 h (Despacho 196) Viernes: 8:30-11:30 h (Despacho 196)</p> <p><b>Miguel Álvarez, Delia</b> <i>First term:</i> Martes: 9:30-11:30h (Despacho 202) Miércoles y Jueves: 12-14h (Despacho 202) <i>Second term:</i> Lunes, Miércoles y Viernes: 9:00-11:00h (Despacho 202)</p> <p><b>Talavera Rodríguez, Eva M<sup>a</sup></b> <i>First term:</i> Lunes: 10-13 h (Despacho 197 y Decanato) Viernes: 10-13 h (Despacho 197 y Decanato) <i>Second term:</i> Miércoles: 10-13 h (Despacho 197 y Decanato) Viernes: 10-13 h (Despacho 197 y Decanato)</p>		
<b>DEGREE WITHIN WHICH THE SUBJECT IS TAUGHT</b>					
Pharmacy Degree					



**PREREQUISITES and/or RECOMMENDATIONS (if necessary)**

Basic knowledges in Mathematics, General Chemistry, General Physics and Biology are strongly recommended

**BRIEF ACCOUNT OF THE SUBJECT PROGRAMME (ACCORDING TO VERIFICA PROGRAMME)**

The subject lays foundations in the key areas of chemical thermodynamics, material and chemical equilibria and study of solutions with application in Pharmacy courses.

**GENERAL AND PARTICULAR COMPETENCES****A. General competences**

- CG1.- Identify, design, obtain, analyze, control and produce pharmacologically active substances and drugs, as well as other products and primary materials of health interest for human and veterinarian use.
- CG10.- Design, apply and evaluate reactants methods and analytical methods in clinical chemistry, knowing the basis of clinical analysis and the characteristics and content of the diagnostic laboratory results.
- CG15.- Recognize the own limitations and the need to keep and update the professional skill, paying special attention to the self-learning of new knowledges taking as a basis the available scientific evidences.

**B. Specific competences**

- CE06.- Know and understand the characteristics of reactions in solution, different states of matter and thermodynamic basis and its application to pharmacy sciences.
- CE07.- Know and understand characteristic properties of the elements and their compounds, as well as their application in pharmaceuticals.
- CE12.- Apply physical and mathematic knowledge to pharmaceutical sciences.
- CE13.- Apply computational techniques and data processing, to interpretate information related to physical, chemical and biological data
- CE15 – Evaluate scientific data related with drugs and sanitary products.

**OBJECTIVES (EXPRESSED IN TERMS OF EXPECTED RESULTS OF THE TEACHING PROGRAMME)**

- To gain knowledge about chemical and physical phenomena and their applications in biological and biochemical processes and in pharmaceutical technology.
- To demonstrate detailed understanding of thermodynamics, in order to get a better understanding to their applications in Chemistry, Biology and Pharmaceutics.
- To gain knowledge on the criteria and the variations of thermodynamic properties in the phase and chemical equilibria
- To know the theoretical models for ideal solutions and to how to use them to the study of properties of real solutions (electrolyte and non-electrolyte solutions) as well as reactions carried out in solution.

**DETAILED SUBJECT SYLLABUS**

### **Theoretical syllabus:**

#### **Lesson 1.- Basis concepts in Physics.**

Magnitudes and units. States of matter. Molecular weight. Mole. Molar mass. Density. Definitions for the system composition. Energy. Kinetic and potential energy. Velocity. Linear momentum. Newton's laws. Rotational motion: angular velocity, angular momentum. Harmonic oscillator. Waves. Electrostatics. Coulombic interactions. Electric field. Electric current and potency.

#### **Lesson 2.- Introduction to Thermodynamics.**

Thermodynamic systems. Thermodynamic state. Thermodynamic equilibrium. Equation of state. Ideal gas. Real gas. Deviations from ideal-gas. Intermolecular interactions. Isotherms for a real gas. Work and heat. The first law of thermodynamics. Internal energy. Enthalpy. Heat capacities. Spontaneous processes. The second law of thermodynamics. Entropy.

#### **Lesson 3.- Material equilibrium.**

Entropy and equilibrium. Criteria for the equilibrium and spontaneity in system at T constant: Gibbs and Helmholtz functions. Chemical potential. General condition for material equilibrium in closed systems. Phase equilibrium. Chemical equilibrium.

#### **Lesson 4.- Thermochemistry.**

Standard enthalpies of formation and reaction. Determination of heats of reaction. Calorimeters. Temperature dependence of reaction heats. Standard Gibbs energy of formation and reaction.

#### **Lesson 5.- One-Component Phase Equilibrium.**

The phase rule. One-component phase equilibrium. The Clapeyron equation. Solid-liquid Equilibrium. Clausius-Clapeyron equation. Liquid-vapor and solid-vapor Equilibrium

#### **Lesson 6.- Reaction equilibrium.**

Ideal gas reaction equilibrium. Partial pressure, concentration and mole-fraction equilibrium constants. Temperature dependence of the equilibrium constant

#### **Lesson 7.- Ideal solutions.**

Solutions. Composition. Ideal solution. Raoult's law. Thermodynamic of ideal solutions. Ideal-dilute solution. Henry's law. Deviations from Raoult's and Henry's laws. Reaction equilibrium in ideal and ideal-dilute solutions. Solubility of gases in liquids.

#### **Lesson 8.- Nonideal solutions. Non-electrolyte solutions.**

Thermodynamics of nonideal solutions. Activity and activity coefficients. Relationship between activity coefficients and vapor pressure. Reaction equilibrium in nonideal solutions. Heterogeneous equilibria. Partition coefficients for a solute in a two-partially miscible phases.

#### **Lesson 9.- Nonideal solutions. Electrolyte solutions.**

Electrolyte solutions. Thermodynamic of electrolyte solutions. The Debye-Hückel theory of electrolyte solutions. Reaction equilibrium in electrolyte solutions. Water ionization equilibrium. Weak acids and bases ionization equilibria. Degree of dissociation. Definition of pH. Solubility product. Hydrolysis. Buffers. Buffer capacity.

#### **Lesson 10.- Colligative properties.**

Colligative properties. Vapor pressure lowering. Boiling point elevation. Freezing point depression. Osmotic Pressure. Osmosis. Colligative properties in electrolyte solutions. Biological applications of the colligative properties: Osmosis, tonicity and osmolarity.

### **Practical Sessions in the laboratory:**

**Session 1.** Measurement of the heat of combustion using an adiabatic bomb calorimeter.

**Session 2.** Potentiometric titration of phosphoric acid.

**Session 3.** Determination of molecular mass by measuring the lowering of the freezing point (Crioscopy)



#### Session 4. Determination of the equivalence point for a weak acid by conductivity measurements

##### BASIC READING

- FÍSICA Y FISICOQUÍMICA APLICADAS A LA FARMACIA, J.M. Alvarez Pez, L. Crovetto González, A. Orte Gutiérrez, M.J. Ruedas Rama y E.M. Talavera Rodríguez. Editorial Técnica Avicam, 2014
- FÍSICA CLÁSICA Y MODERNA, W.E. Gettys, McGraw-Hill, 1999.
- FISICOQUÍMICA para las ciencias químicas y biológicas. Raymond Chang. McGraw-Hill. 2008.
- FISICOQUÍMICA PARA FARMACIA Y BIOLOGÍA. P. Sanz Pedrero. Masson-Salvat. 1992.
- FISICOQUÍMICA quinta edición. I. N. Levine. McGraw-Hill. 2003.
- QUÍMICA FÍSICA. Atkins de Paula. Panamericana. 2008.

##### RECOMMENDED WEBSITES

Journal of Chemical Education

##### TEACHING METHODOLOGY

- **Lectures** will be the main vehicle for the development of the themes of the course. In general, all lectures will be supported by suitable TIC resources. In these sessions theoretical concepts will be explained.
- **Practical work in the laboratory**, in which some experiments to be made by students are selected. Practical work should be read and prepared before sessions. All the results obtained in the practical work must be written up carefully. At the end of the session (4 days), the laboratory notebook will be delivered for evaluation and marked.
- **Practical session for solving numerical problems.** In addition to the practical work in the laboratory, some sessions are reserved for solving numerical problems. These sessions will allow the discussion of the theoretical background for each problem.
- **Oral presentations.** Students are encouraged for make oral presentations related to some point of the theory, numerical problem or a basic bibliographic work. Regarding this, the teacher will provide the appropriate information in order to facilitate the work.
- **Tutorial teaching**, provides the student with a schedule for tutoring activities primarily related to the development of subjects and treat specific problems that must be addressed individually.

##### ASSESSMENT. ASSESSMENT CRITERIA, CONTRIBUTION OF THE DIFFERENT ACTIVITIES ON THE FINAL MARK, ETC.)

Two different types of assessments will be considered:

**A) Continous assessment.** The final mark for those students included in this assessment, will comprises three parts:

1. Written exam about the contents of the subject programme. It will consists of answering questions (types: tests, applications, theoretical...) and solving numerical problems. To pass this exam it will be mandatory to demonstrate a homogeneous knowledge of the subject. The contribution of this part to the final mark will be 80 %

2. To pass practical work it is compulsory to attend to all practical sessions proposed in the laboratorios as well as the submission of a laboratory notebook with the description and resolution of each of the experiments. It is also mandatory to overcome a practical exam by a written/oral exam.

Positive assesment is an essential requirement to pass the subject. La evaluación positiva será requisito indispensable para poder superar la asignatura.

Apart from the exam of practical lessons a second-chance examination would be made to all students that have not passed the first exam. To this second-chance exam could also attend students interested in increasing their qualification. For the students chosing this option their qualification will be the mark obtained in the second-chance exam, although it were lower than the one obtained previously.

Students that not attend to practical lessons in the lab and decide to make extraordinary exams should pass an exam in the laboratory of all the practical lessons. Evaluation will be made by a tribunal consisting of the teachers of the subject.



The contribution of practical work to the final mark will be 10%

3. Other activities: oral presentation, lectures attendance, general attitude during the course and participation in class and/or laboratory, will be evaluated and will contribute with 10% to the final mark.

To pass the subject a homogeneous knowledge of all the contents detailed in previous points it is compulsory.

**B) One examination..** The students who fulfil the requirements specified by the University of Granada and presented in time the corresponding solicitude to the director of the department (in two-week time starting from the day of the enrolment), shall have the right to make this class of examination. It consist of a just one exam. It is mandatory to have previously passed the practice exam. As indicated in ítem A.1. for ordinary exam, the exam will consists of answering questions (types: tests, applications, theoretical...) and solving numerical problems. To pass this exam it will be mandatory to demonstrate a homogeneous knowledge of the subject.

#### **FURTHER INFORMATION**

- The teaching will be made exclusively in Spanish
- The laboratory notebook will be delivered for evaluation and marked.
- Passed "partial exam" will be considered as a part of the subject not under examination in the final exam of February and July.
- The attendance to practical sessions in laboratory is compulsory. The attendance to the lectures is highly recommended.

