SUBJECT GUIDE Academic year 2014-2015

Physics and Physical Chemistry applied to the Pharmacy

MODULE	CONTENT	YEAR	TERM	CREDITS	TYPE
Physics and Mathematics	Physiscs and Physical Chemistry applied to the Pharmacy	1st	1st	6	Compulsory

LECTURER(S)	Postal address, telephone nº, e-mail address
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DEGREE WITHIN WHICH THE SUBJECT IS TAUGHT	
Pharmacy Degree	

PREREQUISITES and/or RECOMMENDATIONS (if necessary)

Basic knowledges in Mathematics, General Chemistry, General Physiscs 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

- CEM2.1.**-** To apply the Physics and Mathematics knowledges to the Pharmaceutical Sciences.
- CEM2.2.- To use computational and data processing techniques regarding the information from physical, chemical and biological data.
- CEM2.4.- To evaluate scientific data related to drugs and health 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 acquire foundations on thermodynamics and chemical thermodynamics particularly, 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 solutions and to how to use them to the study of real solutions (electrolyte and non-electrolyte solutions).

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. Temperatura 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 coeffcients. Relationship between activity coefficients and vapor pressure. Reaction equilibrium in nonideal solutions. Heterogeneous equiliria. 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. Hydrolisis. 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 combustión using an adiabatic bomb calorimeter.

Session 2. Potentiometric titration of phosphoric acid.

Session 3. Determination of molecular weights 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 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 resourses. This supplementary material will be provided to the students in the appropriated web pages.
- **Practical work in the laboratory**, in which some experiments to be made by students are selected. 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 to discuss 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.

ACTIVITIES SCHEDULE

1st Term	Lessons	Presential activities					Non-pressential activities		
		Lectures (hours]	Practical sessions in lab (hours]	Practical sessions for solving numerical problems (hours)	Oral presentations (hours]	Examinations (hours)	Preparation and study of practices in lab (hours)	Preparation of oral presentations (hourss)	Study and personal works of the student (hours)
Week 1	1-2	1-2	2						
Week2	2	2	3						
Week 3	2	2	2		1				
Week 4	3	2-3	1		1				3
Week 5	3-4	3-4	3			1			
Week 6	4	4	2		1				
Week 7	5	4-5	3						
Week 8	6	5-6	2		1				3
Week 9	6-7	6	2		1				
Week 10	7	7	3				1		
Week 11	8	7-8	2		1				
Week 12	8	8	2						
Week 13	9	9	2		1	1			3
Week 14									
Week 15									

Week 16	9	9	2						
Week 17	10	10	2		1	1			3
Week 18	10	10	2		1				
Week 19									
Week 20									
Week 21									
Week 22						2			
Total hours		35	10	9	3	3	10	12	68

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. SE.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. SE.8, SE.10. Practical exam carried out by a written and/or oral exercise. Complete practice sessions and pass the exam will be prerequisites for accessing to the final exam. The contribution of practical work to the final mark will be 10%

3. SE.11, SE12, SE.15. 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.

B) One examination. The students who fulfil the requirements specified by the University of Granada and presented in time the corresponding solicitude, 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 SE.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. To attend to the final exam is compulsory have passed the practical exam
- Passed "partial exam" will be considered as a part of the subject not under examination in the final exam of February and September.
- To be evaluated the activities such as oral presentation, lectures attendance, general attitude during the course and active participation in class and/or in laboratory, is necessary to reach a mark of aproximately 4 over 10.
- The attendance to practical sessions in laboratory is compulsory. The attendance to the lectures is highly

recommended..