



**UCAM**  
UNIVERSIDAD  
CATÓLICA DE MURCIA

# Course guide 2018/2019

*Physical Chemistry*

Degree in Pharmacy

Mode: On Campus

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## Physical chemistry

Module: **Chemistry.**

Subject matter: **Physical chemistry.**

Character: **Obligatory.**

Number of credits: **6 ECTS.**

Time: **1st year - 2nd semester.**

Teachers: **Horacio Emilio Pérez Sánchez / M<sup>a</sup> Encarnación Martínez Moreno.**

Email:

Student tutorials: **Tuesday and Thursday from 16:00 h-18:00 h.**

Coordinating Teacher of the module: **Alfonso Pérez Garrido.**

## Brief Description

With this course students acquire the basic knowledge of Physical Chemistry which is necessary for understanding the subjects of this and following modules, based on previously acquired knowledge. The student will study thermodynamics, fluid state and surface chemistry, interfacial equilibrium, chemical kinetics and colloidal systems, acquiring the basics that will enable them to study the physical and chemical phenomena of pharmaceutical interest, by applying the scientific methods introduced in the previous semester.

## Prerequisites

It is convenient that student have a basic knowledge of physics, chemistry and mathematics

## Objectives of the course

1. Learning about the characteristics of chemical reactions in solution, different states of matter and their application to pharmaceutical sciences.
2. Knowing and understanding the principles of thermodynamics and fundamentals of chemical kinetics and their application to the study of the stability of medicines.
3. Understanding at a basic level the behaviour of macromolecules according to their physico-chemical properties.
4. Knowing the biological and pharmaceutical properties of colloidal systems
5. Introducing students to techniques of data analysis: precision, accuracy, significant figures, dimensional analysis, tables, graph and linear regression.

6. Experimentally verify some of the laws of physical chemistry.

## Competencies

### Basic competencies

(MECES1) That students can demonstrate they have and understand knowledge in an area of study based on that of general secondary education, and which is often at a level that, while supported by advanced textbooks, also includes some aspects that involve state of the art knowledge of their field of study.

(MECES2) That students know how to apply their knowledge to their work or vocation in a professional manner and possess skills that can be demonstrated through the elaboration and defence of arguments and solving problems within their field of study.

(MECES3) That students have the ability to gather and interpret relevant data (typically within their field of study) for making judgements that include a reflection on issues of a social, scientific or ethical nature.

(MECES4) That students can transmit information, ideas, problems and solutions to both specialised and non-specialised audiences.

(MECES5) That students develop those learning skills needed to undertake further studies with a high degree of autonomy.

### General competencies

CG10.- Design, implement and evaluate reagents, methods and clinical analytical techniques, knowing the basic fundamentals of clinical analyses and characteristics and content of laboratory diagnosis.

CG13.- Develop communication and information skills, both oral and written, to deal with patients and users of the health centres where they will perform their professional activities. Promote work and collaboration capabilities in multidisciplinary teams and those related with other health professionals.

CG15.- Recognise their own limitations and the need to maintain and update their professional competence, giving special importance to self-learning of new knowledge based on scientific evidence.

### **Transversal competencies**

CT2.- Demonstrate critical and self-critical reasoning.

CT4.- Incorporate into their behaviour ethical principles that govern research and professional practice.

CT5.- Acquire awareness of the risks and environmental problems inherent in their professional career.

CT7.- Reading and listening comprehension, and oral and written production that allows them to function in a professional context in English. Interpretation of texts in technical and scientific English in the field of research. Communicate in Spanish and English using the usual audiovisual media.

CT8.- Defend personal points of view based on scientific knowledge.

CT9.- Integrate knowledge and apply it to problem-solving using scientific methods.

CT10.- Acquire capacity for organization, planning and implementation.

CT11.- Develop the capacity for autonomous or team work in response too the specific needs of each situation.

CT13.- Progress in their ability to work in multidisciplinary groups.

CT14.- Pursue quality objectives in the development of their professional activity.

CT15.- Acquire the capacity to take decisions and manage human resources.

CT16.- Show creativity, initiative and entrepreneurial spirit to meet the challenges of their activity as pharmacists.

### **Specific competencies**

CEM1.4. Estimate the risks associated with the use of chemicals and laboratory processes.

CEM1.5. Know the physicochemical characteristics of the substances used in the manufacture of medicines.

CEM1.6. Know and understand the characteristics of chemical reactions in solution, different states of matter and the principles of thermodynamics and its application to pharmaceutical sciences.

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CEM1.18. Know the thermodynamic laws upon which the formation of pure substances and in solution are based.

## Methodology

Methodology	Hours	Hours of on-site work	Hours of off-site work
Classroom	18	60 (40 %)	
Academic tutoring	12		
Laboratory practice	12		
Seminars	12		
Assessment in the classroom	6		
Personal study	63		90 (60%)
Resolution of exercises and case studies	9		
Work and preparation of oral submissions (readings and information search)	9		
Online tutoring	9		
<b>TOTAL</b>	<b>150</b>	<b>60</b>	<b>90</b>

## Subject matter

### Theoretical curriculum

#### I. THERMODYNAMICS

Chapter 1: Thermochemistry. Conventional enthalpies. Thermochemical measures. Heat of formation. Hess's law and heat of combustion. Heat of reaction. Kirchhoff's law. Free energy functions. Criteria of balance and spontaneity. Chemical potential. Gibbs-Helmholtz Equation. Condition of material balance.

#### II. EQUILIBRIUM IN HOMOGENEOUS AND HETEROGENEOUS SYSTEMS

Chapter 2. Equilibrium between phases.

Chapter 3. Dissolutions.

Chapter 4. Chemical equilibrium.

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Chapter 5. Equilibrium between phases in multi-component systems.

### III. INTERPHASES EQUILIBRIUM

Chapter 6. Interphases equilibrium.

### IV. CHEMICAL KINETICS

Chapter 7. Formal kinetics.

Chapter 8. Kinetic theoretical mechanisms and models

Chapter 9. Reactions in gas phase and in solution.

### V. TRANSPORT PHENOMENA

Chapter 10. Transport of matter.

### VI. MACROMOLECULES AND COLLOIDS

Chapter 11. General aspects of macromolecules.

Chapter 12. Colloidal systems.

Chapter 13. Stability of colloids.

Chapter 14. Solubility of medicines.

### Practical teaching programme

- Determination of density of mixtures
- Calculation of partial molar volumes.
- Study of colligative properties of solutions.
- Phase diagrams: experimentation with CO<sub>2</sub>.
- Kinetics of reactions.
- Visualisation of macromolecular structures.

## Relationship with other subjects of the curriculum

The knowledge acquired in this course has an impact on the rigorous training of the student enabling them to analyse and evaluate scientific data, as well as to address the study of other subjects included in the curriculum.

The study of physicochemical characteristics will help in "Pharmaceutical chemistry" and "Physical chemistry", while the knowledge of transport phenomena will serve as a basis for more advanced and specific aspects of "Biochemistry and Molecular Biology", "Physiology" and "Pharmacology and pharmacotherapy" studies. Likewise, the interpretation and quantification of physicochemical processes associated with the production and use of medicines will be of help in "Pharmaceutical technology" and "Pharmacokinetics".

## Evaluation system

### June sitting:

- Practical tests and seminars:** (40% of the total mark). Students must attend all practical sessions and participate in them actively and sit an exam regarding the contents worked on during practicals. The seminars will be assessed through examinations (or evaluation tests) with problems involving the direct application of the theoretical contents, involving numerical-mathematical calculations and the use of different magnitudes and units. A mark equal to or higher than 5 in both parts is necessary to pass the course.
- Theoretical tests:** (60% of the total mark). Multiple-choice tests (or evaluation tests) with theoretical and theoretical-practical issues. A mark equal to or higher than 5 is necessary to pass the course.

### September sitting:

- Practical tests and seminars:** (40% of the total grade.). Students need a mark equal to or higher than 5 grade to pass the exam dealing with the contents worked on during practicals to pass the course. The seminars will be assessed through examinations (or evaluation tests) with direct application of the theoretical contents, involving numerical-mathematical calculations and the use of different magnitudes and units. Students must obtain a mark equal to or higher than 5 to pass the course.
- Theoretical tests:** (60% of the total mark.). Multiple-choice tests (or evaluation tests) with theoretical and theoretical-practical issues. Students must obtain a mark equal to or higher than 5 to pass the course.

Students will be adjudged to have passed the subject when the weighted average mark is equal to or higher than 5 and they have completed all the parts that comprise the evaluation system whose overall weighting is equal to or higher than 20%.

If the student has less than 5 in any of the parts whose weighting is equal to or higher than 20%, he or she will be adjudged to have failed and must retake that part or parts in the following sitting within the same academic year. The part or parts passed during official sittings (February/June) will be saved for the future examinations that are held during the same academic year.

If the student does not pass in the September sitting, the passed parts will not count for successive academic years.

The **system of qualifications** (RD 1.125/2003 of the 5th September) will be as follows:

0-4.9 Fail (SS)

5.0-6.9 Pass (AP)

7.0-8.9 Pass with merit (NT)

9.0-10 Outstanding(SB)



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The distinction of a “matrícula de honor” (“with honours”) may be granted to students who have obtained a score equal to or higher than 9.0. Their number may not exceed 5% of the students enrolled in the subject in the corresponding academic year, unless the number of enrolled students is less than 20, in which case only one “with honours” distinction may be granted.

## Bibliography and reference sources

### Basic bibliography

- Atkins, P.W., Química Física, 8ª Ed., Panamericana 2008
- Chang, R. (2000) Fisicoquímica para las ciencias químicas y biológicas. 3ª ed. Ed. McGraw-Hill
- Sanz Pedrero, P. (1992). Fisicoquímica para Farmacia y Biología. Ed. Masson-Salvat Medicina
- Levine, I.N. (2005) Problemas de Fisicoquímica. Mc Graw Hill-Interamericana de España
- Levine, I.N. (2003). Fisicoquímica. 5ª ed. Ed. Mc Graw Hill.

### Complementary bibliography

- Barrow, G.M. (1988). Química Física. 4ª ed. Ed. Reverté
- Florence y Attwood, (1988), *Physicochemical Principles of Pharmacy*, 2ª Ed., MacMillan Press, London.
- Engel, T., Reid, P. (2006). Química Física, Addison-Wesley.

### • Related websites

1. Physics MOOCS (<https://www.mooc-list.com/tags/physics>)
2. Physics Coursera (<https://www.coursera.org/courses?query=physics>)

### • Recommendations for study and teaching

- Continuous daily study of the subject matter taught, including solving numerical problems and theoretical issues.

### • Teaching materials

General:

- PDF document on the presentation of the subject.
- PDF document of the subject guide.

Theoretical part:

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- PDF documents relating to each chapter of the subject

### Practical part:

- Lab coat, scientific calculator.
- PDF document with the handbook of laboratory practicals.
- PDF documents with problems and questions of each chapter of the subject.
- Computer software: Microsoft Word, Power Point, Excel.

A calculator will be needed for the numerical resolution of exercises and problems.

## Tutoring

### Brief description

Academic tutoring will have, among its objectives, giving guidance to students on the contents of the subject, study methods and approaches, presentation of data, problem solving and assessment system. For those students who require it, doubts will be resolved about any given matter and help offered on basic concepts that will facilitate following the subject. In addition, advice will be given on reading articles and monographs to widen the student's knowledge of the matter.

The University also has a Special Tutors Department which provides personal mentoring for students enrolled in the degree. The personal tutor is available to be consulted by students throughout their University degree course. The following link can be consulted:

<http://www.ucam.edu/servicios/tutorias/preguntas-frecuentes/que-es-tutoria>