Course guide
820527 - FQ - Physical Chemistry

Last modified: 04/06/2026

Unit in charge: Barcelona East School of Engineering
Teaching unit: 713 - EQ - Department of Chemical Engineering.

Degree: BACHELOR'S DEGREE IN BIOMEDICAL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN ENERGY ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN MATERIALS ENGINEERING (Syllabus 2010). (Optional subject).

Academic year: 2026 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: NÚRIA BORRÀS CRISTÒFOL

Others: Primer quadrimestre:
NÚRIA BORRÀS CRISTÒFOL - Grup: M1
JUAN TORRAS COSTA - Grup: M1
DAVID ZANUY GOMARA - Grup: M1

PRIOR SKILLS

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REQUIREMENTS

TERMODINÀMICA - Precorequisit

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Understand the basics of physical chemistry.
4. Solve mathematical problems that may arise in engineering. Apply knowledge of linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and partial differential equations; numerical methods; numerical algorithms; statistics and optimisation.
5. Summarise information and undertake self-directed learning activities.
6. Understand the basics of organic chemistry.
7. Understand the fundamental principles of general, organic and inorganic chemistry and apply them in engineering.

Transversal:
2. EFFECTIVE USE OF INFORMATI0N RESOURCES - Level 3. Planning and using the information necessary for an academic assignment (a final thesis, for example) based on a critical appraisal of the information resources used.
3. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.

TEACHING METHODOLOGY

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LEARNING OBJECTIVES OF THE SUBJECT

To expand the knowledge of basic thermodynamics to real cases of material equilibrium, which determines both transport phenomena and chemical equilibrium. To understand the actual behavior of gases. To study mixtures of substances in different phases. In real solutions, to define chemical activity - concentration relationships. To establish equilibrium criteria in mixtures and chemical reactions. To determine the energy exchange in chemical reactions. To study electrolyte solutions and properties whose presence affects. To study electrochemical processes, galvanic cells and corrosion processes. Study of kinetics of adsorption in surfaces and the kinetics of chemical reactions.

STUDY LOAD

Type	Hours	Percentage
Self study	90,0	60.00
Hours large group	60,0	40.00

Total learning time: 150 h

CONTENTS

Chapter 0. Mass Equilibrium

Description:
Gibbs equations, equilibrium condition. Chemical Potential, condition of material equilibrium: phase equilibrium, chemical equilibrium

Full-or-part-time: 12h
Theory classes: 4h
Self study : 8h

Chapter 1. Chemical potentials and equilibrium constant.

Description:
Potencial químico de un gas ideal puro. Potencial químico en una mezcla de gases ideales. Equilibrio químico en una reacción entre gases ideales. Constante de equilibrio. Tipo de constante (Kp, Kc, etc).

Full-or-part-time: 27h 30m
Theory classes: 11h
Self study : 16h 30m

Chapter 2. Mixtures and solutions

Description:
Phases and degrees of freedom. The rule of the phases. Systems Multi component: Dissolutions in liquid-vapor equilibrium. Collaborative properties. Phase diagram of a two component system. Ideal vs. ideals solutions. Real solutions. Phase equilibrium in single component systems.

Full-or-part-time: 30h
Theory classes: 12h
Self study : 18h

Chapter 3. Non ideal Solutions

Description:
Non-ideal dissolutions and chemical activity. Collaborative properties. Cryoscopic and ebulliscopic constant. Osmotic pressure. Phase diagram of a system of two or more components.

Full-or-part-time: 12h
Theory classes: 4h
Self study : 8h

Chapter 4. Termochemistry

Description:
Thermochemistry: study of the heat transfer that accompanies chemical reactions in systems formed by a chemical reactor and its contents. Calorimetric measurements to determine the heat absorbed or produced in a reaction; Calculation of thermodynamic magnitudes of these processes and study of endothermic and exothermic reactions.

Full-or-part-time: 15h
Theory classes: 6h
Self study : 9h

chapter 5. Electrolitic solutions

Description:
Electrolytic solutions. Study of the behavior of electrolytes dissolved in ionizing solvents; Laws of Kholrausch. Properties of electrolyte solutions, conductivity measurement, conductivity, molar conductivity, equivalent conductivity and molar conductivity at infinite dilution. Concept of ionic strength and Debye-Hückel equation. Applications of electrolytic solutions: measure of concentration, solubility, neutralization, the equilibrium constant of an acid and the degree of dissociation.

Full-or-part-time: 15h
Theory classes: 6h
Self study : 9h

Chapter 6. Galvanic Cells

Description:
Concept of electrochemical potential. Equilibrium condition in electrochemical systems. Potential difference in systems with more than one phase. Concept of galvanic cell. Concept of electrodes. Type of electrodes. Standard reduction potential. Nerst equation and f.e.m. Type of commercial electrochemical batteries and accumulators.

Full-or-part-time: 25h
Theory classes: 10h
Self study : 15h

Chapter 7. Corrosion

Description:
Concept. Types of cathodic reactions. Velocity of Corrosion Penetration. Polarization. Polarization by activation and concetration. Overvoltage and exchange current density. Corrosion rate and corrosion potential. Passivity. Type of corrosion: classification. Protection against corrosion: cathodic protection concept. Sacrifice anode.

Full-or-part-time: 15h
Theory classes: 6h
Self study : 9h

Chapter 8. Kinetics

Description:
Concept of adsorption. Adsorption isotherms. Introduction to kinetics of reactions, measurement of velocities, kinetic equations and determination of kinetic constants. Order of reaction. Catalysis and importance of this type of reactions in the industry; Types of catalysts. Order of reaction in biological systems, Michaelis-Menten mechanism.

Full-or-part-time: 15h
Theory classes: 6h
Self study : 9h

GRADING SYSTEM

Any academic fraud, plagiarism or use or possession of unauthorised means in an assessment activity leads to a mark of zero (0) for the affected test or assignment. Furthermore, in accordance with the University's regulations, if disciplinary proceedings are initiated the subject is recorded as "Pending Assessment" until a decision is reached. These incidents are managed in accordance with the **Action Framework for Academic Integrity in Assessment at the UPC**.

Final mark = 0.4 mid-term exam mark + 0.48 final-term exam mark + 0.12 assignments

EXAMINATION RULES.

There will be two exams, one mid term and one final.

BIBLIOGRAPHY

Basic:
- Levine, Ira N. Fisicoquímica [on line]. 5ª ed. Madrid: McGraw-Hill, 2004 [Consultation: 29/04/2020]. Available on: http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=4149. ISBN 9788448137861.
- Atkins, P. W. Química física. 6a ed. Barcelona: Omega, cop. 1999. ISBN 8428211817.
- Ball, David W. Fisicoquímica. México: Thomson, cop. 2004. ISBN 9706863281.

Complementary:
- Enric Brillas [et al.]. Conceptes de termodinàmica química i cinètica. Barcelona: Publicacions i Edicions Universitat de Barcelona, 2004. ISBN 8447528421.
- Chang, Raymond. Fisicoquímica para las ciencias químicas y biológicas. 3ª ed. México: McGraw-Hill, 2008. ISBN 9789701066522.