820527 - FQ - Physical Chemistry

**Coordinating unit:** 295 - EEBE - Barcelona East School of Engineering  
**Teaching unit:** 713 - EQ - Department of Chemical Engineering  
**Academic year:** 2019  
**Degree:**  
BACHELOR’S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)  
BACHELOR’S DEGREE IN ENERGY ENGINEERING (Syllabus 2009). (Teaching unit Optional)  
BACHELOR’S DEGREE IN BIOMEDICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)  
BACHELOR’S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)  
BACHELOR’S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)  
BACHELOR’S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Optional)  
BACHELOR’S DEGREE IN MATERIALS ENGINEERING (Syllabus 2010). (Teaching unit Optional)  
BACHELOR’S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)  
BACHELOR’S DEGREE IN ENERGY ENGINEERING (Syllabus 2009). (Teaching unit Optional)  
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BACHELOR’S DEGREE IN BIOMEDICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)  
BACHELOR’S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)

**ECTS credits:** 6  
**Teaching languages:** Catalan, Spanish

### Teaching staff

**Coordinator:** NÚRIA BORRÀS CRISTÒFOL - DAVID ZANUY GOMARA

**Others:**  
Primer quadrimestre:  
NÚRIA BORRÀS CRISTÒFOL - M10  
JUAN TORRAS COSTA - M10

Segon quadrimestre:  
NÚRIA BORRÀS CRISTÒFOL - M20  
DAVID ZANUY GOMARA - M20

### Opening hours

**Timetable:**

### Prior skills

### 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 INFORMATION 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**

<table>
<thead>
<tr>
<th></th>
<th>Total learning time: 150h</th>
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<tbody>
<tr>
<td>Hours large group:</td>
<td>60h</td>
</tr>
<tr>
<td>Hours medium group:</td>
<td>0h</td>
</tr>
<tr>
<td>Hours small group:</td>
<td>0h</td>
</tr>
<tr>
<td>Guided activities:</td>
<td>0h</td>
</tr>
<tr>
<td>Self study:</td>
<td>90h</td>
</tr>
</tbody>
</table>

| Hours large group:   | 60h   | 40.00% |
| Hours medium group:  | 0h    | 0.00%  |
| Hours small group:   | 0h    | 0.00%  |
| Guided activities:   | 0h    | 0.00%  |
| Self study:          | 90h   | 60.00% |
## Content

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Description</th>
<th>Learning time</th>
<th>Theory classes</th>
<th>Self study</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chapter 0. Mass Equilibrium</strong></td>
<td>Gibbs equations, equilibrium condition. Chemical Potential, condition of material equilibrium: phase equilibrium, chemical equilibrium</td>
<td><strong>12h</strong></td>
<td>4h</td>
<td>8h</td>
</tr>
<tr>
<td><strong>Chapter 1. Chemical potentials and equilibrium constant.</strong></td>
<td>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).</td>
<td><strong>27h 30m</strong></td>
<td>11h</td>
<td>16h 30m</td>
</tr>
<tr>
<td><strong>Chapter 2. Mixtures and solutions</strong></td>
<td>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.</td>
<td><strong>30h</strong></td>
<td>12h</td>
<td>18h</td>
</tr>
<tr>
<td><strong>Chapter 3. Non ideal Solutions</strong></td>
<td>Non-ideal dissolutions and chemical activity. Collaborative properties. Cryoscopic and ebulliscopic constant. Osmotic pressure. Phase diagram of a system of two or more components.</td>
<td><strong>12h</strong></td>
<td>4h</td>
<td>8h</td>
</tr>
</tbody>
</table>
# Chapter 4. Thermochemistry

**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.

**Learning time:** 15h
- Theory classes: 6h
- Self study: 9h

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# Chapter 5. Electrolytic 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.

**Learning time:** 15h
- Theory classes: 6h
- Self study: 9h

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# 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.

**Learning time:** 25h
- Theory classes: 10h
- Self study: 15h

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# Chapter 7. Corrosion

**Description:**

**Learning time:** 15h
- Theory classes: 6h
- Self study: 9h
Chapter 8. Kinetics

**Description:**

<table>
<thead>
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<th>Learning time: 15h</th>
</tr>
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<tr>
<td>Theory classes: 6h</td>
</tr>
<tr>
<td>Self study: 9h</td>
</tr>
</tbody>
</table>

Qualification system

Exams 85% (Mid term (EP) and final (EF))
Assignments and papers 15% (NE)

Regulations for carrying out activities

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

Bibliography

**Basic:**

**Complementary:**