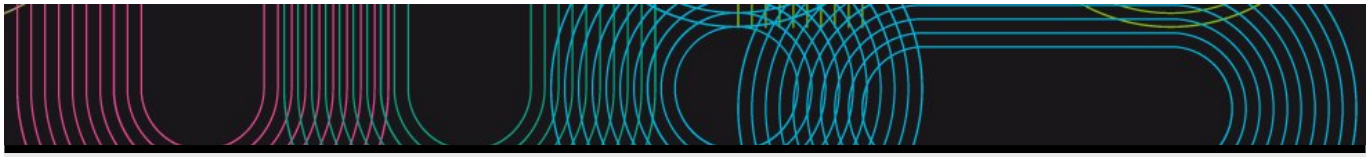

| IDENTIFYING DATA | | | | |
|---|---|---|---|---|
| **Chemistry: Chemistry** | | | | |
| Subject | Chemistry: Chemistry | | | |
| Code | V12G330V01205 | | | |
| Study programme | (*)Grao en Enxeñaría en Electrónica Industrial e Automática | | | |
| Descriptors | ECTS Credits | Choose | Year | Quadmester |
| | 6 | Basic education | 1st | 2nd |
| Teaching language | Spanish<br>Galician<br>English | | | |
| Department | | | | |
| Coordinator | Cruz Freire, José Manuel<br>García Martínez, Emilia | | | |
| Lecturers | Alonso Gómez, José Lorenzo<br>Bocos Alvarez, Elvira Susana<br>Cancela Carral, María Ángeles<br>Cisneros García, María del Carmen<br>Cruz Freire, José Manuel<br>García Martínez, Emilia<br>Izquierdo Pazó, Milagros<br>Moldes Menduíña, Ana Belén<br>Moldes Moreira, Diego<br>Pérez Lourido, Paulo Antonio<br>Pérez Rial, Leticia<br>Rey Losada, Francisco Jesús<br>Rodríguez Rodríguez, Ana M.<br>Rosales Villanueva, Emilio<br>Salgueiro Fernández, José Luis<br>Valencia Matarranz, Laura Maria<br>Yañez Diaz, Maria Remedios | | | |
| E-mail | jmcruz@uvigo.es<br>emgarcia@uvigo.es | | | |
| Web | http://faitic.uvigo.es/ | | | |
| General description | This is a basic subject, common for all levels of the Industrial fields studies. At the end of the course the students will have a basic knowledge about the principles of General Chemistry, Organic Chemistry and Inorganic Chemistry, and its application to Industry. This knowledge will be further applied and expanded in other areas of the studies. | | | |

| Competencies | |
|---|---|
| Code | |
| B3 | CG3 Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations. |
| C4 | CE4 Ability to understand and apply the basic knowledge of general chemistry, organic chemistry and inorganic chemistry, and their applications in engineering. |
| D2 | CT2 Problems resolution. |
| D3 | CT3 Oral and written proficiency in the own language. |
| D10 | CT10 Self learning and work. |
| D17 | CT17 Working as a team. |

| Learning outcomes | | | |
|---|---|---|---|
| Expected results from this subject | Training and Learning Results | | |
| Knowing the chemical bases of industrial technologies. Specifically, the student will gain basic knowledge of general, organic and inorganic chemistry and their applications in engineering. This will allow the student to apply the basic concepts and fundamental laws of chemistry. Due to theoretical-practical training, the student will be able to effectively carry out lab experiments and to solve basic chemistry exercises. | B3 | C4 | D2<br>D3<br>D10<br>D17 |

| Contents | |
|---|---|
| Topic | |
| 1. Atomic theory and chemical bonding | 1.1 Atomic theory:<br>Particles of the atom: Electron, proton et neutron. Characteristics of the atom: Atomic number and Atomic mass. Isotopes. Stability of the nucleus: Radioactivity (natural and artificial). Evolution of the atomic theory.<br>1.2. Chemical bonding:<br>Definition. Intramolecular bonding: Covalent bonding and ionic bonding. Polyatomic molecules: hybridization and delocalization of electrons. Intermolecular bonding: Types of intermolecular forces. |
| 2. States of aggregation: Solids, gases, pure liquids and solutions | 2.1. Solid state:<br>Introduction. Classification of solids: amorphous solids, molecular crystals and liquid crystals, Covalent crystals and ionic crystals. Structure and stabilization energy of crystals.<br>2.2. Gaseous state:<br>Characteristics of the gas phase. Ideal gases: Equation of state. Real gases: Equation of state. Properties of gases.<br>2.3. Liquid state:<br>Characteristics of the liquid phase: physical properties (density, surface tension, viscosity). Changes of state. Phase diagram. Solutions: colligative properties |
| 4.Chemical equilibrium: in gas phase, acid-base-base, redox, solubility | (4.1. Chemical equilibrium:<br>Concept of Equilibrium. Equilibrium Constant. Types of equilibrium. The Le Chatelier Principe.<br>4.2. Acid-base Equilibrium:<br>Definition of acid and base. Auto-ionization of water. Ionic Product. Concept of pH and pOH. Strength of acids and bases: Polyprotic acids. Amphoters. pH calculation. Acid-base titration. Buffer solutions.<br>4.3. Redox equilibrium:<br>Concept of oxidation, reduction, oxidising agent, reducing agent. Balance of redox reactions in acid and alkaline media. Redox titration. Electrochemical cells: basic concepts and redox potential. Thermodynamics of electrochemical reactions: Gibbs Energy and cell Potential. Nernst Equation. Faraday□s Laws.<br>4.4 Solubility equilibrium:<br>Soluble salts: Hydrolysis. Sparingly soluble salts: solubility and solubility product. Factors affecting solubility. Fractional Precipitation. Complex Salts: Definition, properties, dissociation and importance. |
| 5. Chemical kinetics | 5.1. Basic Concepts:<br>Reaction Rate. Reaction Order. Kinetic Constant. Rate Equation.<br>5.2. Determination of the Rate Equation:<br>Initial rate method. Integrated Rate Laws.<br>5.3. Factors affecting the Reaction Rate. |
| 6. Basic principles of Organic Chemistry | 6.1. Fundamentals of Organic formulation and functional groups:<br>6.1.1. ºStructure of the organic compounds: Alkanes, alkenes and alkynes. Aromatic Hydrocarbons.<br>6.1.2. Alcohols and phenols.<br>6.1.3. Ethers.<br>6.1.4. Aldehydes and ketones.<br>6.1.5. Esters.<br>6.1.6. Carboxylic acids and derivatives.<br>6.1.7. Amines and nitro-compounds. |
| 7. Basic principles of Inorganic Chemistry. | 7.1. Metallurgy and the Chemistry of Metals:<br>Abundance of metals. Nature of the metallic bond, properties. Theory of the Conduction Band: conducting materials, semiconductors and superconductors. Metallurgical processes: iron and steel.<br>7.2. Non-metallic elements and their compounds:<br>General properties. Hydrogen. Carbon. Nitrogen and phosphorous. Oxygen and sulphur. Halogens. |

| | |
|---|---|
| 8. Applied Electrochemistry | 8.1. Applications of the Nernst equation: Determination of pH, Equilibrium constant, solubility product.<br>8.2. Electrochemical cells: types of cells. Concentration Cells. Electric Conductivity in electrolytes. Electrolysis Cells.<br>8.3. Industrial Processes of electrolysis: electrodeposition (electroplating), electrometallurgy, electrolysis chlorine□caustic soda. Fuel cells. |
| 9. Corrosion and treatment of Surfaces | 9.1. Basic principles of Corrosion: the corrosión cell.<br>9.2. Corrosion of metals.<br>9.3. Corrosion rate.<br>9.4. Types of Corrosion.<br>9.5. Protection against Corrosion:<br>Design considerations for Corrosion protection. Cathodic protection: sacrificial anodes and impressed current. Organic Coatings. Metallic coatings. |
| 10. Electrochemical sensors | 10.1. Fundamentals.<br>10.2. Typology and function.<br>10.3. Conductivity Sensors.<br>10.4. Potentiometric Sensors.<br>10.5. Ion Selective electrodes. pH sensors.<br>10.6. Sensors for gases in solution.<br>10.7. Enzyme-based sensors: Biosensors.<br>10.8. Amperometric and voltammetric sensors.<br>10.9. Applications of sensors: medicine, industry, environment. |
| 11. Petroleum and derivatives. Petrochemistry | 11.1. Physicochemical characteristics of petroleum (oil).<br>11.2. Physicochemical characteristics of natural gas.<br>11.3. Conditioning and uses of natural gas.<br>11.4. Fractioning of oil.<br>11.5. Cracking of hydrocarbons. Reforming, isomerisation, oligomerisation, alkylation and esterification of hydrocarbons.<br>11.6. Petrochemical processes of BTX; olefins and derivatives; methanol and derivatives.<br>11.7. Treatment of sulphurous compounds and refining units. |
| 12. Carbon: Carbochemistry | (12.1. Formation of carbon.<br>12.2. Types of carbons and their constitution.<br>12.3. Technological uses of carbon.<br>12.4. Pyrogenation of carbon.<br>12.5. Hyidrogenation of carbon.<br>12.6. Direct liquefaction of carbon. Gasification. |

**Planning**

| | Class hours | Hours outside the classroom | Total hours |
|---|---|---|---|
| Master Session | 30 | 45 | 75 |
| Troubleshooting and / or exercises | 7.5 | 12 | 19.5 |
| Laboratory practises | 10 | 7.5 | 17.5 |
| Autonomous troubleshooting and / or exercises | 0 | 25.5 | 25.5 |
| Multiple choice tests | 1 | 0 | 1 |
| Troubleshooting and / or exercises | 3 | 0 | 3 |
| Reports / memories of practice | 1 | 7.5 | 8.5 |

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

**Methodologies**

| | Description |
|---|---|
| Master Session | Presentation by the faculty member of the theoretical content of the subject using audiovisual media. |
| Troubleshooting and / or exercises | Activity in which problems and/or exercises related to the subject will be formulated.<br>Students should develop appropriate solutions by applying formulas or algorithms to manage the available information and interpret the results. |
| Laboratory practises | Activities of application of the theoretical background to specific situations, aimed to the acquisition of basic skills related to the subject. Will be developed in the laboratories or computer rooms of the center in which subject is given. Those rooms will be equipped with the necessary specialized equipment. |
| Autonomous troubleshooting and / or exercises | Activity in which the teacher formulates problems and/or exercises related to the subject, and the student must develop the analysis and resolution in an autonomous way. |

**Personalized attention**

| Methodologies | Description |
|---|---|
| Master Session | Academic activity developed by the professors, individual or in small group, that has like purpose attend the needs and queries of the students related with subjects related with the matter, providing him orientation and support in the process of learning. This activity can carry out of face-to-face form (in the moments that the professor has assigned to office class), or of form no face-to-face (through the email or of the virtual campus). |
| Troubleshooting and / or exercises | Academic activity developed by the professors, individual or in small group, that has like purpose attend the needs and queries of the students related with subjects related with the matter, providing him orientation and support in the process of learning. This activity can carry out of face-to-face form (in the moments that the professor has assigned to office class), or of form no face-to-face (through the email or of the virtual campus). |
| Laboratory practises | Academic activity developed by the professors, individual or in small group, that has like purpose attend the needs and queries of the students related with subjects related with the matter, providing him orientation and support in the process of learning. This activity can carry out of face-to-face form (in the moments that the professor has assigned to office class), or of form no face-to-face (through the email or of the virtual campus). |

**Assessment**

| | Description | Qualification | Training and Learning Results |
|---|---|---|---|
| Autonomous troubleshooting and / or exercises | Students must solve independently, and periodically submit problems or exercises formulated by the faculty member. The results and the procedure followed in the execution will be evaluated.<br>According to current legislation, the final grade will be numeric and between 0 and 10. | 10 | B3 C4 D2 D3 D10 |
| Multiple choice tests | The purpose of these tests, which will be carried out in the date of the official announcement of examinations, is to assess the level of theoretical knowledge acquired by students in classroom sessions. Written tests are multiple choices, multiple responses, in which students can achieve a numerical score between 0 and 10, according to current legislation. | 40 | B3 C4 D10 |
| Troubleshooting and / or exercises | The evaluation of the knowledge gained by students in seminars will be through a written exam, in the official announcement of examinations, in which the student must solve 4 or 5 problems related to the subject under study.<br>The exam will be graded according to the current legislation, with a numerical final grade between 0 and 10. | 40 | B3 C4 D2 D3 D10 |
| Reports / memories of practice | After each laboratory session, the student should prepare a detailed report including aspects such as objective and theoretical foundations, procedure followed, materials used, results and interpretation.<br>The aspects considered in the evaluation are the content of the report, the understanding of the work done, the ability of summarising, quality of presentation, and the personal contribution.<br>The final score, between 0 and 10, will be the average of the marks obtained in the various reports made. | 10 | C4 D3 D17 |

**Other comments on the Evaluation**

The final exam, consisting of two different parts, a test-type quiz for theory content and a set of exercises, will be considered for the final score weighting only when they were rated greater than or equal to 4. Although the average score could be equal or greater than 5, if the qualification of any of the parts of the final exam be lower than 4, the final score will be the lowest mark obtained in the final exam (which is the one that does not permit to calculate the average mark). The attendance to any lab session or any seminar test means that the student is being evaluated and therefore a qualification of "not presented" is no longer possible.

The marks of continuous evaluation (seminars test and lab experiments) and the marks of final exam higher than 5 (test quiz or exercises) obtained in the first call will be kept for the second call.

Those students that obtain officially the renunciation to the continuous evaluation will be evaluated by the final exam, to be held in the official date for the two calls. The final qualification will consist of a 50% of exercises and a 50% of theory (test-type) exam. A rate equal to or greater than 4 in both parts is necessary in order to pass the exam.

The use of electronic devices during the assessment tests will be not permitted. Introducing an unauthorized electronic device into the examination room, will be considered as a FAIL (0.0 points) in the current academic year.

Ethical commitment:

The student is expected to present an adequate ethical behavior. If an unethical behavior is detected (copying, plagiarism, unauthorized use of electronic devices, and others) it is considered that the student does not meet the requirements for passing the subject. In this case, the final grade in the current academic year will be FAIL (0.0 points).

## Sources of information


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Ramos Carpio, M. A., **Refino de Petróleo, Gas Natural y Petroquímica**, Ediciones UPM,

Vian Ortuño, A., **Introducción a la Química Industrial**, Ed. Reverté,

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Quiñoa ,E., **Cuestiones y ejercicios de química orgánica: una guía de estudio y autoevaluación**, Ed. McGraw Hill,

Llorens Molina, J.A., **Ejercicios para la introducción a la Química Orgánica**, Ed Tébar,

Sánchez Coronilla, A., **Resolución de Problemas de Química**, Ed. Universidad de Sevilla,


## Recommendations

### Subjects that it is recommended to have taken before

(*)Física: Física I/V12G350V01102
(*)Matemáticas: Álxebra e estatística/V12G350V01103
(*)Matemáticas: Cálculo I/V12G350V01104

### Other comments

It is recommended that students have taken and passed the subject of ""Chemistry"" in second baccalaureate or, alternatively, passed a specific test of access to the Degree.