



IDENTIFYING DATA

(*)Química: Química

Subject	(*)Química: Química			
Code	V12G380V01205			
Study programme	(*)Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	Galician English			
Department				

Coordinator	Nóvoa Rodríguez, Xosé Ramón
Lecturers	Alonso Gómez, José Lorenzo Álvarez da Costa, Estrella Bolaño García, Sandra Cameselle Fernández, Claudio Cancela Carral, María Ángeles Cisneros García, María del Carmen Cruz Freire, José Manuel González de Prado, Begoña Gutián Saco, María Beatriz Izquierdo Pazó, Milagros Moldes Menduía, Ana Belén Moldes Moreira, Diego Moure Varela, Andrés Nóvoa Rodríguez, Xosé Ramón Pérez Lourido, Paulo Antonio Rey Losada, Francisco Jesús Rodríguez Rodríguez, Ana M. Valencia Matarranz, Laura Maria
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General description	This is one of the basic subjects that is part of all Degrees in Industrial Engineering. The main objective of the subject Chemistry is to provide the students with a basic knowledge in Organic and Inorganic Chemistry as well as the basic principles of Chemistry, and their application to the Chemical Industry.

Competencies

Code	
A3	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.
A17	FB4 Ability to understand and apply the basic knowledge of general chemistry, organic chemistry and inorganic chemistry, and their applications in engineering.
B3	CT3 Oral and written proficiency in the own language.
B10	CS2 Self learning and work.
B17	CP3 Working as a team.

Learning aims

Expected results from this subject	Training and Learning Results
Knowledge of the basic subjects	A3
Ability	A17

Ability to understand and apply the basic principles of the organic chemistry.	A17
Ability to understand and apply the basic principles of the inorganic chemistry.	A17
Ability to understand and apply the basic principles of the general chemistry, organic and inorganic chemistry to engineering.	A17
oral and written communication	B3
Learning	B10
Ability to work in teams	B17

Contents

Topic	
1. Atomic theory and chemical bond	1.1. Atomic theory: Subatomic particles: Electron, proton and neutron. Atom characteristics: atomic number and mass. Isotopes. Nuclear stability: natural and artificial radioactivity. Atomic theory evolution. 1.2. Chemical bond: Definition. Intramolecular bonds: covalent and ionic bond. Poly-atomic molecules: Hybridization and electronic delocalization. Intermolecular bond: Intermolecular forces. Chemical Nomenclature
2. State of matter: Pure solids, liquids and gases and solutions.	2.1. Solid state: Introduction. Classification: amorphous, crystalline solids: molecular and liquid crystals, covalent and ionic crystals. Structure and crystalline energy. 2.2. Gas state: Characteristics. Ideal gases: state equation. real gases: State equation. Properties. 2.3. Liquid state: Characteristics. Physical properties: density, surface tension, viscosity. Phase transitions. Phase diagram. Colligative properties of solutions.
3. Thermochemistry.	3.1. Heat reaction: Enthalpy. Internal energy. Reaction enthalpy. Temperature and reaction enthalpy. Enthalpy of formation. Evaluation of enthalpy of formation: direct method. State function: Hess' law. 3.2. Entropy: Definition. Evaluation. 3.3. Free energy: Definition. Evaluation. Spontaneous - nonspontaneous criteria.
4. Chemical equilibrium: gas state, acid-base, redox, solubility.	4.1. Chemical equilibrium: Definition. Equilibrium constant. Types and examples. Le Chatelier's principle. 4.2. Acid-base equilibrium: Definition. Water auto-ionization. Ionic product. pH and pOH. Acid and base strength. Polyprotic Acids. Amphoteric acids and bases. pH determination. Acid-base titrations. Buffer solutions. 4.3. Redox equilibrium: Oxidation, reduction, oxidant and reductor. Balancing redox reactions: Acidic media, Basic media. Redox titrations. Electrochemical batteries: basic concepts and redox potential. Thermodynamic of electrochemical reactions: Gibbs energy and cell potential. Nerst equation. Faraday Laws. 4.4 Solubility: Soluble salts: hydrolysis. Low soluble salts: solubility and solubility product. Variables that affect solubility. Ion separation by fractional precipitation. Complex salts: Definition, properties, dissociation, interest.

5. Chemical kinetics	5.1. Basic concepts: Reaction rate, reaction order, kinetic constant, rate equation. 5.2. Chemical reaction rate: Quantification. Method of initial rates. Integrated rate equations. 5.3. Factors that modify the rate of a chemical reaction.
6. Basic principles of organic chemistry.	6.1. Nomenclature of organic chemistry and organic functional groups: 6.1.1. Structure of organic compounds: Alkanes, alkenes and alkynes. Aromatic hydrocarbons. 6.1.2. Alcohols and phenols. 6.1.3. Ethers. 6.1.4. Aldehydes and ketones. 6.1.5. Esters. 6.1.6. Carboxylic acids and their derivatives. 6.1.7. Amines and nitro compounds.
7. Basic principles of inorganic chemistry	7.1. Metallurgy and Chemistry of Metals: Abundance of metals. Nature of metallic chemical bond and metallic properties. Theory of conduction band: conductive materials, semiconductors and superconductors. Metallurgical Processes: Iron and Steel. 7.2. Non-metals and their compounds: General properties of non-metals. Hydrogen. Carbon. Nitrogen and phosphorus. Oxygen and sulfur. Halogens.
8. Applied electrochemistry	8.1 Applications of the Nerst equation: Determination of pH, equilibrium constant and solubility product. 8.2. Electrochemical batteries: types of batteries. Cell concentration. Electrical conductivity in electrolytes. Electrolysis cells. 8.3. Industrial processes of electrolysis: electroplating, electrometallurgy, chlorine-NaOH electrolysis. Fuel cells.
9. Corrosion and Surface Treatment	9.1. Basic principles of corrosion: the corrosion cell. 9.2. Corrosion of metals. 9.3. Corrosion rate. 9.4. Types of corrosion. 9.5. Protection against corrosion: Design considerations for protection against corrosion, cathodic protection (Sacrificial anode protection, Impressed current), protective coatings. Electroplating.
10. Electrochemical sensors	10.1. Fundamentals. 10.2. Types and function. 10.3. Conductivity sensors. 10.4. Potentiometric sensors. 10.5. Ion selective electrode. pH sensors. 10.6. Selective Sensors for dissolved gases. 10.7. Selective enzyme electrodes: Biosensors. 10.8. Amperometric and voltametric sensors. 10.9. Sensor applications: medicine, industry, environmental monitoring.
11. Petroleum (oil) and Derivatives: Petrochemistry.	11.1. Physico-chemical characteristics of oil. 11.2. Physico-chemical characteristics of natural gas. 11.3. Conditioning and uses of natural gas. 11.4. Oil Fractioning. 11.5. Cracking of hydrocarbons: Reforming, isomerization, oligomerization, alkylation and eterification. 11.6. Petrochemical processes of BTX, olefins and derivatives, methanol and derivatives. 11.7. Treatment of sulfurous compounds and refining units.
12. The Coal: Carbochemistry	12.1. Coal formation. 12.2. Types of coal and its constitution. 12.3. Coal utilization technology. 12.4. Pyrogenic coal. 12.5. Hydrogenation of coal. 12.6. Direct coal liquefaction, 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	Teaching in the classroom
Troubleshooting and / or exercises	Solving exercises and problems in the classroom
Laboratory practises	Teaching in the laboratory
Autonomous troubleshooting and / or exercises	Students solving exercises on their own

Personalized attention

Methodologies	Description
Master Session	Follow up of the work of the students. Guidance for solving exercises.
Troubleshooting and / or exercises	Follow up of the work of the students. Guidance for solving exercises.
Laboratory practises	Follow up of the work of the students. Guidance for solving exercises.

Assessment

	Description	Qualification
Autonomous troubleshooting and / or exercises	Hand out exercises along the semester	10
Multiple choice tests	Test about the theoretical concepts and exercises in the classroom.	40
Troubleshooting and / or exercises	test about the exercises solved in the classroom	40
Reports / memories of practice	Report that must include all the details about the lab practices: objective, materials, procedure, results and their discussion.	10

Other comments on the Evaluation

It is required a minimum mark of 4 out of ten in the "Troubleshooting and / or exercises" and "Multiple choice tests"

Sources of information

Petrucchi R.H., F.G. Herring, J.D. Madura, C. Bissonnette, **General Chemistry: Principles and Modern Applications**, Pearson,

Petrucchi, R. H., Herring, F.G., Madura, J.D., Bissonnette, C., **Química General 10 ed.**, Ed. Prentice-Hall,

Atkins, P. y Jones, L, **Principios de Química. Los caminos del descubrimiento**, Ed. Interamericana,

Chang, R., **Química**, Ed. McGraw Hill,

González Ureña, A, **Cinética Química**, Ed. Síntesis,

Herranz Agustín, C, **Química para la ingeniería**, Ediciones UPC,

McMurry, J.E. y Fay, R.C, **Química General**, Ed. Pearson,

Herranz Santos, M.J. y Pérez Pérez M.L., **Nomenclatura de Química Orgánica**, Ed. Síntesis,

Reboiras, M.D, **Química. La ciencia básica**, Ed. Thomsom,

Quiñóá, E. y Riguera, R., **Nomenclatura y representación de los compuestos orgánicos : una guía de estudio y autoevaluación**, Ed. McGraw Hill,

Soto Cámara, J. L., **Química Orgánica I: Conceptos Básicos**, Ed. Síntesis,

Soto Cámara, J. L., **Química Orgánica II: Hidrocarburos y Derivados Halogenados**, Ed. Síntesis,

Ballester, A., Verdeja, L. y Sancho, J., **Metalurgia Extractiva I: Fundamentos**, Ed. Síntesis,

Sancho, J. y col., **Metalurgia Extractiva II: Procesos de obtención**, Ed. Síntesis,

Rayner-Canham, G., **Química Inorgánica Descriptiva**, Ed. Prentice-Hall,

Alegret, M. y Arben Merckoci, **Sensores electroquímicos**, Ediciones UAB,

Cooper, J. y Cass, T., **Biosensors**, Oxford University Press,

Calleja, G. y col., **Introducción a la Ingeniería Química**, Ed. Síntesis,

Coueret, F., **Introducción a la ingeniería electroquímica**, Ed. Reverté,

Otero Huerta, E., **Corrosión y Degradación de Materiales**, Ed. Síntesis,

Pingarrón, J.M. y Sánchez Batanero, P., **Química Electroanalítica. Fundamentos y Aplicaciones**, Ed. Síntesis,

Canseco Medel, A., **Tecnología de Combustibles: I Combustibles Sólidos**, Ed. Fundación Gómez Pardo,

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

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

Fernández, M. R. y col., **1000 Problemas de Química General**, Ed. Everest,

Herrero Villén, M.A., Atienza Boronat, J.A., Nogra Murray, P. y Tortajada Genaro, L.A., **La Química en problemas. Un enfoque práctico**, Ediciones UPV,

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

Llorens Molina, J.A., **Ejercicios prácticos de 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: Álgebra e estadística/V12G350V01103

(*)Matemáticas: Cálculo I/V12G350V01104

Other comments

The students are recommended to be passed the subject "chemistry" in the secondary school, or a specific test to access the Degree in Industrial Engineering.
