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320005 - Q - Chemistry

Coordinating unit: 205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering

Teaching unit: 713 - EQ - Department of Chemical Engineering

Academic year: 2019

Degree: BACHELOR'S DEGREE IN INDUSTRIAL DESIGN AND PRODUCT DEVELOPMENT ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN TEXTILE TECHNOLOGY AND DESIGN ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)

ECTS credits: 6 Teaching languages: Catalan, Spanish

Teaching staff

Coordinator: JORGE MACANÁS DE BENITO
MARGARITA MORILLO CAZORLA

Others: MARGARITA MORILLO CAZORLA-JORGE MACANÁS DE BENITO- XAVIER COLOM FAJULA - JOSEP GARCIA RAURICH - MANUEL JOSÉ LIS ARIAS-ESTER GUAUS GUERRERO- TZANKO TZANOV-GEMMA MOLINS DURAN-IRENE LÓPEZ PENA-ROGER CURCOLL-MARTA GUADAYOL

Opening hours

Timetable: Specified in Digital Campus

Degree competences to which the subject contributes

Basic:

CB01. IND_DIS_AUD: That students have demonstrated knowledge and understanding in a field of study that part of the basis of general secondary education, and is typically at a level which, although it is supported by advanced textbooks , includes some aspects that involve knowledge of the forefront of their field of study .

CB02. IND_DIS_AUD: That students can apply their knowledge to their work or vocation in a professional manner and have competences typically demonstrated through devising and defending arguments and solving problems within their field of study.

Specific:

1. IND_BASIC: An understanding of and the ability to apply the fundamental principles of general, organic and inorganic chemistry and their applications to engineering.

G04. (ENG) DIS: Coneixements bàsics de química general , química orgànica i inorgànica i les seves aplicacions en l'enginyeria.

Generical:

CG03. IND: Knowledge in basic subjects and technology that will enable students to learn new methods and theories and equip them with the versatility to adapt to new situations.

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Teaching methodology

- Face-to-face lecture sessions
Lectures are given using digital presentations. Presentations will be made available to students on the Virtual Campus before classes begin to help them follow them. Assessment will be based on mid-semester examinations.
- Face-to-face practical work sessions
During practical work sessions, students work individually or in small groups of 2-3 on problems and questions under the lecturer's supervision. A collection of problems will be made available on the Digital Campus, some of them will be solved in class and other realization is recommended to promote self-learning. Students will be available Moodle questionnaires for each topic that will be used to evaluate the subject.
- Face-to-face laboratory work sessions
Students work in pairs during laboratory sessions. Guidelines for practicals will be made available to students on the Digital Campus at the start of the course. Students must hand in a report for each practical. Marks will be based on the work carried out in the laboratory, the reports handed in and related Moodle questionnaires. Assesment will be based on: the work done in the lab, reports and associated questionnaires. It has a public rubric for evaluation of laboratory practices.

Learning objectives of the subject

On completion of the course, students should be able to:
- Correctly use and interpret the language and basic concepts of Chemistry.
- Recognise the structure of matter and relate it to the physical and chemical properties of organic and inorganic substances.
- Apply stoichiometric calculations and chemistry equilibrium to solve problems.
- Recognise the equipment and apply basic techniques of the chemistry laboratory.

Study load

Total learning time: 150h	Hours large group:	30h	20.00%
	Hours medium group:	15h	10.00%
	Hours small group:	15h	10.00%
	Guided activities:	0h	0.00%
	Self study:	90h	60.00%

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Content

TOPIC 0: INTRODUCTION

Learning time: 6h

Theory classes: 1h
Laboratory classes: 2h
Self study : 3h

Description:
0.1. Introduction to the subject.
0.2. Assignment of tasks.
0.3. Introduction to laboratory, safety rules and various manipulation techniques.

Related activities:
L1. The chemistry laboratory. Introduction to the laboratory, the safety rules and various manipulation techniques.
Assignment of tasks.

Questionnaires Moodle.

Specific objectives:
For students to:
- Understand objectives and assessment method for the subject.
- Be assigned tasks for the subject.
- Understand the main manipulation techniques used in the laboratory.
- Understand the main safety rules observed in the laboratory.

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TOPIC 1. INTRODUCTION TO CHEMISTRY. ATOMIC STRUCTURE AND THE PERIODIC TABLE: PERIODIC PROPERTIES.	Learning time: 12h Theory classes: 3h Practical classes: 2h Laboratory classes: 2h Self study : 5h

Description:

TOPIC 1A:INTRODUCTION TO CHEMISTRY.

1. Basic concepts.
2. Sustances properties.
3. Measurement of substances. Gases. Liquids (pure liquids and solutions).

TOPIC 1B. ATOMIC STRUCTURE AND THE PERIODIC TABLE: PERIODIC PROPERTIES

1. The atom. Atomic theories.
2. Quantum numbers.
3. Electronic configurations.
4. The periodic table. The relationship between electron configuration and position in the periodic table.
5. Periodic properties: atomic radius, ionic radius, ionisation potential, electron affinity, electronegativity. Covalence. Metallic and non-metallic character.
6. Types of bonds. Substances types.

Related activities:

P1. Periodic properties. Presentation of the topic to the entire class with the support of prepared materials via the Digital Campus, followed by exercises and problems related to the topic. Individual continuous assessment.
L4. Preparation of solutions. Measurement of densities.

Questionnaires Moodle

Partial exam 1.

Specific objectives:

For students to:

- Apply appropriate magnitudes of measurement for a particular matter and composition.
- Understand the structure of the periodic table.
- Relate the position of elements in the periodic table with their properties.
-Identify the kind of bond between two elements.

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TOPIC 2. INORGANIC SUBSTANCES.

Learning time: 8h
Self study : 8h

Description:
2.1. Elementary substances.
2.2. Binary compounds.
2.3. Polyatomic compounds.

Related activities:
Self-directed learning with the support of prepared materials via the Digital Campus, followed by exercises related to the topic. Individual continuous assessment.

Questionnaires Moodle.

Partial exam 1.

Specific objectives:
- Understand the language of chemistry and the families of inorganic compounds.

TOPIC 3. IONIC AND METALIC SOLIDS.

Learning time: 16h
Theory classes: 3h
Practical classes: 1h
Laboratory classes: 1h
Self study : 11h

Description:
3.1. States of matter. Solid state.
3.2. Ionic solids.
3.3. Metalic solids.

Related activities:
P3. Physical properties of inorganic substances. Physical properties of organic substances. Presentation of the topic to the entire class with the support of prepared materials via the Digital Campus, followed by exercises related to the deduction of properties on the basis of structure. Individual continuous assessment.

L2. Structure-property relationships. Experimental determination of physical properties of unknown substances in order to identify their structure. Continuous assessment of two-student teams. Laboratory reports.
Questionnaires Moodle
Partial exam 1.

Specific objectives:
For students to:
- Identify the type of bond that two elements will form.
- Grade the strength or intensity of bonds between different pairs of elements.

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TOPIC 5. COVALENT BOND. MOLECULARS AND COVALENTS SUBSTANCES.	Learning time: 16h Theory classes: 4h Practical classes: 2h Laboratory classes: 1h Self study : 9h

Description:
4.1 Lewis structures.
4.2. Molecular geometry (VSEPR method).
4.3. Polarity of molecules.
4.4. Molecular substances. Intermolecular forces. Physical properties of organic and inorganic compounds.
4.5. Covalent solids.

Related activities:
P4. Lewis structures. Molecular geometry and polarity. Presentation of the topic to the entire class with the support of prepared materials via the Digital Campus, followed by exercises and problems related to the topic. Students will use molecular models. Individual continuous assessment.

L2. Structure-property relationships. Experimental determination of physical properties of unknown substances in order to identify their structure. Continuous assessment of two-student teams. Laboratory reports.

Questionnaires Moodle

Partial exam 1.

Specific objectives:
For students to:
-Compare the intensity bond between different elements.
-Construct Lewis structures.
- Describe molecular geometry using the VSEPR method.
- Identify the presence of molecular dipole moment.
- Approximately deduce the general physical properties of any substance.
- Compare and establish gradations in the physical properties of different substances.

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TOPIC 5. ORGANIC COMPOUNDS.	Learning time: 12h Self study : 12h

Description:
5.1. The carbon atom.
5.2. Hydrocarbons.
5.3. Compounds with functional groups.

Related activities:
Self-directed learning with the support of prepared materials via the Digital Campus, followed by exercises related to the topic. Individual continuous assessment.

Questionnaires Moodle

Partial exam 2.

Specific objectives:
For students to:
Understand the language of chemistry and the families of organic compounds.

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TOPIC 6. CHEMICAL REACTIONS: STOICHIOMETRY.	Learning time: 20h Theory classes: 5h Practical classes: 3h Laboratory classes: 2h Self study : 10h

Description:
6.1. Chemical equations. Balancing.
6.2. Stoichiometric calculations. Limiting reagents. Yield.
6.3. Chemical equilibrium. Le Chatelier principle.
6.4. Exothermic and endothermic reactions. Enthalpy, entropy, Gibbs energy.
6.5. Speed of a chemical reaction.

Related activities:
P6. Balancing chemical reactions. Stoichiometric calculations. Presentation of the topic to the entire class with the support of prepared materials via the Digital Campus, followed by exercises and problems related to the topic. Individual continuous assessment.

L3. Determination of the purity and composition of samples. Experimental determination. Continuous assessment of two-student teams. Laboratory reports.

Questionnaires Moodle.

Partial exam 2.

Specific objectives:
For students to:
- Balance chemical equations.
- Detect the presence of limiting reagents.
- Determine the quantities of reactants and products involved in a reaction.
- Apply stoichiometric calculations to determine yield, purity, composition, etc.
-Use equilibrium constants to describe systems at equilibrium
-Use the equilibrium constant expressed in terms of partial pressures (Kp) and relate it to Kc
-Recognize the factors that affect equilibria and predict the effects of a change.
-Understand the terminology of thermodynamics, and the meaning of the signs of changes.
-Use Hess?s Law to find the enthalpy change for a reaction.
-Understand how the spontaneity of a process is related to Gibbs free energy.
-Express the rate of a chemical reaction in terms of changes in concentrations of reactants and products with time.
-Describe the experimental factors that affect the rates of chemical reactions.
-Use the concept of order of a reaction.
-Apply the method of initial rates to find the rate-law expression for a reaction.

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TOPIC 7. ACID BASE REACTIONS.

Learning time: 24h

Theory classes: 4h
Practical classes: 3h
Laboratory classes: 4h
Self study : 13h

Description:
7.1. Acids and bases. Definitions. Acidic and basic oxides. Acid rain.
7.2. Relative strength. Hydrolysis.
7.3. Neutralisation. Buffers solutions. Titration curves.

Related activities:
P7. Acids and bases. Presentation of the topic to the entire class with the support of prepared materials via the Digital Campus, followed by exercises and problems related to the topic. Individual continuous assessment.

L5. Acid-base titration. Experimental determination. Continuous assessment of two-student teams. Laboratory reports.

L7. Synthesis of an organic compound. Application of the reactivity of organic compounds in the synthesis of a compoundof industrial and/or environmental interest. Continuous assessment of two-student teams. Laboratory reports.

Questionnaires Moodle.

Partial exam 2.

Specific objectives:
For students to:
- Identify acidic and basic substances.
- Grade and compare the strength of organic and inorganic acids and bases.
- Predict the possible reaction between two acidic and/or basic substances and their products.
- Determine the concentration of an acid or a base by titration.
-Identify the species which prevails at a given pH
- Understand the autoionization of water
- Understand the pH and pOH scales and how they are used
- Use ionization constants for weak monoprotic acids and bases
- Describe how polyprotic acids ionize in steps
- Apply acid?base equilibrium concepts to salts and discuss the concept of hydrolysis
-Recognize buffer solutions
- Carry out calculations related to buffer solutions and their action
- Describe what species are present at various stages of titration curves

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TOPIC 8. REDOX REACTIONS.	Learning time: 18h Theory classes: 4h Practical classes: 2h Laboratory classes: 2h Self study : 10h

Description:
8.1. Redox reactions. Definitions.
8.2.Standard reduction potential. Electrochemical series.
8.3. Nernst equation.
8.4. Batteries.
8.5. Corrosion.
8.6. Electrolysis.

Related activities:
P8. Redox reactions. Solubility and complex formation. Presentation of the topic to the entire class with the support of prepared materials via the Digital Campus, followed by exercises and problems related to the topic. Individual continuous assessment.
L6. Redox reactions. Electrolysis. Experimental determination and demonstration. Continuous assessment of two-student teams. Laboratory reports.
Questionnaires Moodle
Partial exam 2.

Specific objectives:
For students to:
- Identify oxidising and reducing substances.
- Grade and compare the strength of oxidising and reducing substances.
- Predict the possible redox reaction between two substances and their products.
- Identify and understand the various types of batteries.
- Predict the products of electrolysis.
- Apply stoichiometric calculations to electrolysis.

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TOPIC 9. PRECIPITATION REACTIONS.

Learning time: 13h

Theory classes: 2h
Practical classes: 2h
Self study : 9h

Description:
9.1. Solubility and solubility product.
9.2. Conditions for the precipitation of substances and to solubilize precipitates.

Related activities:
P9. Solubility and precipitation. Resolution of exercises and problems linked to the themes, after the exhibition in large group and with the support of previously prepared and available in Campus Digital materials. Individual continuous assessment.

L3. Determination of the purity and composition of samples. Experimental determination and demonstration. Continuous assessment of two-student teams. Laboratory reports.

Questionnaires Moodle

Partial exam 2.

Specific objectives:
-Understand the concepts of solubility and solubility product. Use Ksp's in chemical calculations.
-Apply the rules of general solubility in water to the possible formation of precipitates and to redisolved precipitates.
-Relate the structure of organic compounds with their solubility in different solvents.
-Describe some methods for dissolving precipitates.

Partial exam 1

Learning time: 2h

Theory classes: 2h

Description:
Test partial levels T1-T4 (and optionally on the part of the T6) that will take place in the middle of semester.

Partial exam 2

Learning time: 2h

Theory classes: 2h

Description:
Written exam to assess the contents of the T5-T9.

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Planning of activities

(ENG) ACTIVITAT 1. FACE TO FACE CLASS. (CONTINGUTS 1, 3, 4, 6, 7, 8 I 9)	Hours: 52h Theory classes: 26h Self study: 26h

Description:
Face to face class.

Support materials:
MS PowerPoint presentations.

Descriptions of the assignments due and their relation to the assessment:
Moodle questionnaires. Exams.

Specific objectives:
Those of the corresponding topics.

ACTIVITY 2. PRACTICES (CONTENTS 1, 3, 4, 6, 7, 8 and 9)	Hours: 30h Practical classes: 15h Self study: 15h

Description:
Face to face problems class.

Support materials:
Presentations MS PowerPoint, problems collection. Moodle questionnaires.

Descriptions of the assignments due and their relation to the assessment:
Moodle questionnaires. Exams.

Specific objectives:
Those of the corresponding topics.

(ENG) ACTIVITAT 3. QÜESTIONARIS MOODLE. (CONTINGUTS TOTS)	Hours: 16h Self study: 16h

Description:
Evaluation and autoevaluation questionnaires .

Support materials:
Presentations MS PowerPoint, problems collection. Moodle questionnaires.

Descriptions of the assignments due and their relation to the assessment:
Moodle questionnaires (10% global qualification).

Specific objectives:
Those of the corresponding topics.

ACTIVITY. LABORATORY (CONTENTS 0, 1, 3, 4, 6, 7, 8 AND 9)	Hours: 35h Laboratory classes: 14h Self study: 21h

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Specific objectives:
Those of the corresponding topics.

ACTIVITY 5. PARTIAL EXAM 1(CONTENTS 1, 2, 3, 4 and optionally on the part of the T6)	Hours: 2h Theory classes: 2h

Description:
Test partial levels T1-T4 (and optionally on the part of the T6) that will take place in the middle of semester.

Support materials:
Presentations MS PowerPoint, problems collection. Moodle questionnaires.

Descriptions of the assignments due and their relation to the assessment:
Face to face exam (35% final qualification)

Specific objectives:
Those of the corresponding topics.

ACTIVITY 6. PARTIAL EXAM 2 (CONTENTS 5, 6, 7, 8 and 9)	Hours: 2h Theory classes: 2h

Description:
Test partial levels T5-T9 that will take place in the end of semester.

Support materials:
Presentations MS PowerPoint, problems collection. Moodle questionnaires.

Descriptions of the assignments due and their relation to the assessment:
Face to face exam (35% final qualification)

ACTIVITY 7. EXAM OF RECONDUCTION (OF PARTIAL 1)	Hours: 1h Theory classes: 1h

Description:
Unsatisfactory results of the first examination may be redirect through a written exam, which will take place the same day of the second test. This exam can be accessed by all students enrolled who have a partial 1 mark <5. Mark obtained by application of the reconduction will replace initial qualification provided if it is superior.

Qualification system

-Oral and written tests: 70 % (35 % 1st examination, 35 % the 2nd test)
-Laboratory sessions: 20%
-Other deliveries: 10% (Application/practicals)

Unsatisfactory results of the first test may redirect through a written test, which will take place the same day of the second exam. This exam can be accessed by all students enrolled who have a partial 1 mark <5. Mark obtained by application of the reconduction will replace initial qualification provided if it is superior.

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Regulations for carrying out activities

Necessary condition to overcome the subject is performing laboratory practices and presenting corresponding reports. The use of coat and safety glasses is required in the laboratory.

Bibliography

Basic:

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Reboiras, M. D. Química: la ciencia básica. Madrid: International Thomson Editores, 2006. ISBN 8497323475.

Atkins, P. W. Principios de química: los caminos del descubrimiento. 3a ed. Buenos Aires: Médica Panamericana, 2006. ISBN 9500600803.

Whitten, Kenneth W. [et al.]. Química general. 5a ed. Madrid: McGraw-Hill, 1998. ISBN 8448113861.

Peterson, W. R. Nomenclatura de las sustancias químicas. 4. Barcelona: Reverté, 2015. ISBN 9788429175721.

Sales i Cabré, Joaquim. Introducció a la nomenclatura química: inorgànica i orgànica. 5a ed. Barcelona: Reverté, 2003. ISBN 8429175512.

Petrucci, Ralph H. Química general: principios y aplicaciones modernas [on line]. Undécima edición. Madrid: Pearson Prentice Hall, 2017 [Consultation: 04/10/2018]. Available on: <http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=6751>. ISBN 9788490355336.

Complementary:

Johll, Matthew E. Química e investigación criminal: una perspectiva de la ciencia forense. Barcelona: Reverté, 2008. ISBN 9788429155129.

Ebbing, Darrell D. Química general. 5a ed. México: McGraw-Hill, 1997. ISBN 9701010256.

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Chang, Raymond. Principios esenciales de química general. 4a ed. Madrid: McGraw-Hill, 2006. ISBN 8448146263.

Quiñoá, Emilio. Nomenclatura y representación de los compuestos orgánicos: una guía de estudio y autoevaluación. 2a ed. Madrid: McGraw-Hill, 2005. ISBN 8448143639.

Others resources:

Hyperlink

http://upcommons.upc.edu/video/handle/2099.2/1241

Videoteca UPC >Grup de Recursos per a la Didàctica de la Química >Materials docents
http://upcommons.upc.edu/video/handle/2099.2/1241