Course guide
220087 - Q2 - Chemistry II

Last modified: 02/02/2024

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 713 - EQ - Department of Chemical Engineering.

Degree: BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: FRANCESC TORRADES CARNÉ

Others: FRANCESC TORRADES CARNÉ
JOSEP MARIA DAGÀ MONMANY
FRANCISCO JAVIER CAÑAVATE AVILA

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CE04-INDUS. Ability to understand and apply the principles of basic knowledge of general chemistry, organic and inorganic chemistry, and their applications in engineering. (Basic training module)

TEACHING METHODOLOGY

It will include:
- Presencial sessions of contents exhibition.
- Presencial sessions of practical work.
- Sessions of experimental chemistry in the laboratory.
- Autonomous work of study and realization of exercises.

In the content exhibition sessions the teaching staff will introduce theoretical bases of subject, concepts, methods and results to facilitate their understanding.
In the problem sessions in the classroom, teaching staff will guide to the students in the application of theoretical concepts for problems resolution. They will propose exercises which students have to solve in order to guarantee the contact and utilization of the basic tools for the resolution of problems.
The laboratory sessions will be structured in small groups. In these classes students take contact with the chemical laboratory and with experimental methods.
The students have to work the material provided by the teaching staff in an autonomous way in order to assimilate and fix concepts. The teaching staff will provide a plan of study and of follow-up of activities (ATENEA).

LEARNING OBJECTIVES OF THE SUBJECT

Broadening the knowledge of chemistry that the students have attained previously, as well as introducing new concepts which give to students a uniform and common chemical basis. It will be necessary to follow some subjects which they will do later. At the end of the course students will have to know the laws that govern the behaviour of solutions, the most important types of reactions in aqueous solutions; and to know electrochemistry fundamentals and their applications. They also will have to know some aspects of metals and nonmetals chemistry, as well as the structure, reactivity and applications of the main organic compounds.
To relate and to apply the theoretical concepts, in the numeric problems and in the realization of laboratory experiments.
To provide the tools because the students are capable of searching information, select it and reflect about it creating some own opinions.
To recognize the Chemistry as an experimental science and fixing knowledge from the experimentation in the laboratory.
To recognize the importance of the Chemistry and the Chemical Technology in the well-being of the society. To know the impact of the industrial activities in the environment and to understand that many environmental problems need a strong chemical knowledge, in order to be solved.

STUDY LOAD

Type	Hours	Percentage
Self study	90,0	60.00
Hours medium group	14,0	9.33
Hours large group	32,0	21.33
Hours small group	14,0	9.33

Total learning time: 150 h

CONTENTS

1. Solutions

Description:
1.1. Types of solutions.
1.2. Ideal solutions. Raoult's Law.
1.3. Non ideal solutions. Activity and activity coefficient.
1.4. Henry's Law. Miscible liquids. Gas and liquid solutions.
1.5. Dilute solutions with non volatile solute. Colligative properties for electrolytes and non-electrolytes.

Related activities:
Theory classes and problems; practices; laboratory.

Full-or-part-time: 21h
Theory classes: 4h
Practical classes: 3h
Laboratory classes: 2h
Self study : 12h

2. Reactions in aqueous solutions

Description:
2.1. Proton transfer reactions.
Acid-base theories. Acid and bases strength. Water acid-base system.
pH concept. pH calculation. Acid-base titrations.
2.2. Complex formation reactions.
Complex definition.
2.3. Precipitation reactions.
Solubility and solubility product.
Factors that affect solubility of precipitates: common ion, acidity, complex formation.

Related activities:
Theory classes and problems; practices; laboratory.

Full-or-part-time: 36h
Theory classes: 9h
Practical classes: 3h
Laboratory classes: 3h
Self study : 21h

3. Electrochemistry

Description:
3.1. Basic concepts in electron transfer reactions.
3.2. Galvanic cells.
3.3. Standard hydrogen electrode. Standard electrode potentials.
3.4. Standard electrode potentials applications. Standard electrode potential of a galvanic cell. Nerst equation. Equilibrium constant.
3.5. Factors that affect electrode potentials.
3.6. Electrolysis. Faraday's Laws. Corrosion.
3.7. Electrochemical analysis techniques.

Related activities:
Theory classes and problems; practices; laboratory.

Full-or-part-time: 23h
Theory classes: 4h
Practical classes: 2h
Laboratory classes: 3h
Self study : 14h

4. Chemistry of metals and nonmetals

Description:
4.1. General properties of metals and nonmetals.
4.2. Metals.
Obtention. Properties. Reactivity and applications.
4.3. Metallurgy.
4.4. Nonmetals.
Obtention. Properties. Reactivity and applications.

Related activities:
Theory classes and problems; practices.

Full-or-part-time: 17h
Theory classes: 4h
Practical classes: 1h
Self study : 12h

6. Organic chemistry

Description:
6.1. Organic structures determination.
6.2. Isomerism.
6.3. Organic chemistry reactions.
6.4. Industrial applications in organic chemistry.
6.5. Instrumental analysis techniques.

Related activities:
Theory classes and problems; practices; laboratory.

Full-or-part-time: 37h
Theory classes: 7h
Practical classes: 3h
Laboratory classes: 6h
Self study : 21h

ACTIVITIES

ACTIVITY 1: THEORY CLASSES

Description:
Methodology: Large group
Contents exhibition of the subject following and expositive and participative model.
The subject has been organized in 6 thematic areas. These 6 thematic areas refers to the 6 chapters that we have presented in this guide.

Specific objectives:
At the end of these classes, the student should be able to consolidate and acquire the necessary chemical knowledge in order to follow Bachelor's degree in Industrial Technology Engineering studies listen in the section:"General learning objectives of the subject"

Material:
Basic and specific bibliography.
Other material elaborated by teachers staff.

Delivery:
This activity is evaluated jointly with activity 2. Two written tests are performed: PARTIAL EXAM (activity 4) and FINAL (activity 5) following ESEIAAT programming. Moreover, other complementary activity will be evaluated, that will be specified at the beginning of the academic year.

Full-or-part-time: 64h
Theory classes: 26h
Self study: 38h

ACTIVITY 2: EXERCISE CLASSES

Description:
Methodology: medium group
From each of the chapters, the teacher indicates to the students a series of questions, exercises and problems that they must solve. In the classes within the classroom, a follow-up is made of the work that the students have done, solving the doubts that may have arisen and discussing the different approaches or solutions to an exercise or
posed problem.

Specific objectives:
At the end of these classes, the student must be able to apply the theoretical knowledge of the subject in the application of practical cases.
Also, from the point of view of the problem solving methodology, the student must be able to:
· Analyze the problem: I will understand the statement. I will answer questions about: What are the data, what are the demands?
· Develop a plan to solve the problem: Consider the possible paths according to the information provided and what is required. Determine the principles and the relationships that relate the data with the unknown.
· Solve the problem: Know how to use the information, the equations and the relationships to solve the unknown. Follow the rules and instructions related to signs, units and significative figures.
· Check the solution: check if the answer is logical and reasonable. Check if both the units and the number of significant figures are correct.

Material:
Basic and specific bibliography.
Other material elaborated by teachers staff.

Delivery:
This activity is evaluated jointly with activity 1. Two written tests are performed: PARTIAL EXAM (activity 4) and FINAL (activity 5) following ESEIAAT programming. Moreover, other complementary activity will be evaluated, that will be specified at the beginning of the academic year.

Full-or-part-time: 46h
Practical classes: 14h
Self study: 32h

ACTIVITY 3: CHEMISTRY LABORATORY

Description:
This activity consists of carrying out 4 chemistry practices that will be carried out in pairs in the chemistry laboratories.
The structure of the work that the students will have to do is:
· Pre-laboratory learning: preparation of the practice by reading it in the laboratory handbook and answering a series of questions related to the practice in the laboratory notebook. This work is done by the students as autonomous work.
Checking and control of pre-laboratory learning, by the teacher and prior to experimentation in the laboratory.
· Realization of the practice: The practice will be done in the chemistry laboratory with a duration of 2 hours.
· Post-laboratory learning: Discussion of the experimental results of the practice, of the methodology for treating these results and of the theoretical concepts involved, in a 1-hour session.
Completion of a report, by pair, on the practice carried out. This work is done by the students as autonomous work.

Specific objectives:
Upon completion of this activity, the student should be able to:
· Perform basic chemical laboratory operations.
· Acquire experimental skills.
· Know how to describe the experiments carried out.
· Know how to deal with experimental data and draw conclusions.
· Learn to prepare reports of experimental work.
· Know and make use of the basic safety standards of a laboratory and waste treatment.

Material:
All the material and reagents necessary to carry out the experiment in the laboratory.
Detailed laboratory handbook with the questionnaire and the model of the report that the students must deliver to the teacher for each of the practices.
Notes on topics related to practices at ATENEA.

Delivery:
For each of the practices:
. Registration, by the teacher of the verification of pre-laboratory learning. It represents 30% of the laboratory grade.
· Report presented by the students. This becomes corrected and with the possible feedback of the teacher.
It represents 30% of the laboratory grade.
·The remaining 40% of the qualification has to do with the assistance and development of the work in the laboratory.

Full-or-part-time: 34h
Laboratory classes: 14h
Self study: 20h

ACTIVITY 4: PARTIAL EXAM

Description:
Methodology: large group
Development of the partial exam of the subject

Specific objectives:
Develop the knowledge acquired in the theoretical, practical and laboratory sessions and show the level of achievement obtained.

Material:
Don't have

Delivery:
Solved exam on the sheet of paper delivered at the beginning of the test.
This activity is evaluated as part of the N1P element of the global evaluation of the subject.

Full-or-part-time: 2h
Theory classes: 2h

ACTIVITY 5: FINAL EXAM

Description:
Methodology: large group
Development of the final exam of the subject

Specific objectives:
Develop the knowledge acquired in the theoretical, practical and laboratory sessions and show the level of achievement obtained.

Material:
Don't have

Delivery:
Solved exam on the sheet of paper delivered at the beginning of the test.
This activity is evaluated as part of the N2P element of the global evaluation of the subject.

Full-or-part-time: 3h
Theory classes: 3h

ACTIVITY 6: ORGANIC FORMULATION CONTROL

Description:
Methodology: large group
Development of a formulation control in organic chemistry

Specific objectives:
To learn the formulation and nomenclature of different organic compounds.

Material:
Don't have

Delivery:
Solved exam on the sheet of paper delivered at the beginning of the test.
This activity is evaluated as part of the N3P element of the global evaluation of the subject.

Full-or-part-time: 1h
Theory classes: 1h

GRADING SYSTEM

Global qualification = 0,20 x N1P + 0,50 x N2P + 0,20 x NL + 0,10 x N3P
Where:
N1P: corresponds to partial exam qualification
N2P: corresponds to final exam qualification
NL: corresponds to laboratory qualification. Activity 3 of this guide.
NP3: corresponds to control qualification in class.

The non satisfactory results in the partial exam qualification (N1P) could be recovered in the final exam qualification (N2P). In this case, global qualification will be 0,70 x N2P + 0,20 x NL +0,10 x N3P; when N2P > N1P.

EXAMINATION RULES.

Each group can ask doubts to teachers staff of the subject as many times as they need it.

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RESOURCES

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