In addition to the general offer of courses taught in English, some Centers also offer for incoming students English Friendly Courses (EFC): subjects taught in Spanish, in which the syllabus summary, lecturer tutoring, examinations and/or papers are available in English.

<table>
<thead>
<tr>
<th>FACULTY OF CHEMISTRY (215)</th>
<th>SEMESTER</th>
<th>CREDITS</th>
<th>SCHEDULE¹</th>
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<td>26116 Caracterización Química y Física de Macromoléculas</td>
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<td>26133 Métodos matemáticos para la química</td>
<td>Jan. 2020- May 2020</td>
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¹ SCHEDULE: Morning (M)/ Afternoon (A): begins at 13.30.
By clicking the subject’s name, its Syllabus will appear.
SUBJECT
26113 - Organic Chemistry I

DESCRIPTION & CONTEXTUALISATION OF THE SUBJECT
Basic concepts of Organic Chemistry, such as molecular structure and reactivity of the principal functional groups will be presented. This knowledge will be applied to the synthesis of structurally simple molecules.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT
Basic structural features, and chemical and physical properties, of hydrocarbons and other families of organic compounds are covered along with an introduction to organic reactions mechanisms.

The aim is that students develop basic competences as specified in RD 1393/2007 that correspond to the sophomore level. Also, the following transversal competences (Fundamental Module M02) will be acquired:
- M02CM08: the ability to discern the appropriate instrumental technique, individual or combined, for the characterization of chemical substances.
- M02CM09: the ability to present, orally and on written, chemical processes and phenomena in a clear and understandable manner.

Likewise, taking this subject should allow students to acquire the following competences specific to Organic Chemistry:
- M02CM02: to know the structure, properties, preparation methods and main reactivity patterns of chemical elements and compounds derived thereof, either organic or inorganic.
- M02CM03: the ability to plan and carry out simple processes of synthesis and characterization of compounds. To carry out chemical experiments in a reliable manner, using appropriate techniques, and monitoring the relevant observations and their correct interpretation.
- M02CM05: To understand the relationships between chemical structure, properties and processing of the different types of materials and their aftermath classification according to the applications sought.

The coordination, both horizontal and vertical, of the subject within the Module and the Degree will be supervised by the Commission of Coordination of the Degree.

THEORETICAL/PRACTICAL CONTENT


The carbonyl group and derivatives. Aldehydes and ketones. Structure, obtaining and reactivity.


METHODS
All teaching resources regarding the subject will be available on the web of UPV/EHU at the outset of the fall. Lectures will be combined with as many as possible face-to-face sessions devoted to exercises. Additional exercises and problems will be also provided for personal training. Doubts and questions will be solved individually during tutorial hours. Efforts will be directed to get as much direct student-teacher interaction as possible.

TYPES OF TEACHING

<table>
<thead>
<tr>
<th>Type of teaching</th>
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Legend:
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ASSESSMENT SYSTEMS
- Continuous assessment system
- Final assessment system

TOOLS USED & GRADING PERCENTAGES

Plan Cycle
215 - Faculty of Chemistry Indiferente
GQUIMI20 - Bachelor's Degree in Chemistry
A) GENERAL RULE
General Regulations adopted by UPV/EHU (BOPV of March, 2017) concerning the assessment of students achievement in the Degrees given by UPV/EHU will be applicable. For more information, see section 2 of such Regulations, articles 8, 9 and 12.

B) CONTINUOUS ASSESSMENT
Continuous assessment will be applied during the ordinary call only, with the following parts and percentages:
- 20% Two written exams covering parts of the subjects in progress.
- 80% Final written exam fully covering the subjects.

If someone does not make the exam, he or she will be rated cero. In case it is the Final exam, the ordinary call would get extinct.
To be eligible for averaging, a mark of 4.0 or higher must be obtained in the Final exam.
Students have the option to renounce a call by informing in writing the professor in charge of the subject. Requests need to be submitted before the fixed deadline, which will be not before one month in advance to the end of the lecturing period. Should this action be taken the subject will be rated as NOT PRESENTED (thee call will not get extinct).

C) ASSESSMENT BY SINGLE FINAL EXAMINATION
Assessment by a single examination is feasible only if a renounce to the continuous assessment has been submitted by the student on time. Requests need to be submitted in writing to the professor in charge of the subject during the first 18 weeks of regular lecturing period.
The single Final examination will account for 100% of the grading.
If someone does not make the Final Exam, the grading will be NOT PRESENTED and the call will not get extinct.

ORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT
- Extended written exam  80%
- Practical work (exercises, case studies & problems set)  20%

EXTRAORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT
Special call will consist of a single Final Examination which will account for 100% of the grading.
If someone does not make such a Final Exam, the grading will be NOT PRESENTED and the call will not get extinct.

COMPULSORY MATERIALS
At least one book among the basic titles listed below is highly recommended. The professor in charge of the subject will give additional directions.

BIBLIOGRAPHY

Basic bibliography

In-depth bibliography

Journals
Organic Letters: http://pubs.acs.org/journal/orlef7
Useful websites

Organic Resources Worldwide: http://www.organicworldwide.net/
Grupo especializado de química orgánica de la RSEQ: http://www.ucm.es/info/rsequim/geqo/
Chemical and Engineering News: http://www.ucm.es/info/rsequim/geqo/
Blog de Química: http://elblogdeuhogris.blogspot.com/

| REMARKS |
This subject deals with instrumental analysis concepts and contents, the basis of the instruments functioning and instrumental techniques classification. Students are trained in methods of standardization and univariate calibration. Finally, and more in detail, the following instrumental techniques are described: spectroscopic, chromatographic and electroanalytic techniques.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

The specific M02CM04 skill and cross-skills M02CM08, M02CM09 and M02CM10 are developing.

M02CM04 - Possess knowledge of the analytical process and the various stages involved and be able to plan, apply and process the most appropriate analytical methods in each specific case.
M02CM08 - Be able to select different simple or combined instrumental techniques for the characterisation of chemical substances.
M02CM09 - Be able to make verbal and written presentations of phenomena and processes related to chemistry and similar subjects in a comprehensible way.
M02CM10 - Be able to search for and select information in the field of chemistry and other sciences through the use of the literature and information technologies.

Vertical and horizontal coordination of the subject in the module and the Bachelor's Degree corresponds to the Bachelor's Degree coordination commission.

TYPICAL CONTENT

1. Instrumental data treatment
OPTICAL METHODS
2. Fundamentals of optical methods
3. Spectrophotometry
4. Spectrofluorimetry
5. Turbidimetry and nephelometry
6. Atomic spectroscopy
CHROMATOGRAPHIC AND ELECTROPHORETIC METHODS
7. Fundamentals of chromatography
8. Gas chromatography (GC).
9. Liquid chromatography (HPLC).
10. Capillary electrophoresis
ELECTROCHEMICAL METHODS
11. Potentiometry
12. Methods based on electrochemistry

METHODS

Lessons consist of:

a. Explanation of theory and exercises. In some cases, a computer is used.
b. Realization of exercises and works by students, in groups or individually. In some cases, a computer is used.
c. Oral presentation of a work.

TYPES OF TEACHING

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<thead>
<tr>
<th>Type of teaching</th>
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Legend:

ASSESSMENT SYSTEMS

- Final assessment system
TOOLS USED & GRADING PERCENTAGES
- Extended written exam 70%
- Practical work (exercises, case studies & problems set) 5%
- Team work (problem solving, project design) 15%
- Exposition of work, readings, etc. 10%

ORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT

CONTINUOUS EVALUATION:
It is necessary to participate in all parts in which the subject is divided.
It is mandatory to attend all the classes in the computers room.
Marks below 5.0 out of 10.0 can not be compensated.
It is necessary that the mark is compensated among the questions in theory and problems in order to pass the exam. A cut-off mark of 3.0 is applied.
Marks among first and second mid-term have to be compensated in order to pass the exam. A minimum mark of 5.0 is necessary in each part.
Students under continuous evaluation can refuse exam call at any time until a month before the ending of the classes by a writing addressed to the teacher. Otherwise, students are having a failing grade in the subject even though they are not attending the exam. These criteria are specified in chapter 2, article 12 of the EHU Bachelor’s Degree students evaluation regulation.

FINAL EVALUATION:
A final proof able to evaluate of the skills to be acquired in the subject is given. All the individual parts of the proof should be passed.
To be evaluated by an unique final proof, students have a period of 18 weeks from the beginning of the course to ask for this option. Criteria to refuse to the continuous evaluation are stablished in chapter 2, article 12 of the EHU Bachelor’s Degree students evaluation regulation.

EXTRAORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT

The extraordinary call consists of a final proof. Anyway, positive partial results obtained in the ordinary call can be saved.

COMPULSORY MATERIALS
Consult the student guide.

BIBLIOGRAPHY

Basic bibliography

In-depth bibliography

Journals
Useful websites
http://www.asdlb.org
http://www.chromacademy.com/
SUBJECT
26127 - Analytical Chemistry I

DESCRIPTION & CONTEXTUALISATION OF THE SUBJECT
As it is the first subject of the Analytical Chemistry area that the student will follow, its main goal is to introduce the analytical process from a global point of view, starting from the sampling design, following with the real sampling and the analysis and ending with the evaluation of the results. A special importance will be given to the sampling and sample treatment, separation methods (non chromatographic ones), and to the application of chemical analytic methods (volumetry and gravimetry). In addition, some lab practices have been included to help understanding the basic operations of this topic.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT
M02CM04 - Possess knowledge of the analytical process and the various stages involved and be able to plan, apply and process the most appropriate analytical methods in each specific case.
M02CM08 - Be able to select different simple or combined instrumental techniques for the characterisation of chemical substances.
M02CM09 - Be able to make verbal and written presentations of phenomena and processes related to chemistry and similar subjects in a comprehensible way.
M02CM10 - Be able to search for and select information in the field of chemistry and other sciences through the use of the literature and information technologies.

THEORETICAL/PRACTICAL CONTENT


Liquid-liquid extraction. Organic solvents. Equilibrium distribution and efficacy. Metallic chelants extraction.


METHODS
The cronogram of the unit will be explained at the beginning of the course. The lectures hours and the data of the practical laboratory are available at the Faculty website.

TYPES OF TEACHING

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ASSESSMENT SYSTEMS
- Continuous assessment system
- Final assessment system

TOOLS USED & GRADING PERCENTAGES
- Extended written exam  60%
- Practical work (exercises, case studies & problems set)   20%
- Exposition of work, readings, etc.   10%
- Computer based practices and problems solving   10%

ORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT

The ordinary evaluation will be divided in the terms presented in the table above.

EXTRAORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT

Same criteria as in the ordinary evaluation.

COMPULSORY MATERIALS


BIBLIOGRAPHY

Basic bibliography


In-depth bibliography


Journals

Useful websites
http://www.asdlib.org

REMARKS
Final evaluation system can be used by the students that cannot make the continuous modality. It will consist in the three tests that have been presented before, and they will produce 100% of the mark.
SUBJECT
26140 - Analytical Problem Solving in Biosciences
ECTS Credits: 6

DESCRIPTION & CONTEXTUALISATION OF THE SUBJECT
This is an applied subject and its main goal is to develop the student's ability to investigate in literature on a specific analytical problem and to identify, evaluate and propose analytical solutions to the problem.
During the first part of the course, the student will receive a global vision on the applications of analytical chemistry in Biosciences regarding needs of society, ways of approaching the sample, most common instrumental techniques and future challenges.
The students will dedicate the second part of the course to solving a specific analytical problem through a bibliographic search. This searching process will be discussed and evaluated along the academic year in different seminars.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT
M03CM06 - Be able to understand the nature of an analytical problem, investigate it in the literature and identify, assess and present analytical solutions.
M03CM11 - Be able to design, programme and carry out experimental processes and use adequate instrumental techniques for different types of chemical problems.
M03CM12 - Possess knowledge of the network tools and services that enable searches for information in the field of chemistry and similar fields.
M03CM14 - Be able to use the information and knowledge gained from the module for training in existing or emerging fields related to chemistry.
M03CM16 - Employ advanced mathematical techniques to consider and resolve matters related to chemistry (data-processing, modelling, etc.).
M03CM17 - Demonstrate observation, analysis and synthesis skills with a capacity for criticism and self-criticism.
M03CM18 - Demonstrate a capacity for learning and for autonomous work for professional development.
M03CM19 - Be able to manage, organise and plan chemical processes, applying criteria of quality and environmental conservation.
M03CM20 - Relate chemistry with other disciplines and understand its impact on the industrial and technological society and the importance of the industrial chemical sector.

THEORETICAL/PRACTICAL CONTENT
1. Introduction. The analytical process
2. Application fields of analytical chemistry
3. Food analysis
4. Pharmaceutical analysis
5. Clinical analysis
6. Forensic analysis
7. Environmental analysis
8. Applied chemometrics

METHODS
Classroom time will be divided in:
> Master classes: lectures on advanced analytical techniques not explained in previous analytical chemistry courses like immunoassays, biosensors, LC-MS or Raman Spectroscopy.
> Computer classes: introduction to chemometrics. Hands on learning using the The Unscrambler (Camo) software for multivariate data analysis.
> Seminars: introduction will be given to general aspects of applied analysis in Biosciences fields like food analysis, forensic analysis or pharmaceutical analysis. Next, the teacher will propose specific analytical problems that students will solve in groups using scientific literature. Finally, a written report will be written and an oral presentation will be given in final seminar. The data for this final presentation will be decided depending on the number of students and groups.

TYPES OF TEACHING

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TA: Workshop  
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GCA: Field workshop
Assessment Systems

- Continuous assessment system
- Final assessment system

Tools Used & Grading Percentages

- Extended written exam 70%
- Practical work (exercises, case studies & problems set) 15%
- Team work (problem solving, project design) 10%
- Exposition of work, readings, etc. 5%

Ordinary Exam Call: Guidelines & Declining to Sit

1) To pass the course, a minimum grade of four will be required in the written exam.

2) Failure to make the report of the research work and/or the oral presentation (or to do it after the deadline) will suppose a zero in the corresponding sections.

3) In accordance with the regulations for the evaluation of undergraduate students of the UPV/EHU, students are entitled to be evaluated through the final evaluation system, regardless of whether or not they have participated in the continuous assessment system. To do this, students must send in writing to the teacher responsible for the subject, the waiver of continuous assessment before 18th week of the academic year, in accordance with the academic calendar of the center.

4) The resignation to the call will mean the qualification of "not presented". In the case of continuous evaluation, students can waive the call in a period that, at least, will be up to one month before the end date of the teaching period of the corresponding subject (week 26 in the teaching calendar). This waiver must be submitted in writing to the teacher responsible for the subject.

Extraordinary Exam Call: Guidelines & Declining to Sit

1) Students who do not pass the subject in the ordinary call, regardless of the evaluation system taken, will have the right to present themselves to the exams and evaluation activities that make up the final evaluation test of the extraordinary call.

2) The evaluation in the extraordinary call will be done exclusively through the final evaluation system. The final evaluation test of the extraordinary call will consist on as many exams and evaluation activities necessary to evaluate and measure the defined learning results, in a way comparable to how they were evaluated in the ordinary call. However, the positive marks obtained by students during continuous evaluation will be kept for the extraordinary call.

3) In the case of having obtained negative results in the continuous assessment carried out during the course, these results cannot be maintained for the extraordinary call. In these cases, the students will be able to obtain 100% of the grade through the final evaluation.

Compulsory Materials

Se indicará cada curso en la Guía Docente.

Bibliography

Basic bibliography


S. Bell, Forensic Chemistry. Pearson (New Jersey, 2006).


In-depth bibliography


R.A. Meyers (Editor), Encyclopedia of Analytical Chemistry. Wiley & Sons (Chichester, UK, 2000).

**Journals**


**Useful websites**
SUBJECT

26114 - Organic Chemistry II

DESCRIPTION & CONTEXTUALISATION OF THE SUBJECT

Organic Chemistry II
Type: Compulsory.
Titulación: Degree in Chemical Sciences.
Degree: Second Cycle
Departamento: Organic Chemistry I.
Credits: 6.5.

Lecturer:
Dr. Aitor Landa Álvarez Credits: 3.25
Dra. Rosa López Álvarez Credits: 3.25

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

- Introduction to the course:

  In the first cycle of the Degree, students complete the basic course Organic Chemistry I, which is focused on the study of
  the basic characteristics and reactivity of the most frequent functional groups in organic compounds. In addition, the basic
  training is completed with the study of conjugated and aromatic systems along with the most important heterocycles.
  The course Organic Chemistry II is designed to delve into two main areas: stereochemistry and organic synthesis for
  which the students already know the fundamental principles.
  Most part of the first semester is focused on knowing in detail the structure, symmetry and stereochemistry of organic
  compounds. The reminder of the first and the second semester deals with modern methods in organic synthesis, through
  general reactions and their specific versions, and the knowledge of fundamental reaction mechanisms considering
  chemo- and stereoselectivity aspects. The final objective of this course is to acquire enough skills to become capable of
  proposing short syntheses of simple molecules.

- Previous knowledge and recommendations:

  It is recommended, although not a prerequisite, to have passed the course Organic Chemistry I.

THEORETICAL/PRACTICAL CONTENT

Objectives of the course:

1. Structure, symmetry and stereochemistry.
   - To provide an introduction to the shape of organic molecules and the basic principles and nomenclature of stereogenic
     elements in organic molecules.
   - Diastereoselectivity.
   - Stereoselective reactions.
   - Enantiomers and chirality.
   - Stereoisomers and constitutional isomers.
   - Absolute and relative stereochemistry.
   - Determination of stereochemistry by spectroscopic methods.

   - Acidity, basicity, and pKa.
   - C-C bond formation. Formation and reactions of enols and enolates. Alkylation of enolates and enamines. Conjugated
     additions of enolates and enamines (Michael reaction). Aldol reaction and its variants. Asymmetric methodology with
     enolates and enamines.

3. C=C bond formation:
   - $\beta$-elimination reactions (E1, E2 and E1cB).
   - Pyrolytic syn elimination.
   - Fragmentation reactions.
   - Alkenes from hydrazones, 1,2-diols or alquines.
   - Controlling the geometry of double bonds (Wittig reaction and its variants, Julia and Peterson olefinations).
   - Olefin Metathesis.
4. Functionalization of alkenes:
   - Electrophilic addition to alkenes.
   - Electrophilic alkenes.
   - Nucleophilic conjugate addition to alkenes

5. Oxidations:
   - Oxidizing agents.
   - Catalytic hydrogenation.

6. Reductions:
   - Reduction of carbonyl groups (Hydride additions).
   - Catalytic hydrogenation.

### METHODS

**Teaching methods:**

In the development of the subject, a mixed methodology based on cooperative learning and self-learning will be followed. The face-to-face activities of the subject are structured mainly on master classes with great content in theoretical aspects and the individual resolution of specific problems.

**Classroom activities:**

1. **Theoretical classes: Approximately 45 hours.**
   The main concepts and theoretical contents of the subject will be introduced in the theoretical classes. With the support of the blackboard and the Power-Point presentations, the teacher will present the objectives and contents of each topic and explain the basic and fundamental aspects of the subject. The student will have, in the days prior to its start, all the material presented necessary to monitor the classes in the Virtual Campus of the UPV / UHU.

2. **Practical classes: Approximately 20 hours.**
   Preferably, problems proposed by the teacher will be solved that will contribute in a decisive way to apply the knowledge acquired in the theoretical classes. Students must have previously worked on the problems that will be solved. For which, the proposed exercises and any other necessary material will be delivered well in advance of the seminar class.

### TYPES OF TEACHING

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<td>Classroom hours</td>
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</table>

**Legend:**

- M: Lecture
- S: Seminario
- GA: Pract.Class.Work
- GL: Pract.Lab work
- GO: Pract.computer wo
- GCL: Clinical Practice
- TA: Workshop
- TI: Ind. workshop
- GCA: Field workshop

### ASSESSMENT SYSTEMS

- Final assessment system

### TOOLS USED & GRADING PERCENTAGES

- Extended written exam  80%
- Practical work (exercises, case studies & problems set)  20%

### ORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT

Evaluation methods and percentage in the final mark:

**Mixed evaluation:**

20% Partial written exam (does not eliminate subject).
50% Final written exam.
10% Seminars.
20% Laboratory practices.

1. To pass the course it is necessary to obtain a minimum mark of 4.0 in the final exam and to pass the laboratory practices.
2. The non-completion of the partial/final exam and seminars (or their presentation after the deadline) will imply a zero for said test.

3. The mark obtained in the partial exam and the seminars is only valid for the first call. In case of failing the first call, the second call will only be evaluated as a single exam with 80% of the grade.

### EXTRAORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT

<table>
<thead>
<tr>
<th>80% Final written exam.</th>
</tr>
</thead>
<tbody>
<tr>
<td>20% Laboratory practices.</td>
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</tbody>
</table>

1. To pass the subject it is necessary to obtain a minimum grade of 5.0 in the final exam and to pass the laboratory practices.
2. Failure to submit to the final written exam will suffice to be qualified NOT PRESENTED (no call is required).

### COMPULSORY MATERIALS

### BIBLIOGRAPHY

#### Basic bibliography

Structure, symmetry and stereochemistry:


Organic reactions. Reactivity and mechanisms:

7. D. Klein, Química Orgánica, Ed. Panamericana, 2014

#### In-depth bibliography

##### Journals

- Organic Syntheses: http://www.orgsyn.org/
- Organic Letters: http://pubs.acs.org/journal/orlef7
- Organic and Biomolecular Chemistry: http://www.rsc.org/Publishing/Journals/Ob/Index.asp
- The Journal of Chemical Education: http://jchemed.chem.wisc.edu/

##### Useful websites

- Organic Resources Worldwide: http://www.organicworldwide.net/

### REMARKS
DESCRIPTION & CONTEXTUALISATION OF THE SUBJECT

In this subject the knowledge in the area of Inorganic Chemistry is deepened through the Coordination Chemistry and the Organometallic Chemistry. Furthermore the basics of Inorganic Solids Chemistry are introduced.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Students will acquire the basic skills defined in RD 1393/2007 for Chemistry, and the general skills for the Fundamental Unit. Furthermore, the more specific skills related to Inorganic Chemistry such as the bonding in coordination and organometallics, structure and most important reactions, thermodynamic, kinetic and application aspects will be developed. The student will also be able to understand the structure, reactivity and properties of inorganic solids and to determine them by the use of instrumental characterization.

M02CM02 - Possess knowledge of the structure, properties, preparation methods and the most important chemical reactions of the chemical elements and their organic and inorganic compounds.
M02CM03 - Possess the capacity to plan and perform simple laboratory processes for the synthesis and characterisation of chemical compounds safely and using appropriate techniques, as well as to evaluate and interpret the data returned from experimental observations in the various fields of chemistry.
M02CM04 - Possess knowledge of the analytical process and the various stages involved and be able to plan, apply and process the most appropriate analytical methods in each specific case.
M02CM05 - Understand the relationships between the structure, properties and processing of the various types of materials and their selection according to each application.

The Degree Coordination Committee will guarantee horizontal and vertical coordination of the course both in the Unit and in the Degree.

THEORETICAL/PRACTICAL CONTENT

Coordination compounds. Structure and bonding.

METHODS

The evaluation will be done as follows:
- Written exam corresponding to the theoretical part (it can be divided in several parts): 70% of the final mark.
- Continuous evaluation of the laboratory work (notebook, reports, work, results, test type exam): 20% of the final mark.
- Directed academic activities (solving of questions, preparation of reports, dissertations): 10% of the final mark.
Remarks:
The minimum mark required in the exams is 4.0 (over 10)
The assistance to the laboratory is compulsory.

TYPES OF TEACHING

<table>
<thead>
<tr>
<th>Type of teaching</th>
<th>M</th>
<th>S</th>
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**TOOLS USED & GRADING PERCENTAGES**

- Extended written exam 70%
- Practical work (exercises, case studies & problems set) 10%
- Prácticas de laboratorio 20%

**ORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT**

The evaluation will be done as follows:
- Written exam corresponding to the theoretical part (it can be divided in several parts): 70% of the final mark.
- Continuous evaluation of the laboratory work (notebook, reports, work, results, test type exam): 20% of the final mark.
- Directed academic activities (solving of questions, preparation of reports, dissertations): 10% of the final mark.

Remarks:
The minimum mark required in the exams is 4.0 (over 10)
The assistance to the laboratory is compulsory.

**EXTRAORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT**

The evaluation will be done as follows:
- Written exam corresponding to the theoretical part: 80% of the final mark. (A minimum of 4.0 is required in this field)
- Evaluation of the laboratory work (notebook, reports, work, results, test type exam): 20% of the final mark. (A minimum of 4.0 is required in this field)

Remarks:
The assistance to the laboratory is compulsory.
The mark &8220;non presented&8221; will be given to those students non taking the final exam.

**BIBLIOGRAPHY**

**Basic bibliography**

**In-depth bibliography**

**Journals**
- Inorganic Chemistry, ACS Publications
- Dalton Transactions, The Royal Society of Chemistry
- European Journal of Inorganic Chemistry, Wiley
- Inorganica Chimica Acta, Elsevier
- Polyhedron, Elsevier
- Inorganic Syntheses, Wiley
- The Journal of Chemical Education, ACS Publications
Useful websites

It will be indicated each year.
SUBJECT
25115 - Chemical Engineering

ECTS Credits: 6

DESCRIPTION & CONTEXTUALISATION OF THE SUBJECT
This subject introduces the students to the industrial aspects of Chemistry and it gives them the basic knowledge and skills to analyze, design and operate basic equipment in the chemical industry. Contents include concepts such as basic operation, property balances and the mathematical modeling of chemical reactors.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT
The competences the student must acquire are:
- Capacity to apply the basic principles of Chemistry in the study of industrial chemical processes.
- Ability to present subjects in the chemical engineering area, in a comprehensible way.
- Capacity to search and select relevant information in the chemical and scientific fields, employing paper and electronic bibliography.
- Ability to relate the chemistry knowledge with other scientific fields and evaluate the impact of chemistry and the chemical industry in the modern world.

The Grade Coordination Commission will guarantee the coordination of this subject with the other ones within the Grade in Chemistry.

THEORETICAL/PRACTICAL CONTENT
1.- Introduction: Chemical engineering. Processes and operations in the chemical industry.

METHODS
The subject includes on-site classes with the teacher and seminars where the student must solve and discuss problems on chemical engineering. In the first semester, Problem Based Learning will be implemented.

TYPES OF TEACHING

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<tr>
<th>Type of teaching</th>
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ASSESSMENT SYSTEMS
- Continuous assessment system
- Final assessment system

TOOLS USED & GRADING PERCENTAGES
- Extended written exam 70%
- Practical work (exercises, case studies & problems set) 25%
- Team work (problem solving, project design) 5%

ORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT
The evaluation of the subject will be done by written exams (70%) and by resolution of exercises carried out in groups (30%).
At the end of the first semester, a partial exam can be written. This exam will have a theoretical (50%) and a practical (50%) part. In order to make the average, a minimum mark of 3 should be obtained in each part. If this partial exam is passed, the subjects corresponding to this part will no be evaluated again in the final exam.
The final mark will be the average of the marks obtained in each semester, if a minimum of 4 has been obtained in the exam of each of them.
In order to obtain a "non-presented" mark, the student should ask for it at least 1 month before the final exam. If the student wants to write a final exam with a value of 100% of the mark, it will have to be asked to the teacher before the 18th week of the course.

EXTRAORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT

Written exam with a value of 100%. This exam will have a theoretical (50%) and a practical (50%) part. In order to make the average, a minimum mark of 3 should be obtained in each part. If a student does not appear to this exam, a "non-presented" mark will be given.

COMPULSORY MATERIALS

It will be said at the beginning of the course.

BIBLIOGRAPHY

Basic bibliography
G. Calleja (Ed.): "Nueva introducción a la Ingeniería Química" (2 vol.). Ed. Síntesis (Madrid, 2016).

In-depth bibliography
J.M. Coulson y J.F. Richardson: "Ingeniería Química (varios volúmenes)". Ed. Reverté.

Journals
Chemical Engineering Journal: https://www.journals.elsevier.com/chemical-engineering-journal
Education for Chemical Engineers: https://www.journals.elsevier.com/education-for-chemical-engineers
Chemical Engineering Educators: http://journals.fcla.edu/cee

Useful websites
https://www.industriaquimica.es/
http://www.chemenonline.com/

REMARKS
**TEACHING GUIDE 2018/19**

<table>
<thead>
<tr>
<th>Centre</th>
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<tr>
<td>GQUIMI20 - Bachelor's Degree in Chemistry</td>
<td>Fourth year</td>
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</table>

**SUBJECT**

| 26131 - Projects in Industrial Chemistry | ECTS Credits: | 6 |

**DESCRIPTION & CONTEXTUALISATION OF THE SUBJECT**

This subject in an introduction to the Chemical Industry and presents the concepts and tools employed in this sector to the student. The content includes a description of the steps for the design, management and development of chemical engineering industrial projects and a survey of the chemical industry. Finally, an introduction to the principles of chemical process safety is given.

**COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT**

The competences the student must acquire are:

- **M02CM07**: Possess the ability to apply the basic principles of chemistry to industrial chemical operations and carry out chemical installation projects.
- **M02CM09**: Be able to make verbal and written presentations of phenomena and processes related to chemistry and similar subjects in a comprehensible way.
- **M02CM10**: Be able to search for and select information in the field of chemistry and other sciences through the use of the literature and information technologies.
- **M02CM11**: Be able to relate chemistry with other disciplines and understand its impact on today's society and the importance of the industrial chemical sector.

The Grade Coordination Commission will guarantee the coordination of this and other subjects within the Grade in Chemistry.

**THEORETICAL/PRACTICAL CONTENT**


- **Chemical Process Safety**: Accidents, Toxicology, Fire and Explosions.

**METHODS**

The subject combines on-site classes with seminars where the student must solve and discuss problems and perform the several tasks proposed during the course.

**TYPES OF TEACHING**

<table>
<thead>
<tr>
<th>Type of teaching</th>
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- **GCA**: Field workshop

**ASSESSMENT SYSTEMS**

- Continuous assessment system
- Final assessment system

**TOOLS USED & GRADING PERCENTAGES**

- Extended written exam 85%
- Practical work (exercises, case studies & problems set) 15%

**ORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT**

- Continuous evaluation system (Practical activities plus written test)

Evaluation guidelines:

- Written test: 85%
- Other activities: 15%

There will be a mid-term exam that allows the student to pass this part of the subject.
Students have the right to be evaluated through the final evaluation system (single test), regardless of whether or not they have participated in the continuous assessment system. To do this, students must submit, within a period of 9 weeks from the beginning of the course, a letter to the teacher responsible for the subject, declining the continuous assessment.

It will be enough for the student not to take the exam to be evaluated as "not presented".

**EXTRAORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT**

Written exam: 100%
It will be enough for the student not to take the exam to be evaluated as "not presented".

**COMPULSORY MATERIALS**

Se indicará cada curso en la Guía Docente.

**BIBLIOGRAPHY**

**Basic bibliography**

- Diseño en Ingeniería Química, Ray Sinnott, Gavin Towler, Ed. Reverté, Barcelona (2012)
- El pronóstico económico en Química Industrial, A. Vian, Alhambra, Madrid (1990)

**In-depth bibliography**


**Journals**

A list will be distributed every course.

**Useful websites**

http://www.essentialchemicalindustry.org/chemicals.html

**REMARKS**
### SUBJECT

26142 - Catalysis and Bioorganometallics

### ECTS Credits:

6

### DESCRIPTION & CONTEXTUALISATION OF THE SUBJECT

In this course studies on catalytic reactions useful for the transformation of organic compounds under homogeneous reaction conditions will be developed. Organometallic complexes will be used as catalysts and examples of asymmetric catalytic reactions of interest in the preparation of medicals will be included. The student will acquire knowledge on the importance of organometallic complexes on biological systems and on medical treatments.

### COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

In this course studies on catalytic reactions useful for the transformation of organic compounds under homogeneous reaction conditions will be developed. Organometallic complexes will be used as catalysts and examples of asymmetric catalytic reactions of interest in the preparation of medicals will be included. The student will acquire knowledge on the importance of organometallic complexes on biological systems and on medical treatments.

Students will acquire cross-skills corresponding to the Advanced Unit: Demonstrate observation, analysis and synthesis skills with a capacity for criticism and self-criticism; demonstrate a capacity for learning and for autonomous work for professional development; be able to manage, organise and plan chemical processes, applying criteria of quality and environmental conservation; relate chemistry with other disciplines and understand its impact on the industrial and technological society and the importance of the industrial chemical sector ([M03.CM17] to [M03.CM20]). Students will also reach more specific skills related to the knowledge of the main reactions that organometallic complexes may undergo, in special those involved in catalytic processes. Special interest will be devoted to industrial applications related to health, both from theoretical and experimental points of view. [M03.CM07], [M03.CM12] to [M03.CM14] (Understand the functioning and importance of homogeneous catalytic processes and their role in obtaining drugs and the biomedical applications of organometallic compounds. Possess knowledge of the network tools and services that enable searches for information in the field of chemistry and similar fields. Transmit phenomena and processes related to chemistry and similar fields in verbal presentations and/or written reports and in a comprehensible way in either of the two official languages of the Autonomous Community of the Basque Country or in English. Be able to use the information and knowledge gained from the module for training in existing or emerging fields related to chemistry)

The Degree Coordination Committee will guarantee horizontal and vertical coordination of the course both in the Unit and in the Degree.

### THEORETICAL/PRACTICAL CONTENT


### METHODS

The methodology includes conferences, seminars and laboratory work. Personalized tutorials will also be available.

### TYPES OF TEACHING

<table>
<thead>
<tr>
<th>Type of teaching</th>
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### ASSESSMENT SYSTEMS

- Final assessment system

### TOOLS USED & GRADING PERCENTAGES

- Extended written exam  75%
- Laboratory work  25%

**ORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT**

Theory 75 %. Minimum required 40 %.
Laboratory 25 %. Minimum required 40 %

**EXTRAORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT**

Theory 75 %. Minimum required 40 %.
Laboratory 25 %. Minimum required 40 %

**COMPULSORY MATERIALS**

**BIBLIOGRAPHY**

**Basic bibliography**


**In-depth bibliography**


**Journals**

- Applied Organometallic Chemistry, Wiley
- Journal of Molecular Catalysis A: Chemical, Elsevier
- Journal of Molecular Catalysis B: Enzymatic, Elsevier
- Journal of Organometallic Chemistry, Elsevier
- Organometallics, ACS Publications

**Useful websites**

**REMARKS**
### SUBJECT
26117 - Physical Chemistry I  
ECTS Credits: 9

### DESCRIPTION & CONTEXTUALISATION OF THE SUBJECT
Physical Chemistry I provides the students the necessary knowledge to analyze the macroscopic behaviour of matter in terms of Thermochemistry, Kinetics or Electrochemistry. Furthermore, it will allow them to understand the fundamentals and applications of transport and surface phenomena, and complex systems as macromolecules and colloids. Overall, the contents of the subject will reveal the importance of physical chemistry in all the different areas of Chemistry, as well as its impact in the industry and technology-based society we live in.

The course is part of the Fundamental Module of the Chemistry Degree, and it is very closely related to the experimental course Experimental Physical Chemistry. The coordination of this course within the Physical Chemistry Module corresponds to the Chemistry Degree Coordination Comission, designated by the Faculty Council.

### COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT
Physical Chemistry I, as part of the Fundamental Module, shares the cross skills [M02CM09], [M02CM10] and [M02CM011] with the other courses of the same module. Besides, this course will also develop the specific skill [M02CM01].

- **M02CM01** - Understand and know how to apply the principles of physical chemistry and how they affect chemical processes.
- **M02CM09** - Be able to make verbal and written presentations of phenomena and processes related to chemistry and similar subjects in a comprehensible way.
- **M02CM10** - Be able to search for and select information in the field of chemistry and other sciences through the use of the literature and information technologies.
- **M02CM11** - Be able to relate chemistry with other disciplines and understand its impact on today's society and the importance of the industrial chemical sector.

### THEORETICAL/PRACTICAL CONTENT
- **Chemical equilibria.** Progress of a reaction, free energy and chemical equilibrium in real gas reactions. Equilibrium constants. Heterogeneous equilibria. Equilibria in non-ionic solutions.

### METHODS
The content has been classified in four different modules, which will be evaluated in separate written tests.

1. Chemical thermodynamics.
2. Solutions, phase equilibria and chemical equilibria.
3. Electrochemical equilibria, surface phenomena, transport phenomena, macromolecules and colloids.

Lectures will typically consist of an explanation about the theoretical contents by the professor. Practical classes, will
generally be employed for the students to analyse and solve practical problems presented by the profesor. Finally, in the seminar activities, the students will have a leading role and will present a subject related to the contents of the course and previously agreed with the professor.

### TYPES OF TEACHING

<table>
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<th>Type of teaching</th>
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### ASSESSMENT SYSTEMS

- Continuous assessment system
- Final assessment system

### TOOLS USED & GRADING PERCENTAGES

- Extended written exam 70%
- Practical work (exercises, case studies & problems set) 15%
- Exposition of work, readings, etc. 15%

### ORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT

The student will have to participate in all the following activities in order to pass the course, with the continuous assessment system: 4 written tests, seminars, practical class work.

The first three written tests will be carried out approximately in October, January and March. The student who passes a written examen will not have to take it again. Those who do not pass the first written test, will have another opportunity in January. The fourth written test, together with the 2nd and 3rd (for those who have to repeat any of them), will take place at the ordinary call in June. This test will evaluate the specific skill [M02CM01].

The 30 % of the final mark will be the average of the results obtained in the following activities:
1. Seminars 15%
2. Practical class work 15%

The skills assessed will be: [M02CM01], [M02CM09], [M02CM10] and [M02CM011] in Seminars; [M02CM01], [M02CM09], [M02CM10] y [M02CM011] in practical classes. This is applicable to both the ordinary and extraordinary calls.

Given the continuous assessment system, the student who does not participate in the compulsory activities will fail the course. The evaluation of the ordinary call will be &amp;#8220;not presented&amp;#8221; only in these cases:

The student has carried out none of the compulsory activities.

The student has previously required the final assessment system and has not taken the exam. The final assessment system will have to be required one month before the last compulsory activity is carried out.

In the case of the extraordinary call, it will be enough for the student not to take the exam to be evaluated as &amp;#8220;not presented&amp;#8221;.

### EXTRAORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT

For those students who have chosen the final assessment system, the test will comprise the contents of the whole course (70%), a presentation of one of the exercises analyzed in practicas de aula, and of one of the subjects discussed in seminar classes (30%). The skills assessed will be [M02CM01], [M02CM09], [M02CM10] y [M02CM011].

### COMPULSORY MATERIALS

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Page : 2 / 3
BIBLIOGRAPHY

Basic bibliography

In-depth bibliography

Journals
- Journal of Physical Chemistry
- Journal of Chemical Physics
- Journal of Chemical Education

Useful websites
- http://riodb01.ibase.aist.go.jp/sdbs/cgi-bin/cre_index.cgi
- http://webbook.nist.gov/chemistry

REMARKS
SUBJECT
26121 - Materials Science

DESCRIPTION & CONTEXTUALISATION OF THE SUBJECT

The basic objective of the subject is to provide the students with the theoretical-practical knowledge that allows them to understand the relationship between the structure and the properties of the different materials, taking into account the influence of the processing. Specifically, it is about that the students know the different types of materials, understand their general behavior, their characteristic properties and their potentialities, and recognize the effects of the environment and the conditions of service on their behavior. This understanding is necessary to be able to select the ideal material to participate in the design of reliable and economical components, systems and processes that use the wide spectrum of materials currently available.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

The subject is framed within the Fundamental Complements of Chemistry, located in the Fundamental Module of the Degree and, as such, shares the competences assigned to that Module. Among them, the following specific competence will be treated and evaluated:
- [M02CM05]: "Understanding of the relationships between structure, properties and processing of the various types of materials and their selection according to the intended applications".
Likewise, the 4 transversal competences will be worked on, with a special emphasis on the last of them:
- [M02CM08]: "Ability to select different instrumental techniques, simple or combined, for the characterization of chemical substances".  - [M02CM09]: "To be able to present, orally and in writing, in a comprehensible manner, phenomena and processes related to Chemistry and related subjects".
- [M02CM10]: "Ability to search and select information in the field of Chemistry and other scientific fields making use of the bibliography and information and communication technologies".
- [M02CM011]: "Be able to relate Chemistry with other disciplines, as well as understand its impact on current society and the importance of the industrial chemical sector.”
The coordination of this subject with the rest of the Module corresponds to the Coordination Commission of the Degree.

THEORETICAL/PRACTICAL CONTENT

THEORETICAL CONTENTS

PART 1
1. - Introduction: (1 hour). Historical perspective. Classification of materials. Advanced materials. New material requirements
3. - Structures of metals and ceramics: (0.5 hours: Review of concepts).

PART 2

PART 3
14. - Electrical properties: (0.5 hours). Semiconductivity. Semiconductor devices. Electrical conduction in ionic ceramics
and in polymers. Dielectric behavior. Ferroelectricity and piezoelectricity.

PRACTICAL CONTENTS
1. Phase diagrams (computer practices).

EXPERIMENTAL CONTENTS
1. Scanning electron microscopy (laboratory practices).
2. Hardness (laboratory practices).
3. Stress-strain test (laboratory practices).

METHODS
In the case of the Theoretical Programme, the methodology will consist of the presentation of the subject through lectures in which computers will be used intensively for the projection of the content. In seminars, students (either individually or in groups) will make presentations on the proposed themes, and will be given sufficient notice to prepare them. Practical laboratory work will be carried out in 3-4-hour sessions in the afternoons, coinciding with the period of theoretical classes on the calendar. Practical work will be done in groups of 3-4. After an explanation of the activities to be carried out and of the handling of the equipment, the students will perform the experiments, compiling incidents and the experimental data obtained. Finally, an analysis and discussion of the results will be carried out. Each part of practical work will be reflected in a report, which must be drawn up and handed in by the group so that it can be marked. Practical work with computers will be done individually, with students working on an in-depth analysis of phase diagrams of different binary systems.

TYPES OF TEACHING

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Legend:
- M: Lecture
- S: Seminario
- GA: Pract.Class.Work
- GL: Pract.Lab work
- GO: Pract.computer wo
- GCL: Clinical Practice
- TA: Workshop
- TI: Ind. workshop
- GCA: Field workshop

ASSESSMENT SYSTEMS
- Final assessment system

TOOLS USED & GRADING PERCENTAGES
- Extended written exam 70%
- Individual work 5%
- Team work (problem solving, project design) 15%
- Exposition of work, readings, etc. 5%
- Computer practices 5%

ORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT
- Ordinary Evaluation: continuous evaluation of theoretical-practical (TP) and experimental (EX) activities. Final mark: average of TP (85%) and EX (15%) scores.

- Evaluation of the TP part: 3 partial exams on each of the three parts contained in the syllabus, plus a final exam on all the subjects. Partial exams will have a pass mark of 7. Each partial exam will represent 10% of the final mark, and the final exam 40%. Written tests will represent 70% of the final mark. Assessment of seminars and work proposed: each student will make an oral presentation on a theme proposed by the seminars. The oral presentation will represent 5% of the final mark. The backup documentation will represent another 5%. Evaluation of practical work with computers: done through the solving of a series of problems proposed: 5%; skills assessed: M02CM05, M02CM09, M02CM10 and M02CM011.

- Marking of the EX part: quality of the results obtained, reports presented, exercise book and group work (10% of the final grade). Final oral or written test to be performed on the last day of the practical work period, or on the day of the final exam: performance of practical work and/or answers to questions related to the practical work (5% of the final mark). Attendance at practical work is compulsory. Skills evaluated: M02CM08 and M02CM10.

- Marking of the EX part: quality of the results obtained, reports presented, exercise book and group work (10% of the final grade). Final oral or written test to be performed on the last day of the practical work period, or on the day of the final exam: performance of practical work and/or answers to questions related to the practical work (5% of the final mark). Attendance at practical work is compulsory. Skills evaluated: M02CM08 and M02CM10.

No-show: Only applicable to students who do not attend any continuous evaluation test (no exam, seminar or practical work session), or who OPT OUT in the set period.

Opt-out (waiver): a student who chooses continuous evaluation may opt out of the system within a minimum of 1 month before the end of the teaching period, in writing to the professor in question. Therefore, it will be understood that any student that does not do this will be considered as having failed, even though he/she does not present him/herself for the final exam, as established in chapter 2, article 12 of the Regulations governing student evaluation in undergraduate degrees of the UPV/EHU.

A request for evaluation, through a single test or a final evaluation, will be sent to the teaching staff within 9 weeks of the
start of the term or course, in accordance with the content of chapter 2, article 8 of the Regulations governing student evaluation in undergraduate degrees of the UPV/EHU. This will consist of an examination on all the theoretical-practical content of the subject and the performance of a practical laboratory exam.

**EXTRAORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT**

Extraordinary Evaluation: One exam (100% mark) on the failed parts (TP and/or EX).

**COMPULSORY MATERIALS**

The teacher will indicate the necessary material at the beginning of the course.

**BIBLIOGRAPHY**

**Basic bibliography**


**In-depth bibliography**


**Journals**

- Progress in Materials Science
- Materials Science and Engineering R-Reports
- Materials Chemistry and Physics
- Journal of Materials Research
- Journal of Materials Science
- Materials Letters
- Nature Materials
- Chemistry of Materials

**Useful websites**

- http://www.wiley.com/college/callister
- http://www.matter.org.uk/
- http://www.matweb.com/
- http://www.msm.cam.ac.uk/doitpoms/
- http://www.soton.ac.uk/~pasr1/
- http://www-g.eng.cam.ac.uk/mmg/teaching/phasediagrams/index4.html
- http://matse1.mse.uiuc.edu/~tw/

**REMARKS**
The subject macromolecular chemical and physical characterization belongs to the fourth year of the Chemistry degree and is included in the advanced modulus of this degree. The subject is part of the Macromolecular Materials Curricular line and is optative and presents theoretical/practical character. Both, the lectures and the laboratory practices are held in the first quarter.

The subject gives to the student the ability for macromolecular materials chemical (Infrared spectroscopy, Nuclear Magnetic Resonance) and physical (molecular weight and its distribution, thermal transitions and morphology) characterization.

To understand this subject it is very convenient to have passed in the third course the subject organic compounds espectrophotometrical identification and to be enrolled in the subject Materials science. This subject is complemented with the other subjects of the macromolecular materials curricular line, especially with the subjects Macromolecular chemistry and Macromolecular materials I.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

The subject is included in the Macromolecules line, and forms part of the advanced modulus and thus, it shares its cross-skills. Specifically the skills [M03CM03] [M03CM11] [M03CM12] [M03CM13] [M03CM17] and [M03CM18].

M03CM03: Possess the ability to understand and use the experimental methods of analysis and characterisation of the most representative properties of macromolecular substances and interpret the results returned in terms of the relationship between structure and properties.

M03CM11: Be able to design, programme and carry out experimental processes and use adequate instrumental techniques for different types of chemical problems.

M03CM12: Possess knowledge of the network tools and services that enable searches for information in the field of chemistry and similar fields.

M03CM13: Transmit phenomena and processes related to chemistry and similar fields in verbal presentations and/or written reports and in a comprehensible way in either of the two official languages of the Autonomous Community of the Basque Country or in English.

M03CM17: Demonstrate observation, analysis and synthesis skills with a capacity for criticism and self-criticism.

M03CM18: Demonstrate a capacity for learning and for autonomous work for professional development.

The coordination of this subject with the others of the line corresponds to the Chemistry Degree Commission that will be elected by the Faculty board.

THEORETICAL/PRACTICAL CONTENT

Theoretical part

Identification and analysis methods. General concepts for the macromolecular analysis.

Use of the spectroscopic techniques in the polymer analysis. Infrared spectroscopy (FTIR) and 1H and 13 C Nuclear Magnetic Resonance (NMR)

Molecular weight and dispersity. Macromolecules in solution. Experimental methods to determine the molecular weight.


Characterization of micro and nanostructures. Electron microscopy.

Practical part

Analysis of commercial samples by FTIR spectroscopy

Molecular weight calculation

Measurements of the thermal properties

METHODS

The course is constituted by the following activities

- Lectures, focus on providing basic knowledge of the subject.
- Practical Classroom Work hours, are directed to the application of the acquired theoretical knowledge to solve problems posed by the professor.
- Individual assignments will be part of the self-study hours of the students, and consist of the resolution of problem sets.
- Practical Lab Work is held in group. In the Lab, commercial polymeric samples will be analyzed applying the concepts obtained in the previous activities.

### TYPES OF TEACHING

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### ASSESSMENT SYSTEMS

- Continuous assessment system
- Final assessment system

### TOOLS USED & GRADING PERCENTAGES

- Extended written exam  55%
- Practical work (exercises, case studies & problems set)  25%
- Individual work  20%

### ORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT

The written exam will account for 55 % of the final mark, and will contain theoretical and practical questions. By means of this part skills M03CM03, M03CM11 and M03CM17 will be evaluated. A continuous evaluation based on the participation in the classroom activities and the resolution of the individual assignments will be used. This evaluation will account for 20% of the final mark. By means of this part skills M03CM03, M03CM12, M03CM13 and M03CM17 will be evaluated. Practical Lab Work is mandatory in the continuous evaluation and will be evaluated based on the progress of the student in the lab and the submitted final report. This evaluation will account for 25% of the final mark. By means of this part skills M03CM03, M03CM11, M03CM12, M03CM13, M03CM17 and M03CM18 will be evaluated. The student must obtain a minimum mark of 5.0 in each part (written exam, individual assignments, practical Lab Work).

Criteria for continuous assessment waiver are those established in Chapter 2, Articles 8 and 12 of the Student Assessment Regulation for Bachelors Degrees of the UPV/EHU.

Criteria for final evaluation request are those established in Chapter 2, Article 8 of the Student Assessment Regulation for Bachelors Degrees of the UPV/EHU. In that case, the final evaluation will contain theoretical and practical questions and a laboratory practice. By means of this exam skills M03CM03, M03CM11, M03CM12, M03CM13, M03CM17 and M03CM18 will be evaluated.

-No presentado- grade is given either if the student gets the continuous assessment waiver within the indicated deadline, or if the student has requested to hold final assessment system but does not take part in the final exam, as established in Chapter 2, Article 12 of the Student Assessment Regulation for Bachelor’s Degrees of the UPV/EHU.

### EXTRAORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT

In the 2nd convocation (July) the student will be evaluated exclusively by means of the mark obtained in a written exam.

### COMPULSORY MATERIALS

They will be described each year in the student's guide.

### BIBLIOGRAPHY

#### Basic bibliography

#### In-depth bibliography

Journals
- Macromolecules
- Polymer
- Polymer Degradation and Stabilization
- Vibrational Spectroscopy

Useful websites
- Macrogalleria: http://pslc.ws/spanish/index.htm
- http://macro.lsu.edu/corecourses/msweb4/VirtualBook/Ch7_Morphology/Ch7_MorphologyMicroscopyScattering_mm.ppt

**REMARKS**

The student must obtain a minimum mark of 5.0 in each part (written exam, individual assignments, practical Lab Work).
DESCRIPTION & CONTEXTUALISATION OF THE SUBJECT

This subject aims to introduce students to the main families of industrial polymers for general purpose, as well as those employed in adhesive and coating technologies. The main objective is to learn the main characteristics of each of them and especially to understand the relationship between its structure, its properties and its applications. The subject includes, in addition to a general description of the polymeric materials, the introduction to the main methods for characterization and testing of polymeric materials. Also, concepts about the effect that polymeric materials can have on the environment, will be studied.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

The subject is part of the specialty of Macromolecules; it is classified inside the Advanced Module, thus sharing the cross-competencies assigned to it. Among them, the following competencies will be treated and evaluated:

M03CM17: Demonstrate observation, analysis and synthesis skills with a capacity for criticism and self-criticism.

M03CM18: Demonstrate a capacity for learning and for autonomous work for professional development.

M03CM20: Relate chemistry with other disciplines and understand its impact on the industrial and technological society and the importance of the industrial chemical sector.

The specific competencies evaluated are:

M03CM03: Possess the ability to understand and use the experimental methods of analysis and characterisation of the most representative properties of macromolecular substances and interpret the results returned in terms of the relationship between structure and properties.

M03CM04: Possess adequate knowledge of the main families of industrial polymers, their production, properties and most typical applications.

M03CM11: Be able to design, programme and carry out experimental processes and use adequate instrumental techniques for different types of chemical problems.

THEORETICAL/PRACTICAL CONTENT

The subject is comprised by three different parts, of different extension:

- Description of polymeric materials (15 master hours)
  - Amorphous and crystalline polymers.
  - Elastomers
  - Thermosetting polymers
  - Adhesives
  - Coatings/Paints
  - Additives for polymers
  - Polymer blends and composites

- Properties of macromolecular materials (20 master hours)
  - Mechanical properties: tensile tests, impact test, other
  - Electrical properties
  - Thermal properties

- Macromolecular materials and environment (5 master hours)
  - Environmental problems of polymers
  - Types of recycling
  - Biodegradable polymers

The following laboratory practices will be carried out:

1) Tensile tests: Structure-Mechanical Properties relationship for different polymeric materials,
2) Impact tests, and
3) Measuring thermal properties of polymers: MFI and Vicat softenig temperature determination.
METHODS

Theoretical-practical (TP) activities and experimental (EX) works will be the main activities of the subject.

The theoretical-practical activities will consist of lectures in which the teacher will explain each of the topics that make up the subject, relying on Power Point presentations, which will be previously available to students. There will also be a series of seminars, in which the work of the students will be prominent, and in which some of the topics seen in the lectures will be deepened, especially those studied in the first two parts of the course. Another activity to be developed in the seminars will consist in the preparation by the students, divided into groups of three or four people, of a topic of "Macromolecular materials and environment", and that they will have to present to the rest of the students during the last days of the course.

On the other hand, the experimental activities will consist of three sessions of laboratory practices to be performed at the laboratory premises in the afternoon.

The attendance to the Seminars and Laboratory Sessions is compulsory and inexcusable.

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Legend:

ASSESSMENT SYSTEMS

- Continuous assessment system
- Final assessment system

TOOLS USED & GRADING PERCENTAGES

- Extended written exam  40%
- Practical work (exercises, case studies & problems set)  15%
- Exposition of work, readings, etc.  15%
- Three written partial exams distributed along the year: one of "Descriptive of Polymeric Materials" (12.6%), another of "Mechanical Properties" (12.0%), and one last of "Electrical and Thermal Properties" (5.4%)  30%

ORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT

Evaluation methodology: Continuous assessment, to evaluate the theoretical-practical (TP) and experimental (EX) activities. The final grade will be obtained by averaging the grades obtained in the TP (85%) and EX (15%) parts.

a) Assessment of TP part: On the one hand, the knowledge of the theoric contents will be assessed by means of 3 partial exams with a total value of 30% of the total score, and a final exam of the total of the subject that is worth 40%.

The activities carried out during the seminars (compulsory attendance) will also be scored. Each student will make an oral presentation of a topic previously worked in the seminars. The participation in activities carried out in the seminars and the exposed work will be worth a total of 15% of the total score. The competencies M03CM03, M03CM04, M03CM18 and M03CM20 will be evaluated.

b) Evaluation of the EX part: In laboratory work, the following items will be evaluated: the quality of the results obtained, the reports presented, the laboratory notebook and the work within the group. Attendance at laboratory practices is compulsory. The competencies M03CM11 and M03CM17 will be evaluated

In the ordinary evaluation, the grade "No-show" will only be given to students who do not attend any continuous assessment test (no exam, seminar, or laboratory practice session).

Those parts (theory, seminars and/or laboratory practices) with an score lower than 4.0, or those parts scored equal to or higher than 4.0 but lower than 5.0, but beeing the average of all of them lower than 5.0, will be reassessed in the extraordinary assessment.

Students who have chosen continuous assessment, may waive the call (opt-out) within a period of up to 4 weeks before the ending of the teaching period of the subject. This resignation must be submitted by writing a letter to the teacher responsible for the subject. On approval of the application, the student will be qualified as "No-show".

Students have the right to be evaluated through the final evaluation system (single test), regardless of whether or not they have participated in the continuous assessment system. To do this, students must submit, within a period of 9 weeks from
the beginning of the course, a letter to the teacher responsible for the subject, declining the continuous assessment.

The application will declare the way in which the knowledge and competences inherent to the subject will be achieved, especially the practical skills.

In both calls (ordinary and extraordinary) the single test will be made of several parts: 1) a written examination of all the theoretical-practical content of the subject, 2) the realization of a practical laboratory exam (realization of a laboratory practice sorted out among those contemplated in the program, and writing the corresponding report), and 3) an oral dissertation with the help of multimedia resources of a topic chosen among those developed in the seminars, selected by the examiners at least 10 days before the examination, followed by a discussion with the examiners. Competencies M03CM03, M03CM04, M03CM11, M03CM17, M03CM18 y M03CM20 will be assessed.

Students who had opted by the evaluation through a single test, but not shown to the exam, will be granted "No-show ", which means the automatic waiver of the call.

**EXTRAORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT**

Evaluation methodology: A single test in which the parts graded no-pass/failed in the ordinary call (theoretical part, seminars and/or laboratory practices) will be assessed, according to the aforementioned final evaluation system (single test).

There will be a written exam for the assessment of the theoretical content, an oral examination consisting of the presentation of a subject among those treated in the seminars, for those students who have failed this activity, and an experimental exam of laboratory practices for those who failed the laboratory work. The written laboratory reports of all the practices will also be required.

The score of the extraordinary call will be the weighted average of the mark gotten in the exam, and of the marks gotten in the parts granted pass saved in the ordinary call.

"No-show" in the extraordinary call will be granted to anyone not attending the exam, which means the automatic waiver of the call.

**COMPULSORY MATERIALS**

There is no compulsory material.

**BIBLIOGRAPHY**

**Basic bibliography**


**In-depth bibliography**


**Journals**

- Macromolecules
- Polymer
- Polymer Engineering and Science
- Journal of Applied Polymer Science
- Composites Science and Technology
- Polymer Testing
Revista de Plásticos Modernos

Useful websites
http://pslc.ws/spanish/index.htm
http://www.plastics.com
http://www.plastunivers.es
http://www.matweb.com

**REMARKS**
If the student gets a final grade of "no pass/failed", the parts graded as "pass" (TP or EX) will not be saved for the following course, and will be examined again.
Context and description of the subject

The goal is to complement basic concepts of Organic Chemistry acquired during the previous courses with a focus on synthesis, also correlating its significance during the development of new pharmacologically and biologically active compounds.

A selection of modern synthetic strategies and methods will be presented, focusing on heterocyclic compounds. The principles of bioactivity at the molecular level will also be introduced using some relevant examples. The subject will be complemented with aspects of structural elucidation of bioactive compounds and stereochemical concepts.

Competences/Results associated with the subject

The subject should help in gaining the following competences:

[M3.10] The ability to interpret structural analysis and apply principles of organic reactivity to the synthesis of pharmacologically and biologically interesting molecules.

[M3.11] The capacity for designing, planning and carrying out experimental work, as well as to use instrumental techniques for solving problems of chemical nature.

[M3.12] The ability for data searching using network services in the chemistry and related areas.

[M3.13] The ability to present orally chemical concepts and processes; also to write properly technical reports in the chemistry area using either Basque, Spanish or English languages.

The following transversal competences of the Module will also be acquired:


[M3.T2] The ability of learning and autonomous work.

[M3.T3] To be able to manage, organize and plan chemical processes based on quality criteria and environmental concerns.

[M3.T4] To be able to translate chemical concepts to other disciplines; to realize of their impact in industry and technology development of our society.

The coordination, both horizontal and vertical, of the subject within the Module and the Degree will be supervised by the Commission of Coordination of the Degree.

Contents (theory and experiments)


Methodology

M: The main concepts and additional learning orientations will be presented during lectures.

S: Seminars consist of exercises, including relevant examples; complementary examples will be posted on Moodle.

GA: Classroom practices consists of some training in the use of Organic Chemistry related software and presentation of a report by each student.

Examination systems

- Continuous assessment system
Final assessment system

Tools and percentages for rating:
  o Written exam (%): 60
  o Practical (exercises, case studies or problems) (%): 20
  o Individual report (%): 20

Ordinary call: directions and how to resign
General Regulations adopted by UPV/EHU (BOPV of March, 2017) concerning the assessment of students' achievement in the Degrees given by UPV/EHU will be applicable. For more information, see section 2 of such Regulations, articles 8, 9 and 12.

A) CONTINUOUS ASSESSMENT

Continuous assessment will be applied during the ordinary call only, with the following parts and percentages:

  (1) Exercises, case studies and problems carried out during the semester: 20%
  (2) Written individual report and its viva voice presentation: 20%
  (3) Written exam: 60%

If someone does not make/present any of the items (1) to (3) above, the item will be rated cero.

Students have the option to renounce a call by informing in writing the professor in charge of the subject. Requests need to be submitted one month in advance to the end of the lecturing period. Should this action be taken the subject will be rated as NOT PRESENTED (thee call will not get extinct).

B) ASSESSMENT BY SINGLE FINAL EXAMINATION

Assessment by a single examination is feasible only if the student submits on time a renounce to the continuous assessment. Requests need to be submitted in writing to the professor in charge of the subject during the first 9 weeks of the semester.

The single Final examination will account for 100% of the grading.

If someone does not make the Final exam, the grading will be NOT PRESENTED and the call will not get extinct.

Special Call: Directions and How to Resign
Special call will consist of a single Final Examination which will account for 100% of the grading, unless the student makes explicit he or she wants to keep ratings of parts (1) (20%) and (2) (20%) for averaging (only if averaging upgrades).

If someone does not make such Final exam, the grading will be NOT PRESENTED and the call will not get extinct.

Materials
At least one book among the basic titles listed below is highly recommended. The professor in charge of the subject will give additional directions.

Literature

Basic literature

Advanced literature

Revistas
Organic Letters: http://pubs.acs.org/journal/orlef7
Organic and Biomolecular Chemistry: http://www.rsc.org/Publishing/Journals/Ob/Index.asp
The Journal of Chemical Education: http://jchemed.chem.wisc.edu/
The Journal of Medicinal Chemistry: http://pubs.acs.org/journal/jmccmar

Web sites
Organic Resources Worldwide: http://www.organicworldwide.net/
Chemical and Engineering News: http://www.ucm.es/info/rsequim/geqo/
### SUBJECT
26139 - Environmental Technology & Chemistry

### ECTS Credits: 6

### DESCRIPTION & CONTEXTUALISATION OF THE SUBJECT
In this subject the student must apply his knowledge of Chemistry to the understanding of the environment, its processes and the fate and effects of chemical compound releases. In addition, the student will employ Chemical Engineering principles for the selection and design of waste treatment plants.

### COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

The competences the student must acquire are:

- M03CM08 - Know how to integrate their knowledge of chemistry and chemical engineering to evaluate the impact and evolution of pollutants in the environment and implement the different means of purification.
- M03CM12 - Possess knowledge of the network tools and services that enable searches for information in the field of chemistry and similar fields.
- M03CM13 - Transmit phenomena and processes related to chemistry and similar fields in verbal presentations and/or written reports and in a comprehensible way in either of the two official languages of the Autonomous Community of the Basque Country or in English.
- M03CM17 - Demonstrate observation, analysis and synthesis skills with a capacity for criticism and self-criticism.
- M03CM18 - Demonstrate a capacity for learning and for autonomous work for professional development.
- M03CM19 - Be able to manage, organise and plan chemical processes, applying criteria of quality and environmental conservation.
- M03CM20 - Relate chemistry with other disciplines and understand its impact on the industrial and technological society and the importance of the industrial chemical sector.

At the end of the course, the student is expected to be able to:
- Explain the characteristics of the environment and environmental processes using chemical arguments.
- Analyze environmental quality data
- Describe the evolution and effects of pollutants in the environment
- Reason and suggest treatment systems for waste streams.

### THEORETICAL/PRACTICAL CONTENT

I/Natural Environment: Atmosphere, Hydrosphere and Pedosphere
II/Environmental chemistry: Soil formation and properties. Continental and marine waters. Atmospheric chemistry
III/Soil and water pollution. Atmospheric pollution.

### METHODS

The subject includes on-site classes with the teacher and seminars where the student must
- a) solve and discuss problems on pollutant dispersion
- b) prepare and make a presentation on a subject related with the environment.

### TYPES OF TEACHING

<table>
<thead>
<tr>
<th>Type of teaching</th>
<th>M</th>
<th>S</th>
<th>GA</th>
<th>GL</th>
<th>GO</th>
<th>GCL</th>
<th>TA</th>
<th>TI</th>
<th>GCA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classroom hours</td>
<td>40</td>
<td>10</td>
<td>10</td>
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<tr>
<td>Hours of study outside the classroom</td>
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<td>15</td>
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</table>

Legend:  
M: Lecture  
S: Seminario  
GA: Pract.Class.Work  
GL: Pract.Lab work  
GO: Pract.computer wo  
GCL: Clinical Practice  
TA: Workshop  
TI: Ind. workshop  
GCA: Field workshop

### ASSESSMENT SYSTEMS

- Continuous assessment system
- Final assessment system

### TOOLS USED & GRADING PERCENTAGES

- Extended written exam  80%
- Exposition of work, readings, etc.  20%
**ORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT**

- Continuous evaluation system (Practical activities plus written test)
- Final evaluation

Evaluation guidelines:

* Written test: 80%
* Other activities: 20%

Students have the right to be evaluated through the final evaluation system (single test), regardless of whether or not they have participated in the continuous assessment system. To do this, students must submit, within a period of 9 weeks from the beginning of the course, a letter to the teacher responsible for the subject, declining the continuous assessment. It will be enough for the student not to take the exam to be evaluated as "not presented".

**EXTRAORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT**

Written exam: 100%

It will be enough for the student not to take the exam to be evaluated as "not presented".

**COMPULSORY MATERIALS**

**BIBLIOGRAPHY**

**Basic bibliography**

**In-depth bibliography**

**Journals**
- Journals of Environmental Chemistry and Technology.

**Useful websites**
### SUBECT

| 26119 - Macromolecular Materials II: Processing | ECTS Credits: 6 |

### DESCRIPTION & CONTEXTUALISATION OF THE SUBJECT

The subject begins with an introduction to Rheology, locating the particular features of macromolecular materials and their behaviour between elastic solids and Newtonian liquids. Rheological knowledge is the basis for the later study of methods to process or convert these materials into useful products. The objectives are: provide students with the theoretical knowledge and practical experience needed to understand the behaviour of polymer flows, and use the main industrial techniques for processing these materials in the context of correlations between structure, rheology, processing and properties.

### COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

This subject is included in the minor called "Macromolecules", located in the Advanced Module of the Degree and so, its transversal competencies will be evaluated. Among them, the following will be worked:

- M03CM17: Demonstrate observation, analysis and synthesis skills with a capacity for criticism and self-criticism.
- M03CM18: Demonstrate a capacity for learning and for autonomous work for professional development.
- M03CM20: Relate chemistry with other disciplines and understand its impact on the industrial and technological society and the importance of the industrial chemical sector.

The specific competencies of this subject are:

- M03CM05: Acquire knowledge and develop skills to use the main methods for transforming macromolecular materials into useful products. Possess basic knowledge of the rheological foundations on which said transformations are based.
- M03CM11: Be able to design, programme and carry out experimental processes and use adequate instrumental techniques for different types of chemical problems.
- M03CM12: Possess knowledge of the network tools and services that enable searches for information in the field of chemistry and similar fields.

The coordination of this subject with the others included in the same module is up to the Undergraduate Degree Coordination Commission.

### THEORETICAL/PRACTICAL CONTENT

- Operations before processing: Drying of polymers and blending in macromolecular materials (mixing and additive addition).

### METHODS

The methodology for teaching the subject consists (in the case of the Theoretical Programme) of lectures in which computers will be used extensively to project the content. Students also participate in seminars where they present the results and conclusions obtained in practical work in the laboratory or specific themes proposed by the professor. The laboratory practical work will be done in 3-hour sessions in the afternoons, linking in with the timetable for the period of theoretical classes. During the practical sessions, the processes and the functioning of machines will be explained, together with the experimental conditions to be applied. In groups of 3-4, students will then perform experiments, noting down any incidents and the data obtained. Finally, an analysis and discussion of the results will be carried out. For each practical work exercise, this will be reflected in a report that will be prepared by the group and presented for grading.
### TYPES OF TEACHING

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### ASSESSMENT SYSTEMS

- Final assessment system

### TOOLS USED & GRADING PERCENTAGES

- Extended written exam 55%
- Practical work (exercises, case studies & problems set) 25%
- Team work (problem solving, project design) 10%
- Exposition of work, readings, etc. 10%

### ORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT

1) In the ordinary evaluation, a final written exam will be held that may contain questions of a theoretical and practical nature; it will represent 55% of the final mark. During lectures, at the end of each theme, tests will be set through the use of interactive response controls. This evaluation may partially replace the final exam.

2) Continuous evaluation of students based on participation in interaction activities in class (controls, projects, explanations...) and/or the performance/resolution of exercises. This modality will account for 20% of the final mark and is compulsory for students who opt for continuous evaluation.

3) An evaluation of practical laboratory work will be made based on the attitude and progress observed, and on documents/reports on the work done. This evaluation will represent 25%. Attendance at practical laboratory work will be essential to pass the subject.

The criteria for opting for evaluation in a final exam are those stated in chapter 2, article 8 of the Regulations governing student evaluation in undergraduate degrees of the UPV/EHU.

If a student opts for evaluation in a final exam, not presenting him/herself for that exam will mean that he/she withdraws from the evaluation and will be considered "Not Present".

The criteria for opting out of continuous evaluation are those stated in chapter 2, article 8 of the Regulations governing student evaluation in undergraduate degrees of the UPV/EHU.

### EXTRAORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT

In the extraordinary evaluation, a student may request that his/her marks are calculated in the percentages referred to in sections 2) and 3) of the ordinary evaluation rules (only if they have passed them). In this case, the student may only do the written exam in section 1), with its corresponding percentage value (55%).

If a student opts for evaluation through a single exam, or has not passed section 2) and 3) of the ordinary evaluation, he/she will take a single exam of a theoretical-practical nature, representing 100% of the final mark. This exam will be used to evaluate all the competences of the subject.

### COMPULSORY MATERIALS

There is no compulsory material.

### BIBLIOGRAPHY

**Basic bibliography**

In-depth bibliography

Journals
Polymer
Journal of Rheology
Rheologica Acta
Applied Rheology
Macromolecular Materials and Engineering
Polymer Engineering and Science
International Polymer Processing
European Polymer Journal
Journal of Applied Polymer Science

Useful websites
http://www.rheology.org/
http://www.bsr.org.uk
http://rrc.engr.wisc.edu/
http://www.strictly-extrusion.com
http://www.ferris.edu/htmls/academics/courses.offerings/hillm
http://www.polymer-age.co.uk
http://www.matweb.com
http://www.plastics.com
http://www.empirewest.com/academy/index.html
http://www.mdacomposites.org
http://www.plastrunivers.es
http://www.mixers.com
http://www.apme.org

REMARKS
TEACHING GUIDE 2018/19

Centre: 215 - Faculty of Chemistry

Plan: GQUMI20 - Bachelor's Degree in Chemistry

Cycle: Indifferent

Year: Fourth year

SUBJECT

26120 – Industrial Polymerization Processes

ECTS Credits: 6

DESCRIPTION & CONTEXTUALISATION OF THE SUBJECT

The main objective of the subject is that the student acquires knowledge of the polymerization reaction engineering, so that he/she can understand the production processes of main commercial polymer families (polylefins, PVC, styrene/acrylic copolymers, vinyl/acrylic copolymers or PET amongst others). For that purpose, the polymerization kinetics, polymerization techniques, different kinds of processes and reactors used and the properties of the polymers and copolymers produced will be discussed.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

The following cross skills will be developed:
M03CM17 - Demonstrate observation, analysis and synthesis skills with a capacity for criticism and self-criticism.
M03CM18 - Demonstrate a capacity for learning and for autonomous work for professional development.
M03CM19 - Be able to manage, organise and plan chemical processes, applying criteria of quality and environmental conservation.
M03CM20 - Relate chemistry with other disciplines and understand its impact on the industrial and technological society and the importance of the industrial chemical sector.

Together with the following specific skills:
M03CM02 - Possess basic knowledge of the most common industrial technologies in the production of polymers and the engineering of the reactors used in the production process.
M03CM04 - Possess adequate knowledge of the large families of industrial polymers, their production, properties and most typical applications.
M03CM12 - Possess knowledge of the network tools and services that enable searches for information in the field of chemistry and similar fields.
M03CM13 - Transmit phenomena and processes related to chemistry and similar fields in verbal presentations and/or written reports and in a comprehensible way in either of the two official languages of the Autonomous Community of the Basque Country or in English.
M03CM14 - Be able to use the information and knowledge gained from the module for training in existing or emerging fields related to chemistry.
THEORETICAL/PRACTICAL CONTENT

1.- Introduction to Polymerization Processes
2.- Ideal reactors. Chemical reactions engineering
3.- Coordination polymerization engineering
4.- Free radical (co)polymerization engineering in homogeneous systems
5.- Polymerization in dispersed phase. Suspension and emulsion polymerization
6.- Step-growth polymerization

METHODS

In the on site lectures, theoretical and practical (exercises, expositions…) concepts will be developed, which will be evaluated by a written exam which will give 60% if the final mark.

In the computer based lectures, the student will learn how to simulate polymerization processes with at commercial software (Predici). In this activity, the student will have to seek for the necessary information in the literature, will have to develop a mathematical model for the process and will solve it numerically by the simulation: finally he/she will write a report and present it in front of the rest of the class.

In the experimental part of the subject, the student will study a polymerization reaction, following its kinetics and the microstructure of the obtained polymer.

ASSESSMENT SYSTEMS

- Continuous assessment system

TOOLS USED & GRADING PERCENTAGES

Extended written exam: 60%
Practical work (exercises, case studies & problems set): 10%
Predici simulation (written report and individual presentation): 30%

ORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT

As explained in the table above, the written exam will be 60% of the final mark. The simulation report and presentation will be 30% of the mark, and the experimental laboratory work will be 10% of the mark.

As the written exam is 60% of the mark, in order to get a “Non-presented”, the student will have to inform the lecturer one month in advance of the exam.

EXTRAORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT

In the extraordinary evaluation the written exam can be repeated, but the mark obtained in the other two activities will be maintained.
As the written exam is 60% of the mark, in order to get a “Non-presented”, the student will have to inform the lecturer one month in advance of the exam.

**BIBLIOGRAPHY**

**Basic bibliography**


**In-depth bibliography**


**Journals**

Macromolecular Reaction Engineering
Macromolecules
Industrial and Engineering Chemistry Research
Polymer

**Websites**

Macrogaleria: http://pslc.ws/spanish/index.htm
26133 - Mathematical Methods for Chemistry

The aim of this subject is to provide the students with the mathematical tools needed to model, formulate and solve problems of interest in the field of Chemistry. This subject presents an expansion of the basic mathematical concepts studied in the previous subjects "Matemáticas I" and "Matemáticas II y Estadística".

In addition to the Basic (CBB1-CB5) and General (G0001-G0005) Skills, the student should develop the following specific skills:

M01CM04 - Understand and know how to use basic mathematical tools and data analysis processes in a scientific environment.

(SS) M03CM16 - Employ advanced mathematical techniques to consider and resolve matters related to chemistry (data-processing, modelling, etc.).


The student is encouraged to actively participate in both theoretical and practical lectures, by posing questions, problems and so on.

Theoretical lectures will be given with the help of powerpoints files (in Spanish), which can be freely accessed by the student.

<table>
<thead>
<tr>
<th>Type of teaching</th>
<th>Classroom hours</th>
<th>Hours of study outside the classroom</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>45</td>
<td>67.5</td>
</tr>
<tr>
<td>S</td>
<td>15</td>
<td>22.5</td>
</tr>
</tbody>
</table>

Legend:


Final exam: 100%

Extended written exam 100%

Final exam: 100%

No specific material is needed.
### BIBLIOGRAPHY

**Basic bibliography**
- Vector calculus, J.E. Marsden & A. J. Tromba
- Differential equations, Ross. S.L.

**In-depth bibliography**
- No further source is required.

**Journals**
- As above.

**Useful websites**
- In internet there are plenty of courses and pages about these topics.
- Students are encouraged to find further approaches in the web.

### REMARKS
- No one