



## IDENTIFYING DATA

### Heating and cooling in the process industry

|                     |   |          |      |            |
|---------------------|---|----------|------|------------|
| Subject             | Heating and cooling in the process industry   |          |      |            |
| Code                | V12G350V01913   |          |      |            |
| Study programme     | Degree in Industrial Chemical Engineering   |          |      |            |
| Descriptors         | ECTS Credits  | Choose   | Year | Quadmester |
|                     | 6   | Optional | 4th  | 2nd        |
| Teaching language   | #EnglishFriendly<br>Spanish<br>Galician   |          |      |            |
| Department          |   |          |      |            |
| Coordinator         | Cerdeira Pérez, Fernando  |          |      |            |
| Lecturers           | Cerdeira Pérez, Fernando  |          |      |            |
| E-mail              | nano@uvigo.es   |          |      |            |
| Web                 | <a href="http://faitic.uvigo.es">http://faitic.uvigo.es</a>   |          |      |            |
| General description | The main objective is for students to acquire basic knowledge about the heat exchanges that take place in the different equipment and installations, as they are the heat exchangers, boilers, heat pumps, etc. |          |      |            |

## Competencies

|      |   |
|------|---|
| Code |   |
| B4   | CG4 Ability to solve problems with initiative, decision making, creativity, critical thinking and the ability to communicate and transmit knowledge and skills in the field of industrial engineering specializing in Industrial Chemistry. |
| B5   | CG5 Knowledge to carry out measurements, calculations, assessments, appraisals, surveys, studies, reports, work plans and other similar works.  |
| B6   | CG6 Capacity for handling specifications, regulations and mandatory standards.  |
| B7   | CG7 Ability to analyze and assess the social and environmental impact of the technical solutions.   |
| B11  | CG11 Knowledge, understanding and ability to apply the necessary legislation in the exercise of the profession of Industrial Technical Engineer.  |
| D2   | CT2 Problems resolution.  |
| D7   | CT7 Ability to organize and plan.   |
| D9   | CT9 Apply knowledge.  |
| D10  | CT10 Self learning and work.  |
| D17  | CT17 Working as a team.   |
| D20  | CT20 Ability to communicate with people not expert in the field.  |

## Learning outcomes

| Expected results from this subject | Training and Learning Results |     |
|------------------------------------|-------------------------------|-----|
| New                                | B4                            | D2  |
|                                    | B5                            | D7  |
|                                    | B6                            | D9  |
|                                    | B7                            | D10 |
|                                    | B11                           | D17 |
|                                    |                               | D20 |
| New                                | B4                            | D2  |
|                                    | B5                            | D7  |
|                                    | B6                            | D9  |
|                                    | B7                            | D10 |
|                                    | B11                           | D17 |
|                                    |                               | D20 |

|     |     |     |
|-----|-----|-----|
| New | B4  | D2  |
|     | B5  | D7  |
|     | B6  | D10 |
|     | B7  | D17 |
|     | B11 | D20 |
| New | B4  | D2  |
|     | B5  | D7  |
|     | B6  | D9  |
|     | B7  | D10 |
|     | B11 | D17 |
|     |     | D20 |

## Contents

| Topic                    |   |
|--------------------------|---|
| Transmission of Heat     | Heat exchangers .<br>- Analysis of heat exchangers.<br>- Method NTU<br>- Types of exchangers.<br>Boiling and condensation   |
| Thermal engineering.     | Processes of combustion.<br>Burners. Boilers<br>Ovens and dryers. Isolations.   |
| Refrigeration technology | Refrigeration machine and Heat pump. Coefficients of efficiency.<br>Vapor compression refrigeration cycles.<br>Devices for the production of cold.<br>Refrigerants<br>Cryogenics. |
| Energetic efficiency     | Application of the renewable energies (solar thermal, geothermal, biomass,...) as an energy source in the process industry.   |

## Planning

|                          | Class hours | Hours outside the classroom | Total hours |
|--------------------------|-------------|-----------------------------|-------------|
| Lecturing                | 24          | 40                          | 64          |
| Laboratory practical     | 8           | 10                          | 18          |
| Problem solving          | 12          | 24                          | 36          |
| Mentored work            | 0           | 10                          | 10          |
| Practices through ICT    | 8           | 8                           | 16          |
| Objective questions exam | 1           | 5                           | 6           |

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

## Methodologies

|                       | Description   |
|-----------------------|---|
| Lecturing             | Explanation in blackboard supported with presentation in transparencies, videos and any material that the teacher consider useful to do comprehensible the syllabus of the subject. |
| Laboratory practical  | Practices of laboratory applied.  |
| Problem solving       | Resolution of exercises and necessary practical cases to comprise the concepts seen in the classes of theory.   |
| Mentored work         | Execution of works individual and/or in group. Inside this activity includes the presentation of works in front of the group and his back evaluation.                               |
| Practices through ICT | Resolution of exercises by means of the support of computer programs.   |

## Personalized assistance

| Methodologies         | Description  |
|-----------------------|--|
| Lecturing             | The professor will attend the doubts of the students so much in the classroom as in the schedule of tutorial.          |
| Laboratory practical  | The professor will attend the doubts of the students so much in the laboratory as in the schedule of tutorial.         |
| Problem solving       | The professor will attend the doubts of the students so much in the classroom as in the schedule of tutorial.          |
| Practices through ICT | The professor will attend the doubts of the students so much in the computer classroom as in the schedule of tutorial. |

Mentored work      The professor will attend the doubts of the students so much in the classroom as in the schedule of tutorial.

| <b>Assessment</b>        |  |               |                               |                               |
|--------------------------|--|---------------|-------------------------------|-------------------------------|
|                          | Description  | Qualification | Training and Learning Results |                               |
| Lecturing                | Classical master explanation on whiteboard supported by presentation on transparencies, videos and any material that the teacher considers useful to make the syllabus of the subject. | 30            | B4<br>B5<br>B6<br>B7          | D2<br>D9<br>D10               |
| Problem solving          | Realization of applied laboratory practices  | 30            | B4<br>B5<br>B6<br>B7          | D2<br>D9<br>D10               |
| Mentored work            | Preparation of a memory and presentation of the work proposed, individually or in group, on the thematic proposal to the start of course.  | 20            | B4<br>B5<br>B6<br>B7<br>B11   | D7<br>D9<br>D10<br>D17<br>D20 |
| Objective questions exam | Consistent proof in short questions or type test to know the progressive evolution of the students during the development of the matter.   | 20            | B4<br>B5<br>B6<br>B7<br>B11   | D7<br>D9                      |

#### **Other comments on the Evaluation**

The final examination could be different for the students that followed the continuous evaluation (laboratory practice, tutored works,...) along the course concerning those that did not follow it. In both cases, the maximum mark of the course be of ten points.

It is expected an adequate ethical behaviour of the student. In case of detecting unethical behaviour (copying, plagiarism, unauthorized use of electronic devices, etc.) shall be deemed that the student does not meet the requirements for passing the subject. In this case, the overall rating in the current academic year will be Fail (0.0).

The use of any electronic device for the assessment tests is not allowed unless explicitly authorized. The fact of introducing unauthorized electronic device in the examination room will be considered reason for not passing the subject in the current academic year and will hold overall rating (0.0).

#### **Sources of information**

##### **Basic Bibliography**

Incropera, F.P. et al, **Principles of heat and mass transfer**, 978-0-470-64615-1, 7th ed., international student version, 2013

Múñoz Domínguez, M.; Rovira de Antonio, A.J., **Ingeniería Térmica**, 84-362-5316-7, 2006

##### **Complementary Bibliography**

Moran, Michael J.; Shapiro, Howard N., **Fundamentos de termodinámica técnica**, 84-291-4313-0, 2ª ed., 2004

Rey Martínez F.J.; Velasco Gómez E., **Bombas de calor y energías renovables en edificios**, 84-9732-395-5, 2005

Torrella Alcaraz, Enrique, **Frío industrial : métodos de producción**, 978-84-96709-33-1, 2010

Kohan, Anthony L., **Manual de calderas**, 84-481-2546-0, 2000

Kreith, Frank, **The CRC handbook of thermal engineering**, 3-540-66349-5, 2000

#### **Recommendations**

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

(\*)Física: Física I/V12G350V01102

(\*)Física: Física II/V12G350V01202

Chemistry: Chemistry/V12G350V01205

Thermodynamics and heat transfer/V12G350V01301

##### **Other comments**

To enrol in this matter is necessary to have surpassed or enrol of all the subjects of the inferior courses.

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## Contingency plan

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### Description

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=== EXCEPTIONAL MEASURES SCHEDULED ===

In front of the uncertain and unpredictable evolution of the sanitary alert caused by the \*COVID-19, the University of Vigo establishes an extraordinary planning that will activate in the moment in that the administrations and the own institution determine it attending to criteria of security, health and responsibility, and guaranteeing the teaching in a no face-to-face stage or partially face-to-face. These already scheduled measures guarantee, in the moment that was prescriptive, the development of the teaching of a more agile and effective way when being known in advance (or with a wide \*antelación) by the students and the \*profesorado through the tool normalised and institutionalised of the educational guides.

=== ADAPTATION OF THE METHODOLOGIES ===

\* educational Methodologies that keep

The theoretical teaching and the resolution of problems will give of virtual form with the help of different tools like the remote campus.

\* Educational methodologies that modify

The classes of laboratory will give of virtual form with help of viewing (whenever it was possible), videos, specific computer programs, etc.

\* Mechanism no face-to-face of attention to the students (tutorial)

The tutorial will keep so much through the email as with the help of the virtual room of the professor or other means that consider timely.

\* There are not modifications of the contents to give

=== ADAPTATION OF THE EVALUATION ===

\* Test already made

Do not modify his weights.

\* Pending proofs that keep

All the proofs of evaluation are supported by the same weights:

Lesson \*magistral: [previous Weight 30%] [Weight Proposed 30%]

Resolution of problems: [previous Weight 30%] [Weight Proposed 30%]

Work \*tutelado: [previous Weight 20%] [Weight Proposed 20%]

Examination of objective questions: [previous Weight 20%] [Weight Proposed 20%]

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