

**COURSE DATA****Data Subject**

Code	34755
Name	Basis of Chemical Engineering I
Cycle	Grade
ECTS Credits	6.0
Academic year	2020 - 2021

Study (s)

Degree	Center	Acad. year	Period
1401 - Degree in Chemical Engineering	School of Engineering	1	Second term

Subject-matter

Degree	Subject-matter	Character
1401 - Degree in Chemical Engineering	14 - Foundations of chemical engineering	Obligatory

Coordination

Name	Department
DEJOZ GARCIA, ANA MARIA	245 - Chemical Engineering
MARZAL DOMENECH, PAULA	245 - Chemical Engineering

SUMMARY

The subject Basis of Chemical Engineering I is part of the material of the same name whose overall objective is that any student acquire and apply the basic principles of chemical engineering for subsequent application to the design and operation analysis of chemical reactors and different types of basic operations of the process industry. It is a compulsory subject that is given in the first year of the Grade in Chemical Engineering during the second quarter. The curriculum consists of a total of 6 ECTS.

This course aims to give an overview of chemical engineering and provide with the skills to apply one of the fundamental tools for analysis and design of any process equipment: macroscopic property balances. Thus, the basis necessities for students to begin to know and understand the objectives of the studies and profession are established and then they successfully study subjects of calculation and design of equipment of the process industry.



This is a very practical subject in which, after the introduction of concepts, students will take numerous practical exercises will be taken, primarily related to the resolution of material and energy macroscopic balances, as well as experimentation in the laboratory.

The **general objectives** of the course are:

- Introduce the students to the basic features of the process industry, the modes of operation in the industry and the concept of unit operation.
- Ensure that students acquire and properly use the basic terminology and nomenclature of chemical engineering.
- Develop the students' ability to pose and solve numerical problems of property balances, and to interpret the results.
- Enhance students' skills in reasoning and making systematic work.
- Introduce students to the experimentation in the field of chemical engineering. Develop students' skills to work in the laboratory, to collect and process data and report the results.

The subject **contents** are: Material and Energy macroscopic balances. Introduction to experimentation in chemical engineering.

Remarks: Theoretical, classroom practices and laboratory practices classes will be taught in the language according to the subject information available on the degree website.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

International system of units. Unit changes.
Expression of the concentration of mixtures.
Equation of elementary reactions and stoichiometric calculations.
Thermodynamics: enthalpy, heat of reaction and equilibrium.
Use of logarithms and exponentials.
Solving systems of linear and nonlinear equations.
Solving immediate integrals.
Solving simple differential equations.
Making graphs of experimental data.

OUTCOMES



1401 - Degree in Chemical Engineering

- G3 - Knowledge of basic and technological subjects that allows students to learn new methods and theories and provides them with versatility to adapt to new situations.
- G4 - Ability to solve problems with initiative, decision-making skills, creativity and critical reasoning and to communicate and transmit knowledge, abilities and skills in the field of industrial engineering.
- G5 - Knowledge to carry out measurements, calculations, assessments, appraisals, surveys, studies, reports, work plans and analogous work.
- TE1 - Knowledge of material and energy balances, biotechnology, matter transfer, separation operations, chemical reaction engineering, reactor design, and valorisation and transformation of raw materials and energy resources.
- TE3 - Ability to design and manage applied experimental procedures, especially for determining thermodynamic and transport properties, and modelling of phenomena and systems in the field of chemical engineering, systems with fluid flows, heat transfer, matter transfer operations, kinetics of chemical reactions and reactors.

LEARNING OUTCOMES

Learning Outcomes

- Know the common forms of operation of chemical processes (G3 competency).
- Understand the concept of property balance and its application in chemical engineering (G3, G5 and TE1 competencies).
- Apply energy and material balances to any chemical process (G3, G4, G5 and TE1 competencies).
- Interpret and extract the information needed to solve the problems (G3, G4, G5, TE1 and TE3 competencies).
- Select and apply appropriate mathematical methods to solve problems (G3, G4, G5, TE1 and TE3 competencies).
- Use different industrial application equipment (G4, G5 and TE3 competencies).
- Take experimental data with accuracy and precision (G4, G5 and TE3 competencies).
- Critically analyse the results obtained by solving both the problems and when doing experimental work (G4, G5, TE1 and TE3 competencies).
- Write clearly, understandably and organized reports of work done in the laboratory (G4, G5 and TE3 competencies).
- Find, select and understand the information in specialized bibliographic sources (G3, G4 and G5 competencies).
- Acquire ability to work in groups (TE3).

Skills to acquire



The student should be able to:

- Distinguish modes of operation of the process industry.
- Make the flow sheet of a process.
- Get information from a problem sentence and the flow sheet of a process.
- Correctly interpret and translate into variables or equations the problem data.
- Account for uncertainties of the process.
- Address problems of macroscopic material balances in systems without chemical reaction in steady state.
- Address problems of macroscopic material balances in systems without chemical reaction in non-steady state.
- Address problems of macroscopic material balances in systems with chemical reaction in steady state.
- Address problems of macroscopic heat energy balances in systems without chemical reaction in steady state.
- Address problems of macroscopic heat energy balances in systems without chemical reaction in non-steady state.
- Address problems of macroscopic heat energy balances in systems with chemical reaction in steady state.
- Address problems of mechanical energy balance.
- Solve the problem using the appropriate mathematical tools.
- Interpret and reason the results of a problem
- Perform experiments of property balances.
- Interpret and report experimental results.

In addition to the specific objectives mentioned above, the course will encourage the development of several **social and technical skills**, among which are included:

- Capacity for analysis and synthesis.
- Ability to argue from rational and logical criteria.
- Ability to communicate in a properly and organized way.
- Ability to develop a problem in a systematic and organized way.
- Ability to self-sufficient work and to properly distribute time.
- Ability to work in groups, promoting respect for diversity, equity and gender equality.

DESCRIPTION OF CONTENTS

1. INTRODUCTION TO CHEMICAL ENGINEERING

Industrial activity. Chemical process industry and Chemical Engineering. Continuous and batch mode. Steady and unsteady state. Unit operation. The chemical engineer in the chemical industry. General approach to the analysis and design of systems. Systems of units.

**2. CONSERVATION LAWS. MACROSCOPIC MATERIAL BALANCES**

Formulation of balances. Process variables. Total mass balance. Total amount of substance balance. Mass balance applied to a component. Amount of substance balance applied to a component. Application of material balances: analysis of systems with a single unit; analysis of systems with several units; non reacting systems in steady state; reacting systems in steady state; non reacting systems in unsteady state.

3. MACROSCOPIC ENERGY BALANCES

Total energy balance. Expression of different terms: enthalpy, potential energy, kinetic energy. Heat energy balance. Application of heat energy balance: non reacting systems in steady state; reacting systems in steady state; non reacting systems in unsteady state. Mechanical energy balance.

4. BASIS OF CHEMICAL ENGINEERING I LABORATORY

Introduction to the laboratory. Material balance in unsteady state. Energy balance in unsteady state. Calculations and reporting.

WORKLOAD

ACTIVITY	Hours	% To be attended
Classroom practices	32,00	100
Theory classes	15,00	100
Laboratory practices	13,00	100
Development of group work	15,00	0
Development of individual work	13,00	0
Preparation of evaluation activities	27,00	0
Preparing lectures	5,00	0
Preparation of practical classes and problem	29,00	0
Resolution of online questionnaires	1,00	0
TOTAL	150,00	

TEACHING METHODOLOGY

The development of the subject is structured around the theoretical and problem classes, laboratory practices and performing work.



In the theoretical classes model of lecture will be used. The teacher will present and / or explain the main contents of each issue to highlight those key aspects for subject understanding. (G3, G5 and TE1 competencies).

Practical sessions of problems will be developed following two models. In some of the classes, the teacher will solve a series of sample problems in order to teach students to identify the essential elements of the problem approach and resolution. In other kinds of practical sessions the students, individually or arranged in clusters, will solve similar problems under the teacher supervision. After the work has been completed, the problems will be collected, analyzed and corrected. (G3, G4, G5 and TE1 competencies).

For laboratory practice sessions some activities will be programmed to introduce the practice to be carried out, experimental activities of laboratory data acquisition and analysis activities of data treatment. Students will have practice scripts and experimental sessions will be carried out entirely by them under the supervision of the teacher. (G3, G4, G5, TE1 and TE3 competencies).

The proposed work will be of several types: Theoretical questions (G3, G5 and TE1 competencies), Numerical questions (G3, G4, G5 and TE1 competencies), Problems (G3, G4, G5 and TE1 competencies), Self-corrective Tests to be done in Virtual Classroom (G3 and TE1 competencies) and Laboratory reports (G3, G4, G5, TE1 and TE3 competencies). Some of these activities will be held in class and the rest of the activities will have a compulsory performance and submission timetable. After correction, the students will be informed of their results so he/she can work the concepts that have been more confusing and generated more mistakes.

EVALUATION

Attendance to the laboratory of experimental practices is a non-recoverable and compulsory activity to overcome the subject.

FIRST CALL

Throughout the course, a series of activities will be proposed (theoretical questions, numerical questions, online tests, reports and problems) some of which will be scored. A compulsory timetable for the performance and delivery of activities will be established.

Learning assement in the first call will be carried out taking into account the activities carried out, the mark of an exam of the theory and problems part of the subject (Objective Test) and the mark of an exam of laboratory practices (Objective Practice Test).

Two types of activities are proposed:

- Non-scoring activities (ANP): Interpretation of block diagrams, approach and/or resolution of non-scoring problems. To be part of the final mark of the subject, at least 60 % of the proposed ANP must have been completed.



- Scoring activities: To be part of the final mark of the subject, 100% of the proposed scoring activities must have been completed. The scoring activities to be carried out are the following:

- CNP: On-line tests or questionnaires to be solved outside class hours.
- CP: Tests to be solved in the class room.
- PR_1: Problems of approach and resolution of material balances in steady state systems.
- PR_2: Problems of approach and resolution of material and energy balances in steady state systems.
- Objective Test (PO): Exam that will consist of a theory part of the whole subject and a part of questions and problems related to the approach and resolution of material balances in steady state systems and of material and energy balances in non-steady state systems.
- Laboratory Practices (PL): They will be evaluated on the basis of the qualifications of the preliminary tests of the practices to be carried out, the reports of the practices carried out and the mark of the Objective Test of Practices. The mark of the Laboratory Practices will be obtained by weighing between the mark of the preliminary tests (5 %), the average mark of the practice reports (75 %), and the mark of the Objective Test of Practices (20 %), provided that the requirements specified below are completed.

All the face-to-face activities will be carried out at the usual time of the subject, with the exception of the Objective Test and the Objective Test of Practices that will be carried out on the date of the official call.

Requirements to overcome the subject:

- Minimum mark of 5 out of 10 in the weighted average of PR_2 (30 %) and PO (70 %).
- Attendance at all the Laboratory Practice sessions.
- Minimum mark of 5 out of 10 in each of the Laboratory Practice reports.
- Minimum mark of 5 out of 10 in the objective test of Laboratory Practices to contribute to the mark of Laboratory Practices (20 %).
- Minimum grade of 5 out of 10 in the Laboratory Practices.

The **Final Mark** of the subject, as long as the indicated requirements have been exceeded, will be obtained as the highest of:

$$\text{Final Mark} = 0,05 \cdot (\text{ANP}) + 0,05 \cdot (\text{CNP}) + 0,10 \cdot (\text{CP}) + 0,10 \cdot (\text{PR}_1) + 0,25 \cdot (\text{PR}_2) + 0,25 \cdot (\text{PO}) + 0,20 \cdot (\text{PL})$$

$$\text{Final Mark} = 0,25 \cdot (\text{PR}_2) + 0,55 \cdot (\text{PO}) + 0,20 \cdot (\text{PL})$$

The mark of the Laboratory Practices if reports marks are lower than the minimum required (5), will be the least of them.

The **Final Mark** if the subject has not been passed for having obtained in the weighted average of PR_2 and PO and/or in the Laboratory Practices (PL) marks lower than the required minimum (5), will be the lower of them.

**SECOND CALL**

Learning assement in the second call will be carried out taking into account the activities carried out, the mark of an exam of the theory/problems part of the subject (Objective Test) and the mark of an exam of laboratory practices (Objective Practice Test). The Objective Test and the Objective Practice Test will be carried out on the date of the official call.

The continuous evaluation marks obtained are maintained (ANP, CNP, CP, PR_1 and PR_2).

- If the subject has not been overcome in the first call because the mark of the Laboratory Practices does not reach the required minimum, but the weighted average of PR_2 and PO is greater than 5 out of 10, the grade of PR_2 and PO is kept for the second call. In order to pass the subject, the practice reports must be submitted on the second call and/or the Objective Practice Test must be taken. The deadline for the delivery of the practice reports is the one established for the official exam of the second call. The evaluation of the Laboratory Practices will be carried out as escribed for the first call. If the minimum mark required for PL is exceeded on the second call (5 out of 10), the final mark will be obtained as described for the first call.

- If the subject has not been overcome in the first call because the weighted average of PR_2 and PO is lower than the required minimum mark but the Laboratory Practices have been passed, the mark of the Laboratory Practices (PL) for the second call is kept, and to pass the subject, an exam for the theory/problems part of the subject (PO) on the date of the official announcement must be taken, and a minimum grade of 5 out of 10 in the exam must be obtained. If the subject has not been overcome in the first call because the weighted average of PR_2 and PO and the mark of Laboratory Practices (PL) are lower than the minimum required, to pass the subject: i) an exam for the theory/problems part of the subject (PO) on the date of the official announcement must be taken, and a minimum grade of 5 out of 10 in the exam must be obtained.; and ii) practice reports must be submitted on the second call and/or the Objective Practice Test must be taken being the deadline for the submission of the reports the data established for the official exam on the second call. The evaluation of the Laboratory Practices will be carried out as escribed for the first call. A minimum grade of 5 out of 10 is required in the Laboratory Practices to pass the subject.

If the minimum mark required for PO (5) an PL (5) is exceeded on the second call, the **Final Mark** will be obtained as the highest of:

$$\text{Final Mark} = 0,05 \cdot (\text{ANP}) + 0,05 \cdot (\text{CNP}) + 0,10 \cdot (\text{CP}) + 0,10 \cdot (\text{PR}_1) + 0,10 \cdot (\text{PR}_2) + 0,40 \cdot (\text{PO}) + 0,20 \cdot (\text{PL})$$

$$\text{Final Mark} = 0,80 \cdot (\text{PO}) + 0,2 \cdot (\text{PL})$$

The **Final Mark** on the second call if the subject has not been overcome for having obtained marks below the required minimum, will be the lowest of them.



In any case, the evaluation system will be governed by the established in the Reglament d'Avaluació i Qualificació de la Universitat de València per a Títols de Grau i Màster (<http://links.uv.es/7S40pjE>).

According to the Regulation of the advanced call to complete the studies of Degree (ACGUV 30/2015), the Academic Grade Commission establishes that in this subject it is not possible to request the advanced call if the student has not exceeded, prior to the request, the laboratory practices.

Competencies evaluation:

- Activities (scoring and non-scoring): G3, G4, G5 and TE1 competencies
- Exams: G3, G4, G5 and TE1 competencies
- Laboratory practice assistance: G3, G4, G5, TE1 and TE3 competencies
- Reports: G3, G4, G5, TE1 and TE3 competencies

REFERENCES

Basic

- "Principios Elementales de los Procesos Químicos" R. M. Felder, R. W. Rousseau (Ed. Addison-Wesley)
 - "Material and Energy Balances" G.V. Reklaitis (Ed. Wiley)
 - "Introducció a l'Enginyeria Química" A. Aucejo y otros (Enciclopèdia Catalana)
 - "Handbook on Material and Energy Balance. Calculations in Materials Processing" (3rd Edition) A.E. Morris, H.A. Fine, G. Geiger (Ed. Wiley-TMS)
- Recurso electrónico

Additional

- "Principles of Chemical and Engineering Processes" N. Ghasem, R. Henda (Ed. CRC Press)
- "Ingeniería Química". Vol. 1. E. Costa Novella y Otros (Ed. Alhambra)
- "Cálculo de Balances de Materia y Energía" E. J. Henley, E.M. Rosen (Ed. Reverté)
- "Principios Básicos y Cálculos en Ingeniería Química" D. M. Himmelblau (Ed. Prentice Hall)
- "Problemas de Balances de Materia" A. Valiente, R. Primo Stivalet (Ed. Alhambra)



- "Problemas de Balances de Energía" A. Valiente, R. Primo Stivalet (Ed. Alhambra)
- "Balances de Materia. Problemas resueltos. I. Procesos sin reacción química". II. Procesos con reacción química" J.J. Peiró, J. García (Universidad Politécnica de Valencia)
- "Curso de Ingeniería Química" J. Costa López y otros (Ed. Reverté)

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

Contents

The contents initially established in the Course Guide are maintained.

Workload and planning of teaching

Workload:

The activities described in the Course Guide with their time dedication are maintained.

Planning of teaching:

The material for the follow-up of the classes allows to continue with the teaching time planning both in days and in time, whether the teaching is face-to-face in the classroom or not.

Teaching methodology

The development of the subject is articulated as has been established in the teaching model of the degree for the second semester (https://www.uv.es/etsedoc/Web/Modelo%20Docente_GIQ_2C.pdf).

If there is a closure of the facilities for sanitary reasons that totally or partially affects the classes, these will be replaced by non-person sessions following the established timetable.

Evaluation

The evaluation system described in the Course Guide in which the activities have been specified as well as their contribution to the final grade of the subject is maintained.



If there is a closure of the facilities for sanitary reasons that affect the development of any face-to-face evaluable activity, it will be replaced by a test/activity of a similar nature that will be carried out in virtual mode using the computer tools licensed by the University of Valencia. The contribution of each evaluable activity to the final grade of the course will remain unchanged, as established in this guide.

References

The recommended references in the Course Guide are maintained, since they are available. In addition, it will be complemented with notes, slides and problems uploaded to the Virtual Classroom.