VNIVERSITAT DE VALÈNCIA

Course Guide
34755 Basis of chemical engineering I

COURSE DATA

Data Subject	
Code	34755
Name	Basis of chemical engineering I
Cycle	Grade
ECTS Credits	6.0
Academic year	2023 - 2024

Study (s)

Degree	Center	Acad. year	Period
1401 - Degree in Chemical Engineering	School of Engineering	1	Second term
1934 - D.D. in Chemistry-Chemical Engineering	Faculty of Chemistry	1	Second term

Subject-matter

Degree	Subject-matter	Character
1401 - Degree in Chemical Engineering	14 - Foundations of chemical engineering	Obligatory
1934 - D.D. in Chemistry-Chemical Engineering	1 - Primer curso	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 necessaries 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.
Chemical equation and elementary 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 competences), 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 at the laboratory of experimental practices is a non-recoverable and compulsory activity to overcome the subject.

The assessment of learning in the first and second call will be carried out through the independent assessment of the theory / problems part and the laboratory part.

Theory and Problems Part (TP)

Learning assessment of this part of the subject will be accomplished from the evaluation of the activities carried out and the mark of an exam of the theory/problems part of the subject (Objective Test, PO) that will be performed on the date of the official call.

Throughout the course, a series of activities will be proposed that will constitute the continuous evaluation of the subject. A compulsory schedule will be established for the performance and delivery of activities. All the face-to-face activities of continuous assessment will be carried out at the usual time of the subject. Continuous evaluation activities are non-recoverable.

The activities to be carried out are:

• Problem solving (RP): approach and/or resolution of problems.

• Questionnaires (Q): nomenclature, concepts, and interpretation of block diagrams.

Regarding the Objective Test (PO), a minimum mark of 5 out of 10 is required. Once this requirement is passed the mark for the theory / problems part (TP) will be obtained as:

Theory/problems Mark (TP) = 0,30·(RP) + 0,10 (Q) + 0,60 (PO)

To pass the course, a minimum mark of 5 out 0f 10 is required for the theory/problems part.

Laboratory Part (PL)

It will be evaluated from the qualifications of the preliminary questionnaires of the practices to be carried out, the reports of the practices performed and the mark of a Practices Exam that will be carried out:

• on the first call, in the usual schedule of the subject.

• on second call, on the official date of the call.

The mark of the Laboratory Practices will be obtained by weighting between the mark of the preliminary questionnaires (5%), the average mark of the practice reports (75%), and the mark of the Practice Exam (20% if the mark is greater than 5; 0% if the grade is less than 5) provided that the following requirements are met:

• Attendance at all the Laboratory Practice sessions, including the introductory session and the calculation sessions.

• Minimum mark of 5 out of 10 in each of the Laboratory Practice reports.

To pass the course, a minimum mark of 5 out of 10 is required for the laboratory part.

The mark of the Laboratory Practices if marks lower than the minimum required (5) have been obtained in the practice reports, will be the lowest of them.

Final Mark

The Final Mark of the subject, provided that a grade equal to or greater than 5 has been obtained in the TP and PL parts, will be:

Final Mark = 0.80 (TP) + 0.20 (PL)

If the TP Mark and/or the PL Mark is less than 5, the Final Score will be the lower of them.

• 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 theory/problems part has been passed, the theory/problems grade (TP) is kept for the second call. In order to pass the course, the practical reports will have to be presented on the second call and/or take the Practices Exam. The deadline for the delivery of the practical reports is the one established for the official exam of the second call. The evaluation of the Laboratory Practices, the requirements to pass the subject and the final mark will be those described above.

• If the subject has not been overcome in the first call because the mark for the theory/problems part is

less than 5 out of 10 but the Laboratory Practices have been passed, the mark of the Laboratory Practices (PL) is kept for the second call. In order to pass the subject, the exam of the theory/problems of the subject (PO) will have to be taken on the date of the official announcement. The requirements to pass the course and the final mark will be those described above.

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. Failure to attend the exam of the second call (PO) will mean the grade "No Show (NS)".

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 (https://www.uv.es/graus/normatives/2017_108_Reglament_avaluacio_qualificacio.pdf).

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: Competencies G3, G4, G5 y TE1

• Exams: Competencies G3, G4, G5 y TE1

• Laboratory practice assistance: Competencies G3, G4, G5, TE1 y TE3

• Laboratory practice reports: Competencies G3, G4, G5, TE1 y TE3

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 lEnginyeria 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)