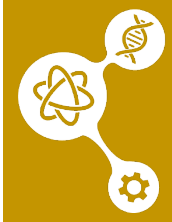
Academic Year 2026/2027

Corse Guide:

APPLIED COMPUTER SCIENCE



FACULTAD DE CIENCIAS QUÍMICAS

1. IDENTIFICATION

Degree Program	Bachelor's Degree in Chemical Engineering			Course Code	801535
Course name	Applied Computer Science			ECTS	6
Subject	Computer Science				
Module	Chemical Technology				
Corse Type	Compulsory	Course	First Year	Semester	First
Department	Chemical Engineering and Materials				

Lecturers in Charge

Group A

Activity	Lecturer	Email	Office
Tª/S/Tut.	PEDRO YUSTOS CUESTA	pyustosc@ucm.es	QP-109
Tª/S/Tut.	Mª. ISABEL GUIJARRO GIL	migg@ucm.es	QA-B70
Tª/S/Tut.	JOSE MANUEL TOLEDO GABRIEL	jmtoledo@ucm.es	QA-B61

Grupo B

Activity	Lecturer	Email	Office
Tª/S/Tut.	PEDRO YUSTOS CUESTA	pyustosc@ucm.es	QP-109
Tª/S/Tut.	Mª. ISABEL GUIJARRO GIL	migg@ucm.es	QA-B70
Tª/S/Tut.	JOSE MANUEL TOLEDO GABRIEL	jmtoledo@ucm.es	QA-B61

2. OBJETIVES

General Objective

The general objective of this course is to provide students with sufficient skills in using EXCEL, ORIGIN, and MATLAB software to solve problems within the field of Chemical Engineering.

Specific Objectives

- Use of basic office applications such as the spreadsheet software, Microsoft EXCEL, and the graphing package, MICROCAL ORIGIN, proficiently enough for performing calculations and preparing scientific reports.
- Development of the main numerical methods in spreadsheets for linear and non-linear regression, solving equations and systems of equations, numerical integration and differentiation, and solving ordinary differential equations of interest in Chemical Engineering.
- Management of the tools available in both EXCEL and ORIGIN that are useful for solving Chemical Engineering problems, knowing how to interpret the results.
- Learning to program with MATLAB.

- Application of MATLAB tools to solve a system of algebraic equations that may appear in Chemical Engineering.
- Application of MATLAB tools to solve a system of differential equations with one independent variable that may appear in Chemical Engineering.
- Developing the necessary skills and attitudes for the student to autonomously use the computer to solve problems in the field of Chemical Engineering.

3. PRIOR KNOWLEDGE AND RECOMENDATIONS

Prior Knowledge

It is necessary to possess high school-level knowledge of Physics, Chemistry, and Mathematics, as the competencies to be acquired are applicable to these sciences and to Chemical Engineering.

Recommendations

It is recommended to have basic computer skills (handling Windows) and possess basic user-level knowledge of word processors and spreadsheet software. It is also advisable for the student to have a basic level of English that enables them to consult bibliography in English, search for information, and communicate both in writing and orally in that language.

4. CONTENTS

Brief Description

Use of: spreadsheets, databases, statistical software, graphics software, data processing software, and equation system solvers. Programming of personal calculators.

Program

BLOCK 1: PROBLEM SOLVING WITH MATLAB

Topic 1: MATLAB Basics

Matrix definition. Operators. Algebraic functions. Handling functions using M-files. Passing variables using the global statement. For, if, and while loops.

Topic 2: Numerical methods with MATLAB

Application of the fzero tool to solve equations with a single unknown that may arise in Chemical Engineering. Application of the csolve tool to solve systems of equations that may arise in Chemical Engineering. Application of the ode15s tool to solve systems of ordinary differential equations of interest in Chemical Engineering. Use of odeset and graphical representation of the results.

BLOCK 2: SPREADSHEETS APPLICATIONS AND GRAPHING SOFTWARE

Topic 3: Spreadsheets

Concept of spreadsheets, their usefulness, and functional features. Basic spreadsheet operations and management. Formatting and customization operations. Formulas and operators for performing automated calculations. Spreadsheet design. Chart generation and customization, including the creation of trendlines. Examples.

Topic 4: Using Spreadsheets to Solve Numerical Methods Problems

Application of numerical methods using **Excel** to solve problems of interest in Chemical Engineering. Use of Excel tools for the statistical analysis of experimental data. Development of a spreadsheet for the numerical integration of functions. Calculation of roots of single-variable functions using the Goal Seek and Solver tools. Solution of systems

of nonlinear equations using Solver. Development of a spreadsheet for solving ordinary differential equations and initial value problems using the Euler and fourth-order Runge–Kutta methods. Resolution of practical case studies.

Topic 5: Graphing Software

Knowledge of graphing software. Introduction to the use of Origin and its working environment. Components of an Origin project, including worksheets and graphs. Creation and customization of different types of graphs. Matrices and 3D graphing. Examples.

Topic 6: Data Analysis in Origin

Knowledge of analytical and computational tools of interest in Chemical Engineering. Description of tools: linear and nonlinear regression, and multiple regression. Modelling of experimental curves. Curve differentiation and numerical integration using Origin. Statistical analysis using Origin. Examples applied to Chemical Engineering.

5. COMPETENCES

General

CG1	Use concepts from basic and technological subjects that enable autonomous learning of new methods and theories and the ability to address new situations.

Specific

CE3-I1	Use and interpret information obtained through the main software packages used in Chemical Engineering.
CE3-I2	Solve structured programming problems.
CE3-I3	Develop programs for data input/output
CE3-I4	Develop simple programs applied to the field of Chemical Engineering.

Transversal

CT6	Use computer tools and programs

6. WORKING HOURS DISTRIBUTED BY ACTIVITY

Activity	Attendance (horas)	Self-study (horas)	Credits
Theory classes	30	45	3
Seminars	15	35	2
Tutorials/guided work	3	4,5	0,3
Preparation of Course work and Exams	3	14,5	0,7
Total	**51**	**99**	**6**

7. METHODOLOGY

The teaching time of the course is divided into lectures, seminars, and tutorials.

The **theoretical classes** will be delivered in a single group in a computer lab, comprising all students enrolled in the course. They will mainly consist of lecture-based sessions in which the theoretical knowledge required to solve the practical examples covered during the course will be presented. In some cases, the lecture format will be combined with the solving of representative problems. Through this methodology, the following competencies are intended to be developed in students: CG1, CE3-I1.

The **seminar classes** will be held in computer rooms at the Faculty of Chemical Sciences, with the group split into two subgroups. In these sessions, examples involving the solution of practical case studies will be proposed and worked on in groups of four students. Students will also receive guidance on their assigned case studies, applying the methodologies explained in class. Part of these activities will be conducted in English. Through this methodology, the following competencies are intended to be developed in students: CG1, CE3-I1, CE3-I2, CE3-I3, CE3-I4, and CT6.

In the **tutorials**, students are assigned a problem to solve, and their progress is monitored while their questions are addressed regarding the content covered in lectures and the solution of the proposed case studies. Through this methodology, the following competency is intended to be developed in students: CT6.

The **Virtual Campus** will be used as a platform to make available to students the materials used in both theoretical and practical classes, and as a means of communication between the instructor and the students.

8. BIBLIOGRAPHY

Basic

- Manuals of the programs and help files of the commercial programs used.
- Higham, D.J.; Higham N.J.: "*MATLAB guide*", Third Edition, SIAM. Philadelphia, 2017.
- Slager, D.; Slager, A.: *"Essential Excel 2019 [Recurso electrónico]: "A Step-by-Step Guide"*, Berkeley, CA : Apress : Imprint: Apress, 2020.

Complementary

- Alexander, M. Kusleika, D.: "*Excel® 2016 formulas [Recurso electrónico]*", Edición Especial. Wiley, 2016.
- Tracy Syrstad: "*My Excel 2016 [Recurso electrónico]*". Que, 2015.
- Bourg, David M.: "*Excel: aplicaciones científicas y de ingeniería*". ANAYA 2007.
- Quintela, P.: "*Matemáticas en Ingeniería con MATLAB*", Publicaciones de la Universidad de Santiago de Compostela, 2000.
- Schiesser, W.E.: "*The numerical method of lines*", Academic Press, San Diego, 1991.
- Gustafsson, F.; Bergman, N.: "*MATLAB for engineers explained*", Springer, Londres, 2003.
- Himmelblau, David M.: "*Principios básicos y cálculos en Ingeniería Química*", 6ª ed., Prentice Hall, 2002.
- Cutlip, Michael B.; Shacham M.: "*Problem solving in chemical and biochemical engineering with POLIMATH, Excel and MATLAB*", 2nd ed., Prentice Hall, 2008.

9. EVALUATION

The assessment of student performance and the competencies acquired in the course will be carried out through a comprehensive evaluation, which will take into account both the exams administered and the supervised activities and independent work completed by the student.

In order to be eligible for the overall assessment of the course, students must have participated in at least 70% of the in-person classroom activities (lectures, seminars, and tutorials).

Academic performance and the final grade will be based on the marks obtained in the problem-solving block using MATLAB (Block 1) (45%), and in the spreadsheets and graphing software block (Block 2) (55%), weighted as follows:

Activity	BLOCK1	BLOCK 2
Exams:	22,50%	27,50%
Seminars:	11,25%	13,75%
Self-work:	11,25%	13,75%

A minimum grade of four will be required in each of the components that make up the course (exam, supervised activities, and independent work).

The final grade will be calculated as the weighted average of the assessable activities. However, in order to pass the course, it will be necessary to achieve the minimum required mark in each of them. If this requirement is not met, the final grade will be the weighted average obtained, with a maximum of 4.5 out of 10.

The grades for the activities included in the course assessment (midterm exams, laboratories, tutorials, problem submissions) will be communicated to students with sufficient advance notice before the final exam, so that they can properly plan their study for this and other courses.

In particular, the grades for the midterm exams will be communicated within a maximum period of 20 days, except for the second midterm, where the deadline may be shorter in order to adapt to the final exam schedule.

In any case, a minimum period of seven days will be respected between the publication of the grades and the date of the course's final exam.

❖ WRITTEN EXAMS:

The assessment of the competencies acquired in the course (CG1, CE3-I1, CE3-I2, CE3-I3, CE3-I4) will be carried out through a final exam, in the regular and/or extraordinary examination sessions, consisting of a set of questions on the content covered in the theoretical classes and on the solution of practical case studies. To pass, a minimum grade of 4 in each part of the exam will be required. If the course is not passed through the final exam in the regular session, it may be retaken in the extraordinary session. In this case, for the purposes of the overall assessment, the exam will also account for 50% of the final grade, with the same evaluation applied to the remaining course activities completed during the semester.

❖ GUIDED ACTIVITIES:

Part of these activities will be assessed in English. The evaluation of the supervised activities will make it possible to determine the level of achievement of competencies CG1, CE3-I1, CE3-I2, CE3-I3, CE3-I4, and CT6. For the extraordinary examination session, the grade obtained in the supervised activities will be retained.

BLOCK 1:

The class will be divided into groups. MATLAB programs will be developed to solve practical case studies assigned to each group. In each program, the meaning of the variables used and the purpose of each of the programming structures and/or commands employed must be explained. The programs will be graded based on their functionality; therefore, all necessary files must be submitted so that they can be executed in MATLAB. The degree of similarity between programs submitted by different groups will negatively affect the grade of all of them. To avoid this, each program must use completely different variables and comments.

BLOCK 2:

Students must submit, according to deadlines established at the beginning of the course, a set of problem assignments designed to assess the level of achievement of competencies and skills in carrying out the exercise, from the problem specifications to the results obtained from the computer.

In order to promote cooperative learning, students will be organized into small groups, so that each group will be responsible for submitting the completed set of exercises.

Once this grade has been obtained, it will be retained in all examination sessions for both parts.

❖ SELF-WORKS:

The evaluation of the supervised activities will make it possible to determine the level of achievement of competencies CG1, CE3-I1, CE3-I2, CE3-I3, CE3-I4, and CT6. For the extraordinary examination session, the grade obtained for independent work will be retained.

BLOCK 1:

To assess independent work, each student must propose a practical case under predefined conditions and submit the MATLAB file that solves the case study, along with the solution. The degree of similarity between case studies proposed by different students will negatively affect the grade.

BLOCK 2:

To assess independent work, each student must propose a practical case under predefined conditions and submit the **Excel and Origin files** that solve the case study, along with the solution. The degree of similarity between case studies proposed by different students will negatively affect the grade.

Once this grade has been obtained, it will be retained in all examination sessions for both parts.

ACTIVITY SCHEDULE

UNIT	ACTIVITY	HOURS	GROUPS	START	END
1. PROBLEM SOLVING WITH MATLAB.	Theory classes	15	1	First week	8th week
	Seminars	7	2		
2. SPREADSHEETS APPLICATIONS AND GRAPHING SOFTWARE.	Theory classes	15	1	8th week	15th week
	Seminars	8	2		
BLOCKS 1 and 2.	Scheduled Tutorials*	3	4	5th, 10th and 15th weeks	

* Scheduled tutorials are subject to possible modifications depending on the overall planning of the course..

SUMMARY OF ACTIVITIES

ACTIVITY	ASSOCIATED COMPETENCES	LECTURE ACTIVITY	STUDENT ACTIVITY	EVALUATION	P	NP	TOTAL	C
Theory classes	CG1, CE3-I1	Presentation of the theoretical knowledge required to solve the practical cases.	Note-taking. Computer skills.	Exam questions on the content presented in the theoretical classes.	30	45	75	
Seminars	CG1, CE3-I1, CE3-I2, CE3-I3, CE3-I4, CT6	Resolution of practical case examples and student advising on assigned case studies. Preparation and proposal of assignments	Note-taking and computer skills. Application of the knowledge acquired in theoretical classes. Written preparation of individual and group assignments.	Grading of assigned practical cases, and exam questions on practical case resolution. Assessment of assignments..	15	35	50	**50%**
Scheduled Tutorials	CT6	Monitoring student progress	Preparing questions for the professor, and absorbing and applying the explanations received	Assessment of students' independent work.	3	4,5	7,5	
Exams	CG1, CE3-I1, CE3-I2, CE3-I3, CE3-I4	Exam design, proctoring, and grading. Student evaluation.	Studying for and taking the exam.	Exam grade.	3	14,5	17,5	**50%**

P: Presential activities

NP No presential activities (self-work

C: Calification