



Course guide.

Scenarios 1,2 & 3

APPLIED COMPUTER CHEMISTRY



CHEMISTRY DEGREE
COMPLUTENSE UNIVERSITY OF MADRID
ACADEMIC YEAR 2021-2022

**SCENARIO 1. ON-SITE COURSE****I.- IDENTIFICATION**

COURSE NAME:	Applied Computer Chemistry
CREDITS (ECTS):	6
CHARACTER:	Mandatory
SUBJECT:	Applied Computer Chemistry
MODULE:	Basic
DEGREE:	Bachelor in Chemistry
SEMESTRE/TERM:	Second semester (first course)
DEPARTAMENTOS:	Analytical Chemistry; Physical Chemistry; Inorganic Chemistry, Organic Chemistry

LECTURERS:

Coordinator	Lecturer: DAVID ÁVILA BRANDE Department: Inorganic Chemistry Office: QA-118, 1st floor A building e-mail: davilabr@ucm.es
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Group E	
Seminars and Tutorials	Lecturer: DAVID ÁVILA BRANDE Department: Inorganic Chemistry Office: QA-118, 1st floor A building e-mail: davilabr@ucm.es

II.- OBJETIVES**■ GENERAL OBJECTIVE**

The main objective of this subject is to provide students with enough skills to handle different computer software's that allow them to solve problems in the field of Chemistry related with common calculations and statistical analyses, creation and management of chemistry databases and with the visualization of molecules, crystals and their symmetry.

■ SPECIFIC OBJECTIVES

- o Use of basic applications such as word processors, spreadsheets editors, scientific graphing and statistical packages that allow curve fittings and statistical analyses related to chemistry, as well as the writing of professional scientific reports



- o Use of office document applications, such as Microsoft EXCEL, to create simple databases.
- o Learn how to manage more complex online databases to obtain specific chemical information (information on chemical substances, structures, properties, etc.) and bibliography.
- o Management of crystal and molecular modelling programs to create and visualize chemical structures and their symmetry.

III.- PREVIOUS KNOWLEDGE AND RECOMMENDATIONS

■ PREVIOUS KNOWLEDGE:

Nomenclature and chemical formulation (both inorganic and organic). Balancing simple chemical equations. Usual units for measuring physical and chemical quantities.

■ RECOMMENDATIONS:

Only basic computer user's skills are required (Windows management).

IV.- CONTENTS

■ BRIEF DESCRIPTION:

Introduction to scientific computing. Use of databases. Creation of databases containing specific information. Drawing molecules and crystals. Geometry-properties relationship. Numerical differentiation: application to titrations. Fitting data using different functions: application to electrochemical measurements. Linear regression: kinetic applications. Statistics. Replicate measurements.

Practical sessions in the laboratory will cover a wide variety of fundamental aspects of chemistry (vapour pressure measurements, reaction kinetics, electrolysis, thermodynamics, titrations, etc.). The calculations and treatment of the data generated in the practical sessions will be carried out in the computer rooms. Simultaneously, in the seminar sessions, the students will learn and manage different software's frequently used in the field of Chemistry, related to the general calculations and statistics, the creation and management of databases and the visualization of molecules and crystals.

■ SYLLABUS:

LABORATORY

Practical sessions in the laboratory

1. Graphing and data analysis. Borax solubility. Determination of thermodynamic magnitudes.
2. Graphing and numerical analysis with non-linear functions. Monitorization of slow kinetic reactions and determination of partial orders and kinetic coefficients.
3. Graphing and numerical analysis of derivatives. Acid-base titration curves with pH-meter.



4. Solving systems of linear equations. Determination of the stoichiometry of coordination complexes.
5. Graphing and data fitting. Water electrolysis and Faraday constant determination.
6. Graphing and data analysis, least-squares fit to a straight line and linearizing functions. Measurement of the vapour pressure of a pure liquid.

Practical sessions in the computer room

1. Numerical solution of algebraic equations. Monoprotic and polyprotic aqueous acid–base equilibria.
2. Drawing chemical structures and reactions schema. Getting started the software ACD/ChemSketch.

THEORY (SEMINARS)

1. Working with Microsoft Excel.

The concept of worksheet. Basic operations in a worksheet. Excel formulas and functions Making charts. Data fitting: Linear regression and curve fitting. Methods for solving equations with one unknown. Practical examples.

2. Working with Origin.

Basic information on navigating the Origin workspace. Main components of an Origin projects, workbooks, worksheets and columns and graphing. Tools for numerical analysis in Chemistry. Curve fitting: Linear and Polynomial Fit. Statistics. Examples.

3. Creating databases with Microsoft Excel.

Introduction to a database: utilities. Use of Excel worksheets as simple databases. Sorting lists, multiple data filtering and auto filtering in Excel worksheets. Examples.

4. Useful databases in chemistry.

Management and utilities of NIST Chemistry webbook. Access to the abstract and citation index databases in the *Web of Science*. Other abstract and citation databases: Scopus, SciFinder and Google Scholar.

5. Computer resources for molecular symmetry.

Visualization of the symmetry elements and their operations in molecules. Introduction to molecular modelling software's.

6. Statistical analyses of the results obtained in the practical sessions.

Global average values and deviations of the results obtained by the students in the practical sessions. Average values by practice and group. Comparative charts between groups.

V.- COMPETENCES

■ GENERAL:



- **CG2:** To recognize the importance of Chemistry in different contexts and relate it with other areas of knowledge.
- **CG3:** To carry on their studies in specialized areas of chemistry or in multidisciplinary areas.
- **CG4:** To express rigorously the chemical knowledge acquired so that they are well understood in multidisciplinary areas.
- **CG6:** To analyse and solve qualitative and quantitative problems.
- **CG8:** To evaluate, interpret and synthesize data and chemical information.
- **CG12:** To interpret data from observations and measurements performed in the laboratory in terms of their significance and the theories that support them.
- **CG13:** To develop good scientific practices for measurement and experimentation.

■ **SPECIFIC:**

- **CE38-IAQ1:** To manage different databases.
- **CE38-IAQ2:** To interpret the data extracted from a database.
- **CE39-IAQ1:** To handle, at the user level, the most used software packages for data graphing and drawing molecules and crystals.
- **CE40-IAQ1:** To fit data with simple functions.
- **CE40-IAQ2:** To handle basic statistic tools.

■ **GENERIC:**

- **CT3:** To demonstrate critical thinking and self-criticism.
- **CT4:** Adaptability to new situations.
- **CT5:** To manage quality chemical information, bibliography, specialized databases and accessible resources from the Internet.
- **CT7:** To use the tools and computer packages for the treatment of experimental results.
- **CT11:** To develop self-learning capacity.

VI. – LEARNING OUTCOMES

After the course, in relation to the knowledge acquired in the seminars, the student should be able to:

Unit 1



1. Use a spreadsheet software, for instance Microsoft Excel, for simple mathematical calculations.
2. Perform mathematical operations that involve formulas predefined by the software
3. Represent experimental data and perform linear or polynomic fittings.

Unit 2

1. Use the Origin software for data calculation and graphing.
2. Fit experimental data with linear or polynomic functions.
3. Derive and integrate experimental data.

Unit 3

1. Create databases in Excel or similar computer programs that facilitate the control and management of the laboratory.
2. Employ ordering and filtering procedures to facilitate the search of information in the databases.

Unit 4

1. Search for basic chemical information (molecular formula, structure, thermodynamic data, etc.) of chemical substances.
2. Use the information extracted from the NIST database to solve simple chemistry problems, in which thermodynamic aspects are considered.
3. Get scientific and bibliographic information through the Web of Science (previously known as Web of Knowledge) online citation indexing service.

Unit 5

1. Identify and differentiate the point symmetry elements in basic molecules.
2. Draw molecules in two and three dimensions through molecular editor and visualizer platforms or molecular modelling programs.

Unit 6

1. Establish the basic statistical parameters (mean, median, mode, standard deviation, etc.) of a series of experimental measures, through the use of programs such as Microsoft Excel or Origin.
2. Calculate the statistical confidence limits of series of experimental measurements.
3. Determine the confidence limits of chemical variables calculated from regression models.

And with regard to the practical sessions, once completed, the student must be able to:

- Plot titration curves by using their own experimental data, and then perform their derivatives to establish the titration final point.



- Determine physicochemical parameters such as the Faraday constant, based on experimental data fitted to mathematical models.
- Calculate the variation of both the standard enthalpy and entropy of a reaction from equilibrium constants obtained at different temperatures.
- Analyse the experimental data obtained during a slow kinetic reaction and determine the order of the reaction and its rate constant.
- Establish the stoichiometry of coloured complexes by measurements of radiation absorption and graphic resolution of linear systems.
- Use a simple vacuum line to measure the vapour pressure of pure liquids as a function of the temperature. Calculate by means of least-squares fitting of the data the vaporization enthalpy of the liquid.
- Use spreadsheets to perform simulations and calculations related to acid-base equilibria.
- Draw molecular structures using the ACD/ChemSketch package.

VII. – WORKING HOURS DISTRIBUTED BY ACTIVITY

Activity	Attendance (hours)	Self-study (hours)	Credits
Lectures			
Seminars	25	25	2
Tutorials/ Guided work	3	4,5	0,3
Labs	30	45	3
Realization and presentation of individual exercises and exams	6	11,5	0,7
Total	64	86	6

VIII.- METHODOLOGY

The teaching practice will follow a mixed methodology based on cooperative learning, collaborative learning and self-learning. The training activities will be carried out through seminar classes (2 credits), computer room work (0.3 credits) and data collection in the laboratory (3 credits). During the seminar sessions, the most common applications of different software packages will be explained and in the computer room they will work with specific examples that, in some cases, may have been previously obtained in the laboratory. The elaboration of tutored works, reports and the completion of exams will suppose a total of 0,7 credits

Each student will undertake one weekly practical session, in a time slot different from their seminar sessions. In total there will be six experimental sessions in the laboratory and two



more in the computer room. After every two experimental sessions, the analysis of data will be performed in the computer room the day after the second one, except for the students of the group G (double bachelor's degree "Chemistry-Biochemistry") who will perform the analysis of data just after the laboratory session. This session will take place in the computer rooms and its duration will be two hours (one hour in the case of group G). Once an experimental session has been carried out, the laboratory instructors and their students will rotate. Each group of students and their instructor will proceed to perform the following experimental session and the calculations corresponding to these two experimental sessions in that week. The cyclic process will be repeated until all students have completed the six laboratory practical sessions and two in the computer room.

In parallel to the practical sessions, and in a schedule that does not interfere with these, a lecturer will give 14 **seminar sessions** (of 1 or 2 hours of duration) in the computer room. In these sessions the student will be introduced to the management and the main applications of different programs useful to solve problems in chemistry.

The **Virtual Campus** will be used to allow a fluid communication between lecturers and students and as an instrument to make available to students the material that will be used in the practical sessions and seminars.

IX.- BIBLIOGRAPHY

■ BASIC:

- Laboratory practical guide Ed. 2021.
- S.R. Crouch; F. James Holler: "*Application of Microsoft Excel in Analytical Chemistry*", Thomson Ed., Belmont, CA (USA) 2004.

■ COMPLEMENTARY:

- Origin video tutorials.
<http://www.originlab.com/index.aspx?go=SUPPORT/VideoTutorials>
- F. Rosino Alonso: "*Guía Visual de Excel 2007*", Anaya Multimedia, Madrid 2008.

If necessary, in addition to these texts, the students will be informed about the specific bibliography for each laboratory session.

X.- ASSESSMENT PROCEDURE

In order to access to the final evaluation, the student must have participated in at least 70% of all the face activities (seminars, tutorials, practical lab and computer sessions). Group changes due to the incompatibility with the activities of other courses or the recovery of unrealized practical sessions will not be allowed, regardless of the causes for the absence. The absence to a practical session will be qualified with a zero. In very exceptional cases, and by appropriate justification, the absence could be considered justified but no more than one practical session.

The evaluation and the final mark of the course will be made according to the following concepts and weighting coefficients. All marking scales have a score over 10 points, in agreement with the scale established in RD 1125/2003. It will be necessary to reach 5



points among all the activities to pass the course. This criterion will be maintained in all calls.

The marks of the practical sessions and tutorials/workshops will be communicated to the students with enough time, before the call of the final exam, so that they can properly plan the study of the course.

In any case, the minimum period of seven days between the publication of the marks and the date of the final exam will be respected.

■ **PRACTICAL SESSIONS:**

20%

It's 20% of the final mark. To pass the subject in the ordinary call, the students may not have failed more than 3 practices. The absence to a practical session implies a zero score in this practice and the non-admission of the corresponding report.

For those students who have not passed the minimum number of practices, a theoretical-practical examination will be carried out in the extraordinary call, which will consist of carrying out one of the practices previously performed during the course chosen at random and answering a series of questions on aspects related to the practical sessions and to the seminars.

Evaluated competences: GC4, GC6, GC8, GC12, GC13, SC39-ACC1, SC40-ACC1, SC40-ACC2, TC3.

■ **PERSONAL WORK:**

20%

It's 20% of the final mark and consist in the preparation of reports. The student must present a report corresponding to each practical session, that must be written in electronic format using the appropriate office tools in a term and according to a pre-established calendar. The presentation of the report after the deadline or without the established format will result in a penalty with a reduction of the qualification of the practical session. Failure to present such report will be equivalent to an absence to the practical session, so will be qualified ZERO.

Associated competences: GC6, GC8, GC12, SC38-AAC1, SC38-AAC2, SC39-AAC1, SC40-AAC1, SC40-AAC2, TC3, TC5, TC7, TC11.

At the end of the practical sessions term and after the presentation of the reports, the lecturer will publish a mark for each practice, with a score between 1 and 10 points. The mark must reflect the work in the laboratory, considering the operations carried out during each session as well as the results obtained, the student's willingness to learn, the correct presentation of the reports and the understanding of the theoretical-practical aspects.

■ **TUTORIALS/ GUIDED ACTIVITIES (SEMINARS):**

10%

In the seminar classes, problems and practical examples will be proposed to the students, that must have solved them and delivered before the deadline indicated by the seminar lecturer for each of the cases. The mark obtained in this activity will represent



10 % of the final mark and it will be necessary to reach a **minimum mark of 3 points** to pass the subject in the ordinary call.

Associated competences: GC6, GC8, GC12, SC38-AAC1, SC38-AAC2, SC39-AAC1, SC40-AAC1, SC40-AAC2, TC3, TC5, TC7, TC11.

■ FINAL EXAM:

50%

Only the students who have attended 70% of the face-to-face activities and have passed the practical sessions (5 points) and tutorials/workshop (3 points) may take this exam. The students who have lost the right to take the final exam because they did not meet these requirements will be classified as FAIL in the ordinary call record.

The final exam will take place at the end of the second semester at the date, time and place previously fixed by the academic authorities of the centre. In this exam, no longer than three hours, the students must demonstrate the knowledge acquired in the practical and seminar sessions by answering a series of theoretical questions related to all aspects of the work carried out both in the laboratory and in the computer room. The qualification of this exam will suppose 50% of the final mark, being necessary, for weighting purposes with the other qualifications, that the student obtains at least a **mark of 4 points**.

Re-sit: for those students who fail more than 3 practices, or whose mark, once the weightings have been applied, does not reach the minimum score of 5 points, must attend the extraordinary call. This exam will be only theoretical for those students who, even though they failed the course in the ordinary call, have passed the practical session (with 3 or less practices suspended). For those students who lost the right to the final exam in the ordinary call due to their absence at face-to-face activities, for having failed more than 3 practices, or for not having passed the average mark of 5 points in the set of practices, in the extraordinary call they will pass a theoretical-practical exam, having both parts the equal weight. The final mark of this extraordinary exam will be obtained from the average between both parts, being necessary a score equal to or greater than 4 points out of 10 in each part. Those students who have not achieved a minimum mark of 3 points in the guided activities must deliver, before the extraordinary call, a set of activities similar to those carried out throughout the course and get a minimum mark greater than 3 points.

Associated competences: GC6, GC13, TC3, TC4, TC11.


ACTIVITY SCHEDULE
SEMINARS and TUTORIALS

UNIT	ACTIVITY	HOURS	START	END
1.- Working with Microsoft Excel	Seminar	7	1 th week	4 th week
	Tutorial	1	4 th week	
2.- Working with Origin	Seminar	7	5 th week	8 th week
	Tutorial	1	8 th week	
3.- Creating databases with Microsoft Excel	Seminar	2	9 th week	
4.- Useful databases in chemistry	Seminar	2	10 th week	
5.- Computer resources for molecular symmetry	Seminar	5	11 th week	13 th week
6.- Statistical analyses of the results obtained in the practical sessions	Seminar	2	13 th week	14 th week
	Tutorial	1	14 th week	

Seminars and tutorials schedules
 (all weeks of the semester)

Group	Schedule	Room
E	Thursday (11:30 – 13:30)	QC26



PRACTICAL SESSIONS SCHEDULE

Group	Schedule	Place
E	Wednesday (15:30 - 18:30)	General Chemistry Laboratory
	Thursday (15:30 - 17:30)	Computer Room

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SUMMARY OF ACTIVITIES (in hours)

Teaching activity	Associated competences	Lecturer activity	Student activity	Learning assessment	P	NP	Total	C
Seminars	GC2, GC3, GC4, GC12, GC13, SC38-ACC1, SC38-ACC2, SC39-ACC1, SC40-ACC1, SC40-ACC2, TC4, TC5, TC7.	Explanation of relevant aspects for the development of the practical sessions. Preparation for the discussion of data and results. Presentation of the theoretical knowledge necessary to solve the practical problems.	Attendance and active participation. Note-taking. Formulation of questions and doubts.	Qualification of the written answers (approach and result) for the resolution of practical exercises and numerical problems	25	25	50	10%
Tutorials		Direction and supervision of the student's study and activities. Asking questions. Resolution of doubts or queries.	Consult the lecturer about the conceptual and methodological difficulties encountered when studying the subject. Approach of questions and response to the proposals made by the lecturer.		3	4,5	7,5	
Laboratory	GC4, GC6, GC8, GC12, GC13, SC39-ACC1, SC40-ACC1, SC40-ACC2, TC3.	Supervision and advice on the appropriate procedure for the work during the practical sessions. Explanation of the most relevant theoretical issues of each session.	Attendance and completion of the tasks proposed by the instructor. Collection and interpretation of measured or calculated data.	Evaluation of the experimental work and the procedures employed.	30	45	75	20%
Individual work	GC6, GC8, GC12, SC38-ACC1, SC38-ACC2, SC39-ACC1, SC40-ACC1, SC40-ACC2, TC3, TC5, TC7, TC11.	Support the students in the resolution of problems that may arise in the preparation of the laboratory notebook or the required reports. Guide the students in the handling of the computer programs.	Preparation of the laboratory notebook and reports requested by the instructor in each practical session.	Review of the laboratory notebooks and reports.		11,5	11,5	20%
Exams	GC6, GC13, TC3, TC4, TC11.	Proposal, monitoring and correction of exams. Students qualification.	Preparation and realization of exams and/or test	Evaluation of the practical and written works	6		6	50%

P: In-class; NP: Self-study; C: Evaluation



SCENARIO 2. BLENDED COURSE

VIII.- METHODOLOGY

- **Seminars and tutorials** will be taught by the lecturer in the usual regime, as in Scenario 1, and with the same content. Following the principle of maximum attendance approved by the UCM rectorate, the session will be followed on-site by the students, up to full capacity of the classroom, considering social distance. Students located in classrooms equipped with cameras, and that do not fit in the classroom, will follow the session virtually, either at their home or in public areas enabled by the Faculty for this purpose, which will be duly publicized in the VC. For those classrooms without a camera, a rotating shift of students to attend the on-site class will be established, according to their ID number. This procedure may be modified by the lecturer throughout the course, as he deems appropriate, to adjust the capacity of the classroom with the number of students attending his class.
 - The materials for teaching will be the class presentations and scientific software available in the UCM Virtual Campus also used in Scenario 1, as well as videos related to the subject and other type of specific material considered of relevance and interest by the lecturers. All this material will be available in advance for students through the Virtual Campus.
 - The telematic platforms used by the students without attendance to the classroom to virtually follow the sessions will be the following: Microsoft Teams available on the VC, Google Meet or Zoom. The lecturer will keep such a session open to maintain a direct and fluid relationship with the students who attend virtually, thus being able to simultaneously project the PowerPoint presentation, to teach how to manage the different software's (Excel, ORIGIN and AVOGADRO) and follow the traditional explanations that are given on the blackboard.
- - The resolution of a test is planned before the beginning of each lab session.
- - The delivery of each lab session is structured in three parts: theoretical-practical introduction, experimental procedure and treatment of results.
- - The experimental procedure will be developed on-site in the lab. However, in the particular cases that this cannot be feasible, the use of recorded material or commercial videos is planned.
- - The other two parts will be taught according to one of these situations, or combinations between them:
 - (a) Face-to-face in a classroom, thus maintaining greater social distance.
 - (b) Virtual in synchronous sessions
 - (c) Virtual in asynchronous sessions.
- - The teaching material used will be the same described in Scenario 1. In addition, written material in the form of manuals, numerical results and graphics and / or PowerPoint presentations accompanied by explanations will be provided to the students through the VC.
- **Laboratory sessions** are planned with a 60% of minimum general attendance in order to keep the necessary social distance. Considering the particularities of each practice, in some cases the attendance may be slightly modified. The experimental teaching organization is based on the following aspects:
 - The resolution of a test is planned before the beginning of each lab session.



- The delivery of each lab session is structured in three parts: theoretical-practical introduction, experimental procedure and treatment of results.
 - The experimental procedure will be developed on-site in the lab. However, in the particular cases that this cannot be feasible, the use of recorded material or commercial videos is planned.
 - The other two parts will be taught according to one of these situations, or combinations between them:
 - (a) Face-to-face in a classroom, thus maintaining greater social distance.
 - (b) Virtual in synchronous sessions.
 - (c) Virtual in asynchronous sessions.
 - The teaching material used will be the same described in Scenario 1. In addition, written material in the form of manuals, numerical results and graphics and / or PowerPoint presentations accompanied by explanations will be provided to the students.
 - All this material will be available in advance for students through the Virtual Campus.
- **Individual tutoring**
They will be held by video conference and/or email.
 - **Monitoring of students**
During on-site teaching, the same techniques used in a traditional way will be followed. During the online teaching, the monitoring can be carried out by various techniques, as the lecturer considers: using the activity registration tool for each session (Microsoft Teams), the name of the attendees (Google meet), signature sheet enabled in the VC as a questionnaire, analysis of downloads made by students in the VC, etc.

ASSESSMENT PROCEDURE

There will be on-site exams with the same procedure described in Scenario 1.



SCENARIO 3. ONLINE COURSE

VIII.- METHODOLOGY

- **Virtual seminars and tutorials** Seminars and tutorials will be carried out preferably by videoconference through the Microsoft Teams tool available on the Virtual Campus, also using narrated PowerPoint presentations and demonstration videos. The forum available in the Virtual Campus will be enabled for the consultation of doubts in which all students can participate. Google Meet or Zoom apps will be used for individualized or small group tutorials and seminars. In these sessions the most common applications of different software packages and useful databases in chemistry will be explained.
- The **lab sessions** will be replaced by virtual **synchronous sessions** supported by explanatory presentations.
 - The material detailed below is available in the VC of each subgroup of the lab:
 - Lab manual.
 - Explanatory videos or particular pictures for each practice.
 - Excel, Origin and ChemSketch tutorials.
 - Sheets of experimental data.
 - Preparation of the practice and data processing prior to the synchronous session.
 - 1 synchronous session with Google Meet / Microsoft Teams.
 - Grabación de la sesión síncrona

X.- ASSESMENT PROCEDURE

DESCRIPTION OF THE ASSESMENT PROTOCOL

- **Identification process of students:**

Students will identify themselves by sending through the Virtual Campus "task" tool, a signed declaration document indicating that they know the regulations for the development of the test and that they will maintain ethical behavior during the test.

- **Type of exam:**

The virtual exam of the ordinary call will consist of delivery of exercises through the Virtual Campus "task" tool with a delivery time limit of 2.5 h. In advance, detailed information on the development of the exam will be provided through the Virtual Campus of each seminar group.

- **Monitoring of students during the test:**

To track the exam, the Google Meet tool will be used. Students must connect to the Google Meet session provided by their lecturer and activate the webcam of their computer equipment throughout the exam. Those students who do not have a webcam on their computer must connect via mobile phone. To maintain privacy in the resolution of particular doubts during the test, if any, students will communicate with their teacher through emails or chats using the Virtual Campus.



- **Exam review:**

Synchronous reviews will be conducted. Previously the students must notify their intention to attend the review to allocate time slots for each.

- **Mechanism proposed for the documentation/recording of assessment exams for subsequent viewing and evidence**

As it is an exam with the delivery of exercises through the “tasks” tool, the delivery of these exercises supposes a record of evidences of the exam.

The lecturer will keep the files (in the specified electronic format) of the exam exercises sent by the student, with the partial grades that he deems appropriate. In addition, the recording of the exam session may be carried out, with the limitations established by the UCM, for a subsequent review if necessary. The recording, if made, will be stored with the necessary security measures in UCM computers and will be eliminated after the exam review.