VNIVERSITAT DE VALÈNCIA

Course Guide
36594 Laboratorio de Química

COURSE DATA

Data Subject	
Code	36594
Name	Laboratorio de Química
Cycle	Grade
ECTS Credits	7.5
Academic year	2020 - 2021

Study (s)

Degree	Center	Acad. year	Period
1929 - D.D. in Physics-Chemistry	Double Degree Program Physics and Chemistry	1	First term

Subject-matter

Degree	Subject-matter	Character
1929 - D.D. in Physics-Chemistry	1 - Primer Curso (Obligatorio)	Obligatory

Coordination

Name	Department
CLEMENTE JUAN, JUAN MODESTO	320 - Inorganic Chemistry

SUMMARY

This course is a compulsory basic course taught in the first semester of the first year of the Double Degree in Physics and Chemistry, with a volume of 7.5 credits. In it, it is essentially intended that the student learn the operation and basic work techniques that they will develop in a chemical laboratory, and the preparation, recording, analysis and presentation of results of an experimental work. In this way, the essential foundations will be established so that you can subsequently successfully tackle the experiences of the different branches that are part of Chemistry.

In this specific subject the security, analysis and interpretation of data necessary for the development of any chemical experience will be addressed, as well as the management and treatment of data obtained in any chemical laboratory. For this, experiments will be carried out in which different basic techniques must be used, so that they can then be applied to more complex tests.

It is assumed that students know and use, in a basic but clear way, the concepts taught in the last year of High School Chemistry. However, all the scripts include a theoretical introduction and whenever necessary additional teaching material will be provided to cover those deficiencies that are detected.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

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

Other requirements

No enrollment restrictions have been specified with other subjects in the curriculum.

It is assumed that students know and use, in a basic but clear way, the concepts taught in the last year of High School Chemistry. However, all the scripts include a theoretical introduction and whenever necessary additional teaching material will be provided to cover those deficiencies that are detected.

OUTCOMES

LEARNING OUTCOMES

In the Chemistry Laboratory subject, the competences corresponding to the Chemistry Laboratory I (34185) and Chemistry Laboratory II (34186) subjects are acquired.

At the end of the Chemistry Laboratory course, the student is able to:

• Distinguish and recognize the most frequently used standard laboratory equipment: glass (volumetric and non-volumetric), electrical equipment and assemblies (heating mantle, distillation, rotary evaporator, scales, melting point apparatus, etc.).

• Know the waste minimization protocols.

• Understand and distinguish the information on the labeling of laboratory products, especially that referring to Safety Standards, H and P phrases, pictograms, etc.

• Use common devices such as the Bunsen burner or the vacuum pump.

• Distinguish between the different types of filtration, depending on the objective pursued.

• Accurately prepare a conical filter and a pleated filter.

• Separate well-differentiated products based on their solubility, using processes such as decantation and choosing the appropriate solvent.

• Accurately manipulate the different types of filtration, both hot and cold.

• Estimate the amount of solute that can be dissolved in a solvent based on its solubility (obtained from the literature).

• Know the phase changes that can be caused in a compound when we are in the laboratory.

• Know the safety measures to take into account when handling and heating flammable liquids.

• Assemble a simple distillation equipment whose objective is to measure the boiling point of a liquid.

• Calculate the efficiency (performance) of the distillation process.

• Properly measure the melting point of a crystallized solid.

• Correctly manipulate the melting point apparatus and select the appropriate program as required.

• Know the liquid-liquid extraction technique.

• Know what characteristics an organic solvent must possess to use it in an extraction.

• Handle a sloping funnel with precision, taking into account the safety protocol.

• Know the procedure to isolate the aqueous phase and the organic phase of the extraction process.

• Know when and at what stage a desiccant (anhydrous salt) should be added.

• Correctly use the quantities and their units in the laboratory processes that involve measurements or quantitative calculations.

• Adequately estimate the errors made in the measurements (absolute, relative error, standard deviation, etc.).

• Correctly carry out the hot filtration process to achieve the most perfect crystallization possible.

• Use the thin layer chromatography technique to identify a previously purified compound.

• Choose the appropriate eluent depending on the polarity of the compound to be identified.

• Adequately distinguish between the functions of the stationary phase and the eluent in the thin layer chromatography technique.

• Know which are the possible eluents to use and know how to order them by their polarity.

• Precisely calculate the amount of solid or liquid needed to prepare a solution of a certain concentration.

• Accurately handle volumetric material in the process of preparing a solution.

• Determine qualitatively and quantitatively the expected pH value for prepared solutions (both acids and solid salts).

• Use the pH-meter accurately in the process of measuring the pH of a solution.

• Know the standardization procedure of a solution and the volumetric material necessary for it.

• Properly manipulate a burette to make an assessment.

• Know what an indicator is and what are the conditions in which its use is useful: in which interval it changes and for what type of valuations it is suitable.

• Know the use of primary patterns and their characteristics.

• Determine the concentration of a solution from a valuation process, calculating the errors made, the standard deviation, etc.

• Precisely prepare solutions by dilution, from a stock solution.

• Make stoichiometric calculations applied to a reaction where there is a limiting reagent.

• Determine the molar mass of $CaCO_3$ by two methods: gravimetric and volumetric.

• Estimate $CaCO_3$ richness by weight in a test sample.

• Analyze the effect of H + ion concentration on the chromate ion-dichromate ion balance.

• Deduct and check the effect of the common ion in simple aqueous solution equilibria (acetic acid, ammonia, etc.)

• Analyze the redissolution of precipitates of metal hydroxides due to the effect of various factors (addition of an acid, formation of a complex, etc.)

• Confirm the existence of reversible and irreversible reactions.

• Analyze the influence of temperature on complex ion equilibria.

• Prepare the assembly to perform a potentiometric evaluation (burette, pH meter, etc.).

• Interpret the behavior of some metals against an HCl solution, according to their reducing power. Check the reaction products by means of specific reactions of the same.

• Obtain a metal from a solution of one of its salts making it react with another more reducing metal.

• Study the influence of some factors on redox reactions, such as pH or complex formation.

• Build galvanic cells with the appropriate mounting (electrodes, salt bridge, voltmeter, etc.) and predict the theoretical voltage that the system should give based on the reduction potentials.

• Prepare an assembly with a U-tube, to provoke an electrolysis reaction, specifically of a potassium iodide solution. Identify the products formed on the electrodes with specific reactions.

• Prepare the appropriate assembly to analyze the migration of metal ions as an example of an electrochemical process in solving environmental problems.

• Determine the hardness of a water sample by means of a complexometric evaluation, using EDTA as titrant and NET as indicator.

• Prepare the appropriate assembly to perform a softening process of a sample of problem water by exchanging the divalent Ca and Mg ions for the Na + ion.

• Carry out a process of deionization of a sample of test water, by exchanging cations for H + and anions for OH–.

• Carry out the pertinent verifications through different tests to interpret whether the softening and deionization processes have been correct (measurement of ionic conductivity, pH, or test for the presence of chlorides).

• Experimentally determine the rate constant and the order of a reaction using a photocolorimetric technique.

• Use the UV-visible spectrophotometer to experimentally measure the absorbance variation of the crystal violet discoloration reaction in basic medium.

• Obtain the graph of the variation of concentration versus time in the kinetics of discoloration of crystal violet

• Calculate the partial reaction orders and the absolute speed constant in the crystal violet discoloration reaction.

DESCRIPTION OF CONTENTS

1. Prevention Session

Prevention and fire performance in buildings for teaching-university use.

2. Seminar 1

Presentation.
Management and organisation of laboratory work.
Preparation of experimental work.

3. Safety and Laboratory Material.

Safety rules. Simplified sheets of compounds. Pictograms. H and P phrases. Laboratory material (glass material, electrical material, assemblies, lighter, vacuum pump, etc.). Types of filtration. Use of the balance. Direct weighing and tare. Waste. Waste minimization program.

4. Dissolution, precipitation and crystallization.

Dissolution and solubility. Precipitation and crystallization.
Solid-liquid separations: decantation and filtration.

5. Characterisation of Liquids and Solids.

Distillation. Boiling point determination.
Melting point determination.

6. Liquid-Liquid Extraction

Separation and isolation of organic unknown compounds.
Extracting solvents.
Aqueous phase and organic phase.

7. Chemical equilibrium.

Chemical reactions in the test tube.
Factors influencing chemical equilibrium.
Reversible and irreversible reactions.

8. Crystallization and identification of compounds.

Session A: Purification (crystallization) and identification of an organic acid.
Session B: Purification (crystallization) and identification of a neutral compound.
Characterisation and identification by melting point.
Thin layer chromatography.

9. Seminar 2

Presentation of results.
Physical magnitudes. Units system.
Measurement and experimental error.
Accuracy and precision. Significant figures.

10. Preparation of Solutions and Measurement of pH.

Acidity, alkalinity, equilibrium and pH.
Preparing solutions of different concentrations.
Solutions from commercial products (solid salts).
Use of the pH-meter and pH measurements.

11. Seminar 3

Analysis and discussion of the results of practices P2 to P5.

12. Acid-Base Titration.

Stoichiometry and neutralisation of acid-base reactions.
Indicators in acid-base titrations.
Use of primary and secondary standards.

13. Potentiometric titration.

Primary standards.
Titration curves.
Determination of water self-ionization constant(Kw).
Determination of acidity constant of acetic acid.

14. Determining water hardness.

Determination of the hardness of a water sample by means of a complexometric titration with EDTA. Ionic exchange. Softening and deionization. Measurements of ionic conductivity and pH. Chlorides test.

15. Practice 11. Stoichiometric Calculations.

Reaction between calcium carbonate and hydrochloric acid.
Molar mass determination of CaCO3.
Percentage purity of an unknown sample.
Gravimetric and volumetric methods.

16. Electrochemistry.

Behaviour of some metals in HCl solution.
Influence of pH and complex formation on redox reactions.
Construction of galvanic cells.
Electrolysis.

17. Kinetics.

Discoloration kinetics of "crystal violet". Instantaneous rate constant. Experimental determination of the rate constant and the order of reaction. Photocolorimetric technique. Apparent rate constants and absolute rate constant.

18. Seminar 4

Analysis and discussion of results of all the practices.

19. Evaluation

Final evaluation session.

WORKLOAD

ACTIVITY	Hours	% To be attended
Laboratory practices	60,00	100
Tutorials	15,00	100
TOTAL	**75,00**	

TEACHING METHODOLOGY

In this subject, you will take part in your training activities: the practical classes of laboratories and seminars.

In the laboratory practical sessions, there will be a global vision of the basic treball of a chemistry laboratory. It is intended that the students acquire a stress in the execution of the technical techniques of the treball d'un laboratori. They must familiarize themselves with the mechanisms of security and management, handling of material and equipment, handling and presentation of data, prey for decisions and choice of the most appropriate procedure, if applicable. A standard session will consist of the initial discussion of the questions that each practice has (which the student must carry out resolutions), and which will serve as the basis for introducing the theoretical concepts on which the practice is based and discussing the possible doubts or special precautions that is required. The important part of the session will be treball and handling of materials and products, depending on the object of the practice (the main part of the experimental procedure is to be registered for the student in the seu quadern de laboratori). And at the end of the session it is convenient to find an inn in common with the results advices, an interpretation of the results and a reflection regarding whether they have advised the object proposals.

S'han programat quatre seminaris adionaless and independents de les sessions de laboratori, which will serve to reinforce the aprenentatge d'aquestes, bé tractant temes monogràfics (per exemple, tractament de magnitudes, unitats i càlcul d'errors), bé per a Resoldre or analyze dubtes that make sorgit in the tractament and interpretation of the results of the practices.

As this is the first laboratory to which the first-year students accessed, there are plans for additional activities related to prevention and management of residus:

- Workshop on Prevention and extinction of fire, taught by the official prevention chapter of the Provincial Consortium of bombers of Valencia.

- Lecture on tractament of residus in the laboratories of the Faculty of Chemistry, taught by a technician of the Laboratory of General Chemistry, and the objective of which is to make students aware of the minimization process and correct management of the residus d'un laboratori d'aquestes caracteristiques.

EVALUATION

Attendance at practical laboratory classes is mandatory. A maximum of two sessions will be allowed excused absence (preferably, their recovery should be suggested in some other subgroup).

The evaluation of student learning will be formative in nature and will be carried out addressing different aspects that are part of two blocks with well-differentiated characteristics:

a) Continuous evaluation

Those aspects that require a continuous evaluation of the progress and of the work developed throughout the course are part of this section. For this, the following will be taken into account: the active participation in the seminars, the resolution of all those questions and problems that are proposed to them so that they work independently, and of course, the handling in the laboratory, the monitoring of the rules of security and lab notebook.

Given that the work in the laboratory, the work of preparing the experience and the preparation of the notebook implies a continuous evaluation process throughout the course, the grade obtained for these three sections, in the first call, will be maintained in the second . The sections listed below, together with the percentage of the grade, cannot be recovered, if necessary, on the second call. Only in the case of the laboratory notebook will a partial recovery of those sections that correspond to the treatment and interpretation of the results be allowed.

1. Preparation of the experience (including previous questions): 20%

2. Laboratory work: 20%

3. Laboratory notebook (including post-laboratory questions): 20%

b) Evaluation of specific activities

The knowledge and skills acquired will be evaluated through tests throughout the course and / or an exam common to all subgroups of the subject that will be carried out at the end of the laboratory work, on an official call date. The oral and written presentation of a laboratory report is also part of this section.

4. Memory of a laboratory practice: 20%.

5. Assessment exercises (including the final exam of the subject): 20%

In order to pass the course, a grade equal to or greater than 4 points is required in each of the five sections that make up the evaluation, and the weighted sum of all of them reaches 5 points.

REFERENCES

Basic

- PETRUCCI, R.H.; HERRING, F.G.; MADURA, J.D. y BISSONNETTE, C. Química General. 11ª Edición. Madrid: Pearson Educación, 2017. ISBN: 9788490355336
- CHANG, R. y GOLDSBY, K.A. Química .11ª edición. México: Mc Graw Hill, 2013. ISBN: 9786071509284
- OLBA A., Química general. Equilibri i canvi. València, Universitat de València, Servei de Publicacions, 2007. ISBN 9788437068435
- Petrucci, R.H. et al. 11ª edición, 2017 (on-line) http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=6751
- Chang, R.; Goldsby, K.A., 11ª edición, 2013 (on-line) http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=4277

Additional

- BROWN, T.L.; LEMAY, H.E.; BURSTEN, B.E.; MURPHY, C.J., WOODWARD, P.M. Química. La Ciencia Central. 12ª Edición. México: Pearson Educación, 2013. ISBN: 9786073222372
- ATKINS, P. y JONES, L. Principios de Química. Los Caminos del Descubrimiento. 5ª Edición. Buenos Aires: Médica Panamericana, 2012. ISBN: 9789500602822
- PETERSON, W.R. "Introducción a la nomenclatura de sustancias químicas" Barcelona: Ed. Reverte, 2010. ISBN 9788429175721
- Brown, T.L. et al., 12ª edición, 2014 http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=4690

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

1.- The contents initially indicated in the teaching guide are maintained.

Workload and temporary teaching planning

Regarding the workload:

1.- The different activities described in the Teaching Guide are maintained with the intended dedication.

Regarding the temporary teaching planning:

2.- The material to follow the theory/tutoring/classroom-seminar classes allows to continue the temporary teaching planning both in days and schedule, whether the teaching is face-to-face in the classroom or not, although in some of the activities the student has the freedom to follow the non-face-to-face sessions according to his own planning.

Teaching Methodology

Laboratory courses: With regard to laboratory courses, the maximum face-to-face teaching will be lying in compliance with the rules of distance and occupation of spaces fixed by the academic authorities. In this sense, the teaching type "L" will be 100% face-to-face, and the teaching type "U" will be non-face-to-face and will be taught through the tools offered by the virtual classroom. [Indicate if there is any variation with respect to the teaching guide (individual work ...)]

The methodology used for non-face-to-face classes shall be:

1. Synchronously using virtual classroom tools (Teams, Blackboard ...)

2. Asynchronously using locut power-point presentations or other virtual classroom tools

3. Resolution of exercises and questionnaires

If there is a closure of the facilities for health reasons that totally or partially affects the classes of the course, they will be replaced by non-face-to-face sessions following the established schedules and using the tools of the virtual classroom.

Evaluation

1. The possibility of exam-only evaluation is eliminated.

2. The evaluation system described in the Teaching Guide of the subject in which the various evaluable 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 health reasons affecting the development of any face-to-face evaluable activity of the subject, it will be replaced by a test 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 subject will remain unchanged, as set out in this guide.

References

2.- The literature recommended in the Teaching Guide is maintained since it is accessible, and it is complemented by notes, slides and problems uploaded to the Virtual Classroom as material of the course.