SUBJECT GUIDE OF

BASIC PRINCIPLES OF CHEMISTRY

Academic year 2020-2021
(Last update: 16/07/2020)
(Approval date: 17/07/2020)

MODULE	CONTENT	YEAR	TERM	CREDITS	TYPE
Chemistry	Basic Principles of Chemistry (PBQ)	1º	1º	6	Basic

LECTURERS	POSTAL ADDRESS, PHONE, E-MAIL
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DEGREE	OTHER POSSIBLE DEGREES
Degree in Pharmacy	Human nutrition and dietetics Food Science and Technology

PREVIOUS REQUIREMENTS AND/OR RECOMMENDATIONS (if necessary)

- Knowledge of basic math operations.
- Bachelor of Science degree.

SUMMARY OF CONTENTS

- Atomic structure
- Electronic configurations
- The periodic system
- Chemical bonds: Covalent, ionic and metallic. Intermolecular interactions.
- Reactions in aqueous media: acid-base, oxidation-reduction and precipitation equilibria.

GENERAL AND SPECIFIC SKILLS

A. General Skills

- Identify, design, collect, analyze, control and produce drugs and medicines, and other products and raw materials of medical interest for human or veterinary use.

- Learn how to apply the scientific method and acquire skills in handling legislation, sources of information, literature, protocol development and other aspects that are necessary for the design and critical assessment of preclinical and clinical trials.

- Design, implement and evaluate reagents, clinical analytical methods and techniques, knowing the basics of clinical analyses, and the characteristics and contents of the reports of laboratory diagnosis.

- Develop capabilities to perform health and hygiene analysis, especially those related to food and the environment.

- Improve the communication skills, both oral and written, to deal with further patients and users. Enhance the collaborative capabilities within multidisciplinary teams, including those related to other professionals of health.

B. Specific Skills

- Identify, design, collect, analyze and produce active compounds, drugs and another products and materials of sanitary interest.

- Select appropriate techniques and procedures for the design, implementation and evaluation of reagents, methods and analytical techniques.

- Perform standard laboratory procedures including the use of scientific equipment for synthesis and analysis of compounds of interest.

- Estimate the risks associated with the use of chemical and laboratory procedures.

- Know the physical and chemical characteristics of the substances used for the production of medicines.

- Know and understand the characteristics of reactions in solution, the different states of matter and the principles of thermodynamics and its application to pharmaceutical sciences.

- Understand the properties of the elements and their compounds, as well as their application in the pharmaceutical field.

OBJECTIVES (EXPRESSED IN TERMS OF EXPECTED RESULTS OF THE TEACHING PROGRAMME)

Students should be able to demonstrate knowledge and understanding of:

- the atomic structure and the radioactive processes related to the nucleus.
- the electronic structure, the Periodic Table and the relationship between the electronic configurations of the elements and their properties.
- the properties of chemical elements, playing important role in biological systems, in relation to their electronic configurations.
- the relationship between chemical and physical properties of the compounds (including pharmaceutical preparations) with the nature of the bond that is established between the componenents (i.e., ions, atoms or molecules).

- the acid-base and redox processes taking place in solution, including the calculations needed for balancing the acid-base equations and for optimizing use of antioxidants in the pharmaceutical preparations.

SYLLABUS CONTENT

Theoretical contents:

Unit 1.- Chemical reactions I: Acid-Base.
Acid-base concept: Arrhenius, Brönsted Lowry and Lewis models. Relative strengths of acids and bases in aqueous solution, dissociation constants. Buffer solutions. Buffers in biological systems. Significance of acid-base reactions and buffers solutions in pharmaceutical preparations.

Unit 2.- Chemical reactions II: Redox.
Definition and general principles. Concept of half-reaction potential and standard potential. Influence of temperature and concentration on potential: Nernst equation. Antioxidants: concept and mechanism of action. Concentration cells. Redox reactions of biological interest.

Unit 3.- Chemical reactions II: Precipitation.
Definition of Solubility. Relationship between solubility and solubility product constant. Factors affecting solubility. Solubility in relation to the solvent. Precipitation reactions of biological interest.

Unit 4.- The Atom.
Introduction: Evolution and the current concept of atom: the standard model. The atomic nucleus: constituents, structure, stability and nuclear reactions. Nuclear properties of biomedical interest. Extra-nuclear Structure: Introduction. Atomic Models based on classical mechanics: Atomic Model Bohr-Sommerfeld. Atomic model based on Wave Mechanics. Electronic configuration of multielectron atoms.

Unit 5.- Periodic Table of the Elements.
The Periodic Table: Description and types of items. Non-periodic and periodic properties of the elements. Relationship between the chemical properties of the elements and their participation in the functioning of biological systems.

Unit 6.- Chemical bond I: Electrostatic model. Ionic bond.
Chemical bonding: Definition and models. Electrostatic model. Application of the electrostatic model to ionic lattices: stoichiometry of ionic networks, networks and energy ionic lattice types. Main properties of ionic compounds. Lattice defects. Ion polarization and partial covalent nature of the ionic bond.

Unit 7.- Chemical bond II: Electron-pair bonding model. Covalent bond.
Introduction. Valence bond (VB) theory: Application of VB to the study of the molecular species. Valence shell electron pair repulsion (VSEPR) theory. Molecular orbital (MO) theory: Application of the MO theory to the study of simple molecular species.

Unit 8.- Chemical bond III: Bonding in coordination compounds.
Introduction: nomenclature, geometry and isomerism of coordination compounds. Application to Covalent bond: Stereochemistry and binding energy. Application to Electrostatic bond: crystal field theory (CFT), energy splitting and crystal field stabilization. Stability. Factors affecting the stability of the complexes: chelate effect and effect macrochelate. Stability assessment. Stability constants. Coordination compounds in aqueous solution.

Unit 9.- Chemical bond IV: Bonding in metals and Intermolecular forces.
Introduction. Metal Networks. General properties of metals. Application of Covalent Model: Stereochemistry and energy bands. Conductors, semiconductors and insulators. Application of electrostatic model to the study of intermolecular interactions: links by Van der Waals forces. Hydrogen bonds; π- π interactions between aromatic rings. General properties of substances that have their origin in intermolecular bonds. Hydrogen bonds and biological systems.

Practical contents:
Practice 1.- Introducing the laboratory: how to behave and work in the laboratory.
Practice 2.- Preparation of solutions of interest.
Practice 3.- Titration experiments: acid-base titrations; oxidation-reduction titrations.
Practice 4.- Preparation of buffer solutions.
Practice 5.- Separation of ions by precipitation reactions.

BIBLIOGRAPHY / RECOMMENDED READING

1.- Navarrete Casas, R., Sánchez-Polo, M. Principios Básicos de Química para estudiantes de Farmacia. Ed. Fleming, 2019.
2.- Ralph H. Petrucci, F. Geoffrey Herring, Jeffry D. Madura y Carey Bissonnette. Química General: principios y aplicaciones modernas. Undécima edición. Pearson Educación, S.A., Madrid, 2017.
3.- E. Colacio Rodriguez. Fundamentos de enlace y estructura de la materia. Base Universitaria. Editorial Anaya, 2004 (Madrid).
4.- Jonnes Atkins. Principios de Química. Los caminos del descubrimiento. Ed. Panamericana.
5.- Raymond Chang. Química. Novena edición. McGraw Hill, 2007.
6.- Stanitski Moore, Wood and Kotz. El mundo de la Química. Ed. Pearson
7.- Química. Un proyecto de la ACS. Ed. Reverté, 2005.
8.- Antonio Navarrete y A. García. La Resolución de problemas de Química. Base Universitaria. Ed. Anaya, 2004.
9.- Cristóbal Valenzuela. Química General e Inorgánica para estudiantes de Farmacia. Ed. Universidad de Granada, 2002.
10.- W.R. Petterson. Fundamentos de nomenclatura química. Editorial Reverté. Año 2012

RECOMMENDED LINKS

- Periodic system: http://www.mcgraw-hill.es/bcv/tabla_periodica/element/elemento1.html
- Orbital Viewer: http://www.orbitals.com/orb/ov.html
- Web site of the department of inorganic chemistry: http://farmacia.ugr.es/cont.php?sec=5&pag=1#26
- Web site of the Faculty of Pharmacy: farmacia.ugr.es

TEACHING METHODOLOGY

The teaching will be based on:
- Exposition of theoretical lectures encouraging the active participation of the students with questions and comments. Board and digital presentations will be used.
- Completion and discussion of numerical problems provided by the lecturer.
- Completion of self-evaluation tests to assess the strength of the acquired knowledge. The tests will be conducted through two digital platforms: PRADO (https://prado.ugr.es) and Kahoot (https://kahoot.it), a free game-based learning platform that makes it fun to learn.

EVALUATION (TOOLS, CRITERIA, PERCENTAGE ON FINAL MARKS, ETC.)

Regular Examination:

The evaluation procedure encompasses four parts:

1- Exam of the practical concepts described above: **10 % of the final mark**.
2- Non-eliminatory exam of the numerical problems related to the units 1-3, consisting on resolving several numerical problems: **30% of the final mark.**
3- Non-eliminatory partial exam of the theoretical concepts described at that time. The test will consist on standard multi-choice questions: **20 % of the final mark.**
4- Final exam which includes all the contents: theoretical contents, numerical problems and chemical formulation: **40 % of the final mark.**

The dates of examinations 2, 3, and 4 are already available at the following link: https://farmacia.ugr.es/pod/2021/doc/Exam202021condoc.pdf

The final mark will be the result of summing up all the sub-marks after applying the corresponding percentages.

Extraordinary Examination:

In this case, the evaluation consist in:

1- Exam of the practical concepts described above: **10 % of the final mark**.
2- Non-eliminatory exam of the numerical problems related to the units 1-3: **45% of the final mark.**
3- Final exam: **45 % of the final mark.**

Student will be allowed to maintain the submark of the practical exam of the regular examination or conduct a new examination of the practices upon request.

SINGLE FINAL EVALUATION ASSESMENT ACCORDING TO "THE REGUALTION FOR EVALUATION AND ASSESMENT OF STUDENTS AT THE UNIVERSITY OF GRANDA (May 20, 2013)"

According to the Reglament for evaluation and assessment of students at the University of Granada (http://secretariageneral.ugr.es/pages/normativa/fichasugr/ncg7121/!), students will be evaluated in a continuous system (as described before) except for those students with specific requirements. In this case, a single final exam will be specifically requested to the Director of the department. The exam will consist on a writing (or oral) test of all the contents. The result of this test will be the final mark.

SITUATION A: IN-CLASS AND ON-LINE LECTURES

TUTORIAL AND PERSONALIZED LESSONS

TIME-TABLE (According to the POD)	**TOOLS for on-line tutorials**
Available at: http://inorganica.ugr.es/	E-mail, PRADO and GoogleMeet

ADAPTATIVE ACTIONS OF THE TEACHING METHODS

The following adaptive actions will be applied:

- The in-class or on-line total time will strictly depend on the sanitary conditions. Conventionally, theoretical courses to large groups will be online while seminars and practical lessons will be in the classroom. During the in-class time, a social distancing (min 1.5 meters) between all the students and the lecturer is strictly required. If this is not possible, the group will be divided into two small groups, which will receive in-class and online lectures in alternate sessions.
- Practical lessons will combine online and in-lab lessons, fitting with the maximum capacity. All the students will receive the same online (prelab, postlab) and in-lab time per week.
- Google Meet (or that recommended by the UGR) will be used for the online lessons. Synchronous in-class and online lessons are strongly recommended. If this is not possible due to specific requirements of the lecturer, asynchronous lessons can be provided through Google drive. In this case, the lessons will be complemented with specifically designed follow-up actions (tutorials, seminars, etc).
- The online tools currently recommended by UGR are Prado, Google Meet, Consigna UGR, Google Drive@go.ugr, and institutional e-mail. However, these recommendations could vary during the course.
- As an additional action, specific learning materials will be provided to the students through Prado, Consigna UGR and/or Google Drive.
- In-lab practical lessons will be carried out individually maintaining the corresponding social distancing and security measures. Occasionally, videos to explain the practices will be provided online.

ADAPTATIVE ACTIONS OF THE EVALUATION (Tools, criteria, percentage on the final mark, etc)

Regular examination

The evaluation criteria and percentages on the final mark will follow the items previously described. Thus, the final mark will be calculated as follow:

- Exam of the practical concepts: **10% of the final mark.**
- Non-eliminatory exam of numeric problems: **30% of the final mark.**
- Non-eliminatory (partial) exam of theory: **20% of the final mark.**
- Final Exam: **40% of the final mark.**

Exams will be conducted at the classroom if the number of students is below the maximum permitted. On the contrary, the exam will be online through PRADO or GoogleMeet. The evaluation criteria will be the same in both cases.

Extraordinary examination

The evaluation criteria and percentages on the final mark will follow the items previously described. Thus, the final mark will be calculated as follow:

- Exam of the practical concepts described above: **10 % of the final mark**.
- Non-eliminatory exam of the numerical problems related to the units 1-3: **45% of the final mark.**
- Final exam: **45 % of the final mark.**

Students will be allowed to maintain the mark of the practical exam conducted during the regular examination or conduct a new examination of the practices upon request.

Exams will be conducted as described in the regular examination procedure, with in-class or online exams according to the total number of students.

Single final evaluation

The single final exam will consist on a writing (or oral) test including all the contents (theory and practice). The result of this test will provide the final mark. Exams will be conducted as described in the regular examination procedure, with in-class or online exams according to the total number of students.

SITUATION B: ON-LINE LECTURES

TUTORIAL AND PERSONALIZED LESSONS

TIME-TABLE (According to the POD)	**TOOLS for on-line tutorials**
Available at: http://inorganica.ugr.es/	E-mail, PRADO and GoogleMeet

ADAPTATIVE ACTIONS OF THE TEACHING METHODS

The following adaptive actions will be applied accordingly:

- Practical and theoretical lesson will be online. Google Meet (or that recommended by the UGR) will be used for the online lessons. Synchronous in-class and online lessons are strongly recommended. If this is not possible due to specific requirements of the lecturer, asynchronous lessons can be provided through Google drive. In this case, the lessons will be complemented with specifically designed follow-up actions (tutorials, seminars, etc).
- The online tools currently recommended by UGR are Prado, Google Meet, Consigna UGR, Google Drive@go.ugr, and institutional e-mail. However, these recommendations could vary during the course.
- As an additional action, specific learning materials will be provided to the students through Prado, Consigna UGR and/or Google Drive.

ADAPTATIVE ACTIONS OF THE EVALUATION (Tools, criteria, percentage on the final mark, etc)

Regular examination

The evaluation criteria and percentages on the final mark will follow the items previously described. Thus, the final mark will be calculated as follow:

- Exam of the practical concepts: **10% of the final mark.**
- Non-eliminatory exam of numeric problems: **30% of the final mark.**
- Non-eliminatory (partial) exam of theory: **20% of the final mark.**
- Final Exam: **40% of the final mark.**

Exams will be conducted online through PRADO or GoogleMeet.

Extraordinary examination

The evaluation criteria and percentages on the final mark will follow the items previously described. Thus, the final mark will be calculated as follow:

- Exam of the practical concepts described above: **10 % of the final mark**.
- Non-eliminatory exam of the numerical problems related to the units 1-3: **45% of the final mark.**
- Final exam: **45 % of the final mark.**

Students will be allowed to maintain the mark of the practical exam conducted during the regular examination or conduct a new examination of the practices upon request.

Exams will be conducted online through PRADO, GoogleMeet or any other virtual tool recommended by UGR.

Single final evaluation
The single final exam will consist on a writing (or oral) test of all the contents conducted online using the virtual tools recommended by UGR. The result of this test will be the final mark.
ADDITIONAL INFORMATION (if necessary)
Following the recommendations of the CRUE and the Secretary of inclusion and diversity of UGR, the tools and criteria for the evaluation of acquisition of competences will be applied according to the functional diversity realities and will aim to facilitate the learning and knowledge acquisition on the basis of the particular necessities and functional diversity of the students.