



UNIVERSITÀ DEGLI STUDI DI PALERMO

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| DEPARTMENT | Scienze e Tecnologie Biologiche, Chimiche e Farmaceutiche | | |
| ACADEMIC YEAR | 2019/2020 | | |
| MASTER'S DEGREE (MSC) | CHEMISTRY AND PHARMACEUTICAL TECHNOLOGIES | | |
| SUBJECT | ANALYTICAL CHEMISTRY | | |
| TYPE OF EDUCATIONAL ACTIVITY | A | | |
| AMBIT | 50324-Discipline Chimiche | | |
| CODE | 01799 | | |
| SCIENTIFIC SECTOR(S) | CHIM/01 | | |
| HEAD PROFESSOR(S) | BONGIORNO DAVID | Professore Associato | Univ. di PALERMO |
| OTHER PROFESSOR(S) | | | |
| CREDITS | 8 | | |
| INDIVIDUAL STUDY (Hrs) | 132 | | |
| COURSE ACTIVITY (Hrs) | 68 | | |
| PROPAEDEUTICAL SUBJECTS | 01900 - GENERAL AND INORGANIC CHEMISTRY | | |
| MUTUALIZATION | | | |
| YEAR | 2 | | |
| TERM (SEMESTER) | 1° semester | | |
| ATTENDANCE | Not mandatory | | |
| EVALUATION | Out of 30 | | |
| TEACHER OFFICE HOURS | BONGIORNO DAVID Monday 14:30 16:30 Via Archirafi n.32, primo piano Stanza 77 | | |

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| PREREQUISITES | Structure of the atom (general description and electronic structure); the chemical bonds; qualitative-quantitative aspects of chemical reactions: atomic and molecular weights, equations balance, nomenclature; mixtures and solutions: concentrations and their units, electrolytes, monoprotic acids and monoprotic bases; definition of buffer solutions. |
| LEARNING OUTCOMES | <p>KNOWLEDGE AND COMPREHENSION ABILITY The course aims at providing the basic concepts for the definition of the composition and chemical characteristics of the equilibrium systems in aqueous solution. The concepts will be developed to highlight interactions among equilibrium processes, in order to apply them to chemical analysis. Particular attention will be paid to the necessity to use the appropriate scientific language, with specific reference to the concepts of precision, accuracy, reproducibility and sensitivity of a method in relation to the measurement uncertainties in an analytical procedure.</p> <p>CAPACITY TO APPLY KNOWLEDGE AND COMPREHENSION Ability to define the main chemical characteristics and the reactivity of the aqueous systems and to carry out the data analysis.</p> <p>MAKING JUDGMENTS Skill to identify and integrate the basic concepts developed during the course, in order to critically evaluate equilibrium processes and provide solutions in analytical procedures.</p> <p>ABILITY OF COMMUNICATION Being able to explain the basic concepts with appropriate scientific language.</p> <p>LEARNING CAPACITY Being able to apply the basic concepts in order to solve equilibrium calculations, highlighting different steps of calculation for obtaining a correct analytical result and an appropriate presentation of the final analytical data.</p> |
| ASSESSMENT METHODS | <p>The final examination consists of one preliminary, selective written test and in an oral examination. The test consists in solving exercises on the chemical equilibrium, and on statistical calculation. The test is selective and evaluated on a 30 points scale. To achieve the access to the following oral examination, a minimum score of 18/30 is requested. This type of test has been chosen in order to evidence a sufficient degree of independence of the students in treating the arguments that have been studied. The oral examination, that determines the final evaluation, allow us to verify the degree of knowledge of the teaching topics, the possession of the scientific language and the ability exposure. The student should answer to 2/3 questions based on the whole program and on the reference textbooks. Different ranging of evaluation will be done based on the following considerations:</p> <ol style="list-style-type: none"> 1) Basic knowledge of topics and ability in processing knowledge for application to Analytical Chemistry. Limited capacity of analysis and exposure of the proposed questions (rating 18-21) 2) Good knowledge of topics and ability in processing knowledge for application to Analytical Chemistry. Good capacity of analysis and exposure of the proposed questions (rating 22-24) 3) Very good knowledge of topics and ability in processing knowledge for application to Analytical Chemistry. Good capacity of analysis and exposure of the proposed questions (rating 25-27) 4) Excellent knowledge of the topics and prompt capacity of knowledge processing for application to Analytical Chemistry. Very good capacity of analysis and exposure of the proposed questions (rating 28-30) 5) Excellent knowledge of the topics, excellent and very smart capacity of processing in order to apply them to Analytical Chemistry. Excellent capacity of analysis and exposure of the proposed questions (rating 30 cum laude) |
| EDUCATIONAL OBJECTIVES | Provide to the students , through a careful study of simple and multiple equilibria in aqueous solution, a basic but rigorous knowledge on chemical principles of the qualitative and quantitative chemical analysis. Introduce the students to the sampling techniques, to the fundamentals of the instrumental analysis and to the statistical evaluation of the analytical data. |
| TEACHING METHODS | Lessons and exercises |
| SUGGESTED BIBLIOGRAPHY | <p>D. A. Skoog, M. West, F. J. Holler, S. R. Crouch, "Fondamenti di Chimica Analitica" (2a Ed. It.), EdiSES, 2005.</p> <p>D. A. Skoog, M. West, F. J. Chimica analitica. Una introduzione</p> <p>D. C. Harris, "Chimica Analitica Quantitativa" (2a Ed. It.), Zanichelli, 2005.</p> <p>D. C. Harris, "FONDAMENTI DI CHIMICA ANALITICA" zanichelli</p> <p>G. D. Christian, "Chimica Analitica", Piccin, 1986.</p> |

SYLLABUS

| Hrs | Frontal teaching |
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| 14 | Statistics for chemical data evaluation (14 hours) Sampling, sample preparation, sampling uncertainty, statistical calculations: mean, median, variance and standard deviation Errors and measurement uncertainty - repeated measures data distribution - confidence interval and Student t distribution. Accuracy, precision, sensitivity, detection and quantification limits - Calibration methods - the method of least squares in ordinary linear regression Tests of significance: Comparison of two precisions (F test), comparison of two experimental averages and of an average value with a known value (T test), identification of outliers (Q test) |
| 6 | Chemical equilibrium and calculation of the equilibrium concentrations (6 hours) The mass action law, equilibrium constants - mass and charge balance equations - Definition of activity and ionic strength - analytical applications of equilibrium: titrations. |
| 8 | Acid-base equilibrium (8 hours) Water autoprotolysis equilibrium- monoprotic and polyprotic weak acids and bases - distribution diagrams - ampholytes, acids or bases mixtures, buffer systems. Acid-base titration and titration curves |
| 10 | Complex formation Equilibrium (10 hours) Lewis acids and bases, metal / binders complexes, chelating effect and equilibrium constants. Competitive complexation equilibrium: hydrolysis of metals, acid-base reactions of complexes Complexometric titrations with ethylenediamine tetraacetic acid |
| 8 | Precipitation equilibrium (8 hours) Calculation of the equilibrium concentrations. Precipitation equilibrium in presence of competitive equilibrium Effect of the ionic strength effect of in common ions on the precipitation equilibrium. Practical examples: chlorides determination through Mohr, Volhard and Fajans volumetric methods. |
| 10 | redox equilibrium (10 hours) Galvanic cells and electrodes potentials. The equilibrium condition in the redox-reactions, Nernst equation - Solutions of two redox pairs in the presence of competitive equilibria Stability of the redox couples in water and pH diagrams / potentia. Typical volumetric applications of redox titrations. |
| Hrs | Practice |
| 12 | numerical exercises (12 hours) training to acquire the best strategies to solve analytical problems . |