



UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Scienze e Tecnologie Biologiche, Chimiche e Farmaceutiche		
ACADEMIC YEAR	2022/2023		
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		

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 and of poorly soluble electrolytes.
LEARNING OUTCOMES	<p>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, written evaluation and in an oral examination. The evaluation is based on the solution of exercises on the chemical equilibria, and/or data evaluations from instrumental analysis. The evaluation 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 evaluation has been chosen in order to evidence a sufficient degree of independence of the students in treating the arguments that have been studied. The final evaluation is solely determined by the following oral examination, that allows 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 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, interdisciplinary seminar activity.
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
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.
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) Gravimetric methods of analysis, precipitation process, precipitating agents. Calculation of the equilibrium concentrations. Precipitation equilibrium in presence of competitive equilibrium, pH effect. Effect of the ionic strength effect, of the "in common" ions on the precipitation equilibria. 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 . Redox titrations, typical indicators. Typical volumetric applications of redox titrations.
Hrs	Practice
12	numerical exercises (12 hours) training to acquire the best strategies to solve analytical problems .