. - **Analytical Chemistry**

Prof. Gian Maria Beone

### ***COURSE AIMS AND INTENDED LEARNING OUTCOMES***

The course aims to provide students with a general knowledge of the fundamentals underlying the design and implementation of an analytical process. For this the main analytical techniques and all the operations necessary for their correct use will be illustrated. At the end of the course, students will be able to perform common laboratory procedures (volumetric analysis, UV-visible spectrophotometry, TLC and column chromatography) from the preparation of the sample through to the writing up of results using the knowledge and skills acquired during the course. The student will also know the basics of electroanalytical techniques, spectroscopy and chromatography.

### ***COURSE CONTENT***

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|  | ECTS |
| **The analytical process**. Classification of analytical methods, stages of a chemical analysis, choice of the method of analysis. Laboratory equipment. Calculations in analytical chemistry. Treatment of analytical data and quality control in the chemical laboratory. Sources of error, precision and accuracy. Sampling. Fundamental analytical operations. | 1.0 |
| Tutorials | 0.5 |
| **Volumetry.** Chemical equilibrium. Systematic treatment of equilibrium. Acid-base equilibria, solubility product and complex formation. Applications in analytical chemistry. Examples of volumetric analysis. | 1.5 |
| Tutorials | 1.5 |
| **Electroanalytical techniques**. Electrochemistry. Standard potentials. Oxidation-reduction reactions Types of electrodes. Potentiometry and pH measurement. | 0.5 |
| **Spectroscopy techniques**. Electromagnetic radiation, radiation and matter interaction. Absorption, emission, luminescence. Lambert-Beer's Law. Qualitative and quantitative analysis. Main spectrometric techniques. Apparatus. Molecular absorption spectroscopy in UV-visible and infrared. Atomic absorption and emission spectroscopy.  | 1.5 |
| Tutorials | 0.5 |
| **Chromatography techniques**. Chromatographic techniques, classification and separation mechanisms, performance efficiency. High efficiency gas chromatography and liquid chromatography. Apparatus. Qualitative analysis and quantitative analysis. | 1.5 |
| Tutorials | 0.5 |

***READING LIST***

D.A. Skoog-D.M. West-F.J. Holler, *Fondamenti di chimica analitica,* EdiSES, Naples, 2015 (paper and ebook).

S.M. Khopkar, *Basic Concepts of Analytical Chemistry,* New Academic Science, 2008 (ebook).

R. de Levie, *How to Use Excel® in Analytical Chemistry And in General Scientific Data Analysis,* Cambridge University Press, 2001 (ebook).

***TEACHING METHOD***

1. Frontal lectures of a theoretical nature where the main topics of the course will be addressed;
2. Classroom tutorials on the application of calculus to analytical chemistry (measurement units of concentrations, dilutions, titrations, accuracy, precision, acid-base systems, solubility, liquid-liquid extractions, chromatography);
3. Students will be divided into pairs for their workshop activities, covering volumetric analysis, UV-visible spectrophotometry, TLC chromatography and column chromatography on food samples (cheese, water, wine, food colouring and spinach). In addition to taking into consideration their attendance at tutorials, the quantitative analyses will also require students to deliver their results at the end of the workshop. The practical assessment of the course will be based on these elements.
4. Students will examine the tools used in the Departmental research workshops (ICP-OES, MP-AES, ICP-MS, GC and HPLC).

***ASSESSMENT METHOD AND CRITERIA***

The assessment will be practical, written and oral. The practical will be based on the student's workshop activities (maximum 3 marks will be awarded). The written test will comprise 5 calculus exercises applied to analytical chemistry and will focus exclusively on the topics covered in the classroom tutorials. The written test will be preparatory for admission to the oral exam. The oral exam will allow the lecturer to verify the student's degree of knowledge, their mastery of the scientific language and their level of understanding of the topics covered in the course. The mark for the practical assessment will be added to the mark obtained for the oral exam, expressed out of thirty.

***NOTES AND PREREQUISITES***

The course also offers 20 hours of classroom tutorials on calculus applied to analytical chemistry and 16 hours of workshop activities, participation at which is strongly recommended. Students must possess a basic knowledge of general chemistry, physical chemistry and organic chemistry.

Should the health situation relating to the Covid-19 pandemic not allow face-to-face teaching, remote teaching in synchronous or asynchronous mode will be guaranteed; this will be communicated in good time to students.

Information on office hours available on the teacher's personal page at <http://docenti.unicatt.it/>.