



Corso di Laurea in **SCIENZA E TECNOLOGIA DEI MATERIALI**

Triennale – L30

General information	
Academic subject	Analytical chemistry I
Degree course	<i>Materials Science and Technology L-30</i>
Academic Year	<i>II</i>
European Credit Transfer and Accumulation System (ECTS)	8
Language	<i>Italian)</i>
Academic calendar (starting and ending date)	<i>II Semester</i>
Attendance	<i>Non mandatory</i>

Professor/ Lecturer	
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Department and address	Dipartimento di Chimica
Virtual headquarters	Working group on Teams software: ifhopdd
Tutoring (time and day)	Any day, provided that the student will contact me one day in advance to set the meeting

Syllabus	
Learning Objectives	<i>The course aims at providing the fundamental knowledge of Analytical Chemistry and the technical and instrumental information about a first group of instrumental techniques, e.g. Electroanalytical ones. Eventually, the student is expected to gain knowledge on both the fundamental aspects of analytical chemistry, including sampling, and data analysis. The student is also expected to acquire an adequate level of expertise on Electroanalysis, becoming capable to choose which electroanalysis approach could better suit the specific needs.</i>
Course prerequisites	<i>General Chemistry, Logarithms and exponential equations</i>
Contents	<p>FUNDAMENTAL ANALYTICAL CHEMISTRY AND EXERCISES</p> <ol style="list-style-type: none"> <i>1. Introduction to Analytical Chemistry: terminology definitions, classifications of analytical methods, sampling theory</i> <i>2. Titrations: general aspects, standard solutions, general properties of titration curves, indicators and solutions for titrations, mathematical prediction of acid-base titration curves (strong or weak reagents), the role of buffers, applications</i> <i>3. Other titration methods (complexation, precipitation, redox reactions)</i> <i>4. Data treatment and errors in Analytical Chemistry: types of error, Q-test, Student's t, hypothesis tests, uncertainty of measurement and of measure, uncertainty of extrapolated values</i> <i>5. Calibration methods</i> <p>ELECTROANALYTICAL CHEMISTRY</p> <ol style="list-style-type: none"> <i>6. . Introduction to Electroanalysis: fundamental aspect of Electrochemistry, cells and electrodes, Nernst Equation, Ohmic drop, electric double layer, junction potential, classification of electroanalytical methods</i>



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	<ol style="list-style-type: none"> 7. <i>Potentiometry: reference electrodes, metal electrodes of I, II, III species, membrane electrodes, glass electrodes, pH measurement and errors (acid, alkaline), ion-selective electrodes</i> 8. <i>Coulometry and Electrogravimetry: constant current vs constant potential electrolyses, polarization, selectivity</i> 9. <i>Voltammetry: concentration polarization, voltammetry at a planar electrode, Cottrell equation, Classic Polarography, Ilkovic equation, equation of the polarographic curve, capacitive currents and equations, reversibility, Tast polarography, Normal Pulse Polarography, Differential Pulse Polarography, Hydrodynamic voltammetry, Rotating disk Electrode, Linear sweep voltammetry, Cyclic Voltammetry, Randles-Sevcik equation, Stripping Voltammetry, Kinetics in Electroanalysis LABORATORY</i> 10. <i>Getting familiar with solutions and standards</i> 11. <i>Standardization of HCl solution (with indicator and pHmeter)</i> 12. <i>Acid-base titration (with indicator and pHmeter)</i> 13. <i>Titration analysis of an unknown solution</i> 14. <i>Preparation of a reference electrode and of a working electrode, using them for a cyclic voltammetry (group activity)</i>
Books and bibliography	<p><i>Chimica Analitica. Una introduzione</i> Skoog, West, Holler – EdISES <i>Chimica Analitica. Equilibri ionici e fondamenti di Analisi Chimica Quantitativa</i> Desimoni - CLUEB <i>Fondamenti di Chimica Analitica</i> D.A. Skoog, D.M. West, F.J. Holler– EdISES. <i>Electrochemical Methods</i> A.J. Bard, L.R. Faulkner –Wiley</p>
Additional materials	<i>Slides, publications, brochure/flyers</i>

Work schedule			
Total	Lectures	Hands on (Laboratory, working groups, seminars, field trips)	Out-of-class study hours/ Self-study hours
Hours			
200	40	45	115
ECTS			
8	5	1 laboratory, 2 exercises	
Teaching strategy			
<i>Lectures, possibly supported by technology enhanced teaching, in case of specific needs related to the COVID19 pandemic, laboratory</i>			
Expected learning outcomes			
Knowledge and understanding on:	This is a fundamental course providing basics of the discipline along with the fundamental and instrumental aspects of several different electroanalytical techniques		
Applying knowledge and understanding on:	the student should become able to design and handle a quantitative analysis, working both on titrations and electroanalysis		
Soft skills	<ul style="list-style-type: none"> • <i>Making informed judgments and choices</i> Ability to define the so-called “analytical problem”. Ability to treat analytical data and the relevant errors. Ability to choose among the different electroanalytical techniques, as a matter of the specific information sought. • <i>Communicating knowledge and understanding</i> 		



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	<p>Usage of the specific technical language. Ability to properly treat and present data, including calibration outputs</p> <ul style="list-style-type: none"> • <i>Capacities to continue learning</i> <p>Ability to obtain and use analytical data making statistical comparison among the outcomes of different approaches</p>
Assessment and feedback	
Methods of assessment	Oral examination. Alternatively, for those attending the lessons it will be possible to hold three tests in progress (written tests, with multiple choices)
Evaluation criteria	<ul style="list-style-type: none"> • <i>Knowledge and understanding</i> The evaluation is based on the effective knowledge of the technical contents of the course • <i>Applying knowledge and understanding and Autonomy of judgment</i> The evaluation is based in the capability of the student to define the specific analytical problem and, consequently, to choose among the different characterization techniques • <i>Communicating knowledge and understanding and Communication skills</i> The evaluation will take into consideration the student's soft skills and the ability to correctly describe/report on the topics of choice • <i>Capacities to continue learning</i> The evaluation will take into consideration the ability of the student to gain information from international databases, manuscripts, technical brochures, book chapters, etc
Criteria for assessment and attribution of the final mark	The oral examination consists of about 10 questions of similar relevance. The Exam is overcome with the minimum score in case the student correctly replies to 60% of them. Higher success rates will correspond to higher scores, in proportion. Same criteria for the tests in progress. In any case, the maximum score corresponds to the correct reply to all the questions.
Additional information	