

COURSE TITLE

Chimica Analitica Applicata e Strumentale

Applied and Instrumental Analytical Chemistry

(Chemistry Bachelor)

Credits (CFU) = **6+6**

MODULE 1 TITLE

APPLIED ANALYTICAL CHEMISTRY

Prof. Santino Orecchio (e-mail: santino.orecchio@unipa.it)

Classroom site: Building 17, Viale delle Scienze, Palermo, Lecture room D

Laboratory site: Building 17, Viale delle Scienze, Palermo, Analytical Chemistry Laboratory

MODULE PROGRAM

Credits (CFU) = **1+5**

Face-to-face lectures (1 CFU, 8 hrs)

Theory and instrumentation for sampling materials of environmental (soil, sediments, air, water, organisms) and industrial interest. Theory for preparing samples for analysis:

- Use of hydrochloric acid;
- Use of nitric acid;
- Use of sulphuric acid;
- Use of hydrofluoric acid;
- Use of mixtures of acids
- Preparation of sample by alkaline melting;
- Use of microwave oven;
- Solvent extractions (liquid/liquid, Soxhlet, etc.);
- Extraction by solid phase (SPE, SPME);
- Analysis on real matrices using the most common analytical techniques (gravimetric, volumetric, spectrophotometric, potentiometric, chromatographic, etc.)

Laboratory (5 CFU, 75 hrs)

1. Sampling of soil;
2. Determination of carbonate in soil;
3. Determination of sulfate in natural waters;
4. Determination of lipid content in a food (biscuit, bread, crackers, etc.);
5. Determination of organic and total nitrogen in a sample (waste water, sediments, etc);
6. Determination of Fe(II) and Fe(III) in a pottery;
7. Determination of Zinc and copper in hairs;
8. Determination of sodium and potassium in natural water by emission spectroscopy;
9. Determination of copper content in wine samples;
10. Determination of water and ash in a food;
11. Determination of heavy metals in a food.

TEXTBOOKS

- Lecture notes
- Skoog, West, Holler, Fondamenti di Chimica Analitica, Edises
- M.Consiglio, V. Frenna, S. Orecchio, Laboratorio di Chimica, Edises.

MODULE 2 TITLE

Chimica Analitica Strumentale

Instrumental Analytical Chemistry

Prof. Alberto Pettignano (e-mail: alberto.pettignano@unipa.it)

Lecture room D of Chemistry department, building 17, Viale delle Scienze.

MODULE PROGRAM

face-to-face lectures (48 hrs, 6 CFU)

Theory and instrumentation of electrochemical techniques: potentiometry (electrode systems, direct potentiometry, potentiometric titrations), electrogravimetry and coulometry (coulometry at constant potential, coulometric titrations), polarographic and voltammetric techniques, applications.

Properties of electromagnetic radiation, electromagnetic spectrum, atomic and molecular energy; absorption and emission of electromagnetic radiation, complexity of spectra and intensity of spectral lines.

Theory and instrumentation of UV-Vis molecular absorption spectroscopy [energy sources, lasers and their mode of action, wavelength selectors (monochromators and filters), sample cells, radiation detectors, use of optical fibers in spectroscopy, single-beam and double-beam instruments], transmittance, absorbance and Beer's law, applications and deviations from Beer's law, errors in spectroscopy, applications.

Theory and instrumentation of molecular and/or atomic fluorescence, phosphorescence and chemiluminescence spectroscopy; applications.

Theory and instrumentation of infrared spectroscopy (IR), FTIR instruments, applications.

Theory and instrumentation of atomic absorption and/or emission spectroscopy with flame, electro thermal atomizer, inductively coupled plasma (ICP) and direct current plasma (DCP), hyphenated techniques. Applications.

Introduction to chromatography, classification of chromatographic techniques, the chromatographic process, rate of solutes migration, widening of the chromatographic band and efficiency of a column, selectivity (α) of a chromatographic process and resolution (R), applications.

Theory and instrumentation of gas chromatography (GC), Gas-liquid (GLC) and gas-solid (GSC) chromatography, GC apparatus, packed and capillary columns, stationary phases, detectors for GC, coupled GC-MS and GC-FTIR, applications.

Theory and instrumentation of liquid chromatography (LC) [Liquid-solid chromatography (LSC), normal and reverse phase Liquid-liquid chromatography (LLC), Bonded-phase chromatography (BPC), Gel permeation (exclusion) chromatography (GPC), ion exchange chromatography (IEC)] and high performance Liquid chromatography (HPLC), equipment for HPLC, pumps, sample injection systems, packed and capillary columns, detectors, hyphenated techniques, comparison between GC and LC.

Theory and instrumentation of supercritical fluid chromatography (SFC) (Characteristics of supercritical fluids, columns, stationary phases, detectors, effect of the pressure on the separations, comparison with GC and HPLC techniques); thin layer chromatography (TLC).

Theory and instrumentation of electrophoresis (factors affecting ionic migration, effect of temperature, pH and ionic strength, electro-osmosis, supporting medium), capillary Zone Electrophoresis (CZE) and micellar electrokinetic capillary electrophoresis (MECC), hyphenated techniques. Applications

TEXTBOOKS

- Lecture notes
- Skoog, West, Holler, Fondamenti di Chimica Analitica, Edises
- Harris, Chimica Analitica Quantitativa, Zanichelli
- Skoog, Leary, Chimica Analitica Strumentale, Edises
- Robinson K.A. e Robinson J.F., Chimica Analitica Strumentale, Zanichelli