

INSTRUMENTAL ANALYSIS METHODS AND TECHNIQUES

(Environmental management and protection, 1st Year of study, 2nd Semester)

Credit value (ECTS): 7

Course category: Further study (mandatory)

Course holder: Assoc. Prof. Ana CAZACU, PhD

Objectives of the discipline (course and practical activity)

Understanding and thorough study the theoretical and practical notions necessary to design and organize complex experiments used in technical-scientific analyses.

Knowledge and appropriate use of the measurement principles and methods presented in the discipline curriculum.

Developing the capabilities to perform experimental measurements and interpret data.

Awareness of the correct handling of experimental devices and the development of the creative spirit in order to train specialists in the field.

Contents (syllabus)

Course (chapters/subchapters)
Instrumental analysis. General principles.
Spectral methods of analysis: UV-VIS absorption spectrometry. Lambert–Beer law. Absorption spectra. Colorimetry. IR absorption spectrometry.
Diffraction methods (with X-rays, with electrons). The XRD diffractometer.
Microscopic analysis techniques. Optical microscopy. Electron microscopy. Atomic force microscopy.
Chromatographic separation methods. The principle of the chromatography method, the classification of chromatographic methods.
Electroanalytical methods. Principles and classification.
General processes of interaction of electromagnetic radiation with the atmosphere: absorption, attenuation and scattering.
Spectroscopy and lasers. Fundamentals.
Interactive models regarding the simulation of trajectories of air masses through the terrestrial atmosphere (e.g.: HYSPLIT, Northern Africa-Middle East-Europe (NA-ME-E) Regional Center).
Passive and active remote sensing techniques for monitoring the terrestrial atmosphere (sun photometer, satellite images, ceilometer, lidar).

Practical activity
Presentation of the objectives and work methodology in the laboratory. Laboratory work protection measures.
Elaboration of the work protocol in the laboratory and processing of experimental data.
Chemical characterization of liquid biological samples using the VIS spectrometry .
Chemical characterization of liquid biological samples using the UV spectrometry.
Determination of surface colors in the CIELAB system using the MiniScan XE Plus portable spectrophotometer.
Characterization of solids using the XRD 6000 diffractometer.
Digitization of the images of the biological material structure using the optical microscope - camera - PC system.
Measuring plant bioelectric properties using the Keysight B2981A Femto/Picoammeter.

Identifying the air quality by monitoring the concentrations of solid particles (PM2.5 and PM10) in the lower atmosphere under variable weather conditions.
Determination of optical parameters of atmospheric aerosols by passive remote sensing techniques for aerosol type characterization.
Determining the height of atmospheric layers and clouds through active remote sensing techniques.
Characterizing long-range aerosol intrusions to determine dust and smoke transport.
Interactive simulation of the dispersion of substances transported through the atmosphere, at local and global scales. Case study.
Interactive simulation of the trajectories of substances transported through the atmosphere, at local and global scales. Case study.

Bibliography

1. Cazacu A., Bodale I., Oancea S., *Fenomene de transfer și operații unitare*, Ed. „Ion Ionescu de la Brad”, Iași, 2021.
2. I. G. David, V. David, *Tehnici instrumentale avansate*, Ed. Universității din București, 2010.
1. Bodale I., *Măsurarea și prelucrarea datelor meteorologice*, Iași, Ed. Ion Ionescu de la Brad, Iasi, 2021.
2. Bodale I., *Referate pentru lucrările practice de fizică*, 2019.
3. Oancea S., Cazacu A., *Probleme rezolvate de fizică*, Editura PIM, Iasi, 2015.
4. Hollas, M.J., *Modern Spectroscopy*, 4th edition, John Wiley & Sons, Ltd., 2004.
5. Silverstein R.M., Webster F.X., Kiemle D.J., *Spectrometric identification of organic compounds*, 8th Ed., 2015, John Wiley & Sons, Inc.
6. Ștefan S., Nicolae D., Caian M., *Secretele aerosolului atmosferic în lumea laserilor*, Ed. Ars Docendi, 2009.
7. D. A. McQuarrie, J. D. Simon, *Physical Chemistry. A molecular approach*, 1997, University Science Books.
8. <https://www.ready.noaa.gov/HYSPLIT.php>
9. <https://aeronet.gsfc.nasa.gov/>

Evaluation

Evaluation form	Evaluation Methods	Percentage of the final grade
Final exam	Written examination	70%
Evaluation of the activity during the semester	Oral evaluation of each laboratory session	30%

Contact

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