University of Zagreb Faculty of Agriculture
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Analytical chemistry in agroecology (289263)

Course coordinators

Prof. Marko Vinceković, PhD, **Assoc. Prof. Monika Zovko, PhD**

Course description

The aim of the course "Analytical Chemistry in Agroecology" is to provide students with basic principles of analytical chemistry and physicochemical processes controlling the fate of pollutants in the environment, and to develop a working knowledge of laboratory methods, chemical analyses of the environmental samples, supervising or performing laboratory operations, and the interpretation of analytical results. This covers several subject domains: basic principles of analytical methods, analytical procedures to obtain data, chemical separation methods, measurements, soil chemistry, plant nutrition, and environmental pollutants and protection, stressing the importance of quality assurance and quality control. Topics include modern analytical methods used for soil quality testing, soil testing for plant available nutrients, determination of environmental pollutants, and specific methods for water analysis. The laboratory component will provide hands-on experience in laboratory methods, operation of analytical instrumentation, and interpretation of the analytical results of testing methods. After finishing the course students should be able to request appropriate chemical analysis, understand procedures and principles of chemical testing methods, perform laboratory operations, and report procedures and results in concise written reports. Theoretical lectures are complemented with practical laboratory exercises in small groups working in the laboratories of the faculty, where the students will familiarize themselves with both classical and instrumental methods usually employed in environmental analytical chemistry. Further considerations include the quality of the analytical results and the generation of precise and accurate analytical data,

ECTS: **6.00**

English language: **L3**

E-learning: **L3**

Teaching hours: 60
Lectures: 29
Laboratory exercises: 24
Seminar: 8

Lecturer

- Prof. Željka Zgorelec, PhD

Associate teacher for exercises

- Asst. Prof. Jelena Horvatinec Isaković, PhD

Grading

Sufficient (2): 60%
Good (3): 61-80%
Very good (4): 81-90%
Excellent (5): 91-100%

Conditions for obtaining signature

Regular attendance of lectures and exercises

Description

Work diary

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Type of course

- Graduate studies / MS Courses taught in English (Elective course, 1 semester, 1 year)

General competencies

Students should have basic experience in a chemistry laboratory and be familiar with common laboratory terms.

Types of instruction

- Lectures
  28 hours of lectures
- Laboratory practice/exercises
  24 hours of laboratory exrecises
- Seminars
  8 hours of seminars

Learning outcomes

Learning outcome	Evaluation methods
By the end of the course, students can: 1. Critically select and apply adequate sustainable methods in agricultural production, food production, and food technology 2. Explain research proposals, reports, and scientific papers to a wider public audience 3. Soil, water, and climate: Explain the atmospheric systems' most important characteristics and functions and agro-meteorology. Identify problems arising from climate change and explain their effects on agriculture, as well as which atmospheric processes (on a scale of time and space) are relevant	Written and oral exam

Working methods

Teachers' obligations

Teachers' obligations
All teaching materials are organized and available in Moodle system; forum for communication with students; calendar of major events for module; information related to the course; tasks for the establishment of knowledge at a particular lecture, instructions for the use of teaching materials, assessment of student assignments, written examinations, conducting oral exams

Students' obligations

Attending lectures, laboratory exercises and seminars is mandatory, and students participate in learning through the system for e-learning. Students during the first two weeks of classes should be sure to log into the system for e-learning Moodle within which they may use the presentation of lectures, examples of solved problems with seminars and other materials.
After each exercise the student must write a report, and submit it to the leader of the exercises within 7 days. Terms for the exam are regularly attend lectures and exercises, seminars, and regularly solve all tasks with lectures and laboratory exercises

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Methods of grading

Evaluation elements	Maximum points or Share in evaluation	Grade rating scale	Grade	Direct teaching hours	Total number of average student workload	ECTS
I Colloqiumm	25	60% 61-70% 71-80% 81-90% 91-100%	Insufficient (1) Sufficient (2) Good (3) Very good (4) Excellent (5)	14	28	2

Evaluation elements	Maximum points or Share in evaluation	Grade rating scale	Grade	Direct teaching hours	Total number of average student workload	ECTS
II Colloqium	25	60% 61-70% 71-80% 81-90% 91-100%	Insufficient (1) Sufficient (2) Good (3) Very good (4) Excellent (5)	13	26	2

Evaluation elements	Maximum points or Share in evaluation	Grade rating scale	Grade	Direct teaching hours	Total number of average student workload	ECTS
Oral exam	50	60% 61-70% 71-80% 81-90% 91-100%	Insufficient (1) Sufficient (2) Good (3) Very good (4) Excellent (5)			

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Weekly class schedule

1. Introduction Classical and advanced methods; analytical concepts and theories: role in science and everyday life; providing qualitative information (what is in a sample) and quantitative information (how much is in a sample) about the matter's importance for environmental issues.
2. Chemical equilibrium Chemical equilibrium in electrolyte solutions, base/acid equilibrium in heterogeneous systems, precipitation/dissolution, complexation, oxidation/reduction.
3. Classical analytical methods Classical volumetric, gravimetric, and titrimetric analysis
4. Treatment of analytical data Basic physical units, stoichiometric relations in chemical equations, errors, evaluation of analytical data
5. Methods and instrumentation in spectrometry and spectroscopy: 1. Instrumentation in optical spectroscopy Spectroscopic methods based on ultraviolet and visible radiation; review of characteristics of electromagnetic radiation; absorption of electromagnetic radiation; basic concepts in absorption spectroscopy; Beer's law and its appliance; AAS.
6. Methods and instrumentation in spectrometry and spectroscopy: 2. Interference and atomic emission spectrometry Origin of spectral interferences and their elimination; chemical interferences; flame-AES interference; plasma emission spectrometry - instrumentation and principles.
7. Examples of destructive and nondestructive methods Basic principles and examples of destructive (IC and CHNS) and non-destructive (pXRF) methods
8. Laboratory environment and equipment performance Equipment performance checks: plan what needs to be done for the routine equipment maintenance; assurance of the measurement's traceability to national and international etalons
9. Laboratory environment and equipment performance: 2. Pipette calibration Pipette calibration procedure; a series of methods for determination of the difference between volumetric measurement value and nominal or the selected value of the tested pipette; the objective of the procedure is to eliminate errors in the measuring process.
10. Laboratory environment and equipment performance: 1. Spectrophotometry - Cuvette calibration The exercise aims to introduce students to the operation of a UV-VIS spectrophotometer; a reference solution (K2CrO4) with known absorbance (A) values in given conditions is used. By measuring absorbance (A) of such solution aberration of spectrophotometer can be determined; path length (b) is also tested. Examples of IC and CHNS) and nondestructive (pXR) analysis
11. Analytical methods and validation Principles of the analytical methods and their confirmation by examination and provision of objective evidence that the requirements for a specific intended uses are fulfilled.
12. Determination of the cadmium concentrationusing the standard addition method This exercise aims to introduce students to the standard addition method which is used for eliminating matrix interference. Matrix interference refers to the components of a sample other than the analyte.
13. Soil properties and methods for laboratory analysis: 1. Determination of cation exchange capacity (CEC) and percent base saturation using barium chloride solution Soil properties and methods for laboratory analysis: 3. Ionic composition of the soil solution using segmented flow analysis (SFA)
14. Quality assurance in analytical laboratory Managing quality Data treatment: 1. Control Chards Data treatment: 2. Measurement uncertainty Statistics used to describe data sets Interlaboratory studies Seminar
15. Written exam

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Obligatory literature

1. G. E. Rayment, D. J. Lyons: Soil Chemical Methods - Australasia. CSIRO Publishing, Australia, 2011.
2. E. J. M. Temminghoff, G.A. Gaikhorst, R. van Eck: Part I: Instrumental Analysis. Wageningen University, Netherlands, 2000.
3. E. J. M. Temminghoff (ed): Methodology of Chemical Soil and Plant Analysis.Wageningen University, Netherlands, 2000

Similar course at related universities

- Analytical chemistry, Actual topics, Analytical state of the art, Integrated analysis Ghent University

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