"APPROVED"
Dean of the Faculty of New Technologies and Chemistry
2 up.
Prof., PhD, Eng. Stanisław Cudziło

Course title: ***Hazardous materials detection technologies***
Course title in Polish: ***Metody wykrywania materiałów niebezpiecznych***
Course Code: WTCCXCSM-HMDT

Course details:

Entity offering the course: Faculty of New Technologies and Chemistry
Entity receiving the course: Faculty of New Technologies and Chemistry
Syllabus valid for enrolments as of: March 2016

Default type of the protocol:
graded course credit

Official language:
English

Short description:
The objectives of the course is:
to provide an introduction into the field of hazardous materials
to introduce the problems related to air monitoring
to familiarize students with various sampling and detection technologies for **hazardous materials**
to teach how to take a sample containing trace amounts of hazardous substances **and analyse it**
to teach how to prepare analytical reports

Description:

1. Sample taking and preparation — lect.-2
   Active and Passive Air Sampling;
   Sample collection devices
2. Laboratory Analysis of Samples — lab.-2; **sem.-2**
   Laboratory Detection and Identification Techniques for Chemical Agents:
   - Gas Chromatography (GC)
   - High Performance Liquid Chromatography (HPLC)
   - Capillary Electrophoresis (CE)
   - Mass Spectrometry (MS)
   - Infrared Spectrometry (IR)
   - Nuclear Magnetic Resonance Spectrometry (NMR)

   Other (Nonchemical) Analytical Techniques;
   Understanding Laboratory Reports
3. Sample Preparation Techniques for Trace Detection and Identification — lect.-2
   - General Considerations
   - Liquid/Liquid Extraction (LLE)
   - Solid Phase Extraction (SPE)
   - Solid Phase Microextraction (SPME)
   - Liquid/Solid Extraction (LSE)
   - Supercritical Fluid Extraction (SFE)
   - Thermal Desorption
   - Derivatisation
   - Solvent Evaporation/Concentration
4. Field Detection and Identification Technologies – Direct Reading Instruments — lect.-6; lab.-6; sem.-4
   - Ionization based detection
     - Photo Ionization
     - Flame Ionization
     - Ion Mobility Spectrometry
   - Detection based on light absorption or emission
     - Flame Photometry
     - Infrared Spectroscopy
     - Chemiluminescence-based detection

- Piezoelectric based detection
  - Surface Acoustic Wave
  - Quartz Crystal Microbalance
- Electrochemical Sensors
- Colorimetric Technology
- Other Gas Detection Technologies
  - Catalytic bead
  - Metal Oxide Semiconductor

5. Bulk Detection Technologies — lect.-4; sem.-2
   - X-ray Technologies
   - Millimeter Wave Imaging Technologies
   - Neutron Technologies
   - Nuclear Quadrupole Resonance Technology

Bibliography:

Mandatory:

- Hazardous Materials Air Monitoring and Detection Devices, Chris Hawley, Delmar/Thomson Learning, 2002 - 134, sygn. III-18299/TWB.35
- Field Detection Technologies for Explosives, Yin Sun, ILM Publications, 2010, 69492.

Complementary:

- Detection Technologies for Chemical Warfare Agents and Toxic Vapors, Yin Sun, Kwok Y. Ong; CRC Press, 2005
- Hazardous Materials Characterization: Evaluation Methods, Procedures, and Considerations; Donald A. Shafer, Wiley 2005
- Emergency Characterization of Unknown Materials; Rick Houghton; Taylor & Francis, 2007.

Learning outcomes:

Symbol	Learning objectives and skills acquired	Reference to learning objectives in the given field of study
W1	The student is familiar with the requirements and general principles of detection and concentration evaluation of hazardous substances.	K_W02
W2	He/she can use databases containing information on the hazardous properties of substances.	K_W09
W3	He/she knows the capabilities and limitations of currently used selected methods for risk assessment.	K_W13; K_W14; K_W15;
U1	The student can identify the solution optimal for a situation requiring detection and characterization of dangerous substances.	K_U03
U2	He/she can use selected analytical methods and devices for the detection of hazardous substances.	K_U06;
U3	He/she can use contemporary technical and scientific literature on the detection and identification of hazardous substances and is able to prepare presentations and participate in discussions on this topic.	K_U10
K1	He/she is able to find sources for autonomous study	K_K01; K_K05
K2	The student is able to efficiently collaborate as a member of a team.	K_K02
K3	He/she understands the significance of issues discussed in the course in terms of public safety and security.	K_K05

Assessment methods and criteria:

To complete the course general knowledge of the subject area is required, this includes the awareness of the possibilities and especially the limitations of each method and equipment. The degree of understanding of the issues as well as the ability to solve practical problems will be evaluated. While solving the problems students will be allowed to support themselves with scientific literature and textbooks.

Students will be evaluated based on their participation in exercises (40%) and an assessment in the form of an interview/discussions on topics chosen by the teacher from the course information card. The purpose of this interview is to assess the ability of the student to correctly select an appropriate methods of detection for a particular purpose and to evaluate the limitations of the proposed methods.

The following grading scale will be used :

5 - unassisted solution to the problem ;

4 - solution found after suggestions have been provided by the teacher

3 - solution to the problem found based on the teacher's guidance ;
2 - failure to resolve the problem, despite help provide by the teacher;
Intermediate grades will result from the degree of difficulty and the amount of the help provided by the teacher.

By the time the final interview all laboratory exercises must be successfully completed.

Learning objectives W1, W2, W3 and skills U1, U2 and U3, and K1, K2 and K3 are evaluated during the assessment.
Objective K2 is evaluated during laboratory exercises.

Internship:

N/A

Study format

full-time studies

Category of studies

second-cycle studies

Course type

elective

Introductory courses and prerequisites

General and Inorganic Chemistry -- Knowledge of principal chemical elements and ability to analyse chemical problems and to find their solutions
Analytical Chemistry -- Knowledge of the fundamentals of qualitative and quantitative analysis and basic instrumental methods of analysis

Programy

Field of study: Chemistry
Specialization: all specializations

Form of teaching, lecture's number / qualification

Semester	x - examination, + - credit, # - project						ECTS points
	Total	lectures	exercises	laboratories	projects	seminars	
III	30	14/ +		8 / +		8 / +	2

Author

ECTS Bilans

Lp.	Activity	Workload in hours.
1	Participation in lectures	14
2	Individual studies of lecture topics	14
3	Participation in exercises	
4	Individual preparation for exercises	
5	Participation in laboratory exercises	8
6	Individual preparation for laboratory exercises	8
7	Participation in seminars	8
8	Individual preparation for seminars	6
9	Implementation of the project	
10	Participation in consultations	2
11	Preparation for the examination	
12	Participation in the examination	

	Hours.	ECTS
Student's aggregate workload	60	2
Classes with teachers: 3 + 1 + 5 + 7 + 9 + 10 + 12	32	1
Classes with practical aspects: 5 + 6 + 9	16	0,5
Classes related to scientific activity: 1 + 2 + 3 + 4 + 7 + 8	42	1,5

AUTHOR OF
COURSE INFORAMATION CARD

Dr Eng. Jarosław SZULC

MANAGER OF THE UNIT
RESPONSIBLE FOR THE COURSE

Prof. PhD Eng. Jerzy CHOMA