

Analytical Toxicology – Xenobiotics [237]

COURSE OUTLINE

(1) GENERAL

SCHOOL	ANIMAL BIOSCIENCES		
ACADEMIC UNIT	DEPARTMENT OF ANIMAL SCIENCE		
LEVEL OF STUDIES	Undergraduate [Major Elective]		
COURSE CODE	237	SEMESTER	6 th
COURSE TITLE	ANALYTICAL TOXICOLOGY - XENOBIOTICS		
INDEPENDENT TEACHING ACTIVITIES		WEEKLY TEACHING HOURS	CREDITS
Course: Theory and Laboratory Practice (2+2)		4	4
COURSE TYPE	Scientific area		
PREREQUISITE COURSES:	Principles of Organic Chemistry (2nd Semester Class)		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS:	NO		
COURSE WEBSITE (URL):	https://mediasrv.aua.gr/eclass/courses/EZPY209/		
TEACHING STAFF:	S. Haroutounian, S. Koulocheri		

(2) LEARNING OUTCOMES

Learning outcomes
Introductory course to analytical toxicology with emphasis on the study of various classes of xenobiotics residues detected in agricultural products and foodstuffs. Practical and theoretical tools for the evaluation of the risk assessment derived from xenobiotics presence. In specific, during classes will be presented and discussed the A) methodologies for the quantitative and qualitative determination of xenobiotics, B) assessment of the consequences of human body exposure to xenobiotics, C) mechanisms of their toxicity and absorption-metabolism by humans, animals and plants, and D) importance of xenobiotics for agricultural production, economy, public health and the environment. Among the large plethora of xenobiotics, special focus will be devoted to molecules used in agriculture either intentionally (Agrochemicals, growth hormones) and/or incidentally (medicines, toxins, heavy metals, permanent organic pollutants and natural products). The course will also cover the mobility of xenobiotics in various media (soil, water, plant and animal tissues), their bioaccumulation process and degradation mechanisms. Upon successful completion of the course, students will be able (according to Bloom) to: - Describe and classify the main categories of xenobiotics and explain their respective toxic actions (Knowledge / Comprehension). - Analyze and explain the mechanisms of toxic action of xenobiotics (Comprehension / Analysis). - Explain the absorption, metabolism, and degradation mechanisms of xenobiotics in soil, water, atmosphere, and tissues (plants and animals) within agricultural and natural ecosystems (Comprehension / Application / Analysis). - Apply the basic assumptions used for the evaluation of risk assessment arising from the presence of xenobiotics in agricultural products, considering economic, public health, and environmental implications (Application / Analysis / Evaluation). - Demonstrate knowledge of the methodologies and techniques for qualitative and quantitative detection of xenobiotics in soil, water, and plant-animal tissues (Knowledge / Application). - Interpret and apply the existing Greek and European legal frameworks regarding xenobiotics in rural environments and propose or implement appropriate management plans (Comprehension / Application / Evaluation). - Produce a structured report or presentation on a class of xenobiotics, including discussion of toxicity, metabolism, mechanism of action, and introduction into the food chain (Application / Analysis / Synthesis).
General Competences
Data analysis-synthesis, information mining. Application of relevant technologies

Adapting new situations
Work as individual
Teamwork
Working in a multidisciplinary environment
Respect the natural environment
Exercise criticism and self-criticism
Promotion of creative and inductive thinking

(3) SYLLABUS

THEORY

- Categories of xenobiotics
- A. Persistent Organic Pollutants (POP)
- B. Heavy metals
- C. Toxins (aflatoxins, ochratoxins etc.)
- D. Residues-metabolites of plant protection products
- E. Hormones - Endocrine Disruptors (EDC's)
- F. Antibiotics, residues-metabolites of veterinary medicines
- G. PCB's, dioxins etc.
- Toxic mechanisms of various classes of xenobiotics. The mechanisms of genetic and acquired toxicities will be presented with particular focus on toxic reactions of liver and the heart and life support systems such as the reproductive, respiratory, endocrine, cardiovascular and cardiovascular systems.
- Mechanisms of diffusion, absorption and metabolism of xenobiotics. The process and techniques to calculate-evaluate the parameters of xenobiotics presence in soil, water, atmosphere and biological materials with emphasis on foodstuffs will be presented, along with the respective toxic impacts and assessment methodology in both rural and natural ecosystems.
- Basic principles and risk assessment methodologies. The basic principles of health risk assessment emerging from xenobiotic exposure will be presented. Specific study areas include risk identification techniques, evaluation of exposure to xenobiotics, dose response toxicity and risk characterization. Study of biomarkers and presentation of appropriate techniques and methods for statistical processing of the critical parameters.
- Basic principles for sampling and instrumental analysis of xenobiotics. This section includes methodologies for sampling, collection and isolation of xenobiotics from diverse environmental and biological matrices. Also, the fundamental principles of colorimetry, chromatography (thinlayer chromatography, column chromatography, HPLC, gas chromatography), and spectroscopic techniques including ultraviolet-visible (UV-Vis) absorption and mass spectrometry will be presented, since they constitute essential methods for the qualitative and quantitative analysis of xenobiotics.
- Existing (Greek-European and International) legal framework. Presentation of the available best practices for the management of xenobiotics.
- Principles for literature research-documentation and writing-authoring scientific publications.

LABORATORY

Introduction

- Safety Guide for toxicology laboratory
- Management of hazardous materials.
- Laboratory equipment

Sampling

- Selection, sampling and handling of samples
- Macroscopic observation of samples

Sample preparation for toxicological analysis - Processing of a milk sample

- Protein precipitation
- Extraction using SPE

Colorimetric methods applications in Toxicology

- Ninhydrin reaction
- O-Cresol/ammonia reaction
- Dragendorff reaction – Detection of Alkaloids
- Diphenylamine reaction

Spectrophotometric methods

- Quantitative assessment of urea in animal feed

Xenobiotics Residues (Qualification)

- Thin Layer Chromatography-HPTLC

Antibiotic residues (Quantitative determination)

- HPLC Chromatography

Assessment of volatile compounds with gas chromatography

- GC-MS determination - Use of the NIST Spectral Library

Literature assignment (individual-group) on modern methods of toxicological analysis

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY	Face to face (theory-laboratory) and remote support via Email	
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Power point presentations and video projections in lab lectures Learning process through e-class platform Communication with students via e-mail	
TEACHING METHODS <i>The manner and methods of teaching are described in detail.</i> <i>Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.</i> <i>The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</i>	Activity	Semester workload
	Lectures	26
	Laboratory practices	26
	Individual work	18
	Teamwork	20
	Case study	6
	Study-analysis of book chapters and articles	4
	Course total (25 h of workload per ECTS)	100
STUDENT PERFORMANCE EVALUATION	I. Theory a) The attendance of lectures by students is optional. b) Since the teaching mode of the course is experiential, students are graded through their individual assignments' evaluation. 1. Literature review implementation-presentation: at semester beginning each student with a distinct toxicological subject. After reviewing the relevant literature, each student presents the outcome which is graded as follows: i. teaching staff evaluation 60% ii. self and fellow students' evaluation 15% 2. Implementation of a case study 25% II. Laboratory 1. Multiple Choice Test: 25% 2. Group Project with Public Presentation: 50% 3. Evaluation of Individual Laboratory Reports and Experimental Results: 25% III. The evaluation language is Greek. IV. The assessment criteria are communicated to the students.	

(5) ATTACHED BIBLIOGRAPHY

Theory All lectures are available at e-class as power-point presentations Books: • «Food Toxicology» (Greek) K. Giaginis, S. Thocharis, Xh. Karantonis, Ziti eds, Thessaloniki, 2015, ISBN 978-960-456-453-8 • «Veterinary Toxicology» (Greek) B.-P. Kotsaki-Kovatsi, Sichroni Paidia eds, 2004, ISBN 978- 960-357064-8 • "Introduction to Food Toxicology," P. A. Tarantilis, Vasileiadis eds, 2022, ISBN 9789925588411. Relevant books freely available in internet • Basic Analytical Toxicology. 1995. World Health Organization, Geneva. pp 58. http://whqlibdoc.who.int/publications/1995/9241544589.pdf • A Textbook of Modern Toxicology. 2004. John Wiley & Sons, Inc., Publication. pp 499. ftp://icksie.noip.org/EBooks/NBC/Chemical/A%20Textbook%20of%20Modern%20Toxicology.pdf Related scientific journals • Journal of Analytical Toxicology http://jat.oxfordjournals.org • Journal of Agricultural and Food Chemistry http://pubs.acs.org/journal/jafcau • Food and Chemical Toxicology http://www.journals.elsevier.com/food-and-chemical-toxicology/ • Toxicology http://www.journals.elsevier.com/toxicology/ • Toxicological Letters http://www.journals.elsevier.com/toxicology-letters/ • Toxicological Sciences

(<http://toxsci.oxfordjournals.org>)

- Journal of Applied Toxicology

([http://onlinelibrary.wiley.com/journal/10.1002/\(ISSN\)1099-1263](http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1099-1263))

- Chemical Research in Toxicology

(<http://pubs.acs.org/journal/crtoec>)

- Archives of Toxicology

(<http://www.springer.com/biomed/pharmacology+%26+toxicology/journal/204>)

LABORATORY

All lectures are available at e-class as power-point presentations