

Title	Ecotoxicology						
Code	XXXXX						
Study Program	Interdisciplinary doctoral study «Protection of Nature and Environment»						
Semester	3						
ECTS	5						
Status	elective						
Lecturer	Dr. Tvrtko Smital						
Co-Lecturers	Dr. Branimir Hackenberger Kutuzović						
Requirements for Enrolment	University degree in Natural or Biotechnical Sciences						
Objectives	To introduce students with basic knowledge in the field of ecotoxicology as scientific discipline, with particular insight on: (1) actual knowledge on types, fate and effects of environmental contaminants, from the cellular level up to possible effects on the biosphere as a whole; (2) research tools, protocols and methods currently being applied for better understanding of the fate and effects of contaminants; and (3) principles and the ways in which the related knowledge is used in the process of ecological risk assessment and sustainable use of the environment.						
Learning Outcomes	<ol style="list-style-type: none"> 1. Knowledge related to definition, basic goals and relationship of the ecotoxicology to other disciplines within the area of environmental science; 2. Knowledge on transfer and fate of different types of environmental contaminants, and key factors affecting those processes, respectively (types of contaminants, routes of entry, traffic/transport of contaminants, factors affecting toxicity, bioavailability, biotransformation, bioaccumulation, biomagnification); 3. Basic knowledge on mechanisms and toxic effects of environmental contaminants on molecular level, as well as at the level of organism, population, community and ecosystem (basic mechanisms of xenobiotics effects; sublethal, acute and chronic toxic effects; toxicity testing; interactive effects of contaminants – basic examples); 4. Knowledge on basic types and specific requirements of biological indicators of environmental contamination (ecotoxicological biomarkers), and knowledge on the concepts and basic types of programmes related to evaluation of biological quality of the environment (biomonitoring); 5. Basic types of global effects of contaminants and methodological and conceptual framework of the ecological risk assessment and sustainable use of the environment; most relevant international initiatives. 						
Connection between Learning Outcomes, Curricular and Student Activities	Student Activities	ECTS	Learning Outcomes	Curricular Activities	Methods of Assessment	Credits*	
						min	max
	Activity during lectures	0.5	1-5	Lectures			
	Preparation of seminar	3.5	1-5	Seminar presentation	Evaluation of presentation		
	Preparation for oral exam	1.0	1-5	Final exam	Oral exam		
Total	5						
Consultations	If necessary; in accordance with lecturer						
Learning Activities	Lectures		Seminars		Practice		
Hours	10		5		0		
Contents / Teaching Units	1. Introduction: history of ecotoxicology, why it is needed, definitions, basic goals and relation towards other environmental science disciplines;						

	<p>2. Fate of contaminants in the environment: types of contaminants, routes of entry, transfer among environmental compartments, factors affecting those processes, toxicity, bioavailability, biotransformation, bioaccumulation, biomagnification;</p> <p>3. Molecular effects of environmental contaminants, basic mechanisms of toxic action of xenobiotics; the effects on organisms; sublethal effects and their identification, acute and chronic lethal effects, toxicity testing, interactive effects of environmental contaminants; the effects on the level of population, community and ecosystem – basic examples;</p> <p>4. Biological indicators of environmental contamination (ecotoxicological biomarkers) – definition, classification; biomonitoring – concepts, types, specific requirements, examples;</p> <p>5. Global effects of environmental contaminants; overview; ecological risk assessment and sustainable use of the environment concept(s), examples; overview of key recent international initiatives on the area of sustainable management of environmental resources.</p>
Recommended Literature	<ul style="list-style-type: none"> • Newman M. C. (1998) Fundamentals of Ecotoxicology, Lewis Publishers, USA. • Walker, C. H., Hopkin, S. P., Sibley, R. M. and Peakall, D. B. (2001) Principles of Ecotoxicology, Taylor & Francis, USA. • Landis, W.G. and Ming-Ho, Y. (1998) Introduction to Environmental Toxicology: Impacts of Chemicals upon Ecological Systems, Lewis Publishers, USA. • Chiras D. D. (1992) Environmental Science – Action for a Sustainable Future, Benjamin/Cummings Publishing, USA. • McCarthy, J.F. and Shugart L.R. (1990) Biological Markers of Environmental Contamination. Lewis Publishers, USA. • J. Lopez-Barea, Biomarkers in Ecotoxicology: an Overview, Archives of Toxicology, Suppl. 17(1994)57-79; Springer. Proceedings of the 1994 EUROTOX Congress meeting, August 21-24, 1994, Basel, Switzerland. • U. Varanasi, Metabolism of Polycyclic Aromatic Hydrocarbons in the Aquatic Environment. CRC Press Inc., 1989, Boca Raton, Florida • W.J.Langston, M.J.Bebianno (editors), Metal Metabolism in Aquatic Environments, Chapman&Hall Ltd, London, 1998.
Additional literature	<ul style="list-style-type: none"> • U.S. EPA. Final Guidelines for Ecological Risk Assessment. Risk Assessment Forum. EPA/630/R-095/002F. Washington DC: US Environmental Protection Agency, April 1998. • FDA /Food and Drug Administration). Guidance for Industry: Environmental Assessment of Human Drug and Biologics Application. CDER/CBER CMC 6, July 1998. • National Research Council, Science and Judgment in Risk Assessment. Washington DC: National Academy Press, 1994. • Directive of the European Parliament and of the Council No. 98/8/EC: On the placing of biocidal products on the market. • National Research Council. Hormonally Active Agents in the Environment. Washington, DC: National Academy Press, 1999. • Chapman P.M. (2002). "Integrating toxicology and ecology: putting the "eco" into ecotoxicology". Marine Pollution Bulletin 44 (1): 7–15. doi:10.1016/s0025-326x(01)00253-3. • Clements, W., Rohr, J. Community Responses to Contaminants: Using Basic Ecological Principles to Predict Ecotoxicological Events." Environmental Toxicology and Chemistry (2009): p1789-1800. • Van Straalen, N. (2003). "Ecotoxicology becomes Stress Ecology". Environmental Science & Technology 37: 324A–329A. doi:10.1021/es0325720. • C.A. Harris, A.P. Scott, A.C. Johnson, G.H. Panter, D. Sheahan, M. Roberts, J.P. Sumpter (2014): Principles of Sound Ecotoxicology. Environ. Sci. Technol., Article ASAP, DOI: 10.1021/es4047507
Requirements for Acquiring Signature	Attendance at lectures or consultations
Type of Exam	Oral exam with the seminar presentation.
Lectures Language	Croatian; English
Quality Monitoring	Survey after classes.

