TOXICOLOGY

1. COURSE DECRIPTION – GENERAL INFORMATION	
1.1. Course teacher	Full Professor Irena Žuntar, specialist of toxicology
1.2. Associate teachers	Associates on exercises from Teaching Institute of Public Health ”Dr. Andrija Štampar” (dr. sc. A. Krivohlavek, Professor. J. Bošnir/ dr. sc. D. Lasić) and Croatian National Institute of Public Health (mr. sc. I. Vidić Štrac)
1.3. Graduate programme	Integrated study of Pharmacy and Medical Biochemistry
1.4. Status of the course	obligatory
1.5. Year of study, Semester	4th year/8th semester
1.6. Credit value (ECTS)	5
1.7. Type of instruction (number of hours L+E+S+e-learning)	30+6+24
1.8. Expected enrolment in the course	150
1.9. Level of use of *e*-learning (1, 2, 3 level), percentage of instruction in the course on line (20% maximum)	2.
2. COURSE DESCRIPTION	
2.1. Course objectives	Students will be introduced into basic toxicological topics, terms and basic principles of interactions of poisons (toxins and toxicants) and human organism (absorption, distribution, metabolism and elimination of poisons from organism), as well as effects of chemicals on ecosystem. Students will understand biochemical mechanisms of poison toxicity, know different types of adverse effects, describe toxokinetic properties of basic chemical groups and understand basic principles of first aid and therapeutic approach. Students will know to link terms hazard, risk assessment and safety of chemicals/poisoning in field of human health and environment. Also, students will be introduced with classification and labelling of chemicals (MSDS, material safety data sheet) and safety handling according to legislation of Republic of Croatia and EU.
2.2. Enrolment requirements and required entry competences for the course	Enrolment pre requirements: audited course Pharmacology Pre-knowledge of Physiology, Pathophysiology, Pharmacology and Biochemistry of Drugs
2.3. Learning outcomes at the level of the study programme to which the course contributes	• Develop solutions of practical problems in production and monitoring of safe and appropriate application of drugs (recognize basic principles of safe work, handling and management with chemicals). • Inform and advise patients and general population about the effects and appropriate application of drugs, possible side-effects of chemicals, dietary supplements and herbal preparations, as well as their combinations.
2.4. Expected learning outcomes at the level of the course (4-10 learning outcomes)	Passing the exam students will be able to: 1. Describe and explain basic toxicological topics, terms; 2. Describe absorption, distribution and elimination (including metabolisms) of poisons as well as factors that influence the extant of these processes; 3. List of basic toxicological processes (absorption, distribution, metabolisms and elimination) and biochemical mechanisms of toxicity of basic group of poisons (chemicals); 4. Estimate procedures of first aid and therapy (antidotes) depending on toxicological characteristics of poisons (chemicals); 5. Link hazard, risk assessment and safety of poisons (chemicals)/poisoning in

	context of human health and environment; 6. Recognize labels of chemical classification and procedures of safe handling.
2.5. Course content broken down in detail by weekly class schedule (syllabus)	LECTURES: • Introduction to toxicology with short history of toxicology (examples of poisoning) • Basic toxicology terms – 1st part • Basic toxicology terms – 2nd part • Transport across membranes. Lipophilicity/Hydrophilicity • Absorption of poisons • Distribution of poisons • Elimination of poisons • Inorganic poisons • Gases • Industrial organic chemicals • Pesticides (Biocides) • Biochemical mechanisms of toxicity of therapeutic drugs • Therapeutic drug monitoring (TDM) • The basis of nanotoxicology • The basis of dermatotoxicology • The basis of military toxicology (chemical warfare agents) • Drugs of abuse • Ecotoxicology SEMINARS: • Classification of chemicals and the handling of chemicals in health institutions (in pharmacies) • Sampling and samples for toxicological analysis (Extraction of poisons from various toxicological samples, Detection of toxicity, Screening test and confirmative techniques for final detection of poisons) • Documentary “Fashion victims” educational film • Plants poisons • Mushroom poisons • Mycotoxins • Bacterial toxins • Excipient toxicity and safety in drug dosage forms • Handling of chemicals in health institutions (in pharmacies) • Poisons of animals • Documentary “The toxin return”” educational film • Seminar student's essays with discussion and repetition of materials EXERCISES & DEMONSTRATION EXERCISES At Teaching Institute of Public Health ”Dr. Andrija Štampar” and Croatian National Institute of Public Health: Demonstration of sample preparation for toxicological analysis with emphasis on the results of the analysis and comment/evaluation of the safety of different samples (e.g. food, beverages, objects for general use and food supplements) 4 hours of demonstration and 2 hours of exercises in the laboratory (student work). Prepared exercises are: 1. Test of acute toxicity on an organism *Daphnia magna* 2. Determination of metals by EDX techniques 3. Determination of the volume fraction of sedimentable substance in waste water samples and Determination of dried and annealed of residue

	(Determination of organic and inorganic substances, for example - antibiotics in water). 4. Preparation of samples for determining the transition of certain elements of materials and articles intended to come into contact with food. Analysis of the results of the AAS. 5. Preparation of samples for determining the transition of certain elements of materials and articles intended to come into contact with food. Analysis of the results of the ICP-MS.			
2.6. Type of instruction	**lectures** seminars workshops **exercises** online in entirety mixed *e*-learning mixed *m*-learning		field work independent study multimedia and the internet work with the mentor (other) **demonstration exercises**	
2.7. Student responsibilities	Class attendance, positive mark of seminar essay, passed exams, written and oral			
2.8. Screening of student's work (specify the proportion of ECTS credits for each activity so that the total number of CTS credits is equal to the credit value of the course)	Class attendance	0.5	Seminar essay	1.5
	Experimental work		Oral exam	2
	Essay		Project	
	Tests		Practical training	
	Written exam	1	(Other--describe)	
	Research		(Other--describe)	
	Report		(Other--describe)	
2.9. Grading and evaluation of student work over the course of instruction and at a final exam				

2.10. Required literature (available at the library and via other media)	**Title**	**Number of copies at the library**	**Availability via other media**
	Plavšić F, Žuntar I. Analitička toksikologija, Školska knjiga, Zagreb, 2006.		
	Plavšić F. et al. Osnove kliničke farmakokinetike, Školska knjiga, Zagreb, 1993.		
	Žuntar I., Plavšić F., Wolf Čoporda A., Štraus B. Određivanje koncentracije lijekova tijekom terapije, str. 605-621., U: Štrausova medicinska biokemija; ur. Čvorišćec D., Čepelak I., Medicinska naklada, Zagreb, 2009.		
	Duraković Z. et al., Klinička toksikologija, Grafos, Zagreb, 2011.		
	Osnove forenzične toksikologije, ed. Davorka Sutlović, Web knjižara Redak, Split, 2011. Sveučilišni udžbenik Sveučilišta u Splitu. • Sutlović D., Žuntar I. Apsorpcija, raspodjela, metabolizam i izlučivanje: ARMI. p. 19-58. • Žuntar I., Plavšić F. Otrovi biljaka i		

	životinja. p. 171-210.		
	Timbrell J.A. Principles of Biochemical Toxicology, Fourth Edition, Informa Healthcare, New York, 2009.		
	Dart R.C. et al., Medical Toxicology, Third Edition, Lippincott, Williams & Wilkins, Philadelphia, 2004.		
	Turk R. Novi hrvatski propisi o kemikalijama – znakove opasnosti zamjenjuju piktogrami. Sigurnost 2013; 55:27-36.		http://hrcak.srce.hr/index.php?show=toc&id_broj=8076
	Žuntar I., Slišković I., Plavšić F. Analiza gospodarenja kemikalijama u ljekarnama u Hrvatskoj. Farm Glas 2007; 63:723-750.		http://www.pliv amed.net/knjizn ica/farmaceutsk i-glasnik/izdanje/ 128/Farmaceuts ki-glasnik-122007.html
2.11. Optional literature	Useful the Internet addressses: - http://ec.europa.eu/environment/chemicals/index_en.htm - http://ec.europa.eu/health/scientific_committees/opinions_layman/nanomaterials/en/index.htm - https://ec.europa.eu/growth/sectors/cosmetics_en - http://echa.europa.eu/hr/ - http://www.unep.org/ - http://www.epa.gov/ - http://www.atsdr.cdc.gov/ - http://ec.europa.eu/growth/sectors/cosmetics_en - https://echa.europa.eu/regulations/biocidal-products-regulation - http://www.hzt.hr/		
	Žuntar I., Wolf Čoporda A., Plavšić F. Farmakokinetički kemijski procesi. p. 18-24. In: Farmakoterapija u gerijatriji, Geriatric pharmacotherapy, ed. Zijad Duraković, C. T. – Poslovne informacije d.o.o., Medixova medicinska biblioteka, Zagreb, 2011. Sveučilišni udžbenik: Sveučilišta u Zagrebu, Sveučilišta u Osijeku, Sveučilišta u Mostaru, Sveučilišta u Splitu i Sveučilišta u Rijeci.		
2.12. Methods of monitoring quality that ensure acquisition of exit competences	Outcomes are verified by written and oral exams.		
2.13. Comments			