1. COURSE DECRIPTION – GENERAL INFORMATION			
1.1. Course teacher	Assoc. Prof. Milena Jadrijević-Mladar Takač Assist. Prof. Monika Barbarić	1.6. Year of study	4th
1.2. Name of the course	Biochemistry od Drugs	1.7. Credit value (ECTS)	5
1.3. Associate teachers	-	1.8. Type of instruction (number of hours L+E+S+e-learning)	30+30+0
1.4. Study programme (undergraduate, graduate, integrated)	Integrated study of Medical biochemistry	1.9. Expected enrolment in the course	25
1.5. Status of the course	Compulsory	1.10. Level of use of e-learning (1, 2, 3 level), percentage of instruction in the course on line (20% maximum)	2nd
2. COURSE DESCRIPTION			
2.1. Course objectives	Students will gain knowledge about biochemical changes of drugs, other chemical substances and endobiotics, and the effects of these metabolic changes in the body. Furthermore, students will gain insights into biochemical processes that involve drugs, their mechanisms, the relationships between drug structure, biotransformation process and biological effect, and the features of enzymes and enzyme systems significant for toxic effects, as well as about drug-drug and drug-other chemical substance interactions.		
2.2. Enrolment requirements and required entry competences for the course	The prerequisite for admission: the attended Pharmaceutical/Medicinal Chemistry and Pharmacology.		
2.3. Learning outcomes at the level of the study programme to which the course contributes	Students will be able to: • Define, analyse and to propose the procedures relevant to research and implementation of new laboratory tests in disease discovery and disease monitoring, as well as in monitoring of therapeutic outcomes and the effectiveness of the therapy, using the knowledge of xenobiotic biotransformation in the body. • Apply an expert knowledge of metabolic pathways and enzymes involved in xenobiotics biotransformation in diagnostic tests and laboratory procedures, in assessment of clinical significance of biochemical and molecular biology indicators, in detecting the source of errors and variability of the results of laboratory analysis and the interpretation of results by biochemical and clinical aspects.		

2.4. Expected learning outcomes at the level of the course (4-10 learning outcomes)	After completing the course students will be able to: 1. Identify the main metabolic pathways for particular endogenous substances and drugs; 2. List the major enzyme systems and their role in biotransformation reactions; 3. Explain the specific pathway of biochemical activation and or toxicity occurrence, side effects and interactions; 4. Describe the pharmacodynamic and pharmacokinetic properties of certain drugs and xenobiotics regarding the specificity of their biotransformation; 5. Link the drug structure with metabolic processes and specific enzymes involved in biotransformation; 6. Predict the major biotransformation products (metabolites) of certain drugs and describe their formation.
2.5. Course content broken down in detail by weekly class schedule (syllabus)	LECTURES: • Introduction to Biochemistry of drugs and the importance of drug metabolism research. • Metabolism and biotransformation of drugs and some other xenobiotics and endobiotics. • Biotransformation by phase I reactions – oxidation, reduction and hydrolysis reactions. • Oxidation (bioxidation); Reductions (bioreduction); hydrolysis; Less common metabolic reactions; Enzymes that catalyse oxidation-reduction reactions. • Biotransformation by phase II reactions. • Methylation; Conjugation with α-amino acids and endogenous amines (N-acylation); acetylation; Sulfoconjugation; glucuronidation; Reactions with the reduced form of glutathione. • Stereoselectivity of drug metabolism. • Features of stereoselectivity and stereochemical aspects of drug metabolism; The stereoselectivity of binding to serum proteins. • Prodrugs. Hydrolysis reactions; Examples of prodrugs and rational reasons for their preparation. • Transport proteins. Drug substrates, inhibitors and activators of P-glycoprotein (P-gp, MDR1), MRP and other carriers. • Induction and inhibition of biotransformation reactions. • Induction of enzyme activity. Induction of Cytochrome P 450 enzymes. • Inhibition of enzyme activity. Inhibition of Cytochrome P 450 enzymes. • Drug-drug interactions and drug-other xenobiotic s interactions. • Reactions of biotransformation of physiological substances and selected drugs. • Biotransformation and toxicity of selected drugs and other xenobiotics. EXERCISES: • QSAR and determine the lipophilicity of the sulfonamide. • Biotransformation of salicilamide.

	• Biotransformation of active substances in cough syrup (ephedrine, codeine). • Binding of drugs to human serum albumin (gel filtration method). • Biotransformation of acetyl salycylic acid.					
2.6. Type of instruction	**lectures** seminars and workshops **exercises** online in entirety mixed e-learning field work		independent study multimedia and the internet **laboratory** work with the mentor (other)		2.7. Comments:	
2.8. Student responsibilities						
2.9. 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	1	Research		Practical training	
	Experimental work	0.5	Report			
	Essay		Seminar essay		(Other--describe)	
	Tests	0.5	Oral exam	2	(Other—describe)	
	Written exam	1	Project		(Other—describe)	
2.10. Grading and evaluation of student work over the course of instruction and at a final exam	The student's activity is evaluated during the teaching process. The final assesment is made on the basis of the succes achieved in the written and oral exam. After completing the practicum students must take colloquium whic is a prerequisite for written exam and the passied written exam is a prerequisite for taking the oral exam.					
2.11. Required literature (available at the library and via other media)	**Title**					
	S. Rendić i M. Medić-Šarić, Metabolizam lijekova i odabranih ksenobiotika, Medicinska naklada, Zagreb, 2013. (ISBN 978-953-176-587-9)					
	Lecture handouts					
	B. Testa, S.D. Krämer, The Biochemistry of Drug Metabolism: Volume 1: Principles, Redox Reactions, Hydrolyses, Wiley-VCH, Verlag GmbH, Weinheim, 2008.					
	B. Testa, S.D. Krämer, The Biochemistry of Drug Metabolism: Volume 2: Conjugations, Consequences of Metabolism, Influencing Factors, Wiley-VCH, Verlag GmbH, Weinheim, 2010.					
2.12. Optional literature						
2.13. Methods of monitoring quality that ensure acquisition of exit competences	Outcomes 1-5 are checked by written and oral exams, while the outcome 6 during the exercise by final qolloquium.					