Description of an Individual Course Unit

Study program	All, except Chemistry		
Module			
Type and level of studies	PhD studies		
Course title	Transport Phenomena in Biological Systems		
Professor (for lectures)	Branko Bugarski, Bojana Obradovic		
Professor/assistant (for practice)			
Professor/assistant (for LAB)			
Number of ECTS	5	**Type of the course (mandatory/elective)**	elective
Prerequisit			
Objective of the course	The aim of this course is to introduce to students transport phenomena in biological systems so to be able to apply the acquired knowledge in the area of momentum, mass and heat transfer to analyze and solve complex problems in these systems. In this way, the students gain comprehension not only of biological processes in living organisms but also of the utilization of engineering principles in analyses of these processes.		
Learning outcomes of the course	The students have acquired: (i) knowledge needed for understanding and analysis of complex processes in biological systems at the macro-levels of the organism and a tissue as well as at the micro-level of the cell; (ii) communication skills for clear formulation, presentation and analysis of the problems in the area of transport phenomena in biological systems; (iii) communication and social competences required for work in a multidisciplinary team of engineers, biologists, pharmacists and medical doctors.		
Course Contents			
Theoretical contents	Within the scope of the course, the students are introduced to the features of transport phenomena in biological systems, which are, regarding the complexity, significantly more demanding than the common chemical engineering systems. Main concepts of momentum, mass and heat transport are applied to biological systems at the macro-levels of the organism and a tissue as well as at the micro-level of the cell. Transport mechanisms are described gradually starting from simpler cases (e.g. rheological properties of blood, oxygen diffusion through blood plasma) to rather complex problems with main approaches to mathematical modeling and finding solutions (e.g. blood flow through arteries, active mass transport through the cell membrane).		
Practical part (practices, LAB, study research work)	The course includes an experimental exercise on the study of rheological properties of biological fluids.		
Literature			
1	Obradovic, B., Transport Phenomena in Biological Systems, Part I, (in Serbian), authorized course material		
2	Bugarski, B., Milivojević M., Nedović, V., Djordjević, V., Bioprocess Engineering (in Serbian), Academic Mind, Belgrade, 2013.		
3	Truskey G.A., Yuan F., Katz D.F., Transport phenomena in biological systems: a textbook for biomedical engineers, Prentice Hall, 2004.		
4	Lightfoot E.N., Transport phenomena and living systems, John Wiley and Sons, New York, 1974		
5	Cherruault Y., Mathematical modelling in biomedicine, D. Reidel Publishing Company, Dordrecht, 1986.		

Lessons per week

Lectures	**Practices**	**LAB**	**Study research work**	**Other activities**
3				

Teaching Methods	theoretical and practical lessons and a laboratory exercise

Grading methods (max. number of points is 100)

Pre-exam assesments	**points**	**Final examination**	**points**
activity during lectures		**written exam**	
homework assignments	70	**oral exam**	30
mid-term exams			
seminars			