

## Specification for the book of courses

<b>Study program</b>		Electrical Engineering and Computer Science		
<b>Module</b>		Communications and Information Technologies - System Engineering and Radio-Communications		
<b>Type and level of studies</b>		Undergraduate Academic Studies		
<b>The name of the course</b>		Application of Artificial Neural Networks in RF Communication Systems		
<b>Lecturer (for lectures)</b>		Marković V. Vera, Marinković D. Zlatica, Stanković Ž. Zoran		
<b>Lecturer/associate (for exercises)</b>		Milijić R. Marija		
<b>Lecturer/associate (for OFE)</b>		Milijić R. Marija		
<b>Number of ECTS</b>	5	<b>Course status (obligatory/elective)</b>	Elective	
<b>Prerequisites</b>				
Acquiring knowledge about artificial neural networks (ANN) and their applications in RF communication systems. Training students to apply artificial neural networks for solving particular problems.				
<b>Course objectives</b>				
Knowledge of the structure of artificial neural networks and the procedures necessary for the development of neural models. Ability to choose a type of neural model for the given problem and to develop a corresponding model. Ability to implement the ANN model in standard software packages for simulation and analysis of communication systems and circuits.				
<b>Course outcomes</b>				
Knowledge of the structure of artificial neural networks and the procedures necessary for the development of neural models. Ability to choose a type of neural model for the given problem and to develop a corresponding model. Ability to implement the ANN model in standard software packages for simulation and analysis of communication systems and circuits.				
<b>Course outline</b>				
Artificial neural networks. Neuron and neuron model. Types of artificial neural networks. Multilayer artificial neural networks. Training, testing and validation of artificial neural networks. Principles of development of models based on artificial neural networks. The concept of knowledge-based neural models. Hierarchical neural models. Examples of application of artificial neural networks for modeling RF and microwave components and circuits. Examples of the application of artificial neural networks in the field of EM wave propagation. Other applications of artificial neural networks in communication systems. Implementation of neural models in software tools for simulation and analysis of communication systems.				
<b>Theoretical teaching</b>				
Artificial neural networks. Neuron and neuron model. Types of artificial neural networks. Multilayer artificial neural networks. Training, testing and validation of artificial neural networks. Principles of development of models based on artificial neural networks. The concept of knowledge-based neural models. Hierarchical neural models. Examples of application of artificial neural networks for modeling RF and microwave components and circuits. Examples of the application of artificial neural networks in the field of EM wave propagation. Other applications of artificial neural networks in communication systems. Implementation of neural models in software tools for simulation and analysis of communication systems.				
<b>Practical teaching (exercises, OFE, study and research)</b>				
Computer-based exercises: creating, training and testing of artificial neural networks. Examples of the development of neural models. Students' project: application of artificial neural networks for solving a specific problem in RF communication systems.				
<b>Textbooks/references</b>				
1	Q. J. Zhang, K. C. Gupta, Neural Networks for RF and Microwave Design, Artech House, 2000.			
2	C. Christodoulou, M. Gerogiopoulos, Applications of Neural Networks in Electromagnetics, Artech House, 2001.			
3	Z. Marinković, V. Marković, A. Caddemi, "Artificial Neural Networks in Small-Signal and Noise Modeling of Microwave Transistors", Chapter 6 in „Artificial Neural Networks“ edited by Seoyun J. Kwon, Nova Science Publishers Inc., 2011, pp. 219-236			
4	Scientific papers			
5				
<b>Number of classes of active education per week during semester/trimester/year</b>				
<b>Lectures</b>	<b>Exercises</b>	<b>OFE</b>	<b>Study and research work</b>	<b>Other classes</b>
2	1	1	0	0
<b>Teaching methods</b>				
Предавања; Рачунарске вежбе; Израда пројекта; Консултације.				
<b>Grade (maximum number of points 100)</b>				
<b>Pre-exam duties</b>		<b>Points</b>	<b>Final exam</b>	<b>Points</b>
<b>Activity during lectures</b>			<b>Written exam</b>	
<b>Exercises</b>			<b>Oral exam</b>	50
<b>Colloquia</b>				
<b>Projects</b>		50		