RTU Course "Adaptive Systems in Industrial Electronics"

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General data

Code	EEI354
Course title	Adaptive Systems in Industrial Electronics
Course status in the programme	Compulsory/Courses of Limited Choice
Responsible instructor	Mihails Gorobecs
Academic staff	Andrejs Potapovs
Volume of the course: parts and credits points	1 part, 4.5 credits
Language of instruction	LV, EN
Annotation	Study course is devoted to adaptive systems that automatically adjust themselves to outside conditions and changes of electric or electro-mechanic control object, changing structure and parameters of control device providing necessary quality of control. Within the study course main features of the adaptive system are the possibilities of embedded systems for self-organization, self-learning and self-regulation with the use of fuzzy logic, associative memory, neural networks and other methods, solving the tasks of extreme control and optimization, automation control as well as searching, recognition, classification, clasterization tasks are studied.
Goals and objectives of the course in terms of competences and skills	The goal of the course is to provide knowledge about basic principles and development approaches of adaptive systems in industrial electronics. The tasks of the study course are to give knowledge about adaptive automatic control systems, their features and to teach students to apply adaptive methods for the complex objects control.
Structure and tasks of independent studies	Theoretic preparation for practical classes. Forming of the practical classes results.
Recommended literature	Obligātā/Obligatory: 1. Alpaydin E. Introduction to Machine Learning. Fourth edition. Cambridge, Massachusetts : The MIT Press, 2020, 682 lpp. 2. Manjaree Pandit, Laxmi Srivastava, Ravipudi Venkata Rao, Jagdish Chand Bansal (ed.) .Intelligent Computing Applications for Sustainable Real-World Systems : intelligent computing techniques and their applications . Springer International Publishing, 2020, 568 lpp. 3. A.Ļevčenkovs, M. Gorobecs, L.Ribickis. Vizuālorientēta programmēšana industriālā elektronikā. Mācību grāmata. Rīga, RTU, 2010, 522 lpp. 4. L.Ribickis, A.Ļevčenkovs, M.Gorobecs. Sistēmu teorijas pamati industriālās elektronikas modelēšanā. Rīga, RTU, 2008 - 100 lpp. 5. I.Mareels, J.W.Polderman. Adaptive Systems. Birkhäuser Basel, 1996 - 342 p. Papildus/Additional: 1. Haykin S. Neural Networks. A Comprehensive Foundation. 2nd ed. – Prentice Hall, 2006 – 1104 p. 2. Ya. Z. Tsypkin, Z. J. Nikolic. Adaptation and Learning in Automatic Systems. Academic Press 1971 - 290 p. 3. Thomas Braunl. Embedded Robotics, Mobile Robot Design and Applications with Embedded Systems, Second Edition. Springer, 2006. 458 p.
Course prerequisites	Programming, electrical engineering.

Course contents

Content	Full- and part-time intramural studies		Part time extramural studies	
	Contact Hours	Indep. work	Contact Hours	Indep. work
Control systems of the complex electric and mechanic objects. Closed systems.	2	3	1	4
Controllable objects and methods of expert evaluation. Criteria of control quality.	2	3	1	4
Adaptive identification in control systems. Algorithm of adaptive identification. Searching algorithms and adaptation.	2	3	1	4
Uninterruptable inertia objects. Adaptation of frequency in the inertia objects.	2	3	1	4
Extreme control. Self-regulated extreme control systems.	2	3	1	4
Adaptation in gradient methods. Self-learning in stochastic processes.	2	3	1	4
Adaptive and intelligent automatic control systems.	2	3	1	4
Self-regulated adaptive automatic control systems.	2	3	1	4
Adaptive control systems with optimization of dynamic and static modes.	2	3	1	4
Self-organized and self-learning adaptive automated control systems.	2	3	1	4
Adaptive automated control systems on the basis of fuzzy logic.	2	3	1	4
Adaptive automated control systems on the basis of expert systems.	2	3	1	4
Adaptive automated control systems on the basis of associative memory.	2	3	1	4
Adaptive automated control systems on the basis of neuron networks.	2	3	1	4
Self-organization principles and adaptation processes. Classification of adaptive sets.	2	3	1	4
Adaptive analysis of main components. Adaptation of models.	2	3	1	4

1. practical class: programming of adaptive methods for PLC in automated control systems.	4	6	2	8
2. practical class: programming of adaptive algorithms for microcontrollers in automated control systems.	4	6	2	8
3. practical class: adaptive control system of transport system electric drive on the basis of neural networks.	4	6	2	8
4. practical class: adaptive control system of traffic lights and electric transport flow.	4	6	2	8
Total:	48	72	24	96

Learning outcomes and assessment

Learning outcomes	Assessment methods
Is able to use languages for controllers programming in the realization of adaptive control methods for the control of electric and electro-mechanic objects.	Practical class. Study project.
Is able to develop robots and other electric devices adaptive control programs.	Practical class. Study project.
Is able to define principles of adaptive systems, features and parameters, describe methods of adaptive control, and control tasks.	Theoretical examinational questions.
Is able to develop adaptive computer models for the systems robots and other electric devices automatization and control in Simulink environment.	Practice in computer class. Study project.
Is able to solve extreme control tasks of the complex electro-mechanical objects.	Practical examination task.

Evaluation criteria of study results

Criterion	%
Answers to theoretical exam questions	15
Fulfillment of practical task of exam	20
Fulfillment of tests	15
Fulfillment of practical tasks	20
Fulfillment of study project	30
Total:	100

Study subject structure

Part	CP	Hours			Tests		
		Lectures	Practical	Lab.	Test	Exam	Work
1.	4.5	2.0	1.0	0.0		*	