RTU Course "Robot Modeling and Virtual Prototyping"

33000 Faculty of Computer Science, Information Technology and Energy

General data

Code	DDI700
Course title	Robot Modeling and Virtual Prototyping
Course status in the programme	Compulsory/Courses of Limited Choice
Responsible instructor	Artjoms Supoņenkovs
Academic staff	Matīss Eriņš
Volume of the course: parts and credits points	1 part, 4.5 credits
Language of instruction	LV, EN
Annotation	In the study course industrial robot (IR) virtual prototyping, modelling and simulations are reviewed. Prototyping is divided into steps and includes IR work station development, work environment, instrument and work object definition and configuration. Advanced prototyping includes manipulator work in many components environments, where work synchronization tasks are described and overlooked. Robot modelling includes the development of robot control principle and work execution programme. The study course is mainly based on practical lectures, where industrial robot irb1600 and RobotStudio modelling software are considered.
Goals and objectives of the course in terms of competences and skills	The aim of the study course is to teach how to use industrial robots to automate mechanical tasks. Tasks of the study course: - to teach the types of industrial robots and their executive tools; - to develop the ability to build a robot control programme; - to develop the ability to integrate robot control with external information systems; - to develop the ability to simulate robot behaviour in a virtual environment.
Structure and tasks of independent studies	Independent work is integrated with the acquisition of theoretical material and the performance of practical tasks. In order to accomplish the study course, each student has to independently make laboratory works. They are in order that in the end student develops a full working IR station.
Recommended literature	Obligātā/Obligatory: 1. Jorge Angeles. Fundamentals of Robotic Mechanical Systems. Theory, Methods, and Algorithms- Third Edition. 2007 Springer Science+ Business Media, LLC. 2. Richard L. Shell, Ernest L. Hall. Handbook of Industrial Automation. 2000 Marced Dekker Inc. 3. B. Siciliano, O. Khatib. Springer Handbook of robotics. Springer-Verlag Berlin Heidelberg 2008. 4. J. Norberto Pires. Industrial robots programming: building applications for the factories of the future. 2007 Springer Science+Business Media, LLC. Papildu/Additional: 5. N. Muro, F. L. Lewis., C. T. Abdallah Robot Manipulator Control. Theory and Practice- Second Edition. Marcel Dekker inc. 2004; 6. Paul E. Sandin. Robot Mechanisms and Mechanical Devices Illustrated. 2003 by The McGraw-Hill Companies; 7. Ben-Zion Sandier. Robotics Designing the Mechanisms for Automated Machiner. 1999 by Academic Press. 8. Matricu teorijas pielietojumi robottehnikā. RPI, Rīga, 1988. 9. Robottehniskās sistēmas un tehnoloģiskie kompleksi. Laboratorijas darbu apraksti. RPI, Rīga, 1987.
Course prerequisites	Math, robotics.

Course contents

Content	Full- and part-time intramural studies		Part time extramural studies	
	Contact Hours	Indep. work	Contact Hours	Indep. work
1. Industrial robot (IR) history, classification, main structural elements and work tasks.	4	4	0	0
2. Manipulator kinematics, kinematic pairs and it technical realization.	4	4	0	0
3. Manipulator coordinate systems.	4	4	0	0
4. IR simple prototyping – robot station, work environment development and configuration.	4	4	0	0
5. IR task execution instrumental case and used work object definition. Coordinate systems.	4	4	0	0
6. Programming of manipulator movement (free form, linear, spherical, cyclic).	4	4	0	0
7. IR complex prototyping – manipulator movement in multi object environment. Manipulator and positioned synchronic work.	6	6	0	0
8. Task execution step modeling and simulation. Movement and general fault evaluation, robot technical component collision.	6	6	0	0
9. IR programme composition, control principle and algorithm definition.	6	6	0	0
10. IR remote control. Central and decentral control.	6	6	0	0
11. Programming by using high level programming languages.	6	6	0	0

12. Industrial conveyor, line, district, and other industry level modelling. Unified control model development and simulation.	6	6	0	0
Total:	60	60	0	0

Learning outcomes and assessment

Learning outcomes	Assessment methods
Knows industrial robot history, structures and types.	Exam.
Knows in-depth theoretical study course issues, including industrial robot control algorithms.	Exam.
Is able to define industrial robot intelectual control principles.	Exam.
Is able to prototype different level industrial robot systems, which include work object and tool definitions.	Practical works.
Is able to make station and work process modelling of an individual industrial robot.	Practical works.
Is able to develop solution of modeling of multi robot stations and their simultaneous work	Practical works.
Is able to solve direct and inverse manipulator kinematic task.	Practical works.

Evaluation criteria of study results

Criterion	%
Exam	50
Practical works	50
Total:	100

Study subject structure

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