AGH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Module name: Industrial robots

Academic year: 2013/2014 Code: RMS-1-504-s ECTS credits: 12

Faculty of: Mechanical Engineering and Robotics

Field of study: Mechatronics with English as instruction languagege Specialty: —

Study level: First-cycle studies Form and type of study: Full-time studies

Lecture language: English Profile of education: Academic (A) Semester: 5

Course homepage: —

Responsible teacher: dr hab. inż. Lisowski Wojciech (lisowski@agh.edu.pl)

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Description of learning outcomes for module

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Connections with FLO	Method of learning outcomes verification (form of completion)
Social competence			
M_K001	Can learn systematically, keeps deadlines, accepts the matter-of-fact critique of his/her achievements	MS1A_K04, MS1A_K05, MS1A_K02	Examination, Execution of a project, Execution of laboratory classes
M_K002	Knows, understands and applies in practice professional code of an engineer	MS1A_K03	Report, Execution of a project, Execution of laboratory classes
M_K003	Can work in a team respecting partition of duties and responsibilities	MS1A_K04	Execution of a project, Execution of laboratory classes
Skills			
M_U001	Can acquire information from professional sources and use it in realization of engineering tasks	MS1A_U01, MS1A_U05	Presentation, Execution of a project, Execution of laboratory classes

M_U002	Can prepare and carry out presentation of results of realization of engineering tasks	MS1A_U04	Presentation, Report
M_U003	Can write down and interpret description of position and orientation	MS1A_U20, MS1A_U08	Examination, Report, Execution of laboratory classes
M_U004	Can formulate and solve direct and inverse kinematic problem of manipulators of open manipulator kinematic chain	MS1A_U20, MS1A_U08	Examination, Report, Execution of a project, Execution of laboratory classes
M_U005	Is able to program simple manipulating operations of industrial robots	MS1A_U02, MS1A_U14	Activity during classes, Report, Execution of laboratory classes
M_U006	Can select and design a robot gripper (mechanism, driving system, sensory system and power supply)	MS1A_U15, MS1A_U13, MS1A_U11, MS1A_U20, MS1A_U12, MS1A_U03, MS1A_U02, MS1A_U08	Examination, Execution of a project
M_U007	Can determine positioning repeatability of a robotic manipulator experimentally	MS1A_U02, MS1A_U19, MS1A_U09	Examination, Report, Execution of laboratory classes
Knowledge			
M_W001	Knows structures, principles of designing and manufacturing of links and joints, structure of driving systems, sensor and control systems, applied grippers and tools of manipulating robots	MS1A_W05, MS1A_W11, MS1A_W06, MS1A_W13	Examination, Report, Execution of a project, Execution of laboratory classes
M_W002	Knows techniques and tools of on-line and off-line robot programming as well as structure of program of operation	MS1A_W05, MS1A_W10	Report, Execution of laboratory classes
M_W003	Knows principles of manipulator kinematics modelling	MS1A_W08, MS1A_W05	Examination, Report, Execution of a project, Execution of laboratory classes
M_W004	Knows definitions of basic parameters and their actual values achieved by industrial robot manipulators	MS1A_W05	Examination, Execution of laboratory classes
M_W005	Knows the manipulator end-effector position and orientation measuring systems	MS1A_W05, MS1A_W07	Examination, Execution of laboratory classes
M_W006	Knows industrial and service applications of manipulating robots	MS1A_W05	Examination, Presentation

FLO matrix in relation to forms of classes

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Form of classes

		Lectures	Auditorium classes	Laboratory classes	Project classes	Conversation seminar	Seminar classes	Practical classes	Others	Fieldwork classes	Workshops	E-learning
Social competence												
M_K001	Can learn systematically, keeps deadlines, accepts the matter-of-fact critique of his/her achievements	-	-	+	+	-	-	-	-	-	-	-
M_K002	Knows, understands and applies in practice professional code of an engineer	-	-	+	+	-	-	-	-	-	-	-
M_K003	Can work in a team respecting partition of duties and responsibilities	-	-	+	+	-	-	-	-	-	-	-
Skills												
M_U001	Can acquire information from professional sources and use it in realization of engineering tasks	-	-	+	+	-	-	-	-	-	-	-
M_U002	Can prepare and carry out presentation of results of realization of engineering tasks	-	-	+	+	-	-	-	-	-	-	-
M_U003	Can write down and interpret description of position and orientation	-	-	-	+	-	-	-	-	-	-	-
M_U004	Can formulate and solve direct and inverse kinematic problem of manipulators of open manipulator kinematic chain	-	-	-	+	-	-	-	-	-	-	-
M_U005	Is able to program simple manipulating operations of industrial robots	-	-	+	-	-	-	-	-	-	-	-
M_U006	Can select and design a robot gripper (mechanism, driving system, sensory system and power supply)	-	-	-	+	-	-	-	-	-	-	-
M_U007	Can determine positioning repeatability of a robotic manipulator experimentally	-	-	+	-	-	-	-	-	-	-	-
Knowledge												
M_W001	Knows structures, principles of designing and manufacturing of links and joints, structure of driving systems, sensor and control systems, applied grippers and tools of manipulating robots	+	-	-	-	-	-	-	-	-	-	-

M_W002	Knows techniques and tools of on-line and off-line robot programming as well as structure of program of operation	+	-	-	-	-	-	-	-	-	-	-
M_W003	Knows principles of manipulator kinematics modelling	+	-	-	-	-	-	-	-	-	-	-
M_W004	Knows definitions of basic parameters and their actual values achieved by industrial robot manipulators	+	-	-	-	-	-	-	-	-	-	-
M_W005	Knows the manipulator end-effector position and orientation measuring systems	+	-	-	-	-	-	-	-	-	-	-
M_W006	Knows industrial and service applications of manipulating robots	+	-	-	-	-	-	-	-	-	-	-

Module content

Lectures

Manipulator’s components and systems (8)

Classification of contemporary robots. Kinematic structures of manipulators: arm and wrist mechanisms. Links and joints. Driving systems of mechatronic positioning devices. Motion transmission systems. Control systems of manipulating robots.

End-effectors of industrial robots (7)

Overview of industrial robots’ end-effectors. Automatic assembly. Structures of grippers. Mechanisms of grippers. Vacuum and electromagnetic grippers. Dexterous robot hand. Driving systems of grippers. Sensoric systems of end-effectors. Tool exchange systems – grasps and storages. End-effectors used in technological operations.

Parameters and characteristics of manipulating robots (7)

Classification and definitions of manipulator parameters and characteristics. Techniques of measurement of the end-effector pose. Robot calibration techniques.

Service robots (7)

Mobile platforms: elements and systems, modelling, navigation and control.

Industrial applications of robots (4)

Robitized manufacturing system: auxiliary devices, sensory systems, integration. Dedicated software tools. Methods of safety assurance in robotics.

Mechanics of manipulators (8)

Description of position and orientation. Manipulator kinematics: direct and inverse problem. Planning of motion path and trajectory. Determination of motion velocity and acceleration. Basics of manipulators’ dynamics.

Basics of industrial robot programming (8)

Techniques of use of operator-programmer panels. Use of the script type of programming – programming languages. Simulation of robot operation – programming

environments.

Off-line industrial robot programming (7)
Techniques of the off-line programming. Software tools of off-line programming. Methods of implementation of the off-line programs.

Application of service robots (4)
Examples of applications: professional robots, household robots, personal robots

Laboratory classes

Testing of robots (15)
Standards in industrial robotics. Rules of planning and execution of experimental testing, analysis and reporting of results of investigation of manipulating robots. Analysis of manipulator workspace. Testing of positioning repeatability. Testing of manipulator kinematic parameters. Techniques of robot calibration.

Manipulator components and systems (15)
Driving systems of manipulators. Sensory systems of manipulators. Integration techniques of robot’s components and subassemblies. Manipulator motion control systems.

Programming of robot operation (15)
Robot programming in laboratory. Robot programming with use of computer simulation tools.

Project classes

Manipulator design (15)
Selection of a kinematic structure. Kinematic analysis: direct and inverse kinematics. Planning of a robot end-effector motion path and trajectory. Selection of driving systems. Design of links and joints.

Designing of robot end-effectors (15)
Characteristics of industrial robots’ grippers – mechanical, vacuum and electromagnetic grippers. Overview of design of grippers – mechanisms, driving systems, and sensors. Operations in automatic assembling. Dexterous robot hands. Tool exchange systems – grasps and storages. End-effectors used in technological operations.

Design of robotized systems (15)
Examples of computer aided design of robotized manufacturing systems.

Method of calculating the final grade

The course final grade is determined basing on:
- average of the laboratory partial grades (35%)
- the project class grade (35%)
- the exam grade (30%)

Prerequisites and additional requirements

Prerequisites and additional requirements not specified

Recommended literature and teaching resources

G. Cook, Mobile Robots: Navigation, Control and Remote Sensing, 2011

K. S. Fu, R. Gonzalez, C.S.G. Lee, “Robotics control, sensing, vision, and intelligence”, Mc Graw Hill 2008
D.T. Pham et all: Robot grippers, Springer Verlag. IFS Ltd., UK, 1986
E. Rivin, Mechanical design of robots, McGraw-Hill, 1988
B. Siciliano, L. Sciavicco, L. Villani, G. Oriolo, “Robotics: Modelling, Planning and Control (Advanced Textbooks in Control and Signal Processing)”, Springer 2010
M. W. Spong, S. Hutchinson, M. Vidyasagar, “Robot Modeling and Control”, John Wiley and Sons, Inc., 2005

Scientific publications of module course instructors related to the topic of the module

Additional scientific publications not specified

Additional information

None

Student workload (ECTS credits balance)

Student activity form	Student workload
Preparation for classes	60 h
Participation in laboratory classes	45 h
Preparation of a report, presentation, written work, etc.	60 h
Participation in project classes	45 h
Completion of a project	45 h
Realization of independently performed tasks	43 h
Participation in lectures	60 h
Examination or Final test	2 h
Summary student workload	360 h
Module ECTS credits	12 ECTS