INSTITUTE OF ELECTRONICS AND INFORMATION TECHNOLOGIES

Subject

Programming of Automation Systems

Link to the curricula

Study unit code OC1.2 **2020**

Level	Study program or it's part	Year	Semester
2	COMPUTER ENGINEERING AND INDUSTRIAL AUTOMATION	1	Spring

ECTS credits	**5**
Hours - Lectures	**32**
Hours - Laboratory Work	**12**
Hours - Practical, Seminars	**6**
Hours - Individual Student's Work	**100**

Lecturers

Assoc. Prof. OLEKSANDR VELIHORSKYI

Languages - lectures	**English**
Languages - tutorial	**English**

Prerequisites

Basic knowledge of programming, electronic circuits and industrial automation.

Content (Syllabus outline)

Introduction: industrial automation system, hierarchical construction of industrial automation, structure and tasks of industrial control system, low and high level of control, SCADA. Programmable logic controllers: producers and programming languages for PLC, structure of PLC, hardware and software organisation of S7-300 PLCs, resource addressing of PLC, peripheral modules of PLC. Getting started with PLC in STEP7: project organisation, libraries. Hardware configuration of S7-300 PLC in STEP7: racks, interface, signal and function modules, power supply, CPU, programming interface, memory, analog input and output. Programming of PLCs: program design strategy, STEP7 blocks, data types, addressing memory, STEP7 instruction sets, writing the control program for PLC on LD, STL and FB languages. Human-machine interface with PLC: types and classifications of PLC UI devices, SIEMENS operator panels, software development for SIEMENS operator panels.

Textbooks

• Clarence T Jones. STEP 7 in 7 steps. - Patrick-Turner Publishing. 2006. – 464 p. • Clarence T Jones. STEP 7 Programming Made Easy in LAD, FBD, and STL: A Practical Guide to Programming S7300/S7-400 Programmable Logic Controllers. - Brilliant Training. 2017. – 562 p. • System Software for S7-300/400 System and Standard Functions. Reference manual (6ES7810-4CA07-8BW1). – Siemens AG. 2004. – 658 p.

Objectives

The objective of this course is to acquaint students with the programming of programmable logic controllers and their implementation into industrial automation systems.

Intended learning outcomes - knowledge and understanding

On completion of this course the student will be able to demonstrate: • knowledge of statement list, functional block diagram and ladder diagram languages for programming PLCs; • understanding of hardware structure, input and output signals of PLC; principles of building automation systems based on PLC.

Intended learning outcomes - transferable/key skills and other attributes'

Communication skills: writing of professional report concerning finished exercise, oral lab work defence, manner of expression at written examination. Use of information technology: using the specialised software tools for programming of programmable logic controllers.

Learning and teaching methods

• Lectures, • lab work, • practical assignment.

Assessment	Weight (%)	
Lab work	50	
Practical assignment	50	

Comments

INSTITUTE OF ELECTRONICS AND INFORMATION TECHNOLOGIES

Subject

MODELLING AND MEASUREMENT OF PHYSICAL PROCESSES IN ROBOTICS

Link to the curricula

Study unit code GC8 **2020**

Level	Study program or it's part	Year	Semester
2	Computer Engineering and Industrial Automation	1	Winter

ECTS kredits	**5**
Hours - Lectures	**24**
Hours - Laboratory Work	**10**
Hours - Practical, Seminars	**6**
Hours - Individual Student's Work	**110**

Lecturers

Assoc. Prof. Anatoliy Prystupa

Languages - lectures	**English**
Languages - tutorial	**English, Ukrainian**

Prerequisits

Basic knowledge of measurement, physics, computer modelling.

Content (Syllabus outline)

• Introduction: general information and measurement system in robotics, functional elements, static and dynamic characteristics. • Analogue and digital measurement instruments. Signals modeling and measurements. • Transducers – resistive, capacitive and inductive: thermometers, pH sensor, gas sensitive sensor, electrochemical sensors, electromagnetic sensors for flow and strain, Hall sensor. • Photo detectors and optical sensors. • Ultrasonic sensors. • MEMS sensors, accelerometers, gyroscopes. • Design and calibration of electronic measurement systems. • Electromagnetic compatibility and interference. Virtual measurement systems.

Textbooks

A. S. Morris: Measurement and Calibration Requirements, John Wiley & Sons, Chichester 1997.
LabVIEW^{TM} Control Design User Manual, 2008.
Connie L. Dotson. Fundament of Dimentional Metrology.– 5nd ed. – Delmar Cengage Learning, 2006.
Mathematical Modeling, Fourth Edition, by Mark M. Meerschaert. - Academic Press
Hans-Petter Halvorsen Control and Simulation in LabVIEW, 2017

Objectives

The objective of this course is to provide detailed knowledge of electrical and non-electrical sensors, transducers and actuator, and design and calibration of electronic measurement system for robotics; modern modeling methods; measurement processing techniques.

Intendend learning outcomes - knowledge and understanding

On completion of this course the student will be able to - explain the operating principles of a given sensor and measure the sensor's characteristics, - apply the sensor and connect it to the analogue or digital circuit, - design and build the simple open measurement system, - carry out modeling in order to determine the required characteristics of the measuring system, - create virtual measurement systems.

Intendend learning outcomes - transferable/key skills and other attributes'

Communication skills, theoretical prepare and practical work on the project, Problem solving, group working, modeling of physical processes, processing of measurement.

Learning and teaching methods

• lectures, •Practical, • lab work.

Assessment	Weight (%)	
Lab work	40	
Practical assignment	20	
Exam	40	

Comments:

The tests may be replaced with a written exam.

INSTITUTE OF ELECTRONICS AND INFORMATION TECHNOLOGIES

Subject

Design and Simulation of Power electronics components

Link to the curricula

Study unit code **OC4.1** **2020**

Level	Study program or it's part	Year	Semester
2	COMPUTER ENGINEERING AND INDUSTRIAL AUTOMATION	1	Spring

ECTS credits	**5**
Hours -Lectures	24
Hours - Laboratory Work	**10**
Hours - Practical, Seminars	6
Hours - Individual Student's Work	110

Lecturers

Assoc. Prof. SERGII IVANETS

Languages - lectures	**English**
Languages - tutorial	**English**

Prerequisites

Basic knowledge of electronic circuits.

Content (Syllabus outline)

Introduction: the basic concepts and definitions, types of power electronics components. Power density, efficiency, reliability and cost of a power electronics systems. **Power electronics switches:** Bipolar transistor, MOSFET and IGBT: Ratings, static and dynamic characteristics, drive and switching aid circuits and cooling. Switched-mode converter is and its basic operating principles. DC-DC, DC-AC, AC-DC converters. **Principles of power electronics simulation:** Steady-State converter analysis. Steady-State equivalent circuit modeling, losses, and efficiency. **EDA tools for power electronics simulation.** PSIM (Powersim) electronics simulation software. MATLAB and Simulink for power converters simulation.

Textbooks

• Robert W. Erickson, Dragan Maksimovic. Fundamentals of Power Electronics. University of Colorado. Boulder, Colorado. 800 p. • L. Ashok Kumar, A. Kalaiarasi, Y. Uma Maheswari. Power Electronics with MATLAB. Cambridge University Press, 2017. 548 p. • Stanislaw Szablowski. Teaching Power Electronics: Simulation Studies using PSIM Software. LAP LAMBERT Academic Publishing, 2019. 148 p.

Objectives

The objective of this course is to to prepare a specialist in the power electronics field that knows basic concept of power supply design.

Intended learning outcomes - knowledge and understanding

On completion of this course the student will be able to demonstrate: • knowledge of Power electronics switches, DC-DC, DC-AC, AC-DC converters, which type of converter is used in the power electronic circuit; • simulation of power electronics converters with EDA tools • design the simple not optimised power supply converter.

Intended learning outcomes - transferable/key skills and other attributes'

Communication skills: writing of professional report concerning finished exercise, oral lab work defence, manner of expression at written examination. Use of information technology: use of specialised EDA software tools for power electronics components simulation. Calculation skills: simulation of power electronics converters with EDA tools.

Learning and teaching methods

• Lectures, • lab work, • practical assignment.

Assessment	Weight (%)	
Lab work	40	
Practical assignment	20	
Exam	40	

Comments

INSTITUTE OF ELECTRONICS AND INFORMATION TECHNOLOGIES

Subject

Model-oriented control in Digital Manufacturing

Link to the curricula

Study unit code **OC4.1** **2020**

Level	Study program or it's part	Year	Semester
2	COMPUTER ENGINEERING AND INDUSTRIAL AUTOMATION	1	Spring

ECTS credits	**5**
Hours -Lectures	24
Hours - Laboratory Work	**10**
Hours - Practical, Seminars	6
Hours - Individual Student's Work	110

Lecturers

Prof. VOLODYMYR KAZYMYR

Languages - lectures	**English**
Languages - tutorial	**English**

Prerequisites

Basic knowledge Systems Modelling, Discrete Mathematics

Content (Syllabus outline)

Introduction: Intelligent Manufacturing Systems; Computer modelling and Industry 4.0; General principles of building control systems; Feedback control systems and Broken feedback control systems; Linear and nonlinear regulators; Adaptive control systems; Intelligent control systems; Basic concepts of Model-Oriented Control; Implementation models; Prediction Models; Recovery models; Neural network control; Fuzzy logic control; Control E-nets; Temporal logic control; Matlab and Wolfram SystemModeler for Model-oriented control

Textbooks

• T. Nanayakkara, F. Sahin, M. Jamshidi. Intelligent control systems with an introduction to system of systems engineering. University of Texas Electrical and Computer Engineering, Department San Antonio, Texas, U.S.A. 2009. 441 p. • M. Diaz. Petri Nets: Fundamental Models, Verification and Applications. Wiley-ISTE. 2009. 656 p. • D. Chaturvedi. Modeling and Simulation of Systems Using MATLAB and Simulink. CRC Press, Inc., 2010. 734 p. •

Objectives

The objective of this course is to give a masters in Computer Engineering knowledge and technics in model-oriented control.

Intended learning outcomes - knowledge and understanding

On completion of this course the student will be able to demonstrate: • knowledge of Control System Architecture, Intelligent Control System basis, methods of control algorithm implementation, technic of modelling and simulation in Matlab and Wolfram SystemModeler

Intended learning outcomes - transferable/key skills and other attributes'

Communication skills: writing of professional report concerning finished exercise, oral lab work defence, manner of expression at written examination. Use of information technology: use of specialised software tools for modelling and simulation. Calculation skills: simulation of control algorithms.

Learning and teaching methods

• Lectures, • lab work, • practical assignment.

Assessment	Weight (%)	
Lab work	40	
Practical assignment	20	
Exam	40	

Comments

INSTITUTE OF ELECTRONICS AND
INFORMATION TECHNOLOGIES

Subject

Simulation of Manufacturing Environment

Link to the curricula

Study unit code **OC1.2** **2020**

Level	Study program or it's part	Year	Semester
2	COMPUTER ENGINEERING AND INDUSTRIAL AUTOMATION	1	Spring

ECTS credits	**5**
Hours -Lectures	24
Hours - Laboratory Work	**10**
Hours - Practical, Seminars	6
Hours - Individual Student's Work	110

Lecturers

Prof. VOLODYMYR KAZYMYR

Languages - lectures	**English**
Languages - tutorial	**English**

Prerequisites

Basic knowledge System Modelling, Discrete Mathematics, Theory of Systems

Content (Syllabus outline)

Introduction: Ecosystems of manufacturing; Cyber-Physical Systems; Principles of System analysis; Support for the full product life cycle; System architecture; Dynamic systems; Hybrid approach to modelling; Synthetic environment; Human in the Loop; Virtual Lab; Distributed modelling; High Level Architecture; Component modelling; Modelica Simulation Environments; Wolfram SystemModeler and OpenModelica for Simulation of manufacturing environment

Textbooks

• P. Pawlewski, A. Greenwood. Process Simulation and Optimization in Sustainable Logistics and Manufacturing. 2014. •J. Beier. Simulation Approach Towards Energy Flexible Manufacturing Systems. 2017. • D. Chaturvedi. Modeling and Simulation of Systems Using MATLAB and Simulink. CRC Press, Inc., 2010

Objectives

The objective of this course is to give a masters in Computer Engineering knowledge and technics in simulation of ecosystems and manufacturing environment.

Intended learning outcomes - knowledge and understanding

On completion of this course the student will be able to demonstrate: • knowledge of Manufacturing structure and environment, Principles of System analysis; Busyness process building; Distributed calculations; Synthetic environment building; modelling technic of system simulation in Wolfram SystemModeler

Intended learning outcomes - transferable/key skills and other attributes'

Communication skills: writing of professional report concerning finished exercise, oral lab work defence, manner of expression at written examination. Use of information technology: use of specialised software tools for modelling and simulation. Calculation skills: simulation of busyness process.

Learning and teaching methods

• Lectures, • lab work, • practical assignment.

Assessment	Weight (%)	
Lab work	40	
Practical assignment	20	
Exam	40	

Comments