COURSE DESCRIPTION CARD - SYLLABUS

Course name
Mechatronics [N1MiBM2>MEC2]

Course

Field of study
Mechanical Engineering

Year/Semester
2/4

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
part-time

Requirements
compulsory

Number of hours

Lecture
8

Laboratory classes
24

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

4,00

Coordinators

Lecturers

Prerequisites

Basics in mathematics - in the field of set theory, complex numbers, differential equations, Boolean algebra and other areas of education in the field of study. Organized theoretical knowledge in the field of study. Basic skills in operating on complex and logical variables and sets, solving simple differential equations, describing basic physical phenomena in mechanics. Ability to use literature (obtaining knowledge from indicated sources) and the Internet. Physics in the field of the structure of matter and the phenomena of electricity and electrical engineering. Understanding the need for lifelong learning. Understanding the societal-wide impacts of engineering activities. Understanding the need for team collaboration.

Course objective

Acquiring knowledge about the principles of operation of electrical machines and devices and the ability to analyze and solve equations describing simple electrical systems. Learning about the elements and systems of automation and machine automation, including basic concepts and static and dynamic properties of elements and linear and non-linear automation systems, selection of controllers, automation of complex systems. Familiarization with the structure, operation and characteristics of electronic components and teaching the basics of designing and commissioning simple electronic systems. Familiarization with microprocessor systems, e.g. Arduino Acquiring knowledge about the structure, principles of operation and parameters of industrial automation components, including measurement, logic, regulation and actuator elements, as well as basic knowledge of the structure and principles of operation of PLC controllers with selected programming languages.

Course-related learning outcomes

Knowledge:
The student has knowledge in the field of electrical engineering covering issues used to design and analyze electric drive systems and machine control systems
The student knows what an automation system is, knows the difference between an open and closed system, knows the basic concepts of automation and knows what the tasks of automation are.
The student knows what binary functions, combinational and sequential systems are, and the hazard phenomenon in switching systems.
The student knows methods of implementing binary functions on contact elements, logic gates and switching fluid systems.
The student knows what operator transfer function is and knows the responses to step excitations of basic linear automation elements.
The student knows what they are and how to determine the frequency characteristics of automation elements. Knows the basic concept and methods of stability testing.
The student knows what classical regulators are and how they are constructed, and knows stability issues.
The student knows what the structure of comprehensive automation systems is and knows in general what production control is.
The student knows the basic passive electronic components and their assembly method.
The student knows the structure of the p-n junction, the principle of operation of diodes and diode rectifiers
The student has knowledge about the structure, operation and parameters of bipolar and unipolar transistors
The student has knowledge about power supply, types and operating systems of transistors
The student has knowledge about integrated circuits, including operational amplifiers
The student has knowledge about microcontrollers, in particular Arduino.
The student has knowledge of the levels of automation used in industrial practice. Knows the principles of operation of the basic components of automation systems, sensors, transducers, regulators, programmable controllers, PLCs and executive systems.

Skills:
The student has the ability to self-educate, including: in order to "improve" professional competences.
The student is able to measure basic electrical quantities, analyze physical phenomena and solve direct and alternating current electrical circuits based on basic laws.
The student is able to use simple power regulators in direct and alternating current circuits
The student is able to describe the basic linear elements of automation, including the transfer function and examples.
The student is able to implement a given binary and sequential function using contact, contactless and fluid systems in a hazard-free manner.
The student is able to determine the frequency characteristics of basic elements and determine the stability of a simple automation system.
The student is able to determine the equivalent transmittance of freely connected basic automation elements.
The student is able to describe the operation of the PID controller and determine the stability of a simple automation system.
The student is able to define the tasks of a comprehensive production automation and control system.
The student is able to build systems with various types of diodes and analyze their operation

The student is able to select elements, design and build a single-transistor circuit - the key
The student is able to build a simple microprocessor system based on Arduino
The student is able to analyze a simple electronic circuit
The student is able to select sensors and transducers, elements of control systems, including drives for the automated device
The student able to design basic control systems for a production device with a PLC controller and develop a control program

Social competences:
The student is aware of the social role of a technical university graduate, and especially understands the need to formulate and convey to society, in particular through the mass media, information and opinions regarding technological achievements and other aspects of engineering activities; makes every effort to convey such information and opinions in a generally understandable manner.
The student understands the need to keep up to date with available solutions in the field of automation and control systems.
The student is aware of the role of electrical engineering and electronics in industry and its importance for society and the environment

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Laboratory: Passing the laboratory, based on preparation for classes and reports on completed classes. Passing is based on correct performance of the exercises and a report on each laboratory exercise according to the instructions of the laboratory instructor. Before the exercise, short entrance tests in the form of oral tests or quizzes. To pass the laboratories, all exercises must be passed (positive grade in the introductory knowledge test and report).
Lecture: Assessment (semester 3) in test form, also in electronic form, in the scope covered by the lectures, consisting of a minimum of 20 questions. Single or multiple choice test with a minimum of 4 possible answers to each question. The passing threshold is 50%.

Programme content

Lecture:
- Effects of electric current on the human body,
- Electric current,
- Electrical measurement,
- DC and AC electrical circuits,
- Methods of solving electrical circuits,
- Electrical resonance,
- Laplace transform
- Linear and non-linear automation systems
- Regulation systems and selection of regulators
- Structure and electrical properties of the atom, conductors, insulators and semiconductors, Passive elements used in electronic systems. Electronics assembly.
- Semiconductors, p-n junction. Rectifier systems.
- Bipolar transistors: structure, parameters, operation.
- JFET and MOSFET transistors, Thyristor, triac.
- Integrated circuits. Operational amplifiers and others.
- Basics of digital technology: gates and microprocessors (Arduino).

Lab:
- Basic measurements in DC circuits
- Basic measurements in alternating current circuits
- Simulation of simple electrical circuits
- Induction motor in a single-phase network
- Power regulators
- DC power supply
- Testing of diode systems
- Testing of bipolar transistors
- Testing of unipolar transistors
- Testing of key systems and transistor amplifiers

- Construction of systems and programming of the Adruino controller
- Testing the characteristics of measuring transducers
- Programming PLC controllers

Course topics

none

Teaching methods

Lecture: blackboard lecture supported by a multimedia presentation containing the discussed program content.
Tutorials: solving tasks, discussion.
Laboratory: practical exercises, team work.

Bibliography

Basic:
1. Opydo W., Elektrotechnika i elektronika dla studentów wydziałów nieelektrycznych, WPP, Poznań, 2012 r.
2. Bolkowski S., Elektrotechnika 4, WSiP, 1995 r.
3. Żelazny M., Podstawy automatyki, PWN, 1976
4. Horla D., Podstawy automatyki - ćwiczenia rachunkowe, WPP, 2008
5. Traczyk W., Układy cyfrowe automatyki, WNT, 1974
6. Horowitz P., Hill W. „Sztuka elektroniki”.
7. Monk S., Arduino dla początkujących Podstawy i szkice
8. Tadeusz Mikulczyński, Zdzisław Samsonowicz, Rafał Więcławek, Automatyzacja procesów produkcyjnych, PWN, WNT 2015
9. Milecki A. Ćwiczenia laboratoryjne z elementów i układów automatyzacji, WPP, 2000.

Additional:
1. Orlik W., Egzamin kwalifikacyjny elektryka w pytaniach i odpowiedziach
2. Miedziński B., Elektrotechnika. Podstawy i instalacje elektryczne, Wydawnictwo Naukowe PWN, Warszawa 1997 r.
3. Mikulski A., Elementy przekaźnikowych urządzeń automatyki, WKŁ, 1970
4. Kindler H., Buchta H., Wilfert H., Zadania z techniki regulacji automatycznej, WNT, 1971
5. Urbaniak A., Podstawy automatyki, WPP, 2001
6. Kostro J., Elementy, urządzenia i układy automatyzacji, WSiP, 1993
7. Kosmol J., Automatyzacja obrabiarek i obróbki skrawaniem, WNT, 1995
8. Pietrzyk W. „Laboratorium z elektrotechniki i elektroniki”

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	34	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	66	2,50