Field of Study: Mechatronics

Offered courses for the academic year 2024/2025, winter semester, with descriptions

Semester 1

Basics of Programming

The main aim of the course is to familiarize students with the basic concepts of programming in C and to acquire practical skills to create software in C and C++.

The course presents information for people learning C and C++ as first programming language. Course will give a full introduction to all of the core concepts in the C and C++ programming language.

Topics:

- C and C++ Introduction
  - Variables & Constants, Data Types, Input/Output, Operators
- Flow Control
- Functions
  - Programming Functions, User-defined Functions, Recursion
- Programming Arrays
  - Arrays, Multi-dimensional Arrays, Arrays & Function
- Programming Pointers
  - Pointers, Pointers & Arrays, Pointers & Functions,
- Programming Strings
- Structure And Union
- Programming Files

Engineering Graphics

The main aim of the course is to familiarize students with the basics of descriptive geometry and the principles of machine engineering; -developing the ability to draw objects with complex geometry; preparing students to read and create technical drawings in rectangular and axonometric projections;

preparing students to create technical documentation in the form of assembly drawings; familiarizing students with CAD software for creating technical drawings.

Topics:

- Basics of descriptive geometry, types of viewports and projections.
- Mapping basic elements: point, line, plane.
- Standardized elements of a machine technical drawing.
- Projecting objects in a technical drawing.
- Views, sections, lays.
- Principles of dimensioning, tolerance of dimensions as well as shape and position.
- Determination of surface roughness and waviness.
- Connections of machine parts.
- Assembly and executive drawings.

Mobile Robots Laboratory

The main objectives of the course are presentation of the basics of construction and programming of mobile robots, familiarizing students with solutions of mobile robotics tasks, preparing students to build and program more complex robots.

Topics:

- Building a simple robot with a Lego set and familiarizing with the programming environment. Programming simple tasks,
- Construction and programming of a Lego robot to find its way in the maze,
- Construction of a multi-tasking robot,
- Getting to know the Mblock environment,
- Programming the LineFollower robot with the MakeBlock set,
- Programming a robot that avoids obstacles with the MakeBlock set,
- Remote robot control,
- Programming multiple tasks,
- Use of a gyroscope sensor in a self-balancing robot,
- Using encoders to map a room,
- Getting to know the structure and operation of the AirBlock set, building simple structures,
- Creating an application to control the AirBlock set,
- Programming the robot on the Arduino kit.

Semester 3

Microcontrollers Programming

The main objectives of the course are presentation of the scope from the basics of construction and programming of microcontrollers, learning to create simple and complex electronic circuits controlled using a microcontroller and the practical use of the microcontroller in everyday life. Classes take place on the basis of the Arduino family of microcontrollers.

Topics:

- Preparation of microcontroller device. Installation of the environment. Uploading the first program.
- UART communication. Serial transmission. Global and local variables in Arduino.
- ADC. Servos. PWM. Voltage measurement by means of an A/D converter.
- Arduino external libraries.
- Servos.
- Control of DC motors.
- LCD Displays. I2C communication.
- Sensors. Measuring humidity, distance, temperature.
- Create charts with the Arduino and its built-in tool.
- Interruptions. Arduino interrupt handling.

Basics of Artificial Intelligence

The aim of the course is to outline the basic methods and techniques of artificial intelligence and to put them in an algorithmic context. The course also equips students with the skills to use artificial intelligence tools in forecasting, classification, approximation, estimation, and logical inference.

Topics:

- Programming in Matlab. Interface. Variables. Vectors (single row or single column matrices). Two-dimensional matrices. Array and array operations.
- Basic functions and constants. Relational Operators. Logical operators and functions.
- If statement. Switch instruction. The for and while loops.
- Creating m-files. Scripts.
- Features. Sub-functions.
- Graphics in Matlab. 2D graphics
- 3D Graphics. Graphs of functions.
- Simulink - modeling of dynamic systems. Mathematical model. Simulink
- Simulink - examples of models of dynamic systems

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- Selected numerical capabilities of the Matlab package
- Working with Toolboxes: Neural Network, Genetic Algorithm.
- Modeling KAG systems in Matlab.
- Classification of raster objects and space points using SSN.
- Application of SSN in approximation tasks.
- Modeling SSN systems in Matlab.

Introduction to Robotics

The main objectives of the course are to provide the students with the knowledge of terms used in robotics, to obtain an understanding of problems associated with engineering of mechanical manipulation, to develop skills to perform basic computations.

Topics:

- Spatial descriptions and transformations
- Forward kinematics: link description, Denavit-Hartenberg notation
- Inverse manipulator kinematics
- Velocities, static forces
- Jacobians

Semester 5

Process Robotization

The aim of the course is to familiarize students with technologies and methodologies of robotization of industrial processes. An accessible introduction to the use of robots and the construction and operation of robotic systems. Inspiration for creative reflection on the social role of robotics and robotization in today's world. Learning the basic concepts of robotics and robotics.

Topics:

- Introduction to robotization of industry and services
- Production and service of processes,
- Robotic system, its components and configurations,
- Transport in close vicinity of the robot (material handling),
- Robotic system control.

Process Visualization

The aim of the course is to introduce the subject of SCADA systems. As part of the course, the student acquires knowledge about the structures of visualization systems, methods of presenting the course of the process and the condition of the facility, methods and guidelines for the designed operator interfaces, methods of monitoring and control of industrial processes.

Topics:

- Structure of InTouch industrial process visualization software.
- Methods for creating objects in the InTouch environment.
- Types of variables and methods of their declaration in the InTouch environment.
- Creating scripts, alarms and trends in InTouch.
- Methods of communication with external applications. Reporting methods in the InTouch environment.
- Ways to compress the application. (Group project - application for the visualization of an industrial technological process)
- Development of the structure and graphic design of the system windows.
- Development and implementation of work algorithms for individual circuits.
- Development and implementation of an algorithm integrating the entire system.
- Implementation of the functionality that allows the application to be secured against unauthorized access and the display of alarms.
- Implementation of the functionality enabling the preparation of reports in text and graphic form on the operation of the system.

Internet of Things Technologies

In this course, students will explore various components of Internet of Things such as sensors, peripheral, networking and client- server communication. After successful completion of this course, students will be able to:

- understand general concepts of Internet of Things,
- recognize a variety of devices, sensors, and applications,
- analyze various M2M and IoT architectures,
- create IoT solutions using sensors, actuators and devices,

Topics:

- Configuration, operation of IOT devices, peripheral controls
- Connecting devices to the Internet
- Exposition of the functionality of devices in the form of websites (1) (SOAP, REST).
- Exposition of the functionality of devices in the form of services (2) (COAP).

- M2M (Machine-2-Machine) information (broadcast communication protocols).
- M2M (Machine-2-Machine) information (Communication based on the exchange of messages eg MQTT, MQTT-S).
- Distributed data processing from IOT (Complex Event Processing).