



Field of Study: Mechatronics

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

Semester 2

Object - Oriented Programming

The course aims to:

- develop knowledge about the paradigm of object programming,
- understanding the principles and logic of writing object-oriented applications,
- understanding the benefits of programming and object design

During the classes, students will learn the principles of creating applications in Java using object oriented paradigms.

Topics:

- NetBeans environment. Variables.
- Familiarization with input/output operations.
- Classes, objects, fields and methods.
- Inheritance
- Interfaces and abstract classes
- Polymorphism
- Java Swing
- Graphics in Java
- Traffic animation
- Algorithms in Java:
 - Hanoi towers
 - Fractals
 - Merge sort



3D construction Laboratory

This course is learning the techniques of 3D printing, laser cutting, milling and engraving in wood and plexiglass. Scanning spatial elements. Scan processing. Designing shapes for printing, milling and cutting. Printing of construction elements of mobile robots. Practical creation of spatial structures using flat elements made of wood and plexiglass. Practical making of flat and spatial models of machine mechanisms and manipulators. Selected elements of reverse engineering in relation to the structure.

Topics:

- The principles of operation and use of a 3D printer
- Designing elements for additive printing and stereolithography
- Supervising the 3D printing process using the SLA method
- The construction and operation of a laser plotter for cutting and engraving
- Designing shapes to be cut on a plotter
- Engraving in wood and plexiglass
- Learning the basics of programming a CNC milling machine
- Scanning of spatial objects and computer processing of scans

Strength of materials

This course is familiarizing students with the classic issues of strength of materials. Analysis of typical load cases: tension/compression, shear, torsion, simple bending. State of deformation, state of stress. Strength hypotheses, basic cases of combined strength. Bar buckling. Analysis of bar systems.

Topics:

- Basic objectives and assumptions of the strength of materials
- Internal and external forces, the principle of mental sections
- Stresses, state of stress. Strain state
- Hooke's law, generalized Hooke's law. Static tensile test, stress concentration, de Saint-Venant's principle
- Strength conditions for tension/compression, shear, bar buckling
- Moments of inertia of plane figures, Steiner's theorem
- Torsion of shafts and axles. Torsion moment and torsion angle diagrams
- Bending beams. Diagrams of shear forces and bending moments of beams. Tangential and normal stresses. Deflection line and beam deflection angle
- Basic cases of combined strength
- Strength hypotheses. Energy methods. Bar systems - trusses, frames.

Digital Electronic

The digital electronic has the task to provide students with basic knowledge and skills regarding design, research, diagnosing the correctness of operation and removal of defects of digital circuits.

Topics:

- Basic knowledge of counting systems,
- Basic logical functions and the rules of Boolean algebra,
- Determine the minimal notation of a logical function using function minimization logical arrays by Karnaugh's method and Quin-McCluskey's method,
- Design the complex, multi-input digital circuits,
- Using a computer software to design and simulation operation of digital circuits,
- Design the asynchronous and synchronous digital circuits,
- Design the sequential digital circuits,
- Basic measurements in digital circuits,
- Creating the simple PLC programs,

Semester 4

Introduction to Computer Networks

The course introduces participants to computer networks. The semester covers topics related to networking terminology and protocols, local area networks (LAN) and wide area networks (WAN), OSI (Open System Interconnection) model, cabling, cabling tools, Ethernet technology, IP (Internet Protocol) addressing and standards for computer networks. The student learns the functions of well-known TCP/IP applications (e.g. WWW, e-mail) and related services (HTTP, DNS, SMB, DHCP, SMTP/POP, and Telnet) and the services, technologies, and problems that professionals encounter when designing, building, and managing modern networks. Student identifies key network components that transmit data and learns the characteristics of network architectures such as: fault tolerance, scalability, quality of service and security. Student is able to solve basic communication problems on a local network.

Topics:

- Initialization of switches and routers
- Building a simple network.
- Analysis of network standards, preview of network traffic
- Ethernet cabling.
- Ethernet frames.



- Building a network with a switch and a router.
- TCP/UDP frame analysis.
- IPv4 and IPv6 addressing.
- Dividing the network into subnets.
- Analysis and performance tracking of application layer protocols.
- Creating a small computer network.

Electric Drives

The course has the task to provide students with basic knowledge and skills regarding design, research, diagnosing of the electric drives. Physical basis of the operation and construction of: electric machines, stepper motors, asynchronous motors, voltage inverter. Examples of application of DC machines

Topics:

- AC single-phase and three-phase circuits
- Physical basis of the operation of electric machines
- Basics of construction and operation of electric machines
- Working states of electric machines. Efficiency of electric drives
- Stepper motors, structure and principle of operation
- Induction motor: principle of work, structure, motor characteristics
- Speed control of asynchronous motors.
- Construction and operation of a voltage inverter.
- DC machines: construction and principle of operation, commutation process, motion characteristics, application of DC machines

Computer Aided Design

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

Fluids Drives

The course has the task to familiarizing students with the basic concepts of pneumatic and hydraulic drive and control. Acquainting with the principles of operation of the basic pneumatic and hydraulic drive and control systems. Presentation of the basic graphic symbols of hydraulic and pneumatic elements. Teaching the principles of marking elements on pneumatic diagrams and reading diagrams. Getting to know the properties of air as a working medium and the preparation of compressed air.

Topics:

- Building basic control systems: direct and indirect control
- Building control systems with the use of logical functions and control systems enabling changes in the piston motion parameters for a single-acting and double-acting actuator
- Implementation of pneumatic sequential control systems: control depending on distance, time and distance, control depending on pressure
- Construction of the automatic control system
- Implementation of control systems with time relays
- Preparation of work cyclograms for various systems.

Programming in the LabVIEW Environment

The course has the task to familiarizing students with the high-level LabVIEW graphical programming environment. To familiarize students with methods and ways of measuring physical quantities using a computer system.

Topics:

- Building basic control systems: direct and indirect control
- Introduction to the National Instruments LabVIEW environment: virtual tools, flow programming, menus, front panel elements,
- Basic control structures, variable types and time functions in the LabVIEW environment,
- Operations on tables in the LabVIEW environment,
- Graphical representation of signals in the LabVIEW environment,
- Defining and editing cluster elements in the LabVIEW environment,
- Text operations in the LabVIEW,
- SubVI, types of variables in the LabVIEW,
- Synchronization methods in the LabVIEW environment,
- Error management in the LabVIEW,
- State machine and advanced control structures,
- Management of the application and its elements in the LabVIEW environment by National Instruments,

- Programming a real-time controller on the example of the MyRIO platform. Data exchange with queuing,
- Using the LabVIEW environment to model control objects,
- Object-oriented programming in the LabVIEW env