

## Field of Study: Automation and Robotics

### Offered courses for the academic year 2021/2022 summer semester, with descriptions

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#### 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

## **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.

## **Basics of Mechanics**

This course is an introduction to the basic concepts of statics and strength of materials. The students acquire ability to identify loads and reactions in mechanical systems by means of principles of statics. Further, knowledge of statics is used in solving problems of strength of materials. The basic concepts of loads of beams and shafts are introduced which can be used in modeling of more complex systems.

### **Topics:**

- Vector operations
- Force, moment, couple
- Conditions of static equilibrium
- Friction in mechanical systems
- Stress, strain – definition (3D case); normal and shear stresses,

- Hooke's law, Young' modulus, shear modulus, Poisson's ratio
- Allowable stresses
- Geometric moment of inertia
- Beam tension/compression
- Torsion of shafts
- Bending of beams – bending moments and shear forces
- Stress of beams in bending

## Semester 4

### Basics of 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

### Programming Microcontrollers

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.



## **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