Faculty of Computer Technology and Cybersecurity

Department of Computer Engineering and Information Security

<u>6B06106</u>
(Code of Educational Program)

<u>Computer Systems and Software Engineering</u>
(Name of Educational Program)

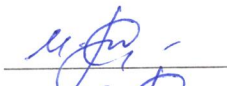# CATALOGUE OF ELECTIVE DISCIPLINES

2021 entry year

2021

The catalogue of elective disciplines for the specialty/EP 6B06106 «Computer Systems and Software Engineering» is developed on the basis of the working curriculum of the specialty/EP.

The catalogue of elective disciplines was discussed at a meeting of the Computer Engineering and Information Security department

minutes No. ___7___ from "_15_" ___02___ 2021.
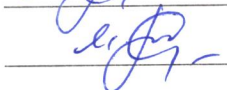
Acting head of Department   M.T. Ipalakova

CED compiler   M.T. Ipalakova

The catalogue of elective disciplines was approved at a meeting of the Academic Council of JSC IITU

minutes No. ___4___ from "_30_" ___03___ 2021.

Head of the Department
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1   TERMS AND ABBREVIATIONS

1. 1   Academic program is a single set of basic characteristics of education, including goals, results and content of training, the organization of educational process, ways and methods for their implementation and criteria for assessing learning outcomes. The content of academic program of higher education consists of three cycles of disciplines – general education disciplines (hereinafter – GED), basic disciplines (hereinafter – BD) and core disciplines (hereinafter – CD). The cycle of GED includes disciplines of the compulsory component (hereinafter – CC), the university component (hereinafter – UC) and (or) the component of choice (hereinafter – COC). BD and CD include disciplines of UC and COC.

1. 2   Catalogue of elective disciplines (CED) is a systematic annotated list of all COC disciplines, for the entire training period, containing a brief description indicating the purpose of study, a summary of main sections and expected learning outcomes. CED reflects the prerequisites and postrequisites of each academic discipline. It should provide the students with the possibility of an alternative choice of elective disciplines for the formation of an individual educational trajectory.

On the basis of academic program and CED, the students develop individual curricula with the help of advisers.

1. 3   Individual curriculum (IC) is a curriculum formed by the students independently with the help of an adviser for each academic year on the basis of the academic program, the catalogue of elective disciplines or modules;

IC defines an individual educational trajectory of each student separately. It includes disciplines and types of educational activities (internship, experimental research, forms of final certification) of the compulsory component (CC), the university component (UC) and the component of choice (COC).

1. 4   Advisor is a teacher who performs the functions of an academic mentor of a student (according to the appropriate academic program) and assists in choosing a learning path (creating an individual curriculum) and mastering the academic program during the training period.

1. 5   The university component is a list of compulsory educational disciplines determined by the university independently for the mastering of the academic program.

1. 6   The component of choice is a list of academic disciplines and the corresponding minimum amounts of academic credits offered by the university and independently chosen by students in any academic period, taking into account their prerequisites and postrequisites.

1. 7   Elective disciplines are educational disciplines that are a part of the university component and the component of choice in the framework of established academic credits, introduced by organizations of education reflecting the individual preparation of students and taking into account the specifics of socio-economic development, the needs of a particular region and established scientific schools.

1. 8   Postrequisites are the disciplines and (or) modules and other types of academic work, the study of which requires knowledge, skills and competencies acquired at the end of the study of this discipline and (or) modules;

1. 9   Prerequisites are the disciplines and (or) modules and other types of educational work containing knowledge, abilities, skills and competencies necessary for the mastering of the studied discipline and (or) modules;

1. 10   Competencies are the ability of the practical use of acquired knowledge and skills in professional activities.

2   ELECTIVE DISCIPLINES

№	Cycle of discipline	Code of discipline	Name of discipline	Number of credits	Prerequisites
			5th semester		
1	PD	SFT6309	UX/UI development	4	ICT6001
2	PD	ANL6302	Exploratory data analysis	4	SFT6304
3	PD	NET6302	Systems administration	4	ICT6001
4	PD	EEC6001	Basic circuit theory	4	PHY6001
5	PD	SFT6310	Web-component development (Java EE)	4	SFT6002
6	PD	ANL6303	NoSQL databases	6	SFT6305
7	PD	NET6303	Switching, routing, and wireless essentials	6	NET6301
8	PD	VRT6301	AR/VR technologies	6	SFT6002
9	PD	VRT6302	Fundamental of graphic design	6	ICT6001
			6th semester		
10	PD	SFT6311	Front-end development	4	SFT6002
11	PD	ANL6304	Machine learning 1	4	ANL6301
12	PD	NET6304	Cloud computing and virtualization	4	ICT6001
13	PD	EEC6002	Design and simulation of electronic devices	4	EEC6001
14	PD	VRT6303	Scientific visualization	4	VRT6302
15	PD	SFT6312	Business component and Web-services development (Java EE)	6	SFT6310
16	PD	ANL6305	Database application development	6	SFT6305, SFT6002
17	PD	NET6305	Enterprise networking	6	NET6303
18	PD	EEC6004	Fundamentals of logic design	6	EEC6001
19	PD	VRT6301	AR/VR technologies	6	SFT6002
20	PD	SFT6313	Mobile technologies and applications	6	SFT6002
21	PD	ANL6306	Audio and text processing	6	ANL6301
22	PD	NET6306	DevNet	6	NET6301, SFT6002
23	PD	HRD6304	Sensor technologies	6	HRD6301
24	PD	VRT6304	Introduction to computer vision	6	ANL6301
			7th semester		
25	PD	SFT6314	Full stack development	7	SFT6311, SFT6307
26	PD	ANL6307	Big data processing	7	ANL6301, ANL6302
27	PD	NET6307	Network security	7	NET6303
28	PD	HRD6305	Applied robotics (IoT)	7	HRD6301
29	PD	VRT6305	Animation and visual effects	7	VRT6302
30	PD	SFT6315	DevOps	7	SFT6002, SFT6307
31	PD	ANL6308	Machine learning 2	7	ANL6304
32	PD	NET6308	Connecting networks	7	NET6303
33	PD	HRD6306	Robotics with artificial intelligence	7	HRD6301
34	PD	VRT6306	Virtual reality systems	7	VRT6301

3 DESCRIPTION OF ELECTIVE DISCIPLINES

Description of discipline	
Code of discipline	SFT6309
Name of discipline	UX/UI development
Number of credits	4
Course, semester	3, 5
Department	CE&IS
Prerequisites	ICT6001 Information and Communication Technology
Postrequisites	Diploma project
Brief course description	This course introduces students to the concept of designing systems that are able to interact effectively with humans. The field of Human Computer Interaction involves understanding and creating methods and artifacts that improve human lives, tasks, goals, and social environments through education in design, computer science, and behavioral and social sciences. In this course, students will learn principles of design and human behavior and the empirical research methods used to solve real problems in the design and use of technology. The course also provides students with opportunities to work on their own as well as in small teams to solve design problems and use HCI methods and principles to model the problems, create solutions, and study the impact of their designs.
Expected learning outcomes	After successful completion of the course students will be able to: Define and Discuss: – the concept of usability engineering, why and when to use it, why and when usage is justified, and its underlying benefits and principles; – the standard usability tools and methods such as personas and scenarios, competitive analysis, flow diagrams, generalized transition networks, site maps, storyboards, wireframes and mockups; – usability-testing methods. This includes understanding the process of planning and preparing a user test, determining and recruiting participants, designing test tasks, scripts, and scenarios, executing a user test, and recording and analyzing user-test data. Use and Design: – HCI tools, methods and concepts to design systems that are able to interact effectively with humans; – the principles of design and human behavior, computer science, and the empirical research methods used to solve real problems in the design and use of technology; – user interfaces from the perspective of the user, creating a design that supports its intended users' existing beliefs, attitudes, and behaviors as they relate to the tasks that the system is being designed to support; – an iterative design process to design interfaces that provide more efficient and satisfying experiences for the user; – design, plan, and conduct usability test and use the results of the test to create recommendations for design improvements and implement those recommendations.

Description of discipline	
Code of discipline	ANL6302
Name of discipline	Exploratory data analysis
Number of credits	4
Course, semester	3, 5
Department	CE&IS
Prerequisites	SFT6304 Programming in Python
Postrequisites	Diploma project
Expected learning outcomes	Students will learn how to get the most out of their data using Exploratory Data Analysis. In this course they will acquire the skills to get the insight they need from the data and take better decisions.
Expected learning outcomes	After successful completion of the course students will be able to: – implement data cleaning and validation tasks to get data ready for data mining activities; – determine if the statistical techniques are appropriate for data analysis; – gain insights on what should be done with data sets before beginning the work on building ML models; – estimate parameters and figure the margins of error.

Description of discipline	
Code of discipline	NET6302
Name of discipline	Systems administration
Number of credits	4
Course, semester	3, 5
Department	CE&IS
Prerequisites	ICT6001 Information and Communication Technology
Postrequisites	Diploma project
Brief course description	This course describes the architecture, components, file systems, regular expression, introduction to system administration, user administration, access control, linux networking. The course teaches how to configure linux servers. The course provides multimedia learning tools, including tests, address a variety of learning styles and promote increased knowledge retention. Hands-on labs and Cisco® Packet Tracer simulation-based learning activities help students develop critical thinking and complex problem solving skills. Embedded assessments provide immediate feedback to support the evaluation of knowledge and acquired skills.
Expected learning outcomes	After successful completion of the course students will be able to: – write shell scripts for automated administration tasks; – install and delete software, create a new user and delete, using man and info pages; – use Linux text editors vim, nano and etc.; – understand the Linux access control/privilege mechanisms.

Description of discipline	
Code of discipline	EEC6001
Name of discipline	Basic circuit theory
Number of credits	4
Course, semester	3, 5
Department	CE&IS
Prerequisites	PHY6001 Physics
Postrequisites	EEC6002 Design and simulation of electronic devices
Brief course description	The course has been designed to introduce fundamental principles of circuit theory commonly used in engineering research and science applications. Techniques and principles of electrical circuit analysis including basic concepts such as voltage, current, resistance, impedance, Ohm's and Kirchoff's law; basic electric circuit analysis techniques, resistive circuits, transient and steady-state responses of RLC circuits; circuits with DC and sinusoidal sources, steady-state power for solving circuit problems.
Expected learning outcomes	After successful completion of the course students will be able to: – recognize common electrical circuit diagram symbols; – understand basic electrical properties; – learn how to design and analyze electrical circuits; – analyze first order and second order circuits by applying electrical circuit laws.

Description of discipline	
Code of discipline	SFT6310
Name of discipline	Web-component development (Java EE)
Number of credits	6
Course, semester	3,5
Department	CE&IS
Prerequisites	SFT6002 Object-Oriented Programming
Postrequisites	SFT6312 Business Component and Web-services Development (Java EE)
Brief course description	During the course, students will learn front-end development from defining functionality of web sites to layout of web pages and back-end development using modern web technologies. Content of the course covers following web technologies: REST API, JAX RS, Hibernate ORM, Spring MVC Framework, Spring Security, Tomcat Server, Servlet API, JSP. During the semester, students will learn development of corporate systems in Java programming language, and correct using of Servlets and JSP. Students must understand MVC pattern, developing secured web application. Students will be able to practice on real web projects and tasks. In addition, students will be able to study new trend technologies by researching.
Expected learning outcomes	After successful completion of the course students will be able to: – analyze advanced web technologies for solving various types of tasks,

	– explain and justify of using java web development tools for certain purposes – know Java Programming Language. – basics of Servlets and JSP (Java Server Pages). – hibernate ORM library. – develop secured corporate server-client web applications.

Description of discipline	
Code of discipline	ANL6303
Name of discipline	NoSQL databases
Number of credits	6
Course, semester	3,5
Department	CE&IS
Prerequisites	SFT6305 Database Design. Introduction to SQL
Postrequisites	Diploma project
Brief course description	This NoSQL Database course provides students the necessary skills to develop applications. Topics include document management, querying data, indexing, aggregation techniques and sharding. At the end of the course, students will leverage what they have learned by solving the problem of a database structure. Students will also be expected to complete six problem sets. Also this course will give you full understanding NoSQL database strengths and weaknesses.
Expected learning outcomes	After successful completion of the course students will be able to – demonstrate an understanding of meaning of NoSQL; – explain the techniques used to create, insert, update and delete data/documents; – demonstrate the various techniques used to query the database; – explain techniques to optimize querying using indexing; – apply methods to analyze data using aggregation techniques; – explain the technique of splitting data across machines via sharding.

Description of discipline	
Code of discipline	NET6303
Name of discipline	Switching, routing, and wireless essentials
Number of credits	6
Course, semester	3,5
Department	CE&IS
Prerequisites	NET6301 Introduction to computer networks
Postrequisites	NET6305 Enterprise networking
Brief course description	The course is devoted to switching technologies and the operation of routers for small and medium-sized businesses. The course also includes topics such as wireless LANs and security concepts. Students will be able to perform basic network settings and

	troubleshoot, identify and prevent local network security threats, and configure and protect the core WLAN.
Expected learning outcomes	After successful completion of the course students will be able to – configure and verify static routing and default routing; – configure and troubleshoot basic operations of a small switched network; – configure and troubleshoot VLANs and inter-VLAN routing; – configure, monitor, and troubleshoot ACLs for IPv4; – configure and verify DHCPv4 and DHCPv6; – configure and verify NAT for IPv4.

Description of discipline	
Code of discipline	VRT6301
Name of discipline	AR/VR technologies
Number of credits	6
Course, semester	3,5
Department	CE&IS
Prerequisites	SFT6002 Object-Oriented Programming
Postrequisites	Diploma project
Brief course description	The course presents an introduction to XR using a broadly chronological approach, focusing on how all of the underlying technologies came together at key moments in the history of XR to launch the concepts of Virtual Reality and Augmented Reality into the mainstream consciousness. Throughout the course, a brief description of each of the supporting technologies, some history about when it first came into use, limitations and future potential for improvement, and how it's used for AR, VR, and MR will be discussed.
Expected learning outcomes	After successful completion of the course students will be able to: – explain how VR and AR technologies work; – compare application development tools using these technologies; – develop apps using AR and VR.

Description of discipline	
Code of discipline	VRT6302
Name of discipline	Fundamental of graphic design
Number of credits	6
Course, semester	3,5
Department	CE&IS
Prerequisites	ICT6001 ICT
Postrequisites	VRT6303 Scientific visualization
Brief course description	The discipline is aimed at the development of design and artistic abilities in the process of students mastering the fundamentals of graphic culture, including the formation of design thinking and the

	ability to perform various types of professional and graphic activities that allow you to manage creativity in the process of searching and implementing new ideas.
Expected learning outcomes	After successful completion of the course students will be able to: – explain the laws of GUI design; – analyze graphic design; – independently develop design of GUI.

Description of discipline	
Code of discipline	SFT6311
Name of discipline	Front-end development
Number of credits	4
Course, semester	3,6
Department	CE&IS
Prerequisites	SFT6002 Object oriented programming
Postrequisites	SFT6314 Full Stack development
Brief course description	In this course, students will study in detail the process of creating the client side of the site, namely the layout of the site template and the development of the user interface. Relevant languages and frameworks are being studied.
Expected learning outcomes	After successful completion of the course students will be able to – create modern websites with HTML CSS and JavaScript; – improved use of HTML CSS and JavaScript; – develop web applications from scratch; – write more efficient web code.

Description of discipline	
Code of discipline	ANL6304
Name of discipline	Machine learning 1
Number of credits	4
Course, semester	3,6
Department	CE&IS
Prerequisites	ANL6301 Introduction to data science
Postrequisites	Machine Learning 2
Brief course description	Machine learning is a type of artificial intelligence (AI) that provides computers with the ability to learn without being explicitly programmed. Machine learning focuses on the development of Computer Programs that can change when exposed to new data. This course will provide you a foundational understanding of machine learning and statistic basics. This course doesn't cover such topics as logistic regression, multilayer perceptron, convolutional neural networks, natural language processing, etc. As this course is aimed to introduce students with Data Science area, so they will be able to make a conscious choice about their elective courses.

Expected learning outcomes	After successful completion of the course students will be able to: – perform explanatory data analysis; – perform sampling and estimation; – create and test hypothesis; – visualize data in different ways; – implement basic ML algorithms from supervised learning methods; – build and apply predictive model on practical tasks.

Description of discipline	
Code of discipline	NET6304
Name of discipline	Cloud computing and virtualization
Number of credits	4
Course, semester	3, 6
Department	CE&IS
Prerequisites	ICT6001 Information and Communication Technology
Postrequisites	Diploma project
Brief course description	The focus of the course will be managing OpenStack using both the web-based dashboard and the command-line interface, in addition to managing instances and installing a proof-of-concept environment using SUSE OpenStack Platform director. Essential skills covered in the course include configuring SUSE OpenStack Platform (using the director UI); managing users, projects, flavors, roles, images, networking, and block storage; setting quotas; and configuring images at instantiation.
Expected learning outcomes	After successful completion of the course students will be able to: – configure and verify OpenStack Administration Utilities; – configure OpenStack Identity Service; – configure and troubleshoot OpenStack Nova component.

Description of discipline	
Code of discipline	EEC6002
Name of discipline	Design and simulation of electronic devices
Number of credits	4
Course, semester	3, 6
Department	CE&IS
Prerequisites	EEC6001 Basic Circuit Theory
Postrequisites	Diploma project
Brief course description	The modern way of life demand from the students good theoretical background and what is particularly important, practical knowledge and skills, which are very important in a market economy. This course provides a basic understanding of the semiconductor materials – characteristics, working principles and applications; provides the insight useful for understanding semiconductor devices

	and technologies; semiconductor physics, p-n junctions diodes, metal-semiconductor contacts, heterojunctions, transistors.
Expected learning outcomes	After successful completion of the course students will be able to: – analyze semiconductor devices, through numerical problems, using fundamental characteristics of semiconductor materials, such as carrier densities, transport, lifetime, generation and recombination; – use basic governing equations to calculate carrier concentrations, position of Fermi energy level, carrier drift current in given field, built - in potential barrier at the space charge region, and current-voltage characteristics of p- n junctions; – analyze main characteristics of electronic and optoelectronic devices such as BJTs, MOSFETs and LEDs.

Description of discipline	
Code of discipline	VRT6303
Name of discipline	Scientific visualization
Number of credits	4
Course, semester	3, 6
Department	CE&IS
Prerequisites	VRT6302 Fundamental of graphic design
Postrequisites	Diploma project
Brief course description	This discipline is aimed at students mastering fundamental knowledge in the field of visualization and related sections of computer graphics and computational geometry. Particular attention in the course is paid to the basic principles of visualization, the particularities of the formulation of problems arising in different subject areas, as well as the most important computational methods and algorithms used to solve them.
Expected learning outcomes	After successful completion of the course students will be able to: – explain the goals of scientific visualization; – compare the algorithms used for scientific visualization; – independently apply scientific visualization tools

Description of discipline	
Code of discipline	SFT6312
Name of discipline	Business component and Web-services development (Java EE)
Number of credits	6
Course, semester	3, 6
Department	CE&IS
Prerequisites	SFT6310 Web-Component Development (Java EE)
Postrequisites	Diploma project
Brief course description	During the course, students will learn front-end development from defining functionality of web sites to layout of web pages and back-

	end development using modern web technologies. Content of the course covers following web technologies: REST API, JAX RS, Hibernate ORM, Spring MVC Framework, Spring Security, Tomcat Server, Servlet API, JSP. During the semester, students will learn development of corporate systems in Java programming language, and correct using of Servlets and JSP. Students must understand MVC pattern, developing secured web application. Students will be able to practice on real web projects and tasks. In addition, students will be able to study new trend technologies by researching.
Expected learning outcomes	After successful completion of the course students will be able to: – analyze advanced web technologies for solving various types of tasks, – explain and justify of using java web development tools for certain purposes – know Java Programming Language. – basics of Servlets and JSP (Java Server Pages). – hibernate ORM library. – develop secured corporate server-client web applications.

Description of discipline	
Code of discipline	ANL6305
Name of discipline	Database application development
Number of credits	6
Course, semester	3, 6
Department	CE&IS
Prerequisites	SFT6305 Database Design. Introduction to SQL SFT6002 OOP
Postrequisites	Diploma project
Brief course description	The course focuses on designing and managing medium-scale database projects, understanding of concepts of DBMS and gain exposure to future trends in databases. Well-designed database systems are at the heart of the enabling and functionally rich, Web-based software applications that are revolutionizing businesses today. This course occupies development of client-server applications in PHP and MySQL, using database management systems. Furthermore, this course prepares students to build such systems, by providing them with the practice and experiences to master key concepts of database system design and implementation.
Expected learning outcomes	After successful completion of the course students will be able to: – understand the MySQL syntax and code; – work in MySQL Developer software and PHP developer software PhPStorm; – understand how web applications work; – write backend to web sites; – develop their own projects; – write simple and complex subprograms in PhP Laravel;

	– create web application for grouping logically related components; – work in the phpmyadmin on the phpstorm.

Description of discipline	
Code of discipline	NET6305
Name of discipline	Enterprise networking
Number of credits	6
Course, semester	3, 6
Department	CE&IS
Prerequisites	NET6303 Switching, routing, and wireless essentials
Postrequisites	Diploma project
Brief course description	The course describes the architectures and considerations related to designing, securing, operating, and troubleshooting enterprise networks. This course covers wide area network (WAN) technologies and quality of service (QoS) mechanisms used for secure remote access.
Expected learning outcomes	After successful completion of the course students will be able to: – implement single-area OSPFv2; – implement IPv4 ACLs to filter traffic and secure administrative access; – configure NAT services on the edge router to provide IPv4 address scalability; – implement protocols to manage the network; – troubleshoot enterprise networks; – explain how network automation is enabled through RESTful APIs and configuration management tools.

Description of discipline	
Code of discipline	EEC6004
Name of discipline	Fundamentals of logic design
Number of credits	6
Course, semester	3, 6
Department	CE&IS
Prerequisites	EEC6001 Basic circuit theory
Postrequisites	Diploma project
Brief course description	This course is designed and formulated to help students understand, solve and design digital logic circuits. Taking this course will give the students an insight on the logic that forms the backbone to 21st century technology. This course has detailed lectures that not only define or describe logic gates but also examples and problems where you get to learn the real life implementation and working of the logic gates.
Expected learning outcomes	After successful completion of the course students will be able to:

	– implement
	o combinational circuits using simulation tool Proteus 7;
	o digital circuits such as binary calculator, BCD-to-Braille converter, BCD-to-7segment converter;
	o sequential circuits using D flip flops, binary counters, shift registers;
	– apply
	o boolean logic in digital circuit construction;
	o Karnaugh maps in their implementation of BCD-to-Braille converter and BCD-to-7segment converter, rounding decimal numbers;
	o design of digital circuits in integration with Atmega microcontrollers;
	– knowledgeably discuss
	o the structure and concepts of the combinational and sequential circuits;
	o fundamental concepts of digital electronics including boolean algebra and logic elements;
	o the structure and function of the common logic elements and their relation to boolean algebra;
	o the design criteria for digital circuits in order to reach optimized solution.

Description of discipline	
Code of discipline	SFT6313
Name of discipline	Mobile technologies and applications
Number of credits	6
Course, semester	3, 6
Department	CE&IS
Prerequisites	SFT6002 Object-Oriented Programming
Postrequisites	Diploma project
Brief course description	Android programming concepts are reinforced through a set of thematic programming exercises that introduce these topics and incrementally allow the student to build a complex application; that is, programming labs form a set of components that collectively implement a continuous sensing application. The resulting phone app allows user to log their exercises (e.g., walks, runs) and display them on Google maps.
Expected learning outcomes	After successful completion of the course students will: – be exposed to technology and business trends impacting mobile applications; – be competent with the characterization and architecture of mobile applications; – be competent with understanding enterprise scale requirements of mobile applications; – be competent with designing and developing mobile applications using one application development framework.

Description of discipline	
Code of discipline	ANL6306
Name of discipline	Audio and text processing
Number of credits	6
Course, semester	3, 6
Department	CE&IS
Prerequisites	ANL6301 Introduction to data science
Postrequisites	Diploma project
Brief course description	Natural language processing (NLP) is one of the most important technologies of the information age, and a crucial part of artificial intelligence. Applications of NLP are everywhere because people communicate almost everything in language: web search, advertising, emails, customer service, language translation, virtual agents, medical reports, etc. In recent years, Deep Learning approaches have obtained very high performance across many different NLP tasks, using single end-to-end neural models that do not require traditional, task-specific feature engineering. In this course, students will gain a thorough introduction to cutting-edge research in Deep Learning for NLP.
Expected learning outcomes	After successful completion of the course students will: – develop a working familiarity with a wide range of methods used to analyze audio and text data; – be able to select appropriate methods for a variety of research questions; – acquire hands-on experience using analytic techniques.

Description of discipline	
Code of discipline	NET6306
Name of discipline	DevNet
Number of credits	6
Course, semester	3, 6
Department	CE&IS
Prerequisites	NET6301 introduction to computer networks SFT6002 Object-Oriented Programming
Postrequisites	Diploma project
Brief course description	Students taking this course will learn the best practices of modern software development, DevOps, understand and learn how to securely use APIs, and how to automate network operations using those APIs.
Expected learning outcomes	After successful completion of the course students will be able to: – use basic Python programming and Linux skills; – implement a development environment using DevNet resources; – use software development and design best practices; – create REST API requests over HTTPS to securely integrate services;

	– use current technologies to deploy and secure applications and data in a cloud environment; – compare software testing and deployment methods in automation and simulation environments.

Description of discipline	
Code of discipline	HRD6304
Name of discipline	Sensor technologies
Number of credits	6
Course, semester	3, 6
Department	CE&IS
Prerequisites	HRD6301 Introduction to Robotics
Postrequisites	Diploma project
Brief course description	The difference between sensor-controlled behavior and what computers usually do is that the input from a sensor is ambiguous. Design sensor solutions for industrial companies that allow for complete digitalization of manual measurements and comprehensive sensor data tracking and analytics. The combination of intelligent sensors and analytical capability allows continuous monitoring of measurement data, but can also be configured to trigger automatic process adjustments in real time. The result is reduced down times and increased precision and reliability. This course will deliver the concepts and ideas towards smart factories.
Expected learning outcomes	After successful completion of the course students will be able to: – develop judgment of what sensors and modalities are appropriate for different applications; – know how to electronically condition the sensor, hook it up to a microcomputer, and process the signal (at least basically); – have some idea of how/where these sensors can be used; – have a reasonable idea of how different sensors work; – develop a sense for recognizing bad data and an intuition of how to resolve problems.

Description of discipline	
Code of discipline	VRT6304
Name of discipline	Introduction to computer vision
Number of credits	6
Course, semester	3, 6
Department	CE&IS
Prerequisites	ANL6301 Introduction to data science
Postrequisites	Diploma project
Brief course description	This discipline is aimed at deepening students' knowledge in the field of pattern recognition, video and image processing, 3D reconstruction and digital photography.

Expected learning outcomes	After successful completion of the course students will be able to: – explain the principles of computer vision algorithms; – apply libraries Tensorflow, OpenCV, etc .; – process images and videos.

Description of discipline	
Code of discipline	SFT6314
Name of discipline	Full stack development
Number of credits	7
Course, semester	4, 7
Department	CE&IS
Prerequisites	SFT6311 Front-end development, SFT6307 Web technologies
Postrequisites	Diploma project
Brief course description	A full stack developer is an engineer who can handle all the work of databases, servers, systems engineering, and clients. Depending on the project, what customers need may be a mobile stack, a Web stack, or a native application stack. In fact, "full stack" refers to the collection of a series of technologies needed to complete a project. "Stack" refers to a collection of sub-modules. These software sub-modules or components combined together to achieve the established function while without the need for other modules.
Expected learning outcomes	After successful completion of the course students will be able to: – create and deploy a database-backed web API (Application Programming Interface); – secure and manage user authentication and access control for an application backend; – deploy a web application to the cloud.

Description of discipline	
Code of discipline	ANL6307
Name of discipline	Big data processing
Number of credits	7
Course, semester	4, 7
Department	CE&IS
Prerequisites	ANL6301 Introduction to data science, ANL6302 Exploratory data analysis
Postrequisites	Diploma project
Brief course description	The course studies the techniques for retrieving data from example database and big data management systems; discusses the connections between data management operations and the big data processing patterns needed to utilize them in large-scale analytical applications.
Expected learning outcomes	After successful completion of the course students will be able to: – explain Big Data phenomenon; – apply main Big Data tools (Hadoop & Spark);

	− use main methods of predictive analytics for Big Data.

Description of discipline	
Code of discipline	NET6307
Name of discipline	Network security
Number of credits	7
Course, semester	4, 7
Department	CE&IS
Prerequisites	NET6303 Switching, routing, and wireless essentials
Postrequisites	Diploma project
Brief course description	Network Security course equips students with the knowledge and skills needed to prepare for entry-level security specialist careers and emphasizes practical experience. Network Security course aims to develop an in-depth understanding of network security principles as well as the tools and configurations required to secure a network.
Expected learning outcomes	After successful completion of the course students will be able to: − explain network threats, mitigation techniques, and the basics of securing a network; − secure administrative access with AAA, implement firewall technologies to secure the network perimeter; − configure IPS to mitigate attacks on the network and implement secure virtual private networks; − test network security and create a technical security policy.

Description of discipline	
Code of discipline	HRD6305
Name of discipline	Applied robotics (IoT)
Number of credits	7
Course, semester	4, 7
Department	CE&IS
Prerequisites	HRD6301 Introduction to Robotics
Postrequisites	Diploma project
Brief course description	This course will simulate, build and demonstrate a complex multi-robotic system, including sensing, computation, and actuation. Student will identify the talk and then will design the solutions. All the knowledge and techniques will be applied here. Real world industrial problems can be considered. Create a robotic system which can sense its environment, reason about it and act on it. Student will design and build the mechanical subsystem with appropriate actuators and sensors for computer control. More mature design will be implemented with proper 1) dynamic model of robot, 2) simulation of A1 for robot and 3) power analysis of electrical system. Students' Robots will compete in a friendly competition at the end of the term.
Expected learning outcomes	After successful completion of the course students will be able to:

	− develop and implement an embedded system (hardware and software) necessary to control a typical robot; − acquire and process data from typical sensors used in robotics; − control typical actuators used in robotics.

Description of discipline	
Code of discipline	VRT6305
Name of discipline	Animation and visual effects
Number of credits	7
Course, semester	4, 7
Department	CE&IS
Prerequisites	VRT6302 Fundamental of graphic design
Postrequisites	Diploma project
Brief course description	The discipline is aimed at using the principles of digital processing when shooting and editing animated films, forming basic ideas, knowledge, skills of students on the basics of computer animation and visual effects.
Expected learning outcomes	After successful completion of the course students will be able to: − explain the basic principles of creating animations and VFX; − use tools for working with animation; − create their own animation projects

Description of discipline	
Code of discipline	SFT6315
Name of discipline	DevOps
Number of credits	7
Course, semester	4, 7
Department	CE&IS
Prerequisites	SFT6002 OOP, SFT6307 Web technologies
Postrequisites	Diploma project
Brief course description	The course examines the key concepts and principles of DevOps, organizational factors and automation tools in the development of software products using this method.
Expected learning outcomes	After successful completion of the course students will be able to: − understand the key concepts and principles of DevOps; − apply the most common and popular DevOps tools; − discuss the critical success factors for DevOps implementation; − compare specific DevOps methodologies and frameworks.

Description of discipline	
Code of discipline	ANL6308
Name of discipline	Machine learning 2

Number of credits	7
Course, semester	4, 7
Department	CE&IS
Prerequisites	ANL6304 Machine learning 1
Postrequisites	Diploma project
Brief course description	During the course students will cover the theory and practical algorithms for machine learning from a variety of perspectives. The student will be taught to define the problems domain, scope and possible solution ways. The students will learn how to design and implement the main ML algorithms and prove their efficiency.
Expected learning outcomes	After successful completion of the course students will be able to: – implement basic ML algorithms from the supervised learning methods; – recognize the type of the task and make proved decision on the appropriate methods and algorithms; – apply ML algorithms for binary/multiclass classification and regression problems; – implement solution of the problem using chosen algorithms in familiar programming and analytic environment.

Description of discipline	
Code of discipline	NET6308
Name of discipline	Connecting networks
Number of credits	7
Course, semester	4, 7
Department	CE&IS
Prerequisites	NET6303 Switching, routing, and wireless essentials
Postrequisites	Diploma project
Brief course description	This course focuses on the LAN and WAN technologies and network services required in a complex network. Students will be able to integrate several LAN technologies and protocols from previous networking courses, implement WAN interconnection, provide security solutions for IP networks, manage networks in a unified manner.
Expected learning outcomes	After successful completion of the course students will be able to: – improve performance at the data link layer by introducing functions and services, including link aggregation; – manage communication and maintain serial WAN links using various technologies; – provide effective security solutions using a variety of technologies, including IPsec and GRE; – build corporate networks that meet business requirements.

Description of discipline

Code of discipline	HRD6306
Name of discipline	Robotics with artificial intelligence
Number of credits	7
Course, semester	4, 7
Department	CE&IS
Prerequisites	HRD6301 Introduction to Robotics
Postrequisites	Diploma project
Brief course description	This class will teach students basic methods in Artificial Intelligence, including: probabilistic inference, planning and search, localization, tracking and control, all with a focus on robotics. Extensive programming examples and assignments will apply these methods in the context of building self-driving cars. At the end of the course, students will leverage what they have learned by solving the problem of a robot. Students will also be expected to complete six problem sets, and deliver a final project that applies one of the methods learned in this class on a dataset of their choosing. Short programming assignments include hands-on experiments with various learning algorithms, and a larger course project gives students a chance to dig into an area of their choice.
Expected learning outcomes	After successful completion of the course students will be able to: – implement basic AI algorithms in Python for various problems of basic object-oriented concepts to model robot motion and perception; – apply AI algorithms for filtering and searching; – make inferencing upon total probabilistic; – recognize the type of the task and make proved decision on the appropriate methods and algorithms; – implement solution of the problem using chosen algorithms in familiar programming and analytic environment as a project assignment.

Description of discipline	
Code of discipline	VRT6306
Name of discipline	Virtual reality systems
Number of credits	7
Course, semester	4, 7
Department	CE&IS
Prerequisites	VRT6301 AR/VR technologies
Postrequisites	Diploma project
Brief course description	The technological aspects of the implementation of virtual reality systems are mainly considered: special devices, stages of creating virtual reality systems, its components, 3D graphics for modeling environments, objects, characters, software tools (engines) for managing the model in real-time interactive mode.
Expected learning outcomes	After successful completion of the course students will be able to: – explain the development cycle of virtual reality projects; – develop their own projects using virtual reality technology; – work in different virtual reality environments.