ХАЛЫҚАРАЛЫҚ АҚПАРАТТЫҚ ТЕХНОЛОГИЯЛАР УНИВЕРСИТЕТІ
МЕЖДУНАРОДНЫЙ УНИВЕРСИТЕТ ИНФОРМАЦИОННЫХ ТЕХНОЛОГИЙ
INTERNATIONAL UNIVERSITY

Faculty of Computer Technology and Cybersecurity

Department of Computer Engineering and Information Security

APPROVED BY
Vice-rector for academic affairs,
International Information
Technology University JSC
Umarov T.F.
"31" 03 2021.

6B06107
(Code of Educational Program)

Cyberphysical Systems
(Name of Educational Program)

CATALOGUE OF ELECTIVE DISCIPLINES

2021 entry year

2021

The catalogue of elective disciplines for the specialty/EP 6B06107 «Cyberphysical Systems» 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
of Academic Affairs _____ A.K. Mustafina

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
			3 year		
1	PD	EEC6001	Basic circuit theory	4	PHY6001
2	PD	VRT6301	AR/VR technologies	6	SFT6002
3	PD	EEC6002	Design and simulation of electronic devices	4	EEC6001
4	PD	EEC6004	Fundamentals of logic design	6	EEC6001
5	PD	HRD6304	Sensor technologies	6	HRD6301
			4 year		
6	PD	HRD6305	Applied robotics (IoT)	7	HRD6301
7	PD	HRD6306	Robotics with artificial intelligence	7	HRD6301

3 DESCRIPTION OF ELECTIVE DISCIPLINES

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	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	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	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;

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

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	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	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.