KARTA PRZEDMIOTU

Bialystok University of Technology		**Faculty of Computer Science**	
Field of study	Computer science	**Degree level and programme type**	full-time Master's degree
Specjalization / diploma path	common subject	**Study profile**	general academic
Field of study	**Image Processing in Biometrics**	**Course code**	INF2APB
		Course type	obligatory

Forms and number of hours	**L**	**C**	**LC**	**P**	**SW**	**FW**	**S**	**Semester**	**2**
	30			20	30			**No. of ECTS credits**	**6**

Entry requirements	
Course objectives	In this course, students will be introduced to the fundamentals of image analysis and processing, as well as techniques of preprocessing, segmentation, feature extraction, and classification for object recognition. In addition, they will learn basic algorithms for human identity verification and identification and applications of biometric systems. Students will also conduct testing of off-the-shelf biometric algorithms implemented in augmented and virtual reality environments.
Course content	Lecture: 1. Fundamentals and techniques of image analysis and processing for object recognition. 2. image preprocessing. 3. biometrics vs biometric systems. 4. biometric features as access key. 5. image stitching methods. 6. Image segmentation methods and finding objects (e.g. faces) in images. 7. Biometric feature selection and extraction methods physiological and behavioral significant in classification. 8. Methods of image description and representation for recognition. 9. human identification and verification. 10. Examples of applications of biometric systems. 11. methods of preparing biometric image for classification and recognition. 12. Examples of physical, behavioral, and emotional measurements. Specialistic workshop: 1. Implementation of image processing and analysis methods. 2. Implementation of image enhancement methods. 3. Implementation of image stitching methods (K3M, KMM, Zhang). 4. Implementation of image segmentation methods and its use in object recognition. 5. implementation of author's biometric system using physical, behavioral and hybrid features. 6. development of multimodal biometric system using artificial intelligence. 7. Testing of currently existing biometric solutions using augmented reality (AR) and virtual reality (VR) techniques. 8. Analyze libraries and programs to link biometrics and AR, VR techniques. Project: 1. development and implementation of biometric algorithms and their presentation and defense.

Calculation:

Student workload (in hours):	**No. of hours**	**with direct teacher participation**	**practical**
Lecture attendance	30	30	
Project attendance	20	20	20
Laboratory classes	30	30	30
Lecture test(s) attendance	2	2	
Participation in teacher-student sessions related to the module	5	5	
Preparation for lecture test(s)	5		
Preparation for classes	58		58
			0
			0
			0
			0
			0
			0
Total hours:	**150**	**87**	**108**
Total of ECTS credits:	**6**	**3,5**	**4,3**

Author of the programme: Data:

Teaching methods	L	informative lecture
	SW	Programming using a computer, subject exercises
	P	Programming using a computer
	-	
Assesment methods	L	test
	SW	introductory tasks performed during the specialist laboratory classes
	P	project of biometric system carried out during the classes of the design laboratory.
	-	

Symbol of learning outcome	**Learning outcomes**	**Reference to the learning outcomes for the field of study**
	Student	
LO1	knows and can use image preprocessing techniques	INF2_W03 INF2_W06 INF2_U04
LO2	knows and can use image segmentation techniques	INF2_W03 INF2_W06 INF2_U04
LO3	knows and can use feature selection and extraction methods in image analysis	INF2_W07 INF2_U03 INF2_U09

LO4	knows and can use basic algorithms for verification and identification of human identity based on biometric features	INF2_W07 INF2_U03 INF2_U09
LO5	is able to independently perform testing of biometric algorithms, including those implemented in augmented reality and virtual reality environments; is able to critically assess the quality of algorithms written in AR, VR environments	INF2_W02 INF2_W05 INF2_W06 INF2_U02 INF2_U03 INF2_U06 INF2_U11 INF2_K04

Symbol of learning outcome	**Methods of assessing the learning outcomes**	**Type of tuition during which the outcome is assessed**
LO1	written exam, introductory tasks performed during specialist workshop, biometric system project carried out during project classes	L, SW, P
LO2	written exam, introductory tasks performed during specialist workshop, biometric system project carried out during project classes	L, SW, P
LO3	written exam, introductory tasks performed during specialist workshop, biometric system project carried out during project classes	L, SW, P
LO4	written exam, introductory tasks performed during specialist workshop, biometric system project carried out during project classes	L, SW, P
LO5	introductory tasks performed in the specialised workshop classes	SW

Basic references	1	K. Saeed, Image Analysis for Object Recognition, Białystok University of Technology Press, 2004.
	2	Wilhelm Burger, Mark J. Burge, Digital Image Processing: An Algorithmic Introduction Using Java. Springer, 2016.
	3	
	4	
	5	
Supplementary references	1	Andreas Antoniou, Digital Signal Processing. Prentice Hall, 2016.
	2	
	3	
	4	
	5	

Author of the programme:	**Data:** *22.05.2020*

KARTA PRZEDMIOTU

Bialystok University of Technology		**Faculty of Computer Science**	
Field of study	Computer science	**Degree level and programme type**	full-time Master's degree
Specjalization / diploma path	Biometry and Image Processing	**Study profile**	general academic
Field of study	**SoC Systems in Signal Processing**	**Course code**	INF2SSP
		Course type	obligatory

Forms and number of hours	**L**	**C**	**LC**	**P**	**SW**	**FW**	**S**	**Semester**	**2**
	30				30			**No. of ECTS credits**	**5**

Entry requirements	
Course objectives	The aim of the course is to familiarize students with contemporary SoC architectures, to familiarize with the methods of designing digital signal processing systems based on FPGA and SoC systems, and to teach how to design systems based on FPGA and SoC, with particular emphasis on the implementation of digital signal processing methods.
Course content	Lecture: 1. SoC architectures. 2. Examples of Soft-Core and Hard-Core. 3. IP blocks for SoC. 4. Designing SoC components. 5. Use of internal and external memory. 6. Design of peripheral systems. 7. Integration of SoC components. 8. Hardware implementation of digital filters. 9. Design of FIR and IIR filters in FPGA structure. 10. Discrete and fast Fourier transform and its implementation in FPGA. 11. Spectral analysis. 12. Adaptive filters and their implementation in FPGA. 13. Examples of SoC applications in signal processing. Specialization workshop: 1. Introduction to Platform Designer. 2. Configuration of a system with a Soft-core processor. 3. Implementation of a simple system with a Soft-core processor. 4. Configuration of a system with a Hard-core processor. 5. Implementation of a simple system with a Hard-core processor. 6. Integration of the processor with the programmable part. 7. FIR hardware filter controlled from the processor. 8. IIR hardware filter controlled from the processor. 9. FFT implementation in FPGA and its application in spectrum analysis. 10. Implementation of adaptive filters in FPGA. 11. Design of a complex DSP system.

Calculation:	**Student workload (in hours):**	**No. of hours**	**with direct teacher participation**	**practical**
	Lecture attendance	30	30	
	Project attendance	30	30	30
	Lecture test(s) attendance		0	
	Participation in teacher-student sessions related to the module	5	5	
	Preparation for lecture test(s)	10		
	Preparation for project classes	50		50
				0
				0
				0
				0
				0
				0
	Total hours:	**125**	**65**	**80**
	Total of ECTS credits:	**5**	**2,6**	**3,2**

Author of the programme: Data:

Teaching methods	L	Informative-problem lecture
	SW	Programming using a computer, simulation, project method
	-	
	-	
Assesment methods	L	test
	SW	reports on exercises and projects
	-	
	-	

Symbol of learning outcome	**Learning outcomes**	**Reference to the learning outcomes for the field of study**
	Student	
LO1	knows the current trends and tools of IT in the field of SoC architectures	INF2_W06
LO2	knows the engineering methods and tools used to design SoC-based systems	INF2_W05
LO3	knows deeply the key issues in the field of digital signal processing and their application in SoC systems	INF2_W03

LO4	can design applications and systems based on SoC using appropriate engineering methods and tools	INF2_U08
LO5	can use analytical and simulation methods to implement systems based on SoC	INF2_U06
LO6	uses learned mathematical solutions to construct SoC systems for digital signal processing	INF2_W01 INF2_U01
LO7	student is able to work in a group, taking various roles in it	INF2_U13 INF2_K05

Symbol of learning outcome	**Methods of assessing the learning outcomes**	**Type of tuition during which the outcome is assessed**
LO1	test	L
LO2	test	L
LO3	test	L
LO4	reports on exercises and projects	SW
LO5	reports on exercises and projects	SW
LO6	reports on exercises and projects	SW
LO7	reports on exercises and projects	SW

Basic references	1	Rao, K. Deergha, and M. N. S Swamy. Digital Signal Processing. Singapore: Springer Singapore Pte. Limited, 2018. Web.
	2	O'Shea, Peter, Zahir M Hussain, and Amin Z Sadik. Digital Signal Processing. 1. Aufl. ed. Berlin, Heidelberg: Springer-Verlag, 2011. Web.
	3	L. T. Wang, C. E. Stroud, N. Touba (editors), System-on-chip test architectures : nanometer design for testability Amsterdam, Elsevier : Morgan Kaufmann Publ., 2008.
	4	Reay, Donald S. Digital Signal Processing Using the ARM Cortex-M4. Hoboken: WILEY, 2015. Web.
	5	L. T. Wang, C. E. Stroud, N. A. Touba, System-On-Chip Test Architectures, Elsevier, 2008.
Supplementary references	1	S. Kilts, Advanced FPGA Design, Wiley, 2007.
	2	Z. Salcic, A. Smailagi, Digital System Design And Prototyping Using Field Programmable Logic, Kluwer, 2002.
	3	Documentation of Intel FPGA Quartus Prime.
	4	Williams, John Michael. Digital VLSI Design with Verilog. Springer International, 2014. Web.
	5	Documentation of ARM architecture

Author of the programme: **Data:** *22.05.2020*

KARTA PRZEDMIOTU

Bialystok University of Technology		**Faculty of Computer Science**	
Field of study	Computer science	**Degree level and programme type**	full-time Master's degree
Specjalization / diploma path	Biometry and Image Processing	**Study profile**	general academic
Field of study	**Game Programming**	**Course code**	INF2PGI
		Course type	obligatory
Forms and number of hours	**L C LC P SW FW S** 30 30	**Semester**	**2**
		No. of ECTS credits	**4**

Entry requirements	
Course objectives	The aim of the course is to expose the student to the key issues related to game design. The most important aspects of game programming will be presented, such as the game engine architecture, computer animation, special effects, physics simulation, spatial sound, user interface and networking. Also, virtual reality technology will be discussed - the student will learn how to use this technology and its capabilities in game developement.
Course content	Lectures and laboratories 1. Architecture of the game engine. Basics of the selected game engine. 2. Graphics in computer games. Basics of two-dimensional and three-dimensional graphics. 3. Techniques and tools for creating special effects and animations. 4. Interaction with virtual reality objects in computer games. 5. Basics of VR technology. Capabilities of the VR technology in game developement. 6. Physics in games. Mapping physical phenomena in the virtual world. 7. Selected topics of the artificial intelligence in computer games. 8. User interface in different genres of games. 9. Sound in games. The issues related to spatial sound. Creating the audio experience in games. 10. Game networking. Design and implementation of multiplayer games. 11. Structure of a typical game developement team. Tasks of individual team members.

Calculation:

Student workload (in hours):	**No. of hours**	**with direct teacher participation**	**practical**
Lecture attendance	30	30	
Project attendance	30	30	30
Lecture test(s) attendance		0	
Participation in teacher-student sessions related to the module	5	5	
Preparation for lecture test(s)	5		
Preparation for project classes	30		30
			0
			0
			0
			0
			0
			0
Total hours:	**100**	**65**	**60**
Total of ECTS credits:	**4**	**2,6**	**2,4**

Author of the programme: Data:

Teaching methods	L	Informative-problem lecture
	SW	Programming using a computer, project method
	-	
	-	
Assesment methods	L	test
	SW	realization of the project tasks, project defense
	-	
	-	

Symbol of learning outcome	**Learning outcomes**	**Reference to the learning outcomes for the field of study**
	Student	
LO1	can create basic two-dimensional and three-dimensional graphics and process sound	INF2_U03 INF2_U08
LO2	knows the trends in the game development industry, is able to independently acquire knowledge and determine the direction of self-education	INF2_W06 INF2_U14
LO3	can use virtual reality technology in computer games	INF2_U03 INF2_U04
LO4	knows the currently used technologies and tools used to create computer games	INF2_W05 INF2_W06
LO5	has knowledge of creating multimedia applications	INF2_W05 INF2_W06

Symbol of learning outcome	**Methods of assessing the learning outcomes**	**Type of tuition during which the outcome is assessed**
LO1	realization of the project tasks, project defense	SW
LO2	realization of the project tasks, project defense	SW
LO3	realization of the project tasks, project defense	SW
LO4	test	L
LO5	test	L

Basic references	1	T. Parisi. Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile, O'Reilly Media; 1 edition, 2015
	2	J. Gregory: Game Engine Architecture, 3rd edition, A K Peters/CRC Press, 2018.
	3	
	4	
	5	
Supplementary references	1	M. McShaffry, D. Graham: Game Coding Complete, 4th edition, Course Technology PTR, 2015.
	2	A. Lake: Game programming Gems 8, Course Technology PTR, 2010.
	3	A.S. Kyaw, J. Stein: Irrlicht 1.7 Realtime 3D Engine Beginner's Guide, Packt Publishing, 2011.
	4	J. Glazer, S. Madhav: Multiplayer Game Programming, Architecting Networked Games, Addison-Wesley, 2015.
	5	

Author of the programme: **Data:** *22.05.2020*

KARTA PRZEDMIOTU

Bialystok University of Technology		**Faculty of Computer Science**	
Field of study	Computer science	**Degree level and programme type**	full-time Master's degree
Specjalization / diploma path	Biometry and Image Processing	**Study profile**	general academic
Field of study	**Intelligent methods of signal processing**	**Course code**	INF2IPS
		Course type	obligatory
Forms and number of hours	**L C LC P SW FW S** 30 15	**Semester** **No. of ECTS credits**	**2** **3**

Entry requirements	
Course objectives	To introduce students to advanced methods of signal processing with elements of machine learning. Upon completion of this module students should be able to develop advanced algorithms of signal processing using high-level programming environments such as MATLAB, Python or R.
Course content	Lecture: 1. Introduction. Examples of EMG, EEG, ECG, IMU and audio signals 2. Signal conditioning 3. Introduction to adaptive filtering and source separation algorithms 4. Beamforming 5. Feature extraction and elements of machine learning 6. Automatic recognition of human activity 7. Signal processing for health applications 8. Computational auditory scene analysis (CASA) 9. Music information retrieval (MIR) 10. Audio event recognition (AER) and acoustic scene classification (ASC) 11. Processing of spatial audio 12. Deep learning in signal engineering 13. Application of intelligent signal processing to music composing and generating pieces of visual art 14. Modern trends in signal processing Specialization workshop 1. Development of an algorithm for conditioning and pre-processing of signals (EMG, EEG, ECG, IMU, audio) 2. Development of an algorithm of feature extraction for the purposes of machine learning 3. Development of an algorithm for automatic classification of signals in such areas as gesture recognition, people identification, recognition of audio scenes and events, music information retrieval 4. Application of deep learning algorithms to analysis, classification, and synthesis of signals.

Calculation:	**Student workload (in hours):**	**No. of hours**	**with direct teacher participation**	**practical**
	Lecture attendance	30	30	
	Project attendance	15	15	15
	Lecture test(s) attendance		0	
	Participation in teacher-student sessions related to the module	5	5	
	Preparation for lecture test(s)	10		
	Preparation for project classes	15		15
				0
				0
				0
				0
				0
				0
	Total hours:	**75**	**50**	**30**
	Total of ECTS credits:	**3**	**2,0**	**1,2**

Author of the programme: Data:

Teaching methods	L	Informative-problem lecture
	SW	Programming using a computer, project method, demonstration
	-	
	-	
Assesment methods	L	test
	SW	written report and oral defence of the computer-based projects
	-	
	-	

Symbol of learning outcome	**Learning outcomes**	**Reference to the learning outcomes for the field of study**
	Student	
LO1	will have extended and in-depth knowledge in the field of intelligent signal processing	INF2_W03 INF2_W05 INF2_W07
LO2	is able to classify and compare the intelligent signal processing methods	INF2_W05 INF2_W07
LO3	knows the trends and challenges related to intelligent signal engineering	INF2_W06
LO4	is able to design and implement intelligent signal processing algorithms using a high-level programming environment	INF2_U03 INF2_U04 INF2_U08

LO5	is able to design, undertake, and report an experiment involving intelligent signal processing	INF2_U05 INF2_U06 INF2_U09

Symbol of learning outcome	**Methods of assessing the learning outcomes**	**Type of tuition during which the outcome is assessed**
LO1	test	L
LO2	test	L
LO3	test	L
LO4	Written reports and oral defence of the computer-based projects	SW
LO5	Written reports and oral defence of the computer-based projects	SW
LO6		
LO7		

Basic references	1	U. Zölzer (Ed.), DAFX: Digital Audio Effects, Wiley, 2011.
	2	G. Richard, T. Virtanen, J.P. Bello, N. Ono and H. Glotin: Introduction to the special section on sound scene and event analysis. IEEE/ACM Trans. Audio Speech Lang. Process. 25(6), pp. 1169–1171, 2017.
	3	
	4	
	5	
Supplementary references	1	K. Choi, G. Fazekas, K. Cho and M. Sandler: A Tutorial on Deep Learning for Music Information Retrieval. https://arxiv.org/abs/1709.04396 (available online), accessed in September, 2018.
	2	D. Stowell, D. Giannoulis, E. Benetos, M. Lagrange, M.D. Plumbley: Detection and classification of acoustic scenes and events. IEEE Trans. Multimedia 17(10), pp. 1733–1746, 2015.
	3	
	4	
	5	

Author of the programme:	**Data:** *22.05.2020*

KARTA PRZEDMIOTU

Bialystok University of Technology		**Faculty of Computer Science**	
Field of study	Computer science	**Degree level and programme type**	full-time Master's degree
Specjalization / diploma path	Biometry and Image Processing	**Study profile**	general academic
Field of study	**Internet of Everything**	**Course code**	INF2IOE
		Course type	obligatory

Forms and number of hours	**L**	**C**	**LC**	**P**	**SW**	**FW**	**S**	**Semester**	**2**
	15				30			**No. of ECTS credits**	**3**

Entry requirements	
Course objectives	The aim of the course is to familiarize students with the technologies of Industry 4.0, in particular data transmission, and to teach practical skills in implementing and applying communication in the applications of the Industrial Internet of
Course content	Lecture: 1. Types of transmission used in the Industrial Internet of Things. 2. Radio data transmission technologies. 3. Topologies of network solutions used in Industry 4.0. 4. Wireless wide area networks in Industry 4.0 applications. 5. IEEE 802.xx standards used in the Industrial Internet of Things. 6. Security of radio transmissions for the Industrial Internet of Things. 7. Technologies for the Internet of Everything. 8. Basics of designing and implementation applications for the Industrial Internet of Things. 9. Troubleshooting, monitoring, management and diagnostics. Specialization Workshop: 1. Wireless radio technology. 2. Topologies and devices of wireless networks. 3. Standard IEEE 802.11 and IEEE 802.15 4. Security of wireless transmissions in the Industrial Internet of Things. 5. Wireless technologies of the Internet of Everything: Zwave, ZigBee, LoRaWan, Bluetooth 6. Designing applications for the Internet of Things. 7. Troubleshooting, monitoring, management and diagnostics

Calculation:	**Student workload (in hours):**	**No. of hours**	**with direct teacher participation**	**practical**
	Lecture attendance	15	15	
	Project attendance	30	30	30
	Lecture test(s) attendance		0	
	Participation in teacher-student sessions related to the module	5	5	
	Preparation for lecture test(s)	5		
	Preparation for project classes	20		20
				0
				0
				0
				0
				0
				0
	Total hours:	**75**	**50**	**50**
	Total of ECTS credits:	**3**	**2,0**	**2,0**

Author of the programme: Data:

Teaching methods	L	Informative-problem lecture
	SW	demonstration, simulation, laboratory exercises
	-	
	-	
Assesment methods	L	test
	SW	carrying out practical tasks with the use of specialized equipment.
	-	
	-	

Symbol of learning outcome	**Learning outcomes**	**Reference to the learning outcomes for the field of study**
	Student	
LO1	knows the principles of operation and construction of wireless data transmission systems	INF2_W05 INF2_W06 INF2_W08
LO2	knows and understands the principles contained in the IEEE 802.11 standard	INF2_W05 INF2_W06 INF2_W08
LO3	has knowledge of the planning and implementation of wireless data transmission systems	INF2_W05 INF2_W06 INF2_W08
LO4	knows and understands the principles of management (including security management) and diagnostics of wireless networks	INF2_W02 INF2_W03 INF2_W05 INF2_W06
LO5	has the ability to start and administer WLAN networks in Adhoc mode	INF2_U03 INF2_U08
LO6	has the ability to start and administer WLAN networks in basic and extended mode	INF2_U02 INF2_U07 INF2_K04
LO7		

Symbol of learning outcome	**Methods of assessing the learning outcomes**	**Type of tuition during which the outcome is assessed**

LO1	test	L
LO2	test	L
LO3	test	L
LO4	test	L
LO5	performing practical tasks with the use of specialized equipment	SW
LO6	performing practical tasks with the use of specialized equipment	SW
LO7		

Basic references	1	R. Pejman, L. Jonathan, "802.11 Wireless LAN Fundamentals", CISCO 1 January 2010
	2	J. Ross, "The Book of Wireless: A Painless Guide to Wi-Fi and Broadband Wireless", 2nd edition,No Starch
	3	Scott J Shackelford, "The Internet of Things: What Everyone Needs to Know(r)", Oxford University Press, USA
	4	
	5	
Supplementary references	1	D. D Guinard, V. M Trifa: Building the Web of Things: With examples in Node.js and Raspberry Pi, Manning 2016, USA
	2	
	3	
	4	
	5	

Author of the programme:	**Data:**	*22.05.2020*

KARTA PRZEDMIOTU

Bialystok University of Technology		**Faculty of Computer Science**	
Field of study	Computer science	**Degree level and programme type**	full-time Master's degree
Specjalization / diploma path	Biometry and Image Processing	**Study profile**	general academic
Field of study	**Advanced Internet Applications**	**Course code**	INF2RIA
		Course type	obligatory

Forms and number of hours	**L**	**C**	**LC**	**P**	**SW**	**FW**	**S**	**Semester**	**2**
	15				15			**No. of ECTS credits**	**2**

Entry requirements	
Course objectives	The aim of the course is to familiarize students with the issues of designing and implementing contemporary web applications. The main emphasis was placed on the understanding and application of issues related to the architecture, frameworks, data exchange method and the role of components in the implementation of specific server tasks of WEB applications.
Course content	Lecture: 1. Architecture of modern WEB application. SOA model - Service Oriented Application 2. Documenting architecture in the 4C approach - Context, Containers, Components, Classes 3. The layered approach. Layer and Tier differences. Data access layer patterns 4. Three-tier division of applications: presentation, services / business logic, persistence 5. Domain Driven Design 6. Command-Query Responsibility Segregation - extended layered architecture. Domain Driven Design support; Sourcing Event; Architecture of microservices and CQRS / ES 7. Modeling of CQRS architecture; Concept of Bounded Context and Aggregates; Design Level Event Storming 8. Evolution of front-end architecture; JavaScript Server Side, frameworks and communication with the server. 9. JavaScript language as an element of modern web applications. 10. Virtual DOM concept; 11. JSX language; Components in React; 12. Embedding React and components into HTML; 13. Working with application data in React; Operating with the state of the application; Specialization worjshop: Implementing Interactive Applications Using React. 1. React.JS library; Components 2. Building Single-Page Applications with React; Application life cycle 3. First React project; Introduction to JSX; 4. Implementation of a simple JSX component 5. React application states and events 6. Rendering a list with data; Simple app styling; 7. Data transfer by 'props' 8. Handling events and working with application states; 9. Forms handling; 10. Implementation of conditional lists and contents in the application;

Calculation:	**Student workload (in hours):**	**No. of hours**	**with direct teacher participation**	**practical**
	Lecture attendance	15	15	
	Project attendance	15	15	15
	Lecture test(s) attendance		0	
	Participation in teacher-student sessions related to the module	5	5	
	Preparation for lecture test(s)			
	Preparation for project classes	15		15
				0
				0
				0
				0
				0
				0
	Total hours:	**50**	**35**	**30**
	Total of ECTS credits:	**2**	**1,4**	**1,2**

Author of the programme: Data:

Teaching methods	L	Informative-problem lecture
	SW	Programming using a computer, project method
	-	
	-	
Assesment methods	L	test
	SW	answers to questions for classes, programming exercises, programming project
	-	
	-	

Symbol of learning outcome	**Learning outcomes**	**Reference to the learning outcomes for the field of study**
	Student	
LO1	knows the methods (and differences) of operation of classic web applications and hybrid Server Side applications	INF2_W05 INF2_W06
LO2	knows the currently available WEB technologies (their advantages and disadvantages) in specific applications	INF2_W03 INF2_W05 INF2_W06

LO3	can create advanced and responsive RWD applications using HTML5 and JavaScript / CSS	INF2_U04 INF2_U08
LO4	can use REST technology and parse XML / JSON communication with the server using JavaScript	INF2_U08

Symbol of learning outcome	**Methods of assessing the learning outcomes**	**Type of tuition during which the outcome is assessed**
LO1	written test, answers to questions for classes	L, SW
LO2	written test, answers to questions for classes	L, SW
LO3	programming exercises, programming project	SW
LO4	programming exercises, programming project	SW
LO5		
LO6		
LO7		

Basic references	1	Argüelles Rojas, Murrugarra Sifuentes, Erikson Haziz Murrugarra Sifuentes, and Murrugarra. Hands-on Full Stack Web Development with Aurelia : Develop Modern and Real-time Web Applications with Aurelia and Node.js.
	2	Tanna, Mayur, and Harmeet Singh. Serverless Web Applications with React and Firebase : Develop Real-time Applications for Web and Mobile Platforms. Packt, 2018. Web.
	3	Chiarelli, Andrea. Beginning React. Packt, Limited, 2018. Web.
	4	Santana Roldan, Carlos. React Cookbook : Create Dynamic Web Apps with React Using Redux, Webpack, Node.js, and GraphQL. Packt, Limited, 2018. Web.
	5	Rodriguez Martinez, Emilio. React : Cross-platform Application Development with React Native : Harness the Power of React Native to Build 4 Real-world Apps. Packt, 2018. Web.
Supplementary references	1	Hoque, Shama. Full-stack React Projects : Modern Web Development Using React 16, Node, Express, and MongoDB. Packt, Limited, 2018. Web.
	2	Wilson, Eddy. MERN Quick Start Guide : Build Web Applications with MongoDB, Express.js, React, and Node. Packt, Limited, 2018. Web.
	3	Sheiko, Dmitry. Cross-platform Desktop Application Development : Electron, Node, NW.js, and React : Build Desktop Applications with Web Technologies. Packt, 2017. Web.
	4	
	5	

Author of the programme:	**Data:**	*22.05.2020*