Faculty Computer Science and Engineering

Undergraduate SECOND CYCLE OF STUDIES

Study program: **COMPUTER TECHNIQUES AND INFORMATICS** (CTI) 1 year

Active from academic 2023/2024 year

One-year (60 EKTS) studies

Degree: Master of Science in Computer Techniques and Informatics.

Acquired skills: embedded systems design, rapid prototyping, high-performance computing, advanced algorithms, cloud computing, supervisory management and data acquisition, genetic algorithms and machine learning, digital forensics, database confidentiality and security, artificial intelligence, cryptography and social network analysis.

CTI 1 year

Year I				
Semester I				
No.	Code	Course Name	No. of classes	ECTS
Core Courses				
1	CSE21M01	Big Data Analytics	2+1	6
2	CSE21M02	Advanced Distributed Systems	2+1	6
3	CSE21M03	Analysis of large social networks	2+1	6
4	CSE21M04	Advanced algorithms	2+1	6
Elective				
5	CSE21Exx	Course from elective list	2+1	6
Year I				
Semester II				
No.	Code	Course Name	No. of classes	ECTS
1	CSE22M05	Data processing in the fog and at the edge	2+1	6
2	CSE22M06	Master's thesis – final project		12
Elective				
3	CSE22Exx	Course from elective list	2+1	6
4	CSE22Exx	Course from elective list	2+1	6
Total credits				60

The second cycle of university studies recognizes the modules:

- C - mandatory (core courses),
- MiE – elected from the list of courses.

List of Elective courses				
id	**code**	**Course**	**Weekly fund of hours**	**ECTS**
1	CSE21E01	Modern simulations and modeling	2+1	6
2	CSE21E02	Artificial intelligence and expert systems	2+1	6
3	CSE21E03	Developmental - research methods in science and engineering	2+1	6
4	CSE21E04	High performance processing	2+1	
5	CSE21E05	Platforms Strategy	2+1	6
6	CSE22E01	Automatic verification	2+1	6
7	CSE22E02	Database management systems	2+1	6
8	CSE22E03	Image processing technologies	2+1	6
9	CSE22E04	Bioinformatics	2+1	6
10	CSE22E05	Advanced cryptography	2+1	6
11	CSE22E06	Supervisory management and data acquisition systems	2+1	6
12	CSE22E07	Advanced Robotics	2+1	6
13	CSE22E08	Communication systems and simulations	2+1	6
14	CTI22E09	Advanced cloud computing	2+1	6
15	CSE22E10	Embedded systems design and rapid prototyping	2+1	6
16	CSE22E11	Knowledge-based decision-making systems	2+1	6
17	CSE22E12	Genetic algorithms and machine learning	2+1	6
18	CSE22E13	Digital forensics	2+1	6
19	CSE22E14	Ethical Hacking	2+1	6
20	CSE22E15	Complexity theory	2+1	6
21	CSE22E16	Processing of textual data	2+1	6
22	CSE22E17	Bayesian data analysis	2+1	6
23	CSE22E18	Performance, reliability and security of databases	2+1	6
24	CSE22E19	Business Process Mining	2+1	6

25	CSE22E20	Advanced topics in artificial intelligence and machine learning	2+1	6
26	CSE22E21	Time Series Analysis and Forecasting	2+1	6
27	CSE22E22	Mathematical Logic for Computer Science	2+1	6
28	CSE22E23	Computational game theory	2+1	6
29	CSE22E24	Advanced Discrete Structures	2+1	6
30	CSE22E25	Financial forecasting	2+1	6
31	CSE22E26	Mathematical modelling	2+1	6
32	CSE22E27	Infrastructure solutions for a smart society	2+1	6

Attachment No. 3	**Course program of the first, second and third cycle of studies**					
1.	Title of the course	Advanced cloud computing				
2.	Code	CSE22E 09				
3.	Studio program / Faculty	Computer Techniques and Informatics / Faculty of Computer Science and Engineering				
4.	Organizer of the study program (unit, i.e. institute, department , division)	Faculty of Computer Science and Engineering, University of Information Sciences and Technologies "St. Paul the Apostle" - Ohrid				
5.	Degree (first , second, third cycle)	Second cycle				
6.	Academic year / semester	1st year / second semester	7.	Number of ECTS credits	6	
8.	Teacher	Dr. Aneta Velkoska				
9.	Prerequisites for enrolling in the course					
10.	Objectives of the subject program (competencies): This course provides students with solid knowledge of cloud technologies and data processing . After completing this course , students will can : After completing this course , students will can : to analyze cloud computing components and business perspective , to rated the different ones cloud development tools , to work with cloud services in real time time , to analyze studies of specific case in order to perform best models and best practices for developing and implementing cloud - based applications .					
11.	Subject content program : Definition of cloud computing, types of cloud, cloud services. Advantages and challenges of cloud computing, the evolution of cloud computing, use cases and applications, business models around cloud - major players in cloud computing. Database as a service, monitoring as a service, communication as a service. Application service providers - Google , Amazon EC2, Microsoft Azure , Sales force . Working with MapReduce , GFS, HDFS, Hadoop frameworks . Cloud data storage infrastructure Technologies for virtualization .					
12.	Teaching methods : This course is based on 30 hours of lectures, supplemented by teamwork, consultations with the subject professor and project development .					
13.	I bought an available fund on time	6 ECTS credits x 30 hours/credit = 180 hours				
14.	Distribution of available resources time	Lectures: 30 hours; Exercises: 15 hours; Independent preparation, projects, homework: 135 hours = Total time of 180 hours				
15.	Forms of teaching activities	15.1.	Lectures - theoretical teaching	30 hours		
		15.2.	Exercises (laboratory, classroom), teamwork	15 hours		
16.	Others forms of activities	16.1.	Project development	50 hours		
		16.2.	Case study	35 hours		
		16.3.	Homemade learning	50 hours		
17.	Method of assessment 6 0 + 3 0 + 10					
	17.1.	Tests	60 points			

	17.2.	Individual work/project (presentation: written and oral)		30 points
	17.3.	Activity and participation		10 points
18.	Assessment criteria (points / grade)		up to 50 points	5 (five) (F)
			from 51 to 60 points	6 (six) (E)
			from 61 to 70 points	7 (seven) (D)
			from 71 to 80 points	8 (eight) (C)
			from 81 to 90 points	9 (nine) (B)
			from 91 to 100 points	10 (ten) (A)
19.	Requirement for signature and passing the final exam		Students should ensure regular attendance at classes in accordance with the UINT regulations.	
20.	Language in which it is performed the teaching		English, Macedonian	
21.	Method of monitoring the quality of teaching		Compliance with UIST quality control procedures	

Literature

Required literature

	Serial number	Author	Title	Publisher	Year
22.1	1.	Bloor R., Kanfman M., Halper F. Judith Hurwitz	Cloud Computing for Dummies	John Wiley & Sons, Inc.	20 12
	2.	John Rittinghouse & James Ransome	Cloud Computing Implementation Management and Strategy	CRC Press,	2010
	3.				

Additional literature

	Serial number	Author	Title	Publisher	Year
22.2	1.				
	2.				
	3.				

Attachment No. 3	**Course program of the first, second and third cycle of studies**

1.	Title of the course	Advanced cryptography			
2.	Code	CSE22E 05			
3.	Study program / Faculty	Computer Techniques and Informatics / Faculty of Computer Science and Engineering			
4.	Organizer of the study program (unit, i.e. institute , department, division)	Faculty of Computer Science and Engineering, University of Information Sciences and Technologies "St. Paul the Apostle" - Ohrid			
5.	Degree (first, second, third cycle)	Second cycle			
6.	Academic year / semester	1st year/second semester	7.	Number of ECTS credits	6
8.	Teacher	Full Professor Dr. Ustiana Rechkoska Shikoska			
9.	Prerequisites for enrolling in the course				
10.	Objectives of the subject program (competencies): This course is intended to enable students to study the mathematical forms of cryptographic algorithms , to understand the mathematical background of cryptography , to understand the taxonomy of cryptographic primitives , to understand symmetric and public key encryption systems , and to apply cryptographic algorithms .				
11.	Contents on the subject program : • Smart cards, hardware security, security engineering • Mobile phone security, RFID systems, access control, user/data authentication • Key size, random number and key generator, symmetric cryptography engineering, key derivation, key management • Bank cards and terminals, history, EMV specifications, different forms of security, fraud, attacks • Public key cryptography engineering, best practices, standardized algorithms and back-up methods, PGP vs. smart cards, PKI vs. alternatives • Digital signature application, legal/regulatory aspects, qualified certificates, timestamping • More applications of public key cryptography , electronic passport and ID card versus SDA/DDA/CDA in bank cards • Electronic commerce, SSL/TLS, transmission security, standard digital signature encoding methods and certificates (X.509) • Financial cryptography, payment system, crypto currencies, Bitcoin • Side-channel attack (timing , SPA, DPA and DFA), side-channel attack countermeasures.				
12.	Teaching methods: This course is based on 30 hours of lectures, supplemented by teamwork, consultations with the subject professor, and project development .				
13.	Total available fund on time	6 ECTS credits x 30 hours/credit = 180 hours			

14.	Allocation of available time	Lectures: 30 hours; Exercises: 1 5 hours; Independent preparation, projects, homework: 1 35 hours = Total time of 180 hours		
15.	Forms on the teaching activities	15.1.	Lectures - theoretical teaching	30 hours
		15.2.	Exercises (laboratory, classroom), teamwork	15 hours
16.	Others forms on activities	16.1.	Project tasks	50 hours
		16.2.	Independent tasks	35 hours
		16.3.	Homemade learning - tasks	50 hours

17.	Way on grading 60 + 30 + 10		
	17.1.	Tests	60 points
	17.2.	Individual work/project (presentation: written and oral)	30 points
	17.3.	Activity and participation	10 points

18.	Assessment criteria (points/grade)	up to 50 points	5 (five) (F)
		51 x to 60 points	6 (six) (E)
		61 x to 70 points	7 (seven) (D)
		from 71 to 80 points	8 (eight) (C)
		from 81 to 90 points	9 (nine) (B)
		from 91 to 100 points	10 (ten) (A)
19.	Requirement for signature and passing the final exam	Students should ensure regular attendance at classes in accordance with the UINT regulations.	
20.	Language of instruction	English , Macedonian	
21.	Method of monitoring the quality of teaching	Compliance with UIST quality control procedures	

22.	Literature					
	22.1.	Mandatory literature				
		Serial number	Author	Title	Publisher	Year

		1.	A.Menezes , P.Van Oorschot and S. Vanstone	Handbook of Applied Cryptography	CRC Press, Fifth Printing,	2009
		2.	W. Stallings	Cryptography & Network Security	Pearson Education, 4th Edition	2002
		3.				
	22.2.	Additional literature				
		Serial number	Author	Title	Publisher	Year
		1.	Charlie Kaufman, Radia Perlman, Mike Speciner	Network Security, Private communication in public world	PHI 2nd edition	2002
		2.	Bruce Schneier, Neils Ferguson	Practical Cryptography	Wiley	2003
		3.				

1.	Title of the course	Advanced discrete structures			
2.	Code	CSE22E 2 4			
3.	Study program	Computer Techniques and Informatics / Faculty of Computer Science and Engineering			
4.	Organizer of the study program (unit, i.e. institute, department, division)	Faculty of Computer Science and Engineering, University of Information Sciences and Technologies "St. Paul the Apostle" - Ohrid			
5.	Degree (first, second, third cycle)	Second cycle			
6.	Academic year / semester	1st year / second semester	7.	Number of ECTS credits	6 (six)
8.	Teacher	Dr. Aneta Velkoska			
9.	Prerequisites for enrolling in the course				
10.	Objectives of the subject program (competencies): After successfully completing this course, students will be able to apply basic and advanced mathematical concepts necessary for higher courses in information technology, computer and software engineering.				
11.	Course content: Definition of (undirected) graphs, paths, circuits, cycles and subgroups. Induced subgraphs. Vertex degree. Connectivity. Planar graphs and their properties. Trees, Duler's Formula for connectivity. Planar graphs, complete and complete bipartite graphs. Kurtowski's theorem and its applications. Fundamental cuts theorems. Spanning trees. Minimal trees and Krushka's algorithm. Matrix representations of graphs. Euler's theorem on the existence of Euler paths and cycles. Directed graphs. In and out degree of a vertex. Weighted graphs. Dijkstra 's algorithm . Directed trees. Tree search. Tree traversal. Finite automata, deterministic automata, Formal grammar and languages.				
12.	Teaching methods: This course is based on 45 hours of lectures and 30 hours of exercises , supplemented by the study of a specific case, consultations with the subject professor and the preparation of a project.				
13.	Total available fund on time	6 ECTS credits x 30 hours/credit = 180 hours			
14.	Allocation of available time	Lectures: 30 hours; Exercises: 15 hours; Independent preparation, projects, homework: 135 hours = Total time of 180 hours			
15.	Forms of teaching activities	15.1.	Lectures - theoretical teaching .	30 hours	
		15.2.	Exercises (laboratory, classroom), teamwork	15 hours	
16.	Other forms of activities	16.1.	Project tasks	50 hours	
		16.2.	Independent tasks	35 hours	
		16.3.	Homework - assignments	5 0 hours	
17.	Grading method 60 + 30 + 10				
	17.1.	Tests		60 points	
	17.2.	Individual work/ project (presentation: written and oral)		30 points	
	17.3.	Activity and participation		10 points	
18.	Assessment criteria (points/grade)	up to 50 points		5 (five) (F)	
		51 x to 60 points		6 (six) (E)	

				61 x to 70 points	7 (seven) (D)	
				from 71 to 80 points	8 (eight) (C)	
				from 81 to 90 points	9 (nine) (B)	
				from 91 to 100 points	10 (ten) (A)	
19.	Requirement for signature and passing the final exam			Students should ensure regular attendance at classes in accordance with the UINT regulations.		
20.	Language of instruction			English, Macedonian		
21.	Method of monitoring the quality of teaching			Compliance with UIST quality control procedures		
22.	Literature					
	22.1.	Required literature				
		Serial number	Author	Title	Publisher	Year
		1.	US Rajput	Advanced discrete mathematics	PHI Learning Pvt. Ltd.	2012
		2.				
		3.				
	22.2.	Additional literature				
		Serial number	Author	Title	Publisher	Year
		1.				
		2.				

Attachment No. 3	**Course program of the first, second and third cycle of studies**				
1.	Title of the course	Advanced robotics			
2.	Code	CSE22E 07			
3.	Studio program / Faculty	Computer Techniques and Informatics / Faculty of Computer Science and Engineering			
4.	Organizer of the study program (unit, i.e. institute, department, division)	Faculty of Computer Science and Engineering, University of Information Sciences and Technologies "St. Paul the Apostle" - Ohrid			
5.	Degree (first , second, third cycle)	Second cycle			
6.	Academic year / semester	1st year / second semester	7.	Number of ECTS credits	6
8.	Teacher	Honorary Professor Anis Sefidanoski			
9.	Prerequisites for enrolling in the course				
10.	Objectives of the subject program (competencies): The objectives of this course program are to expand students' knowledge and skills in the design and development of autonomous machines and research on topics related to robotics.				
11.	Subject content program : 1. Introduction: history and overview of robotics. 2. Basic concepts of kinematics; dynamics; planning and search. 3. Robots without actuators: problem definition and modeling; approach for controlling robots without actuators; practical examples. 4. Robot learning and adaptation: modeling-based approaches; modeling-free approaches; optimization methods. 5. Soft Robots: Modeling Parts for Soft Robots; soft actuators and sensors; control and learning of soft robots. 6. Human-robot interaction: robotics interfaces; theoretical frameworks; spatial, verbal and nonverbal communication; robotics research methodology; applied robotics, robots in society. 7. Distributed robotics: multi-agent models; planning and control of multi-robot systems; methods for learning coordination in multi-robot systems. 8. Hands-on work and robotics projects.				
12.	Teaching methods : This course is based on 30 hours of lectures, supplemented by teamwork, consultations with the subject professor, and project development .				

13.	Total available fund on time		6 ECTS credits x 30 hours/credit = 180 hours	
14.	Distribution of available resources time		Lectures: 30 hours; Exercises: 15 hours; Independent preparation, projects, homework: 135 hours = Total time of 180 hours	
15.	Forms of teaching activities	15.1.	Lectures - theoretical teaching	30 hours
		15.2.	Exercises (laboratory, classroom), teamwork	15 hours
16.	Others forms of activities	16.1.	Project development	50 hours
		16.2.	Case study	35 hours
		16.3.	Homemade learning	50 hours

17.	Method of assessment 6 0 + 3 0 + 10		
	17.1.	Tests	6 0 points
	17.2.	Individual work/project (presentation: written and oral)	3 0 points
	17.3.	Activity and participation	10 points

18.	Assessment criteria (points /grade)	up to 50 points	5 (five) (F)
		from 51 to 60 points	6 (six) (E)
		from 61 to 70 points	7 (seven) (D)
		from 71 to 80 points	8 (eight) (C)
		from 81 to 90 points	9 (nine) (B)
		from 91 to 100 points	10 (ten) (A)
19.	Requirement for signature and passing the final exam	Students should ensure regular attendance at classes in accordance with the UINT regulations.	
20.	Language in which it is performed the teaching	English , Macedonian	
21.	Method of monitoring the quality of teaching	Compliance with UIST quality control procedures	
	Literature		

	22.1	Mandatory literature				
		Serial number	Author	Title	Publisher	Year
		1.	Bruno Siciliano , Oussama Khatib . 2nd Edition. Cham	Springer Handbook of Robotics	Springer International Publishing	2016
		2.				
		3.				
	22.2	Additional literature				
		Serial number	Author	Title	Publisher	Year
		1.				
		2.				
		3.				

Attachment No. 3	**Course program of the first, second and third cycle of studies**					
1.	Title of the course	Advanced topics in artificial intelligence and machine learning				
2.	Code	CSE22E2 0				
3.	Study program / Faculty	Computer Techniques and Informatics / Faculty of Computer Science and Engineering				
4.	Organizer of the study program (unit, i.e. institute, department, division)	Faculty of Computer Science and Engineering, University of Information Sciences and Technologies "St. Paul the Apostle" - Ohrid				
5.	Degree (first, second, third cycle)	Second cycle				
6.	Academic year / semester	1st year / second semester	7.	Number of ECTS credits	6	
8.	Teacher	Dr. Ljubinka Sandžakoska				
9.	Prerequisites for enrolling in the course					
10.	Objectives of the subject program (competencies): This course enables students to establish knowledge of the basic concepts of artificial intelligence and machine learning, as well as to be familiar with the current state-of-the-art and application trends. Additionally, they will gain knowledge of the philosophical and ethical aspects and will confront the open questions about artificial intelligence that are current in the world. The aim of this course is to equip students with the application of artificial intelligence in various areas such as: e-marketplace design, natural sciences, health, and game development.					
11.	Course content: 1. Overview of the basic concepts of artificial intelligence and machine learning. A review of current applications and trends. 2. Multi agent systems for real world applications. 3. Artificial intelligence in designing an electronic market. (Artificial Intelligence in Electronic Market Design) 4. Artificial intelligence in life sciences. (AI in life science) 5. Artificial intelligence techniques applied to health. (AI for Health Applications) 6. Artificial Intelligence Techniques for Games. (AI Techniques for Games) 7. Philosophical and ethical aspects of artificial intelligence. (AI & Philosophy)					
12.	Teaching methods : This course is based on 30 hours of lectures, supplemented by teamwork, consultations with the subject professor and project development.					
13.	I bought an available fund on time	6 ECTS credits x 30 hours/credit = 180 hours				
14.	Allocation of available time	Lectures: 30 hours; Exercises: 15 hours; Independent preparation, projects, homework: 135 hours = Total time of 180 hours				
15.	Forms of teaching activities	15.1.	Lectures - theoretical teaching	30 hours		
		15.2.	Exercises (laboratory, classroom), teamwork	15 hours		
16.	Other forms of activities	16.1.	Project development	50 hours		
		16.2.	Case study	35 hours		
		16.3.	Home learning	50 hours		
17.	Grading method 6 0 + 30 + 10					
	17.1.	Tests	60 points			

	17.2.	Individual work/ project (presentation: written and oral)		30 points
	17.3.	Activity and participation		10 points
18.	Assessment criteria (points /grade)		up to 50 points	5 (five) (F)
			from 51 to 60 points	6 (six) (E)
			from 61 to 70 points	7 (seven) (D)
			from 71 to 80 points	8 (eight) (C)
			from 81 to 90 points	9 (nine) (B)
			from 91 to 100 points	10 (ten) (A)
19.	Requirement for signature and passing the final exam	Students should ensure regular attendance at classes in accordance with the UINT regulations.		
20.	Language of instruction	English, Macedonian		
21.	Method of monitoring the quality of teaching	Compliance with UIST quality control procedures		

Literature

	22.1	Required literature				
		Serial number	Author	Title	Publisher	Year
		1.	Denis Rothmanl	Artificial Intelligence By Example	Packt Publishing	2020
		2.	Max Tegmark	Life 3.0: Being Human in the Age of Artificial Intelligence	Random House Audio	2017
		3.				
	22.2	Additional literature				
		Serial number	Author	Title	Publisher	Year
		1.	Dr. Parag Suresh Mahajan	Artificial Intelligence in Healthcare	Parag Suresh Mahajan; 2nd edition	2019
		2.	Mariya Yao, Adelyn Zhou and Marlene Jia	Applied Artificial Intelligence: A handbook for business leaders	TOPBOTS	2018
		3.				

Attachment No. 3		**Second cycle study program**			
1.	Title of the course	Automatic verification			
2.	Code	CSE22E01			
3.	Study program	Computer Techniques and Informatics / Faculty of Computer Science and Engineering			
4.	Organizer of the study program (unit, i.e. institute, department, division)	Faculty of Computer Science and Engineering, University of Information Sciences and Technologies "St. Paul the Apostle" - Ohrid			
5.	Degree (first, second, third cycle)	Second cycle			
6.	Academic year / semester	1st year / second semester	7	Number of ECTS credits	6
8.	Teacher	Dr. Rasim Salkoski			
9.	Prerequisites for enrolling in the course				
10.	Objectives of the course program (competences): The aim of this course program is to introduce techniques and tools for verifying the possession of the properties of computer systems according to their purpose				
11.	Course Content: In this study program, the following content should be followed: 1. To use the SMV and FDR2 tools for verification and debugging of small-scale (scalable) systems. 2. To understand and grasp the principles and algorithms behind these tools. 3. To explain the application of the tools in the following examples: communication protocols, motion systems, process networks, cache coherence and telecommunication systems. 4. To evaluate the limitations of existing techniques and tools, such as the explosion condition problem, as well as existing efforts to overcome them				
12.	Teaching methods: This course is based on 30 hours of lectures, supplemented by the study of a specific case, consultations with the subject professor and the preparation of a project.				
13.	Total available fund on time	6 ECTS credits x 30 hours/credit = 180 hours			
14.	Allocation of available time	Lectures: 30 hours; Exercises: 15 hours; Independent preparation, projects, homework: 135 hours = Total time of 180 hours			
15.	Forms of teaching activities	15.1.	Lectures - theoretical teaching	30 hours	
		15.2.	Exercises (laboratory, classroom), teamwork	15 hours	
16.	Other forms of activities	16.1.	Project development	50 hours	
		16.2.	Case study	35 hours	
		16.3.	Home learning	50 hours	
17.	Assessment method: 60 + 30 + 10				

	17.1.	Tests	60 points
	17.2.	Individual work/project (presentation: written and oral)	30 points
	17.3.	Activity and participation	10 points
	17.4.		

18.	Assessment criteria (points/grade)	up to 50 points	5 (five) (F)
		51 x to 60 points	6 (six) (E)
		61 x to 70 points	7 (seven) (D)
		from 71 to 80 points	8 (eight) (C)
		from 81 to 90 points	9 (nine) (B)
		from 91 to 100 points	10 (ten) (A)
19.	Requirement for signature and passing the final exam	Students should ensure regular attendance at classes in accordance with the UINT regulations.	
20.	Language of instruction	English, Macedonian	
21.	Method of monitoring the quality of teaching	Compliance with UIST quality control procedures	

22. Literature

22.1. Required literature

Serial number	Author	Title	Publisher	Year
1.	M. Huth and M. Ryan	Logic in Computer Science: Modelling and Reasoning about Systems	Cambridge University Press	2000
2.				
3.				

22.2. Additional literature

Serial number	Author	Title	Publisher	Year
1.	K. McMillan	Symbolic model checking	Kluwer	1993

Attachment No. 3		**Second cycle study program**			
1.	Title of the course	Bayesian data analysis			
2.	Code	CSE22E 17			
3.	Study program	Computer Techniques and Informatics / Faculty of Computer Science and Engineering			
4.	Organizer of the study program (unit, i.e. institute, department, division)	Faculty of Computer Science and Engineering, University of Information Sciences and Technologies "St. Paul the Apostle" - Ohrid			
5.	Degree (first, second, third cycle)	Second cycle			
6.	Academic year / semester	1st year / second semester	7.	Number of ECTS credits	6 (six)
8.	Teacher	Dr. Aneta Velkoska			
9.	Prerequisites for enrolling in the course				
10.	Objectives of the subject program (competencies): Upon successful completion of this course, students will be able to incorporate background knowledge into their analyses when conducting research using Bayesian analysis rather than testing essentially the same null hypothesis over and over again, ignoring the conclusions of previous studies.				
11.	Course content: Introduction to R/Python. Descriptive statistics, visualization, parametric and nonparametric tests, linear regression, ANOVA. Working with databases, SQL. MapReduce. Bayesian rule. Models for discrete and continuous data types. Forecasting future events. Bayesian regression. Decision theory. Monte Carlo approximations. Posterior approximations with Gibbs sampler. MCMC (Monte Carlo Markov chain). Multidimensional normal model. Group comparison and hierarchical modeling.				
12.	Teaching methods: This course is based on 45 hours of lectures and 30 hours of exercises , supplemented by the study of a specific case, consultations with the subject professor and the preparation of a project.				
13.	Total available fund on time	6 ECTS credits x 30 hours/credit = 180 hours			
14.	Allocation of available time	Lectures: 30 hours; Exercises: 15 hours; Independent preparation, projects, homework: 135 hours = Total time of 180 hours			
15.	Forms of teaching activities	15.1.	Lectures - theoretical teaching .	30 hours	
		15.2.	Exercises (laboratory, classroom), teamwork	15 hours	
16.	Other forms of activities	16.1.	Project tasks	50 hours	
		16.2.	Independent tasks	35 hours	
		16.3.	Homework - assignments	5 0 hours	
17.	Grading method 60 + 30 + 10				
	17.1.	Tests		60 points	
	17.2.	Individual work/ project (presentation: written and oral)		30 points	
	17.3.	Activity and participation		10 points	
18.	Assessment criteria (points/grade)	up to 50 points		5 (five) (F)	
		51 x to 60 points		6 (six) (E)	

				61 x to 70 points	7 (seven) (D)	
				from 71 to 80 points	8 (eight) (C)	
				from 81 to 90 points	9 (nine) (B)	
				from 91 to 100 points	10 (ten) (A)	
19.	Requirement for signature and passing the final exam			Students should ensure regular attendance at classes in accordance with the UINT regulations.		
20.	Language of instruction			English, Macedonian		
21.	Method of monitoring the quality of teaching			Compliance with UIST quality control procedures		
22.	Literature					
	22.1.	Required literature				
		Serial number	Author	Title	Publisher	Year
		1.	Peter D. Hoff	A First Course in Bayesian Statistics Methods	Springer	20 09
		2.	Joel Grus	Data Science from Scratch (first principles with Python)	O'Reilly	2015
		3.				
	22.2.	Additional literature				
		Serial number	Author	Title	Publisher	Year
		1.				
		2.				

Attachment No. 3	**Second cycle of studies course program**					
1.	Title of the course	Bioinformatics				
2.	Code	CSE22E 04				
3.	Studio program / Faculty	Computer Techniques and Informatics / Faculty of Computer Science and Engineering				
4.	Organizer of the study program (unit, i.e. institute, department , division)	Faculty of Computer Science and Engineering, University of Information Sciences and Technologies "St. Paul the Apostle" - Ohrid				
5.	Degree (first , second, third cycle)	Second cycle				
6.	Academic year / semester	1st year/ second semester	7.	Number of ECTS credits	6	
8.	Teacher	Dr. Atanas Hristov				
9.	Prerequisites for enrolling in the course					
10.	Objectives of the subject program (competencies): This course provides a comprehensive understanding of the field of bioinformatics and its applications. Upon completion of this course, students should have a basic understanding of bioinformatics, be familiar with bioinformatics databases, understand structural biology and molecular modeling and simulations, and be able to create various applications using bio-software.					
11.	Subject content program : 1. Introduction : (bioinformatics , biology , proteins and AC, sequences) 2. Bioinformatics databases ; 3. Sequence alignment , database search . 4. Structural Biology (proteins , DNA and RNA, CH) 5. Molecular modeling and simulations . 6. Bio -software and its applications .					
12.	Teaching methods : This course is based on 30 hours of lectures, supplemented by teamwork, consultations with the subject professor and project development .					
13.	I bought an available fund on time	6 ECTS credits x 30 hours/credit = 180 hours				
14.	Distribution of available resources time	Lectures: 30 hours; Exercises: 1 5 hours; Independent preparation, projects, homework: 1 35 hours = Total time of 180 hours				
15.	Forms of teaching activities	15.1.	Lectures - theoretical teaching	30 hours		
		15.2.	Exercises (laboratory , classroom) , teamwork	15 hours		
16.	Others forms of activities	16.1.	Project tasks	50 hours		
		16.2.	Independent tasks	35 hours		
		16.3.	Homework - assignments	50 hours		
17.	Method of assessment 6 0 + 30 + 10					
	17.1.	Tests	6 0 points			
	17.2.	Individual work/project (presentation: written and oral)	3 0 points			
	17.3.	Activity and participation	10 points			
18.	Assessment criteria (points / grade)	up to 50 points	5 (five) (F)			
		from 51 to 60 points	6 (six) (E)			

			from 61 to 70 points		7 (seven) (D)
			from 71 to 80 points		8 (eight) (C)
			from 81 to 90 points		9 (nine) (B)
			from 91 to 100 points		10 (ten) (A)
19.	Requirement for signature and passing the final exam		Students should ensure regular attendance at classes in accordance with the UINT regulations.		
20.	Language in which it is performed the teaching		English , Macedonian		
21.	Method of monitoring the quality of teaching		Compliance with UIST quality control procedures		
	Literature				
	22.1	Required literature			
		Serial number	Author	Title	Publisher	Year
		1.	Neil C. Jones and Pavel A. Pevzner	An Introduction to Bioinformatics Algorithms	The MIT Press	2004
		2.				
		3.				
	22.2	Additional literature			
		Serial number	Author	Title	Publisher	Year
		1.				
		2.				
		3.				

Attachment No. 3	**Second cycle study program**				
1.	Title of the course	Business process mining			
2.	Code	CSE22E 19			
3.	Study program / Faculty	Computer Techniques and Informatics / Faculty of Computer Science and Engineering			
4.	Organizer of the study program (unit, i.e. institute, department, division)	Faculty of Computer Science and Engineering, University of Information Sciences and Technologies "St. Paul the Apostle" - Ohrid			
5.	Degree (first, second, third cycle)	Second cycle			
6.	Academic year / semester	1st year / second semester	7.	Number of ECTS credits	6
8.	Teacher	Dr. Anis Sefidanoski			
9.	Prerequisites for enrolling in the course				
10.	Objectives of the subject program (competencies): The objectives of this course are to master methodologies and techniques for business process management. The BPM life cycle will be studied: (Re)design, modeling, execution, monitoring and optimization of business processes. In addition, methodological aspects of BPM such as modeling languages, pattern discovery, qualitative and quantitative analysis of process models will be explored. In the second part of the course, the focus shifts to the Data Science methodology for BPM, namely process mining. Students will learn the three basic steps of process mining: pattern discovery from data, analysis of the compliance of the resulting models with data, and performance analytics.				
11.	Course content: 1. Understanding basic and advanced process modeling and notation methodologies. 2. Informal modeling methods such as BPMN and Petri nets. 3. Using the basics of accuracy and performance analysis using Petri nets through analysis and simulation. 4. Applications of data-driven process modeling. 5. Process mining, including automatic process discovery, quality dimensions in process discovery, data-driven compliance checking, performance analysis, and process improvement. 6. Development of the concepts of process redesign and process improvement. 7. Applicability and implementation of business applications using the methodologies covered in the course, allowing students to connect what they have learned conceptually with its industrial applications.				
12.	Teaching methods: This course is based on 30 hours of lectures, supplemented by teamwork, consultations with the subject professor and project development.				

13.	Total available fund on time		6 ECTS credits x 30 hours/credit = 180 hours	
14.	Allocation of available time		Lectures: 30 hours; Exercises: 15 hours; Independent preparation, projects, homework: 135 hours = Total time of 180 hours	
15.	Forms of teaching activities	15.1.	Lectures - theoretical teaching	30 hours
		15.2.	Exercises (laboratory, classroom), teamwork	15 hours
16.	Other forms of activities	16.1.	Project development	50 hours
		16.2.	Case study	35 hours
		16.3.	Home learning	50 hours

17.	Assessment method 6 0 + 30 + 10		
	17.1.	Tests	6 0 points
	17.2.	Individual work/project (presentation: written and oral)	3 0 points
	17.3.	Activity and participation	10 points

18.	Assessment criteria (points/grade)	up to 50 points	5 (five) (F)
		from 51 to 60 points	6 (six) (E)
		from 61 to 70 points	7 (seven) (D)
		from 71 to 80 points	8 (eight) (C)
		from 81 to 90 points	9 (nine) (B)
		from 91 to 100 points	10 (ten) (A)

19.	Requirement for signature and passing the final exam	Students should ensure regular attendance at classes in accordance with the UINT regulations.
20.	Language of instruction	English, Macedonian
21.	Method of monitoring the quality of teaching	Compliance with UIST quality control procedures
	Literature	
	22.1	Required literature

		Serial number	Author	Title	Publisher	Year
		1.	Jan vom Brocke, Jan Mendling	Business Process Management Cases: Digital Innovation and Business Transformation in Practice	Springer	2018
		2.				
		3.				
	22.2	Additional literature				
		Serial number	Author	Title	Publisher	Year
		1.				
		2.				
		3.				

<table>
<tr><td colspan="2">Attachment No. 3</td><td colspan="5">Second cycle of studies course program</td></tr>
<tr><td>1.</td><td colspan="2">Title of the course</td><td colspan="4">Communication systems and simulations</td></tr>
<tr><td>2.</td><td colspan="2">Code</td><td colspan="4">CSE22E 08</td></tr>
<tr><td>3.</td><td colspan="2">Studio program / Faculty</td><td colspan="4">Computer Techniques and Informatics / Faculty of Computer Science and Engineering</td></tr>
<tr><td>4.</td><td colspan="2">Organizer of the study program (unit, i.e. institute, department , division)</td><td colspan="4">Faculty of Computer Science and Engineering, University of Information Sciences and Technologies "St. Paul the Apostle" - Ohrid</td></tr>
<tr><td>5.</td><td colspan="2">Degree (first , second, third cycle)</td><td colspan="4">Second cycle</td></tr>
<tr><td>6.</td><td colspan="2">Academic year / semester</td><td>1st year/ second semester</td><td>7.</td><td>Number of ECTS credits</td><td>6</td></tr>
<tr><td>8.</td><td colspan="2">Teacher</td><td colspan="4">Dr. Atanas Hristov</td></tr>
<tr><td>9.</td><td colspan="2">Prerequisites for enrolling in the course</td><td colspan="4"></td></tr>
<tr><td>10.</td><td colspan="6">Objectives of the subject program (competencies):
This course aims to:
1. To provide comprehensive coverage of simulation concepts, including the generation of random numbers and random variables, channel, noise, fading, and receiver modeling, and performance evaluation through the determination of error probability and bit error rate.
2. To generate and test properties of random variables and random processes
3. To understand channel, filter and noise models in a communication system
4. To analyze the receiver based on the estimation of various parameters such as SNR , BER , etc.
5. To analyze cellular radio systems as case studies through simulation</td></tr>
<tr><td>11.</td><td colspan="6">Subject content program :
1. Introduction to simulation – Concept of simulation and modeling , role of simulation , types of simulation , limitations of simulation , mapping the problem into a simulation model model , real -time simulations time , effective simulation techniques
2. Random simulation variable and random processes – generating random numbers and sequences , Gaussian and uniform random numbers , correlated random sequence , testing random number generators numbers , random pattern processes , Markov and ARMA sequence
3. Communication modeling systems – Modeling of individual communication blocks , channel models, filter models , noise and fading models, receiver models
4. Estimation of performance measures – Estimator quality , SNR estimation , analog probability density function communication system, BER of digital communication system, Monte Carlo simulation and sampling method , estimation of the power spectral density of a process
5. Simulation of cellular radio systems – Description of system modeling cellular level communication system, simulation methodology , processing of simulation results results .</td></tr>
<tr><td>12.</td><td colspan="6">Teaching methods : This course is based on 30 hours of lectures, supplemented by teamwork, consultations with the subject professor and project development .</td></tr>
<tr><td>13.</td><td colspan="3">I bought an available fund on time</td><td colspan="3">6 ECTS credits x 30 hours/credit = 180 hours</td></tr>
</table>

14.	Distribution of available resources time		Lectures: 30 hours; Exercises: 1 5 hours; Independent preparation, projects, homework: 1 35 hours = Total time of 180 hours	
15.	Forms of teaching activities	15.1.	Lectures - theoretical teaching	30 hours
		15.2.	Exercises (laboratory , classroom) , teamwork	15 hours
16.	Others forms of activities	16.1.	Project tasks	50 hours
		16.2.	Independent tasks	35 hours
		16.3.	Homework - assignments	50 hours

17.	Method of assessment 6 0 + 30 + 10		
	17.1.	Tests	6 0 points
	17.2.	Individual work/project (presentation: written and oral)	3 0 points
	17.3.	Activity and participation	10 points

18.	Assessment criteria (points / grade)	up to 50 points	5 (five) (F)
		from 51 to 60 points	6 (six) (E)
		from 61 to 70 points	7 (seven) (D)
		from 71 to 80 points	8 (eight) (C)
		from 81 to 90 points	9 (nine) (B)
		from 91 to 100 points	10 (ten) (A)
19.	Requirement for signature and passing the final exam	Students should ensure regular attendance at classes in accordance with the UINT regulations.	
20.	Language in which it is performed the teaching	English , Macedonian	
21.	Method of monitoring the quality of teaching	Compliance with UIST quality control procedures	

Literature

Required literature

	Serial number	Author	Title	Publisher	Year
22.1	1.	Jeruchim MC, Philip Balboa and Sam Shanmugam K,	Simulation of Communication System , modeling methodology and techniques	Plenum Press , New York ,	2009
	2.				
	3.				

Additional literature

	Serial number	Author	Title	Publisher	Year
22.2	1.	Law M, and David Kelton W,	Simulation Modeling and Analysis	McGraw Hill Inc. , New York ,	2010
	2.	William H. Tranter , K. Sam Shanmugam ,	Principles of Communication System	Pearson Education	2010

			Theodore S. Rappaport , Kurt L. Kosbar ,	Simulation with Wireless Application	Private Limited ,	
		3.				

Attachment No. 3		**Second cycle study program**			
1.	Title of the course	Complexity theory			
2.	Code	CSE22E15			
3.	Study program	Computer Techniques and Informatics / Faculty of Computer Science and Engineering			
4.	Organizer of the study program (unit, i.e. institute, department, division)	Faculty of Computer Science and Engineering, University of Information Sciences and Technologies "St. Paul the Apostle" - Ohrid			
5.	Degree (first, second, third cycle)	Second cycle			
6.	Academic year / semester	1st year / second semester	7	Number of ECTS credits	6
8.	Teacher	Dr. Rasim Salkoski			
9.	Prerequisites for enrolling in the course				
10.	Objectives of the course program (competences): The aim of the course is to introduce the basic ideas in complexity theory				
11.	Content of the course program: A computational problem is a task that can be solved using a computer. Complexity theory classifies computational problems according to their "inherent" difficulty. Unlike the analysis of algorithms, which considers a single algorithm for solving a computational problem, complexity theory tries to encompass all possible algorithms. This course teaches the fundamental ideas in complexity theory. Studying various types of decision problems and search problems. Using reduction and completeness to connect two pseudo-different computational problems				
12.	Teaching methods: This course is based on 30 hours of lectures, supplemented by the study of a specific case, consultations with the subject professor and the preparation of a project.				
13.	Total available fund on time	6 ECTS credits x 30 hours/credit = 180 hours			
14.	Allocation of available time	Lectures: 30 hours; Exercises: 15 hours; Independent preparation, projects, homework: 135 hours = Total time of 180 hours			
15.	Forms of teaching activities	15.1.	Lectures - theoretical teaching	30 hours	
		15.2.	Exercises (laboratory, classroom), teamwork	15 hours	
16.	Other forms of activities	16.1.	Project development	50 hours	
		16.2.	Case study	35 hours	
		16.3.	Home learning	50 hours	
17.	Assessment method: 60 + 30 + 10				
	17.1.	Tests	60 points		

	17.2.	Individual work/project (presentation: written and oral)		30 points
	17.3.	Activity and participation		10 points
	17.4.			
18.	Assessment criteria (points/grade)		up to 50 points	5 (five) (F)
			51 x to 60 points	6 (six) (E)
			61 x to 70 points	7 (seven) (D)
			from 71 to 80 points	8 (eight) (C)
			from 81 to 90 points	9 (nine) (B)
			from 91 to 100 points	10 (ten) (A)
19.	Requirement for signature and passing the final exam	Students should ensure regular attendance at classes in accordance with the UINT regulations.		
20.	Language of instruction	English, Macedonian		
21.	Method of monitoring the quality of teaching	Compliance with UIST quality control procedures		

2.	Literature					
	22.1.	Required literature				
		Serial number	Author	Title	Publisher	Year
		1.	S. Arora, B. Barak	Computational Complexity: A modern Approach,	Cambridge University Press	2007
		2.	O. Goldreich,	Computational Complexity: A Conceptual Perspective,	Cambridge University Press	2008
		3.				
	22.2.	Additional literature				
		Serial number	Author	Title	Publisher	Year
		1.				
		2.				
		3.				

Attachment No. 3		**Subject program from the second cycle of studies**		
1.	Title of the teaching subject	Computational game theory		
2.	Code	IST22E23		
3.	Study program	Computer Techniques and Informatics / Faculty of Computer Science and Engineering		
4.	Organizer of the study program (unit, i.e. institute, department)	University of Information Sciences and Technologies "St. Paul the Apostle" - Ohrid; Faculty of Computer Science and Engineering – CSE		
5.	Degree (first, second, third cycle)	Second cycle – elective subject from the unit		
6.	Academic year / semester	First year master's	semester	X (tenth)
7	Course Workload Expressed in ECTS Credits	6 (six)		
8.	Teacher (in case of multiple teachers, the responsible instructor is designated)	Aleksandar Karadimche, PhD		
9.	Language of instruction	English		
10.	Prerequisites for Attending and Passing the Course			
11.	Course Objectives (Competencies) and Learning Outcomes:	Course objectives (competencies): Students will learn the basic models in game theory. They will gain knowledge on how to formulate game theory models of simple problems and how to solve such problems. The course introduces students to essential ideas in algorithmic game theory, such as traffic equilibrium, the "parity argument" for the existence and computation of Nash equilibrium and correlated equilibria.		
12.	Detailed course content by chapters and units, with learning outcomes for each chapter	Course content: Game representations, basic concepts. Equilibrium, existence of equilibrium and computational complexity. Submodular and potential games. Games with incomplete information. Extensive games. Games with repetition. Bayesian games. Evolutionary game theory. Coalition games. Social choice. Implementation theory and design mechanism.		
13	Interconnection of Courses			
14.	Detailed Description of the Teaching and Working Methods for the Course	Teaching methods: This course is based on 45 hours of lectures and 30 hours of exercises, supplemented by the study of a specific case, consultations with the subject professor and the preparation of a project.		
15.	Total Available Time Allocation	6 ECTS credits x 30 hours/credit = 180 hours		
16.	Forms of Teaching Activities	16.1.	Lectures – theoretical instruction, hours	30 hours
		16.2.	Exercises (laboratory, auditory), seminars, teamwork: hours	15 hours
7.	Other forms of activities	17.1.	Project assignments: hours	50 hours
		17.2.	Independent tasks: hours	35 hours
		17.3.	Home study – tasks	50 hours
18	Conditions for Signature	Students should ensure regular attendance at classes in accordance with the UINT regulations.		
19	Assessment Method	60 + 30+ 10		
	19.1.	Tests: Points		60 points
	19.2.	Seminar paper/project, written and oral presentation: points		30 points
	19.3.	Final exam: points		10 points
20	Assessment criteria (points/grade)	up to 50 points		5 (five) (F)
		from 51 to 60 points		6 (six) (E)
		from 61 to 70 points		7 (seven) (D)
		from 71 to 80 points		8 (eight) (C)

			from 81 to 90 points		9 (nine) (B)
			from 91 to 100 points		10 (ten) (A)
21.	Method for monitoring the quality of teaching		Compliance with UIST quality control procedures		
22.	Literature				
	22.1.	Mandatory Literature			
		No.	Author	Title	Publisher	Year
		1.	Martin J. Osborne and Ariel Rubinstein	A Course in Game Theory	MIT Press	1994
		2.	Bernhard von Stengel	Game Theory Basics	Cambridge University Press	2021
		3.				
	22.2.	Additional Literature			
		No.	Author	Title	Publisher	Year
		1.	Leonardo Badia, Thomas Marchioro	Game Theory. A Handbook of Problems and Excercises	Società Editrice Esculapio	2022
		2.				
		3.				

Attachment No. 3	**Subject program from the second cycle of studies**				
1.	Title of the course	Advanced Distributed Systems			
2.	Code	CSE21M0 2			
3.	Study program	Computer Techniques and Informatics / Faculty of Computer Science and Engineering			
4.	Organizer of the study program (unit, i.e. institute, department, division)	Faculty of Computer Science and Engineering, University of Information Science and Technology "St. Paul the Apostle" - Ohrid			
5.	Degree (first, second, third cycle)	Second cycle			
6.	Academic year / semester /	1st year / first semester	7.	Number of ECTS credits	6
8.	Teacher	Full Professor Dr. Ustiana Rechkoska-Shikoska			
9.	Prerequisites for attending the course	Databases, Algorithms and Data Structures, Distributed Systems			
10.	Course objectives (competencies): The student will acquire knowledge about Advanced Distributed Systems, Advanced Distributed Systems Architectures ; Modern Processes, Communications; Naming, Synchronization; Distributed Databases – DBP, Advanced Distributed Databases ; Advanced Distributed Database Management Systems, design, object databases, languages and software tools, transaction management and hybrid databases, Security of Advanced Distributed Systems.				
11.	Course content: Object-oriented and service-oriented distributed systems; Objects, connectivity and databases. Distributed databases, redundancy , normalization, functional dependency. Data distribution. Types of distributed databases - DBP. Distributed DBP. Levels of work with DBP. Updating the database from multiple locations. Distributed information systems. Advanced Distributed transaction programs of the information system by locations. Threats in advanced distributed systems. Features and use of the UML language. Logic and design of DBP. Object databases. Object-oriented database languages. Architecture and model of object databases. Operations over object databases. Deductive databases. Hybrid databases. Distributed algorithms. Data analysis and mining , OLAP. Transact - SQL features in MS SQL Server, scalar and table functions, stored procedures, switches. Databases with management systems. LINQ to Entity Framework . Decentralized algorithms; Distributed systems security; Authentication; Access control; DoS ; Secure mobile code; Authorization management.				
12.	Teaching methods: Oral presentation method, lecture method, independent work method and technical aid method .				
13.	Total available study time	6 ECTS credits x 30 hours/credit = 180 hours			
14.	Allocation of available time	Lectures: 30 hours; Exercises: 15 hours; Independent study, projects, homework: 135 hours = Total: 180 hours			
15.	Forms of teaching activities	15.1.	Lectures - theoretical teaching	30 hours	
		15.2.	Exercises (laboratory , classroom) , seminars , teamwork	15 hours	

16.	Other forms of activities	16.1.	Project tasks	50 hours
		16.2.	Independent tasks	35 hours
		16.3.	Homemade learning	50 hours

17.	Grading method 60 + 30 + 10		
	17.1.	Final exam	60 points
	17.2.	Individual work / project (written and oral presentation)	30 points
	17.3.	Activity and participation	10 points

18.	Assessment criteria (points / grade)	up to 50 points	5 (five) (F)
		from 51 to 60 points	6 (six) (E)
		from 61 to 70 points	7 (seven) (D)
		from 71 to 80 points	8 (eight) (C)
		from 81 to 90 points	9 (nine) (B)
		from 91 to 100 points	10 (ten) (A)
19.	Requirement for signature and final examination	Attendance at the Activities 15.1 and 15.2	
20.	Language of instruction	Macedonian and English	
21.	Method of monitoring teaching quality	In accordance with the university procedures and quality control methods	

Literature

Required literature

	Serial number	Author	Title	Publisher	Year
22.1	1.	Maarten van Steen, Andrew S. Tanenbaum	Distributed Systems , Third Edition , Version 3.01. 2017	CreateSpace Independent Publishing Platform	201 7
	2.	Garcia-Molina H., Ullman JD, Widom., J .	Database Systems: The Complete Book	Prentice Hall	2009
	3.	Ben-gan, I	Microsoft SQL Server 2008 T-SQL Fundamentals	Microsoft Press	2008
	4.	Calvert, C.; Kulkarni, D.	Essential LINQ	Addison-Wesley	2009

Additional literature

	Serial number	Author	Title	Publisher	Year
22.2					

		1.	Satinder Bal Gupta, Aditya Mittal	Introduction to Database Management Systems" Second Edition	Typeset at Sukuvisa Enterprises, Delhi	2017

Attachment No. 3	**Course program of the first, second and third cycle of studies**					
1.	Title of the course	Analysis of Large Social Networks				
2.	Code	CSE21M03				
3.	Study program / Faculty	Computer Techniques and Informatics / Faculty of Computer Science and Engineering				
4.	Organizer of the study program (unit, i.e. institute, department , division)	Faculty of Computer Science and Engineering, University of Information Science and Technology "St. Paul the Apostle" - Ohrid				
5.	Degree (first , second, third cycle)	Second cycle				
6.	Academic year / semester	1st year / 1st semester	7.	Number of ECTS credits	6	
8.	Teacher	Dr. Aneta Velkoska				
9.	Prerequisites for enrolling in the course					
10.	Course Objectives (competencies): Complex networks are a representation of a large number natural and social systems . While these systems were modeled how random graphs , it is increasingly significant that the topology and evolution of real networks are governed by certain principles of organization of large networks. This course is intended to meet students with the latest aspects of complex networks, focusing on statistical mechanisms of the structure and dynamics of complex networks.					
11.	Course Content: • Basic concepts : Undirected and directed network, weighted network, bipartite network, bipartite network; nodes , links and their general characteristics • Matrix representation • Graph theory : vertex, edge • Connectivity , Clustering coefficient , Neighborhood • Measures of centrality like degree, closeness , betweenness , PageRank • Search patterns : Depth - first search , Breadth -first search , Shortest path problem path • Partitions , cluster detection and community detection • Examples of special random models Counts : Erdos-Renyi ; Barabasi-Albert , Watts & Strogatz • Hubs , Preferential Attachment , Cumulative advantage , " small world " networks • Graph representation : Adjacency matrices , weighted matrices and sets of pairs • Additional properties of matrices : Matrix degree and Laplace matrix • Graph operations : Subgraphs or reduction , Concatenation , hybrid links • Performance of graph algorithms on large networks • Various tools for graph analysis					
12.	Teaching methods : This course is based on 30 hours of lectures, supplemented by teamwork, consultations with the subject professor and project development .					
13.	Total available study time	6 ECTS credits x 30 hours/credit = 180 hours				
14.	Allocation of available time	Lectures: 30 hours; Exercises: 15 hours; Independent preparation, projects, homework: 135 hours = Total time of 180 hours				
15.	Forms of teaching activities	15.1.	Lectures - theoretical teaching	30 hours		
		15.2.	Exercises (laboratory, classroom), teamwork	15 hours		
16.	Others forms of activities	16.1.	Project development	50 hours		

		16.2.	Case study	35 hours
		16.3.	Homemade learning	50 hours

17.	Method of assessment 6 0 + 3 0 + 10		
	17.1.	Final exam	60 points
	17.2.	Project (presentation : written and oral)	30 points
	17.3.	Activity and participation	10 points

18.	Assessment criteria (points / grade)	up to 50 points	5 (five) (F)
		from 51 to 60 points	6 (six) (E)
		from 61 to 70 points	7 (seven) (D)
		from 71 to 80 points	8 (eight) (C)
		from 81 to 90 points	9 (nine) (B)
		from 91 to 100 points	10 (ten) (A)
19.	Requirement for signature and final examination	Attendance at the Activities 15.1 and 15.2	
20.	Language of instruction	Macedonian and English	
21.	Method of monitoring teaching quality	In accordance with the university procedures and quality control methods	

Literature

Required literature

	Serial number	Author	Title	Publisher	Year
22.1	1.	Carrington, PJ, Scott, J., Wasserman S.	Models and Methods in Social Network Analysis	Cambridge University Press	2005
	2.				
	3.				

Additional literature

	Serial number	Author	Title	Publisher	Year
22.2	1.	Albert, R., Barabasi, AL	Statistical Mechanics of Complex Networks	Reviews of Modern Physic s 74, 47 - 9 7	2002
	2.	Barabasi, AL, Albert, R	Emergence of Scaling in Random Networks	Science , 286, 509 - 512	1999
	3.				

Attachment No. 3	**Subject program from the second cycle of studies**				
1.	Title of the course	Artificial Intelligence and Expertise Systems			
2.	Code	CSE2 1 E 0 2			
3.	Study program / Faculty	Computer Techniques and Informatics / Faculty of Computer Science and Engineering			
4.	Organizer of the study program (unit, i.e. institute, department , division)	Faculty of Computer Science and Engineering, University of Information Science and Technology "St. Paul the Apostle" - Ohrid			
5.	Degree (first , second, third cycle)	Second cycle			
6.	Academic year / semester	1st year/first semester	7.	Number of ECTS credits	6
8.	Teacher	Dr. Anis Sefidanoski			
9.	Prerequisites for enrolling in the course				
10.	Course Objectives (competencies): The aim of this course is to introduce students to the concepts and techniques of artificial intelligence and to provide insight into active research in related areas and current applications.				
11.	Subject content program : 1. Overview of the artificial intelligence , history, approaches and debates ; 2. Production systems and model matching; 3. Knowledge representation and queries : Notation systems trees, graphs, hierarchies , propositional and predicate logics, frameworks, semantic networks, constraints , conceptual dependencies, databases, knowledge discovery in databases (KDD) 4. Search: State- spatial representations ; Depth-first, breadth-first, heuristic search; Planning and playing games ; Genetic algorithms . 5. Logical Reasoning : Resolution, completeness, and strategies of the Predicate Calculus; Unification, prologue, monotonic and non-monotonic reasoning. 6. Probabilistic Reasoning: Probabilistic Inference Networks. Fuzzy Inference Rules, Bayesian Rules, Dempster-Shafer Calculus . 7. Learning: Knowledge acquisition, classification rules, self-directed system. 8. Planning and common sense reasoning: Robot actions, tapes, triangle tables, case-based reasoning, spatial and temporal formalisms. 9. Neural networks: Principles, biological analogies; Training (techniques and errors); Recognition. 10. Expert systems : organization, tools, boundaries, examples.				

12.	Teaching methods : This course is based on 30 hours of lectures, supplemented by teamwork, consultations with the subject professor, and project development .			
13.	Total available study time		6 ECTS credits x 30 hours/credit = 180 hours	
14.	Allocation of available time		Lectures: 30 hours; Exercises: 15 hours; Independent preparation, projects, homework: 135 hours = Total time of 180 hours	
15.	Forms of teaching activities	15.1.	Lectures - theoretical teaching	30 hours
		15.2.	Exercises (laboratory, classroom), teamwork	15 hours
16.	Others forms of activities	16.1.	Project development	50 hours
		16.2.	Case study	35 hours
		16.3.	Homemade learning	50 hours
17.	Method of assessment 60 + 3 0 + 10			
	17.1.	Final exam		60 points
	17.2.	Individual work / project (written and oral presentation)		30 points
	17.3.	Activity and participation		10 points
18.	Assessment criteria (points /grade)		up to 50 points	5 (five) (F)
			from 51 to 60 points	6 (six) (E)
			from 61 to 70 points	7 (seven) (D)
			from 71 to 80 points	8 (eight) (C)
			from 81 to 90 points	9 (nine) (B)
			from 91 to 100 points	10 (ten) (A)
19.	Requirement for signature and final examination		Attendance at the Activities 15.1 and 15.2	
20.	Language of instruction		Macedonian and English	
21.	Method of monitoring teaching quality		In accordance with the university procedures and quality control methods	

	Literature					
	22.1	Mandatory literature				
		Serial number	Author	Title	Publisher	Year
		1.	I. Gupta , G. Nagpal	Artificial Intelligence and Expert Systems	Mercury Learning and Information	20 20
		2.				
		3.				
	22.2	Additional literature				
		Serial number	Author	Title	Publisher	Year
		1.				
		2.				
		3.				

Attachment No. 3	**Course program of the first, second and third cycle of studies**					
1.	Title of the course	Big Data Analytics				
2.	Code	CSE21M01				
3.	Study program / Faculty	Computer Techniques and Informatics / Faculty of Computer Science and Engineering				
4.	Organizer of the study program (unit, i.e. institute, department , division)	Faculty of Computer Science and Engineering, University of Information Science and Technology "St. Paul the Apostle" - Ohrid				
5.	Degree (first , second, third cycle)	Second cycle				
6.	Academic year / semester	1st year / first semester	7.	Number of ECTS credits	6	
8.	Teacher	Ph.D. Atanas Hristov				
9.	Prerequisites for enrolling in the course					
10.	Objectives of the subject program (competencies): The analytics of the big ones data is an item that probably is the fastest growing in the IT world . New tools and algorithms are being created and adopted. quickly . The goal is to get insight into which tools , algorithms and platforms are best to use when solving real-world problems problems (use cases). The students they will gain knowledge for analysis of large The course serves as guidance for students who are expected to deal with storing large data , their processing, analysis, visualization , and their application in workplaces and for research purposes.					
11.	Subject content program : The course them contains the following main topics, according to the books listed in the section Required reading: 1. Introduction to large-scale analytics data ; 2. Platforms for large data ; 3. Storage and analytics of large data ; 4. Algorithms for large scale analytics data ; 5. Working with Hadoop ; 6. Working with a database - Spark					
12.	Teaching methods : This course is based on 30 hours of lectures, supplemented by teamwork, consultations with the subject professor and project development .					
13.	Total available study time	6 ECTS credits x 30 hours/credit = 180 hours				
14.	Allocation of available time	Lectures: 30 hours; Exercises: 15 hours; Independent preparation, projects, homework: 135 hours = Total time of 180 hours				
15.	Forms of teaching activities	15.1.	Lectures - theoretical teaching	30 hours		
		15.2.	Exercises (laboratory, classroom), teamwork	15 hours		
16.	Other forms of activities	16.1.	Project development	50 hours		
		16.2.	Case study	35 hours		
		16.3.	Homemade learning	50 hours		
17.	Method of assessment 6 0 + 3 0 + 10					

	17.1.	Tests		60 points
	17.2.	Individual work/project (presentation: written and oral)		30 points
	17.3.	Activity and participation		10 points
18.	Assessment criteria (points / grade)		up to 50 points	5 (five) (F)
			from 51 to 60 points	6 (six) (E)
			from 61 to 70 points	7 (seven) (D)
			from 71 to 80 points	8 (eight) (C)
			from 81 to 90 points	9 (nine) (B)
			from 91 to 100 points	10 (ten) (A)
19.	Requirement for signature and final examination		Attendance at the Activities 15.1 and 15.2	
20.	Language of instruction		Macedonian and English	
21.	Method of monitoring teaching quality		In accordance with the university procedures and quality control methods	

Literature

Required literature

	Serial number	Author	Title	Publisher	Year
22.1	1.	David Losin	Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph	Morgan Kaufmann	2013
	2.	Tom White	Hadoop: The Definitive Guide	O'Reilly Media	2015
	3.				

Additional literature

	Serial number	Author	Title	Publisher	Year
22.2	1.				
	2.				
	3.				

Attachment No. 3		**Second cycle study program**			
1.	Title of the course	Data Processing in the Fog and at the Edge			
2.	Code	CSE22M05			
3.	Study program / Faculty	Computer Techniques and Informatics / Faculty of Computer Science and Engineering			
4.	Organizer of the study program (unit, i.e. institute , department, division)	Faculty of Computer Science and Engineering, University of Information Science and Technology "St. Paul the Apostle" - Ohrid			
5.	Degree (first, second, third cycle)	Second cycle			
6.	Academic year / semester	1st year/second semester	7.	Number of ECTS credits	6
8.	Teacher	Full Professor Dr. Ustiana Rechkoska Shikoska			
9.	Prerequisites for enrolling in the course				
10.	Objectives of the subject program (competencies): This course is intended to familiarize students with the need for new computing paradigms , to understand the main components of fog and edge computing architectures , to be able to identify potential technical challenges of the transition process and propose new solutions , to analyze the requirements driven by large volumes of data and applications and the corresponding questions , and to be able to design and model appropriate infrastructures .				
11.	Contents on the subject program : 1. New computing paradigms 2. Business and IoT Challenges 3. C2F2T integration infrastructures 4. Autonomous management and orchestration 4.1. Slicing in 5G 4.2. Slicing in software-defined clouds 4.3. Managing slicing in fog and edge 5. Optimization and modeling frameworks 6. Middleware infrastructures 6.1. Edge cloud architectures 6.2. Elementary clouds with edges 6.3. IoT integration and *blockchain* -based orchestration 7. Data in the fog 7.1. Big data analysis 7.2. Data management 7.3. Data protection by design 7.4. GDPR restrictions 8. Applications and techniques 8.1. Smart e-health, smart surveillance, smart transportation 8.2. Predictive analytics for fog application deployment 8.3. Testing fog applications for IoT				

	8.4. ML techniques for defending IoT systems			
12.	Teaching methods: This course is based on 30 hours of lectures, supplemented by teamwork, consultations with the subject professor, and project development .			
13.	Total available study time	6 ECTS credits x 30 hours/credit = 180 hours		
14.	Allocation of available time	Lectures: 30 hours; Exercises: 1 5 hours; Independent preparation, projects, homework: 1 35 hours = Total time of 180 hours		
15.	Forms on the teaching activities	15.1.	Lectures - theoretical teaching	30 hours
		15.2.	Exercises (laboratory, classroom), teamwork	15 hours
16.	Others forms on activities	16.1.	Project tasks	50 hours
		16.2.	Independent tasks	35 hours
		16.3.	Homemade learning - tasks	50 hours
17.	Way on grading 60 + 30 + 10			
	17.1.	Final exam		60 points
	17.2.	Individual work/project (presentation: written and oral)		30 points
	17.3.	Activity and participation		10 points
18.	Assessment criteria (points/grade)		up to 50 points	5 (five) (F)
			51 x to 60 points	6 (six) (E)
			61 x to 70 points	7 (seven) (D)
			from 71 to 80 points	8 (eight) (C)
			from 81 to 90 points	9 (nine) (B)
			from 91 to 100 points	10 (ten) (A)
19.	Requirement for signature and final examination		Attendance at the Activities 15.1 and 15.2	
20.	Language of instruction		Macedonian and English	
21.	Method of monitoring teaching quality		In accordance with the university procedures and quality control methods	
22.	Literature			

	22.1.	Required literature				
		Serial number	Author	Title	Publisher	Year
		1.	Rajkumar Buyya , Satish Narayana Srirama	Fog and Edge Computing: Principles and Paradigms	Wiley	20 1 9
		2.				
		3.				
	22.2.	Additional literature				
		Serial number	Author	Title	Publisher	Year
		1.				
		2.				
		3.				

Attachment No. 3	**Second cycle of studies course program**					
1.	Title of the course		High-Performance Processing			
2.	Code		CSE2 1 E0 4			
3.	Study program / Faculty		Computer Techniques and Informatics / Faculty of Computer Science and Engineering			
4.	Organizer of the study program (unit, i.e. institute, department , division)		Faculty of Computer Science and Engineering, University of Information Science and Technology "St. Paul the Apostle" - Ohrid			
5.	Degree (first , second, third cycle)		Second cycle			
6.	Academic year / semester		1st year/ first semester	7.	Number of ECTS credits	6
8.	Teacher		Dr. Atanas Hristov			
9.	Prerequisites for enrolling in the course					
10.	Objectives of the subject program (competencies): Single-core processors have achieved great speeds, but in recent years it has become clear that this type of architecture has already collided with the three walls of performance and can no longer be upgraded. Therefore, a new trend has begun to integrate multiple processing units on a single integrated circuit or combine them into larger systems using SAN networks. All this has led to the emergence of new architectures for parallel processing and parallel programming. The future of microprocessors and programming itself lies in the use of multiple simple computing cores to overcome the three walls of performance. In this course, students will learn the basics of these massively parallel systems.					
11.	Subject content program : 1. Introduction to advanced computer architectures and parallel processing 2. Networks for connecting multiprocessors, SAN. Systems for connecting multi-core systems 3. Shared memory architectures. Multicore and Multiprocessor systems. 4. Distributed memory architectures. Message Passing interface. 5.Clustering and Network Computing 6. Separation of duties in massively parallel systems. 7. Optimization in parallel architectures					
12.	Teaching methods : This course is based on 30 hours of lectures, supplemented by teamwork, consultations with the subject professor and project development .					
13.	Total available study time		6 ECTS credits x 30 hours/credit = 180 hours			
14.	Allocation of available time		Lectures: 30 hours; Exercises: 1 5 hours; Independent preparation, projects, homework: 1 35 hours = Total time of 180 hours			
15.	Forms of teaching activities	15.1.	Lectures - theoretical teaching		30 hours	
		15.2.	Exercises (laboratory , classroom) , teamwork		15 hours	
16.	Other forms of activities	16.1.	Project tasks		50 hours	
		16.2.	Independent tasks		35 hours	
		16.3.	Homework - assignments		50 hours	
17.	Assessment method: 60 + 30 + 10					
	17.1.	Final exam			60 points	
	17.2.	Individual work / project (written and oral presentation)			30 points	

	17.3.	Activity and participation				10 points
18.	Assessment criteria (points / grade)			up to 50 points		5 (five) (F)
				from 51 to 60 points		6 (six) (E)
				from 61 to 70 points		7 (seven) (D)
				from 71 to 80 points		8 (eight) (C)
				from 81 to 90 points		9 (nine) (B)
				from 91 to 100 points		10 (ten) (A)
19.	Requirement for signature and final examination		Attendance at the Activities 15.1 and 15.2			
20.	Language of instruction		English, Macedonian			
21.	Method of monitoring teaching quality		In accordance with the university procedures and quality control methods			
	Literature					
	22.1	Required literature				
		Serial number	Author	Title	Publisher	Year
		1.	Hesam El-Rewini	Advanced Computer Architecture and Parallel Processing	Wiley	200 5
		2.				
		3.				
	22.2	Additional literature				
		Serial number	Author	Title	Publisher	Year
		1.	William Stallings	Computer Organization & Architecture	Pearson	2015
		2.				
		3.				

Attachment No. 3	**Second cycle of studies course program**					
1.	Title of the course	Image Processing Technologies				
2.	Code	CSE22E0 3				
3.	Study program / Faculty	Computer Techniques and Informatics / Faculty of Computer Science and Engineering				
4.	Organizer of the study program (unit, i.e. institute, department , division)	Faculty of Computer Science and Engineering, University of Information Science and Technology "St. Paul the Apostle" - Ohrid				
5.	Degree (first , second, third cycle)	Second cycle				
6.	Academic year / semester	1st year/ second semester	7.	Number of ECTS credits	6	
8.	Teacher	Dr. Atanas Hristov				
9.	Prerequisites for enrolling in the course					
10.	Objectives of the subject program (competencies): This course aims to introduce students to image processing technologies. Upon completion of the course, students should have knowledge of: techniques for determining image depth, motion and shaping image sequences, compression and representation of three-dimensional images, image processing sensors, as well as methods for image recognition and processing.					
11.	Subject content program : 1. Passive Range Sensing Techniques : Depth Imaging, 2. Optimal approaches to computer visualization and image processing 3. Motion and shaping of image sequences under 55 correspondence features (55 matching features) 4. Compression and representation of three -dimensional images 5. Omnidirectional censorship and its application 6. Sensors for data processing: VLSI vision 7. Facial image processing and recognition and its application 8. Document analysis and recognition 9. Progress so far in image processing in medicine 10. Image processing in intelligent transportation systems					
12.	Teaching methods : This course is based on 30 hours of lectures, supplemented by teamwork, consultations with the subject professor and project development .					
13.	Total available study time	6 ECTS credits x 30 hours/credit = 180 hours				
14.	Allocation of available resources time	Lectures: 30 hours; Exercises: 1 5 hours; Independent preparation, projects, homework: 1 35 hours = Total time of 180 hours				
15.	Forms of teaching activities	15.1.	Lectures - theoretical teaching	30 hours		
		15.2.	Exercises (laboratory , classroom) , teamwork	15 hours		
16.	Others forms of activities	16.1.	Project tasks	50 hours		
		16.2.	Independent tasks	35 hours		
		16.3.	Homework - assignments	50 hours		
17.	Method of assessment 6 0 + 30 + 10					

	17.1.	Final exam		6 0 points
	17.2.	Individual work/project (presentation: written and oral)		3 0 points
	17.3.	Activity and participation		10 points
18.	Assessment criteria (points / grade)		up to 50 points	5 (five) (F)
			from 51 to 60 points	6 (six) (E)
			from 61 to 70 points	7 (seven) (D)
			from 71 to 80 points	8 (eight) (C)
			from 81 to 90 points	9 (nine) (B)
			from 91 to 100 points	10 (ten) (A)
19.	Requirement for signature and final examination		Attendance at the Activities 15.1 and 15.2	
20.	Language of instruction		English, Macedonian	
21.	Method of monitoring teaching quality		In accordance with the university procedures and quality control methods	

Literature

Required literature

	Serial number	Author	Title	Publisher	Year
22.1	1.	Klyoharu Alzawa, Katsuhiko Sakaue, Yasuhito Suenaga	Image Processing Technologies Algorithms, Sensors, and Applications	Marcel Dekker, INC.	200 4
	2.				
	3.				

Additional literature

	Serial number	Author	Title	Publisher	Year
22.2	1.	Phillip A. Laplante	Adaptive image processing	Pennsylvania Institute of Technology	2002
	2.				
	3.				

<table>
<tr><td colspan="2">Attachment No. 3</td><td colspan="5">Course program of the first, second and third cycle of studies</td></tr>
<tr><td>1.</td><td colspan="2">Title of the course</td><td colspan="4">Modern Simulations and Modeling</td></tr>
<tr><td>2.</td><td colspan="2">Code</td><td colspan="4">CSE2 1 E 01</td></tr>
<tr><td>3.</td><td colspan="2">Study program / Faculty</td><td colspan="4">Computer Techniques and Informatics / Faculty of Computer Science and Engineering</td></tr>
<tr><td>4.</td><td colspan="2">Organizer of the study program (unit, i.e. institute, department , division)</td><td colspan="4">Faculty of Computer Science and Engineering, University of Information Science and Technology "St. Paul the Apostle" - Ohrid</td></tr>
<tr><td>5.</td><td colspan="2">Degree (first , second, third cycle)</td><td colspan="4">Second cycle</td></tr>
<tr><td>6.</td><td colspan="2">Academic year / semester</td><td>1st year/first semester</td><td>7.</td><td>Number of ECTS credits</td><td>6</td></tr>
<tr><td>8.</td><td colspan="2">Teacher</td><td colspan="4">Dr. Ljubinka Sandžakoska</td></tr>
<tr><td>9.</td><td colspan="2">Prerequisites for enrolling in the course</td><td colspan="4"></td></tr>
<tr><td>10.</td><td colspan="6">Objectives of the subject program (competencies):

This course provides students with a sufficient understanding of contemporary concepts and approaches in modeling and simulating real-world systems. Additionally, this course aims to help students identify the opportunities and potential of using models, as well as equip them with the skills to develop simulations - as a support for improving systems and processes.</td></tr>
<tr><td>11.</td><td colspan="6">Subject content program :

1. Principles of Modeling of Modeling and Simulation).
2. Theoretical foundations (eng. Theoretical Underpinnings).
3. Practical domains (eng. Practical Domains).

• The first part covers a brief history of the processes: modeling and simulation, followed by an overview of numerous functions. Furthermore, the advantages and disadvantages of using models in problem solving will be learned. And at the end of the first part, two main reasons for using modeling and simulation will be illustrated, through the study of a specific problem related to the use, thus gaining insight into the complex concepts.
• With the second part of the program Theoretically, various modeling techniques are examined and students are introduced to two important simulation concepts: discrete event simulation and continuous system simulation . This section details the two basic methods and also covers the importance of verification and validation.
• The third part of this course, covering practical domains , delves into specific topics related to business , medicine , and social sciences . Furthermore, the challenges of modeling and simulation are covered, along with advanced applied modeling and simulation principles such as representation techniques, integration into application infrastructure, and new technologies.</td></tr>
<tr><td>12.</td><td colspan="6">Teaching methods : This course is based on 30 hours of lectures, supplemented by teamwork, consultations with the subject professor and project development .</td></tr>
<tr><td>13.</td><td colspan="3">Total available study time</td><td colspan="3">6 ECTS credits x 30 hours/credit = 180 hours</td></tr>
<tr><td>14.</td><td colspan="3">Distribution of available resources time</td><td colspan="3">Lectures: 30 hours; Exercises: 15 hours; Independent preparation, projects, homework: 135 hours = Total time of 180 hours</td></tr>
</table>

15.	Forms of teaching activities	15.1.	Lectures - theoretical teaching	30 hours
		15.2.	Exercises (laboratory, classroom), teamwork	15 hours
16.	Others forms of activities	16.1.	Project development	50 hours
		16.2.	Case study	35 hours
		16.3.	Homemade learning	50 hours

17.	Method of assessment 6 0 + 3 0 + 10		
	17.1.	Final exam	60 points
	17.2.	Individual work/project (presentation: written and oral)	30 points
	17.3.	Activity and participation	10 points

18.	Assessment criteria (points / grade)	up to 50 points	5 (five) (F)
		from 51 to 60 points	6 (six) (E)
		from 61 to 70 points	7 (seven) (D)
		from 71 to 80 points	8 (eight) (C)
		from 81 to 90 points	9 (nine) (B)
		from 91 to 100 points	10 (ten) (A)
19.	Requirement for signature and final examination	Attendance at the Activities 15.1 and 15.2	
20.	Language of instruction	English, Macedonian	
21.	Method of monitoring teaching quality	In accordance with the university procedures and quality control methods	

Literature

Required literature

Serial number	Author	Title	Publisher	Year
1.	John A. Sokolowski, Catherine M. Banks	Principles of Modeling and Simulation: A Multidisciplinary Approach , 1st Edition	Wiley	2009
2.	Giuseppe Ciaburro	Hands-On Simulation Modeling with Python: Develop simulation models to help you get accurate results and enhance the decision-making process, 2nd Edition	Packt Publishing	2023
3.	Jonah O'Kelly	Computer Simulation: Advanced Techniques, Methods and Applications	Willford Press	2019

22.1

22.2 Additional literature

Serial number	Author	Title	Publisher	Year

		1.				
		2.				
		3.				

Attachment No. 3	**Course program of the first, second and third cycle of studies**				
1.	Title of the course	Platform Strategy			
2.	Code	CSE21E05			
3.	Study program / Faculty	Computer Techniques and Informatics / Faculty of Computer Science and Engineering			
4.	Organizer of the study program (unit, i.e. institute, department , division)	Faculty of Computer Science and Engineering, University of Information Science and Technology"St. Paul the Apostle" - Ohrid			
5.	Degree (first , second, third cycle)	Second cycle			
6.	Academic year / semester	first year/first semester	7.	Number of ECTS credits	6
8.	Teacher	Dr. Jovanka Damoska Sekuloska			
9.	Prerequisites for enrolling in the course				
10.	Objectives of the subject program (competencies) : This course provides students with methods, tools, and techniques for quantitative and qualitative analysis of market and consumer behavior. They are crucial in determining and deciding on product strategies and introducing new products and services.				
11.	Subject content program : 1. Introduction and development of platform business 2. Characteristics of a digital platform 3. Platforms as a business model 4. Platform ecosystem 5. Life levels on the platforms 6. Platform launch 7. Platform sizing 8. Platform maturity 9. Platform cost 10. Trust, governance and platform brand 11. Platforms, regulation and competition 12. Future platform development				
12.	Teaching methods : This course is based on 30 hours of lectures, supplemented by teamwork, consultations with the subject professor and project development .				
13.	Total available study time	6 ECTS credits x 30 hours/credit = 180 hours			
14.	Distribution of available resources time	Lectures: 30 hours; Exercises: 1 5 hours; Independent preparation, projects, homework: 1 35 hours = Total time of 180 hours			
15.	Forms of teaching activities	15.1.	Lectures - theoretical teaching	30 hours	
		15.2.	Exercises (laboratory , classroom) , seminars , teamwork	15 hours	
16.	Others forms of activities	16.1.	Project tasks	50 hours	
		16.2.	Independent tasks	35 hours	
		16.3.	Homemade learning	50 hours	
17.	Grading method 60 + 30 +10				

	17.1.	Final exam		60 points
	17.2.	Individual work / project (written and oral presentation)		30 points
	17.3.	Activity and participation		10 points
18.	Assessment criteria (points / grade)		up to 50 points	5 (five) (F)
			from 51 to 60 points	6 (six) (E)
			from 61 to 70 points	7 (seven) (D)
			from 71 to 80 points	8 (eight) (C)
			from 81 to 90 points	9 (nine) (B)
			from 91 to 100 points	10 (ten) (A)
19.	Requirement for signature and final examination		Attendance at the Activities 15.1 and 15.2	
20.	Language of instruction		English, Macedonian	
21.	Method of monitoring teaching quality		In accordance with the university procedures and quality control methods	

Literature

22.1 Required literature

Serial number	Author	Title	Publisher	Year
1.	Laure Claire Reillier and Benoit Reillier	Platform strategy: How to Unlock the Power of Communities and Networks to Grow Your Business 1 st ed.	Routledge	2017
2.	Geoffrey G. Parker, Marshall W. Van Alstyne , Sangeet Paul Choudary	Platform Revolution: How Networked Markets Are Transforming the Economy and How to Make Them Work for You	W.W. Norton & Company	2016
3	Amrit Tiwana	Platform Ecosystems: Aligning Architecture, Governance, and Strategy 1 st .ed.	Morgan Kaufmann	2013

22.2 Additional literature

Serial number	Author	Title	Publisher	Year
1.	Michael A. Cusumano , Annabelle Gawer and David B. Yoffie	The Business of Platforms: Strategy in the Age of Digital Competition, Innovation and Power	Harper Business	2019
2.				
3.				

Annex No. 3	**Course Syllabus – Second Cycle Studies**				
1.	Course Title	Database Management Systems			
2.	Code	CSE22E02			
3.	Study Programme / Faculty	Computer Techniques and Informatics			
4.	Organizer of the Study Programme (unit, institute, department)	Faculty of Computer Science and Engineering (CSE), University of Information Science and Technology "St. Paul the Apostle" – Ohrid			
5.	Level (first, second, third cycle)	Second Cycle			
6.	Academic Year / Semester	1st Year	7.	Number of ECTS Credits	6
8.	Lecturer	PhD Dijana Capeska Bogatinoska			
9.	Prerequisites for Enrolment				
10.	Course Objectives (Competencies): This course aims to provide students with an understanding of advanced concepts in database management systems. Upon completion, students should: have a solid knowledge of data modelling and database design, including the advantages and disadvantages of using database management systems, covering both relational and non-relational databases, as well as centralised and distributed databases; acquire solid knowledge of Structured Query Language (SQL) and its use for data manipulation, in particular table navigation and report selection; use SQL at an advanced and detailed level, including operations such as correlated sub-queries, set operators, and existential qualification; understand query processing and optimisation, and fully comprehend why database management systems incorporate optimisers; be able to compare the ACID and BASE transactional models. Students will also be introduced to advanced concepts related to performance, reliability, and security in database management systems.				
11.	Course Content: Introduction to database management systems. Data modelling and database design – advanced design. Use of Structured Query Language (SQL) for data manipulation, table navigation, and report selection. Correlated sub-queries, set operators, and existential qualification in SQL. Query processing in SQL. Big data analytics. Storage management. Transaction processing. Parallel and distributed databases. Advanced topics (advanced indexing, Blockchain databases). Overview of ACID properties in relational databases and BASE properties in non-relational databases. Concurrency control – conceptual and theoretical aspects. Database recovery systems – conceptual and theoretical aspects. Practical methods for ensuring data availability – backup and recovery techniques. Data security in database systems within the overall security of ICT systems.				
12.	Teaching Methods: This course is based on 30 hours of lectures, supplemented by teamwork, consultations with the course lecturer, and project work.				

13.	Total Available Study Time	6 ECTS credits × 30 hours/credit = 180 hours		
14.	Distribution of Available Time	Lectures: 30 hours; Exercises: 15 hours; Independent study, projects, homework: 135 hours = Total: 180 hours		
15.	Forms of Teaching Activities	15.1.	Lectures – theoretical instruction	30 hours
		15.2.	Exercises (laboratory, classroom), teamwork	15 hours
16.	Other Forms of Activities	16.1.	Project assignments	50 hours
		16.2.	Independent assignments	35 hours
		16.3.	Home study – tasks	50 hours

17.	Assessment Method: 60 + 30 + 10		
	17.1.	Tests	60 points
	17.2.	Individual work / project (written and oral presentation)	30 points
	17.3.	Activity and participation	10 points

18.	Grading Criteria (points / grade)	up to 50 points	5 (five) (F)
		51 to 60 points	6 (six) (E)
		61 to 70 points	7 (seven) (D)
		71 to 80 points	8 (eight) (C)
		81 to 90 points	9 (nine) (B)
		91 to 100 points	10 (ten) (A)
19.	Conditions for Signature and Final Examination	Students are required to attend classes regularly in accordance with the UIST regulations.	
20.	Language of Instruction	English, Macedonian	
21.	Method of Monitoring Teaching Quality	Following the quality control procedures of UIST	
22.	Literature		
	22.1.	Required Literature	

		No.	Author	Title	Publisher	Year
		1.	Avi Silberschatz, Henry F. Korth, S. Sudarshan	Database System Concepts, Seventh Edition	McGraw-Hill	2019
		2.	Ramez Elmasri, Shamkant B. Navathe	Fundamentals of Database Systems, 7th Edition	Pearson	2015
		3.	Ron Ben Natan	Implementing Database Security and Auditing	Digital Press	2005
	22.2.	Additional Literature				
		No.	Author	Title	Publisher	Year
		1.	Hector Garcia-Molina, Jeff Ullman, Jennifer Widom	Database Systems: The Complete Book	Prentice Hall	2008
		2.				
		3.				

Attachment No. 3		**Subject program from the second cycle of studies**			
1.	Title of the teaching subject	Design of nested systems and rapid prototype development			
2.	Code	CSE22E10			
3.	Study program	Computer technique and informatics, Faculty of Computer Science and Engineering			
4.	Organizer of the study program (unit, i.e. institute, department)	University of Information Science and Engineering, Faculty of Computer Science and Engineering			
5.	Degree (first, second, third cycle)	Second cycle – mandatory subject for all faculties			
6.	Academic year / semester	Year	1	semester	2
7	Course Workload Expressed in ECTS Credits	6			
8.	Teacher (in case of multiple teachers, the responsible instructor is designated)	Ass. Prof. Ile Dimitrievski, PhD			
9.	Language of instruction	English, Macedonian			
10.	Prerequisites for Attending and Passing the Course				
11.	Course Objectives (Competencies) and Learning Outcomes:	This course aims to acquaint students with the current developments in the field of embedded systems design and the rapid development of prototypes. Microcontroller and microprocessor-based nesting systems can be found everywhere around us, including cell phones, smartphones, PDAs, DVD players, printers, washing machines, modern air conditioners, home security systems, ATMs, aircraft management systems, car engine monitoring systems and many others. By the end of this course students will learn how to develop and program embedded systems. They will be able to master microprocessor-based programming embedded systems in the C programming language, functions and use of frequent used peripherals.			
12.	Detailed course content by chapters and units, with learning outcomes for each chapter	Precisely this course will cover the following topics: 1. What is an embedded system; 2. Programming of microprocessor based embedded controllers in the software language C; 3. Use of multipurpose analog and digital input / output channels; 4. Serial (RS232 / 485), I2C, SPI communication with sensors; 5. Square decoding for wheel position measurement; 6. Wide pulse modulation; 7. Temporal interruptions for creating sampling intervals; 8. Nested operating systems in real time; 9. Introduction to Rapid Prototype Development with Matlab / Simulink; 10. Real time Windows Target and xPC Target.			
13	Interconnection of Courses				
14.	Detailed Description of the Teaching and Working Methods for the Course	Lectures: 30 hours; Exercises: 15 hours; Independent study, projects, homework: 135 hours = Total: 180 hours			
15.	Total Available Time Allocation	6 ECTS credits x 30 hours/credit = 180 hours			
16.	Forms of Teaching Activities	16.1.	Lectures – theoretical instruction, hours		30

		16.2.	Exercises (laboratory, auditory), seminars, teamwork: hours	15
17.	Other forms of activities	17.1.	Project assignments: hours	50
		17.2.	Independent tasks: hours	35
		17.3.	Home study – tasks	50
18	Conditions for Signature	Students should ensure regular attendance at classes in accordance with the UIST study rulebook.		
19	Assessment Method			
	19.1.	Final exam: Points		60
	19.2.	Seminar paper/project, written and oral presentation: points		30
	19.3.	Final exam: points		10
20	Assessment criteria (points/grade)		up to 50 points	5 (five) (F)
			from 51 to 60 points	6 (six) (E)
			from 61 to 70 points	7 (seven) (D)
			from 71 to 80 points	8 (eight) (C)
			from 81 to 90 points	9 (nine) (B)
			from 91 to 100 points	10 (ten) (A)
21.	Method for monitoring the quality of teaching		Follow UIST Quality Assurance Procedures.	

22. Literature

22.1. Mandatory Literature

No.	Author	Title	Publisher	Year
1.	Wayne Wolf	Computers as Components Principles of Embedded Computing System Design	Morgan Kaufman	2008
2.				
3.				

22.2. Additional Literature

No.	Author	Title	Publisher	Year
1.	Steve Heath	Embedded Systems Design, Second Edition	Newnes	2003
2.				
3.				

Attachment No. 3		**Second cycle study program**			
1.	Title of the course	Developmental - research methods in science and engineering			
2.	Code	CSE21E03			
3.	Study program	Computer Technology and Informatics / Faculty of Computer Science and Engineering			
4.	Organizer of the study program (unit, i.e. institute, department, division)	Faculty of Computer Science and Engineering, University of Information Sciences and Technologies "St. Paul the Apostle" - Ohrid			
5.	Degree (first, second, third cycle)	Second cycle			
6.	Academic year / semester	1st year / second semester	7	Number of ECTS credits	6
8.	Teacher	Dr. Rasim Salkoski			
9.	Prerequisites for enrolling in the course				
10.	Course objectives (competencies): The aim of this course is to create professional engineers, scientists and students with a solid and practical framework for the management and development of a real, research project, with a focus on scientific methods, validation and quality control of results.				
11.	Course content: The course is organized as follows: 1. To provide the necessary definitions and concepts for research and development, 2. To present the basic concepts of the process and preparation of scientific research projects 3. To explain the organization of the project and the division of the different tasks. 4. To study the basic ideas of the presentation of knowledge and its boundaries. 5. Presentation, validation, analysis and synthesis of hypotheses 6. Modern scientific research methods				
12.	Teaching methods: This course is based on 30 hours of lectures, supplemented by the study of a specific case, consultations with the subject professor and the preparation of a project.				
13.	Total available fund on time	6 ECTS credits x 30 hours/credit = 180 hours			
14.	Allocation of available time	Lectures: 30 hours; Exercises: 15 hours; Independent preparation, projects, homework: 135 hours = Total time of 180 hours			
15.	Forms of teaching activities	15.1.	Lectures - theoretical teaching	30 hours	
		15.2.	Exercises (laboratory, classroom), teamwork	15 hours	
	Other forms of activities	16.1.	Project development	50 hours	

16.		16.2.	Case study	35 hours
		16.3.	Home learning	50 hours

17.	Assessment method: 60 + 30 + 10		
	17.1.	Tests	60 points
	17.2.	Individual work/project (presentation: written and oral)	30 points
	17.3.	Activity and participation	10 points
	17.4.		

18.	Assessment criteria (points/grade)	up to 50 points	5 (five) (F)
		51 x to 60 points	6 (six) (E)
		61 x to 70 points	7 (seven) (D)
		from 71 to 80 points	8 (eight) (C)
		from 81 to 90 points	9 (nine) (B)
		from 91 to 100 points	10 (ten) (A)
19.	Requirement for signature and passing the final exam	Students should ensure regular attendance at classes in accordance with the UINT regulations.	
20.	Language of instruction	English, Macedonian	
21.	Method of monitoring the quality of teaching	In accordance with the university procedures and quality control methods	

22.	Literature					
	22.1.	Required literature				
		Serial number	Author	Title	Publisher	Year
		1.	P. Bock	Getting it Right: R&D Methods for Science and Engineering	Academic Press	2001
		2.				
		3.				
	22.2.	Additional literature				
		Serial number	Author	Title	Publisher	Year
		1.				
		2.				
		3.				

Attachment No. 3		**Second cycle study program**				
1.	Title of the course	Digital forensics				
2.	Code	CSE22E 13				
3.	Study program / Faculty	Computer Techniques and Informatics / Faculty of Computer Science and Engineering				
4.	Organizer of the study program (unit, i.e. institute , department, division)	Faculty of Computer Science and Engineering, University of Information Sciences and Technologies "St. Paul the Apostle" - Ohrid				
5.	Degree (first, second, third cycle)	Second cycle				
6.	Academic year / semester	1st year/second semester	7.	Number of ECTS credits	6	
8.	Teacher	Full Professor Dr. Ustiana Rechkoska Shikoska				
9.	Prerequisites for enrolling in the course					
10.	Objectives of the subject program (competencies): This course provides a way to understand cybersecurity and various computer forensics technologies, as well as provide students with a foundation in this emerging field. Upon completion of this course, the student should: 1. Understand the importance of firewalls and their types 2. To analyze and validate computer forensics data. 3. To learn the various threats related to information security and " warfare ". 4. To learn the tools and tactics related to cyber forensics.					
11.	Course content: 1. Network and transport level security IPSec protocol - IP header - IP ESP - Key Management protocol for IPSec . Transport level security: SSL protocol, cryptographic calculations - TLS protocol. 2. Email security and firewalls PGP - S / MIME - Internet firewalls for trusted systems: role of firewalls - related terminologies - types of firewalls - firewall designs - security of e-commerce transactions. 3. Introduction to computer forensics Fundamentals of computer forensics - Types of computer forensics - forensic technologies and systems - Understanding computer investigations - data collection. 4. Evidence collection and forensic tools Processing of crime and incident scenes - working with Windows and DOS systems. Current computer forensic tools: software / hardware tools. 5. Analysis and evaluation. Forensic data evaluation - data obfuscation techniques - remote procurement - network forensics - email investigations - mobile phone and mobile device forensics.					
12.	Teaching methods: This course is based on 30 hours of lectures, supplemented by teamwork, consultations with the subject professor, and project development .					
13.	Total available study time	6 ECTS credits x 30 hours/credit = 180 hours				

14.	Allocation of available time	Lectures: 30 hours; Exercises: 1 5 hours; Independent preparation, projects, homework: 135 hours = Total time of 180 hours		
15.	Forms on the teaching activities	15.1.	Lectures - theoretical teaching	30 hours
		15.2.	Exercises (laboratory, classroom), teamwork	15 hours
16.	Others forms on activities	16.1.	Project tasks	50 hours
		16.2.	Independent tasks	35 hours
		16.3.	Homemade learning - tasks	50 hours

17.	Way on grading 60 + 30 + 10		
	17.1.	Tests	60 points
	17.2.	Individual work/project (presentation: written and oral)	30 points
	17.3.	Activity and participation	10 points

18.	Assessment criteria (points/grade)	up to 50 points	5 (five) (F)
		51 x to 60 points	6 (six) (E)
		61 x to 70 points	7 (seven) (D)
		from 71 to 80 points	8 (eight) (C)
		from 81 to 90 points	9 (nine) (B)
		from 91 to 100 points	10 (ten) (A)
19.	Requirement for signature and passing the final exam	Attendance at the Activities 15.1 and 15.2	
20.	Language of instruction	English , Macedonian	
21.	Method of monitoring the quality of teaching	In accordance with the university procedures and quality control methods	

22.	Literature					
	22.1.	Mandatory literature				
		Serial number	Author	Title	Publisher	Year

		1.	Man Young Rhee	Internet Security: Cryptographic Principles", "Algorithms and Protocols	Wiley Publications	2003
		2.				
		3.				
	22.2.	Additional literature				
		Serial number	Author	Title	Publisher	Year
		1.	John R. Vacca	Computer Forensics	Firewall Media,	2005
		2.	Marjie T. Britz	Computer Forensics and Cyber Crime: An Introduction	Pearson Education, 1st Edition,	2012
		3.				

Attachment No. 3	**Second cycle study program**					
1.	Title of the course	Embedded systems design and rapid prototyping				
2.	Code	CSE22E 10				
3.	Studio program / Faculty	Computer Techniques and Informatics / Faculty of Computer Science and Engineering				
4.	Organizer of the study program (unit, i.e. institute, department , division)	Faculty of Computer Science and Engineering, University of Information Sciences and Technologies "St. Paul the Apostle" - Ohrid				
5.	Degree (first , second, third cycle)	Second cycle				
6.	Academic year / semester	1st year / second semester	7.	Number of ECTS credits	6	
8.	Teacher	Dr. Ile Dimitrievski				
9.	Prerequisites for enrolling in the course					
10.	Objectives of the subject program (competencies): This course aims to introduce students to contemporary developments in the field of embedded systems design and rapid prototyping. Microprocessor and microcontroller- based embedded systems can be found all around us, including mobile phones, smartphones, PDAs, DVD players , printers , washing machines, modern air conditioners , home security systems, ATMs, aircraft control systems, automotive engine monitoring systems, and many others. Upon completion of this course, students will learn how to develop and program embedded systems. They will be able to master the programming of microprocessor- based embedded systems in the C programming language, the functions and use of commonly used peripherals.					
11.	Subject content program : Precisely, this course will cover the following topics: What is an embedded system; Programming microprocessor -based embedded controllers in the C programming language; Using multipurpose analog and digital input/output channels; Serial (RS232/485), I2C, SPI communication with sensors; Quadrature decoding for measuring wheel position; Pulse width modulation , Time interrupts for creating sampling intervals ; Real-time embedded operating systems; Introduction to rapid prototyping with Matlab / Simulink , Real time Windows Target and xPC Target .					
12.	Teaching methods : This course is based on 30 hours of lectures, supplemented by teamwork, consultations with the subject professor and project development .					
13.	Total available study time	6 ECTS credits x 30 hours/credit = 180 hours				
14.	Distribution of available resources time	Lectures: 30 hours; Exercises: 15 hours; Independent preparation, projects, homework: 135 hours = Total time of 180 hours				
15.	Forms of teaching activities	15.1.	Lectures - theoretical teaching	30 hours		
		15.2.	Exercises (laboratory, classroom), teamwork	15 hours		
16.	Others forms of activities	16.1.	Project development	50 hours		
		16.2.	Case study	35 hours		
		16.3.	Homemade learning	50 hours		
17.	Method of assessment 6 0 + 3 0 + 10					
	17.1.	Tests	60 points			
	17.2.	Individual work/ project (presentation: written and oral)	30 points			

	17.3.	Activity and participation				10 points
18.	Assessment criteria (points / grade)			up to 50 points		5 (five) (F)
				from 51 to 60 points		6 (six) (E)
				from 61 to 70 points		7 (seven) (D)
				from 71 to 80 points		8 (eight) (C)
				from 81 to 90 points		9 (nine) (B)
				from 91 to 100 points		10 (ten) (A)
19.	Requirement for signature and final examination		Attendance at the Activities 15.1 and 15.2			
20.	Language of instruction		English, Macedonian			
21.	Method of monitoring teaching quality		In accordance with the university procedures and quality control methods			
	Literature					
	22.1	Required literature				
		Serial number	Author	Title	Publisher	Year
		1.	Wayne Wolf	Computers as Components Principles of Embedded Computing System Design	Morgan Kaufman	2008
		2.				
		3.				
	22.2	Additional literature				
		Serial number	Author	Title	Publisher	Year
		1.	Steve Heath	Embedded Systems Design, Second Edition	Newnes	2003
		2.				
		3.				

1.	Title of the course	Ethical hacking			
2.	Code	CSE22E 14			
3.	Study program / Faculty	Computer Techniques and Informatics / Faculty of Computer Science and Engineering			
4.	Organizer of the study program (unit, i.e. institute , department, division)	Faculty of Computer Science and Engineering, University of Information Sciences and Technologies "St. Paul the Apostle" - Ohrid			
5.	Degree (first, second, third cycle)	Second cycle			
6.	Academic year / semester	1st year/second semester	7.	Number of ECTS credits	6
8.	Teacher	Full Professor Dr. Ustiana Rechkoska Shikoska			
9.	Prerequisites for enrolling in the course				

10. Objectives of the subject program (competencies):
The goal of this course is for students to learn how to scan, test, hack, and secure systems. Upon completion of the course, the student should be able to:
1. Understand how hackers assign privileges to themselves in the system.
2. Understand policy creation, social engineering, buffer overflows, and different types of attacks and mechanisms for protecting against them.
3. To become familiar with ethical laws and tests .

11. Course content:

1. Ethical hacking

Types of data stolen from organizations, Elements of information security, authenticity and irrevocability, security challenges, Effects of hacking, Hackers - Types of Hackers, Ethical Hackers, Hacking - The role of security and penetration tester, methodologies, networking and computer attacks - malware, protection against malware, Hacker attacks on networks and computer systems, physical security - key connections and protections.

2. Fingerprints and social engineering

Web fingerprinting tools, conducting appropriate intelligence, Google Hacking, scanning, enumeration, Trojans and backdoors, viruses and worms, proxy and packet filtering, denial of service, obfuscation, social engineering – “shoulder” surfing, “Dumpster” diving, “piggybacking”.

3. Data security

Physical security - attacks and protection, steganography - Methods, attacks and measures, Cryptography - Methods and types of attacks, wireless hacking, windows hacking, Linux hacking.

4. Network security systems and web server hacking

Routers, Firewalls and Honeypots, IDS and IPS, Web filtering, vulnerability, penetration testing, hijacked sessions, web servers, SQL injections, “cross site” scripts, exploit writing, buffer

	overflows, reverse engineering, email hacking, incident handling and response, Bluetooth hacking, mobile phone hacking. 5. Laws and tests of ethical hacking Introduction to specific legal, professional and ethical issues in the domain of ethical hacking, ethical responsibilities, professional integrity and appropriate use of tools and techniques related to ethical hacking - social engineering, host reconnaissance, hijacked sessions, hacking - web servers, databases, password cracking, wired and wireless networks, Trojans, Backdoor, Unix, Linux, Microsoft, NOVEL Server, buffer overflows, denial of service attacks, methodological penetration and testing.			
12.	Teaching methods: This course is based on 30 hours of lectures, supplemented by teamwork, consultations with the subject professor, and project development .			
13.	Total available fund on time	6 ECTS credits x 30 hours/credit = 180 hours		
14.	Allocation of available time	Lectures: 30 hours; Exercises: 1 5 hours; Independent preparation, projects, homework: 1 35 hours = Total time of 180 hours		
15.	Forms of teaching activities	15.1.	Lectures - theoretical teaching	30 hours
		15.2.	Exercises (laboratory, classroom), teamwork	15 hours
16.	Other forms of activities	16.1.	Project tasks	50 hours
		16.2.	Independent tasks	35 hours
		16.3.	Homework - assignments	50 hours
17.	Grading method 60 + 30 + 10			
	17.1.	Exams		60 points
	17.2.	Individual work/project (presentation: written and oral)		30 points
	17.3.	Activity and participation		10 points
18.	Assessment criteria (points/grade)		up to 50 points	5 (five) (F)
			51 x to 60 points	6 (six) (E)
			61 x to 70 points	7 (seven) (D)
			from 71 to 80 points	8 (eight) (C)
			from 81 to 90 points	9 (nine) (B)

			from 91 to 100 points		10 (ten) (A)
19.	Requirement for signature and passing the final exam		Attendance at the Activities 15.1 and 15.2		
20.	Language of instruction		English , Macedonian		
21.	Method of monitoring the quality of teaching		In accordance with the university procedures and quality control methods		
22.	Literature				
	22.1.	Required literature			
		Serial number	Author	Title	Publisher	Year
		1.	Michael T. Simpson, Kent Backman, James E.	Corley, Hands-On Ethical Hacking and Network Defense	Second Edition, CENGAGE Learning	2010
		2.				
		3.				
	22.2.	Additional literature				
		Serial number	Author	Title	Publisher	Year
		1.	Steven DeFino, Barry Kaufman, Nick Valentine	Official Certified Ethical Hacker Review Guide	CENGAGE Learning	2009
		2.	Patrick Engebretson	The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy	Syngress Basics Series – Elsevier	2011

		3.	Whitaker & Newman	Penetration Testing and Network Defense	Cisco Press	2006

Attachment No. 3	**Course program of the first, second and third cycle of studies**				
1.	Title of the course	Financial forecasting			
2.	Code	CSE22E25			
3.	Study program / Faculty	Computer techniques and informatics			
4.	Organizer of the study program (unit, i.e. institute, department, division)	Faculty of Computer Science and Engineering, University of Information Sciences and Technologies "St. Paul the Apostle" - Ohrid			
5.	Degree (first, second, third cycle)	Second cycle			
6.	Academic year / semester	first year/ second semester	7.	Number of ECTS credits	6
8.	Teacher	Dr. Jovanka Damoska Sekuloska			
9.	Prerequisites for enrolling in the course				
10.	Objectives of the course program (competences) : - Understand the principles, methods, and applications of financial forecasting. - Create forecasted financial statements and indicators using appropriate analytical tools and techniques. - Utilise financial forecasts to support strategic business planning and investment decision-making under conditions of uncertainty.				
11.	Course content : 1. Basic and Advanced Financial Analysis and Forecasting Tools - Introduction to fundamental and advanced tools used for analysing financial data and developing reliable financial forecasts to support business planning and decision-making. 2. Financial Forecasting Methods and Models - Overview of qualitative and quantitative forecasting techniques, including trend analysis, regression models, time-series analysis, and scenario planning. 3. Preparation and Forecasting of Financial Statements - Techniques for projecting key financial statements, including the income statement, balance sheet, and cash flow statement, based on historical and expected future performance. 4. Valuation of Short-Term Financial Securities - Principles and methods for valuing short-term financial instruments, such as treasury bills, commercial paper, and money market securities. 5. Valuation of Long-Term Financial Securities and Equity - Methods for assessing the value of bonds, stocks, and other long-term investment instruments using various valuation models and financial indicators. 6. Financial Risk Management - Identification, measurement, and management of financial risks, including market, credit, liquidity, and operational risks, and the application of risk mitigation strategies. 7. Financial Models for Decision-Making - Development and application of financial models to evaluate business alternatives, support investment decisions, and optimise financial performance under different scenarios.				
12.	Teaching methods combine lectures, tutorials, and independent study with project-based learning. Lectures provide theoretical foundations, while tutorials emphasise practical application through case studies and financial analysis exercises. Independent preparation and projects encourage				

	self-directed learning and research. Technology is integrated into teaching through spreadsheets, financial software, and databases.				
13.	Total Available Time Allocation		6 ECTS credits x 30 hours/credit = 180 hours		
14.	Allocation of available time		Lectures: 30 hours; Exercises: 15 hours; Independent preparation, projects, homework: 1 35 hours = Total time of 180 hours		
15.	Forms of teaching activities	15.1.	Lectures - theoretical teaching	30 hours	
		15.2.	Exercises (laboratory, classroom), seminars, teamwork	15 hours	
16.	Other forms of activities	16.1.	Project tasks	50 hours	
		16.2.	Independent tasks	35 hours	
		16.3.	Home learning	50 hours	
17.	Grading method 60 + 30 +10				
	17.1.	Tests		60 points	
	17.2.	Seminar paper/project (presentation : written and oral)		30 points	
	17.3.	Activity and participation		10 points	
18.	Assessment criteria (points /grade)		up to 50 points	5 (five) (F)	
			from 51 to 60 points	6 (six) (E)	
			from 61 to 70 points	7 (seven) (D)	
			from 71 to 80 points	8 (eight) (C)	
			from 81 to 90 points	9 (nine) (B)	
			from 91 to 100 points	10 (ten) (A)	
19.	Requirement for signature and passing the final exam		Students should ensure regular attendance at classes in accordance with the UINT regulations.		
20.	Language of instruction		English, Macedonian		
21.	Method of monitoring the quality of teaching		Compliance with UIST quality control procedures		

Literature

Required literature

Serial number	Author	Title	Publisher	Year
1.	Michael Samonas	Financial Forecasting, Analysis and Modeling: a framework for Long-term Forecasting 1ed	Wiley	2015
2.	Simon Benninga and Tal Mofkadi	Financial Modeling 5th ed.	MIT Press	2022

Additional literature

Serial number	Author	Title	Publisher	Year
1.	Timothy R. Mayes	Financial Analysis with Microsoft Excel	Cengage Learning	2015

		2.				
		3.				

Attachment No. 3	**Second cycle study program**				
1.	Title of the course	Genetic algorithms and machine learning			
2.	Code	CSE22E1 2			
3.	Studio program / Faculty	Computer techniques and informatics			
4.	Organizer of the study program (unit, i.e. institute, department , division)	Faculty of Computer Science and Engineering, University of Information Sciences and Technologies "St. Paul the Apostle" - Ohrid			
5.	Degree (first , second, third cycle)	Second cycle			
6.	Academic year / semester	1st year / second semester	7.	Number of ECTS credits	6
8.	Teacher	Dr. Ljubinka Sandžakoska			
9.	Prerequisites for enrolling in the course				
10.	Objectives of the subject program (competencies): This course provides students with a sufficient understanding of the concepts of genetic algorithms and helps them identify potential uses for them. Upon completion of this course, the student should be able to : 1. To be familiar with the basic concept of genetic algorithms and machine learning 2. To learn and analyze the mathematical foundations of genetic algorithms 3. To learn the different operators of genetic algorithms and their applications 4. Learn to develop applications based on genetic algorithms 5. To understand machine learning and its applications based on genetic algorithms				
11.	Subject content program : 1. Introduction to genetic algorithms and machine learning Robustness of traditional optimization and search methods - optimization goals - genetic algorithms vs. traditional methods - basic genetic algorithms; introduction to machine learning - machine learning vs. artificial intelligence, supervised and unsupervised machine learning - examples of machine learning. 2. Mathematical foundations of genetic algorithms Fundamental theorems - processing schemes - the " 2-armed & karmed Bandit " problem - Building block hypotheses. - the "Minimal deceptive" problem . 3. Genetic algorithm operators Data structures – reproduction – "Roulette-wheel" selection – Boltzmann selection – " tournament " selection – " rank " selection – stability – "state" selection – Crossover and mutation – Mapping of objective functions for the fitness forum. – Fitness scaling. 4. Application of genetic algorithms The rise of genetic algorithms - application of genetic algorithms to historical interactions. - function optimization - current applications of genetic algorithms - Advanced operators and techniques in genetic search: dominance and quiescence. 5. Application of genetic algorithms in machine learning The rise of machine learning based on genetic algorithms - Learning classification systems - development of CS-1, the first classification system. - Smitch poker player - machine learning based on genetic algorithms as a subproblem - Foundations of early machine learning based on genetic algorithms - current applications.				
12.	Teaching methods : This course is based on 30 hours of lectures, supplemented by teamwork, consultations with the subject professor and project development .				
13.	Total Available Time	6 ECTS credits x 30 hours/credit = 180 hours			
14.	Distribution of available resources time	Lectures: 30 hours; Exercises: 15 hours; Independent preparation, projects, homework: 135 hours = Total time of 180 hours			

15.	Forms of teaching activities	15.1.	Lectures - theoretical teaching	30 hours
		15.2.	Exercises (laboratory, classroom), teamwork	15 hours
16.	Others forms of activities	16.1.	Project development	50 hours
		16.2.	Case study	35 hours
		16.3.	Homemade learning	50 hours

17.	Method of assessment 6 0 + 3 0 + 10		
	17.1.	Tests	60 points
	17.2.	Individual work/ project (presentation: written and oral)	30 points
	17.3.	Activity and participation	10 points

18.	Assessment criteria (points / grade)	up to 50 points	5 (five) (F)
		from 51 to 60 points	6 (six) (E)
		from 61 to 70 points	7 (seven) (D)
		from 71 to 80 points	8 (eight) (C)
		from 81 to 90 points	9 (nine) (B)
		from 91 to 100 points	10 (ten) (A)
19.	Requirement for signature and passing the final exam	Students must attend classes regularly in accordance with UIST regulations.	
20.	Language in which it is performed the teaching	English, Macedonian	
21.	Method of monitoring the quality of teaching	Compliance with UIST quality control procedures	

Literature

Required literature

	Serial number	Author	Title	Publisher	Year
22.1	1.	David E. Goldberg	Genetic Algorithms in Search, Optimization & Machine Learning	Pearson Education	2013
	2.				
	3.				

Additional literature

	Serial number	Author	Title	Publisher	Year
22.2	1.	Kalyanmoy Deb,	Optimization for Engineering Design, algorithms and examples	PHI	1995
	2.	Rajasekaran S., Vijayalakshmi Pai GA	Neural Networks, Fuzzy Logic and Genetic algorithms	PHI	2003
	3.				

Attachment No. 3	**Second cycle of studies course program**					
1.	Title of the course	Image processing technologies				
2.	Code	CSE22E0 3				
3.	Studio program / Faculty	Computer techniques and informatics				
4.	Organizer of the study program (unit, i.e. institute, department , division)	Faculty of Computer Science and Engineering, University of Information Sciences and Technologies "St. Paul the Apostle" - Ohrid				
5.	Degree (first , second, third cycle)	Second cycle				
6.	Academic year / semester	1st year/ second semester	7.	Number of ECTS credits	6	
8.	Teacher	Dr. Atanas Hristov				
9.	Prerequisites for enrolling in the course					
10.	Objectives of the subject program (competencies): This course aims to introduce students to image processing technologies. Upon completion of the course, students should have knowledge of: techniques for determining image depth, motion and shaping image sequences, compression and representation of three-dimensional images, image processing sensors, as well as methods for image recognition and processing.					
11.	Subject content program : 1. Passive Range Sensing Techniques : Depth Imaging, 2. Optimal approaches to computer visualization and image processing 3. Motion and shaping of image sequences under 55 correspondence features (55 matching features) 4. Compression and representation of three -dimensional images 5. Omnidirectional censorship and its application 6. Sensors for data processing: VLSI vision 7. Facial image processing and recognition and its application 8. Document analysis and recognition 9. Progress so far in image processing in medicine 10. Image processing in intelligent transportation systems					
12.	Teaching methods : This course is based on 30 hours of lectures, supplemented by teamwork, consultations with the subject professor and project development .					
13.	Total Available Time	6 ECTS credits x 30 hours/credit = 180 hours				
14.	Distribution of available resources time	Lectures: 30 hours; Exercises: 15 hours; Independent preparation, projects, homework: 1 35 hours = Total time of 180 hours				
15.	Forms of teaching activities	15.1.	Lectures - theoretical teaching	30 hours		
		15.2.	Exercises (laboratory , classroom) , teamwork	15 hours		
16.	Others forms of activities	16.1.	Project tasks	50 hours		
		16.2.	Independent tasks	35 hours		
		16.3.	Homework - assignments	50 hours		
17.	Method of assessment 6 0 + 30 + 10					
	17.1.	Tests	6 0 points			

	17.2.	Individual work/project (presentation: written and oral)		3 0 points
	17.3.	Activity and participation		10 points
18.	Assessment criteria (points / grade)		up to 50 points	5 (five) (F)
			from 51 to 60 points	6 (six) (E)
			from 61 to 70 points	7 (seven) (D)
			from 71 to 80 points	8 (eight) (C)
			from 81 to 90 points	9 (nine) (B)
			from 91 to 100 points	10 (ten) (A)
19.	Requirement for signature and passing the final exam	Students must attend classes regularly in accordance with UIST regulations.		
20.	Language in which it is performed the teaching	English, Macedonian		
21.	Method of monitoring the quality of teaching	Compliance with UIST quality control procedures		

Literature

Required literature

	Serial number	Author	Title	Publisher	Year
22.1	1.	Klyoharu Alzawa, Katsuhiko Sakaue, Yasuhito Suenaga	Image Processing Technologies Algorithms, Sensors, and Applications	Marcel Dekker, INC.	200 4
	2.				
	3.				

Additional literature

	Serial number	Author	Title	Publisher	Year
22.2	1.	Phillip A. Laplante	Adaptive image processing	Pennsylvania Institute of Technology	2002
	2.				
	3.				

Attachment No. 3	**Course program of the first, second and third cycle of studies**					
1.	Title of the course	Infrastructure solutions for a smart society				
2.	Code	CSE22E 27				
3.	Study program / Faculty	Computer techniques and informatics				
4.	Organizer of the study program (unit, i.e. institute, department, division)	Faculty of Computer Science and Engineering, University of Information Sciences and Technologies "St. Paul the Apostle" - Ohrid				
5.	Degree (first, second, third cycle)	Second cycle				
6.	Academic year / semester	1st year / second semester	7.	Number of ECTS credits	6	
8.	Teacher	Assoc. Dr. Jovan Karamachoski				
9.	Prerequisites for enrolling in the course					
10.	Objectives of the subject program (competencies): After completing the course, the candidate will be qualified for scientific research and application work in the field of smart societies. The student will become familiar with the characteristics of IoT network concepts and solutions that offer the development of smart societies. He will study in detail the concepts of networking IoT nodes at the sensor level and at the level of backend networks and network services. Through the analysis and design of practical examples, he will also acquire knowledge for the development of specific smart solutions.					
11.	Course content: Introduction to the concept of the Internet of Things (IoT) and smart society. Protocols for devices used to build a smart society . Personal sensor networks, architecture and protocols. RFID , NFC , LoRaWAN , NB - IoT . IoT platforms, applications and services. IoT networking in the cloud. Helium network . Collecting, processing and storing IoT data knots. Development of a complete solution for smart societies.					
12.	Teaching methods : This course is based on 30 hours of lectures, supplemented by teamwork, consultations with the subject professor and project development.					
13.	Total Available Time	6 ECTS credits x 30 hours/credit = 180 hours				
14.	Allocation of available time	Lectures: 30 hours; Exercises: 15 hours; Independent preparation, projects, homework: 135 hours = Total time of 180 hours				
15.	Forms of teaching activities	15.1.	Lectures - theoretical teaching	30 hours		
		15.2.	Exercises (laboratory, classroom), teamwork	15 hours		
16.	Other forms of activities	16.1.	Project development	50 hours		
		16.2.	Case study	35 hours		
		16.3.	Home learning	50 hours		
17.	Grading method 6 0 + 3 0 + 10					
	17.1.	Tests	60 points			
	17.2.	Individual work/project (presentation: written and oral)	30 points			
	17.3.	Activity and participation	10 points			
18.	Assessment criteria (points /grade)	up to 50 points	5 (five) (F)			
		from 51 to 60 points	6 (six) (E)			
		from 61 to 70 points	7 (seven) (D)			

				from 71 to 80 points	8 (eight) (C)	
				from 81 to 90 points	9 (nine) (B)	
				from 91 to 100 points	10 (ten) (A)	
19.	Requirement for signature and passing the final exam			Students must attend classes regularly in accordance with UIST regulations.		
20.	Language of instruction			English, Macedonian		
21.	Method of monitoring the quality of teaching			Compliance with UIST quality control procedures		
	Literature					
	22.1	Required literature				
		Serial number	Author	Title	Publisher	Year
		1.	Carol L. Stimmel	Building Smart Cities: Analytics, ICT, and Design Thinking	Auerbach Publications	2015
		2.	Carles Anton-Haro, Mischa Dohler	Machine-to-machine (M2M) Communications	Elsevier	2016
		3.	S. Greengard	The Internet of Things	MIT press	2015
	22.2	Additional literature				
		Serial number	Author	Title	Publisher	Year
		1.	Vojislav B. Misic, Jelena Misic	Machine-to-Machine Communications: Architectures, Technology, Standards, and Applications	CRC Press	2017
		2.	James Sinopoli	Advanced Technology for Smart Buildings	Artech House	2016
		3.				

Attachment No. 3		**Subject program from the second cycle of studies**		
1.	Title of the teaching subject	Knowledge-based decision-making systems		
2.	Code	CSE22E11		
3.	Study program	Computer Techniques and Informatics		
4.	Organizer of the study program (unit, i.e. institute, department)	University of Information Sciences and Technologies "St. Paul the Apostle" - Ohrid; Faculty of Computer Science and Engineering – CSE		
5.	Degree (first, second, third cycle)	Second cycle – elective subject from the unit		
6.	Academic year / semester	First year master	semester	X (tenth)
7	Course Workload Expressed in ECTS Credits	6 (six)		
8.	Teacher (in case of multiple teachers, the responsible instructor is designated)	Aleksandar Karadimche, PhD		
9.	Language of instruction	English, Macedonian		
10.	Prerequisites for Attending and Passing the Course			
11.	Course Objectives (Competencies) and Learning Outcomes:	The aim of this course is to transfer knowledge and implementation of decision-making systems. After completing the course, the student should: 1. Become familiar with decision-making systems and their characteristics 2. Learn the technologies related to decision-making systems 3. Study "intelligent" decision-making systems and the application of decision-making systems		
12.	Detailed course content by chapters and units, with learning outcomes for each chapter	Course content: Decision making and computerized support. Management support systems: Overview - Decision making, systems, modeling, and support. Decision making systems Decision making systems: Overview - Modeling and analysis - Business intelligence: data warehousing, data acquisition, data mining, business analysis and visualization - developing decision making systems. Collaboration, communication, support systems, and knowledge management Collaborative computing technologies: group support systems - information systems - Knowledge management. Intelligent decision making systems Artificial intelligence and expert systems: knowledge-based systems - Knowledge acquisition, representation, and reasoning - Advanced intelligent systems - Intelligent systems over the Internet. Implementation in the era of electronic business Electronic commerce - integration, impacts, and future of management support systems.		
13	Interconnection of Courses	/		
14.	Detailed Description of the Teaching and Working Methods for the Course	Lectures: 30 hours; Exercises: 15 hours; Independent preparation, projects, homework: 135 hours = Total time of 180 hours		
15.	Total Available Time Allocation	6 ECTS credits x 30 hours/credit = 180 hours		
16.	Forms of Teaching Activities	16.1.	Lectures – theoretical instruction, hours	30 hours
		16.2.	Exercises (laboratory, auditory), seminars, teamwork: hours	15 hours
17.	Other forms of activities	17.1.	Project assignments: hours	50 hours
		17.2.	Independent tasks: hours	35 hours
		17.3.	Home study – tasks	50 hours
18	Conditions for Signature	Students must attend classes regularly in accordance with UIST regulations.		
19	Assessment Method	60 + 30 + 10		
	19.1.	Tests: Points		60 points

	19.2.	Seminar paper/project, written and oral presentation: points		30 points
	19.3.	Final exam: points		10 points
20	Assessment criteria (points/grade)		up to 50 points	5 (five) (F)
			from 51 to 60 points	6 (six) (E)
			from 61 to 70 points	7 (seven) (D)
			from 71 to 80 points	8 (eight) (C)
			from 81 to 90 points	9 (nine) (B)
			from 91 to 100 points	10 (ten) (A)
21.	Method for monitoring the quality of teaching		Compliance with UIST quality control procedures	

22. Literature

22.1. Mandatory Literature

No.	Author	Title	Publisher	Year
1.	Miquel Sànchez-Marrè	Intelligent Decision Support Systems	Springer	2022
2.	Efraim Turban, Jay Aronson E., Ting-Peng Liang,	Decision Support Systems and Intelligent Systems	7th Edition, Pearson Education,	2006
3.				

22.2. Additional Literature

No.	Author	Title	Publisher	Year
1.	George M. Marakas	Decision Support Systems in the 21st century	2nd Edition, PHI	2009
2.	Janakiraman V.S., Sarukesi K.,	Decision Support Systems	PHI Learning Pvt. Ltd.	2009
3.				

Attachment No. 3		**Second cycle study program**			
1.	Title of the course	Mathematical logic for computer science			
2.	Code	CSE22E22			
3.	Study program	Computer techniques and informatics			
4.	Organizer of the study program (unit, i.e. institute, department, division)	Faculty of Computer Science and Engineering, University of Information Sciences and Technologies "St. Paul the Apostle" - Ohrid			
5.	Degree (first, second, third cycle)	Second cycle			
6.	Academic year / semester	1st year / second semester	7	Number of ECTS credits	6
8.	Teacher	Dr. Rasim Salkoski			
9.	Prerequisites for enrolling in the course				
10.	Course objectives (competencies): The aim of the course is to introduce the concepts and properties of propositional and predicate logical calculus and their application in computer science.				
11.	Course content: Propositional calculus: Boolean operations and interpretations, propositional formulas, logical equivalences and substitutions, semantic tables, deductive proofs, resolutions, Gentzen and Hilbert systems. Predicate calculus: relations, predicate formulas, interpretations, logical equivalences and substitutions, semantic tables, deductive forms, functions and terms. Resolution and logic programming: basic resolution, substitution, unification, general resolution, logic programming and temporal logic.				
12.	Теацхинг methods: This course is based on 30 hours of lectures, supplemented by the study of a specific case, consultations with the subject professor and the preparation of a project.				
13.	Total Available Time	6 ECTS credits x 30 hours/credit = 180 hours			
14.	Allocation of available time	Lectures: 30 hours; Exercises: 15 hours; Independent preparation, projects, homework: 135 hours = Total time of 180 hours			
15.	Forms of teaching activities	15.1.	Lectures - theoretical teaching	30 hours	
		15.2.	Exercises (laboratory, classroom), teamwork	15 hours	
16.	Other forms of activities	16.1.	Project development	50 hours	
		16.2.	Case study	35 hours	
		16.3.	Home learning	50 hours	
17.	Assessment method: 60 + 30 + 10				
	17.1.	Tests	60 points		
	17.2.	Individual work/project (presentation: written and oral)	30 points		

	17.3.	Activity and participation		10 points
	17.4.			
18.	Assessment criteria (points/grade)		up to 50 points	5 (five) (F)
			51 x to 60 points	6 (six) (E)
			61 x to 70 points	7 (seven) (D)
			from 71 to 80 points	8 (eight) (C)
			from 81 to 90 points	9 (nine) (B)
			from 91 to 100 points	10 (ten) (A)
19.	Requirement for signature and passing the final exam		Students must attend classes regularly in accordance with UIST regulations.	
20.	Language of instruction		English, Macedonian	
21.	Method of monitoring the quality of teaching		Compliance with UIST quality control procedures	

22.	Literature					
	22.1.	Required literature				
		Serial number	Author	Title	Publisher	Year
		1.	M. Ben-Ari	Mathematical Logic for Computer Science	Springer	2012
		2.				
		3.				
	22.2.	Additional literature				
		Serial number	Author	Title	Publisher	Year
		1.				

Attachment No. 3	**Course program of the first, second and third cycle of studies**				
1.	Course Title	Mathematical Modelling			
2.	Code	CSE22E26			
3.	Study Program/ Faculty	Computer techniques and informatics			
4.	Organising unit	University for Information Science and Technology "St. Paul the Apostle" – Ohrid; Faculty of Computer Science and Engineering			
5.	Cycle of studies	Second			
6.	Academic Year / Semester	I year/ II semester	7.	ECTS credits	6
8.	Teacher	Prof. Elena Hadzieva, PhD.			
9.	Prerequsites	/			
10.	Course Objectives: Students will learn what a mathematical model and mathematical modeling are, and the importance of assumptions in model construction; use proportionality and similarity in modeling; fit curves to data (linear regression) and make predictions; compare linear regression models; model systems using linear equations; fit polynomials (nonlinear regression); apply multiple linear regression; define and solve discrete dynamical systems; solve linear optimization problems; become familiar with the transportation problem; apply the simplex method; solve nonlinear optimization problems using Newton's method, the golden section method, and gradient methods; and use Excel as a tool for solving problems from these topics.				
11.	**Course Content:** Mathematical modeling – concepts and applications. Modeling with proportionality. Linear regression. Linear models. Models reducible to systems of linear equations. Nonlinear regression. Multiple linear regression. Discrete dynamical systems. Discrete logistic equation. Linear predator–prey model. Nonlinear predator–prey model. Linear optimization. Transportation problem. Simplex method. Nonlinear optimization. Newton's method. Golden section method. One-dimensional and two-dimensional gradient methods. Optimization using the Lagrange function. Use of contemporary software for solving problems from the listed topics.				
12.	Teaching Methods: This course is based on 30 hours of lectures supplemented by theoretical and practical exercises, consultations and project work.				
13.	Total Workload	6 ECTS credits x 30 hours/credit = 180 hours			
14.	Total Available Time Allocation	Lectures: 30 hours; Exercises: 15 hours; Independent study, projects, homework: 135 hours; Total: 180 hours			
15.	Forms of Teaching Activities	15.1.	Lectures – theoretical instruction, hours	30 hours	
		15.2.	Exercises (laboratory, auditory), seminars, teamwork: hours	15 hours	
16.	Други форми на активности Other forms of activities	16.1.	Project assignments: hours	50 hours	
		16.2.	Independent tasks: hours	35 hours	
		16.3.	Home study – tasks	50 hours	
17.	Assesment Method 60 + 30 + 10				
	17.1.	Final Exam		60 points	
	17.2.	Seminar paper/project, written and oral presentation: points		30 points	
	17.3.	Presence and activity		10 points	
18.	Assessment criteria (points/grade)	up to 50 points		5 (five) (F)	
		from 51 to 60 points		6 (six) (E)	
		from 61 to 70 points		7 (seven) (D)	
		from 71 to 80 points		8 (eight) (C)	
		from 81 to 90 points		9 (nine) (B)	

				from 91 to 100 points	10 (ten) (A)
19.	Requirement for signature and passing the final exam			Students are required to attend classes regularly in accordance with UIST regulations.	
20.	Language of instruction			English	
21.	Method of monitoring the quality of teaching			Compliance with UIST quality control procedures	
	Literature				
	22.1	Required Literature			
		No	Author	Title	Issued by	Year
		1.	Brian Albright, William P. Fox	Mathematical Modeling with Excel (2nd ed.)	CRC Press, Taylor & Francis Group	2020
		2.				
		3.				
	22.2	Additional Literature				
		No	Author	Title	Issued by	Year
		1.	Frank R. Giordano, William P. Fox, Steven B. Horton	A First Course in Mathematical Modeling, 5th edition	Brooks/Cole, Cengage Learning	2014
		2.				
		3.				

Annex No. 3	**Course Syllabus – Second Cycle Studies**				
1.	Course Title	Performance, Reliability and Security of Database Systems			
2.	Code	CSE22E18			
3.	Study Programme / Faculty	Computer Techniques and Informatics			
4.	Organizer of the Study Programme (unit, institute, department)	Faculty of Computer Science and Engineering (CSE), University of Information Science and Technology "St. Paul the Apostle" – Ohrid			
5.	Level (first, second, third cycle)	Second Cycle			
6.	Academic Year / Semester	1st Year	7.	Number of ECTS Credits	6
8.	Lecturer	PhD Dijana Capeska Bogatinoska			
9.	Prerequisites for Enrolment				
10.	Course Objectives (Competencies): The aim of this course is to introduce students to advanced concepts of performance, reliability, and security in database management systems, including relational and non-relational databases, as well as centralised and distributed databases. Upon completion of the course, students are expected to have knowledge of the theoretical and practical aspects of data reliability and security in database management systems.				
11.	Course Content: The topics covered within this course are: Transaction processing – advanced level, with an overview of ACID properties in relational databases and BASE properties in non-relational databases; Concurrency control – conceptual and theoretical aspects; Database recovery systems – conceptual and theoretical aspects; Practical methods for ensuring data availability – backup and recovery techniques; Data security in database systems within the overall security of ICT systems; Security at the level of the database server and at the application level; Security of communication between databases, trojans, and encryption; Regulations, procedures, compliance, and monitoring.				
12.	Teaching Methods: This course is based on 30 hours of lectures, supplemented by teamwork, consultations with the course lecturer, and project work.				
13.	Total Available Study Time	6 ECTS credits × 30 hours/credit = 180 hours			
14.	Distribution of Available Time	Lectures: 30 hours; Exercises: 15 hours; Independent study, projects, homework: 135 hours = Total: 180 hours			

15.	Forms of Teaching Activities	15.1.	Lectures – theoretical instruction	30 hours
		15.2.	Exercises (laboratory, classroom), teamwork	15 hours
16.	Other Forms of Activities	16.1.	Project assignments	50 hours
		16.2.	Independent assignments	35 hours
		16.3.	Home study – tasks	50 hours

17.	Assessment Method: 60 + 30 + 10		
	17.1.	Tests	60 points
	17.2.	Individual work / project (written and oral presentation)	30 points
	17.3.	Activity and participation	10 points

18.	Grading Criteria (points / grade)	up to 50 points	5 (five) (F)
		51 to 60 points	6 (six) (E)
		61 to 70 points	7 (seven) (D)
		71 to 80 points	8 (eight) (C)
		81 to 90 points	9 (nine) (B)
		91 to 100 points	10 (ten) (A)
19.	Conditions for Signature and Final Examination	Students are required to attend classes regularly in accordance with the UIST regulations.	
20.	Language of Instruction	English, Macedonian	
21.	Method of Monitoring Teaching Quality	Following the quality control procedures of UIST	

22.	Literature					
	22.1.	Required Literature				
		No.	Author	Title	Publisher	Year
		1.	Avi Silberschatz, Henry F. Korth, S. Sudarshan	Database System Concepts, Seventh Edition	McGraw-Hill	2019

		2.	Christopher Diaz	Database Security – Problems and Solutions	Mercury Learning and Information	2022
		3.	Laine Campbell, Charity Majors	Database Reliability Engineering: Designing and Operating Resilient Database Systems	O'Reilly Media	2017
	22.2.	Additional Literature				
		No.	Author	Title	Publisher	Year
		1.	Elisa Bertino, Gabriel Ghinita and Ashish Kamra	Access Control for Databases: Concepts and Systems, Foundations and Trends in Databases	NOW Publishers	2011
		2.	Ramez Elmasri, Shamkant B. Navathe	Fundamentals of Database Systems, 7th Edition	Pearson	2015
		3.	Ron Ben Natan	Implementing Database Security and Auditing	Digital Press	2005

1.	Title of the course	Processing of textual data			
2.	Code	CSE22E 16			
3.	Study program	Computer techniques and informatics			
4.	Organizer of the study program (unit, i.e. institute, department, division)	Faculty of Computer Science and Engineering, University of Information Sciences and Technologies "St. Paul the Apostle" - Ohrid			
5.	Degree (first, second, third cycle)	Second cycle			
6.	Academic year / semester	1st year / second semester	7.	Number of ECTS credits	6 (six)
8.	Teacher	Dr. Alexander Karadimche			
9.	Prerequisites for enrolling in the course				
10.	Objectives of the subject program (competencies): Upon successful completion of this course, the student will be able to recognize the key problems arising from the use of text data, to learn the most appropriate algorithms for their resolution, to explore and analyze text data and discover new knowledge from them, to learn and apply existing tools for processing text data, and to create their own solutions for the realization of individual tasks in the field of processing and mining of text documents and data.				
11.	Course content: Introduction to text data processing and text mining; Data extraction, classification, categorization and grouping; Basic techniques of text mining; Text mining and machine learning; Examples of application of text mining techniques in various applications; Future trends in text data processing.				
12.	Teaching methods: This course is based on 45 hours of lectures and 30 hours of exercises , supplemented by the study of a specific case, consultations with the subject professor and the preparation of a project.				
13.	Total available time	6 ECTS credits x 30 hours/credit = 180 hours			
14.	Allocation of available time	Lectures: 30 hours; Exercises: 15 hours; Independent preparation, projects, homework: 135 hours = Total time of 180 hours			
15.	Forms of teaching activities	15.1.	Lectures - theoretical teaching .	30 hours	
		15.2.	Exercises (laboratory, classroom), teamwork	15 hours	
16.	Other forms of activities	16.1.	Project tasks	50 hours	
		16.2.	Independent tasks	35 hours	
		16.3.	Homework - assignments	50 hours	
17.	Grading method 60 + 30 + 10				
	17.1.	Tests		60 points	
	17.2.	Individual work/ project (presentation: written and oral)		30 points	
	17.3.	Activity and participation		10 points	
18.	Assessment criteria (points/grade)	up to 50 points		5 (five) (F)	
		51 x to 60 points		6 (six) (E)	
		61 x to 70 points		7 (seven) (D)	

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<tr><td></td><td colspan="3"></td><td>from 71 to 80 points</td><td>8 (eight) (C)</td></tr>
<tr><td></td><td colspan="3"></td><td>from 81 to 90 points</td><td>9 (nine) (B)</td></tr>
<tr><td></td><td colspan="3"></td><td>from 91 to 100 points</td><td>10 (ten) (A)</td></tr>
<tr><td>19.</td><td colspan="3">Requirement for signature and passing the final exam</td><td colspan="2">Students must attend classes regularly in accordance with UIST regulations.</td></tr>
<tr><td>20.</td><td colspan="3">Language of instruction</td><td colspan="2">English, Macedonian</td></tr>
<tr><td>21.</td><td colspan="3">Method of monitoring the quality of teaching</td><td colspan="2">Compliance with UIST quality control procedures</td></tr>
<tr><td rowspan="11">22.</td><td colspan="5">Literature</td></tr>
<tr><td rowspan="4">22.1.</td><td colspan="5">Required literature</td></tr>
<tr><td>Serial number</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Dipanjan Sarkar</td><td>Text Analytics with Python: A Practical Real-World Approach to Gaining Actionable Insights from you Date;</td><td>Apres</td><td>2016</td></tr>
<tr><td>2.</td><td>Rob Miller</td><td>Text Processing with Ruby: Extract Value from the Data That Surrounds You</td><td>Pragmatic Bookshelf</td><td>2015</td></tr>
<tr><td>3.</td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="4">22.2.</td><td colspan="5">Additional literature</td></tr>
<tr><td>Serial number</td><td>Author</td><td>Title</td><td>Publisher</td><td>Year</td></tr>
<tr><td>1.</td><td>Gabe Ignatow, Rada F. Mihalcea</td><td>Text Mining: A Guidebook For The Social Sciences</td><td>SAGE Publications Ltd.;</td><td>2016</td></tr>
<tr><td>2.</td><td></td><td></td><td></td><td></td></tr>
</table>

Attachment No. 3		**Second cycle study program**			
1.	Title of the course	Supervisory control and data acquisition systems			
2.	Code	CSE22E06			
3.	Study program	Computer techniques and informatics			
4.	Organizer of the study program (unit, i.e. institute, department, division)	Faculty of Computer Science and Engineering, University of Information Sciences and Technologies "St. Paul the Apostle" - Ohrid			
5.	Degree (first, second, third cycle)	Second cycle			
6.	Academic year / semester	1st year / second semester	7	Number of ECTS credits	6
8.	Teacher	Dr. Rasim Salkoski			
9.	Prerequisites for enrolling in the course				
10.	Course objectives (competencies): This course will enable students to gain an understanding of supervisory control and data acquisition systems and their wide application in industry. They will learn to distinguish the different components of supervisory control and data acquisition systems, to examine the software requirements of supervisory control and data acquisition systems. Upon completion of this course, students will be able to write, execute and debug supervisory control and data acquisition system applications and will also learn to interface these applications with programmable logic controllers (PLCs).				
11.	Course content: 1. Overview of Supervisory Control and Data Acquisition Systems; 2. Programmable Logic Controllers (PLCs); 3. Industrial Communication Network 4. Characteristics of Field (Remote) Terminal Units; 5. Main Terminal Units; 6. Communication between Main and Field Terminal Units; 7. Human Machine Interface; 8. Local Area Network (LAN) in the Main Station and in the Field; 9. Security of Supervisory Control and Data Acquisition Systems; 10. Application of Supervisory Control and Data Acquisition Systems.				
12.	Teaching methods: This course is based on 30 hours of lectures, supplemented by the study of a specific case, consultations with the subject professor and the preparation of a project.				
13.	Total available fund on time	6 ECTS credits x 30 hours/credit = 180 hours			
14.	Allocation of available time	Lectures: 30 hours; Exercises: 15 hours; Independent preparation, projects, homework: 135 hours = Total time of 180 hours			
15.	Forms of teaching activities	15.1.	Lectures - theoretical teaching	30 hours	
		15.2.	Exercises (laboratory, classroom), teamwork	15 hours	
16.	Other forms of activities	16.1.	Project development	50 hours	

		16.2.	Case study	35 hours
		16.3.	Home learning	50 hours

17.	Assessment method: 60 + 30 + 10		
	17.1.	Tests	60 points
	17.2.	Individual work/project (presentation: written and oral)	30 points
	17.3.	Activity and participation	10 points
	17.4.		

18.	Assessment criteria (points/grade)	up to 50 points	5 (five) (F)
		51 x to 60 points	6 (six) (E)
		61 x to 70 points	7 (seven) (D)
		from 71 to 80 points	8 (eight) (C)
		from 81 to 90 points	9 (nine) (B)
		from 91 to 100 points	10 (ten) (A)
19.	Requirement for signature and passing the final exam	Students must attend classes regularly in accordance with UIST regulations.	
20.	Language of instruction	English, Macedonian	
21.	Method of monitoring the quality of teaching	Compliance with UIST quality control procedures	

22. Literature

Required literature

Serial number	Author	Title	Publisher	Year
1.	Stuart A.Boyer	SCADA: Supervisory Control and Data Acquisition	Stuart A.Boyer	SCADA: Supervisory Control and Data Acquisition
2.				
3.				

Additional literature

Serial number	Author	Title	Publisher	Year
1.	Frank D.Petruzella	Programmable Logic Controllers	Frank D.Petruzella	Programmable Logic Controllers
2.	W.Bolton	Programmable Logic Controllers	Elsevier Newnes	2006
3.				

Attachment No. 3		**Subject program from the second cycle of studies**		
1.	Title of the teaching subject	Text-data processing		
2.	Code	CSE22E16		
3.	Study program	Computer Techniques and Informatics		
4.	Organizer of the study program (unit, i.e. institute, department)	University of Information Sciences and Technologies "St. Paul the Apostle" - Ohrid; Faculty of Computer Science and Engineering – CSE		
5.	Degree (first, second, third cycle)	Second cycle – elective subject from the unit		
6.	Academic year / semester	First year master's	semester	X (tenth)
7	Course Workload Expressed in ECTS Credits	6 (six)		
8.	Teacher (in case of multiple teachers, the responsible instructor is designated)	Aleksandar Karadimche, PhD		
9.	Language of instruction	English		
10.	Prerequisites for Attending and Passing the Course			
11.	Course Objectives (Competencies) and Learning Outcomes:	Course objectives (competencies): After successfully completing this course, the student will be able to recognize the key problems arising from the use of text data, to learn the most appropriate algorithms for their resolution, to explore and analyze text data and discover new knowledge from them, to learn and apply existing tools for processing text data and to create their own solutions for the implementation of individual tasks in the field of processing and mining of text documents and data.		
12.	Detailed course content by chapters and units, with learning outcomes for each chapter	Course content: Introduction to text data processing and text mining; Data extraction, classification, categorization and grouping; Basic techniques of text mining;; Text mining and machine learning; Examples of application of text mining techniques in various applications; Future trends in text data processing.		
13	Interconnection of Courses			
14.	Detailed Description of the Teaching and Working Methods for the Course	Teaching methods: This course consists of 30 hours of lectures, supplemented by teamwork, consultations with the subject professor, and project development.		
15.	Total Available Time Allocation	6 ECTS credits x 30 hours/credit = 180 hours		
16.	Forms of Teaching Activities	16.1.	Lectures – theoretical instruction, hours	30 hours
		16.2.	Exercises (laboratory, auditory), seminars, teamwork: hours	15 hours
17.	Other forms of activities	17.1.	Project assignments: hours	50 hours
		17.2.	Independent tasks: hours	35 hours
		17.3.	Home study – tasks	50 hours
18	Conditions for Signature	Students should ensure regular attendance at classes in accordance with the UINT regulations.		
19	Assessment Method	60 + 30 + 10		
	19.1.	Tests: Points		60 points
	19.2.	Seminar paper/project, written and oral presentation: points		30 points
	19.3.	Final exam: points		10 points
20	Assessment criteria (points/grade)	up to 50 points		5 (five) (F)
		from 51 to 60 points		6 (six) (E)
		from 61 to 70 points		7 (seven) (D)
		from 71 to 80 points		8 (eight) (C)

			from 81 to 90 points		9 (nine) (B)
			from 91 to 100 points		10 (ten) (A)
21.	Method for monitoring the quality of teaching		Compliance with UIST quality control procedures		
22.	Literature				
	22.1.	Mandatory Literature			
		No.	Author	Title	Publisher	Year
		1.	Dipanjan Sarkar	Text Analytics with Python: A Practical Real-World Approach to Gaining Actionable Insights from your Data;	Apress	2016
		2.	Rob Miller	Text Processing with Ruby: Extract Value from the Data That Surrounds You	Pragmatic Bookshelf	2015
		3.				
	22.2.	Additional Literature				
		No.	Author	Title	Publisher	Year
		1.	Gabe Ignatow, Rada F. Mihalcea	Text Mining: A Guidebook For The Social Sciences	SAGE Publications Ltd;	2016
		2.				
		3.				

Attachment No. 3	**Second cycle study program**					
1.	Title of the course	Time series analysis and forecasting				
2.	Code	CSE22E 21				
3.	Study program / Faculty	Computer techniques and informatics				
4.	Organizer of the study program (unit, i.e. institute, department, division)	Faculty of Computer Science and Engineering, University of Information Sciences and Technologies "St. Paul the Apostle" - Ohrid				
5.	Degree (first, second, third cycle)	Second cycle				
6.	Academic year / semester	1st year / second semester	7.	Number of ECTS credits	6	
8.	Teacher	Dr. Aneta Velkoska				
9.	Prerequisites for enrolling in the course					
10.	Objectives of the subject program (competencies): The aim of this course is to introduce students to statistical and machine learning methods for time series analysis and forecasting. After completing this course, students will have in-depth knowledge of advanced techniques and methods for time series analysis and forecasting; will be able to understand, present and analyze time series data; apply time series forecasting algorithms to solve real-world problems; and will be able to design, analyze, implement and evaluate the performance of a time series forecasting system.					
11.	Course content: Linear time series analysis, stationary and non-stationary models, transfer function models, seasonal models, Box-Jenkins models (autoregressive and moving average models). Data transformation, numerical representation of time series, evaluation of time series forecasting models. Trend detection and seasonal adjustment. Machine learning techniques for time series forecasting based on neural networks (deep learning), linear regression and ensembles of models.					
12.	Teaching methods : This course is based on 30 hours of lectures, supplemented by teamwork, consultations with the subject professor and project development.					
13.	Total Available Time	6 ECTS credits x 30 hours/credit = 180 hours				
14.	Allocation of available time	Lectures: 30 hours; Exercises: 15 hours; Independent preparation, projects, homework: 135 hours = Total time of 180 hours				
15.	Forms of teaching activities	15.1.	Lectures - theoretical teaching	30 hours		
		15.2.	Exercises (laboratory, classroom), teamwork	15 hours		
16.	Other forms of activities	16.1.	Project development	50 hours		
		16.2.	Case study	35 hours		
		16.3.	Home learning	50 hours		
17.	Grading method 6 0 + 3 0 + 10					
	17.1.	Tests	60 points			
	17.2.	Individual work/project (presentation: written and oral)	30 points			
	17.3.	Activity and participation	10 points			
18.	Assessment criteria (points /grade)	up to 50 points	5 (five) (F)			

				from 51 to 60 points	6 (six) (E)	
				from 61 to 70 points	7 (seven) (D)	
				from 71 to 80 points	8 (eight) (C)	
				from 81 to 90 points	9 (nine) (B)	
				from 91 to 100 points	10 (ten) (A)	
19.	Requirement for signature and passing the final exam			Students should ensure regular attendance at classes in accordance with the UINT regulations.		
20.	Language of instruction			English, Macedonian		
21.	Method of monitoring the quality of teaching			Compliance with UIST quality control procedures		
	Literature					
	22.1	Required literature				
		Serial number	Author	Title	Publisher	Year
		1.	Konar A. , Bhattacharya D.	Time Series Prediction and Applications A Machine Intelligence Approach	Springer	20 1 5
		2.	George EP Box, Gwilym M. Jenkins, Gregory C. Reinsel	Time Series Analysis: Forecasting and Control, 5th Edition	John Wiley & Sons, Inc.	2015
		3.				
	22.2	Additional literature				
		Serial number	Author	Title	Publisher	Year
		1.				
		2.				
		3.				