DESCRIPTION OF THE COURSE

Name of the course **Computer Vision**	Code: **MpCSTS01**	Semester:**1**
Type of training: Lectures (L) Laboratory work (LW)	Hours per semester: L – 30 hours; LW – 15 hours	Number of credits: **5**

LECTURER (S):

prof. d-r Petya Pavlova (FEA), Dep. CST, tel. 659 705, e-mail: p_pavlova@tu-plovdiv.bg,
as.prof. Veselka Petrova – Dimitrova PhD (FEA), Dep. CST, e-mail: vpetrova@tu-plovdiv.bg
Technical University of Sofia

COURSE STATUS IN THE CURRICULUM: Compulsory subject from the curriculum for training of students to obtain Master's degree, specialty Computer systems and technologies, Professional orientation 5.3 General Engineering, Field 5 Technical Sciences.

AIMS AND OBJECTIVES OF THE COURSE: After passing education the students have to obtain skills in area of achromatic and colour images processing, objects' features obtaining and systems for identification. During the labs each student must develop personal software for basic processing of the images

DESCRIPTION OF THE COURSE: Main topics: Methods and techniques for computer images derivation; different types of images and their features; Preliminary image processing – convolution and filtering, linear and non-linear filters, spatial filters, restrictions of applications. Mathematical morphology; Image segmentation; Object's features obtaining and normalizing; Dynamic images processing.

PREREQUISITES: Program languages, Digital signal processing

TEACHING METHODS: Lectures. Labs with programming using Visual Studio, OpenCV and initial shell of a software product, helpful for the personal product development

METHOD OF ASSESSMENT: Two tests on theory and some particular tasks solving. The final estimation is based on the tests results – 70% and laboratory work – 30%.

INSTRUCTION LANGUAGE: Bulgarian

BIBLIOGRAPHY:
1 Павлова П., Н. Шакев, Компютърно зрение, ТУ София филиал Пловдив, 2018 2.R. Gonzalez, R. Woods, Digital Image Processing, 3rd Ed., Prentice Hall, 2007. 3. У. Претт, Цифровая обработка изображений (пр. от англ.), т.1 и т.2, Москва, Мир, 1981. 4.Павлова П., Цифрова обработка на изображения (уч. пособие), Фондация физика, инженерство и медицина XXI, Пловдив 2005. 5.Ed. Al Bovik, Handbook of Image & Video Processing, sec. ed., Elsevier, 2005 6.Holst G., T. Lomheim, CMOS/CCD sensors and cameras systems. Sec. ed. SPIE PRESS, 2011 7. Tekalp A., Digital Video Processing, Prentice Hall, 1995 8. Daugherty Geoff, Pattern Recognition and Identification, an introduction. Springer, 2013 g. 9.Farid H., Fundamentals of Image Processing**,** 2010 – e-book. 10. Ahad, Computer Vision and Action Recognition, A Guide for Image Processing and Computer Vision Community for Action Understanding, Atlantis Press, 2011.

DESCRIPTION OF THE COURSE

Name of the course: **Natural language interfaces**	Code: **MpCST02**	Semester: **1**
Type of teaching: Lectures (L) Laboratory work (LW)	Hours per semester: L – **30 hours** LW - **15** hours	Number of credits: **5**

LECTURER(S):

assoc. prof. eng. Dilyana Budakova PhD (FEA), e-mail: dilyana_budakova@tu-plovdiv.bg
Technical University of Sofia – Plovdiv Branch

COURSE STATUS IN THE CURRICULUM: Compulsory subject for the master's degree course in „Computer systems and technologies "in the Faculty of Electronics and Automation at the Technical University of Sofia, Plovdiv Branch.

AIMS AND OBJECTIVES OF THE COURSE: The goal is for students to acquire knowledge about informal problem-solving methods, knowledge representation models, and inference methods for different models; about intelligent virtual agents, large language models, chatbots, which in recent years have been developing as a new realistic, emotional, computer interface in natural language, as well as for implementing their intelligent agent, chatbot; to become familiar with the basic and hybrid techniques for speech synthesis and synthesis of expressive, emotional speech. Algorithms for morphological and syntactic analysis of natural language, speech recognition, and mathematical models for natural language representation are considered.

DESCRIPTION OF THE COURSE: Some main topics are: Knowledge representation models and inference methods for different models (logical, network, production, frame). Deep neural networks; Transformer models; Large language models; Generative artificial intelligence; Artificial intelligence systems; Expert systems; Logic programming Visual Prolog 7.0; SSML and TTS Processors for speech synthesis. Natural language dialogue systems with CSLU Natural Language Toolkit; Windows Desktop Speech Technology; Visual Studio.NET and C#; synthesized Bulgarian voices.

PREREQUISITES: Basic programming languages.

TEACHING METHODS: Lectures delivered using multimedia tools, presentations provided on the Moodle electronic platform, and laboratory exercises on the main lecture topics.

METHOD OF ASSESSMENT: Assessment of the exam and student work during laboratory exercises and tests.

INSTRUCTION LANGUAGE: Bulgarian

BIBLIOGRAPHY:

1.Russell S., Norvig P., Artificial Intelligence A Modern Approach, Prentice Hall, Third Edition, 2010. 2. Kevin Murphy, ML Machine Learning - A Probabilistic Perspective, 2012, MIT Press, Cambridge; 3. Zhiyuan Liu, Yankai Lin, Maosong Sun, Representation Learning and NLP, Springer, 2020, 2023; 4. What are Transformer models and how do they work, https://www.youtube.com/watch?v=qaWMOYf4ri8 5. The Stanford Natural Language Processing Group http://nlp.stanford.edu/research.shtml; 6. Център за разпознаване на говорима реч (CSLU). http://cslu.cse.ogi.edu/tutordemos/; 7. Visual Prolog - www.visual-prolog.com .

DESCRIPTION OF THE COURSE

Name of the course **Distributed systems and Computer Communications**	Code: **MpCST03**	Semester: **1**
Type of teaching: Lectures (L) Laboratory work (LW)	Hours per semester: L – 30 hours; LW – 15 hours	Number of credits: **4**

LECTURER:
Assoc. prof. Mitko Shopov, PhD, lecturer in TU-Sofia, Plovdiv branch, Faculty of Electronics and Automatics, Dept. CST – tel.: (032) 659 765 e-mail:mshopov@tu-plovdiv.bg

COURSE STATUS IN THE CURRICULUM: Mandatory course for students in MSc program in Computer systems and technologies.

AIMS AND OBJECTIVES OF THE COURSE: At the end of the course the students are expected to have knowledge about the architectures of distributed systems based on client-server applications, web technologies, SOA, REST, MQTT, Cloud computing. To gain their own experience in the design and implementation of distributed applications.

DESCRIPTION OF THE COURSE: Key topics include: Introduction to distributed systems. Application layer communication protocols. Loosely coupled architectures. Middleware protocols. Names and addressing in distributed systems. Distributed processes: client-server, threads, migration code, software agents. Synchronization of distributed systems. Coordination models and replication methods. Distributed file systems (NFS, Hadoop, VMFS). Virtual computer networks. Software defined networks (SDN). Security in distributed systems – policies and mechanisms. Web based distributed systems - SOA, REST. Cloud Computing - IaaS, PaaS, SaaS. Stream processing - MQTT, Kafka. Big data and the Internet of Things (IoT).

PREREQUISITES: Good fundamental knowledge in computer networking, operating systems, programming languages.

TEACHING METHODS: Lectures with multimedia and web resources, laboratory works in main topics with individual and group tasks.

METHOD OF ASSESSMENT: One assessment test at the end of semester (50%), and laboratory work (50%).

INSTRUCTION LANGUAGE: Bulgarian.

BIBLIOGRAPHY:

1. E-learning course in Moodle (https://fea.tu-plovdiv.bg/moodle);

2. Maarten Van Steen, Andrews S. Tanenbaum. „Distributed Systems“ Third edition, Maarten van Steen, 2017, ISBN: 978-90-815406-2-9;

3. George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair „DISTRIBUTED SYSTEMS. Concepts and Design“ Fifth Edition, Addison-Wesley, 2012, ISBN 13: 978- 0-13-214301-1.

4. 4. Dan Marinescu „Cloud Computing. „Theory and practice“, Elsevier, 2013, ISBN: 978-0-12404-627-6.

5. James Kurose, Keith Ross „Computer Networking: A Top-down Approach“, Fifth Edition, Addison-Wesley, 2010, ISBN: 978-0-13607-967-5.

DESCRIPTION OF THE COURSE

Name of the course: **Programming of modern heterogeneous architectures**	Code: **MpCST4.1**	Semester: **1**
Type of teaching: Lectures (L) laboratory work (LW), course work	Hours per semester: **L – 30;** **LW – 15**	Number of credits: **5**

LECTURER (S):

Assoc. Prof. PhD Maria Pl. Marinova, (FEA), tel.: 659728,
e-mail: m_marinova@tu-plovdiv.bg,
Technical University of Sofia

COURSE STATUS IN THE CURRICULUM: Selective for students speciality Computer Systems and Technologies MEng programme of the Faculty of Electronics and Automation

AIMS AND OBJECTIVES OF THE COURSE: At the end of the course the students are expected to know the parallel languages as CUDA C, OpenCL and have knowledge to programming onto MIC processors.

DESCRIPTION OF THE COURSE:

Main topics: Parallel programming of heterogeneous computer architectures. Programming of the multi-GPU. Programming on Xeon Phi accelerators. Using of *warp* execution – warps-thread blocks, warp divergence, distribution of the resources, warp latency and synchronization.

PREREQUISITES: Parallel Programming, Operating Systems, Computer Architectures.

TEACHING METHODS: Lectures, using slides, case studies, laboratory and course work, work in teams, course work description preparation and defence.

METHOD OF ASSESSMENT: One test assessment at the end of the semester (50%), and defence of course work implemented during the laboratory exercises (50%).

INSTRUCTION LANGUAGE: Bulgarian

BIBLIOGRAPHY:

Lecture slides

Han J., Bharatkumar S., Learn CUDA Programming: A beginner's guide to GPU programming and parallel computing with CUDA 10.x and C/C++, 1st edition, 2020

Soyata T., GPU Parallel Program Development Using CUDA. 2020

Kirt D., Wen-mei W., Programming Massively Parallel Processors. A hands-on Approach. Third edition, 2018.

Reinders J., Jeffers J., High Performance Parallelism Pearls. Multicore and Many-core Programming Approaches Volume II – 2015.

Jeffers J., Reinders J., Sodani A., Intel Xeon Phi Processor High Performance Programming, 2016

CUDA Programming. A Developer's Guide to Parallel Computing with GPUs. Shane Cook. 2020

DESCRIPTION OF THE COURSE

Name of the course: **Cybersecurity architecture**	Code: **MpCST4.2**	Semester: **1**
Type of teaching: Lectures (L) Laboratory work (LW) Course work (CW)	Hours per semester: L – 30 hours LW – 15 hours	Number of credits: **5**
Course project (CP)	Code: **MpCST4.2**	Number of credits: **2**

LECTURER(S):
assoc. prof. eng. Maria Marinova, PhD (FEA), tel.: 965 727, e-mail: m_marinova@tu-plovdiv.bg
Technical University of Sofia

COURSE STATUS IN THE CURRICULUM: Compulsory elective curricula for training of students to obtain Master's degree, specialty Computer System and Technologies, Professional orientation 5.3 Computer systems, complex and networks, Field 5 Technical Sciences.

AIMS AND OBJECTIVES OF THE COURSE: At the end of the course the students will develop skills in analysing, designing, and implementing secure architectures using established standards and frameworks such as NIST, ISO 27001, and others. They will also gain practical knowledge of deploying various information security technologies and tools, preparing them to work in the dynamic and constantly evolving field of cybersecurity. Furthermore, students will be able to design security architectures aimed at protecting networks, cloud infrastructures, IoT systems, and applications. Finally, they will become familiar with contemporary defence methodologies and tools designed to counteract emerging cyber threats

DESCRIPTION OF THE COURSE: The main topics concern: Fundamentals of Cybersecurity Architecture examines foundational principles, concepts, and terminology that underpin secure system design; Risk Management and Security Architecture Solutions focuses on identifying, analyzing, and mitigating risks through structured security designs; Cryptographic Systems and Their Integration emphasizes protocols, algorithms, and key management strategies for robust encryption and secure communication; Identity and Access Management (IAM) covers access control models and authentication mechanisms to safeguard critical resources; Network Security Architecture addresses strategic design of firewalls, intrusion detection/prevention systems (IDS/IPS), and VPNs for comprehensive network defence; Cloud Security Architectures explores methodologies for protecting data and services in cloud environments while ensuring compliance; Data Protection in IoT Infrastructures delves into strategies for securing connected devices and safeguarding data flows; Application Security and Secure Software Development Lifecycle (SDLC) highlights DevSecOps principles and threat mitigation throughout development; Defence Against DDoS Attacks examines approaches and technologies for mitigating distributed denial-of-service threats; Architectural Approaches for Protecting Critical Infrastructures outlines best practices for designing resilient defences **for** essential services; Contemporary Trends in Cybersecurity Architecture covers emerging innovations such as artificial intelligence, quantum cryptography, and blockchain, providing insights into next-generation defence mechanisms. etc.

PREREQUISITES: Computer architectures, Modern Java technologies, fundamentals of network technologies, applied network programming.

TEACHING METHODS: Lectures, using slides, case studies, laboratory and course work, work in teams, protocols and course work description preparation and defence.

METHOD OF ASSESSMENT: Two one-hour assessments at mid and end of semester (62%), laboratories (18%), course work - two off assignments (20%).

INSTRUCTION LANGUAGE: Bulgarian/English

BIBLIOGRAPHY: 1. Diana Kelley, Ed Moyle , "Practical Cybersecurity Architecture - Second Edition: A guide to creating and implementing robust designs for cybersecurity architects", Second Edition, 2023, ISBN: 978-1837637164; 2. Ian Loe "Cybersecurity Architecture Fundamentals", 2024, ISBN 13: 979-8321651681. 3. Dan Marinescu "Cloud Computing. "Theory and practice", Elsevier, 2013, ISBN: 979-8321651681. 4. James Kurose, Keith Ross "Modern Approach to a secured Distributed Network", 2024, ISBN: 979-8320007366.

DESCRIPTION OF THE COURSE

Name of the course **Language processors**	Code: **MpCST4.3**	Semester: **1**
Type of teaching: Lectures Laboratory work	Lessons per semester: Lectures – **30** Laboratory work – **15**	Number of credits: **5**

LECTURER:

Assoc. Prof. PhD Velko Ivanov Iltchev, Department of Computer Systems and Technologies,
Technical University of Sofia, branch Plovdiv,
e-mail: iltchev@tu-plovdiv.bg, GSM: 0895-587475

COURSE STATUS IN THE CURRICULUM: Eligible for the students specialty "Computer Systems and Technologies" M.Sc. programme of the Faculty of Electronics and Automatics, Technical University of Sofia, branch Plovdiv.

AIMS AND OBJECTIVES OF THE COURSE: To introduce the students into the theory of formal languages and grammars, and in the methods for parsing and compiling of programming languages.

DESCRIPTION OF THE COURSE: Main topics: Classification of formal languages and their processors, according to Chomsky. Regular languages and grammars. Using finite automata as processors for regular languages and grammars. Descriptor tables. Context-free languages and grammars. Parsing methods classification. Recursive descent method. Transforming a left-recursive grammar into Greibach Normal Form. Parsing by using LL(k)-grammars. Method for generation the LL(1)-parsing table. Interpretation via preliminary translation into RPN. Parsing methods build on precedence grammars. Algorithm for generation the parsing table for simple-precedence grammars. Parsing by using LR(k)-grammars. The SLR(1)-method for generation the parsing tables for LR(k)-grammars. Modifications of this method. Semantic analysis and code generation. Optimization methods. Memory management methods. Syntax-directed compilation. Compiler generators (YACC & LEX).

PREREQUISITES: Object-oriented programming, Discrete Structures, Synthesis and Analysis of Algorithms.

TEACHING METHODS: Lectures - using multimedia presentations. Laboratory work - work with software applications(lectors own development), which implement diffrent parsing methods.

METHOD OF ASSESSMENT: Written exam. Students generate, per hand, parsing tables for context-free grammars given, using different parsing methods.

INSTRUCTION LANGUAGE: bulgarian

BIBLIOGRAPHY: **1.** Илчев В., *"Ръководство за лабораторни упражнения по езикови процесори"*, ТУ-София, ISBN: 978-619-167-043-7, 2013. **2.** Grune D., van Reeuwijk K., Bal H.E., Jacobs C.J.H. & Langendoen K., *Modern Compiler Design*, Springer Verlag, ISBN: 1-461-44698-8, 2012 **3.** Aho A.V. & Ullman J.D., *The Theory of Parsing, Translation and Compiling (Volumes 1-2)*, Prentice Hall, ISBN: 0-139-14556-7, 1972 **4.** Donnelly C. & Stallman R., *Bison - The Yacc-compatible Parser Generator*, Free Software Foundation, ISBN: 1-882-11444-2, 2012 **5.** http://www.jflap.org /tutorial/fa/createfa/fa.html **6.** http://www.asethome.org/pda/PDA_htm.html **7.** http://www.jflap.org /tutorial/pda/construct/

DESCRIPTION OF THE COURSE

Name of the course: **Quantum algorithms**	Code: **MpCST05**.1	Semester: **1**
Type of teaching: Lectures(L) Laboratory work (LW) Course work (CW)	Hours per semester: L – 30 hours LW – 15 hours	Number of credits: **5**

LECTURER(S):
Prof. eng. Petya Pavlova, PhD (FEA), tel.: 659 705, e-mail: p_pavlova@tu-plovdiv.bg
Eng. Jordan Genoff, MSc. (FEA), e-mail: jgenoff@tu-plovdiv.bg
Technical University of Sofia, branch Plovdiv

COURSE STATUS IN THE CURRICULUM: Compulsory subject from the curriculum for training of students to obtain Master's degree, specialty Computer System and Technologies, Professional orientation 5.3 Communication and Computer Equipment, Field 5 Technical Sciences.

AIMS AND OBJECTIVES OF THE COURSE: At the end of the course the students are expected to know the basic principles for formulating and designing algorithms for execution on a quantum computer system, as well as the essence and properties of a nomenclature of currently existing algorithms used in experimental and applied practice

DESCRIPTION OF THE COURSE: Fundamentals of quantum computers; Programming model; Concepts of algorithm and program execution; Programming platforms; Basic algorithms; Special algorithms; Applied algorithms.

PREREQUISITES: None.

TEACHING METHODS: Lectures with traditional and electronic tools for teaching; laboratory exercises with reports. All teaching forms are adapted for attended and distant teaching.

METHOD OF ASSESSMENT: This course includes ongoing assessment during the semester. The overall grade is an aggregation of the tests (30%+35%) and the lab-works grades (35%).

INSTRUCTION LANGUAGE: Bulgarian

BIBLIOGRAPHY: 1. Hundt, R. Quantum Computing for Programmers, Cambridge University Press, 2022, ISBN: 978-1-009-09817-5; 2. Abhijith, J. Quantum Algorithm Implementations for Beginners, ACM Transactions on Quantum Computing, 2022, Vol.3, Iss.4, Art.No.18, Pp. 1-92; 3. Dalzell, Alexander M. Quantum Algorithms: A Survey of Applications and End-to-end Complexities, Cambridge University Press, 2025, ISBN: 978-1-009-63964-4.

DESCRIPTION OF THE COURSE

Name of the course: **Cryptography**	Code: **MpCST5.2**	Semester: **1**
Type of teaching: Lectures (L) Laboratory work (LW) Course work (CW)	Hours per semester: L – 30 hours LW – 15 hours	Number of credits: **5**
Course project (CP)	Code: **MpCST5.2**	Number of credits: **2**

LECTURER(S):
assoc. prof. eng. Maria Marinova, PhD (FEA), tel.: 965 727, e-mail: m_marinova@tu-plovdiv.bg
Technical University of Sofia

COURSE STATUS IN THE CURRICULUM: Compulsory elective curricula for training of students to obtain Master's degree, specialty Computer System and Technologies, Professional orientation 5.3 Computer systems, complex and networks, Field 5 Technical Sciences.

AIMS AND OBJECTIVES OF THE COURSE: The purpose of the course "Cryptography" is to provide students with fundamental theoretical knowledge and practical skills in the field of cryptography, which are essential for ensuring confidentiality, integrity, and authenticity of information in the digital environment. Throughout the course, students will explore core principles, cryptographic algorithms, and security protocols that enable secure communication, identity authentication, and data protection. The curriculum will cover both classical and modern cryptographic techniques, including symmetric and asymmetric encryption, hash functions, digital signatures, and key management strategies. Additionally, students will gain an understanding of real-world cryptographic applications, such as secure email, digital certificates, blockchain technology, and end-to-end encryption in messaging systems. Emphasis will be placed on analyzing potential vulnerabilities, cryptanalysis techniques, and best practices for implementing cryptographic solutions in various security contexts. By the end of the course, students will have the knowledge and skills necessary to apply cryptographic methods effectively in cybersecurity, software development, and digital forensics, preparing them for careers in the rapidly evolving field of information security.

DESCRIPTION OF THE COURSE: The main topics concern: Introduction to Cryptography – fundamental concepts and the role of cryptography in cybersecurity. Classical Cryptographic Systems – historical encryption methods such as the Caesar cipher, Vigenère cipher, and Enigma machine. Symmetric and Asymmetric Cryptography – principles, advantages, and use cases of encryption algorithms like AES, DES, RSA, and ECC. Hash Functions and Digital Signatures – in-depth analysis of cryptographic hashing, including MD5, SHA-1, SHA-2, SHA-3, and HMAC, and their role in data integrity and authentication. Digital Signature Algorithms – DSA, ECDSA, and EdDSA, their security properties, and real-world applications. Cryptographic Protocols – secure communication mechanisms such as SSL/TLS for web security, PGP for encrypted email, and protocols for ensuring confidentiality and integrity in data exchanges. Zero-Knowledge Proofs – cryptographic methods allowing verification without revealing information, used in authentication and blockchain privacy solutions (e.g., zk-SNARKs, zk-STARKs). Cryptography in Blockchain and Web3 – securing transactions with digital signatures (ECDSA, secp256k1) in Ethereum and other decentralized systems. Post-Quantum Cryptography and Future Threats – exploring quantum-resistant algorithms and emerging cryptographic challenges in a post-quantum world. Practical Cryptanalysis and Attacks – Brute-force and dictionary attacks against hashed passwords. RSA vulnerabilities, including Bleichenbacher's attack, Wiener's attack, and RSA CRT fault attacks. Quantum Communication and Quantum Algorithms – studying the impact of quantum computing on cryptography: Shor’s Algorithm (breaking RSA and ECC) and Grover’s Algorithm (speeding up brute-force attacks). Post-Quantum Algorithms – an overview of the NIST PQC competition

and next-generation cryptographic methods. Using Python for Cryptographic Analysis – applying TensorFlow/PyTorch for pattern detection in cryptographic data, exploring machine learning applications in security. This course covers both theoretical foundations and hands-on practice, preparing students for real-world cryptographic implementation and security analysis, etc.

PREREQUISITES: Fundamentals of network technologies, applied network programming, Programming of Software Systems with Python.

TEACHING METHODS: Lectures, using slides, case studies, laboratory and course work, work in teams, protocols and course work description preparation and defence.

METHOD OF ASSESSMENT: Two one-hour assessments at mid and end of semester (62%), laboratories (18%), course work - two off assignments (20%).

INSTRUCTION LANGUAGE: Bulgarian/English

BIBLIOGRAPHY: 1. Diana Kelley, Ed Moyle , "Practical Cybersecurity Architecture - Second Edition: A guide to creating and implementing robust designs for cybersecurity architects", Second Edition, 2023, ISBN: 978-1837637164; 2. Ian Loe "Cybersecurity Architecture Fundamentals", 2024, ISBN 13: 979-8321651681. 3. Dan Marinescu "Cloud Computing. "Theory and practice", Elsevier, 2013, ISBN: 979-8321651681. 4. James Kurose, Keith Ross "Modern Approach to a secured Distributed Network", 2024, ISBN: 979-8320007366.

DESCRIPTION OF THE COURSE

Name of the course: **Systems for remote monitoring and control of space crafts**	Code: **MpCST6.1**	Semester: **1**
Type of teaching: Lectures (L), Laboratory work (LW)	Hours per semester: L – 30 hours LW – 15 hours	Number of credits: **4**

LECTURER:

Assoc. prof. Mitko Shopov, PhD, lecturer in TU-Sofia, Plovdiv branch, Faculty of Electronics and Automatics, Dept. CST – tel.: (032) 659 765 e-mail: mshopov@tu-plovdiv.bg.

Hristo Indzhov, PhD, CEO, Space Cube, Germany, e-mail: h.indzhov@space-cube.de.

COURSE STATUS IN THE CURRICULUM: Electable course for students in the MSc program in Computer systems and technologies.

AIMS AND OBJECTIVES OF THE COURSE: At the end of the course the students are expected to have knowledge about the architecture and organization of monitoring and control systems (MCS), their main information flows, and the components that represent them. They will have beginner experience in the development of components/modules for MCS based on the educational environment of Simple MCS.

DESCRIPTION OF THE COURSE: The discipline is an introduction to monitoring and control systems (MCS) and their application in the space sector and space missions. The content of the course is based on an educational MCS (Simple MCS) developed with the help of Java and Spring Framework. Simple MCS introduces the telemetry chain, the telecommand chain and the components that build them. The main goal of the exercises is to implement missing functionalities in said components e.g. work with specific file formats (YAML), bitwise manipulations and object conversions, encoding and decoding of binary streams, synchronization in multi-threaded environment, storage and retrieval of data.

PREREQUISITES: Good fundamental knowledge in programming languages (including multithreading), programming environments, Computer networks, Database management systems.

TEACHING METHODS: Lectures with multimedia and web resources, laboratory works in main topics with individual and group tasks.

METHOD OF ASSESSMENT: One assessment test at the end of semester (70%), and laboratory work (30%).

INSTRUCTION LANGUAGE: Bulgarian

BIBLIOGRAPHY:

1. E-learning course in Moodle (https://fea.tu-plovdiv.bg/moodle);
2. European Cooperation for Space Standardization http://ecss.nl/

3. European Space Agency https://www.esa.int/ESA
4. European Ground Systems Common Core http://www.egscc.esa.int/
5. Cubesat http://www.cubesat.org/
6. Java https://docs.oracle.com/javase/tutorial/
7. Spring Framework https://spring.io/
8. Maven https://maven.apache.org/
9. GIT https://git-scm.com/

DESCRIPTION OF THE COURSE

Name of the course: **Security and Privacy in Internet of Things**	Code: **MpCST6.2**	Semester: **1**
Type of teaching: Lectures (L) Laboratory work (LW)/Tutorials (T) Course work (CW)	Hours per semester: L – 30 hours LW – 15 hours -	Number of credits: **4**

LECTURER(S):
Assoc. Prof. Eng. Stela Vetova, PhD (FKST), e-mail: st.vetova@tu-sofia.bg
Technical University of Sofia

COURSE STATUS IN THE CURRICULUM: Elective subject from the curricula for training of students to obtain Master's degree, specialty Computer system and technologies, Professional orientation 5.3 Communication and computer engineering, Field 5 Technical Sciences.

AIMS AND OBJECTIVES OF THE COURSE: The main objective of the course is to provide students with knowledge in the field of security and privacy in the Internet of Things and to gain practical skills to preserve data privacy, types of attacks and countermeasures.

DESCRIPTION OF THE COURSE: The discipline provides, in a systematic and compressed form theoretical and practical knowledge and strategies in the field of security and privacy in the Internet of Things: malware schemes in the Internet of Things, analysis of attacks on Smart Home Systems, privacy preservation, dissemination of SPG-based data, enhancing privacy through distributed coloring algorithm, improving availability through message replication, threats and approaches to preserve privacy in smart buildings. The course also comprises: models for privacy preservation in Internet of Things applications.

PREREQUISITES: Compuer Networks, Cryptography, Databases.

TEACHING METHODS: Lectures, presented using multimedia tools and laboratory classes to apply lecture knowledge.

METHOD OF ASSESSMENT: Two tests during the semester

INSTRUCTION LANGUAGE: Bulgarian/

BIBLIOGRAPHY: 1. Shivani Agarwal, Sandhya Makkar, Duc-Tan Tran, Privacy Vulnerabilities and Data Security Challenges in the IoT, CRC Press, 2021. 2. Sudhir Sharma, Bharat Bhushan, Narayan Debnath, Security and Privacy Issues in IoT Devices and Sensor Networks, Elsevier, 2021. 3. Damilare D. Fagbemi, David M Wheeler, JC Wheeler, The IoT Architect's Guide to Attainable Security and Privacy, CRC Press, 2020. 4. Chintan Patel, Nishant Doshi, Internet of Things Security Challenges, Advances, and Analytics, CRC Press, 2019.

DESCRIPTION OF THE COURSE

Name of the course **Project**	Code: **MpCST07**	Semester: **1**
Type of teaching: Course project	Hours per semester: Self work	Number of credits: **2**

Student must select one of the subjects from the current semester and develop course project.

DESCRIPTION OF THE COURSE

Name of the course: **Distributed embedded systems**	Code: **MpCST08**	Semester: **2**
Type of teaching: Lectures (L), Laboratory Work (LW), course work	Hours per semester: **L – 30;** **LW – 15**	Number of credits: **5**

LECTURERS:

Assoc. Prof. PhD Nikolay R. Kakanakov (FEA), tel.: 659765, e-mail: kakanak@tu-plovdiv.bg
Technical University of Sofia

COURSE STATUS IN THE CURRICULUM: Compulsory for student's specialty Computer Systems and Technologies MEng programme of the Faculty of Electronics and Automation

AIMS AND OBJECTIVES OF THE COURSE: At the end of the course the students are expected to know the techniques for design and implementation of application and systems programs for distributed embedded systems as well as communication protocols and architecture for data exchange in distributed embedded systems.

DESCRIPTION OF THE COURSE:

Main topics: Embedded systems programming. Development platforms and tools for DES. Designing DES. Application of Web technologies in DES. Real-time Operating Systems. Ethernet in real-time communication. Sensor networks. Distributed Embedded Systems security. Internet of Things and BigData. Analytical estimation of delays in controller networks.

PREREQUISITES: Microcontroller technologies, Microprocessors, Computer Periphery, Operating Systems, Programming, Computer Networks.

TEACHING METHODS: Lectures, using slides, case studies, laboratory and course work, work in teams, course work description preparation, and defense.

METHOD OF ASSESSMENT: One test assessment at the end of the semester (50%), and defense of course work implemented during the laboratory exercises (50%).

INSTRUCTION LANGUAGE: Bulgarian

BIBLIOGRAPHY:

1. J. Axelson "Embedded Ethernet and Internet Complete", Lakeview Research LLC, 2003, ISBN:1-931448-000;
2. Qing Li and Carolyn Yao, "Real-Time Concepts for Embedded Systems, " CMP Books, 2003.
3. Topp, U., P. Müller, "Web based service for embedded devices", Lecture Notes in Computer Science, Volume 2593 / 2003, pp. 141 – 153, ISSN: 0302-9743;
4. M. Barr, A. Massa, "Programming Embedded Systems," O'Reilly, 2006.;
5. G. Spasov, M. Shopov. V. Spasova, N. Kakanakov, "Tutorial for laboratory work in microprocessor systems", Technical University of Sofia, 2013.
6. G. Spasov, N. Kakanakov, M. Shopov, "Tutorial for laboratory work in computer networks", Technical University of Sofia, 2009.

DESCRIPTION OF THE COURSE

Name of the course **VLSI design**	Code: **MpCST09**	Semester: **2**
Type of teaching: Lectures (L) Laboratory work (LW)	Hours per semester: L – 30 hours; LW – 15 hours	Number of credits: **5**

LECTURER (S):

Assoc. Prof. PhD Atanas Kostadinov, Computer systems and Technologies Department,
Technical University – Sofia, branch Plovdiv, Phone: + 359 32 659 726,
email: kostadat@tu-plovdiv.bg.

COURSE STATUS IN THE CURRICULUM: A compulsory subject for the Computer Systems and Technologies students admitted to the master program. The Computer Systems and Technologies Department belongs to the Electronics and Automation Faculty (EAF). EAF is a part of the Technical University – Sofia, Plovdiv branch.

AIMS AND OBJECTIVES OF THE COURSE: The main goal of the above-mentioned subject is the receiving or refreshing of basic knowledge for CPLDs (Complex Programmable Logic Devices), FPGAs (Field Programmable Gate Arrays), and VHDL (Very high-speed integrated circuit Hardware Description Language). The main topics are connected to the CPLD, FPGA, and VHDL. The acquired knowledge will open to the students the possibilities of using reconfigurable integrated circuits and VHDL in the digital and microprocessor devices and systems design. The objectives of this course are:

- Understand or refresh the concept of reconfigurable logic;

- Know and remember how different processor architectures are designed;

- Learn or refresh your knowledge of how to use the VHDL in the simulation and synthesis of a microprocessor and a simple computer;

- Be able to use CAD tools to design and simulate digital circuits.

DESCRIPTION OF THE COURSE: The main topics covered in this subject are: The basic terms used in VLSI (Very Large–Scale Integration) design. CMOS (Complementary Metal Oxide Semiconductor) logic gates. Behavioral, Structural, and Dataflow descriptions of digital devices using VHDL; Simulation of the designed digital circuits using ModelSim. Work with Quartus II Web Edition/Quartus Prime Lite Edition and Vivado HL System Edition; Cyclone II FPGA Starter Development Board, DE2 (Development and education board) and Nexys4 DDR FPGA boards – basic electronic components and parameters; Fundamentals of different microprocessor architectures; Microprocessors datapath – design and test of simple datapath unit. Microprocessor control unit – implementing basic arithmetic and logic instructions; Verification of the designed computer system consisting of microprocessor and RAM (Random Access Memory) using SignalTap II embedded logic analysis; Optimization of implemented processor architecture using Quartus II Advisors; Different IP (Intellectual Property) microprocessor architectures described by HDLs (Hardware Description Languages); Synchronization and signal propagation in VLSI circuits; Multiple cores microprocessor architectures – short information; Multiprocessor systems – types, advantages and disadvantages.

PREREQUISITES: The prerequisite subject is BpCST17.1 Reconfigurable logic.

TEACHING METHODS: The lectures presented the above material using slides and a multimedia projector. In the laboratory exercises are applied CAD tools to design and simulate digital circuits described in VHDL as well as FPGA boards for their implementation.

METHOD OF ASSESSMENT: The written exam is in the form of a test. The final mark consists of written exam (80%), midterm exam (10%) and laboratory work (lab report grading - 10%).

INSTRUCTION LANGUAGE: Bulgarian

BIBLIOGRAPHY:

1. W. Dally, R. Harting, T. Aamodt, Digital Design Using VHDL: A Systems Approach, 1st Edition, Cambridge University Press, 2016.

2. C. Unsalan and B. Tar, Digital system design with FPGA: Implementation using Verilog and VHDL, 1st Edition, McGraw-Hill Education, 2017.

3. Modern digital design with EDA, VHDL and FPGA, 1st Edition, Terasic Inc., 2015.

4. https://cst.tu-plovdiv.bg/edu/msc/login/index.php

5. https://www.ee.ryerson.ca/~courses/coe328

6. https://www.intel.com/content/www/us/en/products/programmable.html

7. https://www.xilinx.com

DESCRIPTION OF THE COURSE

Name of the course **Pattern recognition algorithms and systems**	Code: MpCSTS10_1	Semester:2
Type of teaching: Lectures (L) Laboratory work (LW)/Tutorials (T) Course work (CW)	Hours per semester: L – 30 hours T – 0 hours LW – 15 hours	Number of credits: 5

LECTURER:

prof. Petya Pavlova, PhD (FEA), Dep. CST, e-mail: p_pavlova@tu-plovdiv.bg
as. prof. Dobrinka Petrova – Dojcheva, PhD, (FEA), Dep. CST, e-mail:, dpetrova@tu-plovdiv.bg
as.prof. Veselka Petrova – Dimitrova PhD (FEA), Dep. CST, e-mail: vpetrova@tu-plovdiv.bg
Technical University of Sofia, branch Plovdiv

COURSE STATUS IN THE CURRICULUM: Elective subject from the curriculum for training of students to obtain Master's degree, specialty Computer systems and technologies, Professional orientation 5.3 General Engineering, Field 5 Technical Sciences..

AIMS AND OBJECTIVES OF THE COURSE: The main goal of the training is for students to expand their opportunities to apply their chosen specialty in a direction related to the use of images for the identification of objects and processes. After completing the course, they should have gained knowledge on shaping feature space for object identification, feature space processing and on the types of recognition systems used, and the approaches used in different cases. After completing the lab sessions, they should be able to work with the available classifiers available in publicly available programming libraries.

DESCRIPTION OF THE COURSE: Main topics: Feature Space Analysis, Clustering and Processing; Algorithms implemented in available libraries; Types of image recognition systems: biometric, security, industrial control, robotics. Recognition approaches: deterministic, probabilistic, logical and linguistic.

PREREQUISITES: Program languages, Digital signal processing, Computer graphics, Statistics, Computer vision.

TEACHING METHODS: Lectures. Labs with programming using Visual Visual Studio, OpenCV and initial shell of a software product, helpful for the personal product development.

METHOD OF ASSESSMENT: The final estimation is based on the exam results – 50% and laboratory work – 50%.

INSTRUCTION LANGUAGE: Bulgarian

BIBLIOGRAPHY:
1. Павлова П., Н. Шакев, Компютърно зрение, ТУ София филиал Пловдив, 2018 2 Daugherty Geoff, Pattern Recognition and Identification, an introduction. Springer, 2013 g. 9.Farid H., Fundamentals of Image Processing**,** 2010 – e-book. 10.Fr. Shih, Image Processing and Pattern Recognition: Fundamentals and Techniques, John Wiley, 2010. 11.R. Kountchev, New Approaches in Intelligent Image Processing, WSEAS Press, 2013. 12. Ahad, Computer Vision and Action Recognition, A Guide for Image Processing and Computer Vision Community for Action Understanding, Atlantis Press, 2011

WEB: https://towardsdatascience.com/support-vector-machine-introduction-to-machine-learning-algorithms-934a444fca47; https://www.analyticsvidhya.com/blog/2021/09/adaboost-algorithm-a-complete-guide-for-beginners/ https://www.analyticsvidhya.com/blog/2021/06/understanding-random-forest/ https://xgboost.readthedocs.io/en/stable/tutorials/model.html ; https://towardsdatascience.com/face-detection-for-beginners-e58e8f21aad9 ; https://www.nec.com/en/global/solutions/biometrics/iris/index.html ; https://pmc.ncbi.nlm.nih.gov/articles/PMC8123416/
https://pslc.ws/macrog/kidsmac/firehouse/arson/fbiprint.htm

DESCRIPTION OF THE COURSE

Name of the course: **Virtual and Mixed Reality Technologies**	Code: **MpCST10.2**	Semester: 2
Type of teaching: Lectures (L) Laboratory work (LW)	Hours per semester: L – 30 hours LW – 15 hours	Number of credits: 5

LECTURER(S):
Assoc. Prof. Eng. Dilyana Budakova, PhD (FEA), tel.: 0878281616, e-mail: dilyana_budakova@tu-plovdiv.bg, dilyana_budakova@yahoo.com
Technical University of Sofia

COURSE STATUS IN THE CURRICULUM: Elective subject from the curriculum for training of students to obtain Master's degree, specialty Computer Systems and Technologies, Professional orientation 5.3 Communication and Computer Equipment, Field 5 Technical Sciences.

AIMS AND OBJECTIVES OF THE COURSE: The course aims to introduce students to Virtual Reality (VR) and Mixed Reality (MR) technologies. To compare these technologies and the hardware used by them. After completing their studies, they will be able to implement their games and applications for VR and MR using the Unity 3D simulation platform and by writing C# scripts for Visual Studio.Net Framework. Students will be able to use the capabilities of the ML-Agents Toolkit with Python and the Deep Reinforcement Learning and Demonstration Learning algorithms it supports for their applications and simulations for VR and AR.

DESCRIPTION OF THE COURSE: The main topics concern: Mixed Reality Technology. Virtual Reality Technology. Mixed Reality Hardware. Unity as a simulation platform. Unity: A General Platform for Intelligent Agents. Path Finding algorithms: Dijkstra; A*. C# realization. World Representations. Graphs. Virtual reality app development. Motion controller visualization and use in VR. Make functionality to allow the user to work with virtual objects, pick them up, and place them in another place. The ML Agents Toolkit using. Deep Reinforcement learning algorithms and Learning by demonstration algorithms using and applying.
PREREQUISITES: Knowledge of „Basic programming languages“, “Learning and self-learning in programming”

TEACHING METHODS: Lectures, using slides, case studies, laboratory, work in teams, protocols and exam.

METHOD OF ASSESSMENT: Two one-hour assessments at mid and end of semester (30%), laboratories (10%), exam (60%).

INSTRUCTION LANGUAGE: Bulgarian

1. **BIBLIOGRAPHY:**
1. Andreas Kunz, Morten Fjeld, *Mixed Reality: A Survey*. Lecture Notes in Computer Science, 2009. DOI: 10.1007/978-3-642-00437-7_3 · Source: OAI. 2009. 2. Achin Bhowmik, James O’Brien, Allen Y. Yang, Fall 2017, CS294-137: *Theory and Applications of Virtual Reality and Immersive Computing*, Berkeley, University of California. 2017. 3. Steve Mann, Tom Furness, Yu Yuan, Jay Iorio, and Zixin Wang, 2018, *All Reality: Virtual, Augmented, Mixed (X), Mediated (X,Y), and Multimediated Reality*, arXiv:1804.08386vl, 2018. 4. Ian Millington, John Funge, *Artificial Intelligence for Games*, Second Edition, Elsevier, 2009. 5. Arthur Juliani, Vincent-Pierre Berges, Esh Vckay, Yuan Gao, Hunter Henry, Marwan Mattar, Danny Lange, *Unity: A General Platform for Intelligent Agents*, Cornell University, arXiv.org, Computer Science, Machine Learning, 2018. 6. Joran van der Sluis, Bachelor Thesis, Industrial Design, March 2017, *Mixed Reality Application and Integration with HoloLens in Manufacturing Environment*, University of Twente. 2017. 7. Ben Sizer, Kylotan, *The total Beginner’s Guide to Game AI*, gamedev.net, Nottingham, UK, 2018.

DESCRIPTION OF THE COURSE

Name of the course **Mathematical methods for digital signal processing**	Code:: **FaMpEE03;** **FaMpCST02;** **FaMpAICE202**	Semester: **II**
Type of teaching: Lectures (L) Laboratoty work (LW)	Semester hours: L – 20 hours, LW – 20 hour	Number of credits: **3**

LECTURER:

Assoc. Prof. PhD B. K. Pachedjieva (FEA) – tel.: 659 708; e-mail: pachedjieva@tu-plovdiv.bg

Technical University of Sofia

COURSE STATUS IN THE CURRICULUM: Optional course for the students in Master's programs in "Electrical Engineering", "Computer Systems and Technologies" and "Automatics, Information and Control Engineering"

AIMS AND OBJECTIVES OF THE COURSE: The aim of the course is to provide theoretical knowledge and practical skills using mathematical methods for digital processing and in particular Probabilistic and statistic methods at solving most important theoretical and practical problems in electronics – in particular statistical treatment of experimental data.

DESCRIPTION OF THE COURSE: The main topics concern: Probabilities; Random variables; System from random variables; Deterministic connections between Random variables; Statistical treatment experimental date; Random Processes; Stationary Random Processes; Markov Random Processes; Elements of the theory telegraphic systems; Transforming random processes in electronics units.

PREREQUISITES:. Good fundamental knowledge in the courses: Higher mathematics, Theoretical electrical engineering, Signals and systems.

TEACHING METHODS: Lectures, and laboratory work.

METHOD OF ASSESSMENT: Two two-hour assessments at mid and end of semester.

INSTRUCTION LANGUAGE: Bulgarian

BIBLIOGRAPHY: 1. Vencel E. S., L. A. Ovcharov. The theory of probability and its engineering applications. Moscow, Science press, 1988. 2. Gmurman V. E. The theory of probabilities and mathematical statistics. Moscow, Higher school press, 2002. 3. Gmurman V. E. Manual to the decision of tasks on the theory of probabilities and mathematical statistics Moscow, Higher school press, 2003. 4. Srinath M. D. Introduction to statistical signal processing with applications. Prentice-Hall, New Jersey, 1996. 5. Alberto Leon-Garcia. Probability and Random Processing for Electrical Engineering, Addison–Wesley, 1994. 6. Ferdinandov E. S., B. K. Pachedjieva. Probabilistic and statistic methods in communications. Sofia, Siela, 2005.

DESCRIPTION OF THE COURSE

Name of the course **Time series forecasting**	Code: FaMpEE01	Semester: 1
Type of teaching: Lectures (L), Laboratory work (LW)	Lessons: L– 20 hours LW– 20 hours	Number of credits: **3**

LECTURER (S): eng. Alexander Angelov, e-mail: aangelov82@abv.bg;
ESO EAD, RDS-South, Plovdiv

COURSE STATUS IN THE CURRICULUM: Facultative course for the student's specialty "Electrical Engineering", "Automatics, Information and Control Engineering" and "Computer Systems and technologies" at the Faculty of Electronics and Automation in TU-Sofia, Plovdiv Branch, Master's degree.

AIMS AND OBJECTIVES OF THE COURSE: After the successful completion of the course students must know the basic methods for forecasting the time series and be able to apply them in data analysis.

DESCRIPTION OF THE COURSE: In the learning process, students are introduced to different methods for predicting time series - conventional (regression and autocorrelation methods, smoothing methods, etc.) and modern, based on artificial intelligence (neural networks, etc.). Algorithms for analysis of the initial data, selection of a suitable mathematical model, and methods for determining the parameters of the model are considered. The course deals with applied examples and tasks, focused mainly on engineering applications for modeling and making forecasts based on the compiled models. Algorithms for quantitative assessment of the accuracy of the applied models are studied.

PREREQUISITES: Knowledge of the basics of mathematics is required.

TEACHING METHODS: Multimedia presentations are used in the lectures. Students have pre-accessed the presentations and can supplement them with explanations from the teacher. Laboratory exercises include specific tasks using computers and data processing software..

METHOD OF ASSESSMENT: Two examines during the semester (80%) and laboratory work (20%).

INSTRUCTION LANGUAGE: Bulgarian

BIBLIOGRAPHY:
1.Вучков, И., С. Стоянов. Математическо моделиране и оптимизация на технологични обекти. Техника, София, 1980, 1986

2. Цочев, В., Д. Дамгалиев, Н. Козарев, Н. Манолов. Ръководство по методи за експериментални изследвания и оптимизация. МАРТИЛЕН, София, 1994.

3. Вучков, И., С. Стоянов, Н.Козарев, В.Цочев. Ръководство за лабораторни упражнения по статистически методи.Издателство "Нови знания", София, 2002

4. R.H. Shumway, D. S. Stoffer. Time Series Analysis and Its Applications, Springer Texts in Statistics, 3rd ed.