

Computer Science Engineering MSc (2021) – Final Exam topics

1. Presentation of the newest communication technologies. Software Defined Network (SDN). Network Function Virtualization (NFV). 4G mobile communication: LTE, LTE-A. 5G mobile communication: comparison of the mobile communication generations, new services.
2. Multivariable differential calculus. Multivariable extrema. Taylor expansion. Multivariable integral calculus. Numerical solution of optimization problems.
3. Shannon's model of communication, uniquely decodable and prefix codes, measures of information. Shannon entropy and its properties. Block encoding. Quantization, optimal quantizer, companded and vector quantizers. Sampling, Nyquist-Shannon sampling theorem.
4. Basic concepts of error correcting coding, linear codes. Decoding and error correction with a syndrome. The Hamming code. Basics of symmetric and asymmetric encryptions, AES, RSA. Hash functions, digital signatures, RSA signature, user authentication.
5. Logic circuits, Computing with circuits, Computational strengths of circuits, The complexity classes P and NP, NP-completeness, Examples of NP-complete problems, Approximation algorithms, Randomized algorithms.
6. Performance measures of queueing systems, M/M/1 type networks, multiple server systems. Finite capacity systems, retrial systems. Systems with non-reliable server, modeling of wireless systems.
7. Simple hardware, control units, microcontroller circuits. General structure of general-purpose microprocessors. Description of the main structural units and properties of common microprocessor families. RISC-based microprocessors. Processor types for specific application areas (DSP) and their main characteristics.
8. Properties of task-oriented soft processor CPUs in FPGAs with configurable instruction set (MicroBlaze, NIOS, Mico32). Combined processing and control units, hardware accelerators and functional units given tasks.
9. Digital systems design flow from specification to implementation. Hardware description languages. Structural and behavioral design examples. Complex modules design using Verilog. Embedded test possibilities.
10. Image transformations. Edge detection, smoothing. Thresholding. Convolutional filtering, object detection. Mathematical morphology. Texture analysis. Parallel/distributed algorithms.
11. Basic terms and mechanisms of the Internet of Things (IoT). Overview of the IoT standards, standardisation institutes, architecture and functions. IoT object identification technics in practice: IPv6, EPC. IoT nodes and technologies. Communication functions of the sensors and actuators.
12. Web of Things (WoT) technology. Cloud computing and fog computing from the Internet of Things (IoT) prospect. Integration of the IoT and multimedia systems and services. Integration of the mobile communication systems. Security issues of the IoT systems, software and hardware based technics.