Computer Science Engineering BSc (2021) – Final Exam topics

1. Embedded systems definitions and main characteristics. Embedded systems control unit implementation options and characteristics (integration options, typically peripherals, programing techniques). Implementing the interaction between the system and the user.

   Program units. Subprograms. Parameter evaluation. Parameter passing methods. Block. Scoping, accessibility. Abstract data type. Generic programming. I/O tools of programming languages, file handling. Exception handling. Parallel programming.

2. Synthesis of continuous time control systems. The gain and phase margin. Linear systems and their description in time- and frequency domains. Signal transfer in control systems.

   Describe the protocol data units (PDU) of the TCP and UDP transport layer protocols and the characteristics and differences of their mechanisms.

3. Combinational logic design. Multiplexers/Demultiplexers. Encoders/Decoders. Comparators. Parity generators/checkers. Arithmetical logical units.

   Problem solving with search, uninformed and heuristic search algorithms. Constraint satisfaction problems.

4. The SSH protocol, key generation, SSH configuration settings.

   The principles of control, feedback control and open loop control. Set point control and reference signal tracking, the role of negative feedback. Requirements for control systems.

5. Two-person games and their representations. Winning strategy, optimal decisions in games.

   MOS transistor: large signal model and characteristics. The MOS transistor as a switch. CMOS inverter, basic logic gates. The operational amplifier. Negative feedback. Basic applications.

6. Sequential logical: Latches and Flip-Flops. Counters. Shift registers. Memories.

   New elements of HTML5. New features of CSS3. Control structures in web scripts. Sensor through a web page. Providing remote management systems through a web page.

7. Basics of software and hardware testing, basic testing methodologies, test levels, unit testing through examples from advanced programming languages and / or hardware description languages.

   Implementation of control structures in assembly language (conditional and unconditional control transfer, branching, cycle organization, subroutine call).

8. Typical peripherals and communication protocols for embedded systems. Describe the control unit, peripherals, and applicability of a single-board mini-computer in embedded systems.

   Describe the functions and services of network management systems and the possibilities of implementing these functions for specific products (for example MRTG or Nagios).

9. Programmable logic devices. Designing a digital system in hardware description language, and implementing it in FPGA devices.

   Basic concepts of system engineering, different paradigms. Characteristics of the classical methods: waterfall, evolution, incremental, agile methods. Fundamentals and patterns of OOdesign. MVC

10. Web server configuration using SSL, the OpenSSL cryptographic library basic functions: authentication, encryption.

    The instruction set architecture (ISA) of Intel X86 processors (registers, addressing, instructions, memory architecture, interrupt system).

11. Inter-process communication methods (file, signal, pipe, socket).

    Complexity of algorithms, asymptotic notations. Insertion sort, searching in linear and logarithmic time. Tables, hash functions, hash tables. Graphs, breadth-first and depth-first search.

12. Entity-relationship (ER) model, design with ER diagrams. Relational data model, relation, scheme, attribute. Building up a relational scheme from an ER-diagram.

    Diodes. Rectifiers. DC to DC converters. Voltage regulators. Current regulators.

13. Modern processor solutions (pipeline, hazard, out-of-order execution, speculative execution, superscalar-, VLIW- and vector processors)

    Optimization and evaluation of relational queries. Tree-based optimization in relational algebra. Cost-based optimization.

14. Purpose, operating algorithms, similarities and differences of NAT/PAT address exchange mechanisms.

    Basic notions concerning data structures: abstraction, abstract data types. Elementary data structures: lists, stacks, queues. Sets, multisets, arrays. Representation of trees, tree traversal, search, insert, delete.

15. Basic concepts of object-oriented paradigm. Class, object, instantiation. Inheritance, class hierarchy. Polymorphism, method overloading. Scoping, information hiding, accessibility levels. Abstract classes and interfaces. Class diagram of UML.

    The architectures and algorithm elements that define the operation of SNMP and RMON network management systems.