UNIVERSITATEA DIN CRAIOVA

Facultatea de Automatică, Calculatoare și Electronică

Departamentul de Calculatoare și Tehnologia Informației

Examen de diplomă, promoția 2023

TEMATICA propusă pentru Proba I

Evaluarea cunoștințelor fundamentale și de specialitate

Programul de studiu: "Calculatoare în limba engleză"

Domeniul: " Calculatoare și Tehnologia Informației"

1. **Mastering fundamental scientific, engineering and IT concepts:**
   1.1. Computer Graphics
      1. Geometric transformations
      2. The modeling/simulation transformation pipeline
      3. The visualization transformation pipeline

   1.2. Data Structures and Algorithms
      1. Binary search trees
      2. Height balanced trees
      3. B trees
      4. Graphs - Minimum cost spanning trees

   1.3. Operating Systems
      1. Process Management
      2. Synchronization in Linux
      3. Synchronization in Windows

   1.4. Concurrent and Distributed Systems
      1. Model of concurrent computing
      2. Critical sections
      3. Semaphores
      4. Monitors
      5. Concurrent objects and linearizability
      6. Concurrent data structures
      7. Concurrent problem solving
      8. Inter-process communication in distributed systems
      9. Object oriented distributed systems and remote method invocation

2. **Design skills in the fields of hardware, software, and communications:**

   2.1. Computer Programming - Programming Techniques

1. Algorithm complexity analysis
2. Algorithm correctness
3. Sorting algorithms
4. Abstract data types
5. Lists, stacks and queues
6. Graphs and trees. Concepts, representation and traversal
7. Divide and conquer algorithms
8. Dynamic programming
9. Greedy algorithms
10. Backtracking algorithms

2.2. Logical Design
1. Boolean Algebra: Axioms and Theorems
2. Switching functions: Switching functions used in computing technique (constants, NOT, AND, OR, NAND, NOR, XOR, XNOR), Relations between switching functions, Properties of switching functions NAND, NOR, XOR
3. Logic forms: Minterms and maxterms, Canonical representations of switching functions (CDNF, CCNF), Normal forms (DNF, CNF), Representation of switching functions in NAND or NOR logic
4. Minimization of switching functions using KV and VEM maps
5. Combinational logic circuits in MSI: Logical Multiplexors (MUX), Logical Decoders (DEC), Binary adders (ADDER), Binary Comparators (COMP)
6. Sequential Logic Circuits: Mealy and Moore model
7. Flip-flops (RS, JK, D, T)
8. Sequential logic circuits in MSI (Registers, Counters)

2.3. Computer Systems Architecture
1. The von Neumann's model of a digital computer
2. Instruction cycle
3. General structure of a CPU
4. EEC – Mode of operation: Fetch phase and Execute phase
5. Memory addressing techniques: based addressing, paged addressing, indexed addressing

2.4. Applied Informatics II
1. Encapsulation
2. Class Cohesion
3. Class coupling

3. Problem solving using scientific and computer engineering tools:

3.1. Computer Programming
1. Programming Languages and Programming Paradigms
2. Algorithms: Design and Implementation
3. Data Structures
4. Expressing the Algorithms
5. Algorithm Analysis: Theoretical and Practical Validation
6. Programming in C: Program Structure and Functions. Preprocessing. Basic

I/O Operations
7. Programming in C: Data and Control Structures
8. Programming in C: Arrays and Pointers
9. Programming in C: File I/O. The Standard Library

3.2. Object Oriented Programming
1. Classes
   - Method overloading. Definition. Example.
   - Public/protected/private Definition. Example.
   - Constructor. Definition. Example.
   - Static member of a class. Definition. Example.
   - The keyword "this" Definition. Example.
   - Class composition. Definition. Example.
2. Inheritance
   - Definition. Advantages
   - Public/protected/private related to inheritance. Explanations. Example.
   - What is method overriding ?
3. Template classes
   - Definition. Use case. Example.
4. Abstract classes. Definition. Where to use it. Example
5. Interfaces. Definition. Where to use it. Example
6. Virtual. Definition. Where to use it. Example

3.3. Databases
1. Entity-Relationship Model
2. Relational Model
3. Basic SQL

4. Improving the performances of the hardware, software, and communication components:

4.1. Computer Networks
1. IP addresses, network masks
2. TCP/IP Four Layers Architecture Model
3. ARP
4. DHCP
5. DNS

4.2. Parallel and Distributed Algorithms
1. Parallel and Distributed Architectures. Virtual Platforms
2. Parallel Programming Models. Performance Metrics
3. Parallel Algorithms: Concurrency, Mapping and Basic Communication
4. Parallel Algorithms: Design Principles
5. Numerical Algorithms and Matrix Computations. Pipeline and Systolic Methods. Parallel Sorting
6. Modeling Distributed Systems: Logical Time, Global States and Causality Constraints
7. Basic Distributed Algorithms: Consistent Global States and Global Predicate Detection, Leader Election
8. Parallel and Distributed Algorithms for Graphs and Trees
9. Distributed Consensus and Agreement

4.3. Data Security

1. Information security objectives (CIA triad).
2. Other relevant properties (access control discretionary / mandatory / role-based, authorisation, non-repudiation, accountability, etc.)
3. Basic cryptography (cryptosystems, Kerckhoff's principle, categories: symmetric vs. asymmetric cryptography)
4. Substitution and transposition techniques. Mono-alphabetic / Poly-alphabetic / Polygraphic / Simple geometric algorithms. Simple and double transposition algorithms.
5. User authentication mechanisms
6. Integrity assurance mechanisms (MAC codes, digest/non-invertible functions)

5. Design, lifecycle management, integration and protection of hardware, software, and communication systems:

5.1. Computer Structure and Organization
1. Signed Number Representation in Computers: FXP direct code and FXP 2's complement representation, Shifting of signed binary numbers
2. Addition and Subtraction of Signed Binary Numbers: FXP addition and subtraction in direct code, FXP addition and subtraction in 2's complement code
3. Computer Organization - Fundamental Concepts: Harvard Architecture, Harvard vs von Neumann, CISC and RISC processors
4. Memory Hierarchy: Cache memory

5.2. Software Engineering
1. Agile Software Engineering.
2. Software Architecture
3. Reliable programming
4. Testing
5. Code Management

5.3. Project Management
1. Project Management Lifecycle/Groups of Processes
2. Project Management Knowledge Areas
3. The Project Management Triangle
4. Project. Definition and attributes.
5. Project Manager. Definition and skills.
6. Project Management Tools.

6. Design of intelligent systems:

6.1. Web Application Design
1. Web infrastructure and architectures
2. Technologies for Web applications
3. Testing Web applications
4. Operation and maintenance of Web applications
5. Usability of Web applications
6. Security for Web applications

6.2. E-Commerce

1. eBusiness models
2. Recommender systems.
   - Classification
   - Recommending on product page
   - Recommending on homepage
3. Auctions
   - English auction
   - Dutch auction
   - Vickrey auction