# SCOPE OF QUESTIONS FOR THE FINAL EXAM - BSc. Eng. INFORMATICS

# I. COMMON COURSES

#### **Theory of Computer Science**

- 1. Turing machine construction, operation, programming
- 2. W-machine construction and operation
- 3. Assembler language, assembling and generation of binary result code
- 4. The concept of system resources and deadlock and methods of protection against deadlocks
- 5. The M/M/1 system

#### **Fundamentals of Computer Programming**

- 1. Functions (call mechanism, parameters, inline, constexpr, lambda)
- 2. Input/output operations
- 3. Memory management, pointers, intelligent pointers, references
- 4. Modularity, separate compilation, consolidation, namespaces
- 5. Array type, declaration of new types, STL data structures

#### **Computer Programming 2**

- 1. Class and derived class declaration, object construction and destruction
- 2. Class methods and operators, operator overloading in C++
- 3. Polymorphism and virtual methods, RTTI mechanism, abstract class in C++
- 4. Multi-base inheritance in C++, virtual inheritance
- 5. Exception mechanism in C++, smart pointers

#### **Computer Programming 3**

- 1. Templates and generic programming in C++, concept of containers, iterators and algorithms in STL library
- 2. Regular expressions in C++
- 3. Multithreading mechanisms in C++
- 4. Memory management mechanisms in .NET
- 5. Data types in C# (characteristics, differences, casting ... )

#### **Software Engineering**

- 1. Designing information systems in Unified Modeling Language (UML)
- 2. Design patterns
- 3. Software development methodologies and risk management in IT projects
- 4. Software verification and validation
- 5. Time optimization of computer programs

# **Digital Circuits Theory**

- 1. Algebra of digital circuit
- 2. Functional digital blocks
- 3. Dynamics of digital circuits
- 4. Structures of sequential digital circuits
- 5. Design methods for sequential asynchronous circuits

# **Arithmetic of Digital Systems**

- 1. Principles of performing arithmetic operations in p-based number systems
- 2. Arithmetic of decimal numbers with binary coded digits
- 3. Formats of numeric words in digital systems
- 4. Principles of arithmetic operations in fixed-point format
- 5. Principles of arithmetic operations in floating point format

# **Digital Circuits Design**

- 1. Principles of using open collector/drain output circuits
- 2. Multiplexed display
- 3. Implementation of keypads in digital circuits
- 4. Static and dynamic interference. Design of memory blocks with preset organization

## **Microprocessor and Embedded Systems**

- 1. Structure and development of memory in embedded systems, (on selected examples of AVR and ARM microcontrollers)
- 2. Buses in embedded systems
- 3. Interrupts in microprocessor systems
- 4. Structure, resources, peripheral circuits of AVR and ARM microcontrollers using selected examples
- 5. Methods of matching logic levels when connecting digital circuits supplied with different voltages

#### **Assembler Programming Languages**

- 1. Procedures and macro definitions similarities and differences
- 2. Segmentation in real and virtual addressing with protection. Program division into segments
- 3. Passing parameters to procedures and returning function values. Conventions of procedure calls for different programming languages
- 4. SIMD technique. Examples of vector instructions
- 5. Evolution of the x86 family processors. Basic 8086 registers and their extensions in modern 32- and 64-bit processors

#### **Discrete Mathematics and Mathematical Logic**

- 1. Binary relation and equivalence relation, principles of abstraction
- 2. Ordering relations, types of order, minimal element vs. smallest element
- 3. Approximate sets, information system, reduct for system and decision table
- 4. Automatic Theorem Proving, proof tree, Prolog language
- 5. Elements of counting, Stirling numbers, Bell numbers

## **Programming of Industrial Controllers**

- 1. Features of industrial controllers
- 2. Programming languages for PLC class devices
- 3. Programming of sequential automations
- 4. Time control and access to resources in industrial controllers
- 5. Construction architecture, and operation models of industrial controllers

# **Data Analysis and Computational Intelligence**

- 1. Data preprocessing
- 2. Data clustering and quality assessment of partitioning
- 3. Classification and regression models and measures and methods for their evaluation
- 4. Fuzzy and neural-fuzzy systems
- 5. Ensemble approaches to perform classification and regression tasks

#### Java in the Internet and Mobile Devices

- 1. Defining classes and other program elements in Java
- 2. Unit testing in Java
- 3. Communication with streams in Java
- 4. Web and database applications in Java
- 5. Designing graphical user interfaces in Java

#### **Computer Graphics**

- 1. Graphics rendering pipeline (implemented by the graphics card)
- 2. Affine transformations
- 3. Representation of orientations (Euler angles, quaternions)
- 4. Illumination modeling (global and local models, Blinn-Phong model, Lambert model)
- 5. Parametric curves and surfaces

#### **Numerical Methods**

- 1. Types of errors in numerical calculations. Loss of significant digits
- 2. Exact and iterative methods for solving systems of linear equations
- 3. Polynomial interpolation methods; glued functions; differences between interpolation and approximation
- 4. Methods of approximation of functions; Systems of approximating polynomials
- 5. Schemes of numerical differentiation and their truncation errors

#### **Algorithms and Data Structures**

- 1. Computational complexity
- 2. The divide-and-conquer method and dynamic programming
- 3. Sorting
- 4. Greedy algorithms and exhaustive search
- 5. Graphs, the problem of determining the shortest path

#### **Computer Construction**

- 1. Reprogrammable circuits construction, internal structure, CAD systems, HDL
- 2. Microprocessor cards design, internal structure, programming
- 3. Methods of increasing data access speed in operational and mass memories
- 4. Data loss protection methods in mass memories Backup, RAID, SFT, UPS
- 5. Bus in computer systems

#### **Computer Networks**

- 1. Layer models of computer networks
- 2. Routing algorithms
- 3. TCP versus UDP, discussion of differences
- 4. Congestion control and QoS
- 5. Virtual connections vs datagrams

### **Computer Architecture**

- 1. Features of processors with CISC, RISC and superscalar architectures
- 2. Problems occurring with pipelined execution of commands data gambling and control gambling
- 3. Vector commands SIMD model in processor architecture
- 4. Characteristics of multiprocessor systems
- 5. Characteristics of computer clusters

#### **Fundamentals of Database Systems**

- 1. Relational algebra as the basis of query languages
- 2. SQL search across multiple tables
- 3. References in databases
- 4. Transaction management in databases transaction isolation levels, transaction log
- 5. Normalization of relational database structure

#### **Database Systems and Applications**

- 1. Accessing databases via ADO.NET (connected and disconnected mode) query processing phases
- 2. Object-relational mapping using Linq2SQL Classes and Entity Framework database first approach
- 3. Object-relational mapping with Entity Framework code first approach
- 4. Accessing Databases Using JDBC
- 5. Object-relational mapping with spring-data, Jpa, hibernate code first approach

#### **Statistical Methods**

- 1. Definition of probabilistic space and examples
- 2. Definition of random variable, probability function, densities, distribution parameters
- 3. Bernoulli distribution, normal distribution with examples
- 4. Point and interval estimator, unboundedness, efficiency of estimator, examples
- 5. Definition and procedure of statistical test, test statistic, critical area

#### **Mobile Technologies**

- 1. Zygote mechanism in Android. A comparison of Dalvik and ART virtual machines
- 2. Life cycle of Android activities. Intents mechanism. Policies for granting permissions to Android resources
- 3. The issue of energy optimization of Android mobile applications
- 4. The concept of optional objects in Swift usage and ways of referring to such objects
- 5. Ways of passing information between views in iOS. Gesture and location support in iOS

#### **Operating Systems**

- 1. Operating systems types, functions, structure, communication models
- 2. Algorithms for serialization of processes in operating systems
- 3. Synchronization of processes semaphores, mutual locking problem
- 4. Page substitution algorithms in the implementation of virtual memory
- 5. Basic methods of memory allocation for disk files

# **Distributed Industrial Computer Systems**

- 1. Communication in industrial computer systems
- 2. Determinism and real-time issues
- 3. Concept and functions derived from Industry 4.0
- 4. Models od ICS class
- 5. Industrial networks and characteristics of protocols

## **Interfaces in Computer Systems**

- 1. USB communication interface architecture communication model, types of packages, communication mechanisms and protocols
- 2. USB OTG technology on the example of Android solutions
- 3. Thunderbolt communication interface the concept of meta-protocol