

Syllabus for the Entrance Exam

Master Study Programme **COMPUTER MODELLING**

Valid from 2015

The syllabus of the entrance exam consists of three parts. The exam test covers all three parts. One task of the exam test is related to one or more topics of the syllabus. The recommended literature is presented for every part of the syllabus, but candidates could use some other literature while preparing for the exam.

The entrance exam is written. The programming language must be used to provide the solutions to programming tasks. The programming languages of strict types, i.e., TurboPascal, C, Java, C#, and C++, are acceptable.

I. Discrete Mathematics, Data Structures, and Algorithms

1. The logical framework: the basic logical operations: **not**, **or**, **and**. Logical equivalence.
2. The principle of induction, summation formulae, recursive definitions.
3. Fibonacci numbers. Principles of counting, permutation, even and odd permutations. Binomial numbers, the sieve principle.
4. Algorithms: their efficiency and complexity. Asymptotic evaluation of algorithms.
5. Sorting algorithms.
6. Graphs, paths, and cycles. Problem of the shortest path in a graph.
7. Trees and search algorithms.
8. Sets. Set operations: union, intersection, and complement.
9. Abstract data types. ADT stack and queue.

Literature:

1. N. L. Biggs. *Discrete mathematics*. Oxford University Press, second edition, 2002.
2. T. H. Cormen, C. Stein, R. L. Rivest, C. E. Leiserson. *Introduction to Algorithms* (3rd Edition). The MIT Press, 2009.

II. Programming

1. Programming paradigms and programming languages.
2. Data types: standard data types, user defined data types, operations, dynamic structures.
3. Controlling program flow: loops, conditionals, branching, breaking, and continuing.
4. Procedures and functions. Types of parameter passing.
5. Interface and implementation.
6. Concept of the class. Principles of encapsulation and/or information hiding.
7. Concept of the object. Instantiation, copying, destruction, and management of the object.
8. Composition and inheritance.
9. Polymorphism and dynamic binding.

Literature:

1. H. M. Deitel, P. J. Deitel. *C How to Program Introducing C++ and Java*. Prentice Hall, 2004.
2. Bruce Eckel. *Thinking in Java (4th Edition)*. Prentice Hall, 2006.
<http://mindview.net/Books/TIJ4>
3. Bruce Eckel. *Thinking in C++ (2nd Edition)*. Prentice Hall, 2000-2003.
<http://www.mindview.net/Books/TICPP/ThinkingInCPP2e.html>
4. Bjarne Stroustrup. *The C++ Programming Language (4th edition)*. Addison Wesley Longman, 2013.

III. Database Management Systems

1. Concepts of the database and database management system.
2. Relational database model.
3. SQL language. Data types. Text, date, and mathematical operators and functions
4. SQL DDL. Modification of the data structures of the database: definition, change, and deletion of databases and tables. Primary and foreign keys. Implementation of constraints.
5. SQL DML: insertion, update, and deletion of data.
6. SQL DML: queries. Grouping, nested queries, union, intersection, and difference of queries. Conditions. Types of table joins. Indexes.
7. Entity-relationship (ER) model. Elements of ER diagram.
8. ER-to-relational mapping.
9. View tables.
10. Transaction management.
11. Data integrity constraints.

Literature:

1. A. Silberschatz, H. Korth, S. Sudarshan. *Database System Concepts (6th Edition)*. McGraw-Hill, 2010.