Course title: DATABASES II

Lecturers	Full Prof. Kornelije Rabuzin, Ph.D., Martina Šestak, M.Inf.
Language of instruction	Croatian and English
Schedule	60 teaching hours - (30 lectures + 14 seminars + 16 laboratory exercises)
Study level	Bachelor
Study programme	Information / Business Systems
Semester	Winter
ECTS	6
Goal	The goal of this course is to introduce the students to methods of database design. The content of the course is focused on design of relational databases because technology of relational databases, as a dominant commercial technology, is a base for development of: relational/object systems, temporal database management systems and knowledge bases, and data warehouses. At the end of this course, the students should be able to perform a conceptual design of a selected application domain. After that, using methods of logical and physical database design they should be able to design a correct schema of the relational database. Since the students usually have problems with formalization of problem domains, second goal of the course is to introduce the students to elements of formal language for databases. This way, the students are able to understand database problems and gain the necessary knowledge for higher levels of education in fields in which database technology plays important or central role.
Content	1. Introduction Introducing the students to: content and goal of the course, literature, classes organization, requirements for passing the examination. Databasedesign problems. 2. Conceptual database design 1.1. Graphical languages for conceptual database design Concepts and reality. Objects. Object relationships. Graphical languages: ER, ORM, UML. 1.2. Elements of ER and UML (part I) Entity sets. Attributes. Relations. Diagrams. Multiplicity of binary relations. Types of relationships. Roles in relationships. Relationship attributes. Transformation of n-ary relationship into a binary relationship.

	1.3. Elements of ER and UML (part II) Associations. Classification. Generalization. Aggregation. Subtypes and supertypes. Partitions. Multiple supertypes. Generalization and inheritance. Weak entities. 1.4. Elements of ER and UML (part III) Constraints modeling: constraints classification, keys, uniqueness, referential integrity, relationship types. Design principles: correctness, redundancy elimination, simplicity, selection of adequate relations, selection of adequate element types. **2. Logical database design** 2.1. Problem of logical database design Database schema. Database. Redundancy. Normalization. Dependencies in databases. Overview of normal forms. 2.2. Functional dependencies Syntax and semantics of functional dependencies. Logical consequence. Implication problem for functional dependencies. Method of solvingthe implication problem for functional dependencies. 2.3. Types of functional dependencies Triviality. Partiality. Transitivity. 1NF. Redundancy and update anomalies. 2.4. Decomposition of relational schema Decomposition preserving information. Decomposition preservingdependencies. Normal forms: 2NF, 3NF, BCNF. 2.5. Algorithm of 3NF synthesis Canonical cover. Algorithm of 3NF synthesis. 2.6. Multivalues dependencies Syntax and semantics of multivalueddependencies. Logical consequence and implication problem. Methods for solving implication problem. 2.7. Joindependencies Syntax and semantics of join dependencies. Logical consequence and implication problem. Methods of solving of the implication problem. 2.8. 4NF i 5NF 4NF. 5NF. Final notions of normalization. Denormalization. **3. Relationship between conceptual and logical database design** Translation of ER diagram into relational database schema. Improvement of

	relational database schema by using logical database design. Practical recommendations for database design. 4. Database evolution Relational databases. Generalized relational databases. Object/relational databases. Deductive database. XML and database.
Exercises	Using adequate graphical tools and database management system, the students learn to design and implement a database, and to build a simple business application.
Preconditions	Databases I, Data structures
Realization and examination	Classes: Lectures, seminars and exercises. Examination: Students take two written exams throughout the semester. After passing the laboratory exercises and presenting the seminar project, students can take the final oral exam.
Related courses	1. Imperial College, London, Department of Computing, Databases; 2. Stanford University, Department of Computer Science, A First Course in Database Systems; 3. James Madison University, Department of Computer Science, Fundamentals of Relational Databases; 4. University of Massachusetts, Databases; 5. California State University, Los Angeles, Department of Computer Science, Database Desig.
Literature	Basic: 1. Lectures 2. H. Garcia-Molina, J. D. Ullman, J. Widom, Database Systems: The Complete Book, Prentice Hall, 2002. Additional: 1. C. J. Date, An Introduction to Database Systems, Addison Wesley, 2004. 2. G. V. Post, Database Management Systems, Mc Graw-Hill, 2001. 3. R. A. Mata-Toledo, P. K. Cushman, Fundamentals of Relational Databases, Schaum's Outline Series, McGraw-Hill, 2000.
Online sources	http://www.rational.com/uml, http://www.dbpd.com, http://www.BRCommunity.com, http://www.dbdebunk.com