

## Specification for the book of courses

<b>Study program</b>		Electrical Engineering and Computer Science		
<b>Module</b>		Computing and Informatics		
<b>Type and level of studies</b>		Undergraduate Academic Studies		
<b>The name of the course</b>		Database Systems		
<b>Lecturer (for lectures)</b>		Stoimenov V. Leonid, Stanimirović S. Aleksandar		
<b>Lecturer/associate (for exercises)</b>		Stanimirović S. Aleksandar, Frtunić-Gligorijević B. Milena		
<b>Lecturer/associate (for OFE)</b>		Bogdanović D. Miloš, Veljković Ž. Nataša		
<b>Number of ECTS</b>		5	<b>Course status (obligatory/elective)</b>	Elective
<b>Prerequisites</b>				
<b>Course objectives</b>		Gaining fundamental knowledge of basic concepts and principles of a database system and its components (applications, DBMS and databases). Learning advanced techniques of using SQL, using DBMS (triggers, safety, query optimization). Gaining knowledge of basic concepts and principles of object-relational databases and object-relational mappers.		
<b>Course outcomes</b>		Theoretical knowledge of database systems, their components and ways of usage; practical knowledge of advanced techniques of database systems usage and developing database applications. The student will be capable of using principles of object-oriented technology with relational databases, with both object-relational systems and object-oriented applications working with relational databases.		
<b>Course outline</b>				
<b>Theoretical teaching</b>		<ol style="list-style-type: none"> <li>1. Introduction: Short overview of the relational data model and relational query languages. Basic concepts and database system architectures. Modern challenges for database systems.</li> <li>2. Advanced techniques of using SQL: different types of joins with SQL, working with dates in SQL, nested queries, data grouping and advanced techniques of grouping.</li> <li>3. Database management systems: overview of architecture, basic modules and functions</li> <li>4. Stored procedures, Triggers: concept, purpose and using of triggers, syntax of the trigger creation command, types of triggers and granularity, row-level triggers and expression-level triggers.</li> <li>5. Processing and optimization of queries: the concept of query optimization, static and dynamic optimization, system catalogue, database statistics and optimization, index structures.</li> <li>6. Database systems safety: the concept of safety in database systems, safety in database management systems (DBMS), user privileges - granting and revoking (GRANT and REVOKE commands), privilege propagation, safety on view level, DAC and MAC mechanisms of safety.</li> <li>8. Database application architecture. Separating application data access logic - typical design patterns.</li> <li>9. Object relational mappers: basic concept, concepts and typical architecture. Creating object-relational mappings for application development over databases. Mapping a relational database model to an object-oriented application data model. Advantages and disadvantages of object-relational mapping. Practical examples of different object-relational mappings.</li> <li>10. Modern trends in database system technology.</li> </ol>		
<b>Practical teaching (exercises, OFE, study and research)</b>		Advanced techniques of using SQL - practical examples and assignments, Query optimization - practical examples, problems, using DBMS tools, Advanced concepts of database design, extended entity-relationship model (EER model). Translating EER model to relational model, Mapping object-oriented model to relational. Object-relational mappers, Example of object-relational mapper technology and its usage: Hibernate/NHibernate, NoSQL databases (notion, basic concepts, division, examples).		
<b>Textbooks/references</b>				
1	R. Emasri, S. Navathe, Fundamentals of Database Systems, Pearson; 7 edition (2016), ISBN-13: 9780133970777			
2	T. Connolly, C.Begg, Database Systems, A Practical Approach to Design, Implementation, and Management, 4th edition, Pearson Education Ltd, Addison Wesley, 2005			
3	G. Harrison, Next Generation Databases: NoSQLand Big Data, 1st edition, Apress, 2015, ISBN-13: 978-1484213308			
4	Different papers regarding modern trends in database system technology.			
5				
<b>Number of classes of active education per week during semester/trimester/year</b>				
<b>Lectures</b>	<b>Exercises</b>	<b>OFE</b>	<b>Study and research work</b>	<b>Other classes</b>
2	2	1	0	0

<b>Teaching methods</b>	Lectures, auditory exercises, laboratory exercises. Individual work of homework and projects		
<b>Grade (maximum number of points 100)</b>			
<b>Pre-exam duties</b>	<b>Points</b>	<b>Final exam</b>	<b>Points</b>
<b>Activity during lectures</b>	10	<b>Written exam</b>	
<b>Exercises</b>	30	<b>Oral exam</b>	30
<b>Colloquia</b>			
<b>Projects</b>	30		