FACULTY OF COMPUTER SCIENCE AND ENGINEERING

CURRICULUM

I confirm:
Dean:

CS 325

ANALYSIS AND DESIGN OF DATABASES AND KNOWLEDGE BASES

Updated: Protocol No.
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ANNOTATION

The course “Analysis and Design of Databases and Knowledge Bases” is a major course for the specialties in field 4.6 Informatics. The course introduces students to various aspects of knowledge management as a strategic resource. Basic concepts, processes, environments and technologies for knowledge management are considered. Special emphasis is placed on Knowledge Management Systems (KMS) and approaches to developing such complex technological solutions.

The main methods of analysis and optimisation of relational schemes are considered, as well as the theoretical foundations and some design and technological techniques for building relational databases, as well as concepts and paradigms related to distributed databases and related opportunities for creating distributed information systems. Using the already acquired skills to work with the MS SQL Server platform, students apply the approaches and techniques learned during this course to analyse and design databases and knowledge bases.

MAIN OBJECTIVES

The main objective of the course is to form in-depth knowledge of methods and techniques for designing, analysing, developing and optimising databases and knowledge bases and their relevant use. Specifically, students need to realise and understand:

- The basic concepts and processes related to knowledge management, as well as the technologies and solutions developed to support these processes.
- Methods for analysis and optimisation of relational schemes based on functional dependencies and logical consequences;
- The basic concepts related to the distributed databases and client-server architecture;
- The basic concepts and principles of the object approach for database modelling;
- Distributed queries processing and decomposition, transaction processing and execution of competitive transactions;
- How to put into practice the methods of design, analysis and optimisation with the means of the Microsoft SQL Server platform.

PREREQUISITES

The basis for this discipline is the knowledge that students have acquired within the study courses in Programming, Algorithm Theory, Discrete Mathematics, Object Oriented Programming and Databases.

STATUS AND STRUCTURE

specialty status		ECTS	full-time training				part-time training			
			L	C	t	total	L	C	t	total
Software Engineering	Mandatory	6	30	0	30	60	15	0	15	30

COURSE CONTENT

Topic 1. Basic concepts and processes in knowledge management. Models and approaches to knowledge management. Organizational environment and knowledge management strategies.

Topic 2. Technology and Knowledge Management Systems (KMS). Knowledge management services. Technology to extract knowledge. Architectures of KMS.

Topic 3. Relational model. Relational algebra – multiple and relational operations, algebraic laws. Relational expressions. Design of relational database.

Theme 4. Functional dependencies. Sets of F-dependences. A logical consequence. Closure of a set of functional dependencies. Armstrong's axioms. Algorithm for optimization of relational expressions.

Theme 6. Functions and architecture of distributed DBMS. Distributed request processing. Client-server architecture. Date's rules for distributed database systems. Distributed databases - queries processing.

Theme 7. Processing of transactions. Basic properties of transactions. Processing of competitive transactions. Methods of managing schedules. Reduce to a sequential schedule. Ensuring the data integrity.

Theme 8. New applications of "Databases" technology. Basic concepts and principles of object-oriented approach. Features of object-oriented and object relational database management systems. Integration of Web and DBMS.

Theme 9. Data warehouses – architecture and information flows. Tools and technologies for construction. Data modelling and analytical processing tools. Data Mining.

Theme 10. Lifecycle for database design and development of an information system.

EXERCISES

Theme 1. Analysis and design of a database for a specific subject area and user requirements.

Theme 2. Functional dependencies. Closure of a set of F-dependencies. Finding minimal closure of a set of F-dependencies.

Theme 3. Optimisation of relational expressions.

Theme 4. Approaches to normalisation of relational schemes.

Theme 5. Practical application of Chase algorithm.

Theme 6. Development of course project – design of databases for information system according to life cycle technology.

PLANNED LEARNING ACTIVITIES AND TRAINING METHODS

The first lecture aims to familiarise students with the content of the program, the objectives and tasks of the discipline, as well as the requirements for the preparation of the discipline.

The lectures are on issues from the conspectus. Students do two control works during the seminar classes and two theoretical tests during the lectures. Each student develops a course project, designing an DB for a subject area of choice. The topic of the course assignment is clarified after discussion with the teacher. Students have the opportunity to demonstrate the level of their theoretical and practical preparation in the discipline, demonstrating creative and critical thinking in the development of their course project.

The e-materials uploaded on the BFU e-learning platform support the preparation of students and provide opportunities to expand their knowledge of the topics.

Training methods cover: technology-assisted learning, example-learning, practice-based learning, reversed classroom, synchronous and asynchronous digital learning.

COURSE PROJECT

Each student develops a coursework task on designing and implementing a specific database.
The criteria for evaluating the development are:

- Originality of the subject.
- Description of the development – complete and correct.
- Operation of the implemented system.
- Presentation of the developed project (defense).

The assignment for the course work requires each student to select a subject area and describe it through appropriate tables and relations.

Definition of appropriate data types and field properties is required.

The project is implemented through MS SQL Server. The course project is demonstrated by the student based on meaningful subject area queries, which include output of data from more than one table; imposing a condition on the data produced; computational queries (using computational fields); sort the query results, etc.

Appropriate reports are required.

SCORING METHODS BY POINT SYSTEM

A. Students who have not completed at least 60 % of the attendance hours do not receive certification from the teacher.

B. The semester exam is written and includes a theoretical test with open and closed questions. The final assessment is complex. It is formed by the assessment obtained from the exam and the assessment of the work of each student during the semester.

1. Classroom work..... 34 points
   1.1 Lectures' control tests 20 points
   1.2 Exercises - participation, control work, etc.) 14 points
2. Out-of-class work..... . 20 points
   (work on course project)

Exemption from the exam is allowed with a very good and excellent score obtained from the activities assessed during the semester (at no less than 42 points) and an interview with the lecturer.

3. Examination procedure..... 46 points

The final score is determined by the sum of the points during the semester and the examination procedure: 38-52 items – Medium (3); 53-70 items – Good (4); 71-80 t. – Mn. good (5); Over 81 – Excellent (6).

The student must have a minimum of 14 control points during the semester and a minimum of 24 points from the examination procedure in order to form a comprehensive assessment.

RECOMMENDED LITERATURE

1. Michael J. Hernandez; Designing databases for mortals; AlexSoft Publishing House; 2021
2. Basics of the design of databases: http://office.microsoft.com/bg-bg/access-help/HA001224247.aspx.
3. Juliana Peneva; Database principles; Ed. New Bulgarian University; 2018
4. Bill Inmon, Patty Haines, David Rapien Integrating Data; Technics Publications, 2022.
5. Dalkir, K., 2005 Knowledge Management in Theory and Practice, Elsevier, Oxford.
6. Laudon, K., Laudon, J., 2006. Management Information Systems, Prentice-Hall.
7. Maier, R. 2007, Knowledge management systems, 3 rd edition, Springer
8. Ms SQL Server Tutorial: https://www.tutorialspoint.com/ms_sql_server/index.htm
9. Rod Stephens; The Beginning Database Design Solutions. Wiley Publishing Inc., Canada, 2010.
10. Santhosh Shekar; Design Knowledge Management System; KDP Print US, USA, 2021.