Syllabus
Course Program

DataBases

Specialty
122 – Computer Science

Institute
Institute of Computer Science and Information Technology

Educational program
Computer Science and Intelligent Systems

Department
Software Engineering and Management Intelligent Technologies (321)

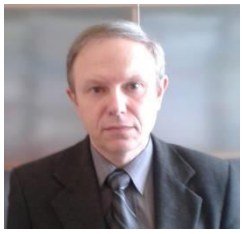
Level of education
Bachelor's level

Course type
Special (professional), Mandatory

Semester
3,4

Language of instruction
English, Ukrainian

Lecturers and course developers



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Ph.D., Associate Professor, Associate Professor of Software Engineering and Management Intelligent Technologies Department

Number of publications - more than 100.
Google Scholar:https://scholar.google.com/citations?user=bvEPOtYAAAAJ&hl
ORCID: https://orcid.org/0000-0002-8261-2988
Scopus: https://www2.scopus.com/authid/detail.uri?authorId=57202894400

More about the lecturer on the department's website

General information

Summary

The objective of the discipline is to provide students with the knowledge and skills necessary:
– to build data models, select and use database management systems (DBMS);
– to design, normalize and create databases in relational DBMS, and work with them using DML (Data Manipulation Language) tools of SQL (Structured Query Language);
– to design and development of relational databases using client-server DBMS;
– to implementate of business logic tools in a database based on stored procedures, functions and triggers;
– to ensure data integrity, maintaining data consistency and security based on transaction mechanisms and user rights;
– to build client-server applications for working with databases.

Course objectives and goals

Developing students' theoretical and practical knowledge necessary for the design and development of databases (DB) in solving problems related to the development, maintenance, and quality assurance of software.

Format of classes

Lectures, laboratory classes, consultations, self-study. Final control in the form of an exam.

Competencies

GC1. Ability to think abstractly, analyze and synthesize.
GC2. Ability to apply knowledge in practical situations.
GC3. Knowledge and understanding of the subject area and understanding of professional activities.
GC6. Ability to learn and master modern knowledge.
PC8. Ability to design and develop software using various programming paradigms: generalized, object-oriented, functional, logical, with appropriate models, methods and algorithms of computation, data structures and control mechanisms.
PC9. Ability to implement a multi-level computing model based on client-server architecture, including databases, knowledge and data warehouses, to perform distributed processing of large data sets on clusters of standard servers to meet the computing needs of users, including cloud services.

Learning outcomes

PLO10. To use tools for developing client-server applications, design conceptual, logical and physical models of databases, develop and optimize queries to them, create distributed databases, data warehouses and showcases, knowledge bases, including cloud services, using web programming languages.
PLO14. To apply knowledge of methodology and CASE tools for designing complex systems, methods of structural analysis of systems, object-oriented design methodology in the development and study of functional models of organizational, economic, production and technical systems.

Student workload

The total volume of the course is 240 hours (8 ECTS credits): lectures - 48 hours, laboratory classes - 64 hours, self-study - 128 hours.

Course prerequisites

Algorithmization and programming
Fundamentals of Computer Science and Artificial Intelligence

Features of the course, teaching and learning methods, and technologies

Teaching and learning methods:
interactive lectures with presentations, discussions, laboratory classes, teamwork, case method, student feedback, problem-based learning.
Forms of assessment:
written individual assignments for laboratory work (CAS), assessment of knowledge in laboratory classes (CAS), express surveys (CAS), online tests (CAS), final/semester control in the form of a semester exam, according to the schedule of the educational process (FAS).

Program of the course

Topics of the lectures

Semester 3
Topic 1. Basic concepts of structural data organization in computer systems
Organization of data in computer systems. Basic concepts and definitions. Classification of data structures. Evolution of data processing systems. Database management systems. ANSI/SPARC architecture. Architecture levels and their characteristics. Basic requirements for modern DBMS.
Topic 2. Basic concepts of data modeling in computer systems
Subject area, information objects, their attributes and relations. Evolution and classification of data models in computer systems. Hierarchical, network, relational, object-oriented data models, features of their application.

Topic 3. Relational data model

Basic concepts and definitions. Terminology for describing Codd's normalized information relation. Basic operators of relational algebra and special relational operations. Application of entity-relationship models for building data models. Procedures for normalization of information relations. The system of business rules and their construction. The place and role of the business rules system in the system of software requirements. Classification of business rules.

Topic 4. Modern CASE-tools and DBMS and their application for creating and using databases

Modern CASE-tools for building data models and their application features (on the example of the AllFusion Data Modeler (ERWin) CASE-tool). The basics of working in the DBMS Microsoft Access environment. Creating a database and its objects. Entering data into the database.

Topic 5. SQL language as a typical example of relational database languages

The evolution of database languages. The SQL language. General characteristics of SQL language tools. Advantages and disadvantages of the SQL language. SQL language standards

Topic 6. SQL DML tools

SELECT-SQL, INSERT-SQL, UPDATE-SQL, DELETE-SQL operators. Purpose, structure and features of application. Examples of using DML statements. Peculiarities of implementation of DML tools of the SQL language in modern DBMS

Topic 7. Modern DBMS and their application for working with databases (on the example of the DBMS Microsoft Access)

Familiarity with SQL operators that provide data manipulation Familiarity with tools for creating reports using the Microsoft Access DBMS. Creating an application focused on end-user work support using the Microsoft Access DBMS

Semester 4

Topic 1. SQL language and its application for the design and development of relational databases

DDL tools of the SQL - a general characteristic. CREATE, ALTER, DROP operators, their purpose and features (on the example of the DBMS Microsoft SQL Server). The main objects of the relational database (tables, indexes, representations, etc.) and working with them using DDL tools.

Topic 2. Business logic requirements. Means of implementing business logic requirements in the database

The main means of implementing business logic requirements in the database. The concept of database program objects. Stored procedures, user-created functions, cursors. Purpose and features of application. SQL operators that provide work with stored procedures, user-created functions, cursors (on the example of the DBMS Microsoft SQL Server)

Topic 3. Data integrity in relational databases

Data integrity in relational databases. Means of data integrity control. General characteristics. Referential integrity. Purpose and features of application. Triggers and their application for data integrity control. DDL operators of the SQL language, providing work with triggers (on the example of the DBMS Microsoft SQL Server).

Topic 4. Transactions and transactions control tools

Definition of transaction. Properties of transactions (ACID). Basic statements of the SQL language for managing transactions. Problems arising from the parallel application of transactions. Isolation of transactions. Levels of insulation and features of their application.

Topic 5. Users of databases and users' control tools

Types of users. User management tools in SQL. View, create and delete users. Granting and revoking privileges to users.

Topic 6. Design and development of applied software systems, which include databases

The main stages of design and development of applied software systems, which include databases, their general characteristics. Application design. Microsoft's typical application architecture. Layers of architecture, their purpose and features. User interface as one of the key components of the application. Basic requirements for the user interface.

Topic 7. Modern DBMS, their architecture and application features for the development of application systems related to data storage and processing

Classification of data processing technologies: file-server model, client-server model. Varieties of client-server models and features of their application. Use of ODBC, ADO and other technologies for data processing.

Topic 8. Application of modern DBMS and RAD-tools for working with databases and applied software development

Familiarization with the features of developing client-server applications using the Microsoft SQL Server DBMS and the Microsoft Visual Studio integrated development environment. Justification of the choice of application software development tools for the development of application systems related to data storage and processing

Topics of the workshops

Workshops are not provided within the discipline.

Topics of the laboratory classes

Semester 3
Topic 1. Development of IDEF1X models. Creating a database based on the IDEF1X model
Topic 2. Learning the basics of working with DBMS Microsoft Access.
Topic 3. Creating a multi-table form using DBMS Microsoft Access tools.
Topic 4. Learning the basic commands for data manipulation using SQL tools.
Topic 5. Learning report development tools in DBMS Microsoft Access
Topic 6. Creating complex reports using the report wizard and modifying them using DBMS Microsoft Access tools.
Topic 7. Add graphs and charts to reports using DBMS Microsoft Access tools.
Topic 8. Combine previously developed application components and create an application using DBMS Microsoft Access tools.
Semester 4
Topic 1. Creating a database using DDL SQL tools (on the example of the DBMS Microsoft SQL Server).
Topic 2. Learning the basic commands for data manipulation using SQL (on the example of the DBMS Microsoft SQL Server).
Topic 3. Creating and using views (on the example of the DBMS Microsoft SQL Server).
Topic 4. Creating and using database program objects (stored procedures, user-created functions, cursors) (on the example of the DBMS Microsoft SQL Server).
Topic 5. Creating and using integrity control tools (on the example of the DBMS Microsoft SQL Server).
Topic 6. Learning the basic commands for transactions control (on the example of the DBMS Microsoft SQL Server).
Topic 7. Creating simple client application for working with Microsoft SQL Server database.
Topic 8. Development of client application (on the example of the DBMS Microsoft SQL Server and RAD-tool Microsoft Visual Studio)

Self-study

Semester 3
Individual assignments are not provided in the curriculum.
Students are recommended with additional materials (videos, articles) for self-study and processing.
Semester 4
The curriculum includes the completion of coursework (CW). At the beginning of the semester, students choose the topics of the course work from the list or propose their own topics and agree them with the teacher. The CW is completed during the semester and is defended during the test week or examination session.
Students are recommended with additional materials (videos, articles) for self-study and processing.

Course materials and recommended reading

Key literature

1. M. Negi, Fundamentals of Database Management System: Learn essential concepts of database systems, BPB Publications, 2019, 175 p.
2. E. Sciore, Database Design and Implementation: Second Edition, Springer Nature, 2020, 468 p.
3. G. Powell, Database Modeling Step by Step, CRC Press, 2020, 268 p.
4. C. J. Date, Database Design and Relational Theory: Normal Forms and All That Jazz, Apress, 2019, 451 p.
5. A. Beaulieu, Learning SQL: Generate, Manipulate, and Retrieve Data, O'Reilly Media, Inc., 2020, 384 p.

Additional literature

1. D. Petkovic, Microsoft SQL Server 2019: A Beginner's Guide. Seventh Edition, McGraw Hill Professional, 2020, 896 p.
2. J. Eckstein, B. R. Schultz, Introductory Relational Database Design for Business, with Microsoft Access, John Wiley & Sons, 2018, 328 p.
3. A. Meier, M. Kaufmann, SQL & NoSQL Databases: Models, Languages, Consistency Options and Architectures for Big Data Management, Springer, 2019, 229 p.
4. B. Gour, M. Shrivastava, V. Richhariya, Database Management System Concepts & Normalization, Educreation Publishing, 2019, 94 p.
5. A. Molinaro, R. de Graaf, SQL Cookbook, O'Reilly Media, Inc., 2020, 572 p.

Assessment and grading

Criteria for assessment of student performance, and the final score structure

Description of the final score structure, course requirements, and necessary steps to earn points, especially paying attention to self-study and individual assignments.

Grading scale

Total points	National	ECTS
90–100	Excellent	A
82–89	Good	B
75–81	Good	C
64–74	Satisfactory	D
60–63	Satisfactory	E
35–59	Unsatisfactory (requires additional learning)	FX
1–34	Unsatisfactory (requires repetition of the course)	F

Norms of academic integrity and course policy

The student must adhere to the Code of Ethics of Academic Relations and Integrity of NTU "KhPI": to demonstrate discipline, good manners, kindness, honesty, and responsibility. Conflict situations should be openly discussed in academic groups with a lecturer, and if it is impossible to resolve the conflict, they should be brought to the attention of the Institute's management.
Regulatory and legal documents related to the implementation of the principles of academic integrity at NTU "KhPI" are available on the website: http://blogs.kpi.kharkov.ua/v2/nv/akademichna-dobrochesnist/

Approval

Approved by	08.06.2023	Head of the department Ihor HAMAIUN
	08.06.2023	Guarantor of the educational program Andrii KOPP