Syllabus
Course Program

Theory and Design of Databases

Specialty
113 Applied Mathematics

Institute
Educational and Scientific Institute of Computer Science and Information Technology

Educational program
Intelligent data analysis

Department
Computer Mathematics and Data Analysis

Level of education
Bachelor's level

Course type
Special (professional), Selective

Semester
5

Language of instruction
Ukrainian

Lecturers and course developers

Nikulchenko Artem

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PhD, Associate Professor, Associate Professor of the Department of CMAD, NTU "KhPI"

Work experience – 12 years. Author of numerous scientific and educational-methodological works. 15 years of experience in IT. Lead lecturer in the disciplines: "Databases and Information Systems," "Software Development."
More about the lecturer on the department's website

General information

Summary

The theory and design of databases belong to the category of system disciplines and form the foundation upon which the design and actual creation of information systems are based. A database is a collection of related data organized according to specific rules, which include general principles of description, storage, and manipulation, and is independent of application programs. A database serves as an informational model of a subject area. Access to databases is carried out through a database management system (DBMS). A knowledge base is a semantic model that describes a subject area and allows for answering questions related to this subject area, even when the answers are not explicitly present in the database. A knowledge base is a key component of intelligent and expert systems.

Course objectives and goals

To provide students with theoretical and practical knowledge necessary for designing and developing databases (DB) when solving tasks related to the development, maintenance, and quality assurance of software in the context of intelligent analysis of big data.

Format of classes

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

Competencies

GC 1. Ability to learn and acquire modern knowledge.

GC 2. Ability to apply knowledge in practical situations.

GC 7. Ability to search for, process, and analyze information from various sources.

GC 8. Knowledge and understanding of the subject area and professional activity.

GC 10. Skills in using information and communication technologies.

SC 5. Ability to develop algorithms and data structures, software tools, and software documentation.

SC 6. Ability to design databases, information systems, and resources.

Learning outcomes

LO 11. Be able to apply modern programming and software development technologies, as well as the technologies for the software implementation of numerical and symbolic algorithms.
LO 12. Solve individual engineering tasks and/or tasks arising in at least one subject area: sociology, economics, ecology, or medicine.
LO 13. Use specialized software products and computer mathematics systems in practical work.
LO 14. Demonstrate the ability for self-learning and continued professional development.
LO 15. Be able to organize one's own activities and achieve results within a limited time frame.
LO 16. Demonstrate teamwork and interaction skills with others.
LO 18. Effectively communicate information, ideas, problems, and solutions with both specialists and the general public.

Student workload

The total volume of the course is 180 hours (6 ECTS credits): lectures – 32 hours, laboratory classes – 32 hours., self-study – 116 hours.

Course prerequisites

To successfully complete the course, it is necessary to have knowledge and practical skills in the following subjects: 'Algorithmic Languages', 'Algorithmization and Programming', 'Data Analysis and Time Series'.

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

Lectures are conducted interactively using multimedia technologies. The project-based learning approach is used in laboratory classes, with an emphasis on the application of information technologies. Educational materials are available to students through OneNote Class Notebook and Teams.

Program of the course

Topics of the lectures

Topic 1.
Client-server architecture of DBMS: WebFullstackSprint08, WebFullstackchronos
Topic 2.
Database design: WebFullstackSprint08, WebFullstackchronos
Topic 3.
Database creation using SQL: WebFullstackSprint08
Topic 4.
Implementation of business logic in a database: WebFullstackSprint08, DBSprint02, DBSprint07
Topic 5.
Integrity. Transactions. Users: WebFullstackSprint08, DBSprint02, DBSprint08
Topic 6.
Building applications for interactions with databases: WebFullstackSprint08, WebFullstackchronos, WebFullstackuevent, WebFullstackwebster, DBSprint03, DBSprint04, DB.

Topics of the laboratory classes

Topic 1. Introduction to Databases.
Study of the basics of working with client-server DBMS. Analysis of the subject area, formation of business rule systems, and their translation into the database structure. Creation of a database using SQL (example: MySQL). Data manipulation using SQL: adding, updating, and deleting data (example: MySQL).

Topic 2. Relational Databases.
Creation and use of views (example: MySQL). Creation and use of stored procedures and triggers (example: MySQL).

Topic 3. Database Normalization, Transaction Management, and Security.
Consideration of normal forms and their application to improve the database structure. Study of the normalization process to avoid data anomalies and maintain integrity. Working with transactions. Managing user permissions (example: MySQL).

Topic 4. Software Development
Development of application software (PHP mysqli library, PHP Data Objects (PDO) framework, Java JDBC library, technologies from the self-study block) for interaction with databases (example: MySQL).

Self-study

The course involves completing additional tasks for each topic (the Python PyMySQL library for working with MySQL databases.. Using ADO.NET and C# for developing application software to work with DBMS. Developing software for working with databases in Microsoft SQL Server, PostgreSQL, and Oracle DBMS. Developing software for working with NoSQL DBMS, using MongoDB as an example). The results of the work are to be presented in a written report. Additional materials (videos, articles) are also recommended for students for independent study and analysis.

Course materials and recommended reading

1. Хайрова Н. Ф. Сучасні технології Web-програмування : навч. посібник / Н. Ф. Хайрова, С. В. Петрасова ; Нац. техн. ун-т "Харків. політехн. ін-т". – Харків : Панов А. М., 2020. – 112 с., https://repository.kpi.kharkov.ua/handle/KhPI-Press/44868 ;
2. Дейт К. Дж. Введение в системы баз данных. 8-е изд. — К.:Диалектика, 2019.— 1328с., https://ilshatpro.files.wordpress.com/2017/08/d0ba-d0b4d0b6-d0b4d0b5d0b9d182-d0b2d0b2d0b5d0b4d0b5d0bdd0b8d0b5-d0b2-d181d0b8d181d182d0b5d0bcd18b-d0b1d0b0d0b7-d0b4d0b0d0bdd0bdd18b.pdf;
3. Берко А.Ю., Верес О.М. , Пасічник В.В. (2021) Системи баз даних та знань. Книга 2: Системи управління базами даних та знань. (рек.МОН України), Магнолія , https://mybook.biz.ua/microsoft-sql-server/sistemi-baz-danih-ta-znan-kniga-2-sistemi-upravlinnya-bazami-danih-ta-znan-navchalniy-posibnik;
4. Saurabh Shrivastava, Neelanjali Srivastav (2020) Solutions Architect's Handbook: Kick-start your solutions architect career by learning architecture design principles and strategies, Packt Publishing Ltd., https://www.perlego.com/book/1443323/solutions-architects-handbook-kickstart-your-solutions-architect-career-by-learning-architecture-design-principles-and-strategies-pdf;
5. Ashwin Pajankar (2020) Learn SQL with MySQL: Retrieve and Manipulate Data Using SQL Commands with Ease, BPB Publications, 132 p , https://www.perlego.com/book/1681500/learn-sql-with-mysql-retrieve-and-manipulate-data-using-sql-commands-with-ease-pdf.

Assessment and grading

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

100% of the final grade consists of the results of the exam (40%) and ongoing assessment (60%).

Exam: written assignment (2 questions on theory + solving 1 problem) and an oral report.

The points for ongoing assessment are assigned as follows:
• laboratory classes: 30% of the semester grade;
• self-study: 30% of the semester grade.

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	Date, signature 29.08.2024		Head of the department Olena AKHIIEZER
	Date, signature 29.08.2024		Guarantor of the educational program Olena AKHIIEZER