DATA MODELS AND STRUCTURES

COURSE SYLLABUS

Code and name of specialty	121 Software Engineering	**Institute / faculty**	Faculty of Computer Science and Software Engineering
Program name	"Software Engineering"	**Department**	Software Engineering and Management Information Technologies
Type of program	Educational and Professional	**Language of instruction**	Ukrainian, English

LECTURER

Full name, *e-mail*	**Andrii Kopp, *Andrii.Kopp@khpi.edu.ua***

Ph.D., Associate Professor at the Department of Software Engineering and Management Information Technologies of NTU «KhPI». Prepared and published more than 60 research papers and textbooks (Google Scholar: https://scholar.google.com/citations?user=B8fggLEAAAAJ; ORCID: https://orcid.org/0000-0002-3189-5623; Scopus: https://www2.scopus.com/authid/detail.uri?authorId=57202887287; Publons: https://publons.com/researcher/2967953/andrii-kopp/).

Leading lecturer of courses: *Data Models and Structures (in Ukrainian and English), Design and Development of Databases (in Ukrainian and English).*

GENERAL DESCRIPTION OF THE COURSE

Summary	The course "Data Models and Structures" is a course in the cycle of professional compulsory training of the specialty 121 "Software Engineering". It is taught in the third semester in the amount of 90 hours (3 ECTS credits), in particular: lectures – 16 hours, laboratory classes – 32 hours, independent work – 42 hours. There are no individual tasks. The study of the discipline ends with the exam.
Course objectives	Formation of students' theoretical and practical knowledge necessary for working with data models and data structures in solving problems related to the development, maintenance and quality assurance of software.
Types of classes and control	Lectures, laboratory classes. Continuous assessment – laboratory works, intermediate modular assessment. Final assessment – exam.
Term	3

Student workload (credits) / Type of course	3 / Mandatory	**Lectures (hours)**	16	**Laboratory classes (hours)**	32	**Self-study (hours)**	42

Program competences	GC01. Ability to abstract thinking, analysis and synthesis. GC05. Ability to learn and master modern knowledge. GC06. Ability to search, process and analyze information from various sources. PC14. Ability to participate in software design, including modelling (formal description) of its structure, behavior and functioning processes. PC15. Ability to develop architectures, modules and components of software systems. PC19. Knowledge of information data models, the ability to create software for data storage, retrieval and processing. PC22. Ability to accumulate, process and systematize professional knowledge on the creation and maintenance of software and recognition of the importance of lifelong learning. PC26. Ability to algorithmic and logical thinking.

Learning outcomes	Teaching and learning methods	Forms of assessment (continuous assessment CAS, final assessment FAS)
PLO01. Analyze, purposefully search for and select the necessary information and reference resources and knowledge to solve professional problems, taking into account modern advances in science and technology. PLO05. Know and apply relevant mathematical concepts, methods of domain, system and object-oriented analysis and mathematical modelling for software development. PLO07. Know and apply in practice the fundamental concepts, paradigms and basic principles of operation of language, tools and computing software engineering. PLO13. Know and apply methods of algorithm development, software design and data and knowledge structures. PLO18. Know and be able to apply information technology processing, storage and transmission of data.	Interactive lectures with presentations, discussions, laboratory classes, teamwork, case method, student feedback method, problem-based learning	Written individual assignments for laboratory works (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)

ASSESSMENT AND GRADING

Ranges of points corresponding to grades

core (points) for all types of learning activities	ECTS grading scale	The national grading scale
90-100	A	excellent
82-89	B	good
74-81	C	
64-73	D	satisfactory
60-63	E	
35-59	FX	Unsatisfactory (with the exam retake option)
0-34	F	Unsatisfactory (with mandatory repetition of the course)

Allocation of grade points

100% Final assessment as a result of Final exam (30%) and Continuous assessment (70%).
30% Final exam
70% Continuous assessment:
Test №1 (15%)
Test №2 (15%)
Laboratory works (40%)
Laboratory work №1 (2%)
Laboratory work №2 (2%)
Laboratory work №3 (3%)
Laboratory work №4 (3%)
Essential level:
Laboratory work №5 (15%)
Laboratory work №6 (15%)
Advanced level:
Laboratory work №5 (15%)
Laboratory work №6 (15%)

Course policy	Students must attend all classes according to the study schedule and adhere to the norms of academic ethics. To study the course, students need to have their personal computer and (or) use computers of the computer center at the department. Students must work with compulsory and recommended reading, including Internet resources. Students must complete and submit all laboratory works during the semester in which the course is taught, before the examination session. The final assessment is not carried out without the personal presence of students.

COURSE STRUCTURE AND CONTENT					
Topic 1	Introduction to databases *Innovation Campus: WebFullstack-Sprint08*	**Laboratory work 1**	Analysis of the most popular DBMS and their functional capabilities.	**Self-study**	Data systems performance. Development of applications to work with a DB. The most common in the corporate segment of the database.
Topic 2	Data storage structures *Innovation Campus: WebFullstack-Sprint08*	**Laboratory work 2**	Analysis of data storage models implemented by modern DBMS.		Data warehouses. Choosing a database for application development. Libraries and frameworks of programming languages to work with DBMS.
Topic 3	Data models *Innovation Campus: WebFullstack-Sprint08, DB-Sprint01*	**Laboratory work 3**	Development of "entity-relationship" and IDEF1X data models.		Objects and object collections. Properties of data models. Data models that the most common DBMS implement.
Topic 4	Relational data model *Innovation Campus: WebFullstack-Sprint08, DB-Sprint01*	**Laboratory work 4**	Creating a database based on the IDEF1X model.		Normal forms: practical aspects.
Topic 5	Data modeling *Innovation Campus: WebFullstack-Sprint08, DB-Sprint05*	***Essential level***			Examples of database modeling.
		Laboratory work 5	Learning the basics of working with Microsoft Access DBMS.		
		Advanced level			
		Laboratory work 5	Introduction to the main features of Microsoft SQL Server DBMS and Microsoft SQL Server Management Studio environment. Creating a database and database objects.		
Topic 6	SQL query	***Essential level***			

	language: DML tools and their usage *Innovation Campus: WebFullstack-Sprint08, DB-Sprint06*	**Laboratory work 6**	Learning the basic commands for manipulating data using SQL language.		SQL window functions. Query optimization.
		Advanced level			
		Laboratory work 6	Using the SELECT statement in Microsoft SQL Server Management Studio to process data in Microsoft SQL Server.		

RECOMMENDED READING

Compulsory

1. Mukesh, Negi. (2019). Fundamentals of Database Management System: Learn essential concepts of database systems. BPB Publications.
2. Sciore, E. (2020). Database Design and Implementation. Springer Nature.
3. Gavin Powell. (2020). Database Modeling Step by Step. CRC Press.
4. Sanjiv Purba (2019). Handbook of Data Management: 1999 Edition. CRC Press.
5. Database Design and Relational Theory. (2019). All That Jazz, Apress.
6. Jonathan Eckstein, Bonnie R. Schultz. (2018). Introductory Relational Database Design for Business, with Microsoft Access. John Wiley & Sons.
7. Alan Beaulieu. (2020). Learning SQL: Generate, Manipulate, and Retrieve Data. O'Reilly Media, Inc.
8. Berko, A. Yu., Veres, O. M. , Pasichnyk, V. V. (2021). Database and knowledge systems. Magnolia.
9. Trofimenko, O. G., Prokop, Yu. V., Loginova, N. I., Kopytchuk, I. M. (2019). Organization of databases: textbook. Manual. Odessa: Phoenix.
10. Anisimov, A. V., Kulyabko, P. P. (2017). Information systems and databases. Kyiv.

Recommended

11. Luca Ferrari, Enrico Pirozzi. (2020). Build and manage high-performance database solutions using. Packt Publishing Ltd.
12. Andreas Meier, Michael Kaufmann. (2019).Databases: Models, Languages, Consistency Options and Architectures for Big Data Management. Springer.
13. M. Tamer Özsu, Patrick Valduriez. (2019). Principles of Distributed Database Systems. Springer Nature.
14. Bhupesh Gour, Manish Shrivastava, Vivek Richhariya. (2019). Database Management System Concepts & Normalization. Educreation Publishing.
15. Anthony Molinaro, Robert de Graaf. (2020). SQL Cookbook. O'Reilly Media, Inc.
16. Guidelines for laboratory works. Retrieved from: https://iiiii-my.sharepoint.com/:f:/g/personal/andrii_kopp_khpi_edu_ua/EilLRTf7k_pNs7kLqLOLzYQBBrdA_Ll4C8o7fOZZeUWhpg?e=10zN1H
17. Orlovskyi, D. L. , Borysova, N. V., Kopp, A. M. (2020). Methodical instructions for laboratory work on the topic. Kharkiv.
18. Orlovskyi, D. L. , Borysova, N. V., Kopp, A. M. (2020). Methodical instructions for laboratory work on the topic. Acquaintance with the main commands of the SQL language, providing data manipulation on the example of Microsoft Access database. Kharkiv.

Academic integrity

Students must adhere to the Code of Ethics of Academic Relations and Integrity of NTU "KhPI": to show discipline, politeness, friendliness, honesty, responsibility

The content of this syllabus is consistent with the course program.