Національний технічний університет України
«КИЇВСЬКИЙ ПОЛІТЕХНІЧНИЙ ІНСТИТУТ
імені ІГОРЯ СІКОРСЬКОГО»

Computer Systems Software Department

DATABASES

Syllabus

Requisites of the Course

Cycle of Higher Education	***First cycle of higher education (Bachelor's degree)***
Field of Study	*12 Information Technologies*
Specialty	*121 Software engineering*
Education Program	*Software Engineering of Multimedia and Information Retrieval Systems*
Type of Course	*Normative*
Mode of Studies	*full-time*
Year of studies, semester	*2 years, 3 semesters*
ECTS workload	*36 hours for lectures, 18 hours for laboratory works, 66 hours for self-study*
Testing and assessment	*Exam, modular control work, calendar control*
Course Schedule	*According to http://roz.kpi.ua/*
Language of Instruction	*English*
Course Instructors	Inna Saiapina, PhD, Assoc. Prof., saiapina@pzks.fpm.kpi.ua
Access to the course	Google classroom. To be provided to registered students.

Outline of the Course

1. Course description, goals, objectives, and learning outcomes

The study of the Databases course allows students to develop the competencies necessary for solving practical problems of professional activity related to the development of information and search systems for processing databases.

***The purpose** of studying the Databases course is to develop in students the ability to independently design, programmatically implement and administer databases to optimize information and search systems and applications built on their basis.*

***The subject** of the Databases course is the methods, models, hardware and software used to design, develop and manage databases.*

The study of the Databases course contributes to the formation for students of general (GK) and professional competencies (PC), which are necessary for solving practical tasks of professional activities related to the development, optimization and operation of databases:
***GC01** Ability for abstract thinking, analysis and synthesis.*
***PC01** Ability to identify, classify and formulate software requirements.*
***PC02** Ability to participate in software design, including its structure, behavior and functioning processes modeling (formal description).*
***PC03** Ability to develop software systems architectures, modules and components.*
***PC04** Ability to formulate and ensure software quality requirements in accordance with customer requirements, specifications and standards.*
***PC07** Knowledge of information data models, the ability to create software for data storage, retrieval, and processing.*
***PC08** Ability to apply fundamental and interdisciplinary knowledge to successfully solve software engineering problems.*
***PC10** Ability to accumulate, process and systematize professional knowledge on software creation and maintenance and recognition of the importance of lifelong learning.*

PC12 *Ability to carry out the system integration process, apply change management standards and procedures to maintain software integrity, overall functionality and reliability.*
PC13 *Ability to reasonably select and master software development and maintenance tools.*
PC14 *Ability to algorithmic and logical thinking.*
PC15 *Ability to apply fundamental and interdisciplinary knowledge to build advanced search algorithms.*
PC17 *Ability to develop software for information retrieval systems.*
PC19 *Ability to develop software for multimedia and multimedia systems.*

The study of the Databases course contributes to the formation of students in the following program learning outcomes (PLO) according to the educational program:

PLO13 *To know and apply algorithm development methods, software, data and knowledge structures design.*
PLO18 *Know and be able to apply information technology of processing, storage, and transmission of data.*
PLO38 *To be able to apply programming technologies for multimedia and information retrieval systems software development.*
PLO44 *Know the most common query languages used in the development of information retrieval systems.*

2. Prerequisites and post-requisites of the course (the place of the course in the scheme of studies in accordance with curriculum)

Successful study of Databases course is preceded by study of disciplines "Higher Mathematics", "Algorithms and Data Structures", "Fundamentals of Programming. Course work", of the curriculum for bachelors training in the specialty 121 Software engineering.

The theoretical knowledge and practical skills obtained during the assimilation of the Databases course contribute to the assimilation of material from the disciplines "Components of Software Engineering. Part 3. Software Architecture", "Fundamentals of Programming. Part 2. Programming Methodologies", "Components of Software Engineering", "Software Security", "Information Retrieval Systems Software" and ensure the successful completion of coursework and diploma projects in the specialty 121 Software Engineering.

3. Content of the course

The Databases course involves the study of the following topics:

Topic 1. Introduction to databases

Topic 2. Database design

Topic 3. Basics of SQL

Topic 4. Modern database technologies

Modular control work

Exam

4. Coursebooks and teaching resources

Main literature:

1. Educational and methodological materials on the subject "Databases".
Use to master the practical skills of the discipline. The materials are in Google classroom; access is to be provided to registered students.

Additional literature:

1. *CJ Date. Introduction to Database Systems. Addison-Wesley Longman, Inc., 2004. 983 p.*
2. *H. Garcia-Molina, J. Ullman, J. Widom. Database Systems: The Complete Book. Pearson, 2008. 1248 p.*

3. *P. Rob, C. Coronel. Database Systems: Design, Implementation, and Management. Course Technology, 2011. 728 p.*
4. *Chaimae Asaad, Karim Baïna, Mounir Ghogho. NoSQL Databases: Yearning for Disambiguation, 2020. URL:https://arxiv.org/pdf/2003.04074.pdf.https://doi.org/10.48550/arXiv.2003.04074*

Educational content

5. Methodology for mastering the course (educational component)

No	Type of a class	Materials for self-study
Topic 1. Introduction to databases		
1	*Lecture 1. Introduction to databases. Relevance of the course (2 academic hours)*	*Introduction. The task of studying the discipline. The relevance of studying the discipline. Course structure. Information on the organization of the educational process. Academic integrity. Useful resources. History of database development.*
2	*Lecture 2. Database environment (2 academic hours)*	*Database technologies. Database system components. Database architecture. Data models. Software and language tools of databases.*
3	*Laboratory work 1. (2 academic hours)*	*Introduction to the PostgreSQL software.*
4	*Lecture 3. Relational data model (2 academic hours)*	*Basic concepts of the relational model. Database integrity. Relational algebra. Basic operations. Basic procedures.*
Topic 2. Database design		
5	*Lecture 4. Stages of designing an information system (2 academic hours)*	*Life cycle of information system development. Life cycle of the database. Tasks and stages of database development.*
6	*Laboratory work 2. (4 academic hours)*	*Conceptual and logical modeling of the database.*
7	*Lecture 5. Conceptual design of databases (2 academic hours)*	*Construction of the "entity - relationship" model. Types of connections. Problems of ER-model construction. An example of building a model. Extended entity-relationship model.*
8	*Lecture 6. Logical design databases (4 academic hours)*	*Stages of logical design. Simplification of the conceptual model. Rules for converting ER-diagrams into relational structures. Checking relations for compliance with normalization rules. Data de-normalization.*
9	*Laboratory work 3. (2 academic hours)*	*Study of the relationship normalization process of the relational model*
10	*Lecture 7. Physical design of databases (2 academic hours)*	*Organization of information storage. Indexing. Hashing. B-trees.*
Topic 3. Basics of SQL		
11	*Lecture 8. SQL language operators (4 academic hours)*	*General characteristics of language means of communication with DBMS. Features and definitions of the structured SQL language. DDL SQL language. . The SQL DML language and an overview of its capabilities.*
12	*Laboratory work 4. (4 academic hours)*	*Laboratory work 4. Physical implementation of a database based on the PostgreSQL DBMS.*

13	*Lecture 9. SQL - queries (2 academic hours)*	*The syntax of the SELECT statement, queries for filtering, sorting and grouping data. Peculiarities of using WHERE, GROUP BY, HAVING, JOIN, ON, LEFT, RIGHT operators. Subqueries*
14	*Lecture 10. Peculiarities of maintaining data integrity. (2 academic hours)*	*Transactions, start and end, transaction cancellation. Triggers. Functions and procedures in the database.*
15	*Laboratory work 5. (2 academic. hours)*	*Data sampling based on the structured SQL language.*
Topic 4. Modern database technologies		
16	*Lecture 11. Distributed data processing (2 academic hours)*	*Control of parallel processing. ACID requirements. Multi-user DBMS. Distributed databases. Standard access interfaces to database servers.*
17	*Lecture 12. Operation of databases (2 academic hours)*	*Administration of databases. Concept of user and database administrator. Database protection methods. Database recovery. Protection of information in databases.*
18	*Laboratory work 6. (4 academic hours)*	*Transaction research. Advanced functions of the SQL standard.*
19	*Lecture 13. Data storage (2 academic h.)*	*Comparative analysis of OLTP and OLAP systems Multidimensional storage model. Design of data warehouses*
20	*Lecture 14. Non-relational databases (4 academic hours)*	*Classification of non-relational databases, features of their purpose and application.*
21	*Modular control work (2 academic hours)*	

6. Self-study work of a student

The discipline "Databases" is based on self-study preparations for classroom classes on theoretical and practical topics.

No.	*The name of the topic submitted for self-study*	*Number of hours*	*literature*
1	*Preparation for the lecture 1*	*1*	*1-3*
2	*Preparation for lecture 2*	*1*	*1-3*
3	*Preparation for laboratory work 1*	*2*	*1-3*
4	*Preparation for the lecture 3*	*1*	*1-3*
5	*Preparation for the lecture 4*	*1*	*1-3*
6	*Preparation for laboratory work 2*	*4*	*1-3*
7	*Preparation for the lecture 5*	*1*	*1-3*
8	*Preparation for the lecture 6*	*1*	*1-3*
9	*Preparation for laboratory work 3*	*3*	*1-3*
10	*Preparation for the lecture 7*	*1*	*1-3*
11	*Preparation for the lecture 8*	*1*	*1-3*
12	*Preparation of laboratory work 4*	*3*	*1-3*

13	*Preparation for the lecture 9*	*1*	*1-3*
14	*Preparation for lecture 10*	*1*	*1-3*
15	*Preparation of laboratory work 5*	*3*	*1-3*
16	*Preparation for lecture 11*	*1*	*1-3*
17	*Preparation for lecture 12*	*1*	*1-3*
18	*Preparation of laboratory work 6*	*2*	*1-3*
19	*Preparation for lecture 13*	*1*	*1-3*
20	*Preparation for lecture 14*	*1*	*4*
21	*Preparation for modular control work*	*5*	*1-4*
22	*Preparation for the exam*	*30*	*1-4*

Policy and Assessment

7. Course policy

- *Attending lectures is mandatory.*
- *Attending laboratory classes can be occasional and as needed to protect laboratory work.*
- *Rules of behavior in classes: activity, respect for those present, turning off phones.*
- *Adherence to the policy of academic integrity.*
- *Rules for the protection of laboratory work: the work must be done according to the student's variant, which is determined by his number in the group list.*
- *The rules for assigning incentive and penalty points are as follows.*

Incentive points are awarded for:
- activity in lectures and laboratory classes. The maximum number of points for all classes is 5 points.
Penalty points are calculated for:
- plagiarism The performed laboratory work does not correspond to the task option, the identity of laboratory work reports among different works (number of points: 5 points).

8. Monitoring and grading policy

During the semester, students perform 6 laboratory works. The maximum number of points for laboratory work: 6 points.

Points are awarded for:
- quality of laboratory work (report): 0-2 points;
- survey (test) during the defense of laboratory work: 0-3 points;
- timely submission of work for defense: 0-1 point.

Criteria for evaluating the quality of laboratory work (report):
2 points – the work is done qualitatively, in full;
0-1 point – the work is incomplete or contains errors.

Evaluation criteria for the survey on the protection of laboratory work:
3 points – the answer is complete, well-argued;
2 points – the answer is generally correct, but has flaws or minor errors;
1 point – there are significant errors in the answer;
0 points - there is no answer or the answer is incorrect.

The maximum number of points for performing and defending laboratory work:
R_L= 6 laboratory works × 6 points = 36 points.

The task for the modular test consists of 9 test questions - 4 questions with one correct answer and 5 questions with several correct answers. Each question with one correct answer is valued at 1 point, each question with several correct answers are valued at 2 points.
Evaluation criteria for each test question with one correct answer:
1 point – the answer is correct;
0 points - there is no answer or the answer is incorrect.

Evaluation criteria for each multiple-choice test question:
2 points – all correct answers and no incorrect answers are selected;
1 point – at least 50% of all correct answers are selected;
0 points – no answer or all answers are incorrect.

The maximum number of points for a modular control work:
R_{MKR} = 1 point × 4 test questions with one correct answer + 2 points × 5 questions with several correct answers = 14 points.

The rating scale for the discipline is equal to:
$R = R_c + R_{exam} = R_L + R_{MKR} + R_{exam}$ = 36 points + 14 points + 50 points = 100 points.

Calendar control: is conducted twice a semester as a monitoring of the current state of fulfillment of the syllabus requirements.
At the first control point (8th week), the student receives "credited" if his current rating is at least 9 points (50% of the maximum number of points a student can receive before the first control point).
At the second control point (14th week), the student receives "passed" if his current rating is at least 18 points (50% of the maximum number of points a student can receive before the second control point).

Semester control: exam
Conditions for admission to semester control:
With a semester rating (Rc) of at least 30 points and the enrollment of all laboratory work, the student is admitted to the exam. After passing the exam, a grade is assigned according to the table (Table of correspondence of rating points to grades on the university scale).

A necessary condition for admission to the exam is the performance and defense of laboratory works.

Table of correspondence of rating points to grades on the university scale:

Points	*Grade*
95-100	Excellent
85-94	Very good
75-84	Good
64-74	Satisfactory
60-64	Fair
Less than 60	Unsatisfactory
Course requirements are not met	Not Graded

Syllabus of the course

Is designed by Inna Saiapina, Ph.D., Assoc. Prof.

Adopted by Computer Systems Software Department (protocol № 12 from 26.04.23)

Approved by the Faculty Board of Methodology (protocol № 10 from 26.05.23)