National Technical University of Ukraine
"Igor Sikorsky Kyiv Polytechnic Institute"

Department of Computer Engineering

# DATABASES

## Working program of the training course discipline (Syllabus)

### Educational details of discipline

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|---|---|
| **Level of higher education** | ***First (undergraduate)*** |
| **Branch of knowledge** | *12 Information technologies* |
| **Specialty** | *121 Software engineering* |
| **Educational program** | *Computer Systems Software Engineering* |
| **Discipline status** | *Normative* |
| **Form of education** | *Daytime* |
| **Year of training, semester** | *2nd year of training, 3rd semester* |
| **Scope of the discipline** | *Lectures: 36 hours, laboratory work: 18 hours, independent work: 66 hours.* |
| **Semester control/ control measures** | *Exam, modular control work, calendar control* |
| **Lessons schedule** | *According to the schedule on autumn semester of the current academic year(http://roz.kpi.ua/)* |
| **Language of teaching** | *English* |
| **Information about the course leader/ teachers** | Lecturer: assistant Department of system programming and specialized computer systems (SPiSKS)RadchenkoKostiantynOleksandrovych, radchenko.kostiantyn@lll.kpi.ua<br>Laboratoryworks: assistantDepartmentofSPiSKSRadchenkoKostiantynOleksandrovych, radchenko.kostiantyn@lll.kpi.ua |
| **Placement of the course** | Google classroom. Access is granted to registered students. https://classroom.google.com/c/NTI4MjIxOTMxMzI0?cjc=xstlot3 |

### Program of educational discipline

1. **Description of the studydisciplines, its purpose, subject of study and learning outcomes**

*Studying the discipline "Databases"allows students to develop the competencies necessary for solving practical problems of professional activity related to the development of information and search systems for database processing.*

***the purpose****study of the discipline "Databases" is the formation of students' ability to independently design, programmatically implement and administer databases to optimize information and search systems and applications built on their basis.*

***Subject of*** *disciplines "Databases" there are methods, models, hardware and software used to design, develop and manage databases.*

*Studying the discipline "Databases" contributes formation of general (GC) and professional competences (PC) in students, necessary for solving practical tasks of professional activities related to development, optimization and exploitation databases:*

*- Ability to abstract thinking, analysis and synthesis (GC1).*

*- Ability to identify, categorize and formulate software requirements (PC1).*

*- Ability to participate in the design of software, including modeling (formal description) of its structure, behavior and functioning processes (PC2).*
*- Ability to develop architectures, modules and components of software systems (PC3).*
*- Ability to formulate and ensure software quality requirements in accordance with customer requirements, specifications and standards (PC4).*
*- Knowledge of data information models, ability to create software for data storage, extraction and processing (PC7).*
*- Ability to apply fundamental and interdisciplinary knowledge to successfully solve software engineering tasks (PC8).*
*- The ability to accumulate, process and systematize professional knowledge about creating and maintaining software and recognizing the importance of lifelong learning (PC10)*
*- Ability to carry out the system integration process, apply change management standards and procedures to maintain the integrity, overall functionality and reliability of the software (PC12).*
*- The ability to reasonably choose and master software development and maintenance tools (PC13).*
*- Ability to algorithmic and logical thinking (PC14).*
*- Ability to apply fundamental and interdisciplinary knowledge to build advanced search algorithms.*
*- Ability to develop software for information and search systems.*

*Studying the discipline "Information and search systems and service" contributes to the formation of students in the following program learning outcomes (PLO) according to the educational program:*

*- To Know and apply methods of developing algorithms, designing software and data and knowledge structures (PLO12).*
*- To Know and be able to apply information technologies for data processing, storage and transmission.*
*- To know the most common query languages used in the development of information and search systems.*

## 2. Pre-requisites and post-requisites of the discipline (place in the structural and logical scheme of training according to the relevant educational program)

*The successful study of the discipline "Databases" is preceded by the study of the disciplines "Mathematical analysis", "Algorithms and data structures", "Programming Fundamentals. Course work" of the curriculum for bachelors in the specialty 121 Software engineering.*

*The theoretical knowledge and practical skills obtained during the mastering of the discipline "Databases" contribute to the assimilation of the material from the disciplines "Software Engineering Components. Part 3. Software architecture", "Programming. Part 2", "Software engineering components", "Software security", and ensure the successful completion of coursework and diploma projects in the specialty 121 Software engineering.*

## 3. Content of the academic discipline

*The discipline "Databases" involves studying the following topics:*

*Topic 1. Introduction to databases*

*Topic 2. Design databases*

*Topic 3. Basics of SQL*

*Topic 4.Modern database technologies*
*Modular control work. Exam*

## 4. Educational materials and resources

***Basic 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*
5. *Connolly, T. and C. Begg, "Database Systems: A Practical Approach to Design, Implementation, and Management," 6th edition, Pearson, 2014*
6. *Coronel, C. and S. Morris, "Database Systems: Design, Implementation, & Management," 12th edition, Cengage, 2016*
7. *Casteel, J., Oracle 12c: SQL," 3rd edition, Cengage, 2015*


***Additional literature:***


1. *Educational and methodological materials on the discipline "Databases". The materials are located in the Google classroom discipline office. Access is granted to registered students.*
2. *Pasichnyk V.V., Reznichenko V.A. Organization of databases and knowledge. Kyiv: Ed. BHV group, 2006. 384 p.*
3. *Haydarzhi V.I., Izvarin I.V. Databases in information systems. Kyiv: University "Ukraine", 2018. 418 p.*
4. *Gayna G.A. Fundamentals of Database Design: A Study Guide. Kyiv: Condor, 2018. 204 p.*
5. *BerkoA.Yu., Veres O.M., PasichnykVVSistemi databases and knowledge: a textbook for students of higher primary institutions. Lviv: Magnolia 2006 Publishing House, 2021 – 2 books.*


**Educational content**

## 5. Methods of mastering the educational discipline (educational component)

**Lecture classes**

| *No.* | *Type of training session* | *Description of the training session* |
|---|---|---|
| *Topic 1.Introduction to databases* | | |
| *1* | *Lecture 1. Introduction to databases. Relevance of the discipline (2 credit hours)* | *Introduction. The task of studying the discipline. The relevance of studying the discipline. Course structure. Information on the organization of the educational process. RSO Academic integrity. Useful resources. History of database development. Tasks on SRS: item 6, number 1.* |
| *2* | *Lecture 2. Database environment (2 credit hours)* | *Database technologies.Database system components. Database architecture. Data models. Software and language tools of databases. Tasks on SRS: item 6, number 2.* |
| *3* | *Laboratory work 1.* | *Getting to know software provisionPostgreSQL. Assignment on SRS: item 6, number 3.* |
| *4* | *Lecture 3. Relational data model (2 credit hours)* | *Basic concepts of the relational model. Database integrity. Relational algebra. Basic operations. Basic procedures. Tasks on SRS: item 6, number 4.* |

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|---|---|---|
| | *Topic 2. Designdatabases* | |
| *5* | *Lecture 4. Stages of information system design (2 credit hours)* | *Life cycle of information system development. Life cycle of the database. Tasks and stages of database development.*<br>*Tasks on SRS: item 6, number 5.* |
| *6* | *Laboratory work 2. (4 credit hours)* | *Conceptual and logical modeling of the database.*<br>*Tasks on SRS: item 6, number 6* |
| *7* | *Lecture 5. Conceptual design of databases (2 credit hours)* | *Construction of the "entity - connection" model. Types of connections. Problems of ER-model construction. An example of building a model. Extended model "entity-relationship".*<br>*Tasks on SRS: item 6, number 7.* |
| *8* | *Lecture 6. Logical design basesdata (4 ac.h.)* | *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.*<br>*Tasks on SRS: item 6, number 8.* |
| *9* | *Laboratory work 3. (2 credit hours)* | *Study of the normalization process relationsrelational model*<br>*Tasks on SRS: item 6, number 9* |
| *10* | *Lecture 7. Physical design of databases (2 credit hours)* | *Information storage organization. Indexing.Hashing. B-trees.*<br>*Tasks on SRS: item 6, number 10.* |
| | *Topic 3.Basics of SQL* | |
| *11* | *Lecture 8. SQL language operators (4 credit 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.*<br>*Tasks on SRS: item 6, number 11.* |
| *12* | *Laboratory work 4. (4 credit hours)* | *Laboratory work 4. Physical implementation of a database based on the PostgreSQL DBMS.*<br>*Tasks on SRS: item 6, number 12.* |
| *13* | *Lecture 9. SQL - queries (2 credit 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.*<br>*Subqueries*<br>*Tasks on SRS: item 6, number 13* |
| *14* | *Lecture 10. Peculiarities of maintaining data integrity. (2 ac.h.)* | *transactions, start and end, cancellation of a transaction. Triggers. Functions and procedures in the database.*<br>*Tasks on SRS: item 6, number 14.* |
| *15* | *Laboratory work 5. (2 credit hours)* | *Data sampling based on the structured SQL language.*<br>*Tasks on SRS: item 6, number 15.* |
| | *Topic 4.Modern database technologies* | |
| *16* | *Lecture 11. Distributed data processing (2 credit hours)* | *Control of parallel processing. ACID requirements. Multi-user DBMS. Distributed databases. Standard access interfaces to database servers.* |

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| | | *Tasks on SRS: item 6, number 16.* |
| *17* | *Lecture 12. Operation of databases (2 credit hours)* | *Administration of databases. Concept of user and database administrator. Database protection methods. Database recovery. Protection of information in databases.*<br>*Tasks on SRS: item 6, number 17.* |
| *18* | *Laboratory work 6. (4 credit hours)* | *Research transactions. Advanced functions of the SQL standard.* |
| *19* | *Lecture 13. Data storage (2 ac.h.)* | *Comparative analysis of OLTP and OLAP systems Multidimensional storage model. Design of data warehouses*<br>*Tasks on SRS: Item 6, No. 19.* |
| *20* | *Lecture 14. Non-relational databases (4 credit hours)* | *Classification of non-relational databases, features of their purpose and application.*<br>*Tasks on SRS: Item 6, No. 20.* |
| *21* | *Modular control work (2 ac. hours) Task on SRS: item 6, number 21* | |

## 6. Independent work of a student/graduate student

*The discipline "Databases" is based on independent preparations for classroom classes on theoretical and practical topics.*

| *No.* | *The name of the topic submitted for independent processing* | *Number of* | *literature* |
|---|---|---|---|
| *1* | *Preparation for the lecture 1* | *1* | *1-4, 6-8* |
| *2* | *Preparation for lecture 2* | *1* | *1-4* |
| *3* | *Preparation for laboratory work 1* | *2* | *1* |
| *4* | *Preparation for the lecture 3* | *1* | *1-8* |
| *5* | *Preparation for the lecture 4* | *1* | *1-4* |
| *6* | *Preparation for laboratory work 2* | *4* | *1, 2, 4* |
| *7* | *Preparation for the lecture 5* | *1* | *1, 3, 4* |
| *8* | *Preparation for the lecture 6* | *1* | *1, 2, 4, 6, 7* |
| *9* | *Preparation for laboratory work 3* | *3* | *1, 2, 4, 6, 7* |
| *10* | *Preparation for the lecture 7* | *1* | *1, 2, 4, 5* |
| *11* | *Preparation for the lecture 8* | *1* | *1, 2, 6, 7* |
| *12* | *Preparation of laboratory work 4* | *3* | *1, 2, 6, 7* |
| *13* | *Preparation for the lecture 9* | *1* | *1, 2, 4* |
| *14* | *Preparation for lecture 10* | *1* | *1-5* |
| *15* | *Preparation of laboratory work 5* | *3* | *1, 2* |
| *16* | *Preparation for lecture 11* | *1* | *1, 2, 4, 5, 6-8* |
| *17* | *Preparation for lecture 12* | *1* | *1, 2, 4, 7* |
| *18* | *Preparation of laboratory work 6* | *2* | *1, 2, 6* |

| | | | |
|---|---|---|---|
| *19* | *Preparation for lecture 13* | *1* | *1, 2, 4, 8* |
| *20* | *Preparation for lecture 14* | *1* | *1, 9* |
| *21* | *Preparation for modular control work* | *5* | *1-9* |
| *22* | *Preparation for the exam* | *30* | *1-9* |

## Policy and control

### 7. Policy of academic discipline (educational component)

- *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 option, 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. Types of control and rating system for evaluating learning outcomes (RSO)

*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 the laboratory work (report): 2 points – the work was performed 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 the performance and defense of laboratory works: RL= 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 is 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 test question with several correct answers: 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 certification (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 certification).*
*At the second certification (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 certification).*

*Semester control: exam*
*Conditions for admission to semester control:*
*With a semester rating ($R_c$) at least 30 points and crediting all laboratory works the student has admission 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 work.*

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

| *Scores* | *Rating* |
|---|---|
| 100-95 | Perfectly |
| 94-85 | Very good |
| 84-75 | Fine |
| 74-65 | Satisfactorily |
| 64-60 | Enough |
| Less than 60 | Unsatisfactoril |
| Admission conditions not | Not allowed |

**Working program academic discipline (syllabus):**

**Designed by** assistant Radchenko K.O.

**Approved** by the Computer Engineering department (protocol No. 13 dated 22.06.22)

**Agreed** Methodical Commission of the Faculty of Informatics and Computer Engineering (protocol No. 9 dated 24.06.2022)