Khmelnytskyi National University
Faculty of Information Technologies
Department of Software Engineering

APPROVE
Dean of the Faculty of IT
Hovorushchenko T.O.
09 2024

SYLLABUS

Educational discipline **Database**
Educational and professional program **Software engineering**
First level of higher education (bachelor)

General information

Position	Content of information
Teacher(s)	Pravorska Nataliia Ivanivna
Profile of the teacher	http://ipz.khnu.km.ua/pravorska-n-i/
E- mail of the teacher(s)	margana2000007@gmail.com
Contact phone number	is filled by agreement
Discipline page at ISU	https://msn.khnu.km.ua/course/view.php?id=6508
Academic year	2024-2025
Consultations	After-hours: Tuesday 6 a.m., 1-2 01 Online: as needed and by prior arrangement

Characteristics of the discipline

Form of education	Course	Semester	Total load		Number of hours					Course project	Course work	Test	Exam
					Auditory classes				Independent work				
			Europe . credit	hours	In total	Lectures	Laboratory work	Practical classes					
Day/after-hours	1	2	5	150	90	36	36		78				+
Together with DFN			5	150	90	36	36		78				+

Abstract of the discipline

The discipline "Databases" is a discipline of applied orientation, which is designed to consolidate and develop the skills of using modern methods of database design and development in bachelor's degree holders

The purpose and tasks of the discipline.

Purpose of the discipline: to form in students a system of knowledge, abilities and skills in the application of methods of designing and developing databases, necessary for professional activity in the field of software engineering .

Tasks of the discipline: formation of students' system of knowledge and practical skills in the field of using methods and means of designing and developing databases; development of professional skills in the field of data engineering and knowledge about the development and design of applications, formation of skills in the design and presentation of research results.

Expected learning outcomes .

After studying the discipline "Databases", the student should achieve the following learning outcomes:

Be able to apply modern information technologies and have the skills to develop and create databases, use Internet resources ; to understand the essence of the processes taking place in automation objects (by field of activity) and to be able to analyze automation objects and justify the choice of the database structure, algorithms and schemes of their management based on the results of the study of their properties; to be able to apply knowledge about the basic principles and methods of measuring physical quantities and basic technological parameters in the development of databases to justify the choice of measuring tools and evaluation of their metrological characteristics; be able to perform database design work for automation systems, know the content and rules of design of design materials, the composition of design documentation and the sequence of design work taking into account the requirements of relevant regulatory documents and international standards.

Thematic and calendar plan of studying the discipline

No. of the week	Lecture topic*	Topic of the laboratory lesson*	Independent work of students		
			Content	Hours	Literature
1	2	3	4	5	6
1.	Databases and DBMSes . Data models . Relational Model . Relations , relation schemas , tuples . Superkeys , candidate keys , primary keys , foreign keys.	Database design	Processing of lecture material. Execution and preparation for the defense of laboratory work №1.	7	[3] p.80-128 [4] p.20-78
2.	Query languages , Data Manipulation Languages (DML). Relational algebra . Fundamental operators , additional operators.	Database design	Processing of lecture material. Execution and preparation for the defense of laboratory work №1.	8	[3] p.80-128 [4] p.20-78
3.	Extended relational algebra operators generalized projection, grouping and aggregation , outer joins Null values . Handling null values in relational algebra . Database modification.	Database normalization	Processing of lecture material. Execution and preparation for the defense of laboratory work №2.	8	[3] pp. 120-148, [10]
4.	Basic SQL DDL	Database	Processing of lecture	8	[[3] pp. 120-

1	2	3	4	5	6
	tables , basic column types , primary keys . Basic SQL statements insert , select , delete . Select statements simple expressions in SELECT, FROM, WHERE	normalization	material. Execution and preparation for the defense of laboratory work №2.		148, [10]
5.	SELECT ordered results , aggregation , grouping . Subqueries in the WHERE clause . Set operations . Subqueries in the FROM clause . Derived relations . INSERT...SELECT. DELETE and WHERE clauses .	Creating a database	Processing of lecture material. Execution and preparation for the defense of laboratory work №3.	8	[3] 450-480, [7] pp. 95-105 [10]
6.	Subqueries in the FROM clause . Derived relations . INSERT...SELECT. DELETE and WHERE clauses . Simple UPDATE statements . NULL values . Predicates involving NULL and UNKNOWN. Alternate join syntax .	Creating a database	Processing of lecture material. Execution and preparation for the defense of laboratory work № 3.	8	[3] 450-480, [7] pp. 95-105 [10]
7.	Catalogs , schemas , tables . DB connection state Primary key constraints . Unique constraints . Not null constraints . CHECK constraints . Foreign key constraints and waterfall operations .	Requests	Processing of lecture material. Execution and preparation for the defense of laboratory work №4.	8	[3] pp. 401-412, [6] pp. 26-117. [10]
8.	Deferred constraint enforcement . Date and time SQL types DATE, TIME, DATETIME, TIMESTAMP, INTERVAL. Large object LOB types BLOB, CLOB, TEXT. Default values	Requests	Processing of lecture material. Execution and preparation for the defense of laboratory work №4.	8	[3] pp. 401-412, [6] pp. 26-117. [10]

1	2	3	4	5	6
	for columns .				
9.	Procedural SQL. User- defined functions . Stored procedures . Cursors . Conditions and condition handlers .	Virtual tables, procedures, functions	Processing of lecture material. Execution and preparation for the defense of laboratory work №5. Test control №1.	8	[3] p.595-602, [9] p.200-248 [1] p.618-648, [10]
10.	Triggers , materialized views , INSERT variants , SQL security . Indexes , MySQL EXPLAIN command.	Virtual tables, procedures, functions	Processing of lecture material. Execution and preparation for the defense of laboratory work № 5.	9	[3] p.595-602, [9] p.200-248 [1] p.618-648, [10]
11.	SQL query evaluation and plan optimization. Plan node implementations file scan , index scan , external-memory sorting , nested loop join , sort- merge join, hash join. Table statistics and database	Triggers, transactions	Processing of lecture material. Execution and preparation for the defense of laboratory work № 6.	9	[6] p.31-34, [10] [7] p.52-58, [9]
12.	Midterm review . Entity-relationship model .	Triggers, transactions	Processing of lecture material. Execution and preparation for the defense of laboratory work № 6.	9	[6] p.31-34, [10] [7] p.52-58, [9]
13.	Entity-relationship model II. Ternary relationships and mapping cardinalities. Mapping ER models that the relational model .	Rights, privileges	Processing of lecture material. Execution and preparation for the defense of laboratory work №7.	9	[5] pp. 480-506
14.	Generalization specialization in the ER model . Alternate schema mappings .	Rights, privileges	Processing of lecture material. Implementation and preparation for the defense of laboratory work №7.	9	[5] pp. 480-506
15.	Normal forms . First Normal Form (1NF). Functional dependencies . Trivial functional dependencies . Closure of a set of functional dependencies . Boyce-Codd Normal Form (BCNF).	Moving, utilities	Processing of lecture material. Execution and preparation for the defense of laboratory work №8.	9	[3] pp. 162-165, [5] pp. 225-245
16.	Functional	Moving, utilities	Processing of lecture	8	[3] pp. 162-

1	2	3	4	5	6
	Dependency Theory I. Functional and Multivalued Dependency Theory .		material. Execution and preparation for the defense of laboratory work №8.		165, [5] pp. 225-245
17.	Alternate schema diagramming methods decision support systems			8	[3] pp. 401-412, [6] pp. 26-117. [10]
18.	Data warehousing II . Passwords tree and hierarchies	Moving, utilities	Processing of lecture material. Preparation for the exam	8	[3] pp. 166-278

*Note. Laboratory classes are held every week for two/four hours (numerator or denominator according to the class schedule).

Politics of discipline

The organization of the educational process in the discipline meets the requirements of the provisions on organizational and educational and methodological support of the educational process, the educational program and the curriculum. The applicant is obliged to attend lectures and laboratory classes according to the schedule, not to be late for classes, to complete the planned tasks according to the schedule. The deadline for the defense of the laboratory work is considered timely if the student defended it in the next class after the completion of the work. The student is obliged to study the missed laboratory session independently in full. For laboratory classes, the student must prepare for the relevant topic and be active. Knowledge acquired by a person in a discipline or its separate sections in non-formal education is credited in accordance with the Regulation on the procedure for re-enrollment of study results at KhNU (http://khnu.km.ua/root/files/01/06/03/006.pdf).

Evaluation criteria

Each type of work in the discipline is evaluated on a four-point scale. The semester final grade is defined as a weighted average of all types of academic work completed and passed positively, taking into account the weighting factor. The weighting factors change depending on the structure of the discipline and the importance of certain types of its work.

The grade given for the laboratory session consists of the following elements: an oral survey of students before admission to the laboratory work; knowledge of theoretical material on the topic; the quality of the design of the protocol and the graphic part; the student's fluency in special terminology and the ability to professionally justify the adopted constructive decisions; timely protection of laboratory work. The deadline for the defense of laboratory work is considered timely if the student defended it in the next session after the work was completed. Untimely defense of laboratory work without a good reason is considered a resubmission and is evaluated with a grade no higher than "satisfactory". The student is obliged to complete the missed laboratory class in the department's laboratories by the deadline set by the teacher, but no later than two weeks before the end of theoretical classes in the semester.

The student's assimilation of the theoretical material of the discipline is assessed by testing.

Assessment of students' knowledge is carried out according to the following criteria:

Evaluation on a national scale	Generalized criterion
Perfectly	The student has deeply and completely mastered the content of the educational material, easily navigates in it and skillfully uses the conceptual apparatus; knows how to connect theory with practice, solve practical tasks, confidently express and justify his judgments. An excellent assessment implies a competent, logical presentation of the answer (both orally and in writing), high-quality external design of the work. The student does not hesitate when changing the question, knows how to make detailed and general conclusions. When answering, he made two or three insignificant ***mistakes*** .
Good	The student has fully mastered the educational material, has a conceptual apparatus, orients himself in the studied

	material; consciously uses theoretical knowledge to solve practical problems; the presentation of the answer is competent, but the content and form of the answer may contain some inaccuracies, unclear formulations of regularities, etc. The student's answer should be based on independent thinking. The student made two or three ***inconsequential*** mistakes in his answer ***mistakes***
Satisfactorily	The student has demonstrated knowledge of the main program material in the amount necessary for further education and practical work in the profession, copes with the implementation of practical tasks provided for by the program. As a rule, the student's answer is built on the level of reproductive thinking, the student has weak knowledge of the course structure, makes inaccuracies and ***significant mistakes*** in the answer, hesitates when answering a modified question. At the same time, he acquired the skills necessary to perform simple practical tasks that meet the minimum evaluation criteria and has knowledge that allows him to eliminate inaccuracies in answers under the guidance of a teacher.
Unsatisfactorily	The student has found scattered, unsystematic knowledge, does not know how to distinguish the main and secondary, makes mistakes in defining concepts, distorts their meaning, presents the material chaotically and uncertainly, cannot use knowledge when solving practical tasks. As a rule, the grade "unsatisfactory" is assigned to a student who cannot continue his studies without additional work on studying the discipline.

Structuring of the discipline by types of work and evaluation of learning outcomes students in the semester by weighting coefficients

2 semester		
Auditory work		Exam
Laboratory work (8 works)	Test control	
0,3	0,3	0,4

Correlation of the domestic evaluation scale and the ECTS evaluation scale

Evaluation of ECTS	Institutional interval scoring scale	Domestic assessment, criteria	
A	4.75–5.00	5	***Excellent*** - deep and complete mastery of the educational material and identification of relevant abilities and skills
B	4.25–4.74	4	***Good*** - complete knowledge of the educational material with a few minor errors
C	3.75–4.24	4	***Good*** - a generally correct answer with two or three significant errors
D	3.25–3.74	3	***Satisfactory*** - incomplete mastery of the program material, but sufficient for practical activities in the profession
E	3.00–3.24	3	***Satisfactory*** - incomplete mastery of the program material that meets the minimum evaluation criteria
FX	2.00–2.99	2	***Unsatisfactory*** – the unsystematic nature of the acquired knowledge and the impossibility of continuing education without additional knowledge of the discipline
F	0.00–1.99	2	***Unsatisfactory*** - serious further work and re-study of the discipline is necessary

QUESTIONS FOR THE TEST IN THE DISCIPLINE "DATABASES"

1. Database Management System (DBMS) is
2. Operations that allow DBMS to be performed
3. What levels exist for working in DBMS
4. Name the type/frequency of operations performed in the DBMS
5. The data model specifies:
6. SQL is loosely based on:
7. A relational database is
8. Each row in the table specifies
9. Tuple is
10. A relationship is

11. A relation schema includes:
12. Keys are used ..
13. A superkey is
14. A minimal superkey is
15. Primary key is
16. Different kinds of query languages
17. A query is
18. Fundamental operations:
19. What does operation mean r-s
20. What does operation mean r ∪ s
21. Rename operator is used for two main purposes:
22. What does operation mean r ∩ s
23. Natural Join Example
24. Which formula is correct - available credit for every credit account
25. Most common aggregate functions:
26. Aggregate functions work on
27. What is it used for **-distinct**
28. When is not used **– distinct**
29. Insert new tuples into a relation
30. Generally based on relational algebra, supports querying, inserting, updating, deleting data and very sophisticated features for multi-table queries – is
31. Specify relation schemas (attributes, domains), specify a variety of integrity constraints, access constraints on data and indexes and other storage “hints” for performance – is
32. In SQL, relations are called
33. The CREATE TABLE syntax also allows
34. The DELETE command allows
35. Find all branches with at least one bank account
36. Aggregate functions:
37. Find the maximum amount of any loan in the bank
38. Find the number of branches that currently have loans
39. Find the average loan amount for each branch
40. The HAVING clause can use
41. Only requirement is that the grouping attributes are specified in the
42. Clause is applied before any grouping occurs
43. To apply filtering that the results of grouping and aggregation , use clause
44. Widely used:
45. It is necessary because a record can appear multiple times in the table
46. When a nested query refers to an enclosing query's attributes, it is a
47. Can test whether a nested query generates any duplicate tuples
48. Command for modifying existing tuples in a table
49. Theta join is
50. Cartesian product can be specified as
51. USING clause is a simplified form of
52. Specifies how the rows/columns are matched
53. Standard mechanism has levels:
54. By default, SQL tables have

55. Can require values in a table to satisfy some predicate, using constraint
56. Database can also resolve some integrity violations
57. For DEFERRABLE constraints is applied immediately by default
58. A combination of date and time values
59. CURRENT_TIMESTAMP() - is
60. Current date/time functions are

QUESTIONS FOR THE FINAL CONTROL OF THE DISCIPLINE "DATABASES"

1. Give a definition of the database and the database system, describe the purpose and means of working in it. Name and describe the levels of abstraction in DBMS, explain their purpose.
2. Name the types of databases and operations that can be performed in them. Describe what databases should represent. What does the data model define?
3. Describe SQL: purpose, tools for work. Explain what connections are, how they are related to attributes, give examples
4. Define tuples, explain why they are used , give examples.
5. Explain what a relationship scheme is - give examples. Explain what a relationship is, the rules of working with them in the database
6. Define a key, what is a primary key, a candidate key, assignment rules, give examples
7. Describe the main fundamental operations of relational algebra and give examples
8. Describe additional operations of relational algebra (∩, ⋈, ÷ and ←) and give examples
9. Explain the use of the operation "Generalized projection" and "Aggregate functions", give examples
10. Explain the use of additional join operations, give examples
11. Basic SQL terms: DDL, DML, table creation, table names, attribute domains. Explain how to select the type for values
12. Show an example SQL query schema, inserting rows, give examples.
13. Define the primary key constraint, examples of use
14. Explain how to delete data tables, give examples.
15. Define queries in SQL, the SELECT operation, give examples of use
16. Explain what duplicates are, the rules for working with them
17. Explain what the selection predicate is, how to work with it in SQL, give examples
18. How to compare rows in SQL, give examples
19. Name operations on rows, give examples
20. Explain how to organize results in SQL, give examples
21. Application of aggregate functions in SQL, give examples
22. Explain how duplicates are filtered in SQL, give examples
23. Explain the use of HAVING in SQL, give examples
24. Explain what nested subqueries are, give examples
25. Explain how to Set Membership Tests, give examples
26. Explain what Empty-Set Tests are, use, examples
27. Explain what Correlated Subqueries are, give examples
28. Explain Derived Relation Syntax, give examples
29. Explain the use of Aggregates of Aggregates, give examples
30. Explain how tuples are deleted and tables are updated, give examples

31. Explain the operation of the GROUP BY function, give examples
32. Explain what Theta Join is, give examples of use in SQL
33. Explain what Cartesian Products are, give examples of use in SQL
34. Explain what Outer Joins are, give examples of use in SQL
35. Explain what Natural Joins is, give examples of use in SQL
36. Explain what SQL constraints are and give examples of their use
37. Work with date/time values in SQL, describe functions, give examples of their use
38. Explain what "large objects" are when working with SQL and give examples of their use
39. Temporary tables in SQL, describe the functions, give examples of their use
40. Complex functions in SQL, describe, give examples of their use
41. Procedures in SQL, describe, give examples of their use
42. Use of loops and conditions in SQL, describe, give examples of their use
43. Define triggers, syntax, describe, give examples of their use
44. Materialized Views, description, Materialized View Maintenance, give examples
45. Authentication and Authorization, give examples
46. Basic SQL Privileges , , describe, give examples of their use
47. B+-Tree Indexes, describe, give examples of use
48. Index Implementations, describe, give examples of use
49. Query Optimization Using Indexes¸ describe, give examples of use
50. MySQL Join Processor , describe, give examples of use
51. Hash Join , describe, give examples of use
52. Entity-Relationship Model , describe, give examples of use
53. Third Normal Form, describe, give examples of use
54. Diagramming Weak Entity-Sets, describe, give examples of use
55. Conversion that Relation Schemas, describe, give examples of use
56. Generalization and Specialization, description, limitations, give examples of use
57. Generalization and Relationships, description, give examples of use
58. Normal Forms, description, give examples of use
59. Boyce- Codd Normal Form, description, give examples of use
60. Multivalued Dependencies, description, give examples of use

Recommended reading

1. Databases. Methodical guidelines for course design for students of the "Software engineering" training direction / Yu. V. Forkun ,. – Khmelnytskyi: KhNU, 20 23 . - 28 p.
2. Losev M. Yu. Bazy data : educational and practical self - help manual work of students / M. Yu. Losev , V. V. Fedko. – Kharkiv : KHNEU named after S. Kuznetsa , 2018. – 233 p. ISBN 978-966-676-731-1
3. Khariv N. O. Kh 20 Bazy data and information systems : educational guide / N. O. Khariv . - Rivne: NUVHP, 2018. - 127 p.
4. Alan Beaulieu Learning SQL: Generate , Manipulate , and Retrieve Data / Beaulieu Alan - O'Reilly Media 2020. - 377 pages .
5. Carlos Coronel. Database Systems : Design , Implementation , & Management (MindTap Course Letter) / Coronel Carlos , Morris Steven - Boston , Massachusetts : Cengage Learning - 14th edition , 2022 - 816 p .
6. Ying Bai . SQL Server Database Programming with Visual Basic.NET /Ying Bai - Wiley, 2020 - 688p .

Information resources

Electronic University :

1. A modular learning environment. Access to the resource: https :// msn . khnu km . ua / course / view . php ? ID = 5801
2. Electronic library of the university. Access to the resource: https: // lib.khnu . km .ua
3. Repository of KhNU. Access to the resource: https: // elar.khnu . km .ua / jspui /? locate = uk

Developer: Pravorska N.I.
Agreed:
Head department of
Software Engineering Bedratyuk L.P.
Guarantor of ONP Bedratyuk L.P.