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

ЦТЕ

Department of Digital Technologies in Power Industry

POSTRELATIONAL DATABASES

Work program of the academic discipline (Syllabus)

Summary of discipline

Level of Higher Education	Second (Master)
Field of knowledge	12 Information technologies
Specialty	122 Computer sciences
Educational program	Digital technologies in energy field
Discipline status	Normative
Form of education	Full-time/distance/mixed
Year of training, semester	1 year, fall semester
Scope of the discipline	4 credits (120 hours)
Semester control/ control measures	oral exam, modular control work, graphic work
Schedule	rozklad.kpi.ua
Language of instruction	Ukrainian/English
Information about head of the course	Lecturer: Mykhailova Iryna, PhD, irenmikhaylova@gmail.com Laboratory: Mykhailova Iryna, PhD, irenmikhaylova@gmail.com
Location	Google classroom, Campus

Program of educational discipline

1. Description of the educational discipline, its purpose, subject of study and learning outcomes

The vast majority of modern web, mobile and cloud applications use NoSQL rather than relational databases. Accordingly, a lot of data is stored in object-oriented and document-oriented (among other types of non-relational DBMS) databases, which must be able to be optimally designed and configured for quick recording or retrieval of data for further processing. In addition, you need to know methods and approaches for fast processing and aggregation of non-relational data.

The purpose of the credit module *is the formation of students' competencies in accordance with EPP*.

ЗК 1	Ability to abstract thinking, analysis and synthesis.
ЗК 2	Ability to apply knowledge in practical situations.
ЗК 5	Ability to learn and master modern knowledge.
ФК 9	Ability to develop and administer databases and knowledge bases.

As a result of mastering the credit module, students must demonstrate the following learning outcomes:

ПРН 1	To have specialized conceptual knowledge that includes modern scientific achievements in the field of computer science and is the basis for original thinking and conducting research, critical understanding of problems in the field of computer science and at the border of the fields of knowledge.
ПРН 2	To have specialized computer science problem-solving skills/skills necessary for conducting research and/or carrying out innovative activities in order to develop new knowledge and procedures.
ПРН 4	Manage work processes in the field of information technology, which are complex, unpredictable and require new strategic approaches.
ПРН 6	Develop conceptual models of an information or computer system.
ПРН 7	Develop and apply mathematical methods for the analysis of information models.
ПРН 9	Develop algorithms and software for data analysis (including large data).

ПРН 11	Create new algorithms for solving problems in the field of computer science, evaluate their effectiveness and limitations on their application.
ПРН 12	Design and support databases and knowledge bases.

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

Prerequisites of the discipline. Knowledge and skills acquired at the previous level of education when studying the disciplines "Object-oriented programming", "Database systems", "Web technologies and web design", "Technologies of software development", "Design of information systems", "Modeling of systems".

Postrequisites of the discipline. The knowledge obtained during the study of the discipline "Post-relational databases" forms the basic knowledge for studying the disciplines related to modeling and software development of automated systems that use non-relational databases to store information.

3. Content of the academic discipline

Chapter 1. Using the InterSystems IRIS multi-model DBMS for application development
- Topic 1.1. Architecture and basics of the InterSystems IRIS multi-model DBMS
- Topic 1.2. Hierarchical model
- Topic 1.3. Object model
- Topic 1.4. Relational model
- Topic 1.5. Work with the web

Chapter 2. Using the document-oriented database MongoDB for application development
- Topic 2.1. Architecture and basics of the MongoDB DBMS
- Topic 2.2. Using drivers to work with MongoDB
- Topic 2.3. Native visualization in MongoDB

4. Educational materials and resources

Basic literature

1. Гайджи В. І. Об’єктно-реляційна СУБД Caché. Багатовимірний сервер даних і способи реалізації бізнес логіки засобами вбудованої мови Caché ObjectScript. Навч. посібн. / В. І. Гайджи, І. Ю. Михайлова. – К.: Освіта України, 2015. – 312 с.
2. Михайлова І. Ю. Об’єктно-реляційна СУБД Caché. Засоби створення віконних застосувань мовами C#, Java, Delphi та Python. Навч. посібн. / І. Ю. Михайлова, В. І. Гайджи. – К.: Освіта України, 2016. – 406 с.
3. Documentation Home Page [Electronic resource]. – Access mode: http://docs.intersystems.com/latest/csp/docbook/DocBook.UI.HomePageZen.cls (last access: 21.05.2021).
4. The MongoDB 5.0 Manual [Electronic resource]. – Access mode: https://docs.mongodb.com/manual/ (last access: 21.05.2021).

Additional literature

5. Kirsten Wolfgang Object-Oriented Application Development Using the Caché Postrelational Database / Wolfgang Kirsten, Michael Ihringer, Mathias Kühn, Bernhard Röhrig. – Springer, 2003. – 404 с.

Educational content

5. Methods of mastering an educational discipline (educational component)

№ з/п	Title of the lecture topic and list of main points
Topic 1.1 – Architecture and basics of multi-model DBMS InterSystems IRIS	

1	The concept of a post-relational database (PRDB). Object-oriented databases and their models. Object-relational databases and their models. Types of NoSQL databases and their models. The main elements of the PRBD IRIS architecture. Multidimensional data server and access mechanisms. *Task for laboratory work №1.*
2	Fundamentals of syntax. Variables in ObjectScript (COS). Operators and expressions. COS commands.
Topic 1.2 – Hierarchical model	
3	The concept of a list and a multidimensional array. Types of lists. Commands for working with different types of lists. Indexed variables. Globals as an internal data storage format. Operations with globals. *Task for laboratory work №2.*
Topic 1.3 – Object model	
4	Architecture of the object model. Types of IRIS classes. Simple and multiple inheritance. Types of properties and methods. Using class parameters. Packages. *Task for laboratory work №3.*
5	Class description language. Adding various types of properties to the class description. Creating objects and filling their properties. Saving and opening objects from the database. The mechanism for saving objects in the form of globals. *Task for laboratory work №4.*
6	Procedures and functions of the ObjectScript language. User code in ObjectScript. System functions of the Object Script language. Using an indirect operator.
7	Types of methods in the object model. Creating class methods and object methods. They are called from user programs written in ObjectScript. Unit testing. Mass generation of test objects. Creation and processing of custom data types. *Task for laboratory work №5.*
8	Handling exceptions in ObjectScript. Variable and transaction locking.
Topic 1.4 – Relational model	
9	Embedded SQL. Extension of the SQL language compared to the SQL 92 standard. Features of SQL to work with objects. Embedded SQL (simple queries and cursors). Dynamic SQL. Using query methods. Using and passing parameters in requests. Query methods based on SQL and ObjectScript. *Task for laboratory work №6.*
Topic 1.5 – Working with web	
10	Introduction to CSP. CSP Platform and Architecture. CSPWEB Gateway configuration. Programming tools, organization of interaction with CSP. Methods of creating CSP pages. Elements of CSP. CSP markup.
11	Introduction to REST. REST platform and architecture. Programming tools and organization of interaction with RESTfull services. Use of various frameworks for graphical display of data.
12	Introduction to SOAP. SOAP platform and architecture. Programming tools and organization of interaction with SOAP services. Ways to transfer data via SOAP.

	Task for laboratory work №7.
Topic 2.1 – Architecture and basics of MongoDB	
13	Architecture and Syntax Fundamentals of the MongoDB Embedded Language. Commands and methods. Requests Aggregation of data.
Topic 2.2 – Using drivers to work with MongoDB	
14	Java driver installation and environment settings. Data recording operations. Execution of various types of requests. Aggregation.
15	C# Driver Installation and Environment Setup. Data recording operations. Execution of various types of requests. Aggregation.
16	Installing the Python driver and setting up the environment. Data recording operations. Execution of various types of requests. *Task for laboratory work №8.*
Topic 2.3 – Native visualization in MongoDB	
17	Configuring MongoDB Charts. Data sources. Types of diagrams. Construction and configuration of diagrams.
18	Modular control

6. Independent work of the student

1 hour of independent student work (SRS) is allotted for each laboratory work.

To prepare for the exam, 36 hours of SRS are allocated.

2 hours of SRS are allocated to prepare for the modular test.

4 hours of SRS are allotted for graphic work.

Policy and control

7. Policy of academic discipline (educational component)

Training by academic discipline can be conducted both in the university classroom and remotely using Google Meet. In the case of conducting classes remotely, the schedule and content of all types of work are saved. Students must attend lectures and laboratory work on time. Students should turn off the sound of phones and other devices during lectures or during lab assignments.

Attending lectures and laboratory classes is mandatory, except for valid reasons (illness, force majeure).

In the case of missing classes, the teacher gives the student the opportunity to pass the tasks of previous laboratory work during the scheduled classes (the exception is the completion of some tasks in connection with the end of the educational process).

In case of violation of the deadline for completing the task (deadline), the student receives 1 point less than the maximum mark for the corresponding task for each week of delay. If a student used a non-trivial approach when completing the task, then at the teacher's discretion, such a student may receive an additional 1 point.

To defend the laboratory work, the student must demonstrate its correct operation, according to the task, source codes/diagrams and answer the teacher's questions on the topic of the work. Laboratory works are performed individually and independently.

During the semester, students:

- prepare and explain the tasks of laboratory works (computer workshops) in the appropriate terms,
- write a modular control work,
- prepare and explain graphic work,
- actively respond to blitz polls at lectures,
- at the end of the educational process, they take an exam.

8. Types of control and rating system for evaluating learning outcomes (RSO)

System of rating (weighted) points and evaluation criteria

The maximum number of points for the credit module is 100.

The rating of the student from the credit module consists of the points received for the following types of educational activities.

1. Participation in a quiz at lectures.
2. Preparation and explanation of laboratory work.
3. Writing a modular control work (MKR) lasting 2 acad. hours
4. Preparation and explanation of graphic work.
5. Taking the exam.

1. Participation in quizzes at lectures

Students may be quizzed during lectures. Such surveys are conducted at random lectures 5 times during the semester. A weighted point for a correct answer is 1. The maximum number of points that each student can receive per semester is 5.

2. Preparation and explanation of laboratory work

The task of laboratory work is individual for each student. The weighted points and topics of the tasks are given in the table.

Types of tasks	*Contribution to the semester rating of points*
Laboratory work #1. Creating a program in a high-level language using OOP concepts.	2
Laboratory work #2. Working with lists and globals in PRBD IRIS.	4
Laboratory work #3. Development of a conceptual database model of the subject area.	4
Laboratory work #4. Creating subject area classes and objects and saving them in IRIS PRDB.	6
Laboratory work #5. Creation of methods of classes and objects of the subject area in PRDB IRIS.	6
Laboratory work #6. Using the SQL language to work with domain objects in the IRIS PRDB.	6
Laboratory work #7. Creation of a Web-project to access objects/tables/globals of the subject area in PRDB IRIS using CSP, REST and SOAP.	6
Laboratory work #8. Creation of domain documents in the MongoDB PRDB, execution of queries and data processing.	6

The maximum weighted score for the execution of all laboratory work is 40 points.

3. Modular control work

At the last lecture, a modular control work is conducted, which consists of 5 questions: the maximum weighted score is 15.

Evaluation of the modular control work is performed as follows:

- 3 points are awarded for each question, to which a complete correct answer is given;
- 2 points are awarded for each question, the answer to which contains minor inaccuracies;
- points for all 5 questions are added up.

The modular control work is considered passed if the student has scored 10 points. Otherwise, the student must write it again.

4. Graphic work

Within the time allotted for the student's independent work, he prepares a graphic work consisting of 4 diagrams/schemes for the project developed in laboratory work 7:

1. Scheme of the relational database.
2. Class diagram.
3. Diagram of objects.
4. Sequence diagram.

The maximum weighted score is 10. The graphic work is submitted together with laboratory work #7. Evaluation of graphic work is carried out as follows:

- 2.5 points are awarded for each complete and correct diagram/diagram;
- points for all 4 diagrams/schemes are added up.

5. Exam

The maximum weighted score is 30.

At the end of the semester, students take an exam on the content of the discipline. Each ticket contains two theoretical and one practical questions. Questions are evaluated out of 10 points.

Evaluation system of theoretical questions:

– “excellent”, complete answer (at least 90% of the required information) – 10-9 points;

– “good”, sufficiently complete answer (at least 75% of the required information, or minor inaccuracies) – 8-6 points;

– “satisfactory”, incomplete answer (at least 60% of the required information and some errors) – 5-3 points;

– “enough”, incomplete answer (at least 40% of the required information and some errors) – 2-1 point;

-"unsatisfactory", an unsatisfactory answer - 0 points.

Evaluation system of the practical question:

– "excellent", full, error-free solution of the task - 10-9 points;

– "good", complete solution of the task with insignificant inaccuracies - 8-6 points;

– "satisfactory", the task was completed with certain shortcomings - 5-3 points;

– "sufficient", the task was completed with significant shortcomings - 2-1 point;

-"unsatisfactory", task not completed - 0 points.

The maximum number of points for the starting component is 70. A necessary condition for admission to the exam is a creditable modular control work, defense of all laboratory work, defense of graphic work and a starting rating of at least 40 points.

According to the results of educational work in the first 7 weeks, the "ideal student" should score 13 points. At the first certification (8th week), the student receives "credited" if his current rating is at least 9 points.

According to the results of 13 weeks of study, the "ideal student" should score 35 points. At the second certification (14th week), the student receives "passed" if his current rating is at least 30.

The sum of points is transferred to the examination grade according to the table:

Number of points	*Mark*
100-95	Excellent
94-85	Very good
84-75	Good
74-65	Satisfactory
64-60	Sufficient
Less than 60	Unsatisfactory
Admission conditions not met	Not admitted

Working program of the academic discipline (syllabus):

Compiled by associate professor, Mykhailova Iryna, Ph.D.

Approved by Department of Digital Technologies in Power Industry (Protocol № 1 dated 01.07.2022)

Approved by Methodological Commission of the institute (Protocol № 10 dated 04.07.2022)