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)
Year of training, semester	1 year, fall semester
Scope of the discipline	5 credits (150 hours): lectures – 36 hours, laboratory work – 36 hours, independent student work – 78 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 think abstractly, analyze and synthesize.
ЗК 2	Ability to apply knowledge in practical situations.
ЗК 5	Ability to learn and master modern knowledge.
ФК 1	Understanding the theoretical foundations of computer science.
ФК 7	Ability to develop software in accordance with the formulated requirements, taking into account available resources and limitations.
ФК 9	Ability to develop and administer databases and knowledge storage.

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

ПРН 1	Have specialized conceptual knowledge, which includes modern scientific achieve-ments in the field of computer sciences and is the basis for original thinking and re-search, critical understanding of problems in the field of computer sciences and on the border of fields of knowledge.
ПРН 2	Have specialized skills for solving computer science problems necessary for carrying out research and/or innovative activities for the purpose of developing new knowledge and procedures.

ПРН 4	Manage work processes in the field of information technologies, which are complex, unpredictable and require new strategic approaches.
ПРН 6	Develop a conceptual model of an information or computer system.
ПРН 7	Develop and apply mathematical methods for the analysis of information models.
ПРН 9	Develop algorithmic support and software for data analysis (including big data).
ПРН 11	Create new algorithms for solving problems in the field of computer sciences, evaluate their effectiveness and limitations on their application.
ПРН 12	Design and support databases and knowledge bases.
ПРН 14	Test the software.

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. Гайдаржи В. І. Об’єктно-реляційна СУБД Caché. Багатовимірний сервер даних і способи реалізації бізнес логіки засобами вбудованої мови Caché ObjectScript. Навч. посібн. / В. І. Гайдаржи, 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. Гайдаржи. – 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

4 hour of independent student work (SRS) is allotted for each laboratory work.
To prepare for the exam, 36 hours of SRS are allocated.
4 hours of SRS are allocated to prepare for the modular test.
6 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.

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).

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 written individually and independently.

The policy and principles of academic integrity are defined in Chapter 3 of the Code of Honor of the National Technical University of Ukraine "Ihor Sikorsky Kyiv Polytechnic Institute". More details: https://kpi.ua/code.

Norms of ethical behavior Norms of ethical behavior of students and employees are defined in Chapter 2 of the Code of Honor of the National Technical University of Ukraine "Ihor Sikorskyi Kyiv Polytechnic Institute". More details: https://kpi.ua/code.

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,
- at the end of the educational process, they take an oral exam.

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

1. The starting rating (performance of work in the semester) is estimated at 50 points. The distribution of points is 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.	1	1

Laboratory work #2. Working with lists and globals in PRBD IRIS.	3	3
Laboratory work #3. Development of a conceptual database model of the subject area.	4	4
Laboratory work #4. Creating subject area classes and objects and saving them in IRIS PRDB.	4	4
Laboratory work #5. Creation of methods of classes and objects of the subject area in PRDB IRIS.	6	6
Laboratory work #6. Using the SQL language to work with domain objects in the IRIS PRDB.	6	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	6
Laboratory work #8. Creation of domain documents in the MongoDB PRDB, execution of queries and data processing.	4	4
Modular control work	10	10
Graphic work	4	4
		50

Penalty points for passing laboratory work are calculated for:
1) suboptimal algorithm - 10% of the maximum number of points;
2) suboptimal information presentation structures - 10% of the maximum number of points;
3) a non-provided or incorrect answer to a question - 20% of the maximum number of points.

At the last lecture, a modular test consisting of 5 questions is conducted. Evaluation of the modular control work is performed as follows:
- 2 points are awarded for each question that is answered completely and correctly;
- 1 point is awarded for each question, the answer to which contains minor inaccuracies;
- points for all 5 questions are added up.

Within the time allotted for independent work, the student prepares a graphic work consisting of 4 diagrams/schemes for the project developed in laboratory work 7, according to his option:
1. Scheme of a relational database.
2. Class diagram.
3. Diagram of objects.
4. Sequence diagram.

Evaluation of graphic work is performed as follows:
- 1 point is awarded for each complete and correct diagram/diagram;
- points for all 4 diagrams/schemes are added up.

2. Calendar control is carried out twice a semester as a monitoring of the current state of meeting the requirements of the syllabus:

Criterion	First calendar control	Second calendar control
Calendar control period	Week 7-8	Week 14-15
Conditions for receiving a positive grade	≥ 5 points	≥ 21 points

3. Conditions for admission to the exam: all laboratory works are submitted and a starting rating of at least 30 points.

4. Examination rating (exam answer) is estimated at 50 points. The examination ticket consists of two theoretical questions and one practical task. The weighting point of each theoretical question is 15 points, the task is 20 points.

The theoretical part is evaluated as follows:
- a correct, clearly stated, complete answer - (at least 90% of the required information) - 13-15 points;
- sufficiently complete answer (at least 75% of the required information) - 11-12 points;
- incomplete answer (at least 60% of the required information) - 9-10 points;
- unsatisfactory answer - 0 points.

The practical task is evaluated as follows:
- complete, error-free solution of the task - 18-20 points;
- complete, solving the task with insignificant discrepancies - 15-17 points;
- the task was completed with certain shortcomings - 12-14 points;
- task not completed - 0 points.

5. The rating for the educational component is calculated as the sum of the points of the initial and examination ratings (50 + 50 = 100 points) and is determined according to the table of the transfer of rating points to the rating on the university scale:

Number of points	*Evaluation*
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)