Yanka Kupala State University of Grodno (YKSUG)

Database design and maintenance

Faculty: Mathematics and Informatics	Amount of student effort (hours): 120
Department: Advanced Programming Technologies	Class contact time (hours): 78
Level: MA, Year 1	Term period(s): Sem. 2
Language of instruction: Russian/English	Course status: Mandatory core
Course leader: Lada Rudikova	Entry requirements: At least 30 ECTS studies of the first degree in the field of programming, data processing, data base, data analysis, systems design, information architecture and usability, interface design have been completed
ECTS: 3	Contact: lada.rudikowa@gmail.com

Course outline:

The training course “Databases design and maintenance” is included in the list of academic disciplines for choice in the preparation of students of the specialty 1 - 40 01 01 “Information Technology Software”. It allows students to acquire the necessary skills in the field of database design methodology, database management systems and information systems. Certainly, mastering the relevant material of the proposed course will contribute to the formation of the professionalism of future software engineers.

The course “Databases design and maintenance” allows students to gain certain skills and knowledge of design databases methodology, technical maintenance and service support of databases. Masters will learn to analyze subjects themselves, make decisions about database models type, design databases. In addition, masters acquire different aspects of database operation. During the course masters should do analysis of subject area, write conclusions regarding database model type, database design using CASE-tools. Furthermore, masters are provided consideration of the issues related to databases optimization, maintenance and support.

Theoretical aspects of the course “Databases design and maintenance” and practice will contribute to gain professional competencies the future masters and form following points:

- better understanding of databases models and database management systems;
- certain skills and knowledge related to databases models implementation using CASE-tools;
- general approaches to estimate of databases productivity and optimization;
- required skills for technical support and update of databases;
- relevant of information society outlook.

Each master participates in group project development on a chosen topic, indeed, better if the topic relates to practical activity of a master in an IT-company. From the lecturer and rest of the group everyone receives

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effective feedback. In addition, masters have a task including database analysis and, as a result, provide technical optimization and maintenance proposals. According to results masters must prepare group projects: databases files, analytical report, presentation. Reached results should be demonstrated in the lecture as a discussion. It can be used in work activity and, certainly, this is bringing practical aspects for promotion own development and possibility to use it for scientific events.

Acquiring information from the course "Databases design and maintenance" will help to gain universal, deep and specific competencies for future masters.

Learning Objectives:

- acquire theoretical and practical knowledge of databases design and maintenance;
- formation and building a vision of general databases models and kinds of database management systems;
- formation necessary skills related to databases models development using automated CASE-tools;
- formation general approaches to performance evaluation and databases optimization;
- formation required skills of technical maintenance and updating of databases;
- formation of relevant outlook, typical for information society.

Learning Outcomes:

Remembering	Understanding	Applying	Analysing	Evaluating	Creating

Learning outcome	Assessment criteria	
1. **analyze** of the subject area in order to obtain models of effective databases	1. **analyze** of the subject area	
	2. **define** main object of subject area	
	3. **specify** relationships between objects	
	4. **set** restrictions of subject area	
	5. **classify** data models for Database Management System corresponding of the subject area	
2. **know** ways of modeling the database at different levels of abstraction	1. **distinguish** of database models	
	2. **handle the tools and the concepts** of methodologies data design	
	3. **define** abstract levels during database development process	
	4. **define** main steps of databases design process	
3. **design** different models of database and databases themselves	1. **classify** CASE-tools for design	
	2. **understand** methodology of databases models design	
	3. **use** CASE-tools for databases design	
	4. **handle** the concepts of data models notations	
	5. **create** data model using CASE-tool	
	6. **transform** data models using CASE-tool	
	7. **generate** data model using CASE-tool	
4. **have skills and competencies** to evaluate the quality of the database	1. **evaluate** database models using criteria	
	2. **conduct** database model normalization	

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model and propose options for its further development and improvement	3. **evaluate** database model quality	
	4. **propose** data model improvement	
	5. **see** the further development of data models based on requirements of subject area changes	
5. **conduct an analysis** of the domain and form the logical and physical structure of the corresponding database	1. **define** abstract and physical data models	
	2. **handle** the main concepts of logic and physical data models	
	3. **design** logic data model	
	4. **get** physical structure based on logic data model	
6. **use** SQL language as the main tool for interaction with relational databases	1. **use** different commands types of SQL	
	2. **use** DDL for data model creation	
	3. **use** commands of DML	
	4. **use** DQL to get data from database	
	5. **use** DCL for manage database	
7. **evaluate** the effectiveness of algorithms for interaction with the database	1. **use** commands for audit and checking of database	
	2. **evaluate** database performance	
	3. **optimize** database models	
	4. **optimize** implemented database	
8. **improve skills and competencies** of using the SQL language to organize interaction with DB	1. **optimize** database queries	
	2. **implement** transactions	
	3. **optimize** transactions	
	4. **maintain** database	
	5. **update** database	
	6. **create** backup of database	
9. **optimize** the operation of the database according to specified criteria	1. **explore** organization IT-infrastructure	
	2. **evaluate** state and performance of database	
	3. **make** conclusions about data migration necessity	
	4. **implement** service support of database	
	5. **provide** help in case of emergency situations	
10. **develop** interpersonal and social skills: negotiation, leadership, team and time management, collaboration.	1. **master** verbal and non-verbal communication tools	
	2. **define** technical communication tools	
	3. **use** different channels of oral and written technical communication	
	4. **recognize** the importance of teamwork	
	5. **deal** with challenges to effective teamwork	
	6. **resolve** conflicts in collaborative projects, **apply** the checklist to team activities.	

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Course methodology:

Masters learn how to apply methods of scientific cognition (analysis, matching, systematization, abstraction, modeling, data validation, making decisions, etc.) during independent creative work for creation of databases projects: generation innovative ideas, formation of analytical document with subject area analysis, implementation of required database model, analytical document includes recommendations for database maintenance which was implemented for certain database management system, analysis of results and formation of plan how to improve it. In addition, skills of using CASE-tools for databases models' creation will contribute to learning IT-method and structural methodology of information systems design. Allocation of complex causal links for database design, creation of model restrictions, definition of permissions for users involve using following methods: problem-based learning, searching method, project method, teamwork, research method, case-study, experience-based learning.

Planned lectures/practical classes and workshops/students independent work

№	Class content	Lectures (hours)	Practical classes (hours)	Students independent work (hours)
1	Data Models classification and Database Management Systems	6		
2	Data Modeling in Case Tools	4	4	
3	Entity-Relationship Model. Data modeling in different notations.	4	4	
4	Logical Data Model		2	2
5	Physical Data Model	4	2	
6	Object Oriented Data Models	2	4	2
7	Multidimensional Data Model	4	6	
8	XML as a Data Model	4	2	
9	New directions in the theory and practice of databases: distributed databases, client-server technologies, object oriented DBMS, data warehouses and OLAP.	2		2
10	Database optimization	2	4	2
11	Database support and maintenance	2	2	6
Total: 78 hours				

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Student workload. Form of student activity.

Lectures: 34 hours
Practical classes: 30 hours (workshops, essay presentation, real-time interview, teamwork simulation)
Students independent work: 14 hours
Reading literature and preparation for classes: 36 hours
Reflection: 6 hours

Teaching and learning strategies:

Usually, the education process is structured so masters will improve subject area modelling skills and databases models design in teamwork. Acquiring the course is going consistently: analytical document of subject area analysis, designed database model using CASE-tools, presentation of the project with database, analytical report with recommendations for database maintenance which was implemented for certain database management system, final presentation of group project.
Special attention will be given to the material of the course. The beginning of the course involves creation of creative groups and definition of a project. Then, each class project should be extended to new material and development. As a result –masters should demonstrate groups of projects as a visual presentation of chosen topics. Demonstration is going as a report and discussion.
Following table provides methods and ways of organizing education for the course “Databases design and maintenance”:

Ways	Lectures	Practice	Independent work	Creative work
Methods				
IT-methods	+	+	+	+
Teamwork		+		+
Case-study	+	+		+
Problem-based Learning	+			+
Experience-based Learning	+			
Project		+	+	+
Searching methods	+			+
Research method	+			+

Masters must be disciplined, participate in the work process during lectures, carry out tasks on time.
An important role in acquiring the course plays independent work, includes work with information sources, data search, analysis and synthesis, formation justified conclusions based on gained knowledge, preparation presentation on chosen topic. To be able to work independently students will have guidance material, Internet-sources.

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Independent work of students can be defined as current and creative.

Current independent students work is work with lectures, preparation for practice, based on using network education sources; leading independent study; carrying out personal tasks; studying topics of independent work; preparation for examination.

Creative problem-based independent work is search, analysis, organization of information based on topics, provided as independent work of students (Internet-sources as well).

Mid-term knowledge control (theoretical and practical) is checking during discussions and lectures, demonstrations of personal tasks during practice.

Control and an assessment of knowledge are conducted based on rating-plan. The final student's assessment is during examination (including scores).

Control of Independent work

The final control (demonstration of personal tasks) includes preparation of presentation, based on chosen practical oriented topic, demonstration and analysis results.

Based on current results and the final assessment is decided to allow students to take the exam.

Range of materials for independent work of students

For independent work of students is used network education sources, Internet and other scientific and educational sources.

Assessment

Assessment Task 1: Analytical document with subject area analysis

Intent: generation ideas for group project with database, data collection and data analysis material of special topic, preparation of analytical document.

Objective(s): task addresses the following learning outcomes: 1, 10.

Type: Analytical Document

Groupwork: Teamwork

Weight:20%

Assessment criteria: 1.1 – 1.5., 10.1 – 10.6

Assessment Task 2: Database model development

Intent: definition main objects and their relationships, choice of CASE-tool (software) for design of model, database implementation using chosen CASE-tool.

Objective(s): task addresses the following learning outcomes: 2, 3, 10.

Type: Document of database model description includes main objects, attributes, relationships and restrictions

Groupwork: Teamwork

Weight:30%

Assessment criteria: 2.1 – 2.4, 3.1 – 3.7, 10.1 – 10.6.

Assessment Task 3: Database model implementation

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Intent: choose of the database management system for project, writing analytical document includes optimization database information, development recommendations for database maintenance.
Objective(s): task addresses the following learning outcomes: 4, 5, 10.
Type: Files of database models implemented using chosen CASE-tools
Groupwork: Teamwork
Weight:30%
Assessment criteria: 4.1 – 4.5, 5.1 – 5.4, 10.1 – 10.6

Assessment Task 4: Database implementation using chosen Databases Management System
Intent: implemented database using chosen Database Management System, simple web-application for demonstration possibilities of database.
Objective(s): task addresses the following learning outcomes: 6, 7, 8, 10.
Type: Project
Groupwork: Teamwork
Weight:20%
Assessment criteria: 6.1 – 6.5, 7.1 – 7.4, 8.1 – 8.6, 10.1 – 10.6.

Assessment Task 5: Demonstration group project
Intent: writing the final project documentation, preparation of presentation, project presentation, analysis of results and proposals for project development.
Objective(s): task addresses the following learning outcomes: 9, 10.
Type: Final project report, Presentation
Groupwork: Teamwork
Weight:30%
Assessment criteria: 9.1 – 9.5, 10.1 – 10.6

Course Assessment Criteria

To pass, students must achieve at least 80% in total. Using the following model of education process, based on the model of competencies specialist.

Activity:	Material (sources):
– lectures; – practice; – creative task; – project activity; – discussions.	– files of lectures; – Internet; – literature.

Methods:
- IT-methods;
- Teamwork;
- Case-study;
- Problem-based Learning;

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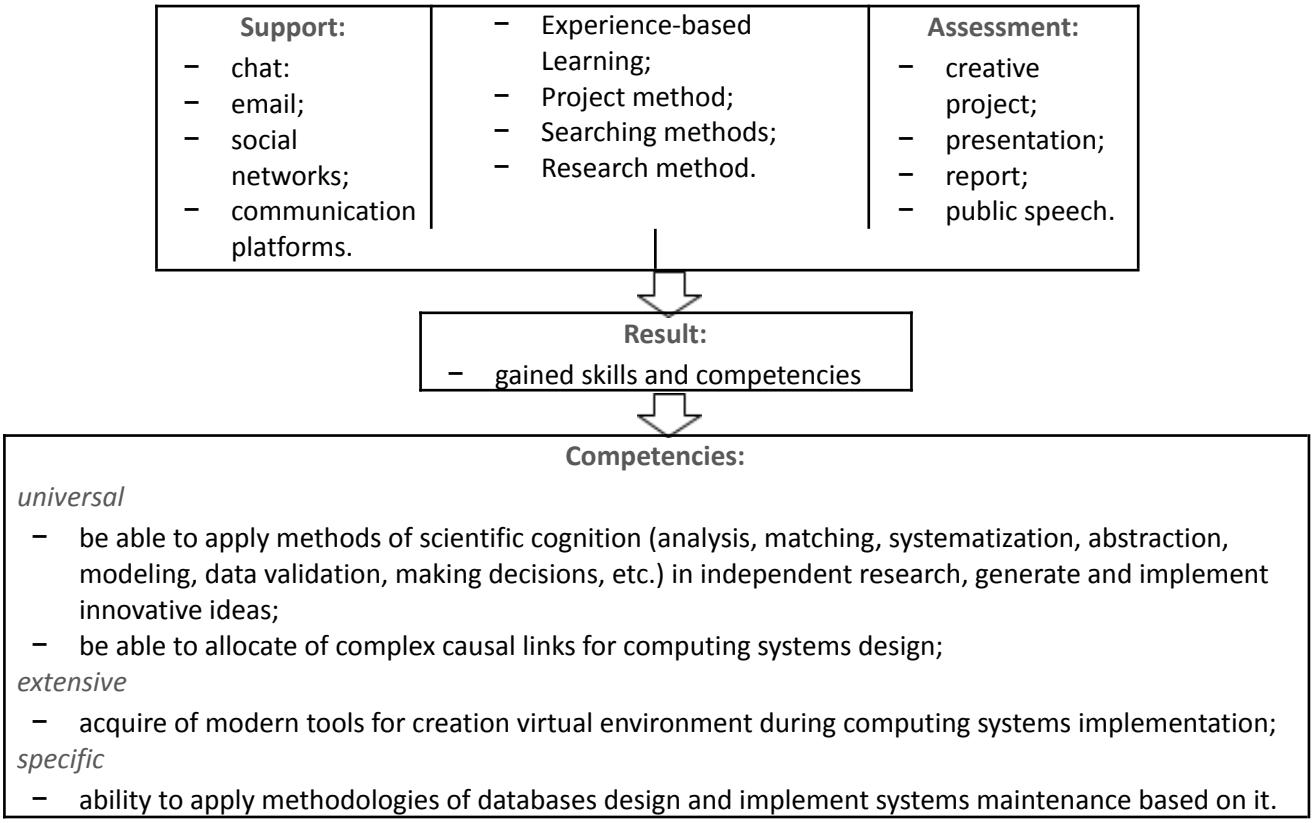

Provided organization of the education process allows to acquire competencies and will increase relevance of masters in the job market.

Student workload. Form of student activity.

Lectures: 16 hours
Practical classes: 20 hours (workshops, essay presentation, real-time interview, teamwork simulation)
Reading literature: 30 hours
Preparation for classes: 40 hours (writing essay, research of IT-occupations, self-assessment survey, career plan development)
Reflection: 4 hours

INDICATIVE STUDENT LEARNING RESOURCES

Primary:

1. Harrington J., Relational Database Design and Implementation (2016)
2. Date Christopher J., *Database Design and Relational Theory: Normal Forms and All That Jazz* (2019)
3. Churcher C., *Beginning Database Design: From Novice to Professional* (2012)
4. Davidson Louis, Moss Jessica, *Pro SQL Server Relational Database Design and Implementation* (2016)
5. Sciore E., *Database Design and Implementation* (2020)
6. Hogan R., *A Practical Guide to Database Design* (2018)

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7. Tillmann G, Usage-Driven Database Design: From Logical Data Modeling through Physical Schema Definition (2017)

Supplementary literature:

8. Mancas C., *Conceptual Data Modeling and Database Design. A Fully Algorithmic Approach, Volume 1: The Shortest Advisable Path* (2015)
9. Lee James., et al., *Hands-On Big Data Modeling: Effective database design techniques for data architects and business intelligence professionals* (2018)
10. Kroenke D.M., *Auer D.J. Database Processing: Fundamentals, Design, and Implementation* (2016)
11. Coronel C., Morris S., *Database Systems: Design, Implementation, & Management* (2019)
12. Connolly T.M., Begg C.E., *Database Systems: A Practical Approach to Design, Implementation and Management: Global Edition* (2014)
13. Chao L., *Cloud Database Development and Management* (2013)
14. Pratt P.J., Last M.Z., *Concepts of Database Management* (2015)
15. Taylor A.G., *SQL All-in-One For Dummies* (2019)

Internet Links:

16. SQL Notes for Professionals: https://goalkicker.com/SQLBook/
17. MySQL Notes for Professionals: https://goalkicker.com/MySQLBook/
18. SQL Tutorial: https://www.w3schools.com/sql/

Course relevance to the objectives of MACICT project

The course "Databases design and maintenance" is developed within a framework of WP2 of MACICT project as one of the professional skills courses categorized as "Knowledge Bases and Expert Systems".

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