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Establishing Modern Master-level Studies in Information Systems
561592-EPP-1-2015-1- FR-EPPKA2-CBHE-JP

WP2
Curriculum development
Data Bases and Data Warehouses

Draft V2.0
(to be updated)

Table 1

List of Competences

Competences Area	Competences
Systems Development and Deployment	1. Managing plan-based, hybrid, and agile development approaches
	2. Specifying and documenting systems requirements
	3. Managing IS development projects
Data, Information and Content Management	4. Selecting appropriate data management technologies based on the needs of the domain
	5. Integrating and preparing data captured from various sources for analytical use
	6. Selecting and using appropriate analytics methods
Innovation, Organizational Change and Entrepreneurship	7. Developing a business plan
	8. Understanding how to apply creative problem solving to technology-related issues
IS Strategy and Governance	9. Engaging in IS strategic planning
	10. Planning and implementing IS governance
Enterprise Architecture	11. Understanding enterprise architecture principles and the value it provides to business
	12. Communicating and deploying an EA
Business Continuity and Information Assurance	13. Implementing and managing quality audit processes
	14. Managing Information Systems risks
IS Management and Operations	15. Managing IS/IT projects and programs
IT Infrastructure	16. Monitoring emerging technologies to understand their potential to support the domain

Table 2

List of Programme Learning Outcomes

№	Professional Learning Outcomes	P
1.	to understand essential concepts, facts, principles, and theories of information system	P1
2.	to understand the diversity and state-of-the-art in area of information system	P2
3.	to be able to analyse, model, and evaluate organization's business processes from the perspective of information systems development	P3
4.	to be able to apply various methods of information systems analysis	P4
5.	to understand problems of users of information systems, to be able to identify, analyse and specify user requirements	P5
6.	to be able to manage information systems development projects and identify, analyse, evaluate, and solve the arising management problems	P6
7.	to be able to identify, analyse, and understand unorthodox problems of information systems development	P7
8.	to be able to apply various methods of information systems design	P8
9.	to be able to apply methods of knowledge, metadata analysis and information safety engineering	P9
10.	to be able to identify, find and evaluate information relevant to information systems by using data bases and other sources of information	P10
11.	to be able to apply various computerized tools for model driven information systems analysis and design	P11
12.	to be able to choose and apply various technologies of information systems' development	P12
13.	to be able to apply various tools for management of information systems projects	P13
14.	to be able to develop innovative decisions for IT business creation and support	P14
Personal and Social Learning Outcomes		
15.	to be able to think systematically when analysing different situations, solving problems and tasks	PS1
16.	to be able to apply the acquired knowledge creatively	PS2
17.	to be able to work individually with minimum guidance, manage one's work and time	PS3
18.	to be able to work efficiently in a group, manage the team, and act collectively	PS4
19.	to be able to understand the impact of information systems solutions on the	PS5

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	society and environment and their economic aspects	
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Table 3

Correlation Matrix of Competences and Programme Learning Outcomes

Competencies/ Learning Outcomes	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	PS1	PS2	PS3	PS4	PS5
1. Managing plan-based, hybrid, and agile development approaches	x	X						x		x	x	x	x	x	x	x	x	x	x
2. Specifying and documenting systems requirements	x	x			x					x					x	x	x	x	x
3. Managing IS development projects					x			x		x	x	x	x		x	x	x	x	x
4. Selecting appropriate data management technologies based on the needs of the domain	x	x							x	x	x	x			x	x	x	x	x
5. Integrating and preparing data captured from various sources for analytical use	x	x							x	x	x	x			x	x	x	x	x
6. Selecting and using appropriate analytics methods	x	x	x				x		x	x	x				x	x	x	x	x
7. Developing a business plan	x	x					x			x	x			x	x	x	x	x	x
8. Understanding how to apply creative problem solving to technology-related issues	x	x					x			x	x			x	x	x	x	x	x

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Competencies/ Learning Outcomes	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	PS1	PS2	PS3	PS4	PS5
9.Engaging in IS strategic planning	x	x	x			x				x	x			x	x	x	x	x	x
10. Planning and implementing IS governance	x	x				x				x	x		x	x	x	x	x	x	x
11. Understanding enterprise architecture principles and the value it provides to business	x		x	x						x					x	x	x	x	x
12. Communicating and deploying an EA	x		x							x	x				x	x	x	x	x
13. Implementing and managing quality audit processes	x		x	x			x		x	x					x	x	x	x	x
14. Managing Information Systems risks	x		x	x		x	x		x	x	x				x	x	x	x	x
15. Managing IS/IT projects and programs	x				x	x				x	x	x	x		x	x	x	x	x
16. Monitoring emerging technologies to understand their potential to support the domain	x			x			x			x					x	x	x	x	x

Table 4

Correlation Matrix of Programme Learning Outcomes and Courses

Programme Learning Outcomes	Courses							
	IS Development and Deployment	Data Bases and Data Warehouses	Enterprise Architecture Management	Management of IS Projects	Enterprise Architecture Management	IS Strategy	IT Infrastructure	Innovations and Entrepreneurship
1	2	3	4	5	6	7	8	9
to understand essential concepts, facts, principles, and theories of information system (P1)		X						
to understand the diversity and state-of-the-art in area of information system (P2)		X						
to be able to analyse, model and evaluate organization's business processes from the perspective of information systems development (P3)								
to be able to apply various methods of information systems analysis (P4)								

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1	2	3	4		6	7	8	9
to understand problems of users of information systems, to be able to identify, analyse and specify user requirements (P5)		X						
to be able to manage information systems development projects and identify, analyse, evaluate, and solve the arising management problems (P6)								
to be able to identify, analyse, and understand unorthodox problems of information systems development (P7)		X						
to be able to apply various methods of information systems design (P8)								
to be able to apply methods of knowledge, metadata analysis and information safety engineering (P9)		X						

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1	2	3	4		6	7	8	9
to be able to identify, find and evaluate information relevant to information systems by using data bases and other sources of information (P10)		X						
to be able to apply various computerized tools for model driven information systems analysis and design (P11)		X						
to be able to choose and apply various technologies of information systems' development (P12)		X						
to be able to apply various tools for management of information systems projects (P13)								
to be able to develop innovative decisions for IT business creation and support (P14)								

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1	2	3	4		6	7	8	9
to be able to think systematically when analysing different situations, solving problems and tasks (PS1)								
to be able to apply the acquired knowledge creatively (PS2)		X						
to be able to work individually with minimum guidance, manage one's work and time (PS3)								
to be able to work efficiently in a group, manage the team, and act collectively (PS4)		X						
to be able to understand the impact of information systems solutions on the society and environment and their economic aspects (PS5)								

Course Descriptors

Course title:	Data Bases and Data Warehouses
Course unit code	DBDW
Course Program:	DBDW
University delivering the course:	NTUKhPI
Type of course unit	Core course
Level of course unit	Masters level
Number of ECTS credits allocated	5 Credits (150 hours of student work)
Mode of delivery	lectures, workshop, independent work, distance learning...

Module Structure:

No	Type	Course	CP (h)	Presence (h)	Self-Study (h)
1	Course	Data Bases and Data Warehouses	150	40	110

Relevant Work:

Number and Type; Connection to Course	Duration	Part of final mark in %
Class participation and case study presentation		20%
Laboratory works	90 min + 10 min presentation	40%
Final Project Presentation	20 min.	40 %

Table 5

List of Course Learning Outcomes (Data Bases and Data Warehouses (DBDW))

Code of Learning Outcomes	Course Learning Outcomes
DBDW1	to understand the distributed database concepts, different database models, and database management systems
DBDW2	to understand general issues of Data Warehouse and Data Mining
DBDW3	to understand data modelling and database development process
DBDW4	to be able to tune and optimize some database applications
DBDW5	to be able to analyse of the different architectures and mining techniques
DBDW6	to be able to explain the stages of ETL process
DBDW7	to be able to discuss/explain some database security issues
DBDW8	to be able to apply Data Mining and Warehouse techniques through the use of different tools
PS2	to be able to apply the acquired knowledge creatively
PS4	to be able to work efficiently in a group, manage the team, and act collectively

Table 6

Correlation Matrix of Programme Learning Outcomes and DBDW Course Learning Outcomes

Programme Learning Outcomes	Course Learning Outcomes	Code
1	2	3
to understand essential concepts, facts, principles, and theories of information system (P1)	to understand the distributed database concepts, different database models, and database management systems	DBDW1
	to understand general issues of Data Warehouse and Data Mining	DBDW2
to understand the diversity and state-of-the-art in area of information system (P2)	to understand the distributed database concepts, different database models, and database management systems	DBDW1
to understand problems of users of information systems, to be able to identify, analyse and specify user requirements (P5)	to understand the distributed database concepts, different database models, and database management systems	DBDW1
	to understand data modelling and database development process	DBDW3
to be able to identify, analyse, and understand unorthodox problems of information systems development (P7)	to understand data modelling and database development process	DBDW3
	to be able to analyse of the different architectures and mining techniques	DBDW5
to be able to apply methods of knowledge, metadata analysis and information safety engineering (P9)	to be able to explain the stages and process different data mining techniques	DBDW6
to be able to identify, find and evaluate information relevant to information systems by using data bases and other sources of information (P10)	to be able to apply Data Mining and Warehouse techniques through the use of different tools	DBDW8
	to be able to carefully explain methods, models and techniques in Big Data	DBDW7

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1	2	3
to be able to apply various computerized tools for model driven information systems analysis and design (P11)	to be able to apply Data Mining and Warehouse techniques through the use of different tools	DBDW8
	to be able to tune and optimize some database applications	DBDW4
to be able to choose and apply various technologies of information systems' development (P12)	to understand data modelling and database development process	DBDW3
to be able to think systematically when analysing different situations, solving problems and tasks (PS1)	to be able to carefully explain methods, models and techniques in Big Data	DBDW7
to be able to apply the acquired knowledge creatively (PS2)	to be able to apply Data Mining and Warehouse techniques through the use of different tools	DBDW8
to be able to work individually with minimum guidance, manage one's work and time (PS3)	to be able to apply Data Mining and Warehouse techniques through the use of different tools	DBDW8
to be able to work efficiently in a group, manage the team, and act collectively (PS4)	to be able to explain the stages and process different data mining techniques	DBDW6
to be able to understand the impact of information systems solutions on the society and environment and their economic aspects (PS5)	to understand the database concepts, different database models, and database management systems	DBDW1
	to understand general issues of Data Warehouse and Data Mining	DBDW2

Table 7

Data Bases and Data Warehouses Learning Outcomes

Themes	Theoretical component	Practical component	Learning Objectives	Learning Outcomes	
				Professional	Personal & Social
1	2	3	4	5	6
MODULE 1. Distributed Database Management Systems					
Topic 1. Introduction into Distributed Database Management Systems (DDMS)	1.1. Definition of DDMS 1.2. Characteristics of DDMS 1.3. Advantages and Disadvantages	Lab works	To learn main concepts of DDMS	DBDW1 to understand the database concepts, different database models, and database management systems	PS2, PS4
Topic 2. Functions and Architecture of DDMS	2.1. Functions of DDMS 2.2. Reference Architecture for a DDMS 2.3. Component Architecture	Lab works	To learn architecture and functions	DBDW5 to be able to analyse of the different architectures and mining techniques	PS2, PS4

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1	2	3	4	5	6
Topic 3. Data Allocation and Fragmentation	3.1. Distributed Database Design 3.2. Types of Data Allocation 3.3. Data Fragmentation – types, advantages and disadvantages	Lab works	To learn design, data allocation and fragmentation strategies	DBDW3 to understand data modelling and database development process	PS2, PS4
Topic 4. Distributed Transaction Management	4.1. Transparencies in a DDBMS 4.2. Classification of Transactions 4.3. Distributed Transaction Management 4.4. Distributed Concurrency Control	Lab works	To learn transaction management in distributed environment	DBDW1 to understand the database concepts, different database models, and database management systems DBDW2 to understand general issues of Data Warehouse and Data Mining	PS2, PS4

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1	2	3	4	5	6
Topic 5. Distributed Locking and Deadlock Detection	5.1. Locking Protocols 5.2. Distributed Deadlock Management 5.3. Distributed Recovery Control	Lab works	To learn locking mechanisms and approaches to deadlock detection	DBDW7 to be able to discuss/explain some database security issues	PS2, PS4
Topic 6. Optimization in Distributed Environment	6.1. Distributed Query Optimization 6.2. Data Localization 6.3. Global Optimization	Lab works	To learn different optimization strategies	DBDW4 to be able to tune and optimize some database applications	PS2, PS4
Topic 7. Replication Strategies	7.1. Replication Model 7.2. Consistency 7.3. Data Ownership	Lab works	To learn various replication models in DDMS	DBDW4 to be able to tune and optimize some database applications	PS2, PS4

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1	2	3	4	5	6
MODULE 2. Data Warehouses and Data Mining					
Topic 8. Introduction into Data Warehouses (DWH)	8.1. DWH concepts 8.2. DWH Architecture 8.3. DWH Tools and Technologies	Lab works	To learn DWH concepts and architecture	DBDW2 to understand general issues of Data Warehouse and Data Mining	PS2, PS4
Topic 9. DWH Lifecycle	9.1. DWH Planning 9.2. DWH Requirements	Lab works	To learn components of DWH lifecycle	DBDW3 to understand data modelling and database development process	PS2, PS4
Topic 10. DWH Design	10.1. Designing a Data Warehouse Database 10.2. Multidimensional Data Model	Lab works	To learn approaches to DWH design and various data models	DBDW3 to understand data modelling and database development process	PS2, PS4
Topic 11. ETL (Extraction, Transformation, Load) Processes	11.1. Data Extraction 11.2. Data Transformation 11.3 Data Loading	Lab works	To learn extraction, transformation and loading processes	DBDW6 to be able to explain the stages of ETL process	PS2, PS4

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1	2	3	4	5	6
Topic 12. Distributed DWH	12.1. Data Placement 12.2. Concurrency Control 12.3. Security Controls	Lab works	To learn methodologies of distributed DWH implementation	DBDW7 to be able to discuss/explain some database security issues	PS2, PS4
Topic 13. DWH Applications	13.1. Retail Sales 13.2. CRM 13.3. Financial Services	Lab works	To learn different DWH application domains	DBDW4 to be able to tune and optimize some database applications DBDW8 to be able to apply Data Mining and Warehouse techniques through the use of different tools	PS2, PS4
Topic 14. Introduction into Data Mining	14.1. Data Mining Techniques 14.2. Data Mining Process 14.3. Data Mining Tools	Lab works	To learn data mining concepts	DBDW2 to understand general issues of Data Warehouse and Data Mining DBDW8 to be able to apply Data Mining and Warehouse techniques through the use of different tools	PS2, PS4

Table 8

Characteristics of Learning Outcomes for Data Bases and Data Warehouses

Course Learning Outcomes	Code of Learning Outcomes	Knowledge	Skills	Communication	Autonomy and responsibility
1	2	3	4	5	6
to understand the distributed database concepts, different database models, and database management systems	DBDW1	Determine basic concepts and models of databases and database management systems	Analyse principles, methods and concepts of databases and database management systems	Demonstrate the ability to build and correct logical reasoning and proof	Make decisions about , different database models, and database management systems
to understand general issues of Data Warehouse and Data Mining	DBDW2	Define main topics in data warehousing and data mining	Analyse application domain for usage of data warehouse and data mining approaches	Ability to explain ofgeneral issues of Data Warehouse and Data Mining	Make decisions aboutgeneral issues of Data Warehouse and Data Mining

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to understand data modelling and database development process	DBDW3	Define requirements, models and development lifecycle	Develop models and applications using databases	Ability to understand data modelling and database development process	Make decisions about database development process
to be able to tune and optimize some database applications	DBDW4	Compare different optimization techniques	Analyse and remove bottlenecks in database performance	Ability to tune and optimize some database applications	Make decisions about tune and optimize some database applications
to be able to analyse of the different architectures and mining techniques	DBDW5	Describe different type of mining architecture and techniques	Select application architecture with data mining	Ability to analyse of the different architectures and mining techniques	Be responsible for analyze the different architectures and mining techniques
to be able to explain the stages of ETL process	DBDW6	Define steps to be done in ETL process	Analyse solutions to be applied during ETL	Ability to explain the stages of ETL process	Be responsible for explain the stages of ETL process
to be able to discuss/explain some database security issues	DBDW7	Determine main issues in database security	Reduce potential security risks	Ability to discuss/explain some database security issues	Make decisions about some database security issues

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to be able to apply Data Mining and Warehouse techniques through the use of different tools	DBDW8	Define best practices in applying Data Mining and Data Warehousing	Apply data warehousing and data mining solutions in different domains	Ability to business communications in a professional field	Be responsible for apply Data Mining and Warehouse techniques through the use of different tools
to be able to apply the acquired knowledge creatively	PS2	Determine best practice and techniques to build solutions	Apply and modify different practice and techniques	Ability to apply the acquired knowledge creatively	Be responsible apply the acquired knowledge creatively
to be able to work efficiently in a group, manage the team, and act collectively	PS4	Determine main issues in collaborative work	Apply team working to improve development process	Ability to demonstrate collaboration work on the project	Be responsible for the results of project implementation

Recommended or required reading

Main:

1. Christopher Adamson. Mastering Data Warehouse Aggregates: Solutions for Star Schema Performance. John Wiley & Sons, July 2006.
2. Inmon W. H.: Building the Data Warehouse, Wiley & Sons, 2002.
3. Kimball R., Ross M.: The Data Warehouse Toolkit. The Complete Guide to Dimensional Modeling, Wiley & Sons, 2002.
4. Ponniah P.: Data Warehousing Fundamental, Wiley & Sons, 2001.
5. David Hand, Heikki Mannila and Padhraic Smyth: Principles of Data Mining. The MIT Press, 2001.
6. Bob Bryla, Kevin Loney: Oracle Database 12c The Complete Reference. Oracle Press, 2013
7. Galit Shmueli, Peter C. Bruce, Inbal Yahav, Nitin R. Patel, Kenneth C. Lichtendahl: Data Mining for Business Analytics: Concepts, Techniques, and Applications in R. Wiley, 2017.

Additional:

1. Claudia Imhoff, Nicholas Gallema, Jonathan G. Geiger: Mastering Data Warehouse Design Relational and Dimensional Techniques, Wiley Publishing, 2003.

Planned learning activities and teaching methods

The primary means of learning for student is through practice. This is supported and developed through:

1. Online teaching materials.
2. Catalogues of case studies.
3. Self and peer-to-peer assessments.
4. Group presentations and discussions.
5. Laboratory works presentations.
6. Final project presentation.

Assessment methods, criteria and regime

Progress and learning is assessed not only at the end but throughout the entire course. Evidence of an ability to think through and critically analyse challenges will be highly rewarded in the assessment. Students' grades will be determined by individual Assignments on laboratory works, based on description of the task, application domain and organization background necessary to build distributed database and data warehouse.

Topics of laboratory works are following:

- Design of Distributed Database
- Data Manipulation in Distributed DBMS
- Distributed Database Fragmentation
- Data Warehouse implementation using Microsoft SQL Server

The relative weight of each laboratory work is 10%, making it total 40% for all four laboratory works. It will

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be marked on the basis of: content of the report clearly formulated - 30%; conclusions are adequate - 20%; task is done fully—50%.

Class participation and active work during lectures will be weighted by 20%. Students should be able to answer questions, work in groups, discuss case studies.

Final project presentation including final assessment paper is weighted by 40%. Students have to show their theoretical and practical knowledge in the application domain and distributed databases and data warehouses technology.