SYLLABUS

1. Data about the program of study

1.1 Institution	The Technical University of Cluj-Napoca
1.2 Faculty	Faculty of Automation and Computer Science
1.3 Department	Computer Science
1.4 Field of study	Computer Science and Information Technology
1.5 Cycle of study	Master
1.6 Program of study/Qualification	Data Science / Master
1.7 Form of education	Full time
1.8 Subject code	10

2. Data about the subject

2.1 Subject name				***Data Warehouse and Business Intelligence***	
2.2 Course responsible/lecturer				Șl.Dr.Ing. Cenan Călin – Calin.Cenan@cs.utcluj.ro	
2.3 Teachers in charge of seminars/ laboratory/ project				Șl.Dr.Ing. Cenan Călin – Calin.Cenan@cs.utcluj.ro	
2.4 Year of study	II	2.5 Semester	1	2.6 Type of assessment (E - exam, C - colloquium, V - verification)	E
2.7 Subject category	Formative category: DA – advanced, DS – speciality, DC – complementary				DS
	Optionality: DI – imposed, DO – optional (alternative), DF – optional (free choice)				DI

3. Estimated total time

3.1 Number of hours per week	4	of which:	Course	2	Seminars	1	Laboratory		Project	
3.2 Number of hours per semester	56	of which:	Course	28	Seminars	14	Laboratory		Project	
3.3 Individual study:										
(a) Manual, lecture material and notes, bibliography										20
(b) Supplementary study in the library, online and in the field										20
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays										8
(d) Tutoring										7
(e) Exams and tests										3
(f) Other activities:										

3.4 Total hours of individual study (suma (3.3(a)…3.3(f)))	58
3.5 Total hours per semester (3.2+3.4)	100
3.6 Number of credit points	4

4. Pre-requisites (where appropriate)

4.1 Curriculum	Databases
4.2 Competence	Development of techniques, technologies, methods and methodologies specific to information systems

5. Requirements (where appropriate)

5.1. For the course	Board, video projector, computer; student present in mandatory 50% of days for admission to the final exam
5.2. For the applications	Computers, specific software; student present in mandatory 100% of days for admission to the final exam

6. Specific competence

6.1 Professional competences	4 Contextual integration and exploitation of dedicated information systems. 4.2 - Using interdisciplinary knowledge to integrate economic and business information systems in the contextual environment 4.3 - Creative use of advanced principles and methods to ensure security, safety and ease of operation of integrated economic information systems

	4.5 - Carrying out professional projects and/or interdisciplinary research and development respecting quality, security and safety standards 5 - Research, development, and optimization of complex economic information systems through creative blending of multi-disciplinary knowledge
6.2 Cross competences	N/A

7. Discipline objective (as results from the *key competences gained*)

7.1 General objective	Data Warehouses and Business Intelligence are components of a modern data stack. They offer support in analyzing massive amounts of structured & semi-structured data. Data Warehouses are the foundation for reporting, ad hoc analysis, business intelligence and machine learning data mining. The main objective of this discipline is to provide specific information and prepare students to design Business Intelligence systems. Thus, it aims to confer the ability to analyze, design and implement any BI system. This course provides the student with in-depth knowledge of Data Warehousing principles, Data Warehouse techniques, and Business Intelligence systems. The course presents the topics of Data Warehouse design, Extract-Transform-Load (ETL), Data Cubes, and Data Marts. Students will be able to create Business Intelligence applications using Data Warehouses with several OLAP and analytical tools.
7.2 Specific objectives	To achieve these general objectives, students will: • Aim to understand the concepts and processing flows of a BI system; Will be able to describe architecture and methods for storage and provision of enterprise data. • Study techniques and tools specific to different processing components (e.g. extraction, transformation, loading, data integration); Study techniques and tools for designing multidimensional structures; Study data analysis techniques and tools (OLAP, Dimensional Model). • Learn to analyze and design a BI system; Will demonstrate competency in data modeling, including dimensional modeling. • Will compare modern and classic strategies of data dimensional modeling. • Will implement data ingest techniques (ETL) and they will learn to maintain data quality. • Will develop competency in essential business intelligence reporting; Will create reports, analysis & visualizations.

8. Contents

8.1 Lectures	Hours	Teaching methods	Notes
The Compelling Need for Data Warehousing and Business Intelligence; Need for Strategic Information Decision-Support Systems (vs Operational Systems OLAP / OLTP) Data Warehouse: Building Blocks: Subject-Oriented Data, Integrated Data, Time-Variant Data, Data Granularity Data Warehouses and Data Marts Source Data Component, Data Staging, Metadata Trends in Data Warehousing	2	PDF & PPT Presentations; Demonstrations and model presentations on board; small exercises to increase interaction	
Planning Data Warehouse Business Requirements Dimensional Analysis: Key Performance Indexes, Key Business Metrics, Facts Data Sources, Data Transformation	2		
Data Warehouse Design Structure for Business Dimensions and Key Measurements Data Storage Specifications, Analysis	2		
Data Warehouse Architecture 1 Dimenisional Modeling; Kimball model	2		
Data Warehouse Architecture 2	2		

Inmon model; Data Vault			
Data Ingestion ETL, Data Extraction, Transformation, Loading Data Quality	2		
Reporting and Business Intelligence Queries and Reports, Online Analytical Processing (OLAP) Graphics elements for Effective Visualization Reporting; Analytics	2		
Advanced Relational Databases - SQL for data analytics Advanced SQL: Pivot, Aggregate Functions; Window Functions; Common Table Expressions (CTE)	2		
Principles of Dimensional Modeling Star Schema; Snowflake Schema	2		
Data Quality Validation of Data; Data Cleansing Tools	2		
Online Analytical Processing Multi-Dimensional Analysis Hypercubes Drill-Down, Roll-Up, Slice-and-Dice Rotation Models: MOLAP, ROLAP, Hybrid	2		
Data Mining Basics Knowledge Discovery Process OLAP Versus Data Mining; Data Mining and Data Warehouse	2		
Major Data Mining Techniques Supervised and Unsupervised Machine Learning Algorithms Cluster Detection, Association Rule Learning, Decision Trees, Memory-Based Reasoning, Link Analysis, Genetic Algorithms	2		
Data Warehouse Business Intelligence and Data Mining Apps. Business Case Examples: Retail, Sales, Inventory, Procurement, Human Resources, Telecommunications, Banking and Finance, Transportation, Education, Health Care, E-Commerce, Insurance	2		

Bibliography

1. Data Mining Techniques by Michael Berry, Gordon Linoff, 2004
2. Modern Data Warehousing, Mining, and Visualization: Core Concepts by George M. Marakas
3. Introduction to Data Mining by Pang-Ning Tan, Michael Steinbach, and Vipin Kumar (2005)
4. Business Intelligence Roadmap: The Complete Project Lifecycle for Decision-Support Applications (Addison-Wesley Information Technology Series) by Larissa T. Moss and Shaku Atre (2003)
5. OLAP Solutions: Building Multidimensional Information Systems by Erik Thomsen (2002)
6. The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling, by R. Kimball M. Ross, Wiley (2013)
7. Building the Data Warehouse, by W. H. Inmon, Wiley (2005)
8. Building a Scalable Data Warehouse with Data Vault 2.0, by D. Linstedt M. Olschimke, Morgan Kaufmann (2015)
9. Data Mining Concepts and Techniques, by J. Han, J. Pei H. Tong, Morgan Kaufmann (2011)

8.2 Applications – Seminars/Laboratory/Project	Hours	Teaching methods	Notes
Practical Exercises - Extract Transform Load ETL	2	Exposure and applications	
Practical Exercises - Data Warehouse technology	2		
Practical Exercises - On-Line Analytical Processing OLAP	2		
Practical Exercises - Presentation and Reporting Business Intelligence	2		
Practical Exercises - Data Mining technology 1	2		
Practical Exercises - Data Mining technology 2	2		
BI apps, Final laboratory work evaluation	2		

Bibliography

1. Data Mining Techniques by Michael Berry, Gordon Linoff, 2004
2. Modern Data Warehousing, Mining, and Visualization: Core Concepts by George M. Marakas
3. Introduction to Data Mining by Pang-Ning Tan, Michael Steinbach, and Vipin Kumar (2005)
4. Business Intelligence Roadmap: The Complete Project Lifecycle for Decision-Support Applications (Addison-Wesley Information Technology Series) by Larissa T. Moss and Shaku Atre (2003)

5. OLAP Solutions: Building Multidimensional Information Systems by Erik Thomsen (2002)

*Se vor preciza, după caz: tematica seminariilor, lucrările de laborator, tematica și etapele proiectului.

9. Bridging course contents with the expectations of the representatives of the community, professional associations and employers in the field

Since this discipline is very important for designing Business Intelligence systems, its content is as modern as possible because it articulates the principles of BI systems and then presents models and techniques for each processing component in the BI stream. The content of the discipline was discussed with important actors in this field, both academic and industrial, from Romania, Europe and the U.S. The discipline was evaluated, together with the master's study program Information Technology in Economics, by ARACIS.

10. Evaluation

Activity type	Assessment criteria	Assessment methods	Weight in the final grade
Course	Solving problems and answers to theoretical questions Ability to solve industry-specific problems Attendance, (inter)activity during classes	2.5 hours written evaluation face to face or using TEAMS platform, if necessary	50% (a grade greater than 5 is mandatory)
Seminar			
Laboratory	Ability to solve industry-specific problems Presentation of implemented projects Attendance, (inter)activity during classes	Ongoing evaluation face to face or on-line using TEAMS platform, if necessary Final presentation face to face or on-line using TEAMS platform, if necessary	50% (a grade greater than 5 is mandatory)
Project			
Minimum standard of performance: Design of a Business Intelligence system, using the formal apparatus specific to the domain Conditions for participating in the final exam: Lab ≥ 5 Conditions for promotion: final exam ≥ 5			

Date of filling in:	**Titulari**	**Titlu Prenume NUME**	**Semnătura**
	Course	Șl.Dr.Ing. Cenan Călin	
	Applications	Șl.Dr.Ing. Cenan Călin	

Date of approval in the department 20.02.2024	Head of department Prof.dr.ing. Rodica Potolea
Date of approval in the Faculty Council 22.02.2024	Dean Prof.dr.ing. Mihaela Dinsoreanu