Universidad Carlos III de Madrid

Database design and administration

Academic Year: (2019 / 2020)   **Review date: 01-06-2020**

Department assigned to the subject: Computer Science and Engineering Department

Coordinating teacher: GENOVA FUSTER, GONZALO

Type: Electives ECTS Credits : 6.0

Year : 4 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Files and Data bases

OBJECTIVES

General competences:
 - Abstraction (PO a)
 - Analysis and Synthesis (PO a)
 - Organize and Planning (PO a)
 - Communication of conclusions (PO g)
 - Problem solving in new or known environments (PO c)
 - Capacity of differentiate and make critical analysis of problem¿s solutions (PO c)
 - Teamwork (PO d)
 - Capacity of applying theoretical concepts (PO c)
 - Capacity of integrating concepts and making critical analysis (PO c)
Specific competences
 - Cognitive (PO a)
   1. Theoretical knowledge about database methodologies and data models
   2. Theoretical knowledge about conceptual, logical and physical database design.
   3. Basic theoretical knowledge about database administration: system security, data integrity, backup and data
recovery.
   4. Theoretical knowledge about monitoring and optimization of the performance of the database and selects.
   5. Theoretical knowledge about databases paradigms, technologies and architectures.
   6. Theoretical basic knowledge about database administration and maintenance of databases (CECRI5).
   7. Theoretical basic knowledge about the use and programming of databases (CGB4).
 - Procedimental/Instrumental (PO a, g, k)
   1. Use of Database Design Methodologies
   2. Conceptual Design, Standard Logical Design and Specific Logical Design based on data models.
   3. Analysis of data redundancy or insert, delete or updates anomalies.
   4. Administration of databases, physical design and database tuning using a commercial Database Management
System (DBMS) as Oracle.
   5. Use of administration tools and tuning tools in a commercial DBMS
   6. Practical cases guaranteeing data integrity, availability and consistency in databases
   7. Ability to actively participate in the specification, design, implementation and maintenance of information systems
and communication (CESI3)
   8. Use ICT efficiently means to write technical reports and project reports and papers on Information Technology
(CG9)

 - Attitudinal (PO c, d, f)
   1. Creativity: Discover new ideas and solve problems in new environments
   2. Capacity to make diagrams, structuring knowledge
   3. Interest for the quality of the work
   4. Motivation for the success
   5. Interest for investigating and finding solutions to new problems
   6. Capacity to differentiate and make critical analysis of problem¿s
   7. Capacity of setting out and discuss different solutions to the same problem, contrasting and comparing different
solutions.
   8. Capacity of communication
   9. Be able to present and discuss proposals on teamwork, demonstrating personal and social skills

that enable it to assume different responsibilities within the same (CG7)

DESCRIPTION OF CONTENTS: PROGRAMME

Database systems, database paradigms, database methodologies, data models, basics about database administration (security and confidentiality; tuning and recovery; data integrity; concurrency and consistency), database design, database tuning and query optimization, distributed databases, parallel databases, analytical databases, NoSQL data storage systems, database trends.

PROGRAM:
TOPIC 1. Introduction to Database Systems
  Item 1.1. Definitions and Concepts
  Item 1.2 Database Paradigms
TOPIC 2: Database methodologies
  Item 2.1. Phases.
  Item 2.2. Components
  Item 2.3. Proposed methodology for Relational Design
TOPIC 3: Conceptual Design: The model E / R
  Item 3.1. Introduction to E / R
  Item 3.2. Basic components: Entities, Attributes, Domains and Interrelations
  Item 3.3. Generalizations / Specializations
  Item 3.4. N-ary relationships
  Item 3.5. Control of Redundancy
TOPIC 4: Logic Design. Transformation from E/R Model to Relational Model
  Item 4.1. Refreshing Concepts of Relational Model
  Item 4.2. Transformation of components from E/R
TOPIC 5: Database Administration
  Item 5.1. Fundamentals of Database Administration
  Item 5.2. Physical design
  Item 5.3. Security and Privacy
  Item 5.4. Recovery and Concurrency
  Item 5.5. Query Optimization
ITEM 6: Distributed and Parallel data storage systems
  Item 6.1. Distributed systems
  Item 6.2. Parallel systems
ITEM 7: Analytical Databases
  Item 7.1. Introduction
  Item 7.2 Transactional Systems vs Analytical Systems
ITEM 8: NoSQL Data storage systems
  Item 7.1. Introduction and motivation
  Item 7.2. Key-value data stores
  Item 7.3. Document-based data stores
  Item 7.4. Column-based data stores
  Item 7.5. Graph-based data stores

LEARNING ACTIVITIES AND METHODOLOGY

1) Theoretical lectures: 1.5 ECTS. To achieve the specific cognitive competences of the course (PO a).
2) Practical lectures: 1,5 ECTS. To develop the specific instrumental competences and most of the general competences, such as analysis, abstraction, problem solving and capacity to apply theoretical concepts. Besides, to develop the specific attitudinal competences. During the practical lectures, practical cases are developed incorporating all studied techniques and methods (PO a, c, d, f, g, k) (CESI3, CECRI5, CGB4, CG9, CG7).
3) Guided academic activities (present teacher): 0.1 ECTS. Critical analysis of problems¿ solutions. (PO a, c, d, g) (CESI3, CG7)
4) Guided academic activities (absent teacher): 1.9 ECTS. Exercises, Documentation of practical activities and complementary readings (PO a, c, d, f, g) (CESI3, CECRI5, CGB4, CG9, CG7).
5) Exercises and examination: 1 ECTS. To complete the development of specific cognitive and procedimental capacities (PO a, c) (CESI3).

ASSESSMENT SYSTEM

Exercises and examinations are both learning and evaluation activities. The evaluation system includes the assessment of guided academic activities and practical cases, with the following weights:

Guided academic activities
- Present teacher: (PO a, c, d, g) (CESI3, CG7).
- Absent teacher: (PO a, c, f, g) (CESI3, CECRI5, CGB4, CG9, CG7).

2) Practical case related to DB Design and Implementation: 30% (PO a, c, d, f, g, k) (CESI3, CECRI5, CGB4, CG9).
3) Examination related to DB Administration: 10% (PO a,c) (CESI3)
4) Final Examination: 50% (PO a, c) (CESI3). A minimum score is required in this test to take into account the continous assessment

% end-of-term-examination: 50

% of continuous assessment (assigments, laboratory, practicals…):   50

BASIC BIBLIOGRAPHY

 - Pramod J. Sadalage & Martin Fowler NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Addison-Wesley Professional, 2012
 - Craig Mullins Database Administration: The Complete Guide to Practices and Procedures, Addison-Wesley Professional, 2012
 - Date, C.J. An Introduction to Database Systems (8th Edition), Prentice Hall (2004).

 - Oracle Oracle Administración de Oracle 10G, http://download-uk.oracle.com/docs/cd/B19188_01/doc/B15921/toc.htm.
 - Oracle Oracle Database Administrator Guide. 11g. Release2 , http://docs.oracle.com/cd/E11882_01/server.112/e25494.pdf, 2014
 - R Ramakrishnan, J Gehrke Database Management Systems - 3rd Edition, McGraw-Hill, 2013

 - Saeed K. Rahimi, Frank S. Haug Distributed Database Management Systems, IEEE Computer Society, 2010

 - Thomas LaRock DBA Survivor: Become a Rock Star DBA, ebook, 2014

ADDITIONAL BIBLIOGRAPHY

 - A. de Miguel, P. Martínez, E. Castro, J.M: Cavero, D. Cuadra, A. Iglesias, C. Nieto Diseño de Bases de Datos: Problemas Resueltos, RA-MA (2001).
 - Biju Thomas OCA: Oracle Database 12c Administrator Certified Associate Study Guide, Wiley / Sybex, 2014

 - D. Cuadra, E. Castro, A. Iglesias, P. Martínez, F.J. Calle, C. de Pablo, H. Al-Jumaily y L. Moreno Desarrollo de Bases de Datos. Casos Prácticos desde el análisis a la implementación (1ª edición), RA-MA, 2007

 - De Miguel, A. y Piattini, M. Fundamentos y Modelos de Bases de Datos, RA-MA (1999).

 - Elmasri y Navathe Fundamentals of Database Systems, fourth edition, Pearson Addison Wesley, (2003).

 - Levene, M. y Loizou, G. A Guided Tour of Relational Databases and Beyond, Springer Verlag (1999).

 - Silberschatz, A.; Korth, H.; Sudarshan, S. Fundamentos de bases de datos (5ª edición), McGraw-Hill /Interamericana Mexico (2005).