



Universidad
de Alcalá

Teaching Guide

Advanced DataBases

**Bachelor's Degree on:
Computer Science
Information Systems**

Universidad de Alcalá

Academic Year 2019/2020
Second Year – Term 2

TEACHING GUIDE

Course Name:	Advanced DataBases
Course Code:	780020
Degree Programas::	Computer Science Information Systems
Department & Subject Field:	Computer Science
Type:	Mandatory
ECTS Credits:	6
Year:	Second Course / Second Terms
Teacher:	Consult the web page of the Department
Office Hours:	Depends on the individual tutor
Classes offered in:	English / Spanish

1. PRESENTATION

It is calculated that every 18 months the amount of information of the world is duplicated. It is obviously that such information volume cannot be analyzed by human experts like before, so it is more extended the use of informatic tools that allow automatically the huge databases managed by the companies and public organisms. The aim of this course is to present an introduction to the databases and the concepts related to the administration and maintenance.

This subject tries to make the student aware of the importance of the techniques to be used in the maintenance, management and optimization of database management systems in order to maintain an adequate performance and a correct security planning, both physical and logical, of the data.

For this, the internal structure and capacities of the Database Management Systems are studied, with special interest in the Relational DBMS. Likewise, optimization techniques related to the execution of a query and design of databases are shown.

Entry requirements:

It is recommended to have completed the previous subject of Data Bases I and Data Structure

2. COMPETENCIES

General Skills:

CG6 Capacity to conceive and develop centralized or distributed computer systems or architectures integrating hardware, software and networks according to the knowledge acquired as established in section 5 of resolution BOE-A-2009-12977.

CG9 Capacity to solve problems with initiative, decision making, autonomy and creativity. Capacity to know how to communicate and transmit knowledge, skills and abilities of the profession of Technical Engineer in Computing.

Specific Skills:

CI5 Knowledge, administration and maintenance systems, services and computer applications.

CI7 Knowledge, design and efficient use of the types and data structures most suited to the resolution of a problem.

CI12 Knowledge and application of the characteristics, functionalities and structure of the databases, which allow their proper use, and the design and analysis and implementation of applications based on them.

Learning Outcomes:

Al terminar con éxito esta asignatura, los estudiantes serán capaces de:

- RA1: Argue the need for databases and know the different database architectures to choose the one that best suits the solution of a problem.
- RA2: Assimilation of the concept of organizational data warehouses and their use for decision making applications.
- RA3: Knowledge to carry out performance evaluation, disk space management, optimization and maintenance management of a database management system.
- RA4: Know how to manage disk space and increase performance through the appropriate use of data structures supported by the DBMS to optimize it.
- RA5: Ability to manage the concurrent and atomic operations of a database to achieve an increase in performance and correct recovery of errors, both transaction and system errors or backup copies.
- RA6: Competence for the design and optimization of a distributed database based on the partitions that are made in the design phase according to the strategies used.

3. CONTENTS

1. Planning the storage and indexes of a database:
 - a. Storage devices.
 - b. Data storage structures (data records).

- c. Planning the storage of records (file structures).
 - d. Types of additional physical structures of acceleration of search of records of data (indexes), and their performance.
2. Processing and optimization of user queries in a database
- a. Implementation and performance of different query processing algorithms.
 - b. Calculation of the cost of a query.
 - c. Optimization of user queries based on the statistics and cost of a given query.
 - d. Optimization algorithms.
 - e. Introduction to the pipelining and the materialization for the management of queries.
3. Management of a database
- a. Control of transactions, control of the concurrence and error recovery systems of a database.
 - b. Audits, monitoring tools and performance optimization of a database.
 - c. Security, users, permissions.
4. Distributed and large databases
- a. Architecture.
 - b. Distributed data storage.
 - c. Types of distribution.
 - d. Control of distributed transactions.
 - e. Control of concurrency and availability.

Content Blocks	ECTS credits or hours
Storage planning and indexes Storage devices. Data storage structures (data records). Planning the storage of records (file structures) Types of additional physical structures of search acceleration of data records (indexes), and their operation	20 hours

Processing and optimization of queries Implementation and performance of the different query processing algorithms. Calculation of the cost of a query Optimization of the queries of the users based on the statistics and cost of a given query. Optimization algorithms. Introduction to the pipelining and the materialization for the management of queries	20 hours
Management of a database Control of transactions, control of the concurrence and error recovery systems of a database. Audits, monitoring tools and performance optimization of a database Security, users, permissions	10 hours
Distributed and large databases Architecture. Distributed data storage. Types of distribution. Control of distributed transactions. Control of concurrency and availability	6 hours

Contents Timing

Week/ Session	Theory Contents	Laboratory Contents
01 ^a	U1: DBMS Architecture. Devices and structures of Data Storage	Organization of laboratories
02 ^a	U1: Planning the Storage of records.	PL1: Publication U1: Planning of the storage and physical structure of a DBMS.
03 ^a	U1: Additional physical structures of search acceleration of data records (indexes), and their performance.	U1: Planning of the storage and physical structure of a DBMS.
04 ^a	U1: Exercises Unit 1	U1: Physical implementation and storage of a real database in a DBMS.
05 ^a	PEI1: U1	PL1: Delivery PL2: Publication PLF: Publication
06 ^a	U2: Processing algorithms of queries	U2: Massive loading of data, processing and optimization of queries.

07 ^a	U2: Optimization of a query based on statistics and calculation of the cost of a query.	U2: Massive loading of data, processing and optimization of queries.
08 ^a	U2: Algorithms of optimization and uses of pipelining and materialization in queries	U2: Massive loading of data, processing and optimization of queries.
09 ^a	U2: Exercises Unit 2	PL2: Delivery. PL3: Publication
10 ^a	PEI2: U2	U3: Users, permissions and security.
11 ^a	U3: Control of transactions, concurrency and recovery.	U3: Control of transactions, concurrency and recovery.
12 ^a	U3: Audits, security, permissions, performance and optimization of a database.	U3: Control of transactions, concurrency and recovery.
13 ^a	U4: Distributed and large databases.	PL3: Delivery PL4: Publication. U4: Implementation of a distributed database.
14 ^a	PEI3: U3+U4	U4: Implementation of a distributed database Delivery of PL4 Delivery of PLF (Official Examination Day)

Acronyms:

PEI#: Intermediate Evaluation Test of theory number#

PL#: Laboratory Test number#

PLF: Final Laboratory Test

4. TEACHING/LEARNING METHODOLOGY. OUTLINE OF ACTIVITIES

4.1. Total number of hours

Class contact hours:	Theory and Problems 28 hours Laboratory 28 hours Final Assessment 4 hours
Independent study hours	90 hour s
Total hours	150 hours

4.2. Methodological strategies, materials and didactic resources.

The Advanced Databases course is organized as a fourth-month course of a 6 ECTS (150 hours).

In the teaching-learning process of the contents, the following training activities will be used:

- Taught Theoretical Classes.
- Supervised Practical classes: solving problems in class.
- Supervised practical laboratories.
- Tutorials: individual or group.

In addition, depending on the nature of the different parts of the subject matter, the following training activities may be used, among others:

- Preparation of works with individual responsibility but with information management as a team.
- Put in common the information, problems and doubts that appear in the realization of the works.
- Organization and realization of public days with oral presentations and discussion of results.
- Use of Virtual Classroom Platform (Blackboard).

Class activities:

1. In the classroom: exhibition and discussion of the basic knowledge of the subject. Approach and theoretical resolution of exercises and related assumptions. Oriented to the teaching of the specific skills of the subject, especially those related to basic knowledge and imperative programming techniques.
2. In the laboratory: planning and development of practical exercises to solve problems and analyze hypotheses and contribute to the development of the ability to analyze results, critical reasoning and understanding of the proposed resolution methods. They will serve as a basis for the acquisition of the generic skills described in the section

Outside of class:

- Analysis and assimilation of the contents of the subject, problem solving, bibliographical consultation, preparation of individual and group work, realization of face-to-face exams and self-evaluations. Specially oriented to the development of methods for the self-organization and planning of individual and team work.
- Tutorials: individual and group counseling during the teaching-learning process, either in person or remotely.

Materials and Resources:

- Database Design Software.
- Database Systems Management Software for the subject to be developed.
Programming tools for the creation of useful programs for the realization of practices on the databases designed / used.
- Reference bibliography.
- Personal computers.
- Internet Connection and Virtual Classroom Platform (Blackboard).
- Projectors.

5. ASSESSMENT: Procedures, evaluation and qualification criteria

The qualification system will be adjusted to RD 1125/2003 by which the ECTS credit system is regulated.

The evaluation of the acquisition of competences will take into account the attitude and interest of the student. Students by default will be in the option of continuous assessment through the Intermediate Assessment Tests (PEI) distributed throughout the semester. In addition, for students who do not qualify for continuous assessment, they may opt for a Final Evaluation. The continuous evaluation will serve in any case as formative evaluation during the teaching-learning process. It will be necessary to acquire ALL the competences and learning results of the subject.

Evaluation Procedures

1. **Continuous Assessment:** the continuous assessment must be inspired by the criteria of Continuous Assessment, always taking into account the acquisition of the competences specified in the subject. The Continuous Assessment will consist in the accomplishment and overcoming of exams and laboratory practices that will be carried out throughout the semester. The student must submit all the proposed learning activities and submit to all the evaluations on the proposed dates, in order to pass the Continuous Assessment.
2. **Final Assessment:** Those students who submit a written request to the School Management and have a justified cause, may be evaluated by Final Assessment, as long as the School Administration grants it. For this they have a period of two weeks from the beginning of the classes of the subject. The Final Assessment will consist of a theoretical written test and a practical part whose set will constitute 100% of the grade of the subject. It will be mandatory to submit to both tests.
3. **Re-sit Assessment:** Students who have not passed the Continuous or Final Assessment will take a theoretical test and a practical part proposed for this call. Both tests will constitute 100% of the grade of the subject. It will be mandatory to submit to both tests.

Evaluation Criteria

The evaluation criteria must meet the degree of acquisition of competences by the student, taking into account the following::

- CE1: The student is able to install, manage and optimize a DBMS.
- CE2: The student shows capacity and initiative when solving problems of management and optimization of a DBMS.
- CE3: The student has acquired the theoretical knowledge about storage planning and indexing of a DBMS.
- CE4: The student is able to generate multiple plans of execution of a query and evaluate them to get the most efficient execution plan.
- CE5: The student has acquired the theoretical knowledge about transactions, concurrence and recovery of errors that can occur in a DBMS.

- CE6: The student can design and implement a distributed database in a computer network and also provide high availability.
- CE7: The student is able to understand and perform successfully each of the tasks and problems entrusted to him.

Assessment Tools

This section indicates the assessment tools that will be applied to each of the Evaluation Criteria:

1. Intermediate Assessment Tests (PEI), consisting of solving theoretical-practical problems of each of the units of the subject in the Continuous Assessment (3 tests).
2. Laboratory tests (PL) where the student will have to solve with the computer a real problem, delivering a series of reports on each of the phases of the implementation and resolution of the problem, for those students who are presented in the Continuous Assessment, Final Assessment or Re-sit Assessment (4 tests)..
3. Final Evaluation Test (PEF) that will consist in solving theoretical-practical problems of each one of the units of the subject for the students that present themselves in the Final Assessment or Re-sit Assessment.

Final Marks Criteria

This section summarizes the evaluation criteria for passing the subject.

Continuous Assessment

Skills	Learning Outcomes	Evaluation Criteria	Assessment Tool	Weight in Mark
CG6, CG9, CI5, CI7, CI12	RA1, RA2, RA3, RA4	CE2, CE3, CE7	PEI1	15%
CG6, CG9, CI5, CI7, CI12	RA3, RA4	CE2, CE3 CE4, CE7	PEI2	25%
CG6, CG9, CI5, CI12	RA5	CE2, CE5, CE7	PEI3	20%

CG6, CG9, CI5, CI7, CI12	RA1, RA3, RA4	CE1, CE2, CE7	PL1	10%
CG6, CG9, CI5, CI7, CI12	RA2, RA3, RA4	CE1, CE2, CE7	PL2	10%
CG6, CG9, CI5, CI12	RA5	CE1, CE2, CE7	PL3	10%
CG6, CG9, CI5, CI12	RA6	CE1, CE2, CE6, CE7	PL4	10%

As a general criterion, those students who in the continuous assessment do not show up for the evaluation of all the corresponding tests, will be considered as Not Presented.

Final Assessment

Skills	Learning Outcomes	Evaluation Criteria	Assesmet Tools	Weight in Mark
CG6, C96, CI5, CI7, CI12	RA1, RA2, RA3 RA4, RA5	CE2, CE3, CE4, CE5, CE7	PEF	60%
CG6, CG9, CI5, CI7, CI12	RA1, RA3, RA4	CE1, CE2, CE7	PL1	10%
CG6, CG9, CI5, CI7, CI12	RA2, RA3, RA4	CE1, CE2, CE7	PL2	10%
CG6, CG9, CI5, CI12	RA5	CE1, CE2, CE7	PL3	10%

CG6, CG9, CI5, CI12	RA6	CE1, CE2, CE6, CE7	PL4	10%
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As a general criterion, those students who in the final assessment do not show up for the evaluation of all the corresponding tests, will be considered as Not Presented.

Re-sit Assessment

Skills	Learning Outcomes	Evaluation Criteria	Assessment Tools	Weight in Mark
CG6, CG9, CI5, CI7, CI12	RA1, RA2, RA3 RA4, RA5	CE2, CE3, CE4, CE5, CE7	PEF	60%
CG6, CG9, CI5, CI7, CI12	RA1, RA3, RA4	CE1, CE2, CE7	PL1	10%
CG6, CG9, CI5, CI7, CI12	RA2, RA3, RA4	CE1, CE2, CE7	PL2	10%
CG6, CG9, CI5, CI12	RA5	CE1, CE2, CE7	PL3	10%
CG6, CG9, CI5, CI12	RA6	CE1, CE2, CE6, CE7	PL4	10%

As a general criterion, those students that in the re-sit assessment do not appear for the evaluation of all the corresponding tests, will be considered as Not Presented. The teacher can decide according to the competences and learning results acquired in the Continuous or Final Assessment, the tests that must be done by each of the students in the Extraordinary Call.

The result of each test will have a mark that will be determined according to the degree of mastery shown in the tasks proposed by the teachers responsible for the subject and according to the following table

Excellent [9-10]	Good [7-9]	Acceptable [5-7]	Insufficient [2-5]	Deficient [0-2]
Total understanding of the problem. It includes all the requirements of the task. <ul style="list-style-type: none"> • Complete and correct answer. • Clear, interesting, detailed and well-organized ideas. 	Considerable understanding of the problem. It includes all the requirements of the task. <ul style="list-style-type: none"> • Complete and reasonable response. • Ideas not organized. • Improvable details. 	Understanding partial of the problem. It includes the most requirements of the task. <ul style="list-style-type: none"> • Clear but incomplete answer. • Ideas not organized. • Many details that can be improved. 	Does not understand the problem. <ul style="list-style-type: none"> • Incomplete response. • Confusing ideas. • Many details that can be improved. 	It does not respond He did not try to do the homework. <ul style="list-style-type: none"> • Incomplete and incorrect response.

6. Bibliography

Basic References

4. ELMASRI R., NAVATHE S.B Fundamentals of Database Systems, Pearson (2007)
5. SILBERSCHATZ A. Database Systems Concepts, McGraw-Hill (2006)

Extended References

- DATE, C.J. An Introduction to Database Systems, Prentice Hall (2002)
- CONNOLLY, T.M. Database Systems, Addison Wesley (2005)