Universidad de Alcalá

TEACHING GUIDE

Advanced Databases

Degree in
Information System Engineering (GISI)
Computer Science Engineering (GII)

Universidad de Alcalá

Academic Year 2026/2027

2nd Year - 2nd Semester (GISI+GII)

Approved by the EPS School Board on June 15th, 2026

TEACHING GUIDE

Course Name:	**Advanced Databases**
Code:	**780020 (GISI+GII)**
Degree in:	**Information System Engineering (GISI)** **Computer Science Engineering (GII)**
Department and area:	**Ciencias de la Computación** **Computer Science**
Type:	**Compulsory (GISI+GII)**
ECTS Credits:	**6.0**
Year and semester:	**2nd Year - 2nd Semester (GISI+GII)**
Teachers:	Consult the web page of the Department
Tutoring schedule:	Depends on the individuat tutor
Language:	English

1. COURSE SUMMARY

It is calculatedthat every 18 months the amount of information of the world isduplicated. It is obviously that such information volume cannotbe 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 aimof 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 queryand design of databases are shown.

Entry requirements

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

2. SKILLS

Basic, Generic and Cross Curricular Skills.

This course contributes to acquire the following basic, generic and cross curricular skills:

en_CG6 - Ability to conceive and develop centralized or distributed computer systems or architectures integrating hardware, software and networks in accordance with the knowledge acquired as set out in section 5, annex 2, of resolution BOEA-2009-12977.

en_CG9 - Ability to solve problems with initiative, decision making, autonomy and creativity. Ability to know how to communicate and transmit the knowledge, skills and abilities of the profession of Computer Engineering Engineer.

en_CB1 - That students have demonstrated to possess and understand knowledge in an area of study that is based on general secondary education, and is usually found at a level that, although supported by advanced textbooks, also includes some aspects that involve knowledge from the forefront of their field of study.

en_CB2 - That the students know how to apply their knowledge to their work or vocation in a professional manner and possess the competencies that are usually demonstrated through the elaboration and defense of arguments and the resolution of problems within their area of study.

en_CB3 - That students have the ability to gather and interpret relevant data (usually within their area of study) to make judgments that include a reflection on relevant social, scientific or ethical issues.

en_CB4 - That students can transmit information, ideas, problems and solutions to both a specialized and non-specialized public.

en_CB5 - That the students have developed those learning skills necessary to undertake further studies with a high degree of autonomy.

en_TRU1 - Capacity of analysis and synthesis.

en_TRU2 - Oral and written competencies.

en_TRU3 - Ability to manage information.

en_TRU4 - Autonomous learning skills.

en_TRU5 - Team work.

Specific Skills

This course contributes to acquire the following professional skills

en_CI5 - Knowledge, administration and maintenance of computer systems, services and applications.

en_CI7 - Knowledge, design and efficient use of the types and structures of data most appropriate to the resolution of a problem.

en_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

After succeeding in this subject the students will be able to:

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

Contents Blocks	Total number of 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 performanceof 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
Managementof a database Control of transactions, control of the concurrence and error recovery systems of a database. Audits, monitoring tools and performance optimization of a databaseSecurity, users, permissions	12 hours
Distributed and large databases Architecture. Distributed data storage. Types of distribution. Control of distributed transactions. Control of concurrency and availability	4 hours

4. TEACHING - LEARNING METHODOLOGIES. FORMATIVE ACTIVITIES.

4.1. Credits Distribution

Number of on-site hours:	60 hours (56 hours on-site + 4 exams hours)
Number of hours of student work:	90 hours
Total hours	150 hours

4.2. Methodological strategies, teaching materials and resources

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:

- 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.
- 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 grading criteria

Preferably, students will be offered a continuous assessment model that has characteristics of formative assessment in a way that serves as feedback in the teaching-learning process.

5.1. PROCEDURES

The evaluation must be inspired by the criteria of continuous evaluation (Learning Assesment Guidelines, LAG, art 3). However, in compliance with the regulations of the University of Alcalá, an alternative process of final evaluation is made available to the student in accordance with the Learning Assesment Guidelines as indicated in Article 10, students will have a period of fifteen days from the start of the course to request in writing to the Director of the Polytechnic School their intention to take the non-continuous evaluation model adducing the reasons that they deem convenient. The evaluation of the learning process of all students who do not apply for it or are denied it will be done, by default, according to the continuous assessment model. The student has two calls to pass the subject, one ordinary and one extraordinary.

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. 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.

Ordinary Call

Continous 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.

Assessment through final exam:

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.

Extraordinary Call

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.

5.2. EVALUATION

EVALUATION CRITERIA

The assessment criteria measure the level in which the competences have been acquired by the student. For that purpose, the following are defined:

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.

GRADING TOOLS

The work of the student is graded in terms of the assessment criteria above, through the following tools:

1. I**ntermediate 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 (PRL)** practical tests that will consist of solving a series of practical problems on

the laboratory deliverables using the laboratory computers (3 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.

GRADING CRITERIA

In the ordinary call-continuous assessment the relationship between the competences, learning outcomes, criteria and evaluation instruments is as follows.

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
CG6, CG9, en_CI5, en_CI7, en_CI12	RA1, RA2, RA3, RA4	CE2, CE3, CE7	PEI1	20%
CG6, CG9, en_CI5, en_CI7, en_CI12	RA3, RA4	CE2, CE3, CE4, CE7	PEI2	20%
CG6, CG9, en_CI5, en_CI12	RA1, RA3, RA4	CE2, CE5, CE7	PEI3	20%
CG6, CG9, en_CI5, en_CI7, en_CI12	RA6	CE1, CE2, CE7	PRL1	10%
CG6, CG9, en_CI5, en_CI7, en_CI12	RA2, RA3, RA4	CE1, CE2, CE7	PRL2	10%
CG6, CG9, en_CI5, en_CI12	RA5, RA6	CE1, CE2, CE6, CE7	PRL3	20%

In the ordinary call-final evaluation, the relationship between the competences, learning outcomes, criteria and evaluation instruments is as follows.

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
CG6, C96, en_CI5, en_CI7, en_CI12	RA1, RA2, RA3, RA4, RA5	CE2, CE3, CE4, CE5, CE7	PEF	60%
CG6, CG9, CI5, en_CI7, en_CI12	RA1, RA3, RA4	CE1, CE2, CE7	PL1	10%
CG6, CG9, en_CI5, en_CI7, en_CI12	RA2, RA3, RA4	CE1, CE2, CE7	PL2	10%
CG6, CG9, en_CI5, en_CI12	RA5, RA6	CE1, CE2, CE6, CE7	PRL3	20%

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. The students must also attend at least 80% of the lab sessions. If they are unable to attend a session for a justified reason, they must submit documentation to that effect. The teacher can decide according to the competences and learning results acquired in prevoius Calls, the tests that must be done by each of the students in the Ordinary Call.

The student will pass the ordinary call if the following criteria are satisfiyed:

- Have presented and satisfactorily passed the evaluation of skills related to the set of all theoretical tests (PEI1, PEI2 and PEI3). It will be understood that a student satisfactorily acquires these competences, if his qualification in the group of the related tests is equal to or greater than 40% of the maximum grade obtainable.

- Have satisfactorily passed the evaluation of the competences related to the laboratory tests (PRL). For this, it will be an essential condition that the student performs all the tests (PRL1, PRL2 and PRL3) obtaining a qualification in the set of said tests equal to or greater than 40% of the maximum grade obtainable.
- Obtain a final weighted grade for all the defined continuous assessment tests equal to or greater than 5 out of 10 points.

Extraordinary call

In the case of the extraordinary call, the same percentages that have been established in the case of the evaluation by means of a final exam will be maintained. 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 student will pass the extraordinary call if the following criteria are satisfiyed:

- Have presented and satisfactorily passed the evaluation of the theoretical test (PEF). It will be understood that a student satisfactorily acquires these competences, if his grade in the set of related tests is equal to or greater than 40% of the maximum grade obtainable.
- Have satisfactorily passed the evaluation of the competences related to the laboratory tests (PRL). For this, it will be an essential condition that the student performs all the tests (PRL1, PRL2 and PRL3) obtaining a qualification in the set of tests equal to or greater than 40% of the maximum grade obtainable.
- Obtain a final weighted grade for all the defined continuous assessment tests equal to or greater than 5 out of 10 points.

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. Excellent domain of the knowledge basic. It includes all the requirements of the task. • Complete and correct answer. • Clear, interesting, detailed and well-organized ideas.	Considerable understanding of the problem. It includes all the requirements of the task. Master the knowledge basic. • Complete and reasonable response. • Ideas not organized. • Improvable details.	Understanding partial of the problem. Master the knowledge basic. It includes the most requirements of the task. • Clear but incomplete answer. • Ideas not organized. • Many details that can be improved.	Does not understand the problem. Low level of understanding and application of ideas. • Incomplete response. • Confusing ideas. • Many details that can be improved.	It does not respond He did not try to do the homework. • Incomplete and incorrect response. • Lack of implication in the tasks proposals.

The laboratory tests (PRL) will be conducted using laboratory equipment. A series of questions similar to the laboratory deliverables will be presented, and the grade will be based on the evaluation of the answers to these exercises. The laboratory deliverables will be submitted through the virtual classroom but will not be considered for the evaluation. They will only serve as practice for solving the problems proposed on the day of the laboratory test (PRL).

"The teaching-learning methodology and the assessment process will be adapted as needed, in accordance with the guidelines of the Diversity Support Unit, to implement curricular adaptations for students with specific needs."

6. BIBLIOGRAPHY

6.1. Basic Bibliography

- ELMASRI R., NAVATHE S.B Fundamentals of Database Systems, Pearson (2007)
- SILBERSCHATZ A. Database Systems Concepts, McGraw-Hill (2006)
- PogreSQL documentation.
- Availlable books of the UAH Library about Data Bases.

6.2. Additional Bibliography

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

Disclosure Note

During the evaluation tests, the guidelines set out in the Regulations establishing the Rules of Coexistence of the University of Alcalá must be followed, as well as the possible implications of the irregularities committed during said tests, including the consequences for committing academic fraud according to the Regulation of Disciplinary Regime of the Students of the University of Alcalá.