

Degree programme	Type	Course
Computer Engineering	FB	1

Contact lecturer

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Group languages

You can consult this information at the [end](#) of the document.

Prerequisites

There are no prerequisites. However, students should be familiar with the most basic concepts of fundamental algebra, such as set theory and applications.

Objectives

The course deals with topics included in the area of Discrete Mathematics focussing on the study of discrete objects. It begins with basic graph theory, path optimisation, algorithms in graphs and complexity of algorithms and problems.

Learning outcomes

- CM01 (Use knowledge and skills related to discrete mathematics to solve problems with multidisciplinary teams.) Use knowledge and skills related to discrete mathematics to solve problems with multidisciplinary teams.
- KM01 (Explain algorithmic procedures related to graphs, sets and combinatorics.) Explain algorithmic procedures related to graphs, sets and combinatorics.
- SM01 (Apply knowledge of graphs and combinatorics in problem solving in computer engineering.) Apply knowledge of graphs and combinatorics in problem solving in computer engineering.

Contents

1. Previous concepts: sets, functions and complexity of algorithms

1. Sets and operations with sets
2. Cartesian product and binary relations
3. Combinatorial elements
4. Finite, infinite and numerable sets
5. Complexity of algorithms and problems
6. Functions of complexity. Polynomial and non-polynomial complexity

2. Fundamentals of graphs

1. Definitions. Variants of graphs
2. Paths, circuits and distances
3. Degrees and handshaking lemma
4. Subgraphs and important types of graphs
5. Graphic sequences (Havel-Hakimi)
6. Graph representation

3. Optimal tours, paths and generating trees

1. Exploration of graphs (DFS and BFS)
2. Minimum cost paths (Dijkstra, Floyd)
3. Characterization of trees
4. Optimal generating trees (Kruskal)

4. Planarity and colouring

1. Basic results
2. Characterization of planar graphs
3. Colouring of planar graphs
4. Annex: chromatic polynomial

5. Eulerian and Hamiltonian graphs

1. Eulerian paths and circuits
2. Fleury method (or Hierholzer)
3. Chinese postman problem
4. Hamiltonian path and circuits
5. Travelling salesman problem

6. Modeling and problem solving

1. Abstraction and formulation of problems using graphs
2. Examples of modeling and solving real-world problems

Learning activities and methodology

Title	Hours	ECTS	Learning outcomes
Preparing exercises and seminars	12.5	0.5	CM01, KM01, SM01
Theoretical classes / lectures	30	1.2	KM01
Seminars	5	0.2	CM01
Preparing the final test	25	1	KM01, SM01
Tutoring and consultations	5	0.2	CM01, KM01, SM01

Independent study	50	2	CM01, KM01, SM01
Exercise-based classes	15	0.6	KM01, SM01

Theoretical content will be taught through lectures, although students will be encouraged to actively participate in the resolution of examples, complexity computation, etc. During problem sessions, a list of exercises will be resolved. Students are encouraged to solve the problems on their own in advance. Students will also be encouraged to present their own solutions in class. In the seminars, related topics will be discussed in depth: several exercises will be carried out on algorithms explained in theory applied to real cases and in a practical format. Campus Virtual will be used for communication between lecturers and students (material, updates, announcements, etc.).

Annotation: within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continuous assessment activities

Title	Weight	Hours	ECTS	Learning outcomes
Two partial tests	60%	3	0.12	KM01, SM01
Tests based on exercise resolutions in exercise-base classes	15%	0.5	0.02	KM01, SM01
Group tests in seminar classes	25%	4	0.16	CM01, KM01, SM01

This subject does not provide for the sigle assessment system.

Continuous-assessment dates will be published on Campus Virtual. Specific programming may change when necessary. Any such modification will always be communicated to students through Campus Virtual, which is the usual communication platform between lecturers and students.

Subject assessment will be carried out as follows:

- Two individual partial tests (30% + 30% of the final grade). The first partial test will be given at the end of the first three chapters of the course; the second partial test will be given on finishing all the chapters of the course. These individual tests will consist mostly of exercises in the style of those worked on during the course; a smaller part will consist of more theoretical questions. A minimum of 3 out of 10 in each partial test is required to pass the course.
- Exercise resolutions (15% of the final grade). As part of continuous assessment, quizzes (which may be online) and problem-solving exercises will be carried out through the application of concepts covered in class. Activities and exercises that are not online will be completed during lectures or problem-solving sessions. These exercises cannot be retaken.
- Continuous assessment for seminars (25% of the final grade). Group activities carried out under supervision during these seminars will be assessed (50% of the grade). Passing the seminars will also require passing the individual tests completed during the sessions (50% of the grade). These tests will assess the assimilation of both the theoretical and practical concepts associated with each activity. In order to pass this part of the course, students must obtain at least 4 out of 10 and attend at least 80% of the sessions. If this part is not passed, students will be required to take an individual assessment worth 100% of the grade for this component, in which they must also obtain a minimum score of 4 out of 10.
- Final exam (60% of the final grade). Those who have not passed the subject through the individual partial tests will have the option to take final exam as a re-assessment grade to compensate the individual partial tests. There is therefore no separate re-assessment for partial tests; this exam covers material from the entire course. It will consist mainly of exercises in the style of those worked on during the course; a smaller part will consist of more theoretical questions. A minimum of 3 out of 10 is required to pass the course.

Notwithstanding other disciplinary measures deemed appropriate, and in accordance with the academic regulations in force, assessment activities will receive a zero whenever a student commits academic irregularities that may alter such assessment. Assessment activities graded in this way and by this procedure will not be re-assessable. If passing the assessment activity or activities in question is required to pass the subject, the awarding of a zero for disciplinary measures will also entail a direct fail for the subject, with no opportunity to re-assess this in the same academic year. Irregularities contemplated in this procedure include, among others:

- the total or partial copying of an evaluation activity;
- allowing others to copy;
- presenting group work that has not been done entirely by the members of the group;
- presenting any materials prepared by a third party as one's own work, even if these materials are translations or adaptations, including work that is not original or exclusively that of the student;
- having communication devices (such as mobile phones, smart watches, etc.) accessible during theoretical-practical assessment tests (individual exams).

To pass the course it is necessary that the mark of each one of the parts exceeds the minimum required and that the overall grade is 5.0 or higher. If you do not pass the course because some of the assessment activities do not reach the minimum mark required, the mark in the Transcript of Records will be the lowest value between 4.5 and the overall average grade. A "non-assessable" grade cannot be assigned to students who have participated in any of the individual partial tests or the final exam. No special treatment will be given to students who have completed the course in the previous academic year, except that the seminar grade previously obtained can be assigned to this course gradebook. In order to pass the course with honours, the final grade must be a 9.0 or higher. Because the number of students with this distinction cannot exceed 5% of the number of students enrolled in the course, this distinction will be awarded to whoever has the highest final grade. In case of a tie, partial-test results will be taken into consideration.

In the case of tests based on exercise resolutions, a review may be requested after the date of the activity or the date of closure of the quiz. For all other assessment activities, a place, date and time of review will be indicated allowing students to review the activity. If students do not take part in this review, no further opportunity will be made available.

The "assessment activity rescheduling request" protocol is available on the School of Engineering website and applies to the cases described in the centre's assessment criteria and instructions.

In this course, the use of Artificial Intelligence (AI) technologies is permitted exclusively for learning support tasks, such as bibliographic or information searches, text correction, or personal study. The use of AI technologies for completing deliverable activities (i.e., assignments, graded exercises, or exams) is not allowed. Any work that includes AI-generated content will be considered a breach of academic integrity and may result in partial or full penalties on the activity's grade, or more severe sanctions in serious cases.

To consult the academic regulations approved by the Governing Council of the UAB, please follow this link: http://webs2002.uab.es/afers_academics/info_ac/0041.htm

Bibliography

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- N.L. Biggs. *Matemàtica discreta*. Vicens-Vives, 1994.
- N. Christofides. *Graph theory, an algorithmic approach*. Academic Press, 1975.
- M.R. Garey, D.S. Johnson. *Computers and intractability. A guide to the theory of NP-Completeness*. W.H. Freeman, 1979.
- F.S. Roberts. *Applied combinatorics*. Prentice-Hall, 1984.
- J. Gimbert, R. Moreno, J.M. Ribó, M. Valls. *Apropament a la teoria de grafs i als seus algorismes*. Eines 23, edicions de la UdL, 1998.
- R. J. Wilson, *Introduction to graph theory*. 5th edition. Pearson, 2010.

Software

Course groups and languages

The information provided is provisional until November 30. After this date, you will be able to consult the language of each group through this [link](#). To access the information, you will need to enter the course CODE

Type of teaching	Group	Language	Semester	Shift
(TE) Theory	41	Spanish	second semester	morning-mixed
(TE) Theory	43	Catalan	second semester	morning-mixed
(TE) Theory	45	Catalan	second semester	afternoon
(TE) Theory	47	Catalan	second semester	afternoon
(PAUL) Classroom practices	411	Catalan	second semester	morning-mixed
(SEM) Seminars	411	Catalan	second semester	morning-mixed
(PAUL) Classroom practices	412	Catalan	second semester	morning-mixed
(SEM) Seminars	412	Catalan	second semester	morning-mixed
(SEM) Seminars	413	Catalan	second semester	morning-mixed
(SEM) Seminars	414	Catalan	second semester	morning-mixed
(SEM) Seminars	415	Catalan	second semester	morning-mixed
(SEM) Seminars	416	Catalan	second semester	morning-mixed
(SEM) Seminars	417	Catalan	second semester	morning-mixed
(SEM) Seminars	418	Catalan	second semester	morning-mixed
(SEM) Seminars	419	Catalan	second semester	morning-mixed
(SEM) Seminars	420	Catalan	second semester	morning-mixed
(SEM) Seminars	421	Catalan	second semester	morning-mixed
(SEM) Seminars	422	Catalan	second semester	morning-mixed
(SEM) Seminars	423	Catalan	second semester	morning-mixed
(SEM) Seminars	424	Catalan	second semester	morning-mixed

(SEM) Seminars	425	Catalan	second semester	morning-mixed
(PAUL) Classroom practices	431	Catalan	second semester	morning-mixed
(PAUL) Classroom practices	432	Catalan	second semester	morning-mixed
(PAUL) Classroom practices	451	Catalan	second semester	afternoon
(PAUL) Classroom practices	452	Catalan	second semester	afternoon
(PAUL) Classroom practices	471	Catalan	second semester	afternoon