

27005 - Graphs and Combinatorics

Información del Plan Docente

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| Academic Year | 2016/17 |
| Academic center | 100 - Facultad de Ciencias |
| Degree | 453 - Degree in Mathematics |
| ECTS | 6.0 |
| Course | |
| Period | Second semester |
| Subject Type | Compulsory |
| Module | --- |

1.Basic info

1.1.Recommendations to take this course

1.2.Activities and key dates for the course

2.Initiation

2.1.Learning outcomes that define the subject

2.2.Introduction

3.Context and competences

3.1.Goals

3.2.Context and meaning of the subject in the degree

3.3.Competences

3.4.Importance of learning outcomes

4.Evaluation

Grading.

For regular students two options:

a) - Homework (Completion of four problem sets) --- 20% of the score.

- Final exam --- 80% of the score.

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b) Only final exam (100%)

For non-regular students only option b).

5.Activities and resources

5.1.General methodological presentation

This course covers elementary discrete mathematics. It emphasizes mathematical definitions and proofs as well as applicable methods

The course consists of lectures and solving problem classes on the topics: "permutations and combinations", "counting principles", "recurrences", "generating functions", "elementary graph theory", "shortest path problems" and "optimal flow problems".

Four problem sets will be assigned during the course. Material covered in exercises will be tested on exams.

5.2.Learning activities

The course consists of lectures (2 sessions / week, 1 hour / session, 30 sessions) and solving problem classes (2 sessions / week, 1 hour / session, 30 sessions).

There are 4 problem sets. Typically, a problem set is due two week after it is assigned. By solving the problem sets a student can get 20% of the final score.

There are 4 additional sessions devoted to solving questions related with the homework. For these additional sessions the students are splitted into small groups.

The students can attend office hours and send questions to him/her teacher via email.

Additional information on the subject (calendar, timetable, problem sets, lecture notes,...) appears in the web page of the

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subject (in University of Zaragoza ADD, <https://moodle2.unizar.es/add/course/view.php?id=StudentCode>).

5.3.Program

Program of the subject:

Part I

- 1.- Enumerative Combinatorics: Permutations and Combinations.
- 2.- Binomial coefficients and binomial formula.
- 3.- Recurrence relations. Some applications.
- 4.- The inclusion-exclusion principle. Applications.

Part II

- 5.- Generating Functions.
- 6.- Rational Generating Functions.

Part III

- 7.- Graphs: Definitions and notation.
- 8.- Traversing a Graph. Algorithms BFS and DFS.
- 9.- Applications of Graph Traversal: Connected components, strong components, bases.
- 10.-The number of trees and paths of a graph.

Part IV

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11.- Weighted Graphs. Algorithms for the minimum spanning tree problem.

12.- The shortest path problem. Dijkstra's algorithm.

13.- PERT-CPM algorithms for scheduling a set of project activities.

Part V

14.- Maximum flow in a network.

15.- The Ford- Fulkerson method for calculating a maximum flow.

16.- Menger's theorems on connectivity of graphs.

17.- Maximum matching in bipartite graphs. Hall's theorem.

18.- Some NP-Hard problems on graphs.

5.4.Planning and scheduling

5.5.Bibliography and recommended resources

Bibliography.

Main:

Lecture notes of the subject at <https://moodle2.unizar.es/add/course/view.php?id=8357>

Complementary books:

Bóna, Miklós. A walk through combinatorics : an introduction to enumeration and graph theory / Miklos Bona . - 2nd ed.. Hackensack: World Scientific, 2008

Brualdi, Richard A. : Introductory combinatorics / Richard A. Brualdi . - 5th ed. Upper Saddle River, New Jersey : Pearson Prentice Hall, cop. 2010

Gross, Jonathan L.. Graph theory and its applications / Jonathan Gross, Jay Yellen . - 2nd ed. Boca Raton : Chapman & Hall/CRC, 2006

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Lint, Jacobus Hendricus Van. A course in combinatorics / J. H. van Lint and R. M. Wilson . - [1st Ed., 2nd. repr.] Cambridge : Cambridge University Press, 1996

Pemmaraju, Sriram. Computational discrete mathematics : combinatorics and graph theory with mathematica / Sriram Pemmaraju, Steven Skiena . 1st publ., repr. Cambridge : Cambridge University Press, 2009

Stanley, Richard P.. Enumerative combinatorics / Richard P. Stanley . Cambridge ; New York : Cambridge University Press, cop. 1997-1999