MMG610   Discrete Mathematics, 7.5 credits

Diskret matematik, 7,5 högskolepoäng

First Cycle

Confirmation

This course syllabus was confirmed by Department of Mathematical Sciences on 2018-03-28 to be valid from 2018-03-28, spring semester of 2018.

Field of education: Science 100%

Department: Department of Mathematical Sciences

Position in the educational system

The course can be part of the following programmes: 1) Computer Science, Bachelor's Programme (N1COS) and 2) Bachelor's Programme in Mathematics (N1MAT)

Main field of studies	*Specialization*
Mathematics	G2F, First Cycle, has at least 60 credits in first-cycle course/s as entry requirements

Entry requirements

General entry requirements and the equivalent of 60 credits in mathematics.

Learning outcomes

On successful completion of the course the student will be able to

- apply basic counting principles,
- solve certain types of recursion relations, including the application of algebraic methods,
- explain basic concepts from additive number theory, Ramsey theory and algorithmic complexity,
- explain basic graph theory and some of the classical problems in the field,
- apply a variety of graph-theoretical algorithms, such as those for minimal spanning tree, shortest path, max-flow-min-cut, maximum matching, stable matching

Course content

The course provides an introduction to two of the basic subfields of discrete mathematics, enumerative combinatorics and graph theory. The course is roughly divided into two halves, with a few lectures providing a transition from the first to the second half.

PART 1: Enumerative Combinatorics

- Principles of counting (addition and multiplication principles)
- Permutations, combinations, binomial coefficients and theorem
- Balls and bins
- Inclusion-Exclusion principle
- Pigeonhole principle
- Recurrence relations, including: linear recurrences in one variable, some non-linear recurrences (e.g. Catalan numbers), multi-variable recurrences (e.g.: Stirling numbers, integer partitions)
- Algebraic techniques for recurrence relations: extended binomial theorem and generating functions.

TRANSITION 1-2:

- Application of generating functions in additive number theory (thin bases)
- Ramsey numbers
- Complexity of algorithms

PART 2: Graph Theory

- Basic graph terminology
- Euler paths (postman problem) and Hamilton paths (Travelling Salesman problem, Keycode problem etc)
- Vertex and edge coloring
- Trees (applications to: sorting, (minimal) spanning trees, search algorithms, counting trees (Cayley's theorem))
- Networks (shortest path, max-flow-min-cut and linear programming, social networks and the Unhappiness Paradox)
- Bipartite graphs and matchings (Turan's theorem, Hall's marriage theorem, stable matchings).

Form of teaching

The course will be taught in English unless everyone involved speaks Swedish.

Assessment

The examination consists of a written examination. During the course, there may be optional assignments that give bonus points on the exam. Examples of such assignments are small written tests, labs, and oral or written presentations. Information about this is found on the course home page.

If a student, who has failed the same examined component twice, wishes to change examiner before the next examination, a written application shall be sent to the department responsible for the course and shall be granted unless there are special reasons to the contrary (Chapter 6, Section 22 of Higher Education Ordinance).

Grades
The grading scale comprises: Pass with Distinction (VG), Pass (G) and Fail (U).

Course evaluation
The course is evaluated with an anonymous questionnaire and/or a discussion with the student representatives. The results of and possible changes to the course will be shared with students who participated in the evaluation and students who are starting the course.

Additional information
For a list of course literature, see:
https://www.chalmers.se/sv/institutioner/math/utbildning/grundutbildning-goteborgs-universitet/kurslitteratur/Sidor/Kurslitteratur-i-matematik.aspx

The syllabus for MMG610 was originally established to take effect from 2007-07-01, when it replaced MAN240, and was revised 2008-06-19.