MT261: Discrete Mathematics

COURSE DETAILS

First Term 2006/2007

Lecturer: Dr Christian Elsholtz
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Lecture times:
Monday 12 C336
Wednesday 10 C336
Thursday 2 ABLT3

Office hour:
I will decide about my office hour when all other tutorials are arranged.

Assessment:
A 2 hour examination.

Course work:
There will be weekly problem sheets. You will get your solutions marked, so that this is a good opportunity to get feedback. The homework does not count towards the exam, but you are strongly encouraged to do homework regularly. You are allowed to discuss homework with fellow students; but when you write it up, you should do it entirely on your own!
I intend to give out solutions to the problem sheets, but you should seriously try the problems before looking at the solutions.

Textbooks/course notes:
I intend to give out lecture notes. You might want to use a pencil to complete these during the lectures.
The following text books cover most of the material (and lots more!)
1) Ian Anderson: A First Course in Discrete Mathematics (Paperback), Springer.
Library: (512.23 AND)
2) Norman L Biggs: Discrete Mathematics (Paperback), Oxford UP 2002.
Library: (510 BIG)

I have also put a copy of these books at the **restricted** bookshelf (behind the counter in the cage like zone). The advantage is that almost always you have access to it. But this copy can be borrowed for very shory periods only.

Course aims:

- To introduce the idea of graphs and some of their important properties, such as connectedness, Eulerian and Hamiltonian paths, planarity.
- To show how the pigeonhole principle and its extensions, sieve methods, and other simple ideas can be used to prove quite deep results on counting.
- To define Latin squares, explaining their use for constructing magic squares, and to introduce block designs.

Learning outcomes: On completion of the course, students should be able to:

- understand the fundamental concepts of graph theory;
- apply them to the determination of the Eulerian and Hamiltonian characters of a (reasonably straight forward) graph;
- prove and apply various forms of the pigeonhole principle and sieve methods;
- prove the basic theorem concerning the multinomial coefficients and apply it to various combinatorial problems;
- apply modular arithmetic and (simple) finite fields to construct orthogonal systems of Latin squares, magic squares and simple block designs.

Content

- **Graphs:** Definitions of graph, adjacency matrix, incidence matrix, graph isomorphism, valency lists. The handshaking lemma; complete graphs, bipartite graphs, simple relationships between n and m. Connected graphs, trees; Eulerian trails and Hamiltonian cycles, planar graphs, Eulers theorem.
- **Methods of counting:** Functions on finite sets; the pigeonhole principle, permutations and combinations, binomial and multinomial coefficients, partitions, Stirling numbers.
- **Finite mathematical structures:** Modular arithmetic, definition and construction of Latin squares; an introduction to the theory of block designs, and relations between their parameters, difference sets and finite geometries.