Aims

This is a third-year course in Discrete Mathematics targeted at students specialising in Mathematics. The purpose of this course is to introducing some basic concepts of Discrete Mathematics such as various counting techniques as well as elementary graph theory.

Syllabus

Naive set theory: Basic definitions of sets and functions, cardinality of a set, operations with sets, infinite sets. (5 lectures)

Counting arguments: Counting principles, enumerative combinatorics, binomial coefficients, Catalan numbers, partitions, Stirling numbers, formal power series, generating functions, group actions and Burnside's lemma. (16 lectures)

Graph theory: Graphs and isomorphisms between graphs, colouring of graphs, bipartite graphs and matching problems, directed graphs, quivers, finite categories. (12 lectures)

Teaching and Assessment

Contact Hours: 3 lectures and 1 tutorial per week
Assessment: 15% by class tests or other continuous assessment

85% by end of course 2-hour exam

Resit Type: exam
By the end of the course, students should be able to:

- apply the basic notations of naive set theory and prove simple theorems in this context;
- apply basic counting arguments such as the rule of sums, the rule of products and the inclusion-exclusion principle to enumerative problems;
- apply permutations and the right type of selections in combinatorial problems;
- use the binomial coefficients in related counting problems;
- apply grid routes and Catalan numbers where appropriate in counting problems;
- represent a partition as a Ferrers diagram and use this representation in simple arguments;
- compute recursively partitions, Stirling and Bell numbers;
- work with equivalence relations;
- compute with formal power series;
- derive generating functions for simple series;
- apply group theory to counting problems with symmetry;
- prove simple theorems in the context of graph theory;
- count various colourings of a given graph;
- apply bipartite graphs in matching problems;
- know the basic definitions of directed graphs and quivers.