



The Hebrew University of Jerusalem

Syllabus

DISCRETE MATHEMATICS - 80181

Last update 05-01-2014

HU Credits: 4

Degree/Cycle: 1st degree (Bachelor)

Responsible Department: Mathematics

Academic year: 1

Semester: 1st Semester

Teaching Languages: Hebrew

Campus: E. Safra

Course/Module Coordinator: Dr. A Gurevich

Coordinator Email: gurevich@math.huji.ac.il

Coordinator Office Hours: Tue, 14-15

Teaching Staff:

Dr. Alex Gourevich
Prof Alex Lubotzky
Ilan Karpas
Avraham Morgenstern

Course/Module description:

1. Basic notions from set theory. Boolean operations, relations and functions. Equivalence relations.
2. Combinatorics: counting problems. Binomial and multinomial coefficients and their properties. Combinatorial identities. The binomial theorem and Newton's multinomial formula. Selection problems. Andre's reflection method. Catalan numbers. Inclusion-exclusion principle with examples and applications: enumeration of permutations without fixed points, enumeration of maps from M onto N . Euler's phi function.
3. Recurrence relations (mainly linear). Fibonacci numbers. Generating functions.
4. Partially ordered sets: chains, independent sets, Dilworth theorem.
5. Graphs: paths, cycles. Eulerian paths and cycles. Detecting graphs with Eulerian cycles. Hamiltonian paths and cycles. Degree sequence of a graph.
6. Matchings: the marriage theorem of P. Hall with applications and extensions.
7. Trees: characteristics, properties and enumeration (Cayley's theorem).
8. Planar graphs. Euler's formula.
9. Ramsey theorem on graphs. Upper and lower estimates on Ramsey number.
10. Stable matchings.

Note: Not all the above topics will be covered every year.

Course/Module aims:

Providing basic notions of Discrete Math and developing the ability to solve problems.

Learning outcomes - On successful completion of this module, students should be able to:

Familiarity with fundamental concepts in Set Theory such as Cartesian Product, equivalence relation.

Familiarity with ideas and fundamental concepts in Combinatorics such as

permutations, transposes and combinations with or without repetitions.

Ability to deduce from the pigeon-hole principle, mathematical induction, and recursive formulas.

Familiarity with fundamental notions in Graph Theory such as connected component. the Euler sphere and the Hamilton sphere.

Ability to solve elementary problems in Set Theory, Combinatorics, and Graph Theory.

Attendance requirements(%):
none

Teaching arrangement and method of instruction: Lecture + exercise

Course/Module Content:

- 1. Basic notions from set theory. Boolean operations, relations and functions. Equivalence relations.*
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- 3. Recurrence relations (mainly linear). Fibonacci numbers. Generating functions.*
- 4. Partially ordered sets: chains, independent sets, Dilworth theorem.*
- 5. Graphs: paths, cycles. Eulerian paths and cycles. Detecting graphs with Eulerian cycles. Hamiltonian paths and cycles. Degree sequence of a graph.*
- 6. Matchings: the marriage theorem of P. Hall with applications and extensions.*
- 7. Trees: characteristics, properties and enumeration (Cayley's theorem).*
- 8. Planar graphs. Euler's formula.*
- 9. Ramsey theorem on graphs. Upper and lower estimates on Ramsey number.*
- 10. Stable matchings.*

Note: Not all the above topics will be covered every year

Required Reading:

none

Additional Reading Material:

Nati Liniel, Michal Parnas,
Discrete Mathematics (Hebrew)

Course/Module evaluation:

End of year written/oral examination 90 %

Presentation 0 %

Participation in Tutorials 0 %

Project work 0 %

Assignments 10 %

Reports 0 %

Research project 0 %

Quizzes 0 %

Other 0 %

Additional information:

none