Term Information

Effective Term	Autumn 2016
Previous Value	*Summer 2012*

Course Change Information

What change is being proposed? (If more than one, what changes are being proposed?)

We propose to change Math 6501 and 6502 from 5-credit to 3-credit courses. We also are taking the opportunity to update the syllabus for each course to a more modern combinatorics curriculum. Moreover, old references to quarter courses are eliminated.

What is the rationale for the proposed change(s)?

Almost all of our 6000-level courses are 3-credit courses. We hope that this will resolve scheduling issues which we have had in recent years, and also problems with low enrollment. We are also happy to update the curriculum to reflect current research areas of broad interest and applications of interest to PhD students in engineering disciplines and theoretical computer science. This is in part also motivated by several recent faculty hires in the area.

What are the programmatic implications of the proposed change(s)?

(e.g. program requirements to be added or removed, changes to be made in available resources, effect on other programs that use the course)?

This will not change any program requirements. However, we hope that it will make it easier for PhD students to satisfy a breadth requirement by taking the 6501-6502 sequence, and also expedite PhD students in combinatorics and discrete mathematics to their research programs.

Is approval of the requrest contingent upon the approval of other course or curricular program request? No

Is this a request to withdraw the course? No

General Information

Course Bulletin Listing/Subject Area	Mathematics
Fiscal Unit/Academic Org	Mathematics - D0671
College/Academic Group	Arts and Sciences
Level/Career	Graduate
Course Number/Catalog	6501
Course Title	Combinatorics and Graph Theory I
Transcript Abbreviation	Combin Graph Thy 1
Course Description	Enumerative combinatorics: factorials, binomials and multinomials, Stirling approximation, recursion and generating functions, Catalan numbers. Graph theory: Kuratowksi's theorem, graph coloring, Ramsey theory, matrix-tree theorem, expander graphs.
Previous Value	*Matching Theory; network flows; matroids; Ramsey Theory; extremal set theory and graph theory; planar graphs, embeddings on surfaces; graph connectivity.*
Semester Credit Hours/Units	Fixed: 3
Previous Value	*Fixed: 5*

Offering Information

Length Of Course	14 Week
Flexibly Scheduled Course	Never
Does any section of this course have a distance education component?	No
Grading Basis	Letter Grade
Repeatable	No
Course Components	Lecture
Grade Roster Component	Lecture

Credit Available by Exam	No
Admission Condition Course	No
Off Campus	Never
Campus of Offering	Columbus

Prerequisites and Exclusions

Prerequisites/Corequisites	Graduate standing or (Math 4581 and Math 2568) or equivalent preparations in undergraduate modern algebra and linear algebra
Previous Value	*5112 (672).*
Exclusions	
Previous Value	Not open to students with credit for 775.

Cross-Listings

Cross-Listings

Subject/CIP Code

Subject/CIP Code	27.0102
Subsidy Level	Doctoral Course
Intended Rank	Doctoral

Requirement/Elective Designation

The course is an elective (for this or other units) or is a service course for other units

Course Details

Course goals or learning objectives/outcomes

- This course aims to introduce graduate students to a modern curriculum in combinatorics and graph theory. An emphasis is placed on covering the fundamentals of these subjects at a fast pace, emphasizing areas which are important for applications.

Previous Value

Content Topic List

- Enumerative combinatorics: factorials, binomials and multinomials
- Enumerative combinatorics: Stirling approximation, recursion and generating functions, Catalan numbers
- Graph theory: Kuratowksi's theorem, graph coloring
- Graph theory:Ramsey theory, matrix-tree theorem, expander graphs

Previous Value

- *Matching Theory*
- *Network flows*
- *Matroids*
- *Ramsey Theory*
- *Extremal set theory and graph theory*
- *Planar graphs, embeddings on surfaces*
- *Graph connectivity*

Attachments

- MATH_6501_Ed_Syllabus.pdf: 6501 Syllabus

  (Syllabus. Owner: Kerler,Thomas)

- MATH_6501_OLD_Syllabus.pdf: OLD 6501 Syllabus

  (Syllabus. Owner: Kerler,Thomas)

Comments

- Please also attach 5-credit syllabus of 6501 for comparison. *(by Vankeerbergen,Bernadette Chantal on 12/04/2015 12:23 PM)*

Workflow Information

Status	User(s)	Date/Time	Step
Submitted	Kerler,Thomas	12/01/2015 01:51 PM	Submitted for Approval
Approved	Husen,William J	12/01/2015 01:56 PM	Unit Approval
Approved	Haddad,Deborah Moore	12/01/2015 03:14 PM	College Approval
Revision Requested	Vankeerbergen,Bernadette Chantal	12/04/2015 12:23 PM	ASCCAO Approval
Submitted	Kerler,Thomas	12/05/2015 06:30 PM	Submitted for Approval
Approved	Husen,William J	12/05/2015 06:46 PM	Unit Approval
Approved	Haddad,Deborah Moore	12/05/2015 07:35 PM	College Approval
Pending Approval	Nolen,Dawn Vankeerbergen,Bernadette Chantal Hanlin,Deborah Kay Jenkins,Mary Ellen Bigler Hogle,Danielle Nicole	12/05/2015 07:35 PM	ASCCAO Approval

Combinatorics and Graph Theory I

Instructor and Class Information

Lecturer:	**Course Num.:**
Office:	**Lecture Room:**
Phone:	**Lecture Times:**
Email:	**Office Hours:**

About Course Goals

Format

The course will meet three times a week for 55 minutes each meeting. Instructions will be mainly by lecture delivered by the instructor. It may also include occasional in-class discussion as well as short student presentations, particularly, by post-candidacy students.

Content & Goals

This course is meant to introduce graduate students to a modern curriculum in combinatorics and graph theory. An emphasis is placed on covering the fundamentals of these subjects at a fast pace, emphasizing areas which are important for application. For example, we will discuss algorithmic point of view.

Many open problems and areas of current research will be pointed out along the way.

Prerequisites

Graduate standing or (Math 4581 and Math 2568) or equivalent preparations in undergraduate modern algebra and linear algebra

Textbook

Main Reference

Reinhard Diestel:*"Graph Theory: Fourth Edition".* Springer, 2012. ISBN:978-3-642-14278-9

Additional References

Richard Stanley: *"Enumerative Combinatorics: Volume 1*. Cambridge University Press, 2011. ISBN: 978-1107602625.

Assessments

Homework Assignments

There will be approximately 10 homework assignments, which will each include problems of varying difficulty. Due dates of assignments will be announced and set typically a week after the assignments are published

Final Project

The final project is a more extensive written assignment that will draw on techniques acquired throughout the semester. It will be published about two weeks before the end of classes and will be dues at the beginning of finals week.

Class Participation and Attendance

Although attendance is not regularly monitored frequent absences are likely to be noted and may factor into the grade in borderline cases.

Grading

Course Score

A course score will be computed from the above assessments. Homework assignments will count 70% towards the grade and the final project 30%.

Letter Grades

Letter grades will be determined based on the course score. The approximate minimum scores letter grades are 80% for an “A”, 73% for an “A-”, 67% for a “B+”, 55% for a “B-”, and 40% for a “C-”. The exact cut-off scores may vary depending on the difficulty of assignments.

Weekly Schedule

Week 1	Introduction to enumerative combinatorics: factorials, binomial and multinomial coefficients, Stirling's approximation
Week 2	Generating functions, Catalan numbers, hook-length formula
Week 3	Counting under symmetry: Polya-Burnside enumeration
Week 4	Introduction to graph theory: trees, cycles, Menger's theorem
Week 5	Planar graphs: Kuratowski's theorem
Week 6	Topological graph theory: 5-color theorem for planar graphs, 7-color theorem for torus
Week 7	Crossing number lemma and applications. The unit distance problem, Szemeredi Trotter.
Week 8	Geometric graph theory: chromatic number of the plane and related topics
Week 9	Linear algebra methods in combinatorics
Week 10	Ramsey theory: upper and lower bounds, the probabilistic method
Week 11	Extremal graph theory: Turan's theorem, Erdos-Stone, bipartite graphs
Week 12	Cayley's formula for spanning trees, Matrix-tree theorem
Week 13	Expander graphs: Cheeger-Buser inequalities, existence of expanders, Cayley graphs
Week 14	Recent progress in combinatorics: Erdos distinct distance problem, Rota's conjecture

General Policies

Academic Misconduct

It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term “academic misconduct” includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct (http://studentaffairs.osu.edu/info_for_students/csc.asp).”

Disability Services

Students with disabilities that have been certified by the Office for Disability Services will be appropriately accommodated and should

inform the instructor as soon as possible of their needs. The Office for Disability Services is located in 150 Pomerene Hall, 1760 Neil Avenue; telephone 292-3307, TDD 292-0901; http://www.ods.ohio-state.edu/.

Combinatorics and Graph Theory I

Instructor and Class Information

Lecturer:	**Course Num.:**
Office:	**Lecture Room:**
Phone:	**Lecture Times:**
Email:	**Office Hours:**

About Course Goals

Format

The course will meet five times a week for 55 minutes each meeting. Instructions will be mainly by lecture delivered by the instructor. It may also include occasional in-class discussion as well as short student presentations, particularly, by post-candidacy students.

Content & Goals

This course is meant to introduce graduate students to a modern curriculum in combinatorics and graph theory. An emphasis is placed on covering the fundamentals of these subjects at a fast pace, emphasizing areas which are important for application. For example, we will discuss algorithmic point of view.

Many open problems and areas of current research will be pointed out along the way.

Prerequisites

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Weekly Schedule

Week 1	Introduction to enumerative combinatorics: factorials, binomial and multinomial coefficients, Stirling's approximation, Rota's “twelvefold way”.
Week 2	Generating functions and recursion. Important special cases: Fibonacci numbers, Catalan numbers, hook-length formula.
Week 3	Counting under symmetry: Polya-Burnside enumeration.
Week 4	Introduction to graph theory: trees, cycles, hypercubes. Graph connectivity: Menger's theorem and variants. Network flows: max cut / min flow theorem
Week 5	Graph coloring: Basic bounds, Brooks's theorem, algorithms and complexity
Week 6	Planar graphs: Kuratowski's theorem. Topological graph theory: embedding graphs on surfaces,
Week 7	Crossing number lemma and applications. The unit distance problem, Szemeredi Trotter theorem, additive combinatorics.
Week 8	Geometric graph theory: chromatic number of the plane and related topics
Week 9	Linear algebra methods in combinatorics, the polynomial method
Week 10	Ramsey theory: upper and lower bounds, the probabilistic method
Week 11	Extremal graph theory: Turan's theorem, Erdos-Stone, bipartite graphs
Week 12	Cayley's formula for spanning trees, Matrix-tree theorem
Week 13	Matroids and algebraic invariants: Tutte polynomial characteristic polynomial, and chromatic polynomial
Week 14	Orthogonal Latin squares, combinatorial designs

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