

# Course Change Request

## New Course Proposal

Date Submitted: 03/02/26 11:39 am

Viewing: **MATH 642 : Enumerative Graph Theory**

Last edit: 03/12/26 9:45 am

Changes proposed by: esander

Are you completing this form on someone else's behalf?

No

**Effective Term:** Fall 2026

**Subject Code:** MATH - Mathematics

**Course Number:** 642

**Bundled Courses:**

**Is this course replacing another course?** No

**Equivalent Courses:**

**Catalog Title:** Enumerative Graph Theory

**Banner Title:** Enumerative Graph Theory

**Will section titles vary by semester?** No

**Credits:** 3

**Schedule Type:** Lecture

**Hours of Lecture or Seminar per week:** 3

**Repeatable:** May be only taken once for credit, limited to 3 attempts (N3)

**Max Allowable Credits:**  
3

**Default Grade Mode:** Graduate Regular

**Recommended Prerequisite(s):**

(1) MATH – 641, Combinatorics and Graph Theory, or equivalent.

(2) MATH – 325, Discrete Mathematics II, or equivalent. (3) MATH – 203,

### In Workflow

1. **MATH Chair**
2. SC Curriculum Committee
3. SC Assistant Dean
4. Assoc Provost-Graduate
5. Registrar-Courses
6. Banner

Matrix Algebra (Linear Algebra), or equivalent.

**Recommended  
Corequisite(s):**

**Required  
Prerequisite(s) /  
Corequisite(s)  
(Updates only):**

MATH – 621, Algebra (First year graduate course), or equivalent.

**Registrar's Office Use Only - Required Prerequisite(s)/Corequisite(s):**

And/Or	(	Course/Test Code	Min Grade/Score	Academic Level	)	Concurrency?

**Registration  
Restrictions  
(Updates only):**

**Registrar's Office Use Only - Registration Restrictions:**

**Field(s) of Study:**

**Class(es):**

**Level(s):**

**Degree(s):**

**School(s):**

**Catalog  
Description:**

This course will server as an introduction to enumerative graph theory or graph enumeration. This is a topic which is quite natural to start to cover right after the definition of a graph, but in most introductory books and courses on graph theory is left out mainly for the following reasons: (i) There often are more practical, “useful” and “urgent” topics one needs to cover. (ii) Many times one needs to introduce helpful tools from algebra and/or analysis in order to interpret functional results in a combinatorial manner. (iii) Finally, many of the results in graph enumeration are exact and conceived from “old-school” formal mathematics. As such, many of the main theorems were developed decades ago, and even earlier. – All this does not mean that their value has diminished in anyway, on the contrary: they often serve as theoretical incarnation of the ultimate verification of empirical result generated heuristically from computers.

**Justification:**

What: New course on graphy theory.

Why: This course will strengthen the PhD and MS offerings for students who are focusing on graph theory and combinatorics. It has been offered as a special topics course in the past and has been well received with good enrollment.

**Does this course cover material which crosses into another department?** No

**Learning Outcomes:**

It is expected that after this course it should be clear that good knowledge in exact graph enumeration is necessary for the working combinatorist, just as it is for many other branches of mathematics like group theory, commutative algebra, discrete mathematics and probability theory. Hopefully enough topics in non-standard graph enumeration and their applications will be covered for the attenders to be able to read advanced monographs and some research articles on advanced graph theory and related topics for research purposes.

**Will this course be scheduled as a cross-level cross listed section?** No

**Attach Syllabus**

[Syll-GE-generic.pdf](#)

**Additional Attachments**

**Staffing:**

Geir Agnarsson, Rachel Kirsch, Jim Lawrence.

**Relationship to Existing Programs:**

This course will supplement and strengthen the Math PhD and MS programs.

**Relationship to Existing Courses:**

The course is a deeper look at certain aspects of Graph Theory and Combinatorics not covered in any other courses in our program.

**Have you reached out to the Libraries to determine whether there are adequate resources to support your course? If not, please email Meg Meiman, Associate University Librarian for Learning, Research, and Engagement at mmeiman2@gmu.edu.**

No

**Additional Comments:**

**Reviewer Comments**





Department of Mathematical Sciences  
4400 University Drive, Fairfax, VA 22030  
Phone: 703.993.1460; Web: <http://math.gmu.edu>

# Enumerative Graph Theory

## Generic sample

**Description/Purpose:** This course will serve as an introduction to enumerative graph theory or graph enumeration. This is a topic which is quite natural to start to cover right after the definition of a graph, but in most introductory books and courses on graph theory is left out mainly for the following reasons: (i) There often are more practical, “useful” and “urgent” topics one needs to cover. (ii) Many times one needs to introduce helpful tools from algebra and/or analysis in order to interpret functional results in a combinatorial manner. (iii) Finally, many of the results in graph enumeration are exact and conceived from “old-school” formal mathematics. As such, many of the main theorems were developed decades ago, and even earlier. – All this does not mean that their value has diminished in any way, on the contrary: they often serve as theoretical incarnation of the ultimate verification of empirical result generated heuristically from computers.

**Learning outcomes:** It is expected that after this course it should be clear that good knowledge in exact graph enumeration is necessary for the working combinatorist, just as it is for many other branches of mathematics like group theory, commutative algebra, discrete mathematics and probability theory. Hopefully enough topics in non-standard graph enumeration and their applications will be covered for the attenders to be able to read advanced monographs and some research articles on advanced graph theory and related topics for research purposes.

**Catalog Description / Material:** Selected topics on the following: (i) Labeled enumeration of graphs. (ii) Unlabeled enumeration of graphs: (iii) Groups and graphs, (iv) Pólya enumeration theorem, (v) Rooted and unrooted trees. (vi) Power group enumeration theorem. (vii) Unlabeled blocks (i.e. non-separable graphs). (viii) Asymptotics (if time allows).

**Prerequisites:** Most important is to have mathematical maturity and an open mind. Roughly what I expect is listed as follows:

- Required: MATH – 621, Algebra (First year graduate course), or equivalent.
- Preferred: (1) MATH – 641, Combinatorics and Graph Theory, or equivalent. (2) MATH – 325, Discrete Mathematics II, or equivalent. (3) MATH – 203, Matrix Algebra (Linear Algebra), or equivalent.

**Suggested Course Number:** MATH – 642 (Combinatorics and Graph Theory is MATH – 641 and this course should have a “close” number shortly after 641)

**Possible Texts:** The lectures will be self contained and mostly be based on notes and posted pdf files. The material making up these lecture notes will be taken from several classic books, monographs and recent research articles.

Results assumed known that are stated without formal proofs will be from the following book. It is recommended to have it available:

- Thomas W. Hungerford *Algebra*, Graduate Texts in Mathematics (GTM-73), Springer Verlag, New York (1974), 12th printing (2003) or most recent one.

Below is a list of the most relevant classic textbooks, from which a bulk of the lectures will be taken.

1. Geir Agnarsson; Raymond Greenlaw *Graph Theory, Modeling, Applications, and Algorithms*, Pearson Prentice Hall, (2007).
2. Richard P. Stanley, *Enumerative Combinatorics, Volumes I and II*, Cambridge University Press (1997) and (1999) respectively.
3. Frank Harary; Edgar M. Palmer, *Graphical Enumeration*, Academic Press, New York-London, (1973).

**Possible Instructors:** Geir Agnarsson, Rachel Kirsch, Jim Lawrence.

**Assessment:** About 3 – 4 homework projects (HW) will be assigned throughout the semester.

**Grading:** The final letter grade for this course will be based on participation and homework. A, A- : 80 – 100%, B, B+ : 70 – 79%, C : 60 – 69%, F : Below.

**AI, Chat-GPT etc:** Currently it is easy to obtain as good as complete solutions to many homework problems by the use of Artificial Intelligence (AI) tools like Chat-GPT which is currently pretty smart, at least for undergraduate mathematical material and some beginning graduate material. The use of such tools is strongly discouraged if you want to develop an understanding of the material.

Please keep in mind that Chat-GPT, and many AI tools in general, are still known to make grotesque, erroneous claims (even in a self-assured and cocky manner!) especially when it comes to more advanced mathematics like what is covered in this course.

**Sample Week by Week for the Course:**

1. Graph Theory Preliminaries, Graph Homomorphisms and Isomorphisms.
2. Counting Examples. Basic Counting Results. Generating functions.
3. Trees and the Catalan Numbers. Partition of Sets and Stirling Numbers.
4. The Labeled Counting Lemma, the Exponential Formula and Applications.
5. Unlabeled Counting. Graphs and Groups. The Cycle Index.
6. The Cycle Index of Graph Automorphism Groups. The Burnside Lemma.
7. The Weighted Form of Burnside Lemma. Pólya Enumeration Theorem.
8. Multivariate Pólya Enumeration Theorem.
9. A Special Configuration Series; Boolean weights.
10. Unlabeled Trees.
11. Unlabeled Rooted Trees.
12. The Pair Group and Graphs.
13. Enumeration of Unlabeled Simple Graphs, Redfield's Theorem.
14. Applications of Redfield's Theorem to Enumerate General Unlabeled Graphs.

Geir Agnarsson  
February 23, 2026



## Common Policies Affecting All Courses at George Mason University

Updated August 2025

These four policies affect students in all courses at George Mason University. This Course Policy Addendum must be made available to students in all courses (see [Catalog Policy AP.2.5](#)).

**Additional policies** affecting this course, and additional resources or guidance regarding these policies, may be provided to students by the instructor.

### Academic Standards

Academic Standards exist to promote authentic scholarship, support the institution's goal of maintaining high standards of academic excellence, and encourage continued ethical behavior of faculty and students to cultivate an educational community which values integrity and produces graduates who carry this commitment forward into professional practice.

As members of the George Mason University community, we are committed to fostering an environment of trust, respect, and scholarly excellence. Our academic standards are the foundation of this commitment, guiding our behavior and interactions within this academic community. The practices for implementing these standards adapt to modern practices, disciplinary contexts, and technological advancements. Our standards are embodied in our courses, policies, and scholarship, and are upheld in the following principles:

- **Honesty:** Providing accurate information in all academic endeavors, including communications, assignments, and examinations.
- **Acknowledgement:** Giving proper credit for all contributions to one's work. This involves the use of accurate citations and references for any ideas, words, or materials created by others in the style appropriate to the discipline. It also includes acknowledging shared authorship in group projects, co-authored pieces, and project reports.
- **Uniqueness of Work:** Ensuring that all submitted work is the result of one's own effort and is original, including free from self-plagiarism. This principle extends to written assignments, code, presentations, exams, and all other forms of academic work.

Violations of these standards—including but not limited to plagiarism, fabrication, and cheating—are taken seriously and will be addressed in accordance with university policies. The process for reporting, investigating, and adjudicating violations is outlined in the university's [academic standards procedures](#). Consequences of violations may include academic sanctions, disciplinary actions, and other measures necessary to uphold the integrity of our academic community.

The principles outlined in these academic standards reflect our collective commitment to upholding the highest standards of honesty, acknowledgement, and uniqueness of work. By adhering to these principles, we ensure the continued excellence and integrity of George Mason University's academic community.

**Student responsibility:** Students are responsible for understanding how these general expectations regarding academic standards apply to each course, assignment, or exam they participate in; students should ask their instructor for clarification on any aspect that is not clear to them.

### **Accommodations for Students with Disabilities**

Disability Services at George Mason University is committed to upholding the letter and spirit of the laws that ensure equal treatment of people with disabilities. Under the administration of University Life, Disability Services implements and coordinates reasonable accommodations and disability-related services that afford equal access to university programs and activities. Students can begin the registration process with Disability Services at any time during their enrollment at George Mason University. If you are seeking accommodations, please visit the [Disability Services website](#) for detailed information about the Disability Services registration process. Disability Services is located in Student Union Building I (SUB I), Suite 2500. Email: [ods@gmu.edu](mailto:ods@gmu.edu). Phone: (703) 993-2474.

**Student responsibility:** Students are responsible for registering with Disability Services and communicating about their approved accommodations with their instructor *in advance* of any relevant class meeting, assignment, or exam.

### **FERPA and Use of GMU Email Addresses for Course Communication**

The [Family Educational Rights and Privacy Act \(FERPA\)](#) governs the disclosure of [education records for eligible students](#) and is an essential aspect of any course. **Students must use their GMU email account** to receive important University information, including communications related to this class. Instructors will not respond to messages sent from or send messages regarding course content to a non-GMU email address.

**Student responsibility:** Students are responsible for checking their GMU email regularly for course-related information, and/or ensuring that GMU email messages are forwarded to an account they do check.

### **Title IX Resources and Required Reporting**

As a part of George Mason University's commitment to providing a safe and non-discriminatory learning, living, and working environment for all members of the University community, the University does not discriminate on the basis of sex or gender in any of its education or employment programs and activities. Accordingly, **all non-confidential employees, including your faculty member, have a legal requirement to report to the Title IX Coordinator, all relevant details obtained directly or indirectly about any incident of Prohibited Conduct** (such as sexual harassment, sexual assault, gender-based stalking, dating/domestic violence). Upon notifying the Title IX Coordinator of possible Prohibited Conduct, the Title IX Coordinator will assess the report and determine if outreach is required. If outreach is required, the individual the report is about (the "Complainant") will receive a communication, likely in the form of an email, offering that person the option to meet with a representative of the Title IX office.

For more information about non-confidential employees, resources, and Prohibited Conduct, please see [University Policy 1202](#): Sexual and Gender-Based Misconduct and Other Forms of Interpersonal Violence. Questions regarding Title IX can be directed to the Title IX Coordinator via email to [TitleIX@gmu.edu](mailto:TitleIX@gmu.edu), by phone at 703-993-8730, or in person on the Fairfax campus in Aquia 373.

**Student opportunity:** If you prefer to speak to someone *confidentially*, please contact one of Mason's confidential employees in [Student Support and Advocacy \(SSAC\)](#), [Counseling and Psychological Services \(CAPS\)](#), [Student Health Services \(SHS\)](#), and/or the [Office of the University Ombudsperson](#).