Math 455: Introduction to Discrete Structures
Spring 2020 Syllabus

Instructor: George Avrunin
Office: 1335D LGRT
Telephone: 545-4251
Email: avrunin@math.umass.edu
Textbook: J. M. Harris, J. L. Hirst, M. J. Mossinghoff, Combinatorics and Graph Theory, Second edition, Springer Verlag. The textbook is required. See the link about “Getting the textbook” on the course web page for instructions for getting a free pdf or a cheap paperback version.
Web page: http://ext.math.umass.edu/455 The web page will be used to post assignments, make announcements, and provide resources (readings, links, etc.). You should check it frequently.
Office hours: Mondays, 11-12, Thursdays 11-12, and by appointment. You can always make an appointment at class or by email. (I may need to adjust this schedule later in the semester; changes will be announced in class and posted here.) You’re also always welcome to look for me in my office; if I’m there and not busy, I’ll be happy to talk to you and if I am busy, we can make an appointment for another time.
TA: Cristian Rodriguez (rodriguez@math.umass.edu). Cristian’s office is LGRT 1323B. We’ll set his office hours soon.

Course description Here’s the official course description:

This is a rigorous introduction to some topics in mathematics that underlie areas in computer science and computer engineering, including: graphs and trees, spanning trees, colorings and matchings; the pigeonhole principle, induction and recursion, generating functions, and (if time permits) combinatorial geometry. The course integrates learning mathematical theories with applications to concrete problems from other disciplines using discrete modeling techniques. Student groups will be formed to investigate a modeling problem and each group will report its findings to the class in a final presentation.
Prerequisites: Calculus (MATH 131, 132, 233), Linear Algebra (Math 235), and Math 300 or CS 250. For students who have not taken Math 300 or CS 250, the instructor may permit students with sufficient experience in reading and writing mathematical arguments to enroll.

We’ll cover most of the first chapter of the textbook, on graph theory, and a good part of the second, on combinatorics.
Integrative Experience: This course satisfies the Integrative Experience graduation requirement for math majors. There are three components to that requirement:

1. Providing a structured, credited context for students to reflect on and to integrate their learning and experience from the broad exposure in their General Education courses and the focus in their major.

2. Providing students with the opportunity to practice General Education learning objectives such as oral communication, collaboration, critical thinking and interdisciplinary perspective-taking, at a more advanced level.

3. Offering students a shared learning experience for applying their prior learning to new situations, challenging questions, and real-world problems.

The course will address the first component in two ways. First, you’ll be doing some explicit, written reflection on your own learning both in mathematics classes and other courses. This will take the form of a (fairly short) reflective essay that will be due at the end of the semester. The detailed requirements for the essay will be made available later in the term. Second, the topics covered in the course are mathematical tools developed to solve real problems in a variety of areas. So you’ll be drawing not just on your mathematics coursework, but also on knowledge you’ve developed from other parts of your education. This focus on mathematics for applications will also address the third component, along with “challenging questions.”

For the second component, you’ll be doing a final project as a team. A little after the first exam I will divide the class into groups of 4-5 students each, based roughly on your interests and backgrounds as provided in a questionnaire I will distribute. The projects will involve developing additional material, not covered in class. Each team will decide on a topic to investigate—I will provide a list of possible topics, or you can come up with your own topic, subject to my approval. Some topics will involve applications of discrete mathematics to real-world problems, others will be more theoretical. Some may involve some computer programming, others can be investigated using pencil and paper. At the end of the semester, each group will submit a paper and give short presentations (about 25 minutes) to the class about what they have learned.

Course structure and policies There will be (more or less) daily reading assignments in the text and (more or less) weekly homework sets. I will probably also give a number of short quizzes, which will be announced at least one day in advance and will cover basic things like definitions. I will not be presenting everything you need to know in class. Instead, you will be expected to learn from the lectures and discussion in class, the textbook, and doing homework problems (as well as discussions outside class with your fellow students, etc.). In class, I will try to go over the main ideas from each section, sometimes presenting them in a different way than the book does, and to answer questions
and clarify things that people had difficulty with. The material we’ll be covering
will involve a variety of mathematical objects that you haven’t studied before
(at least in any depth), and we’ll be introducing a lot of new definitions to
describe those objects. You will need to approach this as if you were learning a
new language and these definitions are the vocabulary; you’ll need to memorize
these definitions or you won’t be able to follow the discussion and reading or do
the problems. You will definitely need to be active and thoughtful in a variety
of ways in both class and your reading. I will frequently ask you to do some
mathematics in class, either individually or in small groups.

Here is some advice:

• When you read a longer or more complicated proof, you will probably want
to make several passes. Sometimes a good first step is to check that the
statement is true in some examples, before reading any of the proof. The
first time through the proof you may just read line-by-line, checking that
each statement is true and follows from the previous statements. Then
on a second pass you can look for the bigger structure, identifying what
are the most important ideas and steps in the proof. Ideally when you
are done you should be able to close the book and reproduce the whole
proof, or at least most of it, in your own words. (Early in the semester, I
will make available some material from a mathematics education group in
Britain on “self-explanations” that seems to be quite effective in helping
university mathematics students do this.)

• When you hit a statement that you don’t understand, don’t just keep
going. Stop! Spend a minute (or more) trying to see what is going on.
You can try examples, try rephrasing it in your own words, or look at how
it relates to other things in the section, for instance.

• If something still isn’t clear, make a note of it so you can come back later.
If you’re using the electronic version of the book, you may want to use
software that lets you highlight and add comments to the text.

• If you’re really stuck, don’t be afraid to ask for help! It can be from
another student, our TA, or me. Both the TA and I have office hours,
which are there for you to use. And, of course, I’m also happy to answer
questions in class.

• In order for this class to be effective, it’s important that you make at least
a first pass through the assigned reading before you come to class. Then we
can spend the time concentrating on the most interesting/difficult parts.

Attendance is required; participation in class discussions is expected and will
count as part of the grade.

There will be two exams during the semester, each counting 25% of the
course grade. Homework, quizzes, and participation together will count 30% of
the grade, and the project and reflection essay(s) will count 20%. Homework
will be due at the start of class and late homework will not be accepted without a
valid reason (e.g., illness, etc.) but I will drop the lowest homework score. If you will be unable to complete an assignment on time or will miss a quiz or exam, it's your responsibility to notify me as soon as possible (before the due date or exam, if at all possible). Note that sending me an email does not automatically excuse late work, a missed exam, etc. And, since email is not a completely reliable medium, if you send me an email and don’t get an acknowledgment in a day or so, you should try reaching me by some other method.

I encourage you to form study groups and work together on homework, but if you do, you must list the names of all the people you worked with and you must write up your homework assignments completely independently. (Obviously, if you consult other sources, such as textbooks or online material, you must explicitly acknowledge those sources as well.) And remember that you'll be taking the exams on your own, too, so if you do work with others, make sure that you're understanding everything. For the team projects, of course, I expect you to be working together and will (with exceptions for particularly unusual circumstances) grade the team together. You must observe the UMass Academic Honesty policy, http://www.umass.edu/honesty.

Pronouns: All members of our community have the right to be addressed by the name and pronouns that they use for themselves. Students can indicate their preferred/chosen first name and pronouns on SPIRE, which appear on the rosters. Please let me know what name and pronouns I should use for you if they are not on the roster.

Accommodation: The University of Massachusetts Amherst is committed to providing an equal educational opportunity for all students. If you have a documented physical, psychological, or learning disability on file with Disability Services (DS), you may be eligible for reasonable academic accommodations to help you succeed in this course. If you have a documented disability that requires an accommodation, please notify me within the first two weeks of the semester so that we may make appropriate arrangements.

Academic Honesty: Since the integrity of the academic enterprise of any institution of higher education requires honesty in scholarship and research, academic honesty is required of all students at the University of Massachusetts Amherst. Academic dishonesty is prohibited in all programs of the University. Academic dishonesty includes but is not limited to: cheating, fabrication, plagiarism, and facilitating dishonesty. Appropriate sanctions may be imposed on any student who has committed an act of academic dishonesty. Instructors should take reasonable steps to address academic misconduct. Any person who has reason to believe that a student has committed academic dishonesty should bring such information to the attention of the appropriate course instructor as soon as possible. Instances of academic dishonesty not related to a specific course should be brought to the attention of the appropriate department Head or Chair. Since students are expected to be familiar with this policy and the commonly accepted
standards of academic integrity, ignorance of such standards is not normally sufficient evidence of lack of intent. See http://www.umass.edu/honesty/.