Math 455: Introduction to Discrete Structures
Fall 2017 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
Office hours: To be announced. In addition to my scheduled office hours, you can always make an appointment in class or by email. And you can stop by my office at any time; if I’m there and not busy, I’ll be happy to talk to you then and if I am too busy to talk, we can set up another time.
TA: Lian Duan (duan@math.umass.edu). Lian’s office is LGRT 1323I. 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.

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, the groups will give short presentations (25 minutes) 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 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. Then
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 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.