DISCRETE MATHEMATICS
A SYLLABUS OF SORTS

Instructor: Tim McLarnan, Dennis 212; 983-1351; 966-0520 (home, before 9 PM); e-mail timm@earlham.edu.

Office Hours: I teach 9–12 MWF, and 1-4 Th. At other times, I'm usually in my office. If I'm in my office, I'm available to talk math. If you want to be sure I'll be there, or if you want to be polite, then talk to me after class or otherwise let me know you're coming; but feel free to come see me at any time, with or without advance warning. Please come see me often!

Text: This course is really about what we can, as a community, discover together. As a result, there can't really be a text.

Other people have, however, thought about this material before us, and there is much we can learn by consulting them. With that thought in mind, and because some of us feel the importance of learning from printed material, I've listed two books as recommended reading.

(1) George Andrews' book, *Number Theory.* Number theory is one of the big areas we'll be exploring this semester, and Andrews' book covers most of what we'll study in this area. He's one of the world's real experts at this sort of mathematics, and his perspective on topics is always interesting and stimulating. As a result, I think Andrews' book is both a reference on the number theoretic component of the course and an opportunity for the more mathematically sophisticated among us to delve deeper into number theory, enjoying the perspective of a real master. For all of us, Andrews offers a chance to work on reading mathematics instead of doing it conversationally as we will do in class, and he offers some different ways of looking at things than we will take together. Please look at Andrews in these lights, and do not be intimidated by the fact that Andrews also does a great deal we won't even try to touch upon, including some rather difficult and new mathematics. Don't, for instance, open the book the first day to Andrews' discussion of the Rogers-Ramanujan identities (a deep topic of current interest among mathematical researchers) and panic. Most of what's in Andrews is a gift for those of you who want to dig deeper and to make a career of this, not a plan for our time together this term.

(2) The second book I've listed as recommended is the *Schaum's Outline* volume on *Discrete Mathematics.* This book doesn't follow the course material as closely as Andrews' book, but it is a great reference on a lot of the basics of the non-number theoretic parts of the class—set theory, functions, relations, logic, the basics of counting, etc. Particularly if you feel shaky about things like functions and sets, you might find it helpful to have this book at your fingertips. I also like it especially as a sort of one-volume compilation of all the discrete math topics a computer scientist might need to know (at least, a computer scientists who isn't a theoretician).

The other good thing about these books is that by the standards of technical publishing, they're practically free. Together, they are less than a quarter the cost of the standard text we've used in the past. Make good use of the $80 I just saved you.

Grading: There will be frequent homework assignments counting 40%. Every 3 weeks there will be a larger assignment which you may choose to regard as a take-home test. These will count for the remaining 60% of your grade. I would anticipate having these assignments due on Sept. 14, Oct. 5, Oct. 26, Nov. 16, and Dec. 14, though these dates are subject to renegotiation if they pose problems. The k^{th} will cover the material for $3s$ weeks, where s is the highest power of 2 dividing k. Your first assignment for the course is to figure out what this means.

Late work: Homework is due at the announced times. In practice, I am willing to accept late homework as long as I have not yet graded the assignment. If I'm late grading work, how can I complain if you are late turning it in? Work turned in after I'm done grading an assignment will not normally be graded. I will put it in a pile of late papers; if I ever have nothing better to do, I will grade that pile. Normally, final grades are due before this happens.

Sometimes I grade homework right away, and sometimes it takes me a few days. If this uncertainty bothers you, there is a sure way to guarantee that your work is turned in before I grade the assignment—you can turn it in on time.

Tests differ from homework. I think it is important that we all work on tests under the same rules. Tests are due in class on the assigned date. I am not tolerant of late tests.

Some Notes on the Class: I conceive this class primarily as a first proof-oriented class, appropriate for students fairly early in their mathematical careers. As I see it, Discrete Mathematics has three principal foci:

(1) We ought to study how to discover mathematical truth and how to convey that truth in a persuasive manner. That is, we should learn to explore and we should learn to prove. This is in some sense the overarching goal of the class.
(2) We should become familiar with some of the basic vocabulary of mathematics, vocabulary related to logic, sets, relations, and functions. I hope we can do this without getting bogged down in it. To some degree, it's like learning vocabulary in any language: you need to do it, but it lacks zest.
(3) There are some concrete mathematical disciplines we ought to explore, particularly number theory and combinatorics. These are important and beautiful areas of mathematics in their own right. For this class, though, what may be most significant is that they are areas of mathematics in which we can all engage in discovery.

Discovery and invention are the themes of the course. We'll work in areas of mathematics where it's possible for us all to do calculations, to look for patterns, and to try to test those patterns for general validity. What I hope to convince you is that mathematics was not dictated by God on Mount Sinai. It's a human activity in which all of us are capable of asking questions and making discoveries. We'll discover by asking questions together, sharing our observations, and agreeing on definitions, questions, and answers. One implication of all this is that the class meetings are an integral part of the course. Please try to be here.

Finally, let me leave you with a word of warning and with a word of hope. It's scary to set out without a map on a journey of discovery. It's hard to tell what's significant and what isn't. (As an extreme example, Bjarne Herjolfsson, the first European recorded to have seen North America, was trying to get to Greenland when he came in sight of Newfoundland. He decided the coast he had seen didn't look like Greenland, and he sailed back without bothering to land.) It is also not easy to learn to do proofs. I had to struggle to do it; many of you may need to struggle as well. Work together. Talk to one another. Come see me. I'm always happy to try to offer suggestions or to help get you started. We can schedule extra help sessions if people like. You're not alone.

I hope this class can be a genuine community engaged in shared inquiry.

Let me know how it's going. I'm usually in my office.