MATH125: Discrete Mathematics – Spring 2019

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Office:	Exploratory Hall, Room 4459
Office Hours:	Tuesday and Thursday 4.30-5.30 or by appointment.
Webpage:	http://math.gmu.edu/∼harbir/m125/ . Note we will not be using BlackBoard.

Textbook: Edgar G. Goodaire and Michael M. Parmenter, *Discrete Mathematics with Graph Theory*, Prentice-Hall, NJ., 3rd edition, 2005.

Homework questions will be set after each section is completed. These will not be collected or graded but you are STRONGLY advised to attempt them and write out your solutions as if they would be. You are encouraged to discuss these problems amongst yourselves and to make use of the office hours. I will go through the majority of the homework questions in the next class and/or post them on the web, but you will not benefit from this unless you have attempted them properly beforehand. Note that the above list of homework questions is the ABSOLUTE MINIMUM you should be doing each week. All of the odd-numbered questions in the book have solutions in the back and you should attempt as many of those as you feel you need to.

The course will be evaluated with 3 (1 hour long) in-class tests on Thursday February 21st, Tuesday April 2nd and Thursday April 25th. Your 2 best results (relative to the class average for that test) will each contribute 25% towards the evaluation and the remaining 50% will come from a (cumulative) final exam on Thursday May 9th. I shall explain the grading system in more detail in the first lecture[1]. If you miss more than one of the in-class exams then you will need to provide very good (and fully-documented) reasons for missing EACH of them. There will be NO make-up tests, alternative test dates, or 'extra-credit' assignments. You are expected to abide by the University Honor Code and all suspected violations will be reported to the Honor Committee. No outside materials will be allowed during any of the examinations.

Additional Remarks:
1) Feel free to ask questions in class. It makes things more interesting for everyone, myself included.
2) In addition to my office hours there is help available for this course at the Math Tutoring Centre.
3) If you are a student with a disability and you need academic accommodations, please see me and contact the Office of Disability Resources at 703 993 2474. All academic accommodations *must* be arranged through that office.
4) It is YOUR responsibility to regularly check the course webpage and your official university email address for announcements.
5) Please check the course webpage or this syllabus for the answers to any questions you may have before emailing me.
6) Finally **turn off and PUT AWAY any and ALL electronic devices** including phones, calculators, tablets and laptops. If I see you even looking at your phone, let alone texting, then you will leave the classroom and miss the rest of the lecture. I don't like having to do this but it is for the benefit of everyone's concentration, not least mine.

[1]NOTE: I DO NOT GRADE ON A CURVE (I think it should be illegal!) . The formula I use to rank you involves the class average but the grade boundaries themselves are determined by absolute, not relative, performance. If you all deserve an A grade then you will all get an A. If you all deserve to fail then you will all fail. I only take the class average into account to cancel out any differences in the difficulty of the in-class tests.

Approximate timetable for the semester and homework questions

Week 1 Statements and Proofs

Week 2 Logic

Week 3 Sets

Week 4 Binary relations and equivalence relations

Week 5 and 6 Functions, cardinality and countability

Week 7 Induction and recursion

Weeks 8 and 9 Permutations and Combinations

Week 10 Elementary Probability and the Binomial Theorem

Week 11 Basic Graph Theory and Isomorhisms

Week 12 Paths and Circuits

Week 13 Trees and applications

Week 14 Planar graphs and colourings

Topic	**Chapter**	**Homework Questions**
Logic, methods of proof	0.1	2abgj—q,5a—gikl,6abe—h,7a—f,8
	0.2	1abc,12,16,24,25,32a—e
Set Theory	2.1	1,3,7,10,11
	2.2	2,4,10,12a—d,16,17,27
	2.3	3,7,9a—e
	2.4	2,3,7,11
Bijections and Cardinality	3.1	1,3,13,15,25
	3.2	1,3,7ab,9a—d,12,19,22
	3.3	2,6,9,11,12,19,21,23
Mathematical Induction and Recursion	5.1	1,4adf,7a—e,9eh,11,12,15
	5.2	1,2a,4,6,20,26,27,40,55
	5.3	1,7,17
'Counting' using sets	6.1	1,4,6,11,22
	6.2	1,5,6,7,8,16,17
Combinatorics	7.1	1,7,8,11,15
	7.2	3,7,11,14,20,25
	7.3	4,10,12
	7.5	1,3,8,10,11,15,16
	7.6	1,2
	7.7	4,5,6,10,20
Graphs	9.1	1,2,3,5,6
	9.2	2,3,6,14,15,21,23,25,26,28,35
	9.3	1—6,10
Paths and Circuits	10.1	1,3,4,7,9—13,17
	10.2	1,2,5,9,15,23
	10.4	10,14abc
Trees	12.1	1,3,4,13,15,23,24
	12.2	4—9
Planar graphs and Colouring	13.1	1,4,6,10,21
	13.2	3,11,16

MATH 125: Frequently Asked Questions

1. I'm not a math major — why is this course a requirement for me?

I realise that many of you are not here by choice. This course contains material that is absolutely fundamental, not just to mathematics but to many other disciplines as well, especially computer science. However, perhaps the most useful thing you can learn from this course is how to think like a mathematician! This involves developing different skills that will be of help in many other situations. The most important are:

- abstracting problems by stripping away irrelevant details and keeping only the information that is essential to the solution
- problem solving
- presenting a clear and convincing argument so that your solution will actually be believed.

Don't be fooled into thinking that this course must be easy because the only requirement is high-school algebra. For most people it is the hardest 100 level math course because there are so many new concepts that have to be understood. However it is also, in my opinion, the most interesting.

2. How much detail am I expected to give when answering the questions?

There is no simple answer to this. This is something you should pick up as we go along, both by reading the textbook and watching how I answer questions in class. A large majority of the questions I set can be answered in a few lines *if* you find the right way to solve it. If you find yourself writing much more than a page to answer a question then there is probably a better way of doing it (or you are doing completely the wrong thing!).

3. Is there partial credit for wrong answers?

Yes there is, but this cuts both ways. Even if you answer a question correctly you will not get full marks unless you clearly and concisely show your reasoning — this is especially true for questions that ask you to provide a proof. And some students seem to think that writing down everything they can remember, even if it's not relevant, will get them extra marks when in fact the opposite is more likely to happen.

4. Why do you set questions in the tests that are outside the material covered in class?

I don't!! But I do always set a few questions that test your understanding of the basic principles and your ability to apply them to slightly different problems.

5. What is the best way to study for the tests?

This is a very individual thing (but see the survival guide on the next page for a few tips). However you should practice doing as many questions as possible — don't just do the homework questions. There are plenty of questions in the textbook you can keep trying, especially the ones with the answers in the back, until you feel confident about the material.

MATH 125: Survival Guide

1. Brush up on your high-school algebra if necessary.

2. Spend as much time as you need on the homeworks to do them *properly* before the next class. Actually answering questions yourself is the most effective way to learn this material and do well in the exams.

3. Reading technical material, especially mathematics, is a skill that needs to be acquired like any other. You should be continuously asking yourself questions as you read. If you get stuck at a particular place (for example in a proof) don't just give up, read on a little further and see whether things become clearer. After you have read something the first time, read it again and try to understand the material at a higher-level i.e. to see the big picture and understand the basic principles.

4. New concepts often require a certain amount of 'fermentation' time. It's amazing how often things fall into place when you let the ideas float around in your head for a while before coming back to them. Don't leave *anything* to the last minute.

5. Don't be put off by the notation, especially the set-theoretic symbols. It may look very complicated but you should really think of it as a kind of mathematical shorthand. To translate from mathematics to English, simply replace each symbol by the word or phrase that it represents (be warned however that translating from English to mathematics is *much* harder).

6. If you find yourself having to memorize lots of material then you probably don't understand it! Yes, there are some things that you have to remember such as the notation and terminology, but almost everything else, including many of the formulæ and definitions, should come to mind easily if you understand the ideas they are trying to convey.

7. In the examinations use your time sensibly, do the questions that you know how to answer first and come back to the others later. Also, read the questions *very* carefully — precise statements are crucial in mathematics and every word in the question is there for a reason!

8. There are many other Discrete Math textbooks out there that you may wish to refer to from time to time. However, be careful since some of the definitions (especially in the graph theory part of the course) may differ slightly from the ones we are using.