**MATH 251 Discrete Mathematics** Spring 2009

**Course Description:** Introduction to basic concepts of mathematics and mathematical reasoning. Logic, sets, number theory, mathematical induction, direct and indirect formal proofs. Active instruction in mathematical writing is given throughout the course and mathematical writing (including effective and correct English expression) is a major component of the course requirements.

**Pre/Corequisite:** Calculus 1
**Prerequisite:** ENG 101

**Text:** Discrete Mathematics with Applications, 3rd ed, Epp, Thomson

**Instructor:** Dr. Hemmer Office S221B (773)442-5772 fax (773)442-5770
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**Course Objectives:** Upon successful completion of the course, the student will be able to perform the following

1. Use proper mathematical language and notation (verbal and written) in a variety of mathematical settings, including effective and correct English expression (verbal and written).
2. Use mathematical logic in a variety of mathematical settings.
3. Give an informal argument (verbal and written) in a variety of mathematical settings, including effective and correct English expression.
4. Read and understand formal mathematical proofs in a variety of mathematical settings.
5. Write a formal proof in a variety of mathematical settings, including direct proof, proof by contrapositive, proof by contradiction, and proof by induction, also including effective and correct English expression.

**Method of Instruction:** Lectures (with class participation) and discussion sessions.
This is a writing intensive course. Mathematical writing (including effective and correct English expression) is a major component of the course requirements and active instruction in writing is given throughout the course.

The homework assignments listed below will not be collected but it is essential that you do the homework as exams will have similar problems. It is also essential that you stay caught up on homework as we will be spending a considerable amount of class time going over the assignments (the following week). In particular, we will be discussing "good" justifications to the logic problems in Chapters 1 & 2 (getting ready for the formal proofs in the rest of the course) and also "good" English translations (also required for the formal proofs). These discussions will not be beneficial if you have not already completed the assignments.

**Class Policies:**
Attendance and class participation may raise your grade in a borderline situation.
**If you are absent or late, it is your responsibility to get notes and information from another student.**

| **Evaluation:** | | |
|---|---|---|
| | Multiple Draft Assignments (3) | 15% |
| | Quizzes (top 3 of 5 scores) | 15% -- announced with 1 week notice |
| | Exams (top 2 of 3 scores) | 40% |
| | Comprehensive Final Exam | 30% |

During the term, three multiple draft assignments will be given. Feedback will be given and you will have an opportunity to revise the assignment before submitting it for a grade. Each grade will take all submissions into account. More detailed information will be given at the time of the first assignment.

There are **NO makeups on exams or quizzes**. Any student who misses an exam or quiz (for **ANY** reason) will get a zero for that score. All exams and quizzes are closed book, closed notes (unless informed otherwise) and are graded with partial credit.

The scores on individual papers as well as the final course grade are assigned as follows:
90-100% A, 80-89% B, 70-79% C, 60-69% D, 0-59% F

In-class work (quizzes and exams) will be given more leeway than out-of-class assignments (homework and multiple draft assignments).

- In-class graded work
  - Abbreviations are allowed.
  - Complete sentences with correct spelling and grammar are required but errors will be given more leeway than in out-of-class work, i.e., extremely minor errors will be marked but no points will be deducted, larger errors will result in a loss of points, and errors that make the mathematical answer itself unclear will lose a majority of (or all) potential points.

- Out-of-class graded work
  - Abbreviations are not allowed.
  - Complete sentences are required.
  - Incorrect spelling/grammar will lower your grade.
- Out-of-class ungraded work
  - Although homework is generally not handed in, students always have the option of either handing in work to be evaluated and returned or bringing it in (during office hours or other times by appointment) to be discussed in person. Students are strongly encouraged to do this throughout the term both with informal justifications and with formal proofs.

Logic (Chapters 1 & 2) contains the building blocks for mathematics and you will find that both writing and translating are critical. Once we get beyond those chapters, essentially all problems break down into two types.

- Informal Problems – rigorous justification is still required
- Formal Proofs/Disproofs

We will discuss the difference between these two types of problems in class but keep in mind the following.

- Informal Justifications – Both the mathematical content **and** the delivery are important. It is expected that all justifications are given in complete English sentences with correct grammar and spelling.
- Formal Proofs/Disproofs – Both the mathematical content **and** the delivery are important. For many reasons to be discussed in class, I prefer what looks like a two-column proof. However, the proofs are still readable; i.e., appropriate English is added to give the proof complete English sentences with correct grammar and spelling.

**Schedule of Exams and Homework Assignments:**

| Week | Week of | Schedule & assignments (tentative) |
|---|---|---|
| 1 | Jan 12 | 1.1(6,8,11,12-18 even,19,25-31 odd,35,37,41,42,45-47,50,52)<br>1.2(3-9 odd,12-16,18-20,22-24,26,28,29,32,35,38,40,43,45,47)<br>1.3(6,8,13,14,18,22,24-32,36,37,41,43) |
| 2 | Jan 19 | 2.1(2,3,5,9,11,13,14,15,16,17,19,22a,23a,26,28,31) |
| 3 | Jan 26 | 2.2(1,3,4,5,6,9,11,13,17a,18,20,22,24,29,33,38,42)<br>2.3(2,3,4,9,12,13,14,16,17,18,19,21,28,32,33,36,40,43) |
| 4 | Feb 2 | 2.4(7,8,9,10,11,12,13,14,15,16,21,23,25) |
| 5 | Feb 9 | 3.1(1,2,4,5,6,9,11,12,14,17,24,25,27,29,34-41,46,53,54,58) |
| 6 | Feb 16 | 3.2(13,14,16-19,23,32-36) |
| **Exam #1** Tues Feb 17 | | |
| 7 | Feb 23 | 3.3(3,5,7,11,13,16,17,19,20,22,23,27,33,37,38,39), also Prove:<br>Any integer that ends in a zero is divisible by 5. (Hint-see definition in box on bottom of page 155) |
| 8 | Mar 2 | 3.4(1,3,5,7,13,24,31a--but do not use the properties …prove everything, 33,49,50) |
| 9 | Mar 9 | 3.5(1,3,5-7,9,14-19,23—in 14-19,23 do all as “informal” problems)<br>3.6(3,5,8,10,12-14,17,19,21,23,24,26,27) |
| 10 | Mar 16 | 4.1(1,3,5,8,10-12,14,18-20,23,27,32,35,36,38,40,44,45-49,58) |
| **Exam #2** Tues Mar 17 | | |
| 11 | Mar 30 | 4.2(3,5,6,8,10,13,15,32)<br>4.3(3,4) |

Fri, **Apr 3**, is the **last day to drop** this course and receive a grade of W. Incompletes are not given in this course. Any student officially registered after Apr 3 will receive a grade of A, B, C, D, or F.

| | | |
|---|---|---|
| 12 | Apr 6 | 5.1(1,3-5,7,9,10,12-14,18-24) |
| 13 | Apr 13 | 5.2(5-8,10,12,18,23,28,32) |
| 14 | Apr 20 | 5.3(1,3,5,6,9,18,23-27,29) |
| **Exam #3** Tues Apr 21 | | |
| 15 | Apr 27 | Review |

**FINAL EXAM** on Thurs, May 7, 8-9:50am. This exam is comprehensive; specific topics will be announced at a later date. **All students are expected to take the final exam during this regularly scheduled time**.

In order to continue to any mathematics course having Math 251 as a prerequisite, you must complete Math 251 with a course grade of A, B, or C.

**Math 251 Discrete Mathematics**
**Writing Formal Proofs - Introduction**

Keep in mind that just as no two people write a paper in the same way, no two people write a formal proof in the same way. Your proof style should evolve not only throughout this course but also as you continue your mathematical career. And although most of the proofs that we look at this term will be written in a two-column format, you will note that texts use more of a paragraph form. So be sure you are reading and understanding the proofs I point out in the text. As you continue to learn to write formal proofs, you will most likely also evolve into writing in a paragraph form.

If you use a two-column proof, keep in mind that the left column is a list of the statements that you believe are true (and don't forget from logic that a statement is a **complete** sentence). The right column lists the justifications for your statements. **Regardless of what form you write in, it is essential that you justify your statements.**

For a variety of reasons that we will discuss in class, I prefer a two-column proof over a paragraph style. However, proofs are still readable, so when you have finished your proof (including polishing it) be sure to read it out loud. You should be checking not only that it makes sense mathematically but also that the English flows. Words that are often seen in formal proofs are listed below.

Words typically seen in the **beginning** of a proof

- Assume
- Suppose
- Let

Words typically seen in the **middle** of a proof

- when the line follows directly from the line above
  - Then
  - So
- when the line starts a new thought
  - Note
  - Now
- when introducing a new variable
  - Let
- others
  - Also
  - Similarly

Words typically seen at the **end** of a proof

- Therefore
- Thus
- Q.E.D. (**Q.E.D.** is an abbreviation of the Latin phrase **quod erat demonstrandum**, which literally means "that which was to be

demonstrated", a notation which is often placed at the end of a mathematical proof to indicate its completion.)

- You will also very often see a restatement of the original statement, usually preceded by the word Thus or Therefore.