MAT231 Transition to Higher Mathematics  
Quad 1, Fall 2014

**General Information**

**Meeting Time and Place**  
Monday, Wednesday, and Friday: 11:25 a.m. – 12:25 p.m., KOSC 109.

**Professor**  
Dr. Jonathan Senning, 246 Ken Olsen Science Center  
978-867-4376, jonathan.senning@gordon.edu

**Office Hours**  
Monday, Wednesday: 3:20 – 4:20 p.m.,
Tuesday, Thursday: 10:30 a.m. – 12:00 p.m.,
and by appointment.

**Text**  
- Website with links to PDF versions of whole book, individual chapters, and other information: [http://www.people.vcu.edu/~rhammack/BookOfProof/index.html](http://www.people.vcu.edu/~rhammack/BookOfProof/index.html)  

**Prerequisite**  
College Algebra.

**On-line Materials**  
On-line materials associated with this class can be found on the departmental web server at [http://www.math-cs.gordon.edu/courses/mat231](http://www.math-cs.gordon.edu/courses/mat231) and on the Blackboard server at [http://blackboard.gordon.edu](http://blackboard.gordon.edu).

**Students with Disabilities**  
Gordon College is committed to assisting students with documented disabilities. (See Academic Catalog Appendix C, for documentation guidelines.) A student with a disability who may need academic accommodations should follow this procedure:

1. Meet with a staff person from the Academic Support Center (Jenks 412, x4746) to:
   1. make sure documentation of your disability is on file in the ASC,
   2. discuss the accommodations for which you are eligible,
   3. discuss the procedures for obtaining the accommodations, and
   4. obtain a Faculty Notification Form.

Last Modified: 2014-08-26 12:26:48 PM
2. Deliver a Faculty Notification Form to each course professor within the first full week of the term and make an appointment to discuss your needs with each professor.

Failure to register in time with your professor and the ASC may compromise our ability to provide the accommodations. Questions or disputes about accommodations should be immediately referred to the Academic Support Center. See Grievance Procedures available from the ASC.

Course Description

Introduction

An important characteristic of higher level mathematics is the notion of proof, the means by which results are shown to be legitimate. Whenever a new theorem is stated, it is immediately followed by an argument, a proof, to verify that the statement is true and to explain why it is true. Consider the following quotation about proof from the excellent book *The Mathematical Experience* by Philip J. Davis and Reuben Hersh:

“Proof serves many purposes simultaneously. In being exposed to the scrutiny and judgment of a new audience, the proof is subject to a constant process of criticism and revalidation. Errors, ambiguities, and misunderstandings are cleared up by constant exposure. Proof is respectability. Proof is the seal of authority.

Proof, in its best instances, increases understanding by revealing the heart of the matter. Proof suggests new mathematics. The novice who studies proofs gets closer to the creation of new mathematics. Proof is mathematical power, the electric voltage of the subject which vitalizes the static assertions of the theorems.

Finally, proof is ritual, and a celebration of the power of pure reason. Such an exercise in reassurance may be very necessary in view of all the messes that clear thinking clearly gets us into.”

As you progress in your study of mathematics you will likely find that the material becomes much more theoretical and that more time is spent understanding why a result is true. When one mathematician shows her work to another, the second is likely to expect to see a proof of the new result. The ability to understand proofs presented by others and to write your own proofs that are clear and logically correct is a tool required by any mathematician. In this course we will introduce and practice several methods for constructing proofs in the context of discussing some important tools of advanced mathematics.

For many students the word “proof” can bring on a feeling of insecurity or even fright. It is likely that to this point reading and writing proofs has not been a priority in your math classes. That is one reason why this course is called a transitions course. One of our goals is to learn about and practice various techniques to construct proofs. As we begin the course, it’s important to remember that you are not expected to have already mastered the ability to write proofs. Our goal is to help you travel a long way down the road toward mastering how mathematics is communicated.

Forming arguments cannot be done in a vacuum. We need a context in which to acquire these
skills. Our context will be the study of topics that are used throughout mathematics, including divisibility, set theory, relations, and functions.

**Content and Learning Outcomes**

This course covers basic logic, proof techniques, set theory, functions, relations, and mathematical induction.

Students completing this course will:

- be able to analyze and understand logic statements.
- learn about and be able to use basic proof techniques.
- Know and work with some of the basic tools of mathematics: set theory, relations, and functions.

**Procedure**

Classes will primarily be lecture, with some time provided for discussion of the homework. Homework will be collected daily.

**Course Requirements**

**Attendance and Classroom Expectations**

You are expected to attend class. I will call roll for the first several days of the course and will continue to mark attendance for the remainder of the term. In the event that your grade is on the borderline at the end of the term it will be to your advantage to have few or no absences. Please let me know ahead of time if you know you will miss a class, come late, or leave early. Also, please refrain from leaving and re-entering the classroom while class is in session.

Laptops and tablets may only be used as appropriate for the current classroom activity. You may not use a cell phone or other device for texting or otherwise communicating with others during class. This activity prevents you from fully concentrating on our topic and is distracting to those around you and to the professor.

**Homework Assignments**

Homework will be due at the start of each class period. Only in unusual circumstances will an assignment be accepted late without penalty. The following are required of all assignments:

- Assignments are to be done on standard size paper.
- Pages should not have ragged edges from spiral bound notebooks.
- Solutions should be laid out in an organized manner.
- Multiple page assignments must be fastened together.
- Most importantly: your work must be legible; if it's too difficult to read then it will not be graded, but you may be given the opportunity to redo the assignment.
You are permitted to work together on the homework assignments. However, the work you turn in should be your own. These problems should be considered tools to help you better understand the theory and to become more proficient with the techniques of this course. It is essential that you understand the solution to each problem in order to derive the greatest benefit from this course. This is particularly important when it comes to making a mathematical argument and writing proofs.

Examinations
There will be two exams: one take-home exam during the term and a comprehensive final exam at the end of the term.

Grading Procedure

Your final average will be computed using the following table:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework</td>
<td>40%</td>
</tr>
<tr>
<td>Mid-quad Exam</td>
<td>30%</td>
</tr>
<tr>
<td>Final Exam</td>
<td>30%</td>
</tr>
</tbody>
</table>

The following table shows the correspondence between the final average and the letter grades that will be assigned.

- \([100 – 97]\) A+
- \([97 – 94]\) A
- \([94 – 90]\) A–
- \([90 – 87]\) B+
- \([87 – 84]\) B
- \([84 – 80]\) B–
- \([80 – 77]\) C+
- \([77 – 74]\) C
- \([74 – 70]\) C–
- \([70 – 67]\) D+
- \([67 – 64]\) D
- \([64 – 60]\) D–


# Tentative Schedule

<table>
<thead>
<tr>
<th>Date</th>
<th>Section(s)</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aug 27, Wed</td>
<td>1.0–1.3</td>
<td>Introduction, Using LaTeX, and Sets</td>
</tr>
<tr>
<td>Aug 29, Fri</td>
<td>1.4–1.9</td>
<td>Sets</td>
</tr>
<tr>
<td>Sep 1, Mon</td>
<td>No class</td>
<td>Labor Day</td>
</tr>
<tr>
<td>Sep 3, Wed</td>
<td>2.0–2.4</td>
<td>Logical Statements</td>
</tr>
<tr>
<td>Sep 5, Fri</td>
<td>2.5–2.8</td>
<td>Truth Tables, Equivalence, and Quantifiers</td>
</tr>
<tr>
<td>Sep 8, Mon</td>
<td>2.9–2.12</td>
<td>More on Logical Statements and Inference</td>
</tr>
<tr>
<td>Sep 10, Wed</td>
<td>4.0–4.3</td>
<td>Direct Proof</td>
</tr>
<tr>
<td>Sep 12, Fri</td>
<td>4.4–4.5</td>
<td>Proofs by Cases</td>
</tr>
<tr>
<td>Sep 15, Mon</td>
<td>5.0–5.3</td>
<td>Contrapositive Proofs and Mathematical Writing</td>
</tr>
<tr>
<td>Sep 17, Wed</td>
<td>6.0–6.2</td>
<td>Proof by Contradiction</td>
</tr>
<tr>
<td>Sep 19, Fri</td>
<td>6.3–6.4</td>
<td>More Proof by Contradiction—and when to avoid it</td>
</tr>
<tr>
<td>Sep 22, Mon</td>
<td>7.0–7.4</td>
<td>Proving Non-Conditional Statements (Take-home exam due)</td>
</tr>
<tr>
<td>Sep 24, Wed</td>
<td>8.0–8.2</td>
<td>Proofs Involving Sets: Element and Subset</td>
</tr>
<tr>
<td>Sep 26, Fri</td>
<td>8.3–8.4</td>
<td>Proofs Involving Sets: Set Equality</td>
</tr>
<tr>
<td>Sep 29, Mon</td>
<td>9.0–9.3</td>
<td>Disproof</td>
</tr>
<tr>
<td>Oct 1, Wed</td>
<td>10.0–10.1</td>
<td>Proof by Strong Mathematical Induction</td>
</tr>
<tr>
<td>Oct 3, Fri</td>
<td>10.2–10.3</td>
<td>Examples of Proof by Induction</td>
</tr>
<tr>
<td>Oct 6, Mon</td>
<td>11.0–11.3</td>
<td>Relations, Equivalence Relations, and Equivalence Classes</td>
</tr>
<tr>
<td>Oct 8, Wed</td>
<td>11.4–11.5</td>
<td>Integers Modulo $n$ and Relations Between Sets</td>
</tr>
<tr>
<td>Oct 10, Fri</td>
<td>12.0–12.3</td>
<td>Functions, Injection and Surjection, and The Pigeonhole Principle</td>
</tr>
<tr>
<td>Oct 13, Mon</td>
<td>12.4–12.6</td>
<td>Function Composition and Inverse Functions</td>
</tr>
<tr>
<td>Oct 15, Wed</td>
<td>13.0–13.2</td>
<td>Cardinality of Sets</td>
</tr>
<tr>
<td>Oct 16, Thu</td>
<td><strong>Final Exam</strong> 9:45 – 11:45 a.m.</td>
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(For Oct 16, Thu)