Math 103 (Intro to Upper Division Mathematics)

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Office Hours: Monday: 2:30-3:30PM, Tuesday: 12:15-1:15PM, Wednesday: 9:10-10:10AM, Friday: 1:15-2:15PM

Texts: How to Think Like a Mathematician: A Companion to Undergraduate Mathematics by Kevin Houston.
AND Writing Research Papers Across the Curriculum by Susan M. Hubbuch.

Prerequisites: English 5 and Math 38, or equivalent

Course Web Site: Moodle page: go to my.stmarys-ca.edu, log in, and click on “Gael-Learn (Moodle)”
This site will have course handouts available for downloading. It will be updated with other information as the semester progresses.

Course Description and Goals: This course is an introduction to mathematical logic and proofs. Learning to write proofs is an essential part of being a mathematician. In order to master the art of writing proofs, you will learn a variety of topics, including:

- Recognizing and composing basic logic statements, including the boolean operators AND, OR, and NOT, and the quantifiers FOR ALL and THERE EXISTS.
- Recognizing and composing statements of implication, converse statements, contrapositive statements, and negations of statements.
- Recognizing the difference between Axioms, Definitions, Lemmas, Theorems, and Corollaries.
- Reading proofs, understanding the assumptions made in the proof, and following the clear and careful organization of well-constructed statements of implications leading to a logical conclusion.
- Writing proofs using standard proof-writing organization and terminology, making the assumptions clear and using careful organization of well-constructed statements of implications to lead to a logical conclusion.
Techniques of proof-writing, including the techniques of direct proof, proof by contradiction, and induction.

Analyzing arguments so as to construct ones that are well supported, are well reasoned, and are controlled by well-defined axioms and/or assumptions.

Use the process of pre-proof-writing and scratchwork to enhance intellectual discovery and unravel complexities of thought.

You will also practice your new proof reading and proof writing skills to the topic of Abstract Algebra. Specifically, you will read and write proofs on

- The division algorithm and prime factorization
- Modular Arithmetic
- Rings, including \( \mathbb{Q}[x] \) and \( \mathbb{R}[x] \).
- Groups, including quotient groups.

Finally, you will be using outside sources for your final project. Through this activity, you will:

- Develop search strategies and use library catalogs and databases to find relevant material.
- Critically evaluate sources.
- Integrate and cite evidence appropriately.
- Understand the concept of intellectual property and practice academic honesty.

**Grading Policy:** We will have weekly homework, 3 exams, a grade component for in-class participation, and a final project. The breakdown will be as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Grade Component</th>
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<tr>
<td>Each of the 3 Midterms</td>
<td>15% of grade each</td>
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<tr>
<td>Written Homework</td>
<td>25% of grade</td>
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<tr>
<td>Class Participation</td>
<td>10% of grade</td>
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<tr>
<td>Final Project</td>
<td>20% of grade</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
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**Exams** We will have three tests throughout the semester. The tests will cover the “nuts and bolts” of logic and proof writing, such as terminology, logic statements, definitions, and Theorem statements. A significant portion of each exam will also include proof writing.

The tests will be taken in class and cannot be made up unless you have an extreme emergency that prevents you from being present. In the rare occasion that such an emergency occurs, you or a caregiver should contact me within 24 hours of the occurrence to let me know what has happened.
Written Homeworks: You will have written homework due weekly. This homework will be “scaffolded” in that your skills will build upon previously learned skills. Near the beginning of the semester, you will learn to write logic statements, and implication statements. You will then learn to make more complicated implication statements, using quantifiers. You will then learn to write negations of these more complicated implication statements. As you learn definitions in the area of Abstract Algebra, you will apply these skills to be able to write negations of definitions (for example, what it means if a ring element is NOT a zero divisor). Finally, you will learn to write proofs of your implication statements.

Proof writing is the core of mathematics, and the structure of a proof is very distinct. In order to master proof-writing, you must read and write many proofs and many different types of proofs. You will get a great deal of practice through the weekly homeworks.

Class Participation: Time in the classroom will be spent on lecture, small-group discussions, short presentations by students, and larger interactive discussion as an entire class. Your participation grade will be based on your attendance, your respectful and constructive criticism of the short writings of your peers, and your attentive participation during lecture and discussions. It will also be based on your feedback on a peer’s final project (see below).

Final Project: Your final project will be a culmination of all of the skills that you learned in this course. Specifically, you will choose an introductory topic in some area of mathematics. With the instructor’s approval, you will choose a book to read about this topic. (You will not need to read the entire book, only a portion of it). You will then write a short paper in which you will write a definition, write an example, write a negation, and write a proof.

For example, you may choose the topic of trees in graph theory. You could give the definition of a graph and the definition of a tree. You could then give a few examples of trees, and state what it means for a graph to NOT be a tree, giving examples. Finally, you could prove that every tree on \( n \) vertices must have \( n - 1 \) edges.

You must choose your topic and get instructor approval of your text by week 7. You will have a draft ready by week 10, which will be read by a peer who will give feedback (you must also give feedback to another student in the class). The final draft is due during the time scheduled for the final examination.

Student Disability Services: Student Disability Services extends reasonable and appropriate accommodations that take into account the context of the course and its essential elements for individuals with qualifying disabilities. Students with disabilities are encouraged to contact the Student Disability Services Office at (925) 631-4358 to set up a confidential appointment to discuss accommodation guidelines.
and available services. Additional information regarding the services available may be found at the following address on the Saint Mary’s website:

http://www.stmarys-ca.edu/sds

Honor Code: Saint Mary’s College expects every member of its community to abide by the Academic Honor Code. According to the Code, Academic dishonesty is a serious violation of College policy because, among other things, it undermines the bonds of trust and honesty between members of the community. Violations of the Code include but are not limited to acts of plagiarism. For more information, please consult the Student Handbook at

http://www.stmarys-ca.edu/your-safety-resources/student-handbook

Center for Writing Across the Curriculum: Students of all levels and disciplines are welcome to drop in or make appointments for one-on-one sessions with CWAC Writing Advisers. Students may request weekly or biweekly sessions with the same peer student Adviser. The Center, in Dante 202, is open 5-8 p.m. Sunday and 2-8 p.m. Monday through Thursday. The phone number is 925.631.4684. Through collaborative engagement, Advisers guide their peers toward expressing ideas clearly and revising their own papers with an eye toward audience and purpose. Writers should bring their assignments, texts, and related material.

Library Resources Reference/Information assistance is available at the Reference Desk, by phone (925) 631-4624, text message at (925) 235-4762 or Chat(IM). Check the Library’s “Ask Us” link for details: http://www.stmarys-ca.edu/library/ask-us. Extended assistance by appointment is also available with your librarian subject specialist. The Mathematics department librarian is Linda Wobbe who can be reached at lwobbe@stmarys-ca.edu or (925) 376-6097.