MATH 265-01 Transition to Advanced Mathematics

Fall 2014 · Syllabus

Class Information

Instructor: Dr. Lauren Williams
Class Meeting: Hirt M209, MWF 9:15 - 10:20 AM
Office: Old Main 401 (Tower)
Office Phone: (814) 824-2226
Office Hours: M 10:45 - 12 and M 4 - 5, T 9:15 - 12, W 10:45 - 12, F 10:45 - 12, and by appointment
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Course Description

This course is designed to facilitate the mathematics students transition to courses requiring a higher level of mathematical maturity. Emphasis will be on the reading and writing of proofs, and on communicating mathematicallyboth orally and in writing. Topics will include logic, set theory, functions, relations, and number theory.

Course Objectives

In this course, you will:

- learn to write using formal, mathematical language with correct notation.
- learn to construct direct proofs, proof by contradiction, and proofs by induction.
- learn to read mathematics critically, and be able to determine whether a proof is sound or flawed.
- define relations between sets of objects and the properties of those relations.
- learn the basic definitions and principles of logic, set theory, combinatorics, and number theory.
- be exposed to several different areas of mathematics, via direct study or within examples designed to clarify other topics.
- learn to apply new techniques of problem solving to challenging material, both in this course and in future study.

Textbook

We will be using the book *A Gentle Introduction to the Art of Mathematics*, Version 3.1SN, by Joe Fields. You will not need any additional materials for the course.

The author of this book has generously made it available as a free pdf. You can also order a printed copy from CreateSpace for about $16 if you prefer, but this is not required for the course.

There is also a workbook to accompany the text if you're looking for extra practice.

Homework

You will have homework assignments due approximately every week. These assignments will feature several questions taken from the text as well as other sources. Using proper mathematical notation and language will be a major part of your grade, aside from simply answering questions correctly. Your lowest homework grade will be dropped when calculating your grade.

Exams

We will have two in class exams on the following dates. You will be given an exact list of topics, along with a review sheet posted here, approximately one week before each exam. Use of notes, textbooks, calculators, electronic devices, or other materials will not be permitted during an exam.

Your lowest exam grade will be replaced by your final exam grade, if your final exam grade is better. There are no make up exams; a missed exam grade will be replaced by your final exam grade. A second missed exam will receive a grade of 0, so please check your schedules carefully and ensure that you can attend all exams.

- Monday, October 6
- Monday, November 10

The final exam will be cumulative, and is scheduled for **Friday, December 12, 8:30 - 10:30**.

Final Grades

Grades will be calculated as follows:

30% - Average of 2 in class exams
50% - Average of homework assignments (lowest grade dropped)
20% - Final Exam

Grading scale:

F	D	D+	C	C+	B	B+	A
0-59	60-64	65-69	70-77	78-83	84-89	90-93	94-100

Support of the Mercy Mission

This course supports the mission of Mercyhurst University by creating students who are intellectually creative. Students will foster this creativity by: applying critical thinking and qualitative reasoning techniques to new disciplines; developing, analyzing, and synthesizing scientific ideas; and engaging in innovative problem solving strategies.

Student Learning Outcomes

Your written homework in this course will be used to assess your ability to effectively write mathematics. This assessment does not affect your grade, and a separate rubric will be used for the assessment vs your assignment grade.

Learning Differences

In keeping with college policy, any student with a disability who needs academic accommodations must call Learning Differences Program secretary at 824-3017, to arrange a confidential appointment with the director of the Learning Differences Program during the first week of classes.

Other Information

1. I will attempt to return emails as thoroughly and promptly as possible. However, it is generally better to ask complicated questions during class or in office hours. If you have a question about the homework, it is quite likely someone else has the same question, so you're doing the class a favor by asking!
2. I do not keep detailed lecture notes. It is highly recommended that you establish contacts among your classmates to get notes in case you miss class.
3. Attendance is not required, but coming to class regularly will generally improve your grade. You are responsible for any work material covered in your absence. Please contact me if you are absent for an extended period.

Is This The Right Class For You?

If you find any of the following intriguing, then this is the class for you. We may not get to all of these, but you'll at least be on the right path.

1. In any group of 23 people, there is (slightly over) a 50% chance that two of them share the same birthday. It is nearly certain (99.95%) among a group of 75 people.
2. There are as many numbers between 0 and 1 as there are in the entire real number line.
3. The words friendly, imaginary, group, ring, field, fiber, smooth, nice, braid, chaotic, surreal, normal, tree, pole, uncountable, tropical, and ideal are all mathematical terms.
4. There is a very good chance that you have a parallelepiped in your backpack right now.
5. Coastlines, ferns, stock markets, mountain ranges, broccoli, and fractals all have something in common.
6. There are 169,518,829,100,544,000,000,000,000,000 ways to play the first 10 moves in a game of chess.
7. There is a geometry in which triangles have less than 180°, and two lines parallel to a third line may intersect.
8. Out of all shapes with the same area, a circle will have the smallest perimeter.
9. To multiply any two digit number by 11, add the two digits together. If the sum is a single digit, insert the sum in the middle: 23*11 = 253. There's an easy trick if the sum is two digits, too.
10. You're on a game show where you're shown three doors. There's a prize behind one, and nothing behind the other two. If you pick the right door, you win the prize. You pick door #2, and without opening your door, the host shows you that there is no prize behind door #3. The host gives you a chance to switch to door #1 before the location of the prize is revealed. You should take it.
11. The word *calculus* is the Latin word for pebble. Many early results in mathematics were obtained by sorting small stones.
12. There is only one cube that is one less than a square.
13. A wallpaper pattern is a pattern that can be repeated infinitely in both directions. Mathematically, there are only 16 different wallpaper patterns.
14. Some of the most famous conjectures in mathematics are intuitive, hundreds of years old, and can be understood by a high school student. Yet, they remain unproven.

Course Schedule

Aug 27	**Topic**: Types of Numbers and a First Proof	
Aug 29	**Topic**: Basic Number Theory and Relations	
Sep 1		*NO CLASS*
Sep 3	**Topic**: 2.1 Predicates and Logical Connectives	**Homework 1 Due**
Sep 5	**Topic**: 2.2 Implication	
Sep 8	**Topic**: 2.3 Logical Equivalences	
Sep 10	**Topic**: 2.4 Two Column Proofs	**Homework 2 Due**
Sep 12	**Topic**: 2.5 Quantified Statements	
Sep 15	**Topic**: 2.6 Deductive Reasoning and Argument Forms	
Sep 17	**Topic**: 2.7 Validity of Arguments and Common Errors	**Homework 3 Due**
Sep 19	**Topic**: 3.1 Direct Proofs of Universal Statements	
Sep 22	**Topic**: 3.2 More Direct Proofs	
Sep 24	**Topic**: 3.3 Contradiction and Contraposition	**Homework 4 Due**
Sep 26	**Topic**: 3.4 Disproofs	
Sep 29	**Topic**: 3.5 By Cases and By Exhaustion	
Oct 1	**Topic**: 3.6 Existential Statements	**Homework 5 Due**
Oct 3	**Topic**: Review for Exam I	
Oct 6		**Exam I**
Oct 8	**Topic**: 4.1 Basic Notions of Set Theory	
Oct 10		*NO CLASS*
Oct 13	**Topic**: 4.2 Containment	
Oct 15	**Topic**: 4.3 Set Operations	**Homework 6 Due**
Oct 17	**Topic**: 4.4 Venn Diagrams	
Oct 20	**Topic**: 5.1 The Principle of Mathematical Induction	
Oct 22	**Topic**: 5.2 Formulas for Sums and Products	**Homework 7 Due**
Oct 24	**Topic**: 5.3 Other Proofs Using PMI	
Oct 27	**Topic**: 6.1 Relations	
Oct 29	**Topic**: 6.2 Properties of Relations	**Homework 8 Due**
Oct 31	**Topic**: 6.3 Equivalence Relations	
Nov 3	**Topic**: 6.4 Ordering Relations	
Nov 5	**Topic**: 6.5 Functions, 6.6 Special Functions	**Homework 9 Due**
Nov 7	**Topic**: Review for Exam II	
Nov 10		**Exam II**
Nov 12	**Topic**: 7.1 Counting	
Nov 14	**Topic**: 7.2 Parity and Counting Arguments	
Nov 17	**Topic**: 7.3 The Pigeonhole Principle **Topic**: 7.4 The Algebra of Combinations	
Nov 19	**Topic**: 8.1 Equivalent Sets	**Homework 10 Due**
Nov 21	**Topic**: 8.2 Examples of Set Equivalence	
Nov 24 - 28		*NO CLASS*
Dec 1	**Topic**: 8.3 Cantor's Theorem	
Dec 3	**Topic**: Selected Topics	**Homework 11 Due**
Dec 5	**Topic**: Review	
Dec 12	**FINAL EXAM, Final Exam 8:30 - 10:30**	