Transitions to Advanced Mathematics

MATH 180, Fall 2017

Section 01

Instructor: Stephen Flood

Office: DMF 443, in the Center for Science & Mathematics (near the Rondileau Campus Center).

Office Hours: Monday 4:45-5:45, Wednesday 10:30-11:30, and Friday 3:00-4:00.

To see me at the posted hours, JUST DROP IN! In addition, I have an
Open Door Policy: If my door is open, then I am happy to answer quick questions!

Email: `stephen.flood@bridgew.edu`
Email Policy: I try to respond to questions by some time the next business day.

Textbook:

- *Book of Proof*, by Richard Hammack, Second Edition.

  This book is avaliable as a PDF for **free** on the author's webpage
  `http://www.people.vcu.edu/~rhammack/BookOfProof/`.

  I also recommend that you purchase a paper copy from the bookstore for **only** $20 (!)

- Additional Notes and Resources will be distributed via the class page.

Important Websites

1. **Blackboard:** General information about this section, including my office hours, and some study aids will be posted at `blackboard.bridgew.edu`

2. **WebWork:** WebWork is a free *online homework system.*

   To log in, go to the `Blackboard Page`, select `Course Content`, and click on the link to `WebWork`.

   I have written an *Introduction and FAQ* at https://webwork.bridgew.edu.
   Let me know if you encounter an error message, or have any question not answered in the FAQ.

   My goal is to provide you with high quality online homework experience, for free.

3. **Email:** It is important to regularly check your Bridgewater email.

Course Description

Topics: This course is an introduction to formal mathematics and provides a transition from computation-based mathematics to the more theoretical approach used in advanced mathematics courses. A large emphasis is placed on reading, analyzing and learning to produce proofs of mathematical statements

Learning Outcomes. By the end of the course, you will be able to:

1. Skills (for *each* mathematical topic)
   - Understand the logical structure of a sentence and argument
   - Know the relevant **definitions**.

- Be able to *use* definitions to give examples and counterexamples
- Be able to *use* definitions to create an argument.

2. Mathematical Topics
   - Sets, subsets, and operations on sets.
   - Elementary symbolic logic.
   - Proving statements about even and odd numbers, divisibility, and prime numbers.
   - Functions and Relations

Alignment with the Common Core

Teaching mathematics is one of the most important jobs in our 21st century world. For those who are interested, the Mathematics Major at BSU will help you prepare to be an excellent mathematics teacher in elementary, middle, or highschool.

The *first* of the Guiding Principles for Mathematics Programs in Massachusetts, as presented in the 2017 Massachusetts Curriculum Framework, states:

> Educators must have a deep understanding of the mathematics they teach, not only to help students learn how to efficiently do mathematical calculations, but also to help them understand the fundamental principles of mathematics that are the basis for those operations. Teachers should work with their students to master these underlying concepts and the relationships between them in order to lay a foundation for higher-level mathematics, strengthen their capacity for thinking logically and rigorously, and develop an appreciation for the beauty of math.
>
> (Guiding Principle 1, on page 14 of the 2017 Massachusetts Curriculum Framework.)

This class is designed to help you begin the process of deepening your understanding of mathematics and of understanding the fundamental principles of mathematics.

Formats and Procedures

The course consists of 3 parts

1. In class lectures, worksheets, & quizzes (3 hours/week)
2. Regular Homework Assignments (6-9 hours/week)
3. Studying to prepare for homework and quizzes (normally ∼3 hours/week, but more before an exam).

The suggested study times for the *average* student (see any website about studying in college). If you are weak in mathematics, you will require more time, but **please talk to me** and I can help you work more efficiently. You can also find useful advice online:

- Math Study Skills: http://mathcs.slu.edu/undergrad-math/success-in-mathematics

Grades

Your grade will be earned as follows. There is no extra credit.

Exam I and II	25% *each*
Homework & Quizzes	25%
Final Exam	25%
Total	100%

Exams, homework, and quizzes will be graded for correctness, completeness, and clarity. The more clear your explanation and organization, the more points you will earn! This also means that points may be deducted for confusing organization and poor handwriting, as well as for incomplete or incorrect work.

How to succeed in this class

This class is designed to introduce you to a *new aspect* of the mathematical method.

We will discover that mathematics has a regular cycle: (1) Recognize a concept. (2) Capture the concept with a precise definition. (3) Illustrate the definition. (4) Use the definition in computations and arguments. (5) Now that you understand the concept, you recognize new patterns. Repeat!

To *succeed* in this class, you will need to

- *Know all definitions:* use **Flash Cards** to memorize them.
- *Understand definitions:* practice **making up** examples that illustrate the pattern and definition.
- *Use definitions:* develop the habit of **collecting** computations and arguments involving each definition.

  Regularly *quiz* yourself the facts, and your ability to combine them in new ways.

Exams

There will be two full length in-class exams and one final exam. The final exam will be cumulative: anything we've studied is fair game. The in-class exams generally cover the material since the last exam. No calculators are permitted on any exam, unless otherwise stated.

No makeup exams are scheduled. If you miss an exam for a valid reason (documented illness, documented family emergency, etc.), your exam grade will be determined by averaging the other exams. At my discretion, I may choose to assign a makeup exam instead.

Tentative dates are given in the Approximate Calendar of Study, below. *Please contact me before the exam* if you will need to miss it. It is much harder to document "valid reasons" after you have missed the exam.

Homework and Quizzes

Quizzes

There will be occasional quizzes. These will be short assignments, and their main purpose is to give you a chance to use, practice, and explore the concepts and tools that we are learning.

In class quizzes and graded worksheets may or may not be announced in advance, and cannot be made up.

Homework

Graded Homework will be assigned and due weekly. Some problems on the homework simply practice ideas covered in class. Other problems will combine the definitions, computations, and ideas in *a variety of new ways.* To succeed, you will also need to *communicate* clearly.

You *must* clearly organize your work, give clear explanations, and use correct terminology and notation.

From time to time **you will** become stumped. In this case, **you should** come to my office hours, drop by my office, or email me to ask for a hint or explanation.

Group Work and Study Aids

You have many excellent resources available to aid you as you work. For example, *you can ask me any and all questions during office hours!* You also have answers to the odd numbered problems in the textbook.

Group work can be helpful. **But** I strongly encourage you to *work on problems yourself first*, before discussing them with your peers. Probably the best way to check that you understand a problem is to ask this question:

"Can I reproduce the solution and explain it to a classmate a whole 10 minutes after I finished the problem?" Try this with the people you are studying with, and have them check your reasoning.

But always remember: you will benefit the most if you *make a serious effort to solve the problems on your own* before you obtain hints or other assistance.

Students with Disabilities

At BSU, we are committed to making our facilities, services, and programs accessible to all students in compliance with applicable law. Students with disabilities who desire reasonable accommodations should contact the Disability Resources Office to discuss the availability of reasonable accommodations or to obtain documentation guidelines. They are located in the Maxwell Library Ground Floor (AAS). You should also contact me by email or during office hours to discuss accommodations due to a documented disability.

Final Letter Grades

The final letter grade cutoffs are as follows:

Percentage:	94	90	87	83	80	77	73	70	60	0
Letter Grade:	A	A-	B+	B	B-	C+	C	C -	D	F

`NOTE: Official grades cannot` ***`and will not`*** `be changed once posted.`[1]

Academic Integrity

Academic honesty is expected of all students. Plagiarism and cheating are subject to academic penalty, which may result in a grade of F for the whole course. In fact, *a violation may result in a reduced grade, suspension, or dismissal from the university.*

You must not not cheat, fabricate, plagiarize, or facilitate academic dishonesty. If you passively engage in cheating (i.e. allowing others to cheat off you) you may receive the same consequences as the person copying.

Withdrawl Policy

Students are allowed to withdraw from a course (see academic calendar for last date to withdraw). In order to receive a grade of "W", students must officially withdraw from a course by completing a withdrawal form. These withdrawal forms, also called drop/add forms, are available in the Enrollment Services Office. Failure to attend classes does not constitute a course withdrawal. Students, who stop attending class, without officially withdrawing, will receive an earned final grade, which may be a failure, if requirements have not been met.

Important Dates

Last day to add/drop: September 13, 2017. *Last day to withdraw:* November 17, 2017.

Tentative Exam Dates:

See "Approximate Calendar of Study" _____ (Subject to Change)

Final Exam Date:

Wednesday, Dec. 20 from 8:00 AM – 10:00 AM _____ (**Set By University**)

[1] Unless there was an error in the grade computation

Approximate Calendar of Study

This schedule is a preliminary outline, and you should expect it to change from time to time.
In particular, it is likely that the days marked "review" will include some amount of new material.

Lesson		Date	Section	Topic	Remarks
1.		4-Sep			
	1		2.1	Statements and Logical Worlds	
	2		2.2, 2.5, 2.6	Combining Sentences and Logical Equivalence	
2.	3	11-Sep	2.3	Conditional Sentences	
	4		2.4	Conditional Sentences II	
	5		2.10.	Negations I	Quiz 1
3.	6	18-Sep	2.10.	Negations II	
	7			Valid Deductions I	
	8			Valid Deductions II	
4.	9	25-Sep		Valid Deductions III	
	10		2.7	Quantifiers and Universes	
	11		2.7	Translating Quantifiers and Multiple Quantifiers	Quiz 2
5.	12	2-Oct	2.10.	Negating Quantifiers	
	13			Necessary and Sufficient Conditions	
	14			Exam I Review	
6.		9-Oct		– No Class –	Columbus Day
	15			Exam I	
	16		1.1	Defining Sets and Set Builder	
7.	17	16-Oct	8.1	Examples of elements, and Proving that $x \in A$	
	18		1.3	Subsets, Set Equality, and Easy Subset Proofs	
	19		1.5, 1.6	Defining Set Operations	Quiz 3

Lesson		Date	Section	Topic	Remarks
8.	20	23-Oct	8.2	Proofs about Basic Set Operations	
	21		1.7	More Set Operations (on 3 sets)	
	22		1.7	More set Operations	
9.	23	30-Oct		Proofs about Relations - is it a function?	
	24			Proofs about Functions - is it one-to-one or onto?	
	25		4.1, 4.2	Exploring Definitions about Natural Numbers	Quiz 4
10.	26	6-Nov	4.3	Proving Implications	
	27		4.3	Proving Implications	Friday Class Schedule
				– No Class –	Veterans Day
11.	28	13-Nov		Exam II Review	
	29			Exam II	
	30		4.4	Proving "If and Only If"	
12.	31	20-Nov	4.4	Proof by Cases	
	32		4.4	Proof by Cases	
				– No Class –	Thanksgiving Recess
13.	33	27-Nov	5.1	Proof by Contrapositive	
	34		5.1	Proof by Contrapositive	
	35		6.1	Proof by Contradiction	Quiz 5
14.	36	4-Dec	6.1	Proof by Contradiction	
	37		10.1	Induction and Recursion	
	38		10.1	Induction and Recursion	
15.	39	11-Dec	10.1	Induction and Recursion	
	40			Final Exam Review	
				– No Class –	**Final Exams Begin**