

Math 110 – Mathematical Explorations

Block 4 2005

Course Procedures

Professor: Josh Laison

Tutt 201

x6544

jlaison@coloradocollege.edu

Paraprofessional: Rahbar Virk (RV)

Tutt 210

x6727

Class Meetings: 9:00-10:30 and 1:00-2:00, Monday through Friday, Tutt 101

9:00-11:00, Wednesday, December 21

Problem Sessions: 10:30-11:30, Monday through Friday, Tutt 101

Office Hours: 2:00-3:00 PM, Monday through Thursday, Tutt 201

Evening Group Study Sessions: 7:00-9:00 PM, Sunday through Thursday, Math Lounge

Text: The Heart of Mathematics, Ed Burger and Michael Starbird

Course Web Page: <http://faculty1.coloradocollege.edu/~jlaison/explorations.htm>

Grading:

Daily Problems (17)	15%
Team Problems (6)	30%
Individual Problems (6)	30%
Class Participation and Attendance (18 days)	15%
Group Project	10%
Total	100%

The Textbook:

The text is probably different from any other math text you have seen (I know that is true for me) and you might be surprised that it is actually fun to read. Certainly, reading it will provide you with greater understanding of the material of the class, and improve your grade.

Assigned Problems:

In this course, you will learn quite a lot of mathematics, but with a slightly different emphasis than other mathematics courses you may have taken in the past. The course is not a prerequisite for any other, and it is unlikely that you will require the material you learn in this course for your career after you graduate. The material is simply presented to satisfy your own intellectual curiosity.

I will try as hard as I can to avoid making any problem you attempt in this course tedious or overly frustrating. Mathematics is all about solving puzzles, exploring patterns, and getting insights into new ideas. For your part, try not to race through the problem assignments with the goal of arriving at the solution as quickly as possible. Play with the ideas! Invent new problems and solve those! Discuss the problems with your friends and classmates! The problems are intended not as hurdles to be leapt over, but as intellectual challenges to be enjoyed. I hope that you will enjoy them as much as I do. *To encourage you to think creatively, particularly interesting, creative, or unique solutions to any problem in this course will be given extra credit. This includes solving a related question that you pose yourself.*

There will be three types of assigned problems in this course. All of them will be available on the course webpage at least a few days before they are due.

- **Daily Problems:** Daily assigned problems will be due every day at 4:30 PM, starting on Tuesday, November 29. They are designed to help you become familiar with the day's topic(s). I encourage you to talk to me, to RV, and to each other about the daily problems. However, when it comes time to write down your solutions to the homework problems, please do so on your own.
- **Team Problems:** Team problems will be due approximately once every three days. You will work with a team of one or two other students on these problems, and will turn in a single solution to each problem for your team. This does not mean that you should divide up these problems and each work on a third of them. They are meant to be discussed in collaboration. I hold you accountable to be an active member of your team.
- **Individual Problems:** The individual problems will also be due once every three days. On these problems, you may talk to no one but me. These problems will be your chance to show your individual problem-solving ability. They will be related to topics covered in class, but different enough that you can work on them independently and still work on the other two types of problems collaboratively.

Since the individual problems are the only completely independent work I will receive from you this block, I will treat collaboration on the individual problems very seriously. Please make every effort to keep your work on these problems independent.

Group Projects: On the group project, you will have an opportunity to explore mathematical ideas beyond what we cover in class. I will provide you with a list of suggested readings, which may be about a mathematical topic, or the history and culture surrounding a piece of mathematics, or both. Each group of 2 students will give a 15-20 minute presentation about their topic to the rest of the class at some point during the block. I encourage groups to sign up for their presentations on different days of the block, so that the class can see a variety of side topics as we progress through the block.

Group Homework Sessions:

The problem sessions will be an opportunity for you to work with other members of the class in a slightly more organized setting. I will be available to answer questions. I do not expect to make any formal presentations during the problem sessions, however, I expect you to attend.

Late Assignments and Missed Classes:

1. Do not turn in late assignments.
2. Do not miss class.
3. If for some reason you are unable to attend class or turn in an assignment, please let me know *as soon as possible*, preferably *before* the missed class or assignment. The longer you wait to tell me, the less sympathetic I will become. The *worst* is to never tell me about it at all.

Exams:

There will be no exams in this course.

Honor Code:

on the daily problems: You may, and are encouraged to, discuss the homework with anyone, get help from calculators, your textbook, etc. However, your submitted written work should be your own.

on the team problems: Each member of the group should contribute to the final product. Do not put your name on a paper written by others.

on the individual problems: You may consult your text and notes. You may not discuss the individual problems with anyone other than me.

Tentative Syllabus

We will cover most of these topics, at the rate of approximately one a day. Since some topics may take more than one day, some of them will be left out. If a particular topic looks especially appealing or unappealing to you, let me know, and I will take it into consideration in planning the rest of the course.

- Chapter 1: Introductory puzzles
- Sections 2.2, 4.3: The Fibonacci numbers and the golden ratio
- Section 2.3: Prime numbers
- Section 2.4: Modular arithmetic
- Sections 2.6, 2.7: Rational, irrational, and real numbers
- Sections 3.1-3.5: Sets and infinity (2 days)
- Sections 4.1, 4.2: The Pythagorean and Art Gallery Theorems
- Section 4.4: Tilings and tessellations
- Section 4.5: The Platonic solids
- Sections 4.6, 4.7: Non-Euclidean geometry and higher dimensional space
- Sections 5.1, 5.2: An introduction to topology
- Section 5.3: An introduction to graph theory
- Section 5.4: An introduction to knot theory
- Sections 6.1, 6.3, 6.6: Fractals
- Section 6.2: Dynamical systems and cellular automata
- Section 6.4: Julia and Mandelbrot sets
- Sections 8.4, 8.5: Decisions, voting theory, and cake-cutting algorithms