GOSHEN COLLEGE
MATHEMATICS DEPARTMENT
MATH 205 DISCRETE MATHEMATICS - FALL 2011

Motivation

Scientists, economists, and others use mathematics to create models and perform calculations to gain a better understanding of the world. Mathematicians use abstraction and deductive reasoning to analyze quantity, shape, and structure. Math 212 Calculus II (continuous structures) and this course (discrete structures) help you transition from a user of mathematics to a creator of mathematics.

Learning Objectives

The student will

1. Use truth tables, symbolic logic, and proof schema to analyze and write definitions, conjectures, and proofs (logical thinking);
2. Describe informal representations, state formal definitions, and provide examples and nonexamples of basic set, function, relation, and graph concepts, and use these concepts to solve problems (relational thinking);
3. Use and create recursive definitions to solve problems, and use mathematical induction to prove theorems (recursive thinking);
4. Use addition and multiplication principles to count discrete structures and algorithmic steps (quantitative thinking);
5. Create, code, execute, and analyze algorithms (algorithmic thinking); and
6. Read, write, listen to, present, and converse about mathematics effectively (communication and learning).

Prerequisites

Grades of A or B in 3-4 years of high-school mathematics, including precalculus or advanced math. An SAT math score of 600 or more or an ACT score of 26 or more is highly recommended.

Instructor

David Housman, SC 117, dhousman@goshen.edu, 535-7405, 875-0339 (home)
Office hours posted on office door and at http://people.goshen.edu/~dhousman/Schedule11Fall.htm

Class Time

MWF 9:00-9:50 a.m. in WY 123.

Textbook

Essentials of Discrete Mathematics, by David J. Hunter, 2nd edition, Jones & Bartlett Learning, 2012, ISBN-13: 978-1-4496-0442-4.

On-line

https://moodle.goshen.edu and M:\Classes\MATH205.

Software

Mathematica, which is available on all campus computers.

Notebook

A three-ring binder with loose-leaf lined and graph paper is recommended so that you can keep a written record of problem solving attempts, questions, math discoveries, and skill assessments.

Activities

The study of mathematics is not a spectator sport! Reading, listening, solving problems, writing explanations, reflecting upon ideas, and receiving feedback are essential to learning mathematics. An average student can obtain an average grade with an average of nine hours each week devoted to this course—adjust if you are not average or desire a grade that is not average.

Moodle will announce the preparation for a class and the graded assignment to be completed before the next class. The preparation will typically involve reading a portion of the text and attempting a selection of odd numbered exercises. During class, a pair of student presenters or the instructor will provide a brief reminder of the key points from the reading and detailed solutions for the selected exercises. All students will verify the correctness of the solutions, ask questions, and provide personal insights. At times, the entire class will engage in problem solving activities.

Grading

Course grades will be based on performance on assignments (40%), presentations (10%), three midterm exams (30%), and a comprehensive final exam (20%). If helpful, the final exam grade will replace one of the exam scores or one-quarter of the assignment score. Final numerical averages will be translated into letter grades in the following manner.

Assignments

Achieve and exhibit understanding by completing the assigned exercises. You are encouraged to collaborate and seek assistance when having difficulties; however, you should eventually write your own solutions. You will have achieved the expected level of understanding when you are able to obtain your own solutions, reproduce on your own solutions developed in collaboration or with assistance, and/or explain a solution to others.

Assignments will be collected at the beginning of almost every class. Rewrites and late submissions will be assessed a 30% penalty and typically be due the second class after the original due date

Exams

Exhibit your ability to solve problems and describe mathematical concepts without assistance or collaboration. There will be both an in-class portion and a take-home portion that will be due when the in-class portion is taken.

Presentations

Practice presenting mathematical information to others. At least four times, you and a partner will present the main ideas of a portion of the text and solutions to exercises that everyone has been asked to explore.

Extra Credit

Find errors in the text or posted course materials, attend a quantitative presentation (e.g., Science Speakers), or participate in a quantitatively based activity (e.g., Math Problem of the Week) to receive extra credit toward your assignments grade. Send an email to the instructor describing the error or some interesting mathematical aspect of the presentation or activity.

Tentative Schedule

Topic	Chapters	Exam Date
Logical Thinking	1	Friday, September 23
Relational Thinking	2	Friday, October 21
Recursive & Quantitative Thinking	3 – 4	Monday, November 14
Everything	1 – 6	Wednesday, December 7, 8-10am

Academic Resource & Writing Center and Disabilities

Goshen College wants to help all students be as academically successful as possible. If you have a disability and require accommodations, please contact Lois Martin, the Director of the Academic Resource & Writing Center early in the semester. In order to receive accommodations, documentation concerning your disability must be on file with the Academic Resource & Writing Center, Good Library 113, x7576, lmartin@goshen.edu . All information will be held in the strictest confidence. The Academic Resource & Writing Center offers tutoring and writing assistance for all students. For further information please see http://www.goshen.edu/studentlife/asc.php.

Collaboration and Academic Integrity

You are encouraged to use all available resources in order to learn the concepts and techniques discussed in this course. In particular, conversations with other students and the instructor can be an effective learning method. Reading other books and web pages can be another effective learning method. However, copying someone else's work subverts the learning process.

For assignments, you may look at and discuss another student's work, but any written work developed during collaboration with another student should be destroyed before writing your own solutions. You should give written acknowledgement to people with whom you have had discussions and to any written materials (other than the text) that were helpful.

For exams, you may *not* use any resources unless a specific exception is stated by the instructor.

Failure to observe the above rules will result in a zero on the assignment or exam. Any violation of academic integrity will be reported to the Academic Dean.

Observation of the above rules will help you learn the material well and give you the satisfaction of knowing that you have earned your grade.

Exam 1 Learning Objectives

This exam will be on the content of Chapter 1 Logical Thinking. Specifically, you should be able to

1. Translate between verbal statements and symbolic statements involving simple statements, predicates, logical connectives (not, and, or, and implies), and quantifiers (for all and there exists).
2. Negate and simplify verbal and symbolic statements.
3. Construct and use truth tables to prove equivalences, validate arguments, and solve problems.
4. Use equivalence and inference rules to write proof sequences.
5. State and use the formal definitions of odd, even, and divides.

6. Develop and write simple direct, contrapositive, and contradiction proofs using axioms, previously proved results, and definitions.

Exam 2 Learning Objectives

This exam will be on the content of Chapter 2 Relational Thinking. Specifically, you should be able to

1. State from memory the formal definitions of subset, union, intersection, complement, power set, Cartesian product, even, odd, divides, rational number, function, one-to-one, onto, one-to-one correspondence, composition, inverse, relation, and equivalence relation.
2. Provide and work with visualizations, examples, and non-examples of set, element, subset, union, intersection, complement, power set, Cartesian product, cardinality, inclusion-exclusion principle, natural number, even, odd, divides, integer, rational number, real number, function, one-to-one, onto, one-to-one correspondence, composition, inverse, relation, equivalence relation, mod, directed graph, undirected graph, isomorphism, degree, path, circuit, connected, color, Euler path, Euler circuit, Hamilton path, Hamilton circuit, and tree.
3. Solve problems and write proofs using the previously listed concepts.

Exam 3 Learning Objectives

This exam will be on the content of Sections 3.1-4 Recursive Thinking and Sections 4.1-4 Quantitative Thinking. Specifically, you should be able to

1. Compute the values of a recursively defined formula.
2. Find a recursive formula for a sequence of numbers.
3. Find a closed form formula for a sequence of numbers.
4. Use mathematical induction to prove that a recurrence relation is equivalent to some conjectured closed form formula.
5. Determine the structures (e.g., strings, geometric figures, or sets) from a recursive definition.
6. Write a recursive definition for a given structure.
7. Use mathematical induction to prove that a recursive definition is correct.
8. Use the addition principle, multiplication principle, rule of complements, inclusion exclusion principle, arrangement principle (permutations), selection principle (combinations), inclusion exclusion principle, binomial theorem, and tree diagrams to count the number of elements in sets and determine probabilities.

Final Exam Learning Objectives

This exam will be on the content of the entire course. A list of learning objectives can be found in the syllabus. In addition to the specific learning objectives from Exams 1-3, you should be able to

1. Trace, count operations executed, and describe the results of algorithms presented as pseudocode or Mathematica code.
2. Create and write simple algorithms in pseudocode and Mathematica code.