

Montgomery County Community College
 MAT 211
 Foundations of Mathematical Proof
 3-3-0

COURSE DESCRIPTION:

This course is designed to introduce students to the foundations of higher mathematics, which includes an introduction to mathematical abstraction and an introduction to the language of mathematical proof. Topics include: logic; the use of quantifiers to assist with logic; set theory; applying appropriate proof techniques; relations and functions, including the Cartesian product and its applications. This course is highly recommended for those students who have not been exposed to mathematical proof and intend to take advanced math courses.

REQUISITE(S):*Previous Course Requirements*

- MAT 190 Calculus & Analytic Geometry I with a minimum grade of "C"

Concurrent or Previous Course Requirement

- MAT 201 Calculus & Analytic Geometry II

LEARNING OUTCOMES Upon successful completion of this course, the student will be able to:	LEARNING ACTIVITIES	EVALUATION METHODS
1. Distinguish between statements and non-statements in logic and define the logical connectives.	Lectures Small Group Discussions and/or Projects Homework Quizzes Projects	Exams Quizzes Homework Projects
2. Analyze statements with truth tables.	Lectures Small Group Discussions and/or Projects Homework Quizzes Projects	Exams Quizzes Homework Projects
3. Identify the hypothesis and conclusion of a conditional statement and determine the converse, contrapositive and, inverse of the statement.	Lectures Small Group Discussions and/or Projects Homework Quizzes Projects	Exams Quizzes Homework Projects

LEARNING OUTCOMES	LEARNING ACTIVITIES	EVALUATION METHODS
4. Distinguish between the universal quantifier and the existential quantifier, and determine truth values of quantified statements.	Lectures Small Group Discussions and/or Projects Homework Quizzes Projects	Exams Quizzes Homework Projects
5. Distinguish between sets and elements. Establish and use the notation of set theory.	Lectures Small Group Discussions and/or Projects Homework Quizzes Projects	Exams Quizzes Homework Projects
6. Define and apply principles of sets, subsets, and set equality.	Lectures Small Group Discussions and/or Projects Homework Quizzes Projects	Exams Quizzes Homework Projects
7. Define and use the basic algebraic properties of sets (including indexed families of sets) and use this knowledge to obtain more properties.	Lectures Small Group Discussions and/or Projects Homework Quizzes Projects	Exams Quizzes Homework Projects
8. Determine the validity of an argument, including providing counterexamples for false statements.	Lectures Small Group Discussions and/or Projects Homework Quizzes Projects	Exams Quizzes Homework Projects
9. Define the Cartesian Product of two sets.	Lectures Small Group Discussions and/or Projects Homework Quizzes Projects	Exams Quizzes Homework Projects
10. Define basic properties of a relation (and the relations' inverse), including relations from one set to another as a subset of a Cartesian Product.	Lectures Small Group Discussions and/or Projects Homework Quizzes Projects	Exams Quizzes Homework Projects

LEARNING OUTCOMES	LEARNING ACTIVITIES	EVALUATION METHODS
11. Define a function as a relation; determine the image and pre-image of functions; determine the basic properties of functions including sum, difference, and composition, and define the properties of one-to-one and onto for functions.	Lectures Small Group Discussions and/or Projects Homework Quizzes Projects	Exams Quizzes Homework Projects
12. Recognize bijections and determine the inverse of bijections.	Lectures Small Group Discussions and/or Projects Homework Quizzes Projects	Exams Quizzes Homework Projects
13. Recognize, and apply valid methods of mathematical proof, including use of truth tables, method of direct proof, method of indirect proof, method of proof by cases, and the of the Principle of Mathematical Induction.	Lectures Small Group Discussions and/or Projects Homework Quizzes Projects	Exams Quizzes Homework Projects

At the conclusion of each semester/session, assessment of the learning outcomes will be completed by course faculty using the listed evaluation method(s). Aggregated results will be submitted to the Associate Vice President of Academic Affairs. The benchmark for each learning outcome is that *70% of students will meet or exceed outcome criteria.*

SEQUENCE OF TOPICS:

1. Intro to Sets and Subsets; Set Operations
2. Indexed Families of Sets; Intro to Logic and Truth Tables
3. Logic continued: Disjunction, Conjunction, Biconditional, and Implications
4. Logic: Tautologies, Contradiction, Equivalences
5. Quantified Statements
6. Intro to Proofs: Direct Proofs & Proof by Contrapositive
7. Proofs by Cases, Applications of Proofs to Integers & Congruence, Real Numbers
8. Applications of Proofs to Sets and the Fundamentals of Set Operations
9. Counterexamples; Proof by Contradiction; The Principle of Mathematical Induction

10. Intro to Relations and their Properties; Equivalence Relations
11. Properties of Equivalence Relations; Congruence Modulo n
12. Intro to Functions; One-to-One Functions, Onto Functions
13. Intro to Functions; One-to-One Functions, Onto Functions
14. Application of Proofs to Properties of the Integers
15. Applications of Proofs to Cardinality of Sets

LEARNING MATERIALS:

Chartrand, Polimeni, Zhang. *Mathematical Proofs: A Transition to Advanced Mathematics*. Pearson Publishing. ISBN: 13 978-0 321-39053-0.

Other learning materials may be required and made available directly to the student and/or via the College's Libraries and/or course management system.

COURSE APPROVAL:

Prepared by: Anna Godfrey, Instructor of Mathematics Date: 3/31/2012

VPAA/Provost or designee Compliance Verification: Victoria L. Bastecki-Perez, Ed.D. Date: 6/18/2012

Revised by: Mark McFadden Date: 2/1/2013

VPAA/Provost or designee Compliance Verification: Victoria L. Bastecki-Perez, Ed.D. Date: 5/23/2013

Revised by: Marion Graziano/James Muscatell Date: 8/31/2017

VPAA/Provost or designee Compliance Verification: Date: 11/13/2017



This course is consistent with Montgomery County Community College's mission. It was developed, approved and will be delivered in full compliance with the policies and procedures established by the College.