

Program Cover Document --- MAT 214 Patterns, Functions, and Algebra for Middle School Teachers

I. Learning Goals

Currently, this course is not a part of any program offered by the Department of Mathematics & Statistics. It is one of a series of courses offered to meet the needs of Elementary Education majors who wish to obtain the New Jersey middle school subject matter endorsement in mathematics. This requires 15 credits in mathematics and passing the Middle School Mathematics Praxis exam. Many students who have taken MAT 105 and/or 106, courses required for elementary education majors, wish to continue their study of mathematics in order to obtain the endorsement and teach mathematics in grades 6-8.

Teaching algebra effectively at the middle grades requires that teachers have a deep and profound understanding of the algebra that is part of the K-12 curriculum. The main goal of this course is to enable middle grades preservice teachers to develop an advanced viewpoint of the algebra that they will teach.

Each course in the series of courses that are offered to middle school mathematics teachers is focused on a particular content strand from the New Jersey Core Curriculum Content Standards (NJCCCS). The other courses are MAT 211, Number Theory and Systems for Middle School Teachers, MAT 212, Data Analysis & Probability for Middle School Teachers, MAT 215, Geometry for Middle School Teachers, MAT 217, Discrete Math for Middle School Teachers, and MAT 218, Concepts of Calculus for Middle School Teachers.

II. Student Assessment

Assessment in this course is similar to the assessment done in the prerequisites, MAT 105 and 106. Preservice teachers can demonstrate their content knowledge through a variety of assessment methods that require them to solve problems, explain their reasoning, and use mathematical representations.

III. Learning Activities

Middle school mathematics curricula are used as a basis for in-depth study of the mathematics content. Many class sessions are devoted to discussions of the mathematics content and the development of the mathematical concepts and skills necessary in the mathematical education of middle-school grades. Other class sessions consist of “hands-on” experiences in order for the preservice teachers to learn how to use concrete manipulative materials, pictorial models, and technology in the development of the mathematical concepts for middle-school grades. Students are expected to complete readings, and prepare projects and/or assignments that are appropriate for the course.

Using middle school mathematics curricula as motivation for in-depth study of the mathematical concepts connects the course content to the middle school classroom. Preservice teachers appreciate that what they are learning will be relevant to their teaching. Teachers must experience standards-based teaching and learning in order to understand how to implement it. A variety of strategies and methods of instruction should be used to model effective teaching of mathematics.

Sample syllabus:

MAT 214 Patterns, Functions, and Algebra for Middle School Teachers Spring, 2024

Instructor: Dr. Cathy Liebars

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Expectations for response times: *24 hours on weekdays, 48 hours on weekends*

Class meetings: Monday and Thursday, 2:00 – 3:20

Office Hours: Monday, 3:30 – 5:00; Thursday, 12:00 – 1:30; and other hours by appointment

Course Materials: All course materials will be posted on Canvas.

Recommended books:

- *Algebra for Elementary and Middle School Teachers, An Inquiry Approach, 2nd edition*, by Stump, Roebuck, and Bishop, Pearson Publishing, 2009.
- *Developing Essential Understandings of Expressions, Equations, & Functions, Grades 6-8*, by Lloyd, Herbel-Eisenmann, and Star, NCTM, 2011.

Course description and purpose: This course gives the middle school mathematics teacher a deeper understanding of patterns, functions, and algebra. Physical materials, models, technology, and middle school curricula will be used to explore these topics. Exploration of ways to engage middle school students meaningfully in experiences that lay a strong foundation for more formal algebraic work will be integrated with the mathematics content.

Learning Goals

Performance goals: By the completion of the course, the successful student will be able to demonstrate all of the following:

- I. Deeper understanding of the concepts, processes and algorithms, and the purposes beneath them, found in the middle school mathematics curriculum, with a focus on algebra.
- II. Fluency in the symbolic language of algebra, including the use and meaning of variables, expressions, relations, and functions.
- III. Ability to apply a variety of algebraic tools to organize information and model relationships.
- IV. Represent, analyze, and generalize a variety of patterns and relationships using words, symbols, graphs, and tables.
- V. Improved ability to communicate mathematical ideas appropriately using the language of mathematics.
- VI. Improved ability to reason mathematically and begin developing mathematical proofs.

- VII. Ability to approach algebraic problems from multiple perspectives.
- VIII. Knowledge of the relationship of mathematics to other subjects, its applications in society, and relationships within mathematics itself; in particular, relationships between multiple representations of algebraic concepts.
- IX. Increased understanding of national and state standards relating to algebra.

Course Requirements and Grading: The final grade will be based on the following:

40%	3 – 6 quests (short tests)
20%	Class participation
20%	Check Your Understanding opportunities/Flip videos
20%	Final Exam

Class policies:

1. Additional assignments for extra credit will not be given.
2. The instructor must be contacted prior to any due date to negotiate alternative arrangements if necessary.
3. Students are responsible for any work that is missed.
4. Make-up quests will be given for excused absences in which case I must be notified within 24 hours of the missed quest. Make-up quests will generally be harder

Format/Learning activities:

The course you are about to begin may be different than any math course you've had before. In this course you will learn the mathematics you need to become a more effective teacher. This is not a methods course. However, it is often said that teachers teach in the manner in which they learned a subject.

What kind of mathematics do teachers need to know? It is mathematics that helps teachers better understand how their students are thinking about mathematics and how they can help their students improve their thinking. It is mathematics that helps teachers see how the different topics in elementary, middle, and high school fit together. It is mathematics that helps teachers see behind all the things they have learned before so they can understand why they work and so they can help their students understand.

This is a different kind of mathematical knowledge. Learning this mathematics requires that you start fresh, that you 'unpack' your current and previous mathematical understandings. It requires that you become curious, genuinely curious, about how and why all those rules in mathematics work like they do, and about the methods children are likely to use to solve mathematical problems and why some of these methods are useful for them and some are not.

Because you will be thinking about middle school topics in mathematics in a new way, you will notice very soon that you are not doing the usual kinds of things. You will not be shown how to do some sample problems and then asked to practice more on your own. Instead:

- You will solve new kinds of problems that are designed to provide insight into several mathematical topics and promote your mathematical reasoning skills. Thus, you will understand familiar problems more deeply.
- You will examine patterns and structure; formulate generalizations and conjectures; investigate and test your conjectures using concrete or virtual materials, calculators, and other

tools; and construct and evaluate mathematical arguments. You will learn to ask yourself: Is there a pattern? What might happen next? Can I make a generalization or conjecture? Do I think my conjecture is true for all cases, true for some cases, true for no cases (that is, false for all cases), and why? Under what circumstances is it not true? Can I give an example?

Why does it work? How might I convince my group members that my conjecture is correct?

- And you will frequently be asked to explain your reasoning – how you were thinking while you were solving a problem, why you think students will solve problems in a particular way, and why you think some methods for solving problems work better than others. Developing good explanations that are convincing to others is the best way to know that you understand.
- My role extends beyond direct instruction to support and facilitate your engagement with and exploration of the material.
- In most classes, we will work in visibly random groups on vertical, non-permanent surfaces (VNPS); i.e., the blackboards!

Check Your Understanding opportunities and Flip:

“Check-your-understanding” opportunities will be assigned frequently. They will not be collected and graded. Instead, solutions will be posted prior to the next class and we will use Flip to record videos of check-your-understanding solutions. You will each choose 5 check-your-understanding problems over the course of the semester to solve and present on Flip. (You will not be permitted to sign up for more than one problem in a two-week period.) Keep in mind that your classmates may be watching your videos to try to understand how to solve the check-your-understanding problems that they weren’t able to solve so you should explain the solution clearly. Flip provides the ability to respond to videos so you will be able to ask each other questions about the solutions. If there is a solution with many questions, it may be discussed in class. In addition to working together in class, you are encouraged to work together outside of class on problems. However, the final expression, the answer to a question, the solution and explanation to a problem, are matters for individual action to show that each person comprehends the matter at hand in their own way. Work that is merely copied will not be tolerated. Expectations and grading for Flip videos will be distributed separately.

Quests:

See course outline for dates. The final exam will be given during final exam week at the scheduled time and will be cumulative.

Class participation:

Participation in the course takes many forms, including actively working and contributing in small groups, participating in whole class discussions, asking questions, listening, presenting work, persevering and taking risks when presented with a challenge, preparing for class by completing Check Your Understanding opportunities and assigned readings, etc. To be successful in the course, it is important for you to be an active participant. Below is a rubric for class participation:

	Unsatisfactory 0-4	Basic 5-6	Proficient 7-8	Distinguished 9-10
Class Contributions and Preparation	Student almost never contributes to class by offering	Student sometimes contributes to class by offering	Acts professionally, often proactively contributes to	Acts professionally at all times, consistently and

<p><i>*Participation is reduced by absence or tardiness</i></p> <p>**Contributing positively to a class also means listening to, acknowledging, and respecting opinions of others.</p>	<p>ideas and asking questions, and/or is almost never prepared for class.</p>	<p>ideas and asking questions, rarely volunteers to present work, and/or is inconsistently prepared for class.</p>	<p>class by offering ideas and asking questions, volunteers to present work, sometimes perseveres and takes risks, and is usually prepared for class.</p>	<p>proactively contributes to class by offering ideas and asking questions sometimes more than once per class, consistently volunteers to present work, collaborates with others, perseveres and takes risks, and is always prepared for class.</p>
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- **Note that your participation grade will not be affected if you are ill and cannot attend class. Please do not come to class if you are sick! A zoom option will be available for anyone who is sick and/or must isolate. Please note that zoom is ONLY to be used in cases of illness or isolation. Otherwise, you are expected to attend class as usual.**
- **Important note:** *Incorrect solutions* can add value to a problem. Your participation grade is therefore not based on the correctness of your work.

4th Hour

In this class, the deep learning outcomes associated with TCNJ's 4th hour are accomplished by a series of rigorous educational assignments that extend beyond the typical scheduled class time. These include additional out-of-class reading, writing, and check your understanding problems.

Tentative Course Outline

Dates	Content
1/22 – 1/25	Problem solving with Algebra/Variables and expressions
1/29 – 2/1	Variables and expressions
2/5 – 2/8	Variables and expressions No class on 2/8
2/12 – 2/15	Quest 1 No class on 2/15 (Teaching and Learning Summit)
2/19 – 2/22	Equality and Equivalence Solving Equations and Inequalities

2/26 – 2/29	Patterns and sequences
3/4 – 3/7	More patterns and sequences Quest 2
3/11 – 3/14	Spring break
3/18 – 3/21	Functional Relationships
3/25 – 3/28	Linear functions, slope
4/1 – 4/4	Forms of linear equations Quest 3
4/8 – 4/11	Quadratic Functions, solving quadratic equations
4/15 – 4/18	Quadratic Functions
4/22 – 4/25	Exponential Functions, exponent rules
4/29 – 5/2	Exponential Functions Quest 4
5/6 – 5/7	Reading Days
5/8 – 5/14	Final exam

SELECTED TCNJ POLICIES

Please note that the “[TCNJ Student Support Resources and Classroom Policies](#)” webpage contains all of the relevant policies mentioned below and others that govern the classroom.

Final Assessment

All courses are to have a final assessment and no final assessments will be scheduled before the final exam period. Students are expected to take their final assessments in the time blocks assigned by Records and Registration. Students must notify the instructor two weeks before the final assessment if they have a conflict as defined by the Final Assessment and Reading Day policy.

Attendance

Students are expected to check the college calendar, and plan their course schedules and vacations so as to enroll only in those classes that they can expect to attend on a regular basis. Students are expected to participate in each of their courses through regular attendance at lecture and laboratory sessions, complete assignments as scheduled, and to

avoid outside conflicts, including for the final exam. It is further expected that every student will be present, on time, and prepared to participate when scheduled class sessions begin. In all circumstances, it remains the student's responsibility to initiate discussion about absence and arrangements for making up any missed work with each instructor.

Academic Integrity Policy

The College of New Jersey is a community of scholars and learners who respect and believe in academic integrity. This integrity is violated when someone engages in academic dishonesty. Complaints of student academic misconduct will be addressed and adjudicated according to the *Academic Integrity Procedural Standards*.

COMMITMENT TO DIVERSITY, EQUITY, INCLUSION, ACCESS AND BELONGING

The TCNJ community is composed of people with diverse backgrounds, perspectives, and experiences, and the college is committed to diversity, equity, inclusion, access and belonging. The college's Campus Diversity Statement can be viewed here: <https://diversity.tcnj.edu/campus-diversity-statement/>."

CLASSROOM ENVIRONMENT AND COMMITMENT TO STUDENT SUCCESS, SAFETY AND WELL-BEING

The TCNJ community is dedicated to the success, safety and well-being of each student. TCNJ strictly follows key policies that govern all TCNJ community members' rights and responsibilities in and out of the classroom. In addition, TCNJ has established several student support offices that can provide the support and resources to help students achieve their personal and professional goals and to promote health and well-being. You can find more information about these policies and resources at the "TCNJ Student Support Resources and Classroom Policies" webpage here: <https://academicaffairs.tcnj.edu/tcnj-syllabus-resources/>.

Students who anticipate and/or experience barriers in this course are encouraged to contact the instructor as early in the semester as possible. The Accessibility Resource Center (ARC) is available to facilitate the removal of barriers and to ensure reasonable accommodations. For more information about ARC, please visit: <https://arc.tcnj.edu/>."