CUNY Common Core
Course Submission Form

Instructions: All courses submitted for the Common Core must be liberal arts courses. Courses may be submitted for only one area of the Common Core. All courses must be 3 credits/3 contact hours unless the college is seeking a waiver for another type of Math or Science course that meets major requirements. Colleges may submit courses to the Course Review Committee at any time. Courses must also receive local campus governance approval for inclusion in the Common Core.

College	Lehman College
Course Prefix and Number (e.g., ANTH 101, if number not assigned, enter XXX)	MAT 124
Course Title	Algebraic Thinking and Functions for Educators
Department(s)	Mathematics
Discipline	Mathematics
Credits	3
Contact Hours	3
Pre-requisites (if none, enter N/A)	Departmental permission
Co-requisites (if none, enter N/A)	n/a
Catalogue Description	Using generalization, algebraic structures, and reasoning to represent and analyze mathematical situations. In-depth attention given to functions, modeling, and the transition from arithmetic to algebra. Note. Intended for pre-service elementary and middle school teachers.
Special Features (e.g., linked courses)	
Sample Syllabus	Syllabus must be included with submission, 5 pages max recommended

Indicate the status of this course being nominated:

☐ current course ☐ revision of current course ☒ a new course being proposed

CUNY COMMON CORE Location

Please check below the area of the Common Core for which the course is being submitted. (Select only one.)

Required	Flexible	
☐ English Composition	☐ World Cultures and Global Issues	☐ Individual and Society
☒ Mathematical and Quantitative Reasoning	☐ US Experience in its Diversity	☐ Scientific World
☐ Life and Physical Sciences	☐ Creative Expression	

Waivers for Math and Science Courses with more than 3 credits and 3 contact hours

Waivers for courses with more than 3 credits and 3 contact hours will only be accepted in the required areas of "Mathematical and Quantitative Reasoning" and "Life and Physical Sciences." Three credit/3-contact hour courses must also be available in these areas.

If you would like to request a waiver please check here:	☐ Waiver requested
If waiver requested: Please provide a brief explanation for why the course will not be 3 credits and 3 contact hours.	
If waiver requested: Please indicate whether this course will satisfy a major requirement, and if so, which major requirement(s) the course will fulfill.	

Learning Outcomes **In the left column explain the course assignments and activities that will address the learning outcomes in the right column.**	
B. Mathematical and Quantitative Reasoning: Three credits A course in this area must meet all the learning outcomes in the right column. A student will:	

This SLO is assessed on assignments, quizzes, and exams. Students will be expected to read, understand, and utilize algebraic expressions, equations, and formulas to solve quantitative problems. Additionally, students will utilize function notation in their approach.
 	
• Examples: Sample problems that students will answer for these objectives are given below.
  ◦ Fill in the blanks so that the points lie on the graph of the function y=-2x+1 and explain your work: (3, _), (_, -13), (a, _), (_, b).
  ◦ Draw, label, and shade a rectangle so that it gives rise to the equivalent expressions (x+3)(y+4) and xy+4x+3y+12. Explain your answers
	• Interpret and draw appropriate inferences from quantitative representations, such as formulas, graphs, or tables.

This SLO is assessed in classroom and small group discussions as well as on assignments, quizzes, and exams. Students will be expected to understand and utilize the relationship between algebraic representation and function graphs to solve problems symbolically and geometrically. • Example. Below is a sample problem that students will address to demonstrate proficiency in this objective. ◦ An object is dropped from the top of a building. After t seconds, the height h of the object in feet is given by h=16(13+t)(13-t). Sketch the graph of the function, reason about the structure of the graph with regards to the context, then determine when the object hits the ground.	• Use algebraic, numerical, graphical, or statistical methods to draw accurate conclusions and solve mathematical problems.

This SLO is assessed through small group projects, in class discussions, and on written assignments. Students will be expected to create algebraic/function models to express written and/or verbal problems in an appropriate mathematical format.
 	
• Examples. Several examples of problems covering this objective are included below.
  ◦ At a yogurt shop, frozen yogurt is 45 cents for each ounce; a waffle cone to hold the yogurt is $1. Create a table to describe the cost of buying a frozen yogurt cone for different ounces. Then, create an equation for the situation and graph it. Be sure to clearly define any and all variables you use.
  ◦ Consider the sequence given by 1, 4, 7, 10, 13, 16, … Find an expression for the Nth entry in this sequence and explain why your expression is valid.
	• Represent quantitative problems expressed in natural language in a suitable mathematical format.

This SLO is assessed using in-class discussions/presentations and on written assignments, quizzes, and exams. Student will be expected to explain, describe, and effectively communicate the fundamentals of	• Effectively communicate quantitative analysis or solutions to mathematical problems in written or oral form.

algebra and functions to audiences of varied maturity: K-8 learners, 9-12 students, and college-level peers. Students will also be expected to familiarize themselves with, interpret, and explain common mathematical errors made by elementary and middle school students with algebra and functions.
 	
• Examples. Several examples of problems that students will be expected to address for these objectives are given below.
  • State the commutative property of addition. Explain what it means for the expressions to be equal and then provide at least two different ways to explain why the expressions are equal.
  • Solve 3x+2=x+8 in two ways: with properties of equations and with pictures of a pan balance.
  • What's wrong with the chain of reasoning below proving that x-1=0 has no solutions:
  ▫ x-1=0
  ▫ (x-1)/(x-1)=0
  ▫ 1=0
  ▫ Not true, so no solutions exist.	

This SLO is assessed using in-class discussion and on graded written work. Students will be expected to explain and describe why/how function models describe a given situation, recognize when they do not, and determine an appropriate alternative when feasible.
 	
• Example. The following is an example of work students will be expected to do to meet this objective.
  • The levels of a certain toxin in a lake have been found to go up and down over time. Biologists are interested in studying the number of fresh-water mussels in a lake, the level of toxin in the lake, and any relationship between the two.
  ▫ Explain why the following proposed function with this rule might not be a function: Assign to each amount of toxin found in the lake, the number of mussels when there is that amount of toxin in the lake.
  ▫ What could you do to fix this situation and develop a working model of this situation?
	• Evaluate solutions to problems for reasonableness using a variety of means, including informed estimation.

This SLO is assessed using in-class discussion and using written graded assignments. Students will be expected to apply algebraic representation and function models to solve real-world problems including various regression models. • Examples. The examples below show sample problems that students will be expected to solve that address these objectives. • At a store that sells fences, if you buy 15 feet of fencing or less, the total cost, including delivery is $200. Each additional foot of fencing costs an additional $10. Let F be the number of feet of fencing in an order and let C be the cost (in dollars) of the order.	• Apply mathematical methods to problems in other fields of study.

▫ What restriction should be made on F so that the relationship between C and F is linear? Explain. ▫ Without writing an equivalent equation, explain how to interpret each side of the equation below and explain why the equation describes the relationship between F and C: ▫ C-200=10(F-15) • Give an example of two variables that have a positive linear relationship. Give an example of two variables that have a negative linear relationship. Explain your reasoning.	

MAT 124 Syllabus

General Information

MAT 124: Algebraic Thinking and Functions for Educators *(3hr, 3cr)*

Course Description: This course will examine representing and analyzing mathematical situations and structures using generalization and algebraic symbols and reasoning. Special attention will be given to the transition from arithmetic to algebra, working with functions, and how to use algebra to model, analyze, and predict change.

Prerequisites: Departmental Permission

Note: Material covered in this class will help teachers/teacher candidates prepare for a leadership position as elementary mathematics specialist.

Instructor: Your instructor will provide contact information, office hours and meeting times for your section.

Course Format and Grading

Expectations: This course covers algebraic representations and structures to analyze, model and predict mathematical situations. This course uses the problem-solving approach to teaching and learning mathematics concepts. Students are encouraged to ask questions. Class participation is essential. You are strongly encouraged to take good notes and do not miss class. Bring your concerns and challenges to the instructor's attention early on in the course so that they can address them effectively.

Homework: Homework will be assigned in class. Solutions to most problems from the previous session will be reviewed and discussed in class. In order to be successful in this course it is essential that you devote a lot of time to your homework.

Grades: Your grade will be made up of 70% exams and 30% assignments that include homework.

Text, Materials, and Accommodating Disabilities

References:

- Beckmann, S. (2018). Mathematics for elementary teachers (5^{th} ed). Pearson.
- Billstein, R., Libeskind, S., & Lott, J. W. (2016). A problem solving approach to Mathematics for elementary school teachers (12^{th} ed). Pearson.
- Randall, C., & Thompson, A. (1996). Secondary math an integrated approach: Focus on algebra. Addison-Wesley
- Sonnabend, T. (2010). Mathematics for teachers: an interactive approach for grades k-8 (4^{th} ed). Brooks/Cole Cengage Learning.

Materials: Physical and Virtual Manipulatives; Learning Tools

Calculator: Texas Instruments and Scientific Calculators

Accommodating Disabilities: Lehman College is committed to providing access to all programs and curricula to all students. Students with disabilities who may need classroom accommodations are encouraged to register with the Office of Student Disability Services. For more info, contact the Office of Student Disability Services, Shuster Hall, Room 238, 718-960-8441.

Course Objectives and Content

Course Objectives: This course meets all of the overall objectives for a CUNY common core Quantitative Reasoning course; these objectives and how they are met in this course are detailed below.

At the end of this course, students will be able to:

1. Interpret and draw appropriate inferences from quantitative representations, such as formulas, graphs, or tables.
    - Read, understand, and utilize algebraic expressions, equations, and formulas to solve quantitative problems.
    - Read, understand, and utilize function notation to solve quantitative problems.

2. Represent quantitative problems expressed in natural language in a suitable mathematical format.
    - Create algebraic/function models to express written and/or verbal problems in an appropriate mathematical format.

3. Use algebraic, numerical, graphical, or statistical methods to draw accurate conclusions and solve mathematical problems.
    - Understand and utilize the relationship between algebraic representation and function graphs to solve problems symbolically and geometrically.

4. Effectively communicate quantitative analysis or solutions to mathematical problems in written or oral form.
    - Explain, describe, and effectively communicate the fundamentals of algebra and functions to audiences of varied mathematical maturity: K-8 learners, 9-12 students, and college-level peers.
    - Familiarize self with, interpret, and explain common mathematics errors made by elementary and middle school students with algebra and functions.

5. Evaluate solutions to problems for reasonableness using a variety of means, including informed estimation.
    - Explain and describe why/how function models describe a given situation, recognize when they do not, and determine an appropriate alternative when feasible.

6. Apply mathematical methods to problems in other fields of study.

- Apply algebraic representation and function models to solve real-world problems including various regression models.

Course Topics

There is flexibility in the order and time allotted to each of the topics below, but all topics must be covered by the instructor and understood by the student. Historical development and perspective will be embedded within the topics where appropriate.

1. Real Number System and Properties
2. Variables and Expressions
    - Algebraic Notations, Symbols
    - Variables
    - Order of Operations
    - Structure of Expressions
3. Equality Relation and Equations
    - Meaning of Equal Sign
    - Solving Equations and Inequalities
    - Proportional Relationships

4. Functions, Their Representations and Features
    - Domain and Range
    - Constant and Linear
    - Quadratic
    - Polynomial
    - Exponential
    - Other Functions
    - Sequences and Series
    - Transformations of Functions

5. Modeling with Functions and Predicting Change (Regression Equations)
    - Real World Applications

Professional Standards

(Specific content and objectives will include the following standards from **NCTM CAEP Mathematics Content for Elementary Mathematics Specialist (Addendum to the NCTM CAEP Standards 2012)**

To be prepared to support the development of student mathematical proficiency, all elementary mathematics specialists should know the following topics related to algebra with their content understanding and mathematical practices supported by appropriate technology and varied representational tools, including concrete models:

C.2.1Algebraic notation, symbols, expressions, equations, inequalities, and proportional relationships, and their use in describing, interpreting, and modeling relationships and operations

C.2.2 Function classes including constant, linear, quadratic, polynomial, exponential, and absolute value, and how choices of parameters determine particular cases and model real- world situations

C.2.3 Functional representations (tables, graphs, equations, descriptions, and recursive definitions), characteristics (e.g., zeros, average rates of change, domain and range), and notations as a means to describe, interpret, and analyze relationships and to build new functions

C.2.4 Patterns of change in linear, quadratic, polynomial, and exponential functions and in proportional and inversely proportional relationships and types of real-world relationships these functions can model

C.2.5 Historical development and perspectives of algebra including contributions of significant figures and diverse cultures