MA 201 MATHEMATICS FOR ELEMENTARY TEACHERS (UK Course) (3 credit hours)

Official Course Description	Sets, numbers and operations, problem solving and number theory. Prerequisites: MA 109 or MA 111 or consent of department.

OFFICIAL COURSE COMPETENCIES/OBJECTIVES

Upon completion of this course, the student can:

1. Develop a strong sense of place value in a base ten system and of the limitations and rationale behind various other numeration systems.
2. Understand the underlying mathematics for commonly used algorithms for operations involving whole numbers, integers, and fractions and the relationships among these operations.
3. Use the Prime Factorization Theorem and the Fundamental Theorem of Arithmetic to investigate prime and composite numbers, least common multiples, and greatest common factors.
4. Explain the mathematical concepts behind the Division Algorithm and develop conjectures about related concepts such as odd and even numbers and divisibility.
5. Develop various interpretations and visualizations of operations to solve problems involving whole numbers, integers, and fractions.
6. Determine the implications for ordering, estimating, and approximating various numbers.
7. Understand and use the standard order of operations convention.
8. Use concrete models to illustrate the concepts that justify procedures for operations on whole numbers and fractions.
9. Identify the mathematical reasoning and misconceptions found in examples of student's work on problems that involve operations on whole numbers, integers, and fractions.
10. Critique explanations of concepts or procedures for coherent mathematical reasoning and correct usage of vocabulary and symbolism

OFFICIAL COURSE OUTLINE (Approved Fall 2007)

I. Number and Operations
   A. Understand models and interpretations of operations with whole numbers:
      1. Have a large repertoire of interpretations of addition, subtraction, multiplication and division, and of ways they can be applied.
      2. Understand relationships among operations.
   B. Develop a strong sense of place value in the base-10 number system:
      1. Understand how place value permits efficient representation of number.
      2. Recognize the value of each place as ten times larger than the value of the next place to the right and the implications of this for ordering numbers and for estimation and approximation.
      3. Recognize how the operations of addition, multiplication, and exponentiation are used in representing numbers.
      4. Use place value to explain multiplication and division algorithms for whole numbers and rational numbers expressed as decimals.
      5. Recognize the relative magnitude of numbers and relate large numbers to known quantities.
   C. Understand multidigit calculations, including standard algorithms, "mental math", and non-standard methods commonly created by students:
      1. Recognize how the base-10 structure of number is used in multidigit computations.
      2. Recognize how decimal notation allows for approximation by "round numbers" (multiples of powers of 10).
      3. Understand and use the properties of commutativity, associativity, and distributivity to organize and justify thinking about computation.
      4. Develop flexibility in mental computation and estimation.
      5. Understand the different ways of interpreting a division remainder and when each is appropriate.
      6. Make sense of computation strategies devised by students and appreciate the number sense involved in their creation.
      7. Express and calculate with large and small numbers using scientific notation.
   D. Develop a deep understanding of rational numbers and operations on rational numbers:
      1. Understand what rational numbers are, understand fractions and decimals as representations of rationals, and develop a sense of their relative size.
      2. Estimate calculations with fractions, decimals, percents.

3. Know interpretations and applications for arithmetic operations on rationals and recognize that fraction symbols are used to represent a variety of mathematical situations.
4. Understand the mathematics that underlies commonly used algorithms for fraction operations.
5. Understand the relationship between fractions and the operations of multiplication and division.
6. Understand how and why whole number decimal arithmetic extends to finite decimals and, in particular, how place value extends to decimal fractions.
7. Understand how any number represented by a finite or repeating decimal is rational, and conversely.
8. Recognize, among proposed solutions to rational number problems, those that are unreasonable.
9. Determine which operation or operations can appropriately be applied to a situation.
10. Understand percent as a special case of ratio.

E. Develop the concepts of integer and operations on integers:
1. Understand what integers are and the meaning of sign and magnitude.
2. Know interpretations and applications for the arithmetic operations in the integers.
3. Understand how whole number arithmetic extends to integers.

F. Understand the structure of the rational number system and the real number system:
1. Change repeating decimals to fractions and fractions to decimals.
2. Establish the relationships among whole, integral, rational, irrational, and real numbers.
3. Understand the number line as a representation of the real numbers.

G. Understand and explain fundamental ideas of number theory:
1. Use the Prime Factorization Theorem and relate it to algebra.
2. Be able to make conjectures about odd and even numbers and about composite and prime numbers, and provide justifications that prove or disprove the conjectures.
3. Be able to justify and use the Euclidean Algorithm. (optional)

H. Use mathematical conventions properly:
1. Understand and interpret results from different types of calculators and know how to use calculators properly.
2. Use various problem solving strategies in different situations.
3. Understand and use standard Order of Operations convention.
4. Use Venn diagrams to express relationships. (optional)

II. Algebra and Functions

A. Generalize arithmetic and reason quantitatively:
1. Use a variety of representations, including conventional algebraic notation, to articulate and justify generalizations.
2. Understand algebraic expressions as shorthand for describing calculation; understand algebraic identities as statements of equivalence of expressions.
3. Understand different forms of argument and learn to devise deductive arguments
4. Solve word problems via algebraic manipulation.

B. Understand functions:
1. Be familiar with the notion of function.
2. Be able to read and create formulas (closed and recursive), and tables.

C. Understand and experience the different roles algebra plays:
1. As a study of patterns.
2. As a symbolic language useful in many areas of life.
3. As a tool for problem solving.
4. As generalized arithmetic.
5. As generalized quantitative reasoning.
6. As a way of modeling and understanding physical situations.

GENERAL EDUCATION COMPETENCIES

A. Knowledge of human cultures and the physical and natural worlds through study in the sciences and mathematics, social sciences, humanities, histories, languages, and the arts.
B. Intellectual and practical skills, including
    - inquiry and analysis
    - critical and creative thinking
    - written and oral communication
    - quantitative literacy
    - information literacy
    - teamwork and problem solving
C. Personal and social responsibility, including
    - civic knowledge and engagement (local and global)
    - intercultural knowledge and competence
    - ethical reasoning and action
    - foundations and skills for lifelong learning
D. Integrative and applied learning, including synthesis and advanced accomplishment across general and specialized skills.

STUDENT LEARNING OUTCOMES FOR QUANTITATIVE REASONING (Approved Fall 2017)

In MA 201, students will learn to:

1. Interpret information presented in mathematical and/or statistical forms by (Gen Ed Comp B):
    - Developing a strong sense of place value in a base ten system and of the
    - limitations and rationale behind various other numeration systems.
    - Understanding the underlying mathematics for commonly used algorithms for operations involving whole numbers, integers, and fractions and the relationships among these operations.
    - Using the Prime Factorization Theorem and the Fundamental Theorem of Arithmetic to investigate prime and composite numbers, least common multiples, and greatest common factors.
    - Explaining the mathematical concepts behind the Division Algorithm and develop conjectures about related concepts such as odd and even numbers and divisibility.

2. Illustrate and communicate mathematical and/or statistical information symbolically, visually, and/or numerically by (Gen Ed Comp A, B, C):
    - Developing various interpretations and visualizations of operations to solve problems involving whole numbers, integers, and fractions.

3. Determine when computations are needed and execute the appropriate computations by (Gen Ed Comp A, B):
    - Determining the implications for ordering, estimating, and approximating
    - various numbers.
    - Understanding and using the standard order of operations convention.

4. Apply an appropriate model to the problem to be solved by (Gen Ed Comp A, B, C):
    - Using concrete models to illustrate the concepts that justify procedures for operations on whole numbers and fractions.

5. Make inferences, evaluate assumptions, and assess limitations in estimation modeling and/or statistical analysis by (Gen Ed Comp A, D):
    - Identifying the mathematical reasoning and misconceptions found in examples of student's work on problems that involve operations on whole numbers, integers, and fractions.
    - Critiquing explanations of concepts or procedures for coherent mathematical reasoning and correct usage of vocabulary and symbolism.