South Central College

MATH 115 Concepts in Mathematics

Course Outcome Summary

Course Information

Description Concepts in Mathematics is a general education survey course designed to spotlight the field as an important component of our cultural heritage. It introduces a broad range of topics from classical as well as modern mathematics. The emphasis is on problem solving and developing the logical skills to successfully defend solutions, while at the same time showing how mathematics is a creative human endeavor influencing how we perceive the world. Among the major topics considered are logic, set theory, axiomatic systems, number theory, number systems, analytic geometry, algebra, combinatorics, and elementary probability. (Prerequisites: MATH 0085 with a grade of C or higher, or a score of 76 or higher on the Elementary Algebra portion of the Accuplacer test.)(MNTC 4: Mathematical/Logical Reasoning)

Total Credits 4

Total Hours 64

Types of Instruction

Instruction Type	Credits/Hours
Lecture	4/64

Pre/Corequisites

MATH 0085 with a grade of C or higher, or a score of 76 or higher on the Elementary Algebra portion of the Accuplacer test.

Institutional Core Competencies

Critical and Creative Thinking - Students will be able to demonstrate purposeful thinking with the goal of using a creative process for developing and building upon ideas and/or the goal of using a critical process for the analyzing and evaluating of ideas.

Course Competencies

1. Explain how to approach a mathematical problem

Learning Objectives

Apply the Pólya approach to the analysis of a problem
Explain the difference between induction and deduction
Demonstrate that inductive thinking can lead to invalid arguments

2. Describe an axiomatic system

Learning Objectives

Explain the logical need for undefined terms and axioms
Define new concepts in terms of these (definitions)
Explain how theorems are deduced from undefined terms, axioms and definitions

3. Explain the key components of deductive reasoning

Learning Objectives

Define statement
Define truth value of a statement
Define the truth values of the three fundamental Boolean expressions
Translate English language statements into symbolic form

4. Derive additional logical operators

Learning Objectives

Define the conditional by means of a truth table
Define the biconditional by means of a truth table
Associate a conditional with its inverse
Associate a conditional with its converse
Associate a conditional with its contrapositive

5. Apply some elementary rules of logic

Learning Objectives

Compose a truth table to derive the truth values of a compound statement
Deduce the law of double negation
Deduce the law of contrapositives
Deduce DeMorgan□s laws
Negate an implication
Recognize the logical form of certain English language arguments

6. Describe the two essential approaches to logical proof

Learning Objectives

Explain modus ponens as an example of direct reasoning
Show how transitivity can be used to thread several such statements together
Explain modus tollens as an example of indirect reasoning
Recognize certain fallacies of argument

7. Express numbers in different numeration systems

Learning Objectives

Explain repetitive type systems
Explain the subtraction and multiplication principles in Roman numeration
Explain the advantages of a weighted positional system
Express numbers in the decimal Hindu-Arabic numeration system
Interpret decimal fractions
Convert decimal numbers to and from binary form

8. Explain the properties of natural numbers

Learning Objectives

Explain closure for addition and multiplication
Explain commutativity for addition and multiplication
Explain associativity for addition and multiplication
Explain the distributive property of multiplication over addition

9. Deduce properties of prime and composite numbers

Learning Objectives

Partition natural numbers into prime, composite or neither
Test composites for divisibility by certain divisors

Use the Fundamental Theorem of Arithmetic to express a natural as a product of primes
Compute the least common multiple of two natural numbers
Compute the greatest common divisor of two natural numbers
Prove the infinitude of prime numbers as Euclid might have

10. Explain the properties of integers

Learning Objectives

Extend the natural numbers to the integers
Compute sums, differences, products and quotients of integers (where possible)
Explain which properties are preserved when moving from the naturals
Describe new properties which arise when moving from the naturals

11. Explain the properties of rational numbers

Learning Objectives

Extend the integers to the rationals
Compute sums, differences, products and quotients of rationals (where possible)
Explain which properties are preserved when moving from the integers
Describe new properties which arise when moving from the integers

12. Describe irrational numbers

Learning Objectives

Define the principal square root function
Interpret the Pythagorean Theorem
Simplify radical expressions
Prove the square root of 2 is irrational as Euclid might have

13. Explain the properties of real numbers

Learning Objectives

Extend the rationals to the reals
Compute sums, differences, products and quotients of reals (where possible)
Explain which properties are preserved when moving from the rationals
Consolidate the real number properties as the eleven field axioms
Simplify expressions by means of the usual algebraic order of operations

14. Manipulate simple polynomial expressions

Learning Objectives

Simplify certain polynomial expressions
Interpret factoring in terms of partitioning rectangular areas as the ancient Greeks might have
Factor certain quadratics relative to the integers

15. Solve simple equations

Learning Objectives

Solve linear equations using the eleven field axioms
Solve simple systems of linear equations
Solve certain quadratic equations by factoring or the quadratic formula
Apply the solution of linear and quadratic equations to real world phenomena

16. Solve linear inequalities

Learning Objectives

Explain the Law of Trichotomy
Solve linear inequalities using the eleven field axioms, and a property of negatives

17. Contrast the different geometries

Learning Objectives

Review the notion of an axiomatic system
Describe synthetic Euclidean geometry
Describe synthetic non-Euclidean geometries
Contrast the axioms of (b) and (c), above

Describe transformational geometry
Explain the key features of analytic geometry

18. Review properties of polygons and angles

Learning Objectives

Categorize angles as straight, right, acute or obtuse
Label the various types of quadrilaterals
Deduce the properties of Thales transversal cutting a pair of parallel lines

19. Review certain properties of triangles

Learning Objectives

Categorize triangles as scalene, acute, right, isosceles, equilateral or obtuse
Correlate parts in a pair of similar triangles
Deduce the sum of the measures of angles in a triangle

20. Measure the distances of inaccessible objects using plane geometry

Learning Objectives

Establish proportions in a pair of similar triangles
Prove two triangles congruent
Explain how Thales measured the height of the Great Pyramid of Egypt
Explain how Thales measured the distance of a ship from shore
Explain how Eratosthenes measured the circumference of the earth

21. Visualize a function s behavior by its graph

Learning Objectives

Define function
Define graph
Explain the Cartesian coordinate system
Graph certain conic sections such as lines and parabolas
Demonstrate real-world methods for plotting parabolas and ellipses
Explain the historical importance of ellipses
Graph certain non-algebraic functions such as exponentials

22. Graph linear inequalities in one and two variables

Learning Objectives

Graph half-planes
Graph intersecting parts of the plane
Compute the corner points of such graphs

23. Apply certain sequences to real-world problems

Learning Objectives

Evaluate arithmetic sequences
Evaluate geometric sequences
Solve applied problems involving these types of sequences
Define recursive sequences
Apply the Fibonacci sequence to problems in nature

24. Geometrically interpret statements concerning sets

Learning Objectives

Describe the Venn diagram
Use Venn diagrams to solve real-world partitioning problems
Use Venn diagrams to visualize theorems from logic such as DeMorgan s Laws

25. Apply elementary combinatorics to counting problems

Learning Objectives

Explain the fundamental counting principle
Count permutations
Define factorial recursively

Count combinations
Use Pascal□s Triangle to compute combinations
Solve various elementary real-world counting problems

26. Solve elementary probability problems

Learning Objectives

Define essential properties of probability
Explain the Law of Large Numbers
Compute simple probabilities by hand
Compute probabilities of unions and intersections

27. Explain the cultural significance of mathematics

Learning Objectives

Know the names and contributions of certain important mathematicians
Find expressions of mathematics in art, music, literature and popular culture
Explain how mathematics has aided the development of other sciences
Explain how mathematics upset the Aristotelean view of the world in Western culture
Describe the influence of mathematics in your life
Write essays or make presentations on some of these topics

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