Medina County Schools'

# Course of Study

For

# Math

## Calculus (MCCC)
## Calculus Honors (Buckeye)

June 2008

## STANDARD 1: Number, Number Sense and Operations

Students demonstrate number sense, including an understanding of number systems and operations and how they relate to one another. Students compute fluently and make reasonable estimates using paper and pencil, technology-supported and mental methods.

| Ohio Benchmarks Grades 12 | Instructional Organization | Grade Level Indicators | Notes |
|---|---|---|---|
| **By the end of the 11-12 program:**<br><br>A. Demonstrate that vectors and matrices are systems having some of the same properties of the real number system.<br><br>B. Develop an understanding of properties of and representations for addition and multiplication of vectors and matrices.<br><br>C. Apply factorials and exponents, including fractional exponents, to solve practical problems.<br><br>D. Demonstrate fluency in operations with real numbers, vectors and matrices, using mental computation or paper and pencil calculations for simple cases, and technology for more complicated cases.<br><br>E. Represent and compute with complex numbers. | | | |

## STANDARD 2: Measurement

Students estimate and measure to a required degree of accuracy and precision by selecting and using appropriate units, tools and technologies.

| Ohio Benchmarks Grade 12 | Instructional Organization | Grade Level Indicators | Notes |
|---|---|---|---|
| **By the end of the 11-12 program:**<br><br>A. Explain differences among accuracy, precision and error, and describe how each of those can affect solutions in measurement situations.<br><br>B. Apply various measurement scales to describe phenomena and solve problems.<br><br>C. Estimate and compute areas and volume in increasingly complex problem situations.<br><br>D. Solve problem situations involving derived measurements; e.g., density, acceleration. | M.2.C.12.3<br>*Use Measurement Techniques and Tools* | 3. Apply informal concepts of successive approximation, upper and lower bounds, and limits in measurement situations; e.g., measurement of some quantities, such as volume of a cone, can be determined by sequences of increasingly accurate approximations. | |

## STANDARD 3: Geometry and Spatial Sense

Students identify, classify, compare and analyze characteristics, properties and relationships of one-, two- and three-dimensional geometric figures and objects. Students use spatial reasoning, properties of geometric objects, and transformations to analyze mathematical situations and solve problems.

| Ohio Benchmarks Grade 12 | Instructional Organization | Grade Level Indicators | Notes |
|---|---|---|---|
| **By the end of the 11-12 program:**<br><br>A. Use trigonometric relationships to verify determine solutions in problem situations.<br><br>B. Represent transformations within a coordinate system using vectors and matrices.<br><br>*Note: This is an extension of benchmark H in grades 11-12 in Mathematical Processes.*<br><br>H. Use formal mathematical language and notation to represent ideas, to demonstrate relationships within and among representation systems, and to formulate generalizations. | | | |

## STANDARD 3: Geometry and Spatial Sense (Cont.)

Students identify, classify, compare and analyze characteristics, properties and relationships of one-, two- and three-dimensional geometric figures and objects. Students use spatial reasoning, properties of geometric objects, and transformations to analyze mathematical situations and solve problems.

| Ohio Benchmarks Grade 12 | Instructional Organization | Grade Level Indicators | Notes |
|---|---|---|---|
| **By the end of the 11-12 program:** | | | |
| | *Outcome* | I. Present Derivatives numerically and analytically. | |
| | *Outcome* | II. Define derivative as the limit of the difference quotient. | |
| | *Outcome* | III. Use the derivative at a point to describe the tangent line to the curve at that point. | |
| | *Outcome* | IV. Compare the graphs of a function and its derivative, noting relationships between increasing and decreasing behaviors, and other characteristics. | |
| | *Outcome* | V. Explain the Mean Value Theorem. | |
| | *Outcome* | VI. Summarize corresponding characteristics of the graphs of f, f', and f''. | |

## STANDARD 4: Patterns, Functions and Algebra

Students use patterns, relations and functions to model, represent and analyze problem situations that involve variable quantities. Students analyze, model and solve problems using various representations such as tables, graphs and equations.

| Ohio Benchmarks Grade 12 | Instructional Organization | Grade Level Indicators | Notes |
|---|---|---|---|
| **By the end of the 11-12 program:** | | | |
| A. Analyze functions by investigating rates of change, intercepts, zeros, asymptotes, and local and global behavior. | M.4.A.12.3 *Use Patterns, Relations and Functions* | 3. Describe and compare the characteristics of transcendental and periodic functions; e.g., general shape, number of roots, domain and range, asymptotic behavior, extrema, local and global behavior. | |
| | *Outcome* | VII. Model rates of change in varied applied contexts, including related rates, velocity, and acceleration. | |
| | *Outcome* | VIII. Use implicit differentiation to find the derivative of an inverse function. | |
| | *Outcome* | IX. Apply derivations to solve optimization problems. | |

## STANDARD 4: Patterns, Functions and Algebra

Students use patterns, relations and functions to model, represent and analyze problem situations that involve variable quantities. Students analyze, model and solve problems using various representations such as tables, graphs and equations.

| Ohio Benchmarks Grade 12 | Instructional Organization | Grade Level Indicators | Notes |
|---|---|---|---|
| **By the end of the 11-12 program:** | | | |
| A. Analyze functions by investigating rates of change, intercepts, zeros, asymptotes, and local and global behavior. | M.4.A.12.7 *Use Algebraic Expressions* | 7. Make mathematical arguments using the concepts of limit. | |
| | *Outcome* | X. Demonstrate an understanding of asymptotes and asymptotic behavior in terms of limits. | |
| | *Outcome* | XI. Demonstrate an intuitive and geometric understanding of continuity in terms of limits and graphs of continuous functions. | |

## STANDARD 4: Patterns, Functions and Algebra (Cont.)

Students use patterns, relations and functions to model, represent and analyze problem situations that involve variable quantities. Students analyze, model and solve problems using various representations such as tables, graphs and equations.

| Ohio Benchmarks Grade 12 | Instructional Organization | Grade Level Indicators | Notes |
|---|---|---|---|
| **By the end of the 11-12 program:** | | | |
| A. Analyze functions by investigating rates of change, intercepts, zeros, asymptotes, and local and global behavior. | M.4.A.12.10 *Analyze Change* | 10. Use the concept of limit to find instantaneous rate of change for a point on a graph as the slope of a tangent at a point. | |
| B. Use the quadratic formula to solve quadratic equations that have complex roots. | | | |
| C. Use recursive functions to model and solve problems; e.g., home mortgages, annuities. | M.4.C.12.8 *Use Algebraic Representatives* | 8. Compare estimates of the area under a curve over a bounded interval by partitioning the region with rectangles; e.g., make successive estimates using progressively smaller rectangles. | |
| | *Outcome* | XIII. Evaluate integrals using basic properties and the Fundamental Theorem of Calculus. | |
| | *Outcome* | XIV. Find specific antiderivatives using initial conditions, including applications to motion along a line. | |
| | *Outcome* | XV. Solve separable differential equations and use them in modeling exponential growth. | |

## STANDARD 4: Patterns, Functions and Algebra (Cont.)

Students use patterns, relations and functions to model, represent and analyze problem situations that involve variable quantities. Students analyze, model and solve problems using various representations such as tables, graphs and equations.

| Ohio Benchmarks Grade 12 | Instructional Organization | Grade Level Indicators | Notes |
|---|---|---|---|
| **By the end of the 11-12 program:**<br><br>D. Apply algebraic methods to represent and generalize problem situations involving vectors and matrices. | *Outcome* | XVI. Apply integrals to find the area of a region the volume of a solid with known cross-sections, the average value of a function, and the distance traveled by a particle along a line. | |

## STANDARD 5: Data Analysis and Probability

Students use patterns, relations and functions to model, represent and analyze problem situations that involve variable quantities. Students analyze, model and solve problems using various representations such as tables, graphs and equations.

| Ohio Benchmarks Grade 12 | Instructional Organization | Grade Level Indicators | Notes |
|---|---|---|---|
| **By the end of the 11-12 program:**<br><br>A. Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.<br><br>B. Use descriptive statistics to analyze and summarize data, including measures of center, dispersion, correlation and variability.<br><br>C. Design and perform a statistical experiment, simulation or study; collect and interpret data; and use descriptive statistics to communicate and support predictions and conclusions. | | | |

# STANDARD 5: Data Analysis and Probability (Cont.)

Students use patterns, relations and functions to model, represent and analyze problem situations that involve variable quantities. Students analyze, model and solve problems using various representations such as tables, graphs and equations.

| Ohio Benchmarks Grade 12 | Instructional Organization | Grade Level Indicators | Notes |
|---|---|---|---|
| **By the end of the 11-12 program:**<br><br>D. Connect statistical techniques to applications in workplace and consumer situations. | | | |

# STANDARD 6: Mathematical Processes

Students use mathematical processes and knowledge to solve problems. Students apply problem-solving and decision-making techniques, and communicate mathematical ideas.

| Ohio Benchmarks Grade 12 | Instructional Organization | Grade Level Indicators | Notes |
|---|---|---|---|
| **By the end of the 11-12 program:** | | | |
| A. Construct algorithms for multi-step and non-routine problems. | M.6.A.12 | Note: Mathematical processes are used within all of the content standards and should be incorporated within the instruction and assessment of the benchmarks and grade-level indicators. | |
| B. Construct logical verifications or counter-examples to test conjectures and to justify or refute algorithms and solutions to problems. | M.6.B.12 | | |
| C. Assess the adequacy and reliability of information available to solve a problem. | M.6.C.12 | | |
| D. Select and use various types of reasoning and methods of proof. | M.6.D.12 | | |
| E. Evaluate a mathematical argument and use reasoning and logic to judge its validity. | M.6.E.12 | | |
| F. Present complete and convincing arguments and justifications, using inductive and deductive reasoning, adapted to be effective for various audiences. | M.6.F.12 | | |

## STANDARD 6: Mathematical Processes (Cont.)

Students use mathematical processes and knowledge to solve problems. Students apply problem-solving and decision-making techniques, and communicate mathematical ideas.

| Ohio Benchmarks Grade 12 | Instructional Organization | Grade Level Indicators | Notes |
|---|---|---|---|
| **By the end of the 11-12 program:** | | | |
| G. Understand the difference between a statement that is verified by mathematical proof, such as a theorem, and one that is verified empirically using examples or data. | M.6.G.12 | | |
| H. Use formal mathematical language and notation to represent ideas, to demonstrate relationships within and among representation systems, and to formulate generalizations. | M.6.H.12 | | |
| I. Communicate mathematical ideas orally and in writing with a clear purpose and appropriate for a specific audience. | M.6.I.12 | | |
| J. Apply mathematical modeling to workplace and consumer situations, including problem formulation, identification of a mathematical model, interpretation of solution within the model, and validation to original problem situation. | M.6.J.12 | | |