CALCULUS / AP CALCULUS (AB)

Topics identified by an asterisk (*) are covered in non-AP calculus only if time allows

GOALS: Students will develop skills and understanding in:

1. Graphing and performing basic operations on functions
2. Taking limits of functions and evaluating the continuity of functions
3. Performing differentiation
4. Solving applied problems involving:
   a) related rates
   b) curve sketching
   c) extrema
5. Performing integration
6. Solving applied problems involving:
   a) area
   b) volume
   c) average value
7. Performing integration and differentiation on exponential and logarithmic functions*
8. Incorporating graphing technology in:
   a) numerical differentiation
   b) numerical integration

OBJECTIVES: Students will be able to:
(Parentheticals refer to sections of Thomas' Calculus, Weir et al., 11th ed.)

Goal 1. Graphing and performing basic operations on functions

1.1. Write equations of lines (1.2)
1.2. Write functions to model physical situations (1.3)
1.3. Determine the piecewise definition of the absolute value of a function and sketch its graph (1.3 supplemented by instructor)
1.4. Perform operations on functions including composition and finding domain and range (1.3, 1.5)
1.5. Evaluate the six basic trigonometric functions for standard angles on the unit circle (1.6)
1.6. Sketch conic section graphs (1.3, 1.5)
1.7. Determine appropriate viewing window for viewing graphs on calculator (1.7)
1.8. Find x and y intercepts, symmetry to x- and y-axis and the origin, and sketch the graph of a given function (4.4)

Goal 2. Taking limits of functions and evaluating the continuity of functions

2.1. Determine limits using a table or graph and determine when a limit does not exist (2.1, 2.4)
2.2. Use the properties of limits and evaluate a limit using direct substitution (2.2)
2.3. Perform simple δ-ε proofs (2.3)
2.4. Evaluate limits of indeterminate form using the squeeze theorem and the two special trigonometric limits (2.3, 2.4)
2.5. Evaluate one-sided limits, infinite limits and limits at infinity (2.4, 2.5)
2.6. Use limits to verify the existence of vertical, horizontal, and oblique asymptotes and sketch graphs of rational functions (2.4, 2.5, supplemented by instructor)
2.7. Determine the intervals on which a function is continuous or discontinuous, identify the different types of discontinuity, re-define functions having removable discontinuities (2.6)
2.8. Use the Intermediate Value Theorem (2.6)

Goal 3. Performing differentiation

3.1. Write the equation of a tangent or normal line (2.7, 3.1, 3.2, 3.4, 3.5, 3.6)
3.2. Calculate derivatives using the regular and alternative definition of the derivative and know the definition of differentiability at a point and on an interval (3.1)
3.3. Differentiate a constant, multiple, sum, difference, power, product, or quotient (3.2)
3.4. Understand that the derivative represents an instantaneous rate of change (3.3)
3.5. Differentiate the six basic trigonometric functions (3.4)
3.6. Differentiate composite functions using the chain rule (3.5)
3.7. Differentiate implicit functions using implicit differentiation (3.6)

Goal 4. Solving applied problems using the derivative

4.1. Solve problems involving motion (3.3, 3.4)
4.2. Solve problems involving related rates (3.7)
4.3. Identify local and absolute extrema graphically (4.1)
4.4. Calculate absolute extrema of a function on a closed interval using the Extreme Value Theorem(4.1)
4.5. Solve problems involving optimization on open or closed intervals (4.1, 4.5)
4.6. Apply Rolle's Theorem and the Mean Value Theorem (4.2)
4.7. Determine the intervals on which a function is increasing or decreasing and find local extrema using the first derivative test (4.3)

4.8. Find relative extrema using the second derivative test, determine intervals on which the graph of a function is concave up or concave down, and identify points of inflection (4.4)
4.9. Sketch the graph of a function using information gathered from the first and second derivatives of the function (4.4)
4.10. Sketch the graph of a function given the graph of its first derivative (4.4 supplemented by instructor)

Goal 5. Performing integration

5.1 Antidifferentiate a constant, multiple, sum, difference, power, or derivative of one of the six basic trig functions (4.8)
5.2 Solve separable differential equations, including those involving motion (4.8, 5.4, 5.5)
5.3 Use slope fields to investigate solutions to differential equations (9.1)*
5.4 Approximate the area under a curve using upper and lower sums, and the midpoint rule (5.1)
5.5 Understand the integral as an accumulating operation (5.1)
5.6 Evaluate finite sums using sigma notation and summation properties and formulas (5.2)
5.7 Calculate area under a curve by taking the limit of a Riemann sum (5.2)
5.8 Know the definition and properties of the definite integral and understand the relationship between area under a curve and integration (5.3)
5.9 Determine the average value of a function over a closed interval (5.3)
5.10 Use the Fundamental Theorem of Calculus to evaluate integrals and to take the derivative of certain integrals (5.4)
5.11 Use the Fundamental Theorem of Calculus (part 1) to take the derivative of an integral (5.4)*
5.12 Use the Fundamental Theorem of Calculus (part 2) to evaluate integrals (5.4)
5.13 Integrate and antidifferentiate using the method of substitution (5.5, 5.6)
5.14 Perform integration by parts (8.2)*
5.15 Approximate definite integrals using the trapezoidal rule (8.7)*

Goal 6. Solving applied problems using the definite integral

6.1. Find the area of a region bounded by two or more graphs (5.4, 5.5, 5.6)
6.2. Find the volume of solids with known cross-sections using the method of slicing (6.1)*
6.3. Find the volume of solids of revolution using the disc,washer, and shell methods (6.1, 6.2)

Goal 7. Performing integration and differentiation on exponential and logarithmic functions

7.1 Determine if a function has an inverse, find the inverse of a function, evaluate the derivative of the inverse of a function (7.1)*
7.2 Perform logarithmic differentiation (7.2)*
7.3 Integrate and differentiate exponential and logarithmic functions, apply properties of logarithms and exponents (7.2, 7.3, 7.4)*
7.4 Integrate tangent, cotangent, secant, and cosecant (7.2)*
7.5 Solve problems of exponential growth and decay and Newton's Law of Cooling (7.5)*

Goal 8. Incorporating graphing technology

8.1. Numerical differentiation (text supplemented by instructor)
8.2. Numerical integration (text supplemented by instructor)