# Calculus -- Advanced Placement (BC Level)

For each of the sections that follow, students may be required to analyze, recall, explain, interpret, apply, or evaluate the particular concepts being taught.

FUNCTIONS, GRAPHS, AND LIMITS

ANALYSIS OF GRAPHS

- apply geometric and analytic information on the use of calculus both to predict and to explain the observed local and global behavior of a function

LIMITS (Limits of functions, including one-sided limits)

- calculate limits using algebra
- estimate limits from graphs or tables of data
- apply the use of a graphic utility to evaluate limits
- identify the nonexistence of limits

ASYMPTOTIC AND UNBOUNDED BEHAVIOR

- understand asymptotes in terms of graphical behavior
- describe asymptotic behavior in terms of limits involving infinity
- compare relative magnitudes of functions and their rates of change

CONTINUITY

- relate continuity in terms of limits
- define and apply Intermediate Value Theorem

PARAMETRIC, POLAR, AND VECTOR FUNCTIONS

- analyze planar curves including those given in parametric form, polar form, and vector form

DERIVATIVE

- define derivative
- relate differentiability and continuity
- apply derivative to determine equation of tangent line at a point
- determine instantaneous rate of change as the limit of average rate of change
- approximate rate of change from graphs and tables of values

DERIVATIVE AS A FUNCTION

- compare characteristics of graphs of f and the derivative of f
- understand the relationship between the increasing and decreasing behavior of f and the sign of its derivative
- apply the Mean Value Theorem
- solve equation involving derivatives

SECOND DERIVATIVES

- compare characteristics of the graphs of f and its first and second derivative
- relate the concavity of f and the sign of the second derivative
- analyze and interpret points of inflection as places where concavity changes

APPLICATIONS OF DERIVATIVES

- use and apply first derivative test, second derivative test, concavity, and inflection
- analyze and interpret all concepts graphically
- analyze planar curves given in parametric form, polar form, and vector form
- understand the geometric interpretation of differential equations via slope fields and the relationship between slope fields and derivatives of implicitly defined functions
- determine numerical solution of differential equations using Euler's method
- apply L'Hopital's Rule and its use in determining convergence of improper integrals and series

COMPUTATION OF DERIVATIVES

- differentiate algebraic functions by using the basic rules including exponential, logarithmic, trigonometric, and inverse trigonometric functions
- determine derivative of parametric, polar, and vector functions

INTEGRALS

RIEMANN SUMS

- apply concepts of a Riemann Sum over equal subdivisions
- evaluate Riemann sums

DEFINITE INTEGRALS

- define integrals and apply to basic formulas
- apply basic properties of definite integrals (for examples, additivity and linearity)

APPLICATION OF INTEGRALS

- adapt knowledge and techniques to solve application to model physical, social, or economic situations

- apply the integral of a rate of change to setting up an approximating Riemann sum and represent its limit as a definite integral
- apply the Fundamental Theorem to evaluate definite integrals and provide a graphical analysis of functions so defined
- determine antiderivatives by substitution of variables (including change of limits), parts, and simple partial fractions (nonrepeating linear factors only)
- evaluate improper integrals (as limits of definite integrals)
- calculate volume of a solid of revolution including disc, washer, and shall method

POLYNOMIAL APPROXIMATIONS AND SERIES

CONCEPT OF SERIES

- define series as a sequence of partial sums, and convergence is defined as the limit of the sequence of partial sums
- apply series of constants (including motivating examples with decimal expansion)
- apply geometric series, harmonic series, alternating series, terms of series, and its use in testing the convergence of p-series
- apply the ratio test for convergence and divergence

TAYLOR SERIES

- apply Taylor polynomial approximation with graphical demonstration of convergence
- apply the general Taylor series centered at $x = a$
- apply Maclaurin series for the functions
- manipulate Taylor series and shortcuts to computing Taylor series, including differentiation, antidifferentiation, and the formation of new series from known series
- apply defined power series and radius of convergence
- apply LaGrange error bound for Taylor polynomials

TECHNOLOGY

GRAPHING CALCULATORS TI-82, TI-83, TI-85 AND TI-86

- calculate derivatives at a point
- evaluate definite integrals
- determine areas
- apply regression formulas

COMPUTERS

- apply appropriate software as dictated by areas of content as available

GRADUATION PROJECT

- Optimization Project

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