Calculus BC Syllabus

Unit Information

Unit Name (Timeframe):
I. Limits and Continuity (3 weeks)

Content and /or Skills Taught:
-Intuitive understanding of limits
- Using graphs and tables to understand limits
- Finding limits analytically
- Use limits to justify horizontal and vertical asymptotes
- Connect the limits to justify horizontal and vertical asymptotes
- Connect the limit as x approaches infinity to global behavior of function
- Intuitive understanding of continuity
- Definition of continuity
- Types of continuity (removable, jump, and infinite)
- Prove functions continuous or discontinuous
- Intermediate Value Theorem

II. Differentiation (3 weeks)

Content and /or Skills Taught:
- Definition of derivative
- Derivative as slope of tangent line
- Find derivatives using definition
- Use the definition to discover the power rule for finding derivatives
- Power rule, sum/difference rule, product rule, quotient rule, chain rule
- Location linearization (see curves as locally linear)
- Use local linearization to estimate functional values
- Derivative as a rate of change
- Relationship between differentiability and continuity
- Prove functions differentiable or not differentiable
- Three cases where the derivative does not exist (discontinuous, vertical tangent, cusp)
- Derivatives of the trig functions

III. Applications of Derivative (3 weeks)

Content and /or Skills Taught:
- First derivative test for relative extrema
- Justify increasing, decreasing, and relative extrema
- justify concavity and inflection points with second derivative
- Second derivative test for relative extrema
- Sketch graphs of functions by analyzing first and second derivatives
- Relating graphs of f, f and f

- Max/min applications
- Closed Interval Test (Max/Min theorem)
- Mean Value Theorem, Rolles Theorem
- Rectilinear motion
- Implicit differentiation
- Related rates

IV. Integration (3 weeks)

Content and /or Skills Taught:
- Estimate the area under the curve using Riemann Sums and trapezoids
- Find the area under a curve using the definition of the definite integral
- Applications of area under the curve
- Find area under a curve using Fundamental Theorem of Calculus, part a
- Mean Value Theorem for Integrals Average of a Function
- U-substitution

V. Applications of the Definite Integral (3 weeks)

Content and /or Skills Taught:
- Area between two curves
- Volume of revolution (discs, washers, and cylindrical shells)
- Volume of solids with known cross sections
- Work problems
- Fluid force problems
- Arc length problems
- Revisit rectilinear motion
- Define integral as an area accumulator
- Fundamental Theorem of Calculus, part b

VI. Logarithmic, Exponential, and other Transcendental Functions (3 weeks)

Content and /or Skills Taught:
- Find derivatives of exponential function ($f(x) = e^x$ and $f(x) = a^x$)
- Find integrals of exponential functions (base e and other bases)
- Solving variables-separable differential equations
- Applications of variable-separable differential equations
- Draw slope curves for differential equations and sketch solution curves
- Use slope fields to geometrically solve differential equations
- Euler's method to estimate a numerical solution for a differential equation
- Differential inverse trig functions
- Integrations that yields inverse trig functions

VII. Techniques of integration, Improper Integrals, and L'Hopital's Rule (3 weeks)

-Integration by parts
- Integration by partial fractions
- Logistic growth
- Improper integrals
- L'Hopital's rule (0/0 infinity and intermediate forms that are exponential in nature)

VIII. Parametric Equations and Vectors (2 weeks)

Content and /or Skills Taught:
- Graph parametric equations
- Eliminate the parameter in parametric equations
- Find first and second derivatives of parametric equations
- Vectors as parametric equations
- Vector application along a curve
- Position, velocity, and acceleration as vectors
- Magnitude of velocity and speed
- Distance as arc length
- Slope of a path

IX. Polar Curves (1 week)
Content and /or Skills Taught:
- Graph polar curves
- Polar curves as parametric equations
- Slope of polar curve
- Area of a polar curve
- Area bounded by two polar curves

X. Infinite Series (3 weeks)

Content and /or Skills Taught:
- Convergent and divergent series
- Definition of series as a limit of partial sums
- Geometric and telescopic series
- Nth term test
- Comparison test
- Limit comparison test
- Integral test
- Ratio test
- Root test
- Alternative series test
- Absolute convergent test
- Power series
- Taylor and Maclaurin series of familiar functions
- Find interval of convergence for a power series

- Estimate error in power series
- Alternate series test
- LaGrange error

XI. Post AP Exam (4 weeks)

Content and /or Skills Taught:
- Trigonometric substitution
- Further integration involving trigonometric functions
- 3-D vectors
- Vector projections
- Dot product and applications
- Cross product and applications