LOCALLY DEVELOPED COURSE OUTLINE

Calculus Advanced (2021)35-3

Submitted By:

The St. Albert School Division

Submitted On:

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Course Basic Information

Outline Number	Hours	Start Date	End Date	Development Type	Proposal Type	Grades
35-3	62.50	09/01/2021	08/31/2025	Developed	Authorization	G12

Course Description

Calculus Advanced 35 provides the opportunity for students to pursue more advanced levels of study in mathematics calculus. It provides the means for these students to succeed in completing the equivalent learning of a first year university calculus course in a high school setting.

Calculus Advanced 35 may be used to prepare students for the Advanced Placement Calculus AB exam or with including the elective learning outcomes the Advanced Placement Calculus BC exam. Students may choose to write an AP Calculus exam, but the exam is not part of the course.

Course Prerequisites

Math 30-1

Sequence Introduction (formerly: Philosophy)

Calculus Advanced 35 provides the opportunity for students to pursue more advanced levels of study in mathematics calculus. This course has a broad scope and requires students to think critically in a collaborative environment. It provides the means for these students to succeed in completing the equivalent learning of a first year university calculus course in a high school setting. This course is a logical extension of the seven Mathematical Processes identified in the WNCP Mathematics Curriculum. Through the use of graphing calculators, and other computer based graphical software, students can refer to visual models to reinforce their algebraic understandings, as well as initiate discussions regarding the concepts and problems within this course. Throughout Calculus Advanced 35 students will be engaged in mathematical learning activities that deepen their abilities to creatively solve problems, collaborate with others to navigate mathematical challenges, and to take risks in their learning processes. Instruction will facilitate students' abilities to investigate, examine, communicate and innovate with mathematical problems to discover solutions. This course is based on the AP Calculus AB Course and with elective outcomes the BC Course and Exam Description (2020) guidelines.

Student Need (formerly: Rationale)

The material found in Calculus Advanced 35 will better prepare students to write the AP examinations and give them a competitive edge for university level courses in calculus. The course provides students the opportunity to work with more advanced mathematical concepts that are discussed during their first year university math classes.

The successful completion of Advanced Placement exam can provide students with university credit for a first year math course.

Scope and Sequence (formerly: Learner Outcomes)

Instruction will be led by the "Rule of Three" which ensures students look at mathematical concepts in Graphical, Numeric and Algebraic Methods. This rule is fundamental to AP Mathematics as well as a solid mathematical understanding, building off of skills from their math courses in order to develop an appreciation for the science of Mathematics. This course will help students with their confidence in taking risks, engage them in the collaborative process of learning, and develop their skills as a technologically fluent life-long learner, communicator, and problem-solver.

Guiding Questions (formerly: General Outcomes

1 Students will employ mathematical practices.

2 Students will understand the distinction between evaluating a function at a point and considering what value the function is approaching, if any, as x approaches a point.

3 Students will examine how derivatives allow us to determine instantaneous rates of change.

4 Students will understand how to differentiate composite functions to determine derivatives of implicit and inverse functions.

5 Students will develop an understanding of average and instantaneous rates of change in problems involving motion.

6 Students will apply reasoning with definitions and theorems.

7 Students will understand the relationship between differentiation and integration using the Fundamental Theorem of Calculus.

8 Students will set up and solve separable differential equations.

9 Students will understand how to find the average value of a function, model particle motion and nets, and determine areas, volumes, and lengths defined by the graphs of functions.

10 (Elective) Students will develop their understanding of straight-line motion to solve problems in which particles are moving along curves in the plane.

11 (Elective) Students will develop an understanding that sum of infinitely many terms may converge to a finite value.

Learning Outcomes (formerly: Specific Outcomes)

1 Students will employ mathematical practices.	**35-3**
1.1 Determine expressions and values using mathematical procedures and rules.	X
1.2 Translate mathematical information from a single representation or across multiple representations.	X
1.3 Justify reasoning and solutions.	X
1.4 Use correct notation, language, and mathematical conventions to communicate results or solutions.	X

2 Students will understand the distinction between evaluating a function at a point and considering what value the function is approaching, if any, as x approaches a point.	**35-3**
2.1 Interpret the rate of change at an instant in terms of average rates of change over intervals containing that instant.	X
2.2 Represent limits analytically using correct notation.	X
2.3 Interpret limits expressed in analytic notation.	X
2.4 Estimate limits of functions.	X
2.5 Determine the limits of functions using limit theorems.	X
2.6 Determine the limits of functions using equivalent expressions for the function or the squeeze theorem.	X
2.7 Justify conclusions about continuity at a point using the definition.	X
2.8 Determine intervals over which a function is continuous.	X
2.9 Determine values of x or solve for parameters that make discontinuous functions continuous, if possible.	X
2.10 Interpret the behaviour of functions using limits involving infinity.	X
2.11 Explain the behaviour of à function on an interval using the Intermediate Value Theorem.	X

3 Students will examine how derivatives allow us to determine instantaneous rates of change.	**35-3**
3.1 Determine average rates of change using difference quotients.	X
3.2 Represent the derivative of à function as the limit of a difference quotient.	X
3.3 Estimate derivatives.	X
3.4 Explain the relationship between differentiability and continuity.	X
3.5 Calculate derivatives of familiar functions.	X
3.6 Calculate derivatives of products and quotients of differentiable functions.	X

4 Students will understand how to differentiate composite functions to determine derivatives of implicit and inverse functions.	**35-3**
4.1 Calculate derivatives of compositions of differentiable functions.	X
4.2 Calculate derivatives of implicitly defined functions.	X
4.3 Calculator derivatives of inverse and inverse trigonometric functions.	X
4.4 Determine higher order derivatives of a function.	X

5 Students will develop an understanding of average and instantaneous rates of change in problems involving motion.	**35-3**
5.1 Interpret the meaning of a derivative in context.	X
5.2 Calculate rates of change in applied contexts.	X
5.3 Interpret rates of change in applied contexts.	X
5.4 Calculator related rates in applied contexts.	X
5.5 Interpret related rates in applied contexts.	X
5.6 Approximate à value on a curve using the equation of a tangent line.	X

5.7 Determine the limits of functions that result in indeterminate forms.	X

6 Students will apply reasoning with definitions and theorems.	**35-3**
6.1 Justify conclusions about functions by applying the Mean Value Theorem over an interval.	X
6.2 Justify conclusions about functions by applying the Extreme Value Theorem.	X
6.3 Justify conclusions about the behaviour of a function based on the behaviour of its derivatives.	X
6.4 Calculate minimum and maximum values in applied contexts or analysis of functions.	X
6.5 Interpret minimum and maximum values calculated in applied contexts.	X
6.6 Determine critical points of implicit relations.	X
6.7 Justify conclusions about the behaviour of an implicitly defined function based on evidence from its derivatives.	X

7 Students will understand the relationship between differentiation and integration using the Fundamental Theorem of Calculus.	**35-3**
7.1 Interpret the meaning of areas associated with the graph of a rate of change in context.	X
7.2 Approximate a definite integral using geometric and numerical methods.	X
7.3 Interpret the limiting case of the Riemann sum as a definite integral.	X
7.4 Represent the accumulation functions using definite integrals.	X
7.5 Calculate a definite integral using areas and properties of definite integrals.	X
7.6 Evaluate definite integrals analytically using the Fundamental Theorem of Calculus.	X

7.7 Determine antiderivatives of functions and indefinite integrals, using knowledge of derivatives.	X
7.8 For integrands requiring substitution or rearrangements into equivalent forms, determine indefinite integrals.	X
7.9 For integrands requiring substitution or rearrangements into equivalent forms, evaluate definite integrals.	X
7.10 For integrands requiring integration by parts, determine indefinite integrals.	X
7.11 For integrands requiring integration by parts, evaluate definite integrals.	X
7.12 For integrants requiring integration by linear partial fractions, determine indefinite integrals.	X
7.13 For integrants requiring integration by linear partial fractions, evaluate definite integrals.	X
7.14 (Elective) Evaluate an improper integral or determine that the integral diverges.	X

8 Students will set up and solve separable differential equations.	**35-3**
8.1 Interpret verbal statements of problems as differential equations involving a derivative expression.	X
8.2 Verify solutions to differential equations.	X
8.3 Estimate solutions to differential equations.	X
8.4 Determine general solutions to differential equations.	X
8.5 Interpret the meaning of a differential equation and its variables in context.	X
8.6 Determine general and particular solutions for problems involving differential equations in context.	X
8.7 Interpret the meaning of logistic growth model in context.	X

9 Students will understand how to find the average value of a function, model particle motion and nets, and determine areas, volumes, and lengths defined by the graphs of functions.	**35-3**

9.1 Determine the average value of a function using definite integrals.	X
9.2 Determine values for positions and rates of change using definite integrals in problems involving rectilinear motion.	X
9.3 Interpret the meaning of a definite integral in accumulation problems.	X
9.4 Determine net change using definite integrals in applied contexts.	X
9.5 Calculate areas in the plane using the definite integral.	X
9.6 Calculate volumes of solids with known cross sections using definite integrals.	X
9.7 (Elective) Determine the length of a curve in the plane defined by a function, using a definite integral.	X

10 (Elective) Students will develop their understanding of straight-line motion to solve problems in which particles are moving along curves in the plane.	**35-3**
10.1 (Elective) Calculate derivatives of parametric functions.	X
10.2 (Elective) Determine the length of a curve in the plane defined by parametric functions, using a definite integral.	X
10.3 (Elective) Calculate derivatives of vector-valued functions.	X
10.4 (Elective) Determine a particular solution given a rate vector and initial conditions.	X
10.5 (Elective) Determine values for positions and rates of change in problems involving planar motion.	X
10.6 (Elective) Calculate derivatives of functions written in polar coordinates.	X
10.7 (Elective) Calculate areas of regions defined by polar curves using definite integrals.	X

11 (Elective) Students will develop an understanding that sum of infinitely many terms may converge to a finite value.	**35-3**

11.1 (Elective) Determine whether a series converges or diverges.	X
11.2 (Elective) Approximate the sum of a series.	X
11.3 (Elective) Represent a function at a point as a Taylor polynomial.	X
11.4 (Elective) Determine the error bound associated with a Taylor polynomial approximation.	X
11.5 (Elective) Determine the radius of convergence and interval of convergence for a power series.	X
11.6 (Elective) Represent a function as a Taylor series or a Maclaurin series.	X
11.7 (Elective) Interpret Taylor series and Maclaurin series.	X
11.8 (Elective) Represent a given function as a power series.	X

Facilities or Equipment

Facility

No specific facilities required.

Facilities:

Equipment

No specific equipment required.

Learning and Teaching Resources

No specific learning resources required.

Sensitive or Controversial Content

No sensitive or controversial content.

Issue Management Strategy

Health and Safety

No health and safety concerns.

Risk Management Strategy

Statement of Overlap with Existing Programs

Calculus Advance provides additional learning opportunities beyond Math 30-1 and Math 31.

Student Assessment

No specific assessments.

Teachers may use assessment tools from CollegeBoard for this course.

The Advanced Placement exam is not part of the assessment of the final grade for this course.

Course Approval Implementation and Evaluation

Future revisions to this course will include updating to reflect changes made by CollegeBoard.