Dominican International School

SUBJECT: Calculus

GRADE LEVEL: 12 **SCHOOL YEAR: 2023-24**

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COURSE DESCRIPTION:

This course aims to introduce the two main branches of calculus: differential calculus and integral calculus. Initially, the course will review the students on pre-calculus concepts. This is important for the study of limits and its properties. Limits will then be used to define the basic definitions of the two main branches of calculus. Applications of the concepts taught will be supplied to give the students an idea of how to recognize or design applications in future experiences.

COURSE OBJECTIVES:

Standard 1 Limits and Continuity
Students understand the concept of limit, find limits of functions at points and at infinity, decide if a function is continuous, and use continuity theorems.

C.1.1 Understand the concept of limit and estimate limits from graphs and tables of values.
C.1.2 Find limits by substitution.
C.1.3 Find limits of sums, differences, products, and quotients.
C.1.4 Find limits of rational functions that are undefined at a point.
C.1.5 Find one-sided limits.
C.1.6 Find limits at infinity.
C.1.7 Decide when a limit is infinite and use limits involving infinity to describe asymptotic behavior.
C.1.8 Find special limits
C.1.9 Understand continuity in terms of limits.
C.1.10 Decide if a function is continuous at a point.
C.1.11 Find the types of discontinuities of a function.
C.1.12 Understand and use the Intermediate Value Theorem on a function over a closed interval.
C.1.13 Understand and apply the Extreme Value Theorem: If f(x) is continuous over a closed interval, then f has a maximum and a minimum on the interval.

Standard 2 Differential Calculus
Students find derivatives of algebraic, trigonometric, logarithmic, and exponential functions. They find derivatives of sums, products, and quotients, and composite and inverse functions. They find derivatives of higher order, and use logarithmic differentiation and the Mean Value Theorem.

C.2.1 Understand the concept of derivative geometrically, numerically, and analytically, and interpret the derivative as a rate of change.
C.2.2 State, understand, and apply the definition of derivative.
C.2.3 Find the derivatives of functions, including algebraic, trigonometric, logarithmic, and exponential functions.
C.2.4 Find the derivatives of sums, products, and quotients.
C.2.5 Find the derivatives of composite functions, using the chain rule.
C.2.6 Find the derivatives of implicitly-defined functions.
C.2.7 Find second derivatives and derivatives of higher order.
C.2.8 Find derivatives using logarithmic differentiation.
C.2.9 Understand and use the relationship between differentiability and continuity.
C.2.10 Understand and apply the Mean Value Theorem.

Standard 3 Applications of Derivatives
Students find slopes and tangents, maximum and minimum points, and points of inflection. They solve optimization problems and find rates of change.

C.3.1 Find the slope of a curve at a point, including points at which there are vertical tangents and no tangents.
C.3.2 Find a tangent line to a curve at a point and a local linear approximation.
C.3.3 Decide where functions are decreasing and increasing. Understand the relationship between the increasing and decreasing behavior of f and the sign of f'.
C.3.4 Find local and absolute maximum and minimum points.
C.3.5 Analyze curves, including concavity.
C.3.6 Find points of inflection of functions. Understand the relationship between the concavity of f and the sign of f''. Understand points of inflection as places where concavity changes.
C.3.7 Use first and second derivatives to help sketch graphs. Compare the corresponding characteristics of the graphs of f, f', and f''.
C.3.8 Solve optimization problems.
C.3.9 Find average and instantaneous rates of change. Understand the instantaneous rate of change as the limit of the average rate of change. Interpret a derivative as a rate of change in applications, including velocity, speed, and acceleration.
C.3.10 Find the velocity and acceleration of a particle moving in a straight line.
C.3.11 Model rates of change, including related rates problems.

Standard 4 Integral Calculus
Students define integrals using Riemann Sums, use the Fundamental Theorem of Calculus to find integrals, and use basic properties of integrals. They integrate by substitution and find approximate integrals.

C.4.1 Use rectangle approximations to find approximate values of integrals.
C.4.2 Calculate the values of Riemann Sums over equal subdivisions using left, right, and midpoint evaluation points.
C.4.3 Interpret a definite integral as a limit of Riemann Sums.
C.4.4 Understand the Fundamental Theorem of Calculus: Interpret a definite integral of the rate of change of a quantity over an interval as the change of the quantity over the interval.
C.4.5 Use the Fundamental Theorem of Calculus to evaluate definite and indefinite integrals and to represent particular antiderivatives. Perform analytical and graphical analysis of functions so defined.
C.4.6 Understand and use these properties of definite integrals.
C.4.7 Understand and use integration by substitution (or change of variable) to find values of integrals.
C.4.8 Understand and use Riemann Sums, the Trapezoidal Rule, and technology to approximate definite integrals of functions represented algebraically, geometrically, and by tables of values.

Standard 5 Applications of Integration
Students find velocity functions and position functions from their derivatives, solve separable differential equations, and use definite integrals to find areas and volumes.

C.5.1 Find specific antiderivatives using initial conditions, including finding velocity functions from acceleration functions, finding position functions from velocity functions, and applications to motion along a line.
C.5.2 Solve separable differential equations and use them in modeling.
C.5.3 Use definite integrals to find the area between a curve and the x-axis, or between two curves.
C.5.4 Use definite integrals to find the average value of a function over a closed interval.
C.5.5 Use definite integrals to find the volume of a solid with known cross-sectional area.
C.5.6 Apply integration to model and solve problems in physics, biology, economics, etc., using the integral as a rate of change to give accumulated change and using the method of setting up an approximating Riemann Sum and representing its limit as a definite integral.

PRIMARY TEXTBOOK & OTHER RESOURCES:

Students are responsible for coming to class prepared with all the required supplies. Laptops or equivalent devices are permitted for some activities based on Teacher's instructions.

- Textbook – Hass, Heil and Weir. Thomas' Calculus: Early Transcendentals, Single Variable 14th ed. 2018.
- Ti-nspireCX Graphing calculator
- Khan Academy

ASSESSMENT:

Tests and Quarterly Exams are scheduled and announced in advance. Pop Quizzes are unannounced and can be given at any time during the class so the students must come to class prepared. ALL Tests, Exams and Quizzes may be cumulative so students are responsible for staying prepared for the previous scopes and lessons learned.

Homeworks/Classworks/Seatworks are graded based on the completion and whether it is completed by the due dates. Students are responsible for checking the assignments' due dates posted on Google Classroom. Students are expected to be prepared to turn in any work by the due date class time even if the Teacher did not instruct them to turn in the due date. Any Missing, Incomplete, or Late works are counted with a 10% or more penalty with due dates as posted on the Google Classroom. Students MUST submit "Mark as Done" in Google Classroom for each assignment posted. Not submitting "Done" count as Incomplete with 10% penalty. An additional 10% are penalized for each day for late turn-in work.

The student who misses the scheduled Test or Quarterly Exam with legit reason may write a makeup test/exam right after the student returns back to school. The make-up test/exam may be different and more challenging than the originally scheduled test/exam. The student grades are assigned as the following:

1. Tests and Pop Quizzes	30%
2. Homework/Classwork/Seatwork /Projects	30%
3. Quarterly Exam	30%
4. Deportment	10%
Total Grade	100%

ADDITIONAL INFORMATION:

Academic Dishonesty means employing a method or technique or engaging in conduct in an academic endeavor that contravenes the standards of ethical integrity expected at DIS. Academic dishonesty includes but is not limited to, the following:

1. Purposely incorporating the ideas, words of sentences, paragraphs, or parts thereof without appropriate acknowledgment and representing the product as one's own work; and
1. Representing another's intellectual work such as photographs, paintings, drawings, sculpture, or research or the like as one's own, including failure to attribute content to an AI.
2. Employing a tutor, making use of Artificial Intelligence without acknowledgement, getting a parent to write a paper or do an assignment, paying for an essay to be written by someone else and presented as the student's own work.
3. Committing any act that a reasonable person would conclude, when informed of the evidence, to be a dishonest means of obtaining or attempting to obtain credit for academic work.

Any act of academic dishonesty will result in an automatic zero on the entire assignment

1st QUARTER – TENTATIVE COURSE CONTENT

(NB: Depending on time and interest, the teacher may delete and/or add other selections.)

Week / Date	Topic / Projects / Assessments
Week 1 **Aug 10th to 11th** **Only 2 School Days** *10 ~ First Day / Orientation Day*	1.1 Functions and Their Graphs
Week 2 **Aug 14th to 18th** *15 ~ Opening Mass*	1.2 Combining Functions; Shifting and Scaling Graph 1.3 Trigonometric Functions
Week 3 **Aug 21st to 25th**	1.4 Graphing with Software 1.5 Exponential Functions
Week 4 **Aug 28th to Sep 1st**	1.6 Inverse Functions and Logarithms
Week 5 **Sep 4th to 8th** *8 ~ Holy Mass & VIP Induction*	Chapter 1 Test 2.1 Rates of Change and Tangent Lines to Curves
Week 6 **Sep 11th to 15th** *12-14 ~ Pre-Exam Days*	2.2 Limit of a Function and Limit Laws 2.3 The Precise Definition of a Limit
Week 7 **Sep 18th to 22nd**	2.4 One-Sided Limits 2.5 Continuity
Week 8 **Sep 25th to 29th** **No Classes** *25-28 ~Teacher's Conference* *29 – Moon Festival Holiday*	
Week 9 **Oct 2nd to 6th** **3 Days of Class** *5-6 ~Q1 Exams*	**Quarter Exam**

2nd QUARTER – TENTATIVE COURSE CONTENT

(NB: Depending on time and interest, the teacher may delete and/or add other selections.)

Week / Date	Topic / Projects / Assessments
Week 1 (10) **Oct 9th to 13th** **3 Days of Class** *9-10 – Double 10 Holiday*	2.6 Limits Involving Infinity; Asymptotes of Graphs
Week 2 (11) **Oct 16th to 20th**	3.1 Tangent Lines and the Derivative at a Point 3.2 The Derivative as a Function
Week 3 (12) **Oct 23rd to 27th**	3.3 Differentiation Rules 3.4 The Derivative as a Rate of Change
Week 4 (13) **Oct 30th to Nov 3rd** *1 - All Saint's Day Mass*	3.5 Derivatives of Trigonometric Functions 3.6 The Chain Rule
Week 5 (14) **Nov 6th to 10th**	3.7 Implicit Differentiation
Week 6 (15) **Nov 13th to 17th**	3.8 Derivatives of Inverse Functions and Logarithms
Week 7 (16) **Nov 20th to 24th**	3.9 Inverse Trigonometric Functions
Week 8 (17) **Nov 27th to Dec 1st**	Quarter Exam Desmos Project
Week 9 (18) **Dec 4th to 8th** 8 - Foundation Day Celebrations	Desmos Project
Week 10 (19) **Dec 11th to 15th** **3 Days of Class** *14-15 ~ Q2 Exams*	Desmos Project
Dec 18th to Jan 1st	**Christmas Break**

3rd QUARTER – TENTATIVE COURSE CONTENT

(NB: Depending on time and interest, the teacher may delete and/or add other selections.)	
Week / Date	Topic / Projects / Assessments
Week 1 (20) **Jan 3rd to 5th** **3 Days of Class** *4 ~ New Year Mass*	3.10 Related Rates
Week 2 (21) **Jan 8th to 12th**	3.11 Linearization and Differentials
Week 3 (22) **Jan 15th to 19th**	4.1 Extreme Value of Functions on Closed Intervals 4.2 The Mean Value Theorem
Week 4 (23) **Jan 22nd to 26th**	4.3 Monotonic Functions and the First Derivative Test 4.4 Concavity and Curve Sketching
Week 5 (24) **Jan 29th to Feb 2nd**	4.5 Indeterminate Forms and L'Hopital's Rule
Week 6 (25) **Feb 5th to 9th** **3 Days of Class** *8-9 ~ CNY*	4.6 Applied Optimization
Feb 8th to 16th	**Chinese New Year**
Week 7 (26) **Feb 19th to 23rd** *19 ~ Lenten Mass* *21-23 ~ Pre-Exam Days*	4.7 Newton's Method
Week 8 (27) **Feb 26th to March 1st** **4 Days of Class** 28 ~ 228 Memorial Day Holiday	4.8 Antiderivatives
Week 9 (28) **March 4th to 8th** **4 Days of Class** *8 ~ Q3 Exams*	Quarter Exam

4th QUARTER – TENTATIVE COURSE CONTENT

(NB: Depending on time and interest, the teacher may delete and/or add other selections.)

Week / Date	Topic / Projects / Assessments
Week 1 (29) **March 11th to 15th** **4 Days of Class** *11 ~ Q3 Exams* *12 ~ Q4 Begins*	5.1 Area and Estimating with Finite Sums
Week 2 (30) **March 18th to 22nd** *18-21 ~ Fire Drill*	5.2 Sigma Notation and Limits of Finite Sums
March 25th to Apr 5th	**Easter Break**
Week 3 (31) **Apr 8th to 12th** *10 ~ Easter Mass*	5.3 The Definite Integral
Week 4 (33) **Apr 15th to 19th**	5.4 The Fundamental Theorem of Calculus
Week 5 (34) **Apr 22th to 26th** 22-26 ~ AP Mock Exams	5.5 Indefinite Integrals and the Substitution Method
Week 6 (35) **Apr 29th to May 3rd** *1-2 ~ Pre-Exam* *1-10~ Final Exams (K, 5, 8, 12 only)* *4/29 – 5/10 ~ AP Exams*	5.6 Definite Integral Substitutions and the Area Between Curves
Week 7 (36) **May 6th to 10th** *1-10~ Final Exams (K, 5, 8, 12 only)* *4/29 – 5/10 ~ AP Exams*	Quarter Exam
Week 8 (37) **May 13th to 17th** **2 Days of Class** *15-16 ~ Q4 Exams* *17 ~ Record Day*	Graduation Preparation
Week 9 (38) **May 20th to 24th** **ACTIVITIES: *Double check the school calendar and emails from the administration.***	Graduation Preparation
Week 10 (39) **May 27th to 31st** **ACTIVITIES: *Double check the school calendar and emails from the administration.***	