COURSE OUTLINE – CALCULUS 12

TERM: January – April 2020
CLASS TIME: Monday – Friday
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TEXTBOOK: Calculus 12 Castle Rock
Students notes and problems

INTRODUCTION:

This course examines the concept of slope in a linear function and then generalizes it to cover the slopes of the graphs. This course provides an insight into the changing slopes of the non-linear functions and by introducing the concept of derivative, which determines the instantaneous rate of change. The second part deals with the Integral Calculus. Integral Calculus is a powerful concept in finding the area under the graph and the volumes of revolution about (X) and (Y) axis.

TOPICS:

- Limits
- Derivatives and Derivative Theorems
- Derivatives of Polynomial, Rational, Exponential, Logarithmic and Trigonometric Functions
- Extreme Values and Curve Sketching
- Anti-Derivatives and Area

BIG IDEAS:

The **Concept of a Limit** is the foundation of calculus	Differential Calculus develops the concept of **Instantaneous Rate of Change**	Integral Calculus develops the concept of determining the sums involving a **continuously changing** quantity over an interval	Derivatives and Integrals are **inversely related**

By the end of this course students will be expected the following big ideas:

- **Limits**

Is the fundamental concept that relates conventional mathematics to calculus. Slope of a curve is changing throughout its domain. By considering two very close points on the curve where the limit of the distance between these two points approach zero, we are able to determine the slope at any point of a function.

- **Derivative and Derivative Theorems**

0 Derivative is the instantaneous rate of change in any function.
0 Not all the points on a function are differentiable.
0 Differentiability requires continuity.

- **Derivatives of Polynomial, Rational, Exponential, Logarithmic and Trigonometric Functions**

0 Derivative rules are different for each function.
0 To determine rate of change at every point in the above-mentioned functions, the appropriate derivative rules must be applied.

- **Extreme Values and Curve Sketching**

0 Curve Sketching needs a sound knowledge of derivatives.
0 To understand the behavior of functions, asymptotes and (X) and (Y) Intercept(s) must be determined.
0 Successful graph sketching requires knowledge of the symmetry and transformations.
0 Maximum and minimum are the points where the derivative is zero.

- **Anti-Derivatives and Area**

0 Derivatives and integrals are inversely related.
0 There are different rules to determine the anti-derivative of different Functions.
0 Area under graph and volumes of revolution of different functions can be calculated by using the definite integral.
0 Mathematical modeling of real world problems requires setting up and Solving the resulting differential equations.

CORE COMPETENCES:

By the end of this course students will be expected to:

- Acquire and communicate mathematical ideas using appropriate language, connections, and representation.
- Collaboratively develop, analyze, and carry out mathematical modeling based on proven calculus concepts.
- Reflect on experiences and accomplishments to demonstrate one's own progress in learning.

CURRICULAR COMPETENCIES:

By the end of this course students will be expected to:

- Demonstrate a sustained intellectual curiosity about mathematical topic or problem of personal, local, or global interest
- Formulate multiple hypotheses and predict multiple outcomes
- Collaboratively and individually plan, select, and use appropriate investigation methods, including class work and lab experiments, to collect reliable ideas (qualitative and quantitative)
- Apply the concept of accuracy and precision to experimental procedures and data (significant figures, uncertainty, mathematical notions)
- Seek and analyze patterns, trends, and connections in data, including describing relationships between variables, performing calculations and identifying inconsistencies
- Construct, analyze, and interpret graphs, models, and/or diagrams
- Use knowledge of mathematical concepts to draw conclusions that are consistent with graphical and numerical data
- Evaluate their methods and their initial conditions, including identifying sources of error or uncertainty, confounding variables, and possible alternative explanations and conclusions
- Describe specific ways to improve their investigation methods and the quality of their data
- Demonstrate an awareness of assumptions, question information given, and identify bias in their work and in primary and secondary sources
- Assess risks in the context of personal safety and social responsibility

Students are expected to know the following:

- Slope of straight line
- Function notation
- Limit theory
- Limits at infinite
- Slope of tangent line
- Slope of curves
- Derivatives as slope functions
- Derivative rules
- Continuity and differentiability
- Mean value theorem
- Curve sketching
- Asymptotes
- Symmetry
- First and second derivative test

- Implicit differentiation

- Logarithmic differentiation
- Related rates
- Optimization
- Fundamental theorem of calculus
- Anti-derivative
- Area under the graph of functions
- Volume of revolution
- L'Hospial's rules
- Integration by parts
- Partial fractions

COURSE REQUIREMENTS:

- It is the student's responsibility to preview and study the material that will be covered in class.
- Attendance is mandatory. If you are late to class by more than 15 minutes, you will be marked as an absent.
- Students are not allowed to use their cell phones in the classroom.
- Homework needs to be completed and is due at the beginning of class.
- Behave responsibly in the class. Show consideration and respect for your fellow classmates, and your teacher.

TESTING/FINAL EXAM POLICY:

- Test MUST be written during the times scheduled. It is the student's responsibility to be aware of scheduled test dates and of any changes to these dates. It is your responsibility to ensure you arrive on time – no extra time will be given.
- A score of zero will be assigned to any missed test. If a valid reason (**medical note)** is provided, the instructor may allow make up tests. If you miss an exam due to illness contact your instructor as soon as possible.
- No rewrites are allowed for low test marks.
- Students are required to write the **Final Exam** in order to receive course credit. There is no make up for final exam.
- A student caught cheating on a quiz, test or exam will receive an automatic "0". A second cheating offence may result in expulsion from Coquitlam College.

ASSESSMENT:

Formative
Self assessment, oral quizzes, team project on life and achievement of a famous mathematicians.

Summative
Unit test, presentation, mid-term and final exam.

EVALUATION:

Unit Tests	30%
Mid-Term Exam	25%
Final Exam	35%
Research Project	10%
Total	100%

LETTER GRADES AND THEIR EQUIVALENTS:

A	(86-100%)	Excellent
B	(73-85%)	Very Good
C+	(67-72%)	Good
C	(60-66%)	Average
C-	(50-59%)	Minimal Achievement
I	(0-49%)	Incomplete
F	(0-49%)	Fail (Final Grade)

To avoid an undeserved low grade, if you stop attending class, it is your responsibility to officially withdraw through the office.

FPPL:
- Learning ultimately supports the well-being of the self, the family, the community, the land, the spirits, the ancestors.

CALCULUS 12 0VERVIEW

Curriculum Organizer	Teaching Strategies Assignments	Big Ideas & Core Competence	Exploration of Curriculum
Pre-Calculus 12 Review Week 1	• Review of some of the important topics in pre-calculus 12 such as: • Polynomial function • Rational functions • Transformations • Trigonometry • Exponential function • Logarithms • Quizzes and oral questions • Self assessment	• Polynomials are the building blocks of advanced mathematics • Most natural phenomena are mathematically modeled by exponential, logarithmic, and rational functions • Limit behaviour is demonstrated by rational functions	• Define polynomial functions divide, factor polynomials • Understand the fact that Pythagorean theorem is the foundation of trigonometry • Exponential and logarithmic functions are inverse of each other • Apply transformations to obtain horizontal, vertical shift, and find the symmetry about (x) and (y) axis and the origin • Solve trigonometry in solving periodic behaviour like tidal waves and problems involving rotations

FPPL:

- Learning is holistic, reflexive, reflective, experiential, and rational (focused on connectedness, on reciprocal relationship, and a sense of place.

Curriculum Organizer	Teaching Strategies and Assessments	Big Ideas & Core Competencies	Exploration of Curriculum
Limits	• Limits, graphically,	• The concept of the	• Explain the concept of

Week 2-3	numerically, and algebraically • Limits of rational expressions • Two sided limits • Limits at infinite • Vertical and horizontal asymptote • Removable and irremovable discontinuity • Indeterminate limits • Worksheet quizzes and use of technology • Self assessment	limit is fundamental to understanding derivatives • Horizontal and vertical asymptotes are the limits at infinite • Not all infinites are the same • The indeterminate form can be solved by factoring or rationalization • Limits of trigonometric functions • Divergence and convergence	limits graphically and numerically • Perform calculations to obtain horizontal/ vertical asymptote • Determine the actual limit of functions when the indeterminate form of 0/0 is involved • Extend the concept of limit to determine the derivative formula • Explain why the concept of limit is the bridge that connects mathematics to calculus

FPPL:

- Learning involves recognizing the consequences of one's actions.

Curriculum Organizer	Teaching Strategies and Assessments	Big Ideas & Core competencies	Curricular Competencies
Derivatives and Derivative Theorems	• Derivatives of exponential, polynomial, rational, and logarithmic functions • Differentiability means continuity and the continuity is the	• Calculus is the mathematics of varying rates of change • Slopes of various elementary functions vary	• Demonstrate an understanding of slope or rate of change in a linear function • Extend the concept of limit to establish the rate of change in non-linear

Week 4-5	necessary condition for differentiability, but does not guarantee it • Almost all elementary functions can be graphed, using their first and second derivative • Worksheets, quizzes, use of technology in graphing functions • Self assessment	throughout their domain • Derivatives are functions which determine the slope at any point on the graph • Mathematical modeling of real world problems leads to differential equations • Solution of differential equations requires a good understanding of derivatives and anti- derivatives	functions • Demonstrate an understanding of the slope of the tangent line to the graph which is the instantaneous rate of change at that point • Be able to differentiate between the average and the instantaneous rate of change • Demonstrate an understanding of chain rule, product rule, and quotient rule • Apply the rules to solve application problems

FPPL:
- Learning involves generational roles and responsibilities.

Curriculum Organizer	Teaching Strategies and Assessments	Big Ideas & Core Competencies	Exploration of Curriculum
Derivatives of Trigonometric, Logarithmic and Exponential Functions	• Characteristics of exponential, logarithmic, and trig functions • Asymptotes in trigonometric, logarithmic, and exponential functions • Restricted domain in a periodic function	• Many natural phenomena like PH measurements, the intensity of an earthquake can be modeled and measured by logarithmic function • Exponential function are used in	• Sketch the graph of exponential, logarithmic, and trigonometric functions • Determine the inverse of an exponential function and understand the fact that its inverse is a logarithmic function • Extend the idea of

Week 6-7 Students will meet and review current grades to understand areas needing growth	• Exponential and logarithmic functions are inverse of each other • Application problems and mathematic modeling • Quizzes, test using the graphing calculator • Self assessment	calculating regeneration of rodents and computation of compound interest etc • Trig functions are the foundation by which periodic behavior like tidal wave and human heart activities can be monitored • Harmonics are the building block of waves that can only be modeled by trigonometric functions	determining derivatives to exponential, logarithmic, and trig functions • Use the concepts in compound interest, to understand the natural logarithm • Determine the inverse of trig functions and their derivatives • Mathematical modeling, using derivatives

FPPL:
- Learning recognizes the role of indigenous knowledge.

Curriculum Organizer	Teaching Strategies and Assessments	Big Ideas & Core Competencies	Exploration of Curriculum
Extreme Values and Curve Sketching Week 8-9	• Sketch the graphs of polynomial, rational, exponential, and trig functions • Determine X and Y intercepts of functions, if they exist • Determine horizontal, vertical, and oblique asymptote • Find the symmetry of the graph • Find the local and absolute max/min • Perform the first and the second derivative test	• Graph of a function is the ultimate explanation of its behavior • Asymptotes are the result of limits at infinite • Symmetry, X and Y intercepts • Optimization of any system requires graphing, first and second derivative tests • Related rate are almost	• Graph and analyze most algebraic functions • Determine X and Y intercepts • Determine any horizontal or vertical asymptotes • Determine any symmetry by using their knowledge of transformation • Determine max/min, using derivatives

	• Determine intervals of max/min and the concavity • Quizzes, test using the graphing calculator • Self assessment	always non-linear • Related rates problems require the knowledge of implicit differentiation • Interpolation and extrapolation are predictive tools, which lead to prediction of system behavior	• Explain concavity, using the second derivative • Compare the graph of a function with the graph of its derivative • Compare the graph of a function with the graph of its second derivative

FPPL:

- Learning is embedded in memory, history, and story.
- Learning involves recognizing that some knowledge is sacred and only shared wit permission and/or in certain situations.

Curriculum Organization	Teaching Strategies and assessment	Big Ideas & Core Competencies	Exploration of Curriculum
Anti-Derivative and Area Week 10-13 Students will meet and review current grades to understand areas needing growth	• Find the anti-derivative of a simple polynomial and trigonometric functions • Find the anti-derivative of a simple exponential function • Use anti-derivatives to solve problems with initial conditions • Solve second order differential equations with Hook's Law as an application • Evaluate a definite integral • Find the signed area under the graph	• Differentiation and integration are inverse of each other according to the fundamental Law of Calculus • Definite integral calculates the area under the graph • Integral calculus leads to computation of accumulative amount of many time varying quantities • Logistic exponential functions used in many branches of science and engineering, including the sustainability of habitat and balance of the prey and the predator	• Use the first and the second fundamental law of calculus to show that one is the inverse of the other • Recognize the difference between definite and indefinite integral • Determine anti-derivatives of different functions by substitution method, integration by parts, and partial fractions • Compare and contrast the connection between the function and its anti-derivative • Determine the definite integral, which represent the area under the graph

	• Approximate area, using the Rectangular and Trapezoidal Rules • Approximate the area using, Riemann Sum • Quizzes, test using the graphing calculator • Self assessment		• Determine the indefinite integral • Set up and evaluate integrals representing volumes of revolutions • Mathematically model science, engineering and business related problems by using the differential equation

FPPL:

- Learning involves patience and time. Learning requires exploration of one's identity.