MOHAWK VALLEY COMMUNITY COLLEGE
UTICA AND ROME, NEW YORK

COURSE OUTLINE

MA151

CALCULUS 1

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Reviewed and Revised by Gabriel Melendez - 5/11
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COURSE OUTLINE

Title: Calculus 1

Catalog Number: MA151

Credit Hours: 4

Lecture Hours: 4

Lab Hours: 0

Prerequisite: An appropriate placement test result or MA150 Precalculus

Catalog Description

This is the first in a sequence of three courses in analytical geometry and calculus for students intending to transfer to programs requiring a thorough background in calculus. Topics include limits and continuity, differentiation of algebraic, trigonometric, exponential and logarithmic functions, and indefinite and definite integration. Applications are included.

Course Objectives

1. To help the student learn the basics of the calculus of functions of one variable.

2. To raise the student's level of logical thinking by requiring the student to write some basic calculus proofs.

3. To increase the student's ability to use technology as a problem solving tool by requiring the student to use technology as an aid in solving applied problems.

4. To challenge the student, through both applied and theoretical problems, to appreciate calculus as a problem solving art.

General Student Learning Outcomes

1. The student will demonstrate the ability to interpret and communicate mathematics in writing.
2. The student will demonstrate the ability to work effectively in a group by participating in group work and demonstrating openness toward diverse points of view; drawing upon knowledge and experience of others; and demonstrating skill in negotiating differences and working toward correct solutions.
3. The student will be able to state a problem correctly, reason analytically to its solution, and interpret the result.
4. The student will be able to solve equations and application problems from numerical, graphical, and / or analytical perspectives.
5. The student will demonstrate an understanding of how mathematics can be used to analyze real world situations.

6. The student will be able to use technology to collect and / or analyze data and to solve problems.

SUNY Learning Outcomes

1. The student will develop well-reasoned arguments by demonstrating an ability to write proofs.
2. The student will identify, analyze, and evaluate arguments as they occur in their own and other's work.
3. The student will demonstrate the ability to interpret and draw inferences from mathematical models such as formulas, graphs, tables, and schematics.
4. The student will demonstrate the ability to represent mathematical information symbolically, visually, numerically, and verbally.
5. The student will demonstrate the ability to employ quantitative methods such as arithmetic, algebra, geometry, or statistics to solve problems.
6. The student will demonstrate the ability to estimate and check mathematical results for reasonableness.

Major Topics to be Covered

1. Limits and Continuity

The concepts of limit and continuity are introduced intuitively and then the definition of each is stated in precise mathematical terms. Some methods of evaluating limits are discussed and the continuity of functions is determined.

Student Learning Outcomes

The student will be able to:

1.1 Evaluate limits numerically, graphically, and analytically.
1.2 Apply the properties of limits.
1.3 Evaluate limits involving trigonometric functions.
1.4 Evaluate limits at infinity.
1.5 Determine if a function has an infinite limit.
1.6 Determine the continuity of a function at a point using the definition.
1.7 Describe the continuity of a function over an interval.
1.8 Demonstrate an understanding of the precise definition of the limit of a function.

2. Differentiation

The derivative is introduced as the slope of the tangent line to a curve at a point. Formulas for differentiating algebraic, trigonometric, exponential and logarithmic functions are derived. The formulas are then used to find the instantaneous rate of change of functions, to locate maxima and minima of functions, and to solve related rate problems. The formulas are also used as aids in sketching graphs of functions and approximating roots via Newton's Method.

Student Learning Outcomes

The student will be able to:

2.1 Find the derivative of a function using the limit definition.
2.2 Evaluate the derivative of a function at a point.
2.3 Write an equation of a tangent line to a curve at a point.
2.4 Find derivatives by applying the product, quotient, power, and chain rules.
2.5 Find higher order derivatives.
2.6 Determine derivatives of trigonometric functions.
2.7 Determine derivatives of exponential and logarithmic functions.
2.8 Find derivatives by implicit differentiation.
2.9 Find instantaneous rates of change.
2.10 Analyze and sketch the graph of a function using calculus methods.
2.11 Solve application problems involving derivatives, including related rates, optimization, and Newton's Method problems.

3. Integration

The definite integral of a function is defined as a limit. The fact that the area under a curve can be represented as a definite integral is discussed. The Fundamental Theorem of Calculus is stated and proved. Some elementary formulas are developed and the method of u-substitution is used for both definite and indefinite integration.

Student Learning Outcomes

The student will be able to:

3.1 Find antiderivatives using basic integration rules.
3.2 Solve application problems using antiderivatives, including initial value problems.
3.3 Set-up and / or evaluate a definite integral using the definition.
3.4 Apply the properties of the definite integral.
3.5 Find the area under a curve.
3.6 Apply the Fundamental Theorem of Calculus.
3.7 Evaluate indefinite and definite integrals using the method of u-substitution.

4. Mathematical Reasoning

One intention of the MA151 course is to give the student insight into mathematical proof. Understanding theorem statements, writing short proofs, and deriving formulas are included.

Student Learning Outcomes

The student will be able to:

4.1 Prove at least one of the properties of limits.
4.2 Analyze the applicability of theorems, including Rolles' Theorem, the Mean Value Theorem, and the Fundamental Theorem of Calculus.
4.3 Derive at least one differentiation formula.

Teaching Guide

Title:	Calculus 1
Catalog Number:	MA151
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Lecture Hours:	4
Lab Hours:	0
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Catalog Description

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Text: Contemporary Calculus by Dale Hoffman, which is a free on-line calculus text, supported by **SUNY OER Services**. The course includes the use of the **On-line Homework Manager (OHM).**

Students must have a graphing calculator for MA151 (instructors may recommend, though not require a particular model).

Some Preliminary Comments

The Calculus 1, 2, and 3 sequence is intended to give students an insight into mathematical thought and proof.

Although throughout the sequence there is an increasing expectation that the student acquires the discipline connected with systematic mathematical reasoning, she/he is not expected to become a "theorem prover". The instructor should strive to achieve a reasonable balance between the manipulative and theoretical aspects of the course.

Chapter 0: Welcome to Calculus **4 hours**

1. A Preview of Calculus
2. Lines in the Plane
3. Functions and Their Graphs
4. Combinations of Functions
5. Mathematical Language

Chapter 1: Limits and Continuity **8 hours**

1. Tangent Lines, Velocity, Growth
2. The Limit of a Function
3. Properties of Limits
4. Continuous Functions
5. Definition of Limit

Chapter 2: The Derivative **16 hours**

1. Introduction to Derivatives
2. The Definition of Derivative
3. Derivatives, Properties and Formulas
4. More Differentiation Patterns
5. The Chain Rule
6. Applications of the Chain Rule
7. Related Rates
8. Newton's Method
9. Linear Approximation and Differentials
10. Implicit and Logarithmic Differentiation

Chapter 3: Derivatives and Graphs **12 hours**

1. Finding Maximums and Minimums
2. Mean Value Theorem
3. The First Derivative and the Shape of f
4. The second Derivative and the Shape of f
5. Applied Maximum and Minimum Problems
6. Asymptotic Behavior of Functions
7. L'Hospital's Rule

Chapter 4: The Integral **16 Hours**

1. Area
2. Sigma Notation and Riemann Sums
3. The Definite Integral
4. Properties of the Definite Integral
5. Areas, Integrals and Antiderivatives
6. The Fundamental Theorem of Calculus
7. Finding Antiderivatives
8. First Applications of Definite Integrals
9. Using Tables (and Technology) to Find Antiderivatives
10. Approximating Definite Integrals

Remark

The teaching guide allows 4 additional hours for the in-class assessment of student learning. A two hour comprehensive final examination will be given during final exam days.

On the 27th of May 1998, the Department of Mathematics unanimously decided that students enrolled in MA 151 should learn, without use of so–called "cheat sheets", certain fundamental rules concerning differentiation and integration as below.

$$\frac{d}{dx}[c]=0 \qquad \int kf(u)du = k\int f(u)du$$

$$\frac{d}{dx}[cu]=c\frac{du}{dx} \qquad \int u^n du = \frac{u^{n+1}}{n+1}+C, n\neq -1$$

$$\frac{d}{dx}[x]=1 \qquad \int du = u + C$$

$$\frac{d}{dx}[u^n]=nu^{n-1}\frac{du}{dx} \qquad \int [f(u)\pm g(u)]du = \int f(u)du \pm \int g(u)du$$

$$\frac{d}{dx}[u\pm v]=\frac{du}{dx}\pm\frac{dv}{dx} \qquad \int \sin u du = -\cos u + C$$

$$\frac{d}{dx}[uv]=u\frac{dv}{dx}+v\frac{du}{dx} \qquad \int \cos u du = \sin u + C$$

$$\frac{d}{dx}\left[\frac{u}{v}\right]=\frac{v\frac{du}{dx}-u\frac{dv}{dx}}{v^2} \qquad \int \sec^2 u du = \tan u + C$$

$$\frac{d}{dx}[\sin u]=(\cos u)\frac{du}{dx} \qquad \int \csc^2 u du = -\cot u + C$$

$$\frac{d}{dx}[\cos u]=-(\sin u)\frac{du}{dx} \qquad \int \sec u \tan u du = \sec u + C$$

$$\frac{d}{dx}[\tan u]=(\sec^2 u)\frac{du}{dx} \qquad \int \csc u \cot u du = -\csc u + C$$

$$\frac{d}{dx}[\cot u]=-(\csc^2 u)\frac{du}{dx}$$

$$\frac{d}{dx}[\sec u]=(\sec u \tan u)\frac{du}{dx}$$

$$\frac{d}{dx}[\csc u]=-(\csc u \cot u)\frac{du}{dx}$$