

# MATH M16A: APPLIED CALCULUS I

**Originator**

abarcenas

**College**

Moorpark College

**Discipline (CB01A)**

MATH - Mathematics

**Course Number (CB01B)**

M16A

**Course Title (CB02)**

Applied Calculus I

**Banner/Short Title**

Applied Calculus I

**Credit Type**

Credit

**Start Term**

Fall 2023

**Catalog Course Description**

Covers limits, continuity, and differentiation. Applies differential calculus to problems in business, economics, social and biological sciences. Introduces anti-differentiation and its applications in business and economics.

**Additional Catalog Notes**

Credit Limitation - MC, CSU and UC: MATH M16A, MATH M25A, and M25AH combined: maximum credit, one course.

**Taxonomy of Programs (TOP) Code (CB03)**

1701.00 - Mathematics, General

**Course Credit Status (CB04)**

D (Credit - Degree Applicable)

**Course Transfer Status (CB05) (select one only)**

A (Transferable to both UC and CSU)

**Course Basic Skills Status (CB08)**

N - The Course is Not a Basic Skills Course

**SAM Priority Code (CB09)**

E - Non-Occupational

**Course Cooperative Work Experience Education Status (CB10)**

N - Is Not Part of a Cooperative Work Experience Education Program

**Course Classification Status (CB11)**

Y - Credit Course

**Educational Assistance Class Instruction (Approved Special Class) (CB13)**

N - The Course is Not an Approved Special Class

**Course Prior to Transfer Level (CB21)**

Y - Not Applicable

**Course Noncredit Category (CB22)**

Y - Credit Course

**Funding Agency Category (CB23)**

Y - Not Applicable (Funding Not Used)

**Course Program Status (CB24)**

1 - Program Applicable

**General Education Status (CB25)**

B - Satisfies Math/Quantitative Reasoning req (CSUGE-B B4, IGETC 2, or 4-yr)

**Support Course Status (CB26)**

N - Course is not a support course

**Field trips**

Will not be required

**Grading method**

(L) Letter Graded

**Alternate grading methods**

(O) Student Option- Letter/Pass

(P) Pass/No Pass Grading

**Does this course require an instructional materials fee?**

No

**Repeatable for Credit**

No

**Is this course part of a family?**

No

**Units and Hours**

**Carnegie Unit Override**

No

**In-Class**

**Lecture**

**Minimum Contact/In-Class Lecture Hours**

52.5

**Maximum Contact/In-Class Lecture Hours**

52.5

**Activity**

**Laboratory**

**Total in-Class**

**Total in-Class**

**Total Minimum Contact/In-Class Hours**

52.5

**Total Maximum Contact/In-Class Hours**

52.5

## Outside-of-Class

### Internship/Cooperative Work Experience

Paid

Unpaid

### Total Outside-of-Class

Total Outside-of-Class

Minimum Outside-of-Class Hours

105.0

Maximum Outside-of-Class Hours

105.0

### Total Student Learning

Total Student Learning

Total Minimum Student Learning Hours

157.5

Total Maximum Student Learning Hours

157.5

Minimum Units (CB07)

3

Maximum Units (CB06)

3

### Prerequisites

MATH M05 or MATH M07 or MATH M11 or placement as determined by college's multiple measures assessment process

## Entrance Skills

### Entrance Skills

MATH M05

### Prerequisite Course Objectives

MATH M05-state and apply the definition of a function and use the vertical line test.

MATH M05-evaluate functions at both numerical and algebraic domain values.

MATH M05-determine the domain and range of a relation or function given its equation or its graph.

MATH M05-form a new function from original functions using the functional operations of addition, subtraction, multiplication, division, and composition.

MATH M05-graph the functions which yield the parabola, the absolute value, the cubic, the square root, the cube root, and ones defined piecewise; solve linear and radical equations, and absolute value equalities and inequalities, and use these graphs to model real-life applications.

MATH M05-test equations of graphs for symmetries about the x-axis, the y-axis, and the origin.

MATH M05-apply transformations to the graphs of functions.

MATH M05-graph a parabola given by a quadratic function.

MATH M05-give a rough sketch of the graph of a polynomial function of degree three or larger given its factored form.

MATH M05-determine the domain and range as well as the horizontal and vertical asymptotes of a rational function and use that information to graph it; be able to solve rational equations.

MATH M05-graph exponential and logarithmic functions.

MATH M05-convert equations back and forth from exponential to logarithmic form.

MATH M05-apply the rules of logarithms involving logarithms of products, quotients, powers, and change of base and solve logarithmic functions, and use logarithms to solve real-life application problems.

MATH M05-solve exponential equations which have the same base on both sides and ones that do not have the same base on both sides of the equation by using logarithms, and use exponents to solve real-life application problems.

MATH M05-use the following theorems (over the complex numbers): Remainder, Factor, Fundamental Theorem of Algebra, Rational Roots (with synthetic

division), and Conjugate Roots to solve polynomial equations.

MATH M05-solve systems of linear equations using substitution and addition (elimination) with two and three variables and determine consistency and dependency as germane.

MATH M05-solve systems of nonlinear equations and linear and non-linear systems of inequalities.

MATH M05-identify and analyze the algebraic representations of conic sections to determine their properties and sketch their graphs, including circles, ellipses and hyperbolas.

### Entrance Skills

MATH M07

### Prerequisite Course Objectives

MATH M07-graph functions and relations in rectangular coordinates and polar coordinates.

MATH M07-analyze and identify the features of the graphs and/or the equations of functions and relations.

MATH M07-apply transformations to the graphs of functions and relations.

MATH M07-recognize the relationship between functions and their inverses graphically and algebraically.

MATH M07-solve and apply equations including rational, linear, polynomial, exponential, absolute value, radical, and logarithmic, and solve linear, nonlinear, and absolute value inequalities.

MATH M07-solve systems of equations and inequalities.

MATH M07-apply functions to model real world applications.

MATH M07-write the standard form of a circle given the general equation.

MATH M07-graph plane curves described by parametric equations.

### Entrance Skills

MATH M11

### Prerequisite Course Objectives

MATH M11-state and apply the definition of a function and identify whether a relation is a function.

MATH M11-determine the domain and range of a function, and evaluate the function at a numerical or algebraic value.

MATH M11-perform basic operations on functions, including addition, subtraction, multiplication, division and composition of functions, and determining the inverse of a one-to-one function.

MATH M11- identify transformations of functions, in comparison to basic function graphs, including shape change, reflection, horizontal and vertical shift, and sketch graph.

MATH M11-identify features of the graph of a function, including intercepts, vertices, maximum and minimum values, asymptotes and symmetry.

MATH M11-solve equations and determine roots of various functions, including linear, quadratic, polynomial and rational functions.

MATH M11-solve inequalities, including linear, quadratic, polynomial and rational inequalities, stating answer in set notation or interval notation.

MATH M11-perform division of polynomials, including use of synthetic division to determine roots of higher order polynomials.

MATH M11-sketch the graph of a polynomial of degree three or higher, using the roots of the polynomial and its factored form.

MATH M11-sketch the graph of a rational function, using the roots, asymptotes and intervals where function is positive or negative.

MATH M11-sketch the graph of basic exponential and logarithmic graphs.

MATH M11-use properties of logarithms to simplify logarithmic expressions.

MATH M11- solve exponential equations using properties of exponents, logarithms, and the change of base formula to find numerical solutions to equations that may or may not have a common base on both sides of an equation.

MATH M11-solve logarithmic equations using properties of logarithms.

MATH M11-use the techniques of solving exponential and logarithmic equations to solve application problems in biology, economics or other scientific fields.

MATH M11-solve systems of linear equations involving two variables, using substitution or elimination, and stating whether system is independent, dependent or inconsistent.

MATH M11-solve systems of linear equations involving three variables, using substitution or elimination, and stating whether system is independent, dependent or inconsistent.

## Requisite Justification

### Requisite Type

Prerequisite

### Requisite

MATH M05

### Requisite Description

Course in a sequence

**Level of Scrutiny/Justification**

Required by 4 year institution

**Requisite Type**

Prerequisite

**Requisite**

MATH M11

**Requisite Description**

Course in a sequence

**Level of Scrutiny/Justification**

Required by 4 year institution

**Requisite Type**

Prerequisite

**Requisite**

MATH M07

**Requisite Description**

Course in a sequence

**Level of Scrutiny/Justification**

Required by 4 year institution

**Student Learning Outcomes (CSLOs)****Upon satisfactory completion of the course, students will be able to:**

- |   |                                         |
|---|-----------------------------------------|
| 1 | find the area between two curves.       |
| 2 | find a limit of a function graphically. |

**Course Objectives****Upon satisfactory completion of the course, students will be able to:**

- |    |                                                                                                                                                                                                                                                             |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1  | evaluate the limit of a function, including one-sided and two-sided, using numerical and algebraic techniques and the properties of limits, including continuity.                                                                                           |
| 2  | calculate the derivative of an algebraic function using the formal definition of the derivative.                                                                                                                                                            |
| 3  | explain the concept of derivative as an "instantaneous rate of change" and the slope of the tangent line; find derivatives of functions using the constant, power, sum, difference, product, quotient, and chain rules, and using implicit differentiation. |
| 4  | find the derivative of algebraic, exponential, and logarithmic functions.                                                                                                                                                                                   |
| 5  | determine maxima and minima in optimization problems using the derivative.                                                                                                                                                                                  |
| 6  | sketch the graph of functions using the first and second derivatives to determine intervals where the functions are decreasing and increasing, maximum and minimum values, intervals of concavity and points of inflection.                                 |
| 7  | solve applied problems involving tangent lines, rates of change, and related rates.                                                                                                                                                                         |
| 8  | apply the concept of derivative to solve applied problems involving marginal cost, profit and revenue, and exponential growth and decay problems.                                                                                                           |
| 9  | find definite and indefinite integrals by using general integral formulas, integration by substitution, and other integration techniques.                                                                                                                   |
| 10 | use integration techniques to find the area under a curve and the area between two curves.                                                                                                                                                                  |
| 11 | use integration in business and economic applications, such as to analyze revenue, cost and profit.                                                                                                                                                         |
| 12 | evaluate a limit using L'Hopital's rule.                                                                                                                                                                                                                    |

## Course Content

### Lecture/Course Content

#### 35% A. Differentiation

1. Limits, evaluation of limits, and continuity
2. Average rates of change
3. Differentiation using limits
4. Instantaneous rates of change and tangent line
5. Differentiation rules: sum, product, quotient, and the chain rule
6. Differentiation of polynomial, rational, radical, exponential, and logarithmic functions
7. Implicit differentiation

#### 25% B. Applications of Differentiation

1. Using first derivatives to find maxima, minima and intervals where function is increasing or decreasing.
2. Using second derivatives to find maxima, minima, inflection points, interval of concavity, and to sketch graphs
3. Graph sketching: asymptotes and rational functions
4. Optimization
5. Marginal cost, profit, and revenue analysis
6. Implicit differentiation and related rates

#### 25% C. Applications of Integration

1. Finding the area under a curve
2. Finding the area between curves
3. Application in business and economics

#### 15% D. Integration

1. The anti-derivative
2. Indefinite and definite integrals
3. Approximating the definite integral as a finite sum
4. General integration formulas
5. Integration by substitution
6. Integral tables

### Laboratory or Activity Content

Not Applicable.

## Methods of Evaluation

Which of these methods will students use to demonstrate proficiency in the subject matter of this course? (Check all that apply):

Written expression  
 Problem solving exercises  
 Skills demonstrations

Methods of Evaluation may include, but are not limited to, the following typical classroom assessment techniques/required assignments (check as many as are deemed appropriate):

Computational homework  
 Individual projects  
 Objective exams  
 Problem-solving exams  
 Problem-solving homework  
 Quizzes  
 Other (specify)  
 Classroom Discussion  
 Participation

### Other

Quizzes and graded work will be used to evaluate students for the critical thinking skills needed to solve math problems. Problems must require students to demonstrate analytic skills and the step-by-step details required for the solution.

## Instructional Methodology

### Specify the methods of instruction that may be employed in this course

Class activities  
 Class discussions  
 Computer-aided presentations  
 Demonstrations  
 Distance Education  
 Group discussions  
 Instructor-guided interpretation and analysis  
 Instructor-guided use of technology  
 Lecture  
 Problem-solving examples  
 Other (specify)

### Specify other method of instruction

All instructors will use best practices to provide an inclusive learning environment that respects all forms of racial, ethnic, age, and gender diversity, and provides for the individual needs of students of all learning styles.

### Describe specific examples of the methods the instructor will use:

1. Demonstration of mathematical concepts on a whiteboard or document camera, such as the computation of one-sided and two-sided limits both algebraically and graphically.
2. Discussion of abstract concepts, such as the definition and meaning of first and second derivatives.
3. Employing student exploration of concepts in group discussion, such as computation and application of marginal cost, revenue and profit.

## Representative Course Assignments

### Writing Assignments

1. Homework problems selected from the applied calculus textbook where answers require a written explanation of the solution, such as problems involving exponential growth and decay.
2. Short answer problems on exams, such as stating the meaning of marginal functions.
3. Graded assignments: in-class and/or homework assignments requiring complete solutions using both written English and symbolic mathematical language.

### Critical Thinking Assignments

1. Describe and apply the algorithmic steps for obtaining the solution to a mathematical problem, such as using derivatives to sketch the graph of a function.
2. Compare and contrast methods of solution to mathematical problems, such as evaluating limits using more than one method.

### Reading Assignments

1. Reading introductory theory from textbook, such as the basic idea of a mathematical limit, or the meaning of an instantaneous rate of change.
2. Reading instructor prepared material, such as explanations of basic Calculus topics in the words of an instructor.
3. Reading reference materials from the library, including applications of derivatives in rates of change in the sciences or economics.

### Skills Demonstrations

1. Demonstration of computational skills such as the computation of a derivative.
2. Demonstration of graphing skills, such as curve sketching using first and second derivative tests.

### Problem-Solving and Other Assignments (if applicable)

1. Computing marginal cost, marginal revenue, and marginal profit for a business application problem.
2. Solving mathematical and application problems, such as using the derivative to solve optimization problems.

## Outside Assignments

### Representative Outside Assignments

1. Group or individual applied calculus projects.
2. Additional problem sets provided by the instructor, such as practice exercises on using the chain rule to find derivatives.

## Articulation

### C-ID Descriptor Number

MATH 140

### Status

Approved

### Equivalent Courses at 4 year institutions

University	Course ID	Course Title	Units
San Francisco State University	MATH 107	Mathematics for Business Calculus I	3
CSU Long Beach	MATH 115	Calculus for Business	4
CSU Channel Islands	MATH 140	Calculus for Business Applications	3

### Comparable Courses within the VCCCD

MATH R106 - Business Calculus

MATH V46 - Applied Calculus

## District General Education

### A. Natural Sciences

### B. Social and Behavioral Sciences

### C. Humanities

### D. Language and Rationality

#### D2. Communication/Analytical Thinking

Approved

### E. Health and Physical Education/Kinesiology

### F. Ethnic Studies/Gender Studies

### Course is CSU transferable

Yes

### CSU Baccalaureate List effective term:

FALL 1995

## CSU GE-Breadth

### Area A: English Language Communication and Critical Thinking

### Area B: Scientific Inquiry and Quantitative Reasoning

#### B4 Mathematical/Quantitative Reasoning

Approved



**Area C: Arts and Humanities**

**Area D: Social Sciences**

**Area E: Lifelong Learning and Self-Development**

**Area F: Ethnic Studies**

**CSU Graduation Requirement in U.S. History, Constitution and American Ideals:**

### UC TCA

UC TCA  
Approved

### IGETC

**Area 1: English Communication**

**Area 2A: Mathematical Concepts & Quantitative Reasoning**

Area 2A: Mathematical Concepts & Quantitative Reasoning  
Approved

**Area 3: Arts and Humanities**

**Area 4: Social and Behavioral Sciences**

**Area 5: Physical and Biological Sciences**

**Area 6: Languages Other than English (LOTE)**

### Textbooks and Lab Manuals

#### Resource Type

Textbook

#### Classic Textbook

No

#### Description

Hughes-Hallett, Deborah, et al. *Applied Calculus*. 7th ed., Wiley, 2022.

#### Resource Type

Textbook

#### Classic Textbook

No

#### Description

Lial, Margaret, Raymond Greenwell, and Nathan Ritcheny. *Calculus with Applications*. 12th ed., Pearson, 2022.

#### Resource Type

Textbook

#### Classic Textbook

No

**Description**

Bittinger, Marvin, et al. *Calculus and Its Applications*. 2nd ed., Pearson, 2020.

**Resource Type**

Textbook

**Description**

Calaway, Shana, Dale Hoffman, and David Lippman. *Business Calculus*. E-Book, Opentextbookstore, 2013, <http://www.opentextbookstore.com/buscalc/BusCalc.pdf>. Accessed 20 Oct 2022.

**Library Resources****Assignments requiring library resources**

Use of textbooks on reserve. Use the Library's print and online resources, including other calculus texts and periodical articles, to supplement application problems such as maximizing profit and minimizing cost.

**Sufficient Library Resources exist**

Yes

**Example of Assignments Requiring Library Resources**

Using library resources to look up current interest rates to apply to exponential and logarithmic computations on current value, future value, and principle in loan, mortgage and bank account computations and other applications to business and economics.

**Distance Education Addendum****Definitions****Distance Education Modalities**

Hybrid (1%–50% online)  
Hybrid (51%–99% online)  
100% online

**Faculty Certifications**

**Faculty assigned to teach Hybrid or Fully Online sections of this course will receive training in how to satisfy the Federal and state regulations governing regular effective/substantive contact for distance education. The training will include common elements in the district-supported learning management system (LMS), online teaching methods, regular effective/substantive contact, and best practices.**

Yes

**Faculty assigned to teach Hybrid or Fully Online sections of this course will meet with the EAC Alternate Media Specialist to ensure that the course content meets the required Federal and state accessibility standards for access by students with disabilities. Common areas for discussion include accessibility of PDF files, images, captioning of videos, Power Point presentations, math and scientific notation, and ensuring the use of style mark-up in Word documents.**

Yes

**Regular Effective/Substantive Contact****Hybrid (1%–50% online) Modality:**

Method of Instruction	Document typical activities or assignments for each method of instruction
Asynchronous Dialog (e.g., discussion board)	Use of student discussion boards to discuss concepts from the material, solutions to homework problems, general discussion of techniques in solving problems, study skills, or arranging study groups.
E-mail	Responding to student queries about material, grade information, course policies and procedures, scheduling and due dates, submitting homework assignments, or making general announcements to the class.
Face to Face (by student request; cannot be required)	Students requesting to speak to instructor in person for personal help on material, grade information, or discussion of policies and procedures.

Other DE (e.g., recorded lectures) Posting of recorded lectures either by the instructor, recorded lessons available through campus resources, or use of public online resources available on the internet.

Synchronous Dialog (e.g., online chat) Active live discussion with the instructor on material concepts, techniques for problem solving, feedback on solutions to problems, general chat on study skills, or answers to homework problems, quizzes or tests.

### Hybrid (51%–99% online) Modality:

Method of Instruction	Document typical activities or assignments for each method of instruction
Asynchronous Dialog (e.g., discussion board)	Use of student discussion boards to discuss concepts from the material, solutions to homework problems, general discussion of techniques in solving problems, study skills, or arranging study groups.
E-mail	Responding to student queries about material, grade information, course policies and procedures, scheduling and due dates, submitting homework assignments, or making general announcements to the class.
Face to Face (by student request; cannot be required)	Students requesting to speak to instructor in person for personal help on material, grade information, or discussion of policies and procedures.
Other DE (e.g., recorded lectures)	Posting of recorded lectures either by the instructor, recorded lessons available through campus resources, or use of public online resources available on the internet.
Synchronous Dialog (e.g., online chat)	Active live discussion with the instructor on material concepts, techniques for problem solving, feedback on solutions to problems, general chat on study skills, or answers to homework problems, quizzes or tests.

### 100% online Modality:

Method of Instruction	Document typical activities or assignments for each method of instruction
Asynchronous Dialog (e.g., discussion board)	Use of student discussion boards to discuss concepts from the material, solutions to homework problems, general discussion of techniques in solving problems, study skills, or arranging study groups.
E-mail	Responding to student queries about material, grade information, course policies and procedures, scheduling and due dates, submitting homework assignments, or making general announcements to the class.
Other DE (e.g., recorded lectures)	Posting of recorded lectures either by the instructor, recorded lessons available through campus resources, or use of public online resources available on the internet.
Synchronous Dialog (e.g., online chat)	Active live discussion with the instructor on material concepts, techniques for problem solving, feedback on solutions to problems, general chat on study skills, or answers to homework problems, quizzes or tests.

## Examinations

### Hybrid (1%–50% online) Modality

On campus

### Hybrid (51%–99% online) Modality

On campus

## Primary Minimum Qualification

MATHEMATICS

## Review and Approval Dates

### Department Chair

MM/DD/YYYY

**Dean**

MM/DD/YYYY

**Technical Review**

MM/DD/YYYY

**Curriculum Committee**

MM/DD/YYYY

**DTRW-I**

MM/DD/YYYY

**Curriculum Committee**

MM/DD/YYYY

**Board**

MM/DD/YYYY

**CCCCO**

MM/DD/YYYY

**Control Number**

CCC000429536

**DOE/accreditation approval date**

MM/DD/YYYY