

MATH M16B: APPLIED CALCULUS II

Originator

pabramoff

Co-Contributor(s)
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College

Moorpark College

Discipline (CB01A)

MATH - Mathematics

Course Number (CB01B)

M16B

Course Title (CB02)

Applied Calculus II

Banner/Short Title

Applied Calculus II

Credit Type

Credit

Start Term

Fall 2023

Catalog Course Description

Includes integration, elementary and separable differential equations, functions of several variables, partial derivatives, relative maxima and minima, Lagrange multipliers, method of least squares, double integrals, infinite series, Taylor approximation, and Newton's method. Applies calculus to problems in business, economics, and social and biological sciences.

Course Credit Limitations: MC, CSU, UC - MATH M16B and MATH M25B 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

Maximum Outside-of-Class Hours

105

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 M16A or MATH M25A or MATH M25AH or placement as determined by college's multiple measures assessment process

Entrance Skills**Entrance Skills**

MATH M16A

Prerequisite Course Objectives

MATH M16A-evaluate the limit of a function, including one-sided and two-sided, using numerical and algebraic techniques and the properties of limits, including continuity.

MATH M16A-calculate the derivative of an algebraic function using the formal definition of the derivative.

MATH M16A-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.

MATH M16A- find the derivative of algebraic, exponential, and logarithmic functions.

MATH M16A-determine maxima and minima in optimization problems using the derivative.

MATH M16A-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.

MATH M16A-solve applied problems involving tangent lines, rates of change, and related rates.

MATH M16A-apply the concept of derivative to solve applied problems involving marginal cost, profit and revenue, and exponential growth and decay problems.

MATH M16A-find definite and indefinite integrals by using general integral formulas, integration by substitution, and other integration techniques.

MATH M16A-use integration techniques to find the area under a curve and the area between two curves.

MATH M16A- use integration in business and economic applications, such as to analyze revenue, cost and profit.

MATH M16A-evaluate a limit using L'Hopital's rule.

Entrance Skills

MATH M25A

Prerequisite Course Objectives

MATH M25A-evaluate the limit of a function using numerical and algebraic techniques, the properties of limits, and analysis techniques.

MATH M25A-determine analytically whether a limit fails to exist.

MATH M25A-determine whether a function is continuous or discontinuous at a point.

MATH M25A-use the formal definition of the derivative to find the derivative of an algebraic function.

MATH M25A-apply the basic rules of differentiation to find the derivative of a function including the constant, power, sum, product, and quotient rules and The Chain Rule.

MATH M25A-find first-order and higher-order derivatives of algebraic and transcendental functions and their inverses.

MATH M25A-find the derivatives of functions and relations using implicit differentiation.

MATH M25A-solve applied problems using the derivative including rates of change, the tangent line problem, and related rates.

MATH M25A-demonstrate an understanding of the connection between differentiability and continuity of a function.

MATH M25A-identify indeterminate forms and use L'Hospital's Rule to evaluate limits.

MATH M25A-apply analytic techniques to a function and its derivatives to solve curve sketching problems.

MATH M25A-use the formal definition of the definite integral to evaluate the integral of an algebraic function over a closed interval.

MATH M25A-evaluate definite integrals using the properties of integrals and the Fundamental Theorem of Calculus.

Requisite Justification**Requisite Type**

Prerequisite

Requisite

MATH M16A

Requisite Description

Course in a sequence

Level of Scrutiny/Justification

Required by 4 year institution

Requisite Type

Prerequisite

Requisite

MATH M25A

Requisite Description

Course not 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 use partial derivatives to find the extrema of a function of two variables.
- 2 use a double integral to find the volume of a solid.

Course Objectives

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

- 1 evaluate definite and indefinite integrals using techniques including change of variables and integration by parts, or also by the integral tables. (optional)
- 2 apply integration techniques in finding the volume of a solid, consumer's surplus, producer's surplus, and exponential growth and decay.
- 3 evaluate the first and second partial derivatives of functions of several variables.
- 4 solve applied optimization problems for a function of several variables.

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|----|--|
| 5 | find a maximum or minimum value for a function of several variables subject to a given constraint. |
| 6 | evaluate double integrals of functions of several variables. |
| 7 | apply double integration techniques in evaluating the volume of a solid. |
| 8 | solve simple and separable differential equations. |
| 9 | apply differential equations in the growth model and inhibited growth model. |
| 10 | compute a Taylor polynomial of a given degree for a given function. |
| 11 | determine convergence and divergence of infinite sequences and series. |
| 12 | evaluate a limit using L'Hopital's Rule. |

Course Content

Lecture/Course Content

25% A. Integration of Single-variable Function

1. Integration techniques: substitution method
2. Integration techniques: integration by parts
3. Integration techniques: using integration tables (optional)

20% B. Applications of Integration

1. Economic applications: consumer's surplus and producer's surplus
2. Applications of exponential growth and decay
3. Volume of the solid of revolution
4. Simple differential equations

25% C. Functions of Several Variables

1. Introduction to the functions of several variables
2. Partial derivatives
3. Applied maximum and minimum problems
4. Double integrals
5. Constrained maximum and minimum values: Lagrange Multipliers
6. Least-squares technique (optional)

20% D. Differential Equations

1. Introduction to different types of differential equations
2. Separation of variables
3. Applications: The Growth Model and The Inhibited Growth Model
4. L'Hopital's Rule

10% E. Taylor Series and Numerical Techniques

1. Taylor polynomials
2. Infinite sequences and series
3. Power series

Laboratory or Activity Content

n/a

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

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:

Demonstration of mathematical computations on whiteboard or overhead projector, such as solutions to advanced integration techniques.

Discussion of analytical concepts such as determining which technique of integration is appropriate in solving an indefinite integral. Engaging students in group work, analyzing business and economics models to determine 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 partial differentiation.
2. Short answer problems on exams, such as stating the results for an application problem involving economics, finance, or natural sciences.
3. Graded assignments: in-class and/or homework assignments requiring complete solutions using both written English and symbolic mathematical language, such as expressing infinite sums in proper summation notation.

Critical Thinking Assignments

1. Describe and apply the algorithmic steps for obtaining the solution to a mathematical problem, such as solving a differential equation.
2. Compare and contrast methods of solution to mathematical problems, such as different integration techniques.

Reading Assignments

1. Reading textbook to view various techniques of integration and comparing examples of the various types.
2. Reading articles on business and economics to identify applications of marginal cost, revenue and profit that exist in real life.
3. Viewing diagrams in the textbook that show graphs illustrating the progression of the Taylor Series.

Skills Demonstrations

1. Demonstrate the computation of a Taylor Series and analyzing the accuracy of an estimate from a Taylor Series of specific degree.
2. Demonstrate the solution of an optimization problem using derivatives.

Problem-Solving and Other Assignments (if applicable)

1. Problem-solving exercises to practice computing indefinite and definite integrals.
2. Problem-solving exercises to practice applying analytic techniques for solving application problems such as finding different types of growth rates.
3. Graded problem-solving assignments, such as a practice set on finding antiderivatives.

Outside Assignments

Representative Outside Assignments

1. Group or individual projects, such as applying the principles of growth and decay to models that exist in economics, biology, physics and other sciences.
2. Additional problem sets provided by the instructor, such as application of double integrals.
3. Assigned homework problems selected from the textbook, such as practice on finding maximum and minimum values subject to a constraint.
4. Assigned reading material from the textbook, such as examining explanations of different integration techniques, including those using the integration tables.

Articulation

Equivalent Courses at 4 year institutions

University	Course ID	Course Title	Units
CSU Sacramento	MATH 26B	Calculus II for the Social and Life Sciences	3
San Francisco State University	MATH 108	Mathematics for Business Calculus II	3

Equivalent Courses at other CCCs

College	Course ID	Course Title	Units
Santa Monica College	MATH 29	Calculus 2 for Business and Social Sciences	3
College of San Mateo	MATH 242	Applied Calculus II	3
Chabot College	MTH 16	Applied Calculus II	3

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:

F1995

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

Bittinger, Marvin, et al. *Calculus and Its Applications: Expanded Version*. 2nd ed., Pearson, 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

Description

Calaway, Shana, Dale Hoffman, and David Lippman. *Business Calculus*. E-book, Opentextbookstore, 2013. [www.http://www.opentextbookstore.com/buscalc/BusCalc.pdf](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 identify real-life examples of the application of marginal cost, revenue and profit in business journals or reference books.

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	
Online	
Hybrid (51%–99% online) Modality	
On campus	
Online	

Primary Minimum Qualification

MATHEMATICS

Review and Approval Dates**Department Chair**

10/12/2022

Dean

10/17/2022

Technical Review

10/20/2022

Curriculum Committee

11/01/2022

DTRW-I

MM/DD/YYYY

Curriculum Committee

MM/DD/YYYY

Board

MM/DD/YYYY

CCCCO

MM/DD/YYYY

Control Number

CCC000435329

DOE/accreditation approval date

MM/DD/YYYY