MATH M25AH: HONORS: CALCULUS WITH ANALYTIC GEOMETRY I

Originator
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College
Moorpark College

Discipline (CB01A)
MATH - Mathematics

Course Number (CB01B)
M25AH

Course Title (CB02)
Honors: Calculus With Analytic Geometry I

Banner/Short Title
Honors: Calculus Analytic Geom

Credit Type
Credit

Start Term
Fall 2023

Catalog Course Description
Covers limits, continuity, differentiation and integration of algebraic functions, and differentiation and integration of transcendental functions with applications. Honors work challenges students to be more analytical and creative through expanded assignments and enrichment opportunities.

Course Credit Limitations:
1) Credit will not be awarded for both the honors and regular versions of a course. Credit will be awarded only for the first course completed with a grade of “C” or better or "P". Moorpark College Honors Program requires a letter grade.
2) MATH M16A, M25A, and M25AH combined: maximum 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

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
87.5
Maximum Contact/In-Class Lecture Hours
87.5

Activity

Laboratory

Total in-Class

Total in-Class
Total Minimum Contact/In-Class Hours
87.5
Total Maximum Contact/In-Class Hours
87.5

Outside-of-Class

Internship/Cooperative Work Experience

Paid

Unpaid

Total Outside-of-Class

Total Outside-of-Class
Minimum Outside-of-Class Hours
175
Maximum Outside-of-Class Hours
175

Total Student Learning

Total Student Learning
Total Minimum Student Learning Hours
262.5
Total Maximum Student Learning Hours
262.5

Minimum Units (CB07)
5
Maximum Units (CB06)
5

Prerequisites
MATH M05 and MATH M06 or MATH M07 or placement as determined by college's multiple measures assessment process

Entrance Skills

Entrance Skills
MATH M05 and MATH M06

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-recognize the relationship between functions and their inverses algebraically and graphically.
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.
MATH M05-determine and identify terms for sequences and series, and evaluate sums for both finite and infinite series.
MATH M05-apply rational and polynomial equations and apply functions and other algebraic techniques to model real-world STEM applications.
MATH M06-identify special triangles and their related angle and side measures.
MATH M06-evaluate the trigonometric function of an angle in degree and radian measure.
MATH M06-manipulate and simplify a trigonometric expression.
MATH M06-solve trigonometric equations, triangles, and applications.
MATH M06-graph the basic trigonometric functions and apply changes in period, phase and vertical shifts, and amplitude to generate new graphs.
MATH M06-evaluate and graph inverse trigonometric functions.
MATH M06-prove trigonometric identities.
MATH M06-convert between polar and rectangular coordinates and equations.
MATH M06-calculate powers and roots of complex numbers using DeMoivre's Theorem.
MATH M06-graph polar and parametric equations.
MATH M06-represent a vector (a quantity with magnitude and direction) in the form <a,b> and ai+bj.

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-prove trigonometric identities.
MATH M07-identify special triangles and their related angle and side measures.
MATH M07-evaluate the trigonometric function at an angle whose measure is given in degrees and radians.
MATH M07-manipulate and simplify a trigonometric expression.
MATH M07-solve trigonometric equations, triangles, and their related applications.
MATH M07-graph the basic trigonometric functions and apply changes in period, amplitude, phase shift and vertical shift to generate new graphs.
MATH M07-evaluate and graph inverse trigonometric functions.
MATH M07-convert between polar and rectangular coordinates.
MATH M07-calculate powers and roots of complex numbers using DeMoivre's Theorem.
MATH M07-represent a vector (a quantity with magnitude and direction) in the form and ai+bj, compute the magnitude of a vector, and graph vectors on the xy-plane.
MATH M07-perform vector operations including addition, subtraction, scalar multiplication, and dot product. Determine the angle between two vectors and when vectors are parallel or perpendicular, and compute the projection vector.
MATH M07-write the standard form of a circle given the general equation.
MATH M07-graph plane curves described by parametric equations.
MATH M07-find parametric forms for functions in the plane and eliminate the parameter given curves in parametric form.
MATH M07-work with sequences and series or use the Binomial Theorem or determine the equations of the standard conics or perform partial fraction decomposition.

Requisite Justification

Requisite Type
Prerequisite

Requisite
MATH M05 and MATH M06

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	use limits to determine the continuity of a function.
2	apply differentiation techniques on an optimization or related rates problem.

Course Objectives

	Upon satisfactory completion of the course, students will be able to:
1	evaluate the limit of a function using numerical and algebraic techniques, the properties of limits, and analysis techniques.
2	evaluate one-sided and two-sided limits for algebraic and trigonometric functions.
3	determine analytically whether a limit fails to exist.
4	determine whether a function is continuous or discontinuous at a point.
5	apply the Intermediate Value Theorem to a continuous function on a closed interval.
6	use the formal definition of the derivative to find the derivative of an algebraic functions.
7	apply the basic rules of differentiation to find the derivative of a function including the constant, power, sum, product, quotient, and chain rules.
8	find first-order and higher-order derivatives of algebraic and transcendental functions and their inverses.
9	find the derivatives of functions and relations using implicit differentiation.
10	solve applied problems using the derivative including rates of change, the tangent line problem, and related rates.
11	apply the method of logarithmic differentiation for finding derivatives.
12	demonstrate an understanding of the connection between differentiability and continuity of a function.
13	apply Rolle's Theorem and the Mean Value Theorem to a function on a closed interval.
14	identify indeterminate forms and use L'Hospital's Rule to evaluate limits.
15	apply analytic techniques to a function and its derivatives to solve curve sketching problems.
16	use differentials with linear approximation problems.
17	solve applied optimization problems.

18	find an approximate solution to an equation using Newton's Method.
19	apply the basic rules of integration for finding anti-derivatives for algebraic and transcendental functions.
20	use summation notation with Riemann sums and upper and lower sums.
21	use the formal definition of the definite integral to evaluate the integral of an algebraic function over a closed interval.
22	evaluate definite integrals using the properties of integrals and the Fundamental Theorem of Calculus.
23	integrate indefinite and definite integrals using change of variable techniques.
24	use integration and analysis techniques to find the area of a region between two curves.
25	Honors: solve exponential growth and decay problems.
26	Honors: construct a formal proof (using e - d) for the existence of limit of a function.
27	Honors: verify the conditions under which the Intermediate Value Theorem, Rolle's Theorem and the Mean Value Theorem are applicable.
28	Honors: use the formal definition of the derivative to find the derivative of the trigonometric functions.
29	Honors: apply the basic rules of differentiation to derive the rules of differentiation for algebraic and trigonometric functions.
30	Honors: apply analytic techniques to a function and its derivatives to solve curve sketching problems for algebraic and transcendental functions.
31	Honors: use differentials to perform error analysis, and apply to real life projects.
32	Honors: apply optimization techniques to real life problems and projects.
33	Honors: perform error analysis on an approximate solution to an equation found by Newton's Method.
34	Honors: apply the basic rules of integration to physics and other application problems.
35	Honors: demonstrate the proof of the Fundamental Theorem of Calculus.

Course Content

Lecture/Course Content

20% A. Limits and Continuity
1. The concept of a limit
2. One-sided limits
3. Properties of limit
4. The formal definition of a limit
5. Continuity and the Intermediate Value Theorem
6. Limits at infinity

40% B. The Derivative
1. Tangent lines and rates of change
2. The definition of the derivative
3. Derivatives of polynomials and exponential functions
4. The product and quotient rules
5. Derivatives of trigonometric functions
6. The Chain Rule
7. Implicit differentiation
8. Derivatives of inverse trigonometric functions
9. Derivatives of exponential and logarithmic functions
10. Logarithmic differentiation
11. Honors: Exponential growth and decay
12. Related rates
13. Honors: Linear approximation and differentials

20% C. Applications of the Derivative
1. Extrema of a function
2. Rolle's Theorem and the Mean Value Theorem
3. The first derivative test
4. Concavity and the second derivative test
5. Indeterminate forms and L'Hospital's Rule
6. Applications of derivatives to curve sketching
7. Optimization problems
8. Honors: Newton's Method

20% D. Integrals
1. Anti-derivatives
2. Summation notation and area

3. The definition of the definite integral
4. Properties of the definite integral
5. The Fundamental Theorem of Calculus
6. Indefinite integral
7. The substitution rule
8. Area between two curves

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
Projects
Participation
Reports/Papers/Journals

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
Collaborative group work
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 the epsilon-delta construction of the definition of a limit.
- Discussion of the various uses of the first derivative, including detecting local extrema of a function or intervals where the function is increasing or decreasing.
- Practice, with student demonstration, the evaluation of the definite interval as representing the area under a curve.

Representative Course Assignments

Writing Assignments

1. Homework problems selected from the textbook where answers require a written examination of the solution such as solving an optimization problem using derivatives.
2. Short answer problems on exams such as stating the results for an application problem, such as indicating proper length, width, height, area, volume, and other measurements in maximization and minimization problems with proper unit labels.
3. Graded in-class and/or homework assignments requiring complete solutions using written English and symbolic mathematical language such as stating the results for an application problem involving science, engineering or architecture.
4. Honors: Demonstration of formal proofs such as the Mean Value Theorem.

Critical Thinking Assignments

1. Describe and apply the algorithmic steps for obtaining the solution to a mathematical problem such as a related rate problem.
2. Compare and contrast methods of solution to mathematical problems such as finding an antiderivative by more than one method.
3. Apply analytic techniques for solving mathematical and application problems such as determining an appropriate method for finding a derivative.
4. Honors: Determine the applicability of theorems, such as the Intermediate Value Theorem and the Mean Value Theorem, by comparing and contrasting functions for which the theorems apply and those which do not.

Reading Assignments

1. Observe diagrams in the textbook illustrating areas that are estimated by Riemann Sums with n-elements.
2. Read scenarios in textbook whereby derivatives are used in solving application problems in physics, economics or engineering.
3. Honors: Read an article in engineering, technology, or computer programming where optimization techniques are applied to real life problems or projects.

Skills Demonstrations

1. Determine the area under a curve by finding the limit of Riemann sums as the number of elements, n, approaches infinity.
2. Find the derivative of a function using the proper rule, including the product rule, quotient rule or the Chain Rule.
3. Honors: Demonstrate the proof of the Fundamental Theorem of Calculus.

Problem-Solving and Other Assignments (if applicable)

1. Graded problem-solving assignments, such as practice sets providing the simplified values of definite integrals.
2. Problem-solving exercises to determine continuity of functions.
3. Honors: Perform error analysis on an approximate solution to an equation found by Newton’s Method.

Outside Assignments

Representative Outside Assignments

1. Group or individual calculus-related projects, such as providing examples of definite integrals that simulate actual areas that occur in sciences, architecture and engineering.
2. Additional problem sets provided by the instructor such as practice exercises on finding and simplifying derivatives.
3. Assigned reading material from the calculus textbook, such as reading the theory and proofs of various limit and derivative theorems.
4. Honors: Group or individual projects emphasizing real-life projects, such as growth and decay problems related to finance or biology and use of technology to enhance conceptualization.

Articulation

C-ID Descriptor Number
MATH 210

Status
Approved

Additional C-ID Descriptor(s)

C-ID Descriptor(s)	Status
MATH 900S (with MATH M25A/H and MATH M25B)	Approved

Equivalent Courses at 4 year institutions

University	Course ID	Course Title	Units
UC Davis	MATH 21AH	Honors Calculus	4
CSU Northridge	MATH 150A	Calculus I	5

Comparable Courses within the VCCCD

MATH M25A - Calculus with Analytic Geometry I
MATH R120 - Calculus with Analytic Geometry I
MATH V21A - Calculus with Analytic Geometry I

Equivalent Courses at other CCCs

College	Course ID	Course Title	Units
Orange Coast College	MATH A180H	Honor Calculus 1	4
Pasadena City College	MATH 103EH	Honors Calculus and Analytic Geometry I	5
Fullerton College	MATH 151HF	Honors Calculus I	4

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:
F2004

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
Hass, Joel R., et al. *Thomas' Calculus: Early Transcendentals.* 15th ed., Pearson, 2023.

Resource Type
Textbook

Classic Textbook
No

Description
Stewart, James. *Calculus: Early Transcendentals.* 9th, Cengage, 2023.

Resource Type
Textbook

Classic Textbook
No

Description

Larson, Ron, and Bruce H. Edwards. *Calculus: Early Transcendental Functions.* 8th ed., Cengage, 2021.

Resource Type

Textbook

Description

Strang, Gilbert, Edwin Herman. *Calculus Volume 1.* E-book, Open Stax, 2020, https://openstax.org/details/books/calculus-volume-1. Accessed 20 Oct 2022.

Library Resources

Assignments requiring library resources

Use of textbooks on reserve. Using Library's print and online resources to supplement application problems relating to sciences, technology and engineering, such as researching scientific formulas for related rates problems or architectural structures that simulate areas under curves.

Sufficient Library Resources exist

Yes

Example of Assignments Requiring Library Resources

Identifying examples of applications of rates of change and use of the derivative that occur in engineering, biology, physics or architecture.

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
CCC000426907

DOE/accreditation approval date
MM/DD/YYYY