MATH M25C: CALCULUS WITH ANALYTIC GEOMETRY III

Originator
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College
Moorpark College

Discipline (CB01A)
MATH - Mathematics

Course Number (CB01B)
M25C

Course Title (CB02)
Calculus with Analytic Geometry III

Banner/Short Title
Calc/Analy Geometry III

Credit Type
Credit

Start Term
Fall 2023

Catalog Course Description
Covers vectors in plane and in three-dimensional space, dot and cross products, spherical and cylindrical coordinates, vector-values functions, functions of several variables, partial derivatives, gradients, and Lagrange multipliers. Presents multiple integrals and their applications, vector calculus with line and surface integrals, Green’s, Stokes', and Divergence Theorems and applications.

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
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 M25B or MATH M25BH or placement as determined by the college's multiple measures assessment process

Entrance Skills

Entrance Skills
MATH M25B or MATH M25BH

Prerequisite Course Objectives
MATH M25B-apply the definite integral to solve problems involving area, volume, arc length, surface area, work, moments and centers of mass in the plane, fluid force, and other applications.
MATH M25B-select appropriate techniques for evaluating an indefinite integral; techniques include basic integration forms, change of variables, integration by parts, trigonometric identities, trigonometric substitutions, partial fractions, and estimation techniques.
MATH M25B-identify and evaluate improper integrals using correct limit notation.
MATH M25B-determine the convergence or divergence of an infinite sequence using analytic techniques.
MATH M25B-determine whether a sequence is bounded or is monotonic.
MATH M25B-compute partial sums for infinite series.
MATH M25B-recognize telescoping, geometric, and p-series.
MATH M25B-determine the convergence or divergence of a geometric series and p-series.
MATH M25B-compute the sum of a convergent telescoping series and geometric series.
MATH M25B-apply appropriate tests which include the nth-term test, integral test, comparison tests, and ratio and root tests to determine the convergence or divergence of positive term series.
MATH M25B-apply the algebraic properties of infinite series.
MATH M25B-apply the alternating series test and analyze the remainder of an alternating series.
MATH M25B-determine if a series converges absolutely, conditionally, or if the series diverges.
MATH M25B-determine the interval of convergence for a power series using analysis techniques and the tests for convergence.
MATH M25B-apply integration and differentiation techniques for finding power series of elementary functions.
MATH M25B-compute Taylor and Maclaurin polynomial approximations of elementary functions with remainder.
MATH M25B-compute the power series for an elementary function centered at a point.
MATH M25B-sketch the graph of a parametric curve and indicate its orientation.
MATH M25B-convert the equation of a curve given in parametric form to rectangular form and vice versa.

MATH M25B-find the slope of the tangent line at a point on a curve given in parametric form.
MATH M25B-compute the arc length of a curve and the area of a surface of revolution for curves given in parametric form.
MATH M25B-sketch the graph of a polar equation.
MATH M25B-convert the equation of a curve given in polar form to rectangular form and vice versa.
MATH M25B-find the slope of the tangent line at a point on a curve given in polar form.
MATH M25B-find the area of a region bounded by a polar equation.
MATH M25B-find the arc length of a curve given in polar form.
MATH M25B-compute and identify the critical information for the standard conics, such as the vertex, directrix, and axis of symmetry for a parabola; the foci and vertices of an ellipse; and the vertices, foci, and asymptotes of a hyperbola.

Requisite Justification

Requisite Type

Prerequisite

Requisite

MATH M25B or MATH M25BH

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	apply Green's Theorem, Stokes's Theorem, or Divergence Theorem in a vector field.
2	use vector-valued functions to describe curves and surfaces in space.

Course Objectives

	Upon satisfactory completion of the course, students will be able to:
1	apply the basic rules of vector algebra to carry out vector operations in the plane and in space.
2	evaluate dot, cross and triple scalar products and projections.
3	use the dot product, cross product, and triple scalar product to solve applied problems.
4	write the parametric equations and symmetric equations of a line in space and write the standard equation of a plane in space.
5	identify the six quadric surfaces.
6	convert from rectangular to the cylindrical and spherical coordinates in space.
7	evaluate derivatives and integrals of vector-valued functions.
8	compute velocity and acceleration vectors for vector-valued functions.
9	find the tangential and normal components of an acceleration vector and compute arc length and curvature of a space curve.
10	evaluate limits and determine continuity for functions of two variables at a point.
11	find the first-order and higher-order partial derivatives of functions of several variables, determine differentiability, and apply the chain rule to find partial derivatives.
12	compute the directional derivative and the gradient vector for a function of two or three variables.
13	write the equation of a tangent plane at a point on a surface.
14	find and classify all critical points for a function of two variables and use Lagrange multipliers to find maxima and minima of functions of two variables subject to side conditions.
15	use double integrals to compute areas and volumes and surface areas.
16	evaluate double integrals using polar coordinates, and change of variables (Jacobians).
17	find the center of mass of a variable density planar lamina.
18	evaluate triple integrals using rectangular, cylindrical, or spherical coordinates.

19	compute the potential function, curl, and divergence of a vector field.
20	evaluate the line integral of a vector field on a curve and surface integrals.
21	apply Green's Theorem to compute line integrals in the plane.
22	use the Divergence Theorem to compute the flux of a vector field through a surface.
23	use Stokes's Theorem to compute line integrals within a vector field around a closed curve.

Course Content

Lecture/Course Content

15.00% A. Vectors and the Geometry of Space
1. Vectors in the plane and vector operations
2. Space coordinates and vectors in space and vector operations
3. The dot, cross, and triple product of vectors and projections
4. Vector, parametric, and symmetric forms for a line
5. Vector and parameteric equations of planes and the rectangular equation of a plane in space
6. Surfaces in space
7. Cylindrical and spherical coordinates

20.00% B. Vector-Valued Functions
1. Introduction to vector-valued functions
2. Differentiation and integration of vector-valued functions
3. Velocity and acceleration
4. Tangent vectors, normal vectors, and binormal vectors
5. Arc length and curvature

25.00% C. Functions of Several Variables
1. Introduction of functions of several variables, level curves and level surfaces
2. Limits and continuity and their properties
3. Partial derivatives and higher order derivatives
4. Differentials and differentiability
5. Chain rules for functions of several variables
6. Directional derivatives and gradients
7. Tangent planes and normal lines
8. Extrema and saddle points of functions of two variables
9. Applications of extrema of functions of two variables
10. Lagrange multipliers

20.00% D. Multiple Integration
1. Iterated integrals and area in the plane
2. Double integrals and volume
3. Change of variables: polar coordinates
4. Center of mass and moments of inertia
5. Surface area
6. Triple integrals and applications
7. Triple integrals in cylindrical and spherical coordinates
8. Change of variables: Jacobians

20.00% E. Vector Analysis
1. Vector fields, gradient vector fields, divergence and curl
2. Line integrals
3. Conservative vector fields and independence of path
4. Green's theorem
5. Parametric surfaces
6. Surface integrals
7. Divergence theorem
8. Stokes's theorem

Enrichment topics related to MATH M25C also may be presented by the instructor if time allows.

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

Other

Quizzes and/or 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
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:

lecture on the basic theoretical concepts such as the meaning of vectors, vector spaces, gradients, and the actions of vectors such as divergence and curl.

discussion of the solutions to computational problems attempted by students, such as determining whether a vector field is conservative (irrotational) and the computation of a potential function.

use of technology, such as computer websites projected onto board which can interactively illustrate the graphs of multidimensional functions and vector-valued functions.

Representative Course Assignments

Writing Assignments

1. Homework problems selected from the calculus textbook where answers require a written explanation of the solution, such as finding critical points of functions of two variables and identifying if the point is a maximum, minimum or saddle point.
2. Short answer problems on exams such as stating the results of application problems, such as stating the moments and center of mass for a density region, or interpreting the meaning of the computation of a flux integral, or surface integral.
3. Graded assignments done in class or as homework assignments requiring complete solutions using both written English and symbolic mathematical language, such as representing the directional derivative and gradient in proper symbolic language, and giving written explanation of its meaning.

Critical Thinking Assignments

1. Apply proper theorems to the evaluation of a line integral within a vector space, such as identifying whether vector field is conservative, or applying Green's Theorem or Stokes's Theorem to the evaluation of the integral.

2. Identify and apply various methods for solving application problems involving optimization, such as employing the second derivative test, or using Lagrange multiplier methods.
3. Apply analytic techniques for solving mathematical and application problems such as reversing the order of integration when evaluating a double integral, or converting the integral to polar coordinates.

Reading Assignments

1. Viewing diagrams in textbook which illustrate the three-dimensional graphs of the six basic Quadric Surfaces.
2. Reading examples from textbooks which model real-life applications of line integrals and surface integrals.
3. Reading theoretical concepts from the textbook such as the graphical and algebraic meaning of the dot product and cross product.

Skills Demonstrations

1. Demonstrate how to use vector-valued functions to describe curves and surfaces in space.
2. Demonstrate the use of technology such as a graphing tool to illustrate graphs of multidimensional functions, or parameterized surfaces in three dimensions.

Problem-Solving and Other Assignments (if applicable)

1. Problem sets assigned as homework involving various vector computations such as addition, dot product, cross product, magnitude and direction, directional angles, projection and orthogonal component.
2. Problem sets attempted in class, and presented by students, such as determining the tangential and normal components of acceleration at various locations on a vector-valued function.

Outside Assignments

Representative Outside Assignments

1. Group or paired assignments in which students discuss and apply proper theorems and methods for solving double or triple integrals, line or surface integrals, proper methods of optimization in application problems, or computing arc length and curvature.
2. Graded problem sets assigned from the book, such as assignments on vector computations, uses of vector valued functions, limits and derivatives involving multi-dimensional functions, computing volumes under surfaces and densities of three-dimensional regions, or computations of line integrals and surface integrals.
3. Additional problem sets provided by the instructor, such as practice exercises on partial derivatives, double integrals, triple integrals, surface integrals or line integrals in density spaces and/or vector fields.
4. Assigned reading from the calculus textbook, such as reading the explanation and proofs of theorems, such as Green's Theorem, Stokes's Theorem or the Divergence Theorem.

Articulation

C-ID Descriptor Number

MATH 230

Status

Approved

Equivalent Courses at 4 year institutions

University	Course ID	Course Title	Units
CSU Channel Islands	MATH 250	Calculus III	3
UC Berkeley	MATH 53	Multivariable Calculus	4
CSU Northridge	MATH 250	Calculus III	3

Comparable Courses within the VCCCD

MATH R122 - Calculus with Analytic Geometry III
MATH V21C - Multivariable Calculus

Equivalent Courses at other CCCs

College	Course ID	Course Title	Units
Sacramento City College	MATH 402	Calculus III	5
Santa Barbara City College	MATH 200	Multivariable Calculus	4
Cerritos College	MATH 225	Calculus III	5

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

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

Resource Type
Textbook

Description
Strang, Gilbert, and Edwin Herman. *Calculus Volume 3.* E-book, Open Stax, 2020, https://openstax.org/details/books/calculus-volume-3. Accessed 20 Oct 2022.

Library Resources

Assignments requiring library resources
Assignments requiring the use of resources to link course content to practical applications. Applications may relate to fields such as physics, engineering, meteorology, architecture, marine science and other fields. Such practical applications may involve applying

the computation of divergence and curl, the computation and interpretation of gradients and directional derivatives, or applying the computation of moments and centers of mass in three dimensional situations. Use of textbooks on reserve at Circulation Desk.

Sufficient Library Resources exist

Yes

Example of Assignments Requiring Library Resources

Using library resources to identify examples of real-life applications of multidimensional graphs, vector fields, or space curves that occur in nature, engineering, physics, meteorology, Earth science and other fields.

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
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
CCC000431268

DOE/accreditation approval date
MM/DD/YYYY