MATH M35: APPLIED DIFFERENTIAL EQUATIONS

Originator
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College
Moorpark College

Discipline (CB01A)
MATH - Mathematics

Course Number (CB01B)
M35

Course Title (CB02)
Applied Differential Equations

Banner/Short Title
Appld Differen Equations

Credit Type
Credit

Start Term
Fall 2023

Catalog Course Description
Covers ordinary differential equations, equations with constant coefficients, variation of parameters, Laplace transforms, systems of linear equations, first order differential equations, series solutions, and existence and uniqueness of solutions. Emphasizes applications to physics and engineering, and provides an introduction to numerical solutions.

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 M25B or MATH M25BH or equivalent course

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.
MATH M25BH-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.
MATH M25BH-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 M25BH-identify and evaluate improper integrals using correct limit notation.
MATH M25BH-determine the convergence or divergence of an infinite sequence using analytic techniques.
MATH M25BH-determine whether a sequence is bounded or is monotonic.
MATH M25BH-compute partial sums for infinite series.
MATH M25BH-recognize telescoping, geometric, and p-series.
MATH M25BH-determine the convergence or divergence of a geometric series and p-series.
MATH M25BH-compute the sum of a convergent telescoping series and geometric series.
MATH M25BH-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 M25BH-apply the algebraic properties of infinite series.
MATH M25BH-apply the alternating series test and analyze the remainder of an alternating series.
MATH M25BH-determine if a series converges absolutely, conditionally, or if the series diverges.
MATH M25BH-determine the interval of convergence for a power series using analysis techniques and the tests for convergence.
MATH M25BH-apply integration and differentiation techniques for finding power series of elementary functions.
MATH M25BH-compute Taylor and Maclaurin polynomial approximations of elementary functions with remainder.
MATH M25BH-compute the power series for an elementary function centered at a point.
MATH M25BH-sketch the graph of a parametric curve and indicate its orientation.
MATH M25BH-convert the equation of a curve given in parametric form to rectangular form and vice versa.
MATH M25BH-find the slope of the tangent line at a point on a curve given in parametric form.
MATH M25BH-compute the arc length of a curve and the area of a surface of revolution for curves given in parametric form.
MATH M25BH-sketch the graph of a polar equation.
MATH M25BH-convert the equation of a curve given in polar form to rectangular form and vice versa.
MATH M25BH-find the slope of the tangent line at a point on a curve given in polar form.
MATH M25BH-find the area of a region bounded by a polar equation.
MATH M25BH-find the arc length of a curve given in polar form.
MATH M25BH-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	find inverse Laplace transforms.
2	solve higher order linear differential equations using reduction of order, undetermined coefficients, or variation of parameters.

3	solve first order differential equations utilizing the standard techniques for separable, exact, linear, homogeneous, or Bernoulli cases and find particular solutions given initial or boundary conditions.

Course Objectives

	Upon satisfactory completion of the course, students will be able to:
1	identify the type of a given differential equation and select and apply the appropriate analytical technique for finding the solution of first order and selected higher order ordinary differential equations.
2	evaluate first order differential equations including separable, homogeneous, exact, and linear.
3	show existence and uniqueness of solutions.
4	create and analyze mathematical models using first order differential equations to solve application problems such as circuits, mixture problems, population modeling, orthogonal trajectories, and slope fields.
5	solve second order and higher order linear differential equations.
6	determine fundamental solutions and independence using the Wronskian.
7	solve nonhomogeneous equations.
8	create and analyze mathematical models using higher order differential equations to solve application problems, such as harmonic oscillator and circuits.
9	solve differential equations using variation of parameters.
10	compute Laplace Transforms.
11	find series solutions.
12	solve linear systems of ordinary differential equations.

Course Content

Lecture/Course Content

5% A. First Order Differential Equations (DEs)
1. Separable, Exact, Linear, and Homogeneous DEs
2. Bernoulli DEs

25% B. Applications of First Order Differential Equations such as Growth and Decay, Newton's Law of Cooling, and Mixture Problems

5% C. Existence and Uniqueness of Solutions

25% D. Higher Order Linear Differential Equations
1. Initial and Boundary Value Problems
2. Homogeneous and Non-Homogeneous DEs
3. Reduction of Order, Linear DEs with Constant Coefficients, Method of Undetermined Coefficients, and Variation of Parameters
4. Cauchy-Euler DEs
5. Fundamental solutions, independence, Wronskian

10% E. Applications of Higher Order Differential Equations such as Harmonic Oscillators and Circuits

10% F. Series Solutions of Differential Equations

15% G. Solving Differential Equations Using Laplace Transforms

5% H. Solving Systems of Differential Equations

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
Skills demonstrations
Other (specify)
Classroom Discussion
Projects

Other

Quizzes and/or graded work will be used to evaluate students for the critical thinking skills needed to solve differential equation problems. Problems will require students to demonstrate analytic skills and the step-by-step details required for the solution, such as showing all the steps in solving a differential equation using Laplace Transforms

Instructional Methodology

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

Class discussions
Distance Education
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:

Use of whiteboard or document camera to present lecture on theory of concepts and demonstration of computational examples.

Classroom discussion and student participation in discussing theory and determining appropriate methods for solving differential equations requiring use of Taylor Series.

Student individual and group work in attempting computational problems such as solving first and second order homgeneous differential equations.

Review material from previous topics as related to the current topic, such as review solving homogeneous equations before covering nonhomogeneous equations; provide detailed step-by-step examples; provide practice problems to develop proper mathematical skills and techniques; provide student interaction for questions and answers; use projects and/or group work to enhance student understanding of the concepts, such as modeling spring/mass systems under various conditions; and discuss application problems.

Representative Course Assignments

Writing Assignments

1. Homework problems selected from the differential equations textbook where answers require a written explanation of the solution, such as in applications of first order differential equations involving circuits, mixture problems, population modeling, orthogonal trajectories, and slope fields.
2. Short answer problems on exams, such as stating the results for an application problem relating to fields of engineering, physics or electronics.
3. Graded assignments: in-class and/or homework assignments requiring complete solutions using both written English and symbolic mathematical language, such as the solution to a nonhomogeneous differential equation.

Critical Thinking Assignments

1. Describe and apply the algorithmic steps for obtaining the solution to a mathematical problem, such as solving differential equations using Laplace Transforms.
2. Compare and contrast methods of solution to mathematical problems, such as solving differential equations by more than one method.
3. Apply analytic techniques for solving mathematical and application problems, such as higher order differential equations for harmonic oscillator and circuits.

Reading Assignments

1. Reading from textbook to explore the meaning and applications of Bernoulli Equations.
2. Reading paper resourced in library to understand the applications of Homogeneous Equations to Pursuit Curves.
3. Reading from textbook to understand the applications of linear systems to predator-prey ecosystems.

Skills Demonstrations

1. Demonstrate the methods of determining the general and particular solutions to first order differential equations.
2. Demonstrate the application of second order differential equations to mechanical and electrical systems.

Problem-Solving and Other Assignments (if applicable)

1. Use the Laplace Transform to solve high order linear differential equations.
2. Solve homogeneous differential equations.

Outside Assignments

Representative Outside Assignments

1. Group or individual projects, applying principles of differential equations to applications in physics and engineering.
2. Graded problem solving assignments, such as problem sets on
3. Additional problem sets provided by the instructor, such as practice exercises on solving first order differential equations.
4. Assigned reading material from the differential equations textbook, such as reading the theory of the Wronskian.

Articulation

C-ID Descriptor Number
MATH 240

Status
Approved

Additional C-ID Descriptor(s)

C-ID Descriptor(s)	Status
MATH 910S with MATH M31	Approved

Equivalent Courses at 4 year institutions

University	Course ID	Course Title	Units
CSU Northridge	MATH 280	Applied Differential Equations	3
CSU Fresno	MATH 181	Differential Equations	3
UC Davis	MATH 22B	Differential Equations	3
UCLA	MATH 33B	Differential Equations	4

Comparable Courses within the VCCCD
MATH R143 - Differential Equations
MATH V23 - Introduction to Differential Equations

Equivalent Courses at other CCCs

College	Course ID	Course Title	Units
Santa Barbara City College	MATH 220	Differential Equations	4
Pasadena City College	MATH 055	Differential Equations	4
Skyline College	MATH 275	Ordinary Differential Equations	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
Boyce, William E., Richard C. DiPrima, Douglas Meade. *Elementary Differential Equations.* 12th ed., Wiley, 2021.

Resource Type
Textbook

Classic Textbook
No

Description
Polking, John, Al Boggess, and David Arnold. *Differential Equations with Boundary Value Problems.* 2nd ed., Pearson, 2023.

Resource Type
Textbook

Classic Textbook
No

Description
Edwards, C. Henry, David E. Penney, and David Calvis. *Differential Equations and Boundary Value Problems: Computing and Modeling.* 6th ed., Pearson, 2023.

Library Resources

Assignments requiring library resources
Use of textbooks on reserve at Circulation Desk. Research how other disciplines, such as engineering and physics, model problems using differential equations.

Sufficient Library Resources exist
Yes

Example of Assignments Requiring Library Resources
Researching Science books for examples of the applications of first and second order differential equations occurring in electronics, engineering and physics.

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
10/06/2022

Curriculum Committee
10/18/2022

DTRW-I
MM/DD/YYYY

Curriculum Committee
MM/DD/YYYY

Board
MM/DD/YYYY

CCCCO
MM/DD/YYYY

Control Number
CCC000431440

DOE/accreditation approval date
MM/DD/YYYY