

Course Outline of Record

1. Course Code: MATH-002C
2.
  - a. Long Course Title: Ordinary Differential Equations
  - b. Short Course Title: DIFFER EQUATIONS
3.
  - a. Catalog Course Description:
 

This is a standard introductory course in differential equations and their applications in modeling dynamic phenomena. Topics include first, second and higher order differential equations; systems of first order equations, linear, homogeneous and nonhomogeneous differential equations; solutions by power series; numerical methods, LaPlace transforms; and applications.
  - b. Class Schedule Course Description:
 

MATH-002C is the traditional sophomore level Differential Equations course with Calculus 1B prerequisite.
  - c. Semester Cycle (if applicable): N/A
  - d. Name of Approved Program(s):
    - MATHEMATICS Associate in Science for Transfer Degree (AS-T)
4. Total Units: 4.00      Total Semester Hrs: 108.00  
 Lecture Units: 3      Semester Lecture Hrs: 54.00  
 Lab Units: 1      Semester Lab Hrs: 54.00  
 Class Size Maximum: 35      Allow Audit: No  
 Repeatability No Repeats Allowed  
 Justification 0
5. Prerequisite or Corequisite Courses or Advisories:
 

*Course with requisite(s) and/or advisory is required to complete Content Review Matrix (CCForm1-A)*

 Prerequisite: MATH 001B
6. Textbooks, Required Reading or Software: (List in APA or MLA format.)
  - a. Boyce & DiPrima (2008). Elementary Differential Equations (9th /e). NY John Wiley & Sons Inc.. ISBN: 9780470039403  
 College Level: Yes  
 Flesch-Kincaid reading level: 12
  - b. Borrelli, Robert; Coleman, Courtney (2004). Differential Equations - A Modeling Perspective (2/e). Wiley. ISBN: 9780471433323  
 College Level: Yes  
 Flesch-Kincaid reading level: N/A
  - c. Zill & Cullen (2012). Differential Equations with Boundary Value Problems (9th /e). Brooks/Cole. ISBN: 9780495108368  
 College Level: Yes  
 Flesch-Kincaid reading level: 12
7. Entrance Skills: *Before entering the course students must be able:*
  - a.
 

Evaluate definite and indefinite integrals using a variety of integration formulas and techniques.

    - MATH 001B - Evaluate definite and indefinite integrals using a variety of integration formulas and techniques;
  - b.
 

Apply integration to areas and volumes, and other applications such as work or length of a curve.

    - MATH 001B - Apply integration to areas and volumes, and other applications such as work or length of a curve;

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c.

Evaluate improper integrals.

- MATH 001B - Evaluate improper integrals;

d.

Apply convergence tests to sequences and series.

- MATH 001B - Apply convergence tests to sequences and series;

e.

Represent functions as power series.

- MATH 001B - Represent functions as power series; and

f.

Graph, differentiate and integrate functions in polar and parametric form.

- MATH 001B - Graph, differentiate and integrate functions in polar and parametric form.

## 8. Course Content and Scope:

### Lecture:

1. Solutions of ordinary differential equations;
2. First order DE including separable, homogeneous, exact, and linear;
3. Existence and uniqueness of solutions;
4. Applications of first order differential equations such as circuits, mixture problems, population modeling, orthogonal trajectories, and slope fields;
5. Introduction to linearity as an abstract mathematical concept;
6. How linearity (or lack of it) affects the nature of solutions of differential equations;
7. Second order and higher order linear differential equations;
8. Application of Superposition principle to get more solutions;
9. Geometric interpretations for solutions using direction fields and phase portraits;
10. Apply Numerical methods to find numerical solutions to ordinary differential equations, including Euler's methods
11. Fundamental solutions, independence, Wronskian;
12. Nonhomogeneous equations;
13. Applications of higher order differential equations such as the harmonic oscillator and circuits;
14. Variation of parameters;
15. Apply Laplace transforms to solve second order equations, in particular to second order equations with discontinuous forcing functions;
16. Solutions to some nonlinear differential equations of contemporary interest including bifurcation and chaotic dynamics;
17. Series Solutions;
18. Systems of Ordinary differential equations;
19. Sensitivity of solutions to changes in initial conditions especially in relation to the eigensystem of the matrix that defines the system.

Lab: (if the "Lab Hours" is greater than zero this is required)

1. Use of technology in solving differential equations.
2. Use of technology in mathematical modeling using differential equations.

## 9. Course Student Learning Outcomes:

1. Define an ordinary differential equation or system of equations and classify them in terms of order, linearity, and homogeneity.
2. Define a solution to an ordinary differential equation or system of equations and describe the requirements for a solution to exist and be unique.
- 3.

Use ordinary differential equations as a tool to model and solve real-world problems that

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involve rates of change (e.g. velocity and acceleration) and solve these models using a variety of methods.

4.

Demonstrate critical and logical thinking, by frequent use of deductive reasoning in mathematics, in the context of differential equations.

10. Course Objectives: *Upon completion of this course, students will be able to:*

- a. Use slope fields to examine qualitative behavior of solutions;
- b. Create and analyze mathematical models using ordinary differential equations, including circuits, mixture problems, population modeling, orthogonal trajectories and harmonic oscillator;
- c. 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;
- d. Apply the existence and uniqueness theorems for ordinary differential equations;
- e. Apply numerical methods to find numerical solutions to ordinary differential equations, with error analysis;
- f. Characterize equations as linear vs. non-linear using linear operators;
- g. Find power series solutions to ordinary differential equations;
- h. Determine the Laplace Transform and inverse Laplace Transform of functions;
- i. Apply Laplace transforms to solve second order equations, in particular to second order equations with discontinuous forcing functions;
- j. Solve Linear Systems of ordinary differential equations.

11. Methods of Instruction: *(Integration: Elements should validate parallel course outline elements)*

- a. Discussion
- b. Laboratory
- c. Lecture
- d. Technology-based instruction

12. Assignments: *(List samples of specific activities/assignments students are expected to complete both in and outside of class.)*

In Class Hours: 108.00

Outside Class Hours: 108.00

a. In-class Assignments

1. Attend classroom lectures and take
2. Participate in classroom discussions to review, analyze, diagnose, and evaluate various methods of solution used in homework
3. Complete laboratory assignments using appropriate mathematical tools.
4. Complete examinations involving problems that apply studied principles to new situations.

b. Out-of-class Assignments

1. Read textbooks and supplementary
2. Complete assigned homework including problem solving, exercises to improve skills and mathematical
3. Complete examinations involving problems that apply studied principles to new situations.

13. Methods of Evaluating Student Progress: *The student will demonstrate proficiency by:*

- Written homework
- Computational/problem solving evaluations
- Mid-term and final evaluations
- Other

Chapter tests with in-class essay type exam questions, additional assignments as per the direction of the instructor and a comprehensive final exam with essay questions. Assignments and exams involve both performing computational

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problems and applying skills and ideas to new situations.

14. Methods of Evaluating: Additional Assessment Information:

15. Need/Purpose/Rationale -- *All courses must meet one or more CCC missions.*

IGETC Area 2: Mathematical Concepts and Quantitative Reasoning

A: Mathematic

CSU GE Area B: Physical and its Life Forms(mark all that apply)

B4 - Mathematics/Quantitative Thinking

PO-GE C4.b - Language & Rationality (Communication & Analytical Thinking)

Gather, assess, and interpret relevant information.

Apply logical and critical thinking to solve problems; explain conclusions; and evaluate, support, or critique the thinking of others.

IO - Scientific Inquiry

Analyze quantitative and qualitative information to make decisions, judgments, and pose questions.

IO - Global Citizenship - Scientific & Technological Literacy

Utilize quantitative expression in a variety of contexts. These would include units of measurement, visual representations, and scales and distributions.

Synthesize, interpret, and infer, utilizing information, data, and experience to solve problems, innovate, and explore solutions.

16. Comparable Transfer Course

University System	Campus	Course Number	Course Title	Catalog Year
UC	UC Riverside	Math 46	Intro to Ordinary Differential Equations	11-12

17. Special Materials and/or Equipment Required of Students:

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18. Materials Fees:  Required Material?

**Material or Item**

**Cost Per Unit**

**Total Cost**

19. Provide Reasons for the Substantial Modifications or New Course:

Change SLO's to align with number of units

20. a. Cross-Listed Course (*Enter Course Code*): *N/A*

b. Replacement Course (*Enter original Course Code*): *N/A*

21. Grading Method (*choose one*): Letter Grade Only

22. MIS Course Data Elements

a. Course Control Number [CB00]: CCC000326726

b. T.O.P. Code [CB03]: 170100.00 - Mathematics, General

c. Credit Status [CB04]: D - Credit - Degree Applicable

d. Course Transfer Status [CB05]: A = Transfer to UC, CSU

e. Basic Skills Status [CB08]: 2N = Not basic skills course

f. Vocational Status [CB09]: Not Occupational

g. Course Classification [CB11]: Y - Credit Course

h. Special Class Status [CB13]: N - Not Special

i. Course CAN Code [CB14]: *N/A*

j. Course Prior to College Level [CB21]: Y = Not Applicable

k. Course Noncredit Category [CB22]: Y - Not Applicable

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l. Funding Agency Category [CB23]: Y = Not Applicable

m. Program Status [CB24]: 1 = Program Applicable

Name of Approved Program (if program-applicable): MATHEMATICS

*Attach listings of Degree and/or Certificate Programs showing this course as a required or a restricted elective.)*

23. Enrollment - Estimate Enrollment

First Year: 0

Third Year: 0

24. Resources - Faculty - Discipline and Other Qualifications:

a. Sufficient Faculty Resources: Yes

b. If No, list number of FTE needed to offer this course: N/A

25. Additional Equipment and/or Supplies Needed and Source of Funding.

N/A

26. Additional Construction or Modification of Existing Classroom Space Needed. (Explain:)

N/A

27. FOR NEW OR SUBSTANTIALLY MODIFIED COURSES

Library and/or Learning Resources Present in the Collection are Sufficient to Meet the Need of the Students Enrolled in the Course: Yes

28. Originator John Learned Origination Date 10/20/17