



## MATH 2280

**Division:** Natural Science and Mathematics

**Department:** Mathematics

**Course:** MATH 2280

**Title:** Differential Equations

**Catalog Description:**

This is a course which covers methods of solving ordinary differential equations. The class is designed to meet the needs of math, engineering, and certain science majors. Included in the class are techniques for finding solutions to linear and nonlinear first-order differential equations as well as higher-order linear equations with constant and variable coefficients. Laplace transforms, power series solutions, numerical methods along with systems of linear first-order differential equations are also addressed. Some mathematical modeling of differential equations is included.

**General Education Requirements:** N/A

**Semesters Offered:** Spring

**Credit/Time Requirement:** Credit: 3; Lecture: 3; Lab: 0

**Clock/Hour Requirements:** 0

**Offered for Non-Credit:** No

**Prerequisites:** MATH 2210

**Justification:**

This class is required for students majoring in mathematics, engineering, computer science, physics, and chemistry. The material from this course is a basic foundation and problem solving tool for students entering science-related fields. Knowledge and abilities of solving differential equations are a prerequisite to be successful in many engineering, math, and science related courses at the upper-division level. This course is fully transferable to USU, U of U, BYU, Weber, and SUU (all senior institutions in Utah).

**Student Learning Outcomes:**

Students will understand and be able to use standard methods of solving differential equations to solve problems.

The students will increase their problem solving abilities and mathematical maturity.

The students will be able to generalize and think more abstractly.

Students will be able to solve problems and apply mathematical models relating to standard differential equation concepts.

**Content:**

- Introduction to Differential Equations

- Definitions and terminology
- Initial-Value problems
- Differential equations as mathematical models
  
- First-Order Differential Equations
  - Solution curves without the solution
  - Separable variables
  - Linear equations
  - Exact equations
  - Solutions by substitutions
  - A numerical solution
  
- Modeling With First-Order Differential Equations
  - Linear equations
  - Nonlinear equations
  - Systems of linear and nonlinear differential equations
  
- Higher-Order Differential Equations
  - Initial and boundary value problems
  - Homogeneous and nonhomogeneous equations
  - Reduction of order
  - Homogeneous linear equations with constant coefficients
  - Undetermined coefficients-superposition approach
  - Undetermined coefficients-annihilator approach
  - Variation of parameters
  - Cauchy-Euler Equations
  - Solving systems of linear equations by elimination
  - Nonlinear equations
  
- Modeling With Higher-Order Differential Equations
  - Linear equations: spring mass systems, series circuits
  - Linear equations: boundary-value problems
  - Nonlinear equation applications
  
- Series Solutions of Linear Equations
  - Solutions about ordinary points
  - Solutions about singular points
  - Bessel and Legendre Equations
  
- The Laplace Transform
  - Definitions of the Laplace transform
  - Inverse transform and transforms of derivatives
  - Translation theorems

- Additional operational properties
- Dirac Delta Function
- Systems of linear equations
  
- Systems of Linear First-Order Differential Equations
  - Preliminary theory
  - Homogeneous linear systems with constant coefficients
  - Variation of parameters
  - Matrix exponential
  
- Numerical Solutions of Ordinary Differential Equations
  - Euler Methods and error analysis
  - b. Runge-Kutta Methods
  - Multistep methods
  - Higher-Order equations and systems
  - Second-Order boundary-value problems

**General Education Outcomes:**

6) Apply computational skills to a variety of contexts.

Students solve 10-20 homework problems per section; many of which require computation. They receive scores and feedback on their assignments. Theory about the existence of solutions to differential equations stretches students minds in different ways; there are some abstract concepts, so the computations are not all numerical. Students also learn to use graphing calculators and standard software packages as time and resources will allow.

**Key Performance Indicators:**

Homework problems: 10%-25% of the final grade

Quizzes: 10%-20% of the final grade

Tests: 15%-25% of the final grade

Comprehensive final exam: 15%-30% of the final grade

**Representative Text and/or Supplies:**

Differential Equations With Modeling Applications, current edition, by Dennis G. Zill

**Optimum Class Size:** 24

**Maximum Class Size:** 30

**Signatures:**

I hereby submit this course syllabus:

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Kari Arnoldsen, PhD, Professor

I hereby find this course consistent with the goals and resources of the Mathematics Department:

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Kari Arnoldsen, PhD, Professor, Chair

I hereby find this course consistent with the goals and resources of the Natural Science and Mathematics Division:

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Dan Black, EdD, Associate Professor, Dean

I have discussed the need for library resources related to this class with the person submitting the syllabus:

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Lynn Anderson, MLIS, Technical Services Librarian (Main Campus)

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Michelle Olsen, MLS, Campus Librarian (Richfield Campus)