6. Differential Equations

3-4 semester hours

Prerequisite: At least Calculus II with a grade "C" or better

Note: See Technology Statement in the Introduction

This is an introductory course, focusing on writing, solving, and applying first- and higher-order ordinary differential equations.

Course Content

The following required topics are considered foundational for the course. Additionally, the course must cover at least one of the further topics in detail.

1. Required Topics
   - A. First-order equations, including all of the following topics:
     - i. existence and uniqueness of solutions,
     - ii. initial value problems,
     - iii. basic numerical methods,
     - iv. separable equations,
     - v. linear equations,
     - vi. exact equations,
     - vii. substitution methods, and
     - viii. applications.
   - B. Higher-order equations, including all of the following topics:
     - i. the general solution to homogeneous linear equations,
     - ii. linear independence,
     - iii. method of undetermined coefficients,
     - iv. the general solution to linear non-homogeneous equations,
     - v. variation of parameters, and
     - vi. applications.
   - C. Solutions to initial value problems by Laplace transforms, including the following topics:
     - i. definition of Laplace transforms,
     - ii. inverse Laplace transforms and their properties,
     - iii. convolution,
     - iv. unit step function, and
     - v. applications.
2. Further Topics
   - A. Power series solutions,
   - B. Partial differential equations and Fourier series,
   - C. Systems of linear differential equations,
   - D. Further numerical methods,
   - E. Non-cursory treatment of other advanced topics.

Course Objectives—The student will be able to:

1. Use Laplace transforms to solve initial value problems.
2. Classify differential equations and determine appropriate methods of solution for those types studied in this course.
3. Apply basic numerical methods to obtain approximate solutions of first order differential equations.
4. Solve first order differential equations by various elementary methods such as separation of variables, integrating factors, and substitutions.
5. Solve higher order homogeneous (and certain non-homogeneous) linear ordinary differential equations having constant coefficients.
6. Use variation of parameters to solve higher order nonhomogeneous linear ordinary differential equations.

7. Write and solve differential equations that model natural processes that evolve in time.
8. Apply existence and uniqueness theorems.

Addendum for the 2024 Updates

The first Articulation Guide (called the Curriculum Guide) was prepared in 1969-1973. Since then, there has been an ongoing effort to edit or modify this guide to continue providing colleges and universities in Illinois with guidelines on structuring mathematics and computer science courses. A more detailed history of the Articulation Guide can be found in previous editions.

Listed here is the collaborative work done since the previous edition. This collaboration is a joint effort between the Illinois Section of the Mathematical Association of America and the Illinois Mathematics Association of Community Colleges. This work supplements the efforts of the panel members of the Illinois Articulation Initiative appointed by the Illinois Community College Board and Illinois Board of Higher Education.

The collaborative efforts between ISMAA and IMACC focused on the tasks of:
1. reviewing and revising Differential Equations
2. creating a new Addendum Section for updates

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A special thanks to Keven Hansen at Southwestern Illinois College for facilitating these efforts.