Common Course Outline
MATH 259
Elementary Differential Equations
3 Credits

Community College of Baltimore County

Description

MATH 259 – Elementary Differential Equations includes techniques for solving first order differential equations, second and higher order differential equations, initial value problems, and solving differential equations by using numerical methods, Laplace Transform. Among the applications studied are exponential growth and decay, physical vibrations, electric circuits, falling bodies and more.

3 Credits

Prerequisite: MATH 252 with a grade of "C" or better

Overall Course Objectives

Upon successfully completing the course, students will be able to:

1. formulate real-world problems in mathematical forms such as Newton's Law of Cooling;
2. solve first order linear differential equations and initial value problems;
3. solve Bernoulli and Cauchy-Euler differential equations using a substitution method and first order differential equation solution methods;
4. solve separable differential equations, exact differential equations, and homogeneous differential equations and corresponding initial value problems;
5. solve application problems such as natural growth and decay problems, cooling and heating problems, compartmental analysis problems, and Newtonian mechanics problems using separable and first order differential equation methods;
6. find the family of curves that intersects a given family of curves orthogonally at each point by solving differential equations;
7. solve second and higher order homogenous linear differential equations with constant coefficients;
8. formulate mathematical models of mechanical systems and electrical circuits by utilizing differential equation methods;
9. solve non-homogeneous second and higher order differential equations utilizing the methods of undetermined coefficients and variation of parameters;
10. solve initial value problems by using a Laplace transform;
11. discuss and apply the existence and uniqueness theorems for ordinary differential equations;

12. use Euler's method to solve a differential equation numerically;
13. articulate orally and in writing, utilizing correct grammar and sentence structure, the solutions to differential equation mathematics problems;
14. apply appropriate computer and/or calculator technology to aid in the solution of differential equations mathematical problems;
15. working both individually and in groups, using an ethical approach, construct and explain solutions to real world differential equation problems by
16. evaluate, using an ethical approach, differential equation solutions of fellow classmates;
17. utilizing academically appropriate sources, research and examine worldwide mathematical contributions related to differential equations made by people from diverse cultures throughout history;
18. present solutions to differential equations numerically, orally, and in written paragraph form;
19. use MATLAB as well as other technology to solve differential equations numerically, to graph direction fields, to solve linear and non-linear equations, and to solve linear and non-linear systems;
20. utilize an ethical approach to solve application based differential equations which pertain globally to the pure sciences, the social sciences, the medical sciences, the technological sciences, the humanities and/or the arts; and
21. synthesize multicultural contributions of past mathematicians to the field of differential equations in order to create solutions to relevant real world problems.

Major Topics

I. Introduction
   A. Classification of differential equations
   B. Historical remarks
II. First order differential equations
   A. Linear equations
   B. Further discussion of linear equations
   C. Separable equations
   D. Difference between linear and nonlinear equations
   E. Modeling with linear equations; applications
   F. Exact equations and integrating factors
   G. Homogeneous equations
   H. The existence and uniqueness theorem
III. Second order linear equations
   A. Homogeneous equations with constant coefficients
   B. Fundamental solutions of linear homogeneous equations
   C. Linear independence and the Wronskian
   D. Complex roots and repeated roots of the characteristic equation
   E. Nonhomogeneous equations; method of undetermined coefficients
   F. Variation of parameters
IV. Higher order linear equations
   A. General theory of nth order linear equations

B. Homogeneous equations with constant coefficients
C. The method of undetermined coefficients
D. The method of variation of parameters

V. The Laplace transform
A. Definition of Laplace transform
B. Solution of initial value problems
C. Differential equations with discontinuous forcing functions
D. The convolution integral

VI. Numerical methods
A. The Euler or tangent line method
B. Errors in numerical procedures
C. Improvements on the Euler method

VII. Systems of differential equations
A. General theory of first order linear systems
B. Homogeneous linear systems
C. Numerical solutions of linear systems
D. Applications of systems of differential equations

Course Requirements

Grading procedures will be determined by the individual faculty member but will include the following:

Grading/exams

1. At least two other exams in addition to the final exam. The exams, cumulatively, will count for no less than 20% of the overall course grade.
2. A comprehensive final exam which will count for no less than 20% of the overall course grade.
3. Project(s) and/or assignments requiring the use of MATLAB will be completed by students and will count for no less than 5% of the overall course grade. Project results must be presented in written form requiring at least two written pages and which have utilized at least two appropriate research sources.
4. Homework to be counted no more than 15% of the overall grade course grade.

Written Assignments: Students are required to use appropriate academic resources.

Other Course Information

This course is an elective course for Mathematics and Computer Science majors and a required course for Engineering majors. This course is an approved General Education course in the Mathematics category. Please refer to the current CCBC Catalog for General Education course criteria and outcomes.

Date Revised: 01/30/2019