COURSE OUTLINE

MATH-260
Differential Equations
3 Semester Hours

HOWARD COMMUNITY COLLEGE

Description

This course consists of concepts generally encountered in a first course in differential equations including a comprehensive treatment of first order differential equations employing a variety of solution techniques. A study of higher order equations, largely second order, is included with emphasis on linear equations possessing constant coefficients as well as variable coefficients. Classical and contemporary applications are included throughout coming from diverse fields such as mechanics, electrical circuits, and economics. Computer uses with MATHLAB software provide an integrated environment for symbolic, graphic, and numeric investigations of routine solutions of differential equations and of modeling physical phenomena. The course concludes with a discussion of the Laplace transform and its application to linear equations with constant coefficients,
Prerequisites: Completion of a calculus sequence, equivalent to MATH -182. A grade of C or higher is recommended.

Statement on General Education and Liberal Learning

A liberal education prepares students to lead ethical, productive, and creative lives and to understand how the pursuit of lifelong learning and critical thinking fosters good citizenship. General education courses form the core of a liberal education within the higher education curriculum and provide a coherent intellectual experience for all students by introducing the fundamental concepts and methods of inquiry in the areas of mathematics, the physical and natural sciences, the social sciences, the arts and the humanities, and composition. This course is part of the general education core experience at Howard Community College.

Objectives: The general objective of MATH-260 is to develop the basic ideas commonly encountered in a first course in differential equations, to demonstrate some of their many applications, to enhance computer/calculator literacy, and to promote mathematical maturity for more advanced studies in mathematics. Successful completion of MATH-260 can be briefly described by the acquisition of the following behaviors.

State and use basic definitions and theorems, correctly use standard symbolism, and accurately and quickly perform required computations both manually and with the support of MATLAB software.
Build, solve and analyze mathematical models.
Translate the basic ideas of ordinary differential equations between their analytic and their graphic representations
Solve routine application problems for first and second order ordinary differential equations
Solve simple non-routine problems so as to extend the scope of a topic to solve problems amid slightly altered conditions
Follow mathematical reasoning as provided in elementary proofs, develop logical arguments, and identify mathematical patterns.

General Approach with MATLAB: The general approach of the course falls under the following themes:

1. Existence and uniqueness of solutions
2. Dependence of solutions on initial values.
3. Derivation of formulas for solutions.
4. Numerical calculation of solutions.
5. Graphical analysis of solutions.
6. Qualitative analysis of differential equations and their solutions.

The symbolic, numerical, and graphical capabilities of MATLAB will be used to analyze differential equations and their solutions.

Major Topics

First Order Differential Equations

- Linear Equations with Variable Coefficients
- Separable Equations
- Modeling with First Order Equations
- Difference Between Linear and Non-linear Equations
- Exact Equations and Integrating Factors
- Numerical Approximation: Euler's Method
- Existence and Uniqueness Theorem

Second Order and Higher order Linear Equations

- Homogeneous Equations with Constant Coefficients
- Fundamental Solutions of Linear Homogeneous Equations
- Linear Independence and The Wronskian
- Complex Roots of the Characteristic Equations
- Repeated Roots: Reduction of Order
- Non-homogeneous Equations; Method of Undetermined Coefficients
- Variation of Parameters
- Mechanical Vibrations and Electrical Oscilations
- Forced Vibrations

Series Solutions of Second Order Linear Equations

- Review of Power Series
- Series Solution near an Ordinary Point I and II
- Euler Equations

The Laplace Transform

- Definition of the Laplace Transform
- Solution of Initial Value Problems
- Step Functions
- Differential Equations with Discontinuous Forcing Functions
- Impulse Functions (Optional)

Systems of linear differential Equations

- Application Laplace transforms to systems of differential equations or the use of the operator method