**RARITAN VALLEY COMMUNITY COLLEGE**

**ACADEMIC COURSE OUTLINE**

# MATH 254: DIFFERENTIAL EQUATIONS

## 1. Basic Course Information

A. Course Number and title: MATH 254 Differential Equations

B. New or Modified Course: Modified Course

C. Date of Proposal: Semester: Spring Year: 2020

**D. Effective Term: Fall , 2020**

E. Sponsoring Department: Mathematics and Computer Science

F. Semester Credit Hours; 4

G. Weekly Contact Hours; Lecture: 4
Laboratory: 0
Out of class student work per week: 8

H. Prerequisites/Co-requisites: Prerequisite - MATH 152 Calculus II with a grade of C or higher or MATH 152H Calculus II Honors, with a grade of C or higher.

I. Laboratory Fees: None

J. Name and Telephone Number or Email Address pf Department Chair and Divisional Dean at time of approval: Lori Austin, Lori.Austin@raritanval.edu (Chair), Sarah Imbriglio, Sarah.Imbriglio@rritanval.edu (Divisional Dean)

## II. Course Description:

A. Prerequisite: MATH 152 Calculus II with a grade of C or higher or MATH 152H Calculus II Honors, with a grade of C or higher. Includes first order differential equations, models and numerical methods, linear higher order equations, systems of linear equations, nonlinear systems and phenomena, Laplace Transforms, and power series methods.

**III. Statement of Course Need:**

**A.** This course serves as an elective in the Mathematics AS Degree

**B.** This course generally transfers as a general education course.

**C.** This course generally transfers as a Mathematics program requirement or program elective.

**IV.** Place of Course in College Curriculum

A. This course is a free elective

B. This course serves as a General Education requirement in Mathematics

C. This course serves as an elective in the Physics, Engineering, Mathematics, and Computer Science AS degrees.

D. To see course transferability
a) for New Jersey schools, go to the NJ Transfer website, www.njtransfer.org;
b) for all other colleges and universities, go to the individual websites.

**V. Outline of Course Content**

A. First-Order Differential Equations

1. Differential Equations and Mathematical Models
2. Integrals and General and Particular Solutions
3. Slope Fields and Solution Curves
4. Separable Equations and Applications
5. Substitution Methods and Exact Equations

B. Mathematical Models and Numerical Methods
1. Population Models
2. Equilibrium Solutions and Stability
3. Acceleration-Velocity Models
4. Numerical Approximation Euler's Method
5. A Closer Look at the Euler Method
6. The Runge-Kutta Method

B. Linear Equations of Higher Order
1. Introduction: Second-Order Linear Equations
2. General Solutions of Linear Equations
3. Homogeneous Equations with Constant Coefficients
4. Mechanical Vibrations

5. Nonhomogeneous Equations and Undetermined Coefficients
6. Forced Oscillations and Resonance
7. Electrical Circuits
8. Endpoint Problems and Eigenvalues

C. Introduction to Systems of Differential Equations
   1. First-Order Systems and Applications
   2. The Method of Elimination
   3. Numerical Methods for Systems

D. Linear Systems of Differential Equations
   1. Matrices and Linear Systems
   2. The Eigenvalue Method for Homogeneous Systems
   3. A Gallery of solution Curves of Linear Systems
   4. Second Order Systems and Mechanical Applications
   5. Multiple Eigenvalue Solutions
   6. Matrix Exponential and Linear Systems
   7. Nonhomogeneous Linear Systems

E. Nonlinear Systems and Phenomena
   1. Stability and the Phase Plane
   2. Linear and Almost Linear Systems
   3. Ecological Models: Predators and Competitors
   4. Nonlinear mechanical Systems
   5. Chaos in Dynamical Systems

F. Laplace Transform Methods
   1. Laplace Transforms and inverse Transforms
   2. Transformation of Initial Value Problems
   3. Translation and Partial Fractions
   4. Derivatives, Integrals, and Products of Transformations
   5. Impulses and Delta Functions

G. Power Series Methods
   1. Introduction and Review of Power Series
   2. Series Solutions Near Ordinary Points
   3. Regular Singular Points

**V, General Education and Course Learning Outcomes:**

**A. <u>General Education Outcomes:</u>**

At the completion of the course students will be able to:

1, Apply mathematical arguments to problems (GE-NJ2).

2, Solve problems quantitatively and symbolically (GE-NJ2)

**B. Course Learning Outcomes:**

Students will be able to:

1. Solve first order differential equations, using methods such as separable, linear first order, exact, and others.
2. Solve linear second order differential equations.
3. Determine whether a unique solution is guaranteed to exist for a differential equation.
4. Solve systems of linear equations, using methods such as elimination, eigenvalues/eigenvectors, matrix exponentials, and numerical methods.
5. Locate equilibrium points for systems of non-linear differential equations.
6. Utilize Laplace transform methods and power series methods to solve differential equations.

**C. Assessment Instruments**

1. Tests (Required)
2. Quizzes
3. Projects/Homework
4. Cumulative final examination (Required)

## VII. Grade Determinants

1. Tests (Required)
2. Quizzes
3. Projects/Homework
4. Cumulative final examination (Required)
5. Individual teacher determinants

Primary formats, modes, and methods for teaching and learning that may be used in the course;

1. Lecture/discussion
2. Small-group work
3. Computer-assisted instruction
4. Student collaboration

## VIII. Texts and Materials

Suggested textbook: *Differential Equations and Boundary Value Problems – Computing and Modeling, 5th edition (Tech Update)*

(Please note: The course outline is intended only as a guide to course content and resources. Do not purchase textbooks based on this outline. The RVCC Bookstore is the sole resource for the most up-to-date information about textbooks.)

A graphing calculator may be required. TI-84 is recommended.

## IX. Resources

No additional resources needed.

## X. Honors Options (if relevant): This course does not have an honors option.