SYLLABUS

Code: **MATH 274** **Title**: **ELEMENTARY DIFFERENTIAL EQUATIONS**

Institute: STEM **Department: MATHEMATICS**

Course Description: This is an introductory course in concepts and applications of differential equations. Topics include classical methods of solving first- and higher-order differential equations, mathematical models for phenomena such as growth and decay, chemical reactions, motion of a body, spring-mass systems and electric circuits, qualitative and numerical aspects of differential equations, and systems of differential equations. Problems are approached from a variety of perspectives, including graphical, numerical, verbal, and algebraic. Computer software will be used extensively in class to gain a greater understanding of concepts as well as to consider non-routine problems.

Section Information: All tests will be proctored in person.

Prerequisite or Corequisite: MATH 273

Credits: 4 **Lecture Hours:** 4 **Lab:** 0

Required Textbook/Materials:

See your instructor addendum for a complete list of required materials for your section.

Textbook: Zill, Dennis G., A First Course in Differential Equations with Modeling Applications, Eleventh edition, Cengage Learning, 2018.

Note: WebAssign (EWA) will be required for online homework and quizzes in some sections. Check with your instructor.

Recommended Materials

Zill, Dennis G., Wright, Warren S., and Wright, Carol D. Student Resource and Solutions Manual, Brooks/Cole Publishing Company.

Additional Time Requirements

You may need to allow some on-campus time during each unit to meet with your group to work on the unit projects. Some discussions can be done via email, but you will need some group meeting time and your group may need to meet with your instructor to discuss parts of the project. For information on Brookdale's policy on credit hour requirements and outside class student work refer to Academic Credit Hour Policy.

Other Time Commitments

- In addition to the regular class hours, you will need to set aside time each week for homework. The weekly time will vary by topic and level of difficulty, but as an estimate, you should expect two homework hours for *each* class hour per week. For example, if your class

meets for four hours per week, you should expect to spend about ***eight*** hours per week on homework.
- You may need to allow time on campus to do homework problems that require the use of computer software.
- If you are having any difficulty with the course material, you may need to allow time to see your instructor during office hours or to get help in the Math Lab.

Course Learning Outcomes

Upon completion of this course, students will be able to:

- Use algebra and calculus skills to solve ordinary differential equations. (M)
- Use the appropriate differential equation to model, analyze and solve application problems. (M)
- Explain the analysis and solution of application problems. (M)
- Use computer software to understand concepts and to explore and solve problems. (M)

Learning Outcome(s) support the following General Education Knowledge Areas:

- (M) Mathematics

Grading Standard

In this course, you will be evaluated by means of tests, projects, and quizzes (and possibly homework).

A. TESTS

There will be three tests, one after each unit. All supporting work must be shown on tests in order for your instructor to properly assess your understanding of the material. Computer software is used on these tests, although there may be non-computer parts. The tests will be given in class and it is expected that you will be in class to take the test on the day it is given. If you are very ill (verifiable with a doctor's note) or you have some other emergency, you *must* contact your instructor immediately. Each test will be worth between 25% and 30% of your grade. Your instructor's addendum will state the exact percentage.

Note: All tests will be proctored in person, see Instructor Addendum for more information.

B. QUIZZES/HOMEWORK

There are periodic quizzes and your instructor may also choose to use homework assignments for evaluation.

C. PROJECTS

There is one project for each unit of the course, to be done outside of class. In the projects, you will apply the concepts and skills learned in class to a problem situation, present the mathematics, write careful explanations, and interpret your results. Specific guidelines for the projects will be handed out with Project 1.

SYLLABUS

GRADING

Each test is graded on the basis of 100 points and is worth between 25% and 30% of your grade. Quizzes, homework and projects result in a combined grade worth between 15% and 25% of your grade. Your instructor's addendum will state the exact percentages.

FINAL GRADE

Your final grade is determined as follows:

If your final course average is	Your final grade is
90 – 100	A
88 – 89	A-
86 – 87	B+
80 – 85	B
78 – 79	B-
76 – 77	C+
70 – 75	C
60 – 69	D**
Below 60	F

** To use this course as a prerequisite for another mathematics course, you must have a grade of C or better.

Incomplete

INC is only given at the discretion of your instructor. This may occur in documented cases of hardship or emergency. In this case, you must meet with the instructor to discuss the work that must be completed to earn a grade in the course. All work must be completed within 21 days after the end of the term, exclusive of official college closings.

Withdrawal

You may withdraw from the course, without penalty, up to a date set by the College. If you do not withdraw from the course but stop attending, your grade at the end of the semester will be F.

Course Content

Unit 1: In this unit, you will solve first-order differential equations using a variety of techniques. You will classify differential equations, solve application problems and predict the behavior of solutions using the differential equation.

Unit 1 Outcomes: You will: (Text Section)

- Classify differential equations (1.1,1.2)
- State and use the existence and uniqueness theorem for first order initial value problems (1.2)
- Verify a function is a solution to a differential equation or an initial value problem (1.1,1.2)

- Write a differential equation as part of a mathematical model for some specific models in biology, chemistry, and physics (1.3).
- Use computer software to create a direction field (2.1)
- Use a computer generated direction field to sketch solution curves for a first order differential equation (2.1)
- Find critical points and develop phase portraits for autonomous first order differential equations and use the phase portrait to predict behavior of the solutions (2.1)
- Solve first order differential equations using separation of variables (2.2)
- Solve first order linear differential equations (2.3)
- Solve exact differential equations (2.4)
- Solve Bernoulli equations (2.5)
- Solve homogeneous differential equations (2.5)
- Use linear and nonlinear first order differential equations to model and solve application problems (3.1, 3.2)

Unit 2: In this unit, you will solve higher order linear differential equations. You will also model and solve application problems and predict the behavior of solutions using the differential equation. You will also model and solve systems of linear differential equations.

Unit 2 Outcomes: You will: (Text Section)

- Show that functions are independent by using the Wronskian (4.1)
- Verify that a two parameter family of functions is a general solution to a nonhomogeneous differential equation (4.1)
- State and interpret the existence and uniqueness theorem for linear higher order initial value problems (4.1)
- Use reduction of order to solve a second order differential equation (4.2)
- Find the general solution to homogeneous linear differential equation with constant coefficients (4.3)
- Solve a homogeneous linear differential equation with constant coefficients subject to initial or boundary conditions (4.3)
- Solve a differential equation by undetermined coefficients (4.4)
- Solve a differential equation by variation of parameters (4.6)
- Solve Cauchy-Euler equations (4.7)
- Solve systems of differential equation by elimination (3.3, 4.9)
- Use linear second order differential equations to model and solve physical problems (5.1, 5.2, 5.3)

Unit 3: In this unit you will use the Laplace transform to solve a variety of differential and integral equations. You will solve first-order systems of differential equations using the matrix method. You will use various numerical methods to solve first- and higher- order differential equations and systems of differential equations.

Unit 3 Outcomes: You will: (Text Section)

- Know the definition of the Laplace transform (7.1)
- Find the Laplace transform of a given function using the definition (7.1)
- Find the Laplace transform of a given function using the definition and computer software (7.1)

- Find the inverse Laplace of a given function (7.2)
- Use the first and second translation theorems to find the Laplace transform of a given function (7.3)
- Use Laplace transforms to solve initial value problems (7.2, 7.3, 7.5)
- Use Laplace transforms to solve integral equations (7.4)
- Use Laplace transforms to solve applied problems (7.3,7.4)
- Use Laplace transforms to solve problems involving the Dirac delta function (7.5)
- Write a system of differential equations in matrix form (8.1)
- Given the matrix form, write the corresponding system of differential equations (8.1)
- Verify that a vector is a solution to a system (8.1)
- Find the eigenvalues and eigenvectors of a 2 by 2 matrix by hand (8.2)
- Find the eigenvalues and eigenvectors of a matrix by using computer software (8.2)
- Solve a system of differential equations with using eigenvalues (8.2)
- Find numerical solutions using the Euler's and improved Euler's method for a few steps by hand (2.6, 9.1)
- Find numerical solutions with specified accuracy using the Euler's, the improved Euler's, and the Runge-Kutta method (9.1, 9.2)
- Know the order of the three numerical methods (9.1, 9.2)
- Describe the change in global truncation error based on the change of step size for the three numerical methods (9.1, 9.2)
- Use the Runge-Kutta method, with computer software, to approximate the solution of a system of differential equations (9.4)
- Write a second-order initial-value problem as a system of first-order differential equations and find numerical solutions using the Runge-Kutta method (9.4)

Department Policies

The Math Department wants you to be successful in this course. Because of this, we have compiled a list of strategies and behaviors.

Attendance and class participation

- If you want to be successful in this course, attend every class.
- Come to class on time, and stay for the entire class period. If you are late or leave during class, you will miss important class material and you will also distract your classmates and your instructor. (See the Student Conduct Code)
- Turn off your cell phone during class. You and your classmates need to be free from distractions. (See the Student Conduct Code)
- Bring your book and calculator to every class.
- Respect your classmates and your instructor. Listen carefully to questions asked and answers given. Treat all questions with respect.
- Participate fully in class. Volunteer answers, work problems, take careful notes, and engage in discussions about the material. Use computers only for designated work. Above all, stay on task. Contribute your share to your in-class group work and your projects and do your best to make the group experience a positive one for all members.
- Do your own work on tests and quizzes. Cheating will not be tolerated. (See the Academic Integrity Code.)

SYLLABUS

Homework

- Homework is the way you practice the ideas and skills that are introduced in class. To be successful on the tests, you must do the homework. Homework may be collected and homework questions may be included on quizzes or tests.
- When you do the homework, write down all supporting work. Using the correct process is at least as important as getting the correct answer, so your work and steps are very important.
- Remember to check your answers. They will be in the back of the text or in the student's solutions manual.
- If there are questions you can't get or don't understand, ask about them at the beginning of the next class. If you have trouble with more than a few problems, try starting your homework in the Math Lab, where help is available.

Absence

- If you are sick and an absence is unavoidable, please call or email your instructor. You are still responsible for all material that was covered during your absence. You are expected to read the textbook and do the homework.
- Make time to see your instructor when you return so that you can get any papers you missed.
- Remember that you are expected to be in class for the tests and quizzes.

Getting Help

After you have tried the homework, there are ways to get help:

- Look in your text and your class notes for examples similar to the problems you are finding difficult.
- See your instructor during office hours or make an appointment. Bring the work you have done.
- Go to the **Math Lab** to get extra help on your homework or simply go and do your homework there. Someone will be there if you get stuck. You don't need an appointment to use the Math Lab.
- Form a **study group** with other class members. Working with other students can be a great way to learn. If you have a group to work with, consider meeting and working together in the Math Lab.
- Your textbook may have a complete solutions manual available in the Math Lab, which can be used in the Math Lab.
- You can use the computers in the computer lab within the Math Lab to do work related to your math course.
- In the Math Lab, you can get help on how to use your calculator.

Visit the **Math Lab website** to view hours and other useful information about the Math Lab.

SYLLABUS

COLLEGE POLICIES:

As an academic institution, Brookdale facilitates the free exchange of ideas, upholds the virtues of civil discourse, and honors diverse perspectives informed by credible sources. Our College values all students and strives for inclusion and safety regardless of a student's disability, age, sex, gender identity, sexual orientation, race, ethnicity, country of origin, immigration status, religious affiliation, political orientation, socioeconomic standing, and veteran status. For additional information, support services, and engagement opportunities, please visit www.brookdalecc.edu/support.

For information regarding:

- Brookdale's Academic Integrity Code
- Student Conduct Code
- Student Grade Appeal Process

Please refer to the **BCC STUDENT HANDBOOK AND BCC CATALOG.**

NOTIFICATION FOR STUDENTS WITH DISABILITIES:

Brookdale Community College offers reasonable accommodations and/or services to persons with disabilities. Students with disabilities who wish to self-identify must contact the Disabilities Services Office at 732-224-2730 (voice) or 732-842-4211 (TTY) to provide appropriate documentation of the disability, and request specific accommodations or services. If a student qualifies, reasonable accommodations and/or services, which are appropriate for the college level and are recommended in the documentation, can be approved.

MENTAL HEALTH:

- Mental Health Crisis Support: From a campus phone, dial 5555 or 732-224-2329 from an external line; off-hours calls will be forwarded to BCC police (2222 from a campus phone)
- Psychological Counseling Services: 732-224-2986 (to schedule an appointment during regular hours)

The syllabus is intended to give student guidance in what may be covered during the semester and will be followed as closely as possible. However, the faculty member reserves the right to modify, supplement, and make changes as the need arises.