COLLIN COLLEGE EXPANDED GENERIC COURSE SYLLABUS

COURSE INFORMATION

Course Number: MATH 2320
Course Title: Differential Equations
Credit Hours: 3
Lecture Hours: 3
Lab Hours: 1

Prerequisite
MATH 2414 with a C or better.

Course Description
Ordinary differential equations, including linear equations, systems of equations, equations with variable coefficients, existence and uniqueness of solutions, series solutions, singular points, transform methods, and boundary value problems; application of differential equations to real-world problems. Lab required.

Textbook/Supplies
Differential Equations with Boundary-Value Problems, 9th ed. Dennis G. Zill, 2018, Cengage Learning.

Supplies: Graphing calculator required.

STUDENT LEARNING OUTCOMES (SLO)

Upon completion of this course the students should be able to do the following:

1. Identify homogeneous equations, homogeneous equations with constant coefficients and exact and linear differential equations
2. Solve ordinary differential equations and systems of equations using
   a. Direct integration,
   b. Separation of variables,
   c. Reduction of order,
   d. Methods of undetermined coefficients and variation of parameters,
   e. Series solutions,
   f. Methods for finding particular solutions,
   g. Laplace transform methods
3. Determine particular solutions to differential equations with given boundary conditions or initial conditions (Empirical/Quantitative)
4. Analyze real-world problems in fields such as Biology, Chemistry, Economics, Engineering, and Physics, including problems related to population dynamics, mixtures, growth and decay, heating and cooling, electronic circuits, and Newtonian mechanics. (Critical Thinking and Communication)

REQUIRED CORE OBJECTIVES FOR MATHEMATICS

As per the Texas Higher Education Coordinating Board, mathematics students must develop and demonstrate the following three required core objectives:

- Critical Thinking Skills - creative thinking, innovation, inquiry, and analysis, evaluation and synthesis of information.
- Communication Skills - effective development, interpretation and expression of ideas through written, oral and visual communication.
- Empirical and Quantitative Skills - manipulation and analysis of numerical data or observable facts resulting in informed conclusions.

METHOD OF EVALUATION

Course requirements
Attending class**,** completing homework assignments**,** completing labs, and completing required exams.

Course format
Lecture, labs, core assessments, exams, and guided practice.

A minimum of three proctored exams, lab assignments, three proctored core assessments, and a proctored comprehensive final exam are required. The proctored final exam must count at least 20% of the total grade. Graded Homework and Labs may be submitted in person or worked online. Graded core assessments will count for 3-5% of the overall course grade. The weight of each evaluation component will be detailed in the individual instructor's syllabus. Credit for all out-of-class coursework-- including homework assignments, service-learning projects, and other assessments or learning activities--may not exceed 25% of the total course grade. At least 75% of a student's final grade must be based on proctored exams. Retaking of proctored exams is not permitted without professor's approval.

Core Assessment Statement
Core assessments consist of problems or tasks that measure student achievement of state required core objectives – Critical Thinking Skills, Communication Skills, and Empirical and Quantitative Skills. These assessments are designed to be meaningful and require students to extend and apply course concepts. Students should be able to clearly see how these assessments reflect both the skills they are developing and the outcomes of the course.

COURSE POLICIES

College-wide policies are pre-loaded into the Concourse Syllabi and are not duplicated in the Expanded Generic Syllabi for each course.

Instructor specific policies should be added to the Concourse Syllabus.

COURSE CONTENT

Proofs and derivations will be assigned at the discretion of the instructor. The student will be responsible for knowing all definitions and statements of theorems for each section outlined in the following modules.

Module 1

INTRODUCTION TO DIFFERENTIAL EQUATIONS, FIRST ORDER DIFFERNTIAL EQUATIONS, AND MODELING WITH FIRST ORDER DIFFERENTIAL EQUATIONS

The student will be able to:

1. Write Definitions and understand Terminologies of Differential Equations
2. Solve Initial-Value Problems of Differential Equations (SLO 3)
3. Solve Mathematical Models of Differential Equations (SLO 4)
4. Identify Solution Curves Without analytical solutions of Differential Equations
5. Solve Autonomous First-Order Differential Equations
6. Solve Separable Differential Equations (SLO 2b)
7. Solve General Differential Equations
8. Solve Exact Differential Equations
9. Solve Differential Equations by Substitutions
10. Solve Linear Models of Differential Equations (SLO 4)
11. Solve Nonlinear Models of Differential Equations (SLO 4)
12. Use Modeling to solve First-Order Differential Equations (SLO 4)

Module 2

HIGHER ORDER LINEAR DIFFERNTIAL EQUATIONS AND MODELING WITH HIGHER ORDER LINEAR DIFFERENTIAL EQUATIONS

The student will be able to:

1. Explore the Theory-Linear Differential Equations
2. Solve the Initial-Value and Boundary-Value Problems (SLO 3)
3. Solve Homogeneous Differential Equations
4. Solve Nonhomogeneous Differential Equations
5. Use Reduction of Order to solve Differential Equations (SLO 2c)
6. Solve Homogeneous Linear Differential Equations with Constant Coefficients (SLO 2d)
7. Use the Undetermined Coefficients-Superposition Approach to solve Differential Equations (SLO 2d)
8. Use the Variation of Parameters Method to solve Differential Equations (SLO 2d)
9. Use the Cauchy-Euler Method to solve Differential Equations
10. Solve the Initial-Value Problems of Differential Equations to find solutions of Linear Models (SLO 4)

11. Use Solutions of Differential Equations to solve the Spring/Mass Systems of Free Undamped Motion (SLO 4)
12. Use Solutions of Differential Equations to solve the Spring/Mass Systems of Free Damped Motion (SLO 4)
13. Use Solutions of Differential Equations to solve the Spring/Mass Systems of Driven Motion (SLO 4)
14. Use Solutions of Differential Equations to solve the Series Circuit Analogue problems (SLO 4)

Module 3

SERIES SOLUTIONS OF LINEAR DIFFERENTIAL EQUATIONS AND LAPLACE TRANSORMS

The student will be able to:

1. Review of Power Series (SLO 2e)
2. Find Solutions about Ordinary Points (SLO 2e)
3. Find Solutions about Singular Points (SLO 2e)
4. Study the Definition of the Laplace Transform (SLO 2g)
5. Study the Inverse Transforms and Transforms of Derivatives (SLO 2g)
6. Study the Operational Properties of translation on the s-axis and on the t-Axis (SLO 2g)
7. Study the Operational Properties of derivatives of transforms and transforms of Integrals (SLO 2g)
8. Find the Transforms of Periodic Functions (SLO 2g)
9. Solve Systems of Linear Differential Equations by using the Laplace Transform (SLO 2g)

Module 4

SYSTEMS OF LINEAR FIRST-ORDER DIFFERENTIAL EQUATIONS, FOURIER SERIES, AND BOUNDARY-VALUE PROBLEMS IN RECTANGULA COORDINATES

The student will be able to:

1. Explore the Theory of Linear Systems of Differential Equations (SLO 2)
2. Solve Homogeneous Linear Systems of Differential Equations (SLO 2)
3. Find Distinct Real Eigenvalues of Linear Systems of Differential Equations (SLO 2)
4. Find Repeated Eigenvalues of Linear Systems of Differential Equations (SLO 2)
5. Find Complex Eigenvalues of Linear Systems of Differential Equations (SLO 2)
6. Solve Nonhomogeneous Linear Systems of Differential Equations (SLO 2)
7. Use the Method of Undetermined Coefficients to solve Linear Systems of Differential Equations (SLO 2)
8. Use the Method of Variation of Parameters to solve Linear Systems of Differential Equations (SLO 2)