

**SOUTHERN UNIVERSITY and A&M COLLEGE  
DEPARTMENT OF MATHEMATICS**

**MATH 395  
CALCULUS III AND DIFFERENTIAL EQUATIONS FOR  
JUNIOR ENGINEERING MAJORS**

**COURSE DESCRIPTION:** This course combines selective topics normally covered in both calculus III and differential equations courses. Major focus is on application of fundamental mathematical principles to investigate realistic design elements. Topics include: vector differential and integral calculus; power series (Bessel and Legendre functions, and Fourier Series), partial fractions, Fourier and LaPlace Transforms of derivatives, modeling and solutions to differential equations with real coefficients, initial value problems, free and forced oscillations.

**INSTRUCTOR'S EMPHASIS:** The course aims to foster genuine knowledge of course content, the development of key concepts, and the ability to think critically and solve problems. This course should be taken after the normal calculus II. Hence a purpose of the course is to extend the students' knowledge of the Calculus by introducing them to additional topics in mathematics, which make use of the concepts, learned in calculus. The instructor will emphasize problem solving, critical thinking and communicating, both writing and orally. In addition, the instructor will emphasize solutions to problems numerically, algebraically, graphically and several applications. The instructor will also provide the students with essential concepts and skills in differential equations which is needed to successfully complete their studies in engineering.

**INTENDED AUDIENCE:** This course is designed for students in engineering at the junior level.

**CREDIT HOURS:** 4.0

**PREREQUISITES:** Mathematics 265 with a grade of "C" or better and junior standing in engineering are required prerequisites for this course

**TEXTBOOK:** A First Course In Differential Equation (The Classical Edition), by Dennis G. Zill, Seventh Edition.

## **GENERAL GOALS:**

1. To provide the student with the skills to use logical and critical thinking and computational skills to master the course content.
2. To provide the student with the skills necessary to give an explanation both orally and in writing of concepts in differential equations
3. To provide the student with critical problem solving skills.
4. To provide the student with concepts of differential equations that may be used in other areas of the sciences and engineering.

## **LEARNING OUTCOMES:**

Upon completion this course, the student will:

1. define and give examples of terms relative to the course content.
2. recall and use formulas from integral and differential calculus.
3. draw figures to illustrate the meaning of the definition or theorem.
4. compute multiple integrals.
5. explain and give examples of theorems.
6. apply Taylor's Theorem, First and Second Shifting Theorem, to evaluate LaPlace Transforms, Bessel and Legendre functions and Fourier Series.
7. apply differential Equations to solve problems involving mechanical systems, electrical systems and changes relative to Newton's First and Second Law of cooling.
8. solve and present specific problems from the text under the supervision of the professor.

## **ASSESSMENT MEASURES:**

- A. Instructor will create examinations, quizzes and homework.
- A. The student will solve problems on the board with the help and supervision of the instructor.

## **COURSE CONTENT:**

### **Chapter 1.** Introduction to Differential Equations

- 1.1 Definitions and Terminology
- 1.2 Initial - Value Problem
- 1.3 Differential Equations and Mathematical Models

### **Chapter 2.** First - Order differential Equations

- 2.1 Separable Variables
- 2.2 Linear Differential Equations
- 2.3 Exact Differential Equations
- 2.3 Solution by Substitutions
- 2.5 Some Numerical Solutions

### **Chapter 3.** Modeling With First Order Differential Equations

- 3.1 Linear Differential Equations
- 3.2 Nonlinear Differential Equations

### **Chapter 4.** Higher Order Differential equations

- 4.1 Some Preliminary Theory as Needed
- 4.2 Initial Value and Boundary Value Problems
- 4.3 Homogeneous and Non-homogeneous Differential Equations
- 4.4 Homogeneous Differential Equations with Constant Coefficients
- 4.5 Undetermined Coefficients
- 4.6 Variation of Parameters
- 4.7 Cauchy - Euler Differential equations

## **Chapter 5. Mathematical Modeling With Higher Order Differential Equations**

- 5.1 Linear Differential Equations and Initial Value Problems
- 5.2 Free Undamped Motion
- 5.3 Free Damped Motion
- 5.4 Series Circuit Analogue
- 5.5 Linear Differential Equations and Boundary Value Problems
- 5.6 Nonlinear Differential equations

## **Chapter 6. Series Solutions of Linear Differential equations**

- 6.1 Solutions About Ordinary Points
- 6.2 Solutions About Singular Points
- 6.3 Review Several Special Differential Equations (Optional)

## **Chapter 7. The Laplace Transform**

- 7.1 Review and Solve problems by The Definition
- 7.2 Inverse Laplace Transform and Laplace Transform of Derivatives
- 7.3 Translation Theorems
- 7.4 Some Additional Operational Properties (Optional)

## **Chapter 8. System of Linear First Order Differential Equations**

- 8.1 Some Preliminary Theory as needed
- 8.2 Homogeneous Linear Systems with Constant Coefficients
- 8.3 Distant Real Eigenvalues
- 8.4 Repeated Real Eigenvalue
- 8.5 Complex Eigenvalues
- 8.6 Eigenvectors
- 8.7 Variation of Parameters for System of Differential Equations

## **Chapter 9. Numerical Solutions of Ordinary Differential Equations**

- 9.1 Bessel's equations and Legendre functions
- 9.2 Fourier Series
- 9.3 Taylor's Series

## **COURSE EXPECTATIONS AND STUDENT SUPPLEMENTS:**

### **1. EXPECTATIONS**

Students are expected to have the skills prerequisite for the course.

### **2. THE MATHEMATICS LABORATORY (MATH LAB)**

The mathematics will be used to solve differential using the program “Joy of Mathematics”.

### **3. OTHER RESOURCES**

- a) Free individual tutoring in the Math Lab Room 318 T.T. Allain Hall.
- b) Individual help by the professor during the office hours

### **4. CLASS ATTENDANCE**

Regular and punctual attendance is expected. Excessive absences and tardiness will not be tolerated. The student is responsible for keeping up with course work, whether or not an absence is excused. When a student receives **FOUR** or more absences, his/her academic standing in the course may be compromised, extenuating circumstances may be considered.

### **5. EXITING MATHEMATICS 395**

To exist math 395 the and receive credit in the area of the sciences or Engineering the student must have a semester grade of “C” or better.

The teacher will administer the **FINAL EXAMINATION** according to the time printed in the Class Schedule.

**DISABILITY STATEMENT:** If you have a documented disability, then please discuss it with personnel at 771-3546 in Room 246 Blanks Hall. Learners, those considered having a disability, are to provide the professor with a letter from Professor P. Hebert through the Office of Disability Service stating the appropriate accommodations required of this course.

**DISCLAIMER:** These activities and assignments are tentative. Changes may occur due to assessment of learners by the professor and due to the professor.