MATH 250B Differential Equations & Linear Algebra Summer 2023

Instructor: Dr. Derdei Bichara

Email/Phone: dbichara@fullerton.edu/657-278-3196

Webpage: http://mathfaculty.fullerton.edu/dbichara/

Class: MTWTh 6:00pm–8:55pm on MH 438.

Office Hours: MW 3:30pm–5:00pm on MH178.

Textbook: *Differential Equations & Linear Algebra*, 4^{th} Edition, by Stephen W. Goode & Scott A. Annin, Pearson, 2015.

Course description

This course is the second semester in a three-semester sequence in calculus. Topics covered include techniques of integration, improper integrals, applications of integration, an introduction to differential equations, parametric equations, and sequences and series.

Prerequisites

Math 250A.

Calculators

Calculators, of any form, are not allowed during exams and quizzes. Its usage on homework is therefore strongly discouraged. While, it might be handy in some cases, a simple pocket calculator could do the job.

Exams

Students must bring student ID to all exams. No books, calculators, cell phones, smart watches, or other technology are allowed during exams. Headphones are also prohibited during exams. If you leave the room during an exam, your examination period is over. Answers without justification will receive no credit. No make up exams will be given.

- There will be two **midterm exams** during the regular lecture time on the following dates:
  - ☞ Monday, June 6, 2023.
  - ☞ Monday, June 27, 2023.
- The comprehensive **final exam** will be on:
  ☞ *Thursday, June 30, 2023, from 6:00pm - 8:00pm.*

Assignments

1. **Homework:** There will be required and recommended weekly homework assignments. These assignments are typically due on **Mondays at the start of class sessions**.

   The additional recommended homework will be assigned for each sections, but these will not be turned in. It is highly recommended to do them.

   The lowest graded homework will be dropped.

2. **Quizzes:** There will be weekly quizzes, usually on Wednesday during the last 10-15 minutes of the regular class time. These quizzes may include questions from the recommended homework.

Technology Requirements:

Students are required to have an electronic device (laptop, desktop or tablet) with a camera, a built-in microphone and a reliable wifi connection. CSUF students can submit device requests to borrow PC laptops, webcams, and headsets by submitting the Device Request form.

Course Policies

- **Grade Distribution:**

Homework	5%
Quizzes	15%
Midterm exam average	45%
Final exam	35%

- **Letter Grade Distribution:**

97.00 - 100	A+	77.00 - 79.99	C+
93.00- 96.99	A	73.00 - 76.99	C
90.00 - 92.99	A-	70.00 - 72.99	C-
87.00 - 89.99	B+	67.00 - 69.99	D+
83.00 - 86.99	B	60.00 - 66.99	D
80.00 - 82.99	B-	50.00 - 59.99	D-
		< 50	F

I reserve the right to impose some flexibility in these boundaries. Positive attitude and active participation during class may help raise students' grade at these boundaries.

- **Grading Issues:**
  Any grading issues must be presented to the instructor no later than 10 days from the date the quiz or exam was taken or assignment was due.

Course Policies:

- **General**
  - Computers are not to be used unless instructed to do so.
  - Exams are closed book, closed notes.
  - **No makeup quizzes or exams will be given.**
- **Grades**
  - A grade in the **C-** or better is required to meet this General Education requirement; Grades in the **B** range represent performance that is **substantially better** than the expectations; Grades in the **A** range represent work that is **excellent**. A grade of **D+** or below will not satisfy this General Education Requirement.
  - **No late assignments will be accepted under any circumstances**.
- **Attendance and Absences**
  - Attendance is expected and will be taken each class. You are allowed to miss **1** class during the semester without penalty. Any further absences will result in point and/or grade deductions.
  - Students are responsible for all missed work, regardless of the reason for absence. It is also the absentee's responsibility to get all missing notes or materials.

Resources

There are many resources available for students, including myself. The textbook is an excellent resource for most of your questions, and you should read every section covered in this course. There is only so much that can be covered during lecture, and so it is the student's responsibility to study the text as well. All material in the text in the sections covered is assessable on exams and quizzes.

Important dates

- *Friday, June 5, 2023*: The deadline for submitting Instructor-Initiated drops.

Course Specific Learning Goals:

Upon completing of this course, students should:

- Know real-world examples of differential equations
- Appreciate first-order differential equations qualitatively, geometrically, numerically, and analytically
- Be able to analytically solve first-order differential equations that are separable, linear, or can be solved via using a change-of-variables technique
- Be able to do basic matrix operations, such as addition, subtraction, multiplication, scalar multiplication, transpose, derivatives, and integrals
- Understand how to use matrices to represent linear systems of equations
- Master the technique of Gaussian elimination, including bringing a matrix into row-echelon form, to solve linear systems of equations
- Be able to determine the inverse of a square matrix, if it exists, using the Gauss-Jordan technique
- Understand the equivalence of statements in the Invertible Matrix Theorem
- Be able to compute the determinant of a matrix and understand its interpretation
- Know the basic properties of determinants, including how they behave under transpose, inverse, multiplication, elementary row operations, and so on
- Know the definition and basic examples of vector spaces
- Be able to check whether a subset S of a vector space V forms a subspace
- Be able to determine, given a subset S of a vector space V, whether S spans V, is linearly independent, both (i.e. S is a basis), or neither
- Be able to compute a basis and the dimension for a given vector space V
- Determine bases and dimensions for nullspace(A), rowspace(A), and colspace(A), for any $m \times n$ matrix A
- Know and understand the value and uses of the Rank-Nullity Theorem for a matrix A
- Know the definition and basic examples of inner product spaces
- Be able to determine whether a set of vectors in an inner product space is orthogonal or orthonormal
- Be able to apply the Gram-Schmidt process to a set of vectors
- Know the definition and examples of linear transformations
- Be able to compute bases and dimension for the kernel and range of a linear transformation
- Know the relationships between the dimensions of the kernel and range of a linear transformation via the general Rank-Nullity Theorem
- Be able to determine whether a given linear transformation is one-to-one, onto, both (i.e., an isomorphism), or neither
- Understand the basic concepts of eigenvalues and eigenvectors, as well as their use in the diagonalization process
- Be able to determine whether a given square matrix is diagonalizable or not
- Know the requirements of a basis of solutions to an nth order linear homogeneous differential equation
- Be able to determine the general solution to an nth order constant-coefficient linear homogeneous differential equation

- Be able to use the annihilator and variation-of-parameters techniques to determine a particular solution to an nth order linear non-homogeneous differential equation, and therefore, determine the general solution of such differential equations
- Be able to use matrices to represent a first-order linear system of differential equations
- Be able to draw a phase portrait to represent the solutions to a first-order linear system of differential equations
- Be able to determine the general solution to a first-order homogeneous linear system of differential equations that is represented by a diagonalizable coefficient matrix
- Be able to determine the general solution to a first-order homogeneous linear system of differential equations that is represented by a non-diagonalizable coefficient matrix (in the case of 2x2 and 3x3 matrix only)
- Be able to use the variation-of-parameters technique to determine a particular solution to a first-order non-homogeneous linear system of differential equations (in the case of 2x2 coefficient matrix only)

These goals are achieved through the course work, including homework, classroom activities, quizzes, exams and projects, which require the student to demonstrate understanding of the mathematical concepts presented in the course and to apply these concepts to the solutions of real world applied problems.

Academic Honesty Policy Summary

Academic Integrity

Students who violate university standards of academic integrity are subject to disciplinary sanctions, including failure in the course and suspension from the university. Since dishonesty in any form harms the individual, other students, and the university, policies on academic integrity are strictly enforced. Examples of academic dishonesty include, but are not limited to: (1) copying from another student's homework, quiz, or exam; (2) allowing another student to copy your work; and (3) copying homework solutions from the text solutions manual. You should familiarize yourself with the academic integrity guidelines found in the current student handbook.

Emergency Procedures

In the event of an emergency such as earthquake or fire:

- Take all your personal belongings and leave the classroom (or lab). Use the stairways located at the east, west, or center of the building.
- Do not use an elevator. They may not be working once the alarm sounds.
- Go to the lawn area towards Nutwood Avenue. Stay with class members for further instruction.
- For additional information on exits, fire alarms and telephones, *Building Evacuation Maps* are located near each elevator.
- Anyone who may have difficulty evacuating the building, please see the instructor.

Disability Support Services (DSS)

The University requires students with disabilities to register with the Office of Disability Support Services (DSS), located in UH-101 and at (714) 278 - 3112, in order to receive prescribed accommodations appropriate to their disability. Students requesting accommodations should inform the instructor during the first week of classes about any disability or special needs that may require specific arrangements/accommodations related to attending class sessions, completing course assignments, writing papers or quizzes/tests/examinations.

Tentative schedule:

The schedule may be subject to change.

Monday	Tuesday	Wednesday	Thursday
May 30th **1** **No class**: Memorial Day Observance	31st **2** Orientation, 1.1 DE Everywhere, 1.2, 1.4: Separable DE.	June 1st **3** 1.6: First-Order Linear DE, 1.7 Modeling Problems, 1.8 Change of Variables, Quiz 2	2nd **4** 2.1: Matrices: Definitions & Notation, 2.2: Matrix Algebra, 2.3: Terminology for Systems of Equations
6th **5** 2.4: ERO and Row-Echelon Matrices, 2.5: Gaussian Elimination, 2.6: The Inverse of a Square Matrix	7th **6** 2.8 Gaussian Elimination, 2.6 The Inverse of a Square Matrix	8th **7** 3.1: Definition of the Determinant, 3.2: Properties of Determinants, 3.3: Cofactor Expansions	9th **8** 4.1: Vectors in $\mathbb{R}^n$, 4.2: Definition of a Vector Space, **Exam Review**
13th **9** **Exam 1** (Chap 1, 2 & 3), 4.3: Subspaces, 4.4: Spanning Sets	14th **10** 4.5: Linear Dependence/Independence, 4.6: Bases and Dimension, Catch up	15th **11** 4.8: Row Space and Column Space, 4.9: The Rank-Nullity Theorem, 4.10: Invertible Matrix Theorem II	16th **12** 5.1: Definition of an Inner Product Space, 5.2: Orthogonal Sets & Orthogonal Projections, 5.3: Gram-Schmidt Process
20th **13** 6.1: Definition of a Linear Transformation, 6.3: Kernel & Range of a Linear Transformation, 6.4: Additional Properties of LTs	21st **14** 7.1: Eigenvalue-Eigenvector Problem, 7.2: General Results for Eigenvalues-Eigenvectors	22nd **15** 8.1: General Theory for Linear DE, 8.2: Constant Coeff. Homogeneous LDE, 8.7: Variation Of Param.	23rd **16** 9.1: 1^{st} Order Linear Syst., 9.2: Vector Formulation, **Exam 2 Review**
27th **17** **Exam 2** (Chap 4, 5, 6, 7 & 8), 9.3: General Results for 1^{st} Order Linear Syst	28th **18** 9.4: Non-defective Coeff. Matrix, 9.5: Defective Coeff. Matrix	29th **19** 9.6: Variation of Param. for Linear Syst. Review	30th **20** **Final Exam**

Final Exam: Thursday, June 30, 2023 - From 6pm to 8:00pm