

## Course Syllabus

M 427J Differential Equations with Linear Algebra, Fall 2019

Unique Number: 52835

**Classes:** MWF 3:00 pm - 4:00 pm, PHR 2.110

**Instructor:** Solomon Manukure, PhD      **Email:** smanukure@math.utexas.edu      **Office:** RLM 13.146

**Office hours:** MW 4:00 pm - 5:30 pm (or by appointment)

**Discussion sessions:** TTH 8:30 am - 9:30 am, CPE 2.208

**Text:** *Martin Braun, Differential Equations and Their Applications*, 4th Edition.

**Course description:** Topics include first-order differential equations, second-order linear differential equations, systems of differential equations, qualitative theory of differential equations, separation of variables and Fourier series and Sturm-Liouville boundary value problems.

**Prerequisites:** Mathematics 408D, 408L, or 408S with a grade of at least C-.

**Attendance policy:** You are expected to attend all lectures and discussion sessions. While in class, you should turn off your cell phones, laptops, and any other electronic devices. If you miss class, please contact another student (not the TA or me) to find out what you missed.

**Homework:** Homework problems from the textbook will be assigned on Canvas at the end of every section. These problems will not be graded.

**Quizzes:** Seven quizzes will be given in the discussion sessions which will account for 20 % of your overall grade. These quizzes will be based on your textbook homework problems. I will drop the two lowest quiz scores.

**Exams:** There will be two midterm exams, each of which will account for 25% of our overall grade. Final exam will be cumulative and will account for 30% of your overall grade. Your final exam score will replace your lowest test score only if the former is higher than the latter. The location of the final exam will be announced later in the semester.

### Grade distribution:

Midterm Exams: 50%

Quizzes: 20%

Final exam: 30%

**Make-up policy:** Some assignments of each type are dropped to accommodate illnesses, emergencies, and other legitimate reasons that prevent assignment completion or submission. **Therefore, no late assignments will be accepted and no make-up exams will be given.**

**Grade scale:** Letter grades will be assigned according to the scale: A (100-93), A- (92-90), B+ (89-87), B (86-83), B- (82-80), C+ (79-77), C (76-73), C- (72-70), D+ (69-67), D (66-63), D- (62-60), F (59-0).

**Email policy:** All emails should be sent through Canvas. If you choose to send an email to my email address (smanukure@math.utexas.edu), please include your course name and the unique number of the section you are in. Please note that it is impossible to teach mathematics via email so please do not email me mathematics problems.

**Some important dates:**

08/28 (Wednesday) Classes begin.  
09/02 (Monday) Labor day holiday.  
09/03 (Tuesday) Last day of the official add/drop period  
09/12 (Thursday) Quiz 1  
09/13 (Friday) Last day to drop a class for a possible refund  
09/26 (Thursday) Quiz 2  
10/04 (Friday) Exam 1  
10/17 (Thursday) Quiz 3  
10/31 (Thursday) Quiz 4  
11/07 (Thursday) Quiz 5  
11/15 (Friday) Exam 2  
11/21 (Thursday) Quiz 6  
11/27-30 (Wednesday-Saturday) Thanksgiving holidays  
12/05 (Thursday) Quiz 7  
12/09 (Monday) Last class day.  
12/18 (Wednesday) Final Exam, 7:00 pm - 10:00 pm

**Drop days:** Thursday, October 31 is the last day an undergraduate student may, with the deans approval, withdraw from the University or drop a class except for urgent and substantiated, nonacademic reasons. It is also the last day an undergraduate student may change registration in a class to or from the pass/fail basis. For other important dates, please visit

<https://registrar.utexas.edu/calendars/19-20>

**Sanger Center:** Additional help on the course material is available at the Sanger Learning Center. Please check their website for free drop-in tutoring:

[www.utexas.edu/ugs/slc](http://www.utexas.edu/ugs/slc)

**Students with disabilities:** The University of Texas at Austin provides upon request appropriate academic accommodations for qualified students with disabilities. For more information contact Services for Students with Disabilities.

<http://ddce.utexas.edu/disability/>

**Counseling & Mental Health:** To help with stress, study habits, crises, or any personal matters, please look for assistance at the Counseling and Mental Health Center;

Student Services Bldg (SSB) 5th Floor; Hours: M–F 8am–5pm, 512 471 3515 (appointments), 512 471 CALL (crisis line).

See:

[www.cmhc.utexas.edu](http://www.cmhc.utexas.edu)

**UT Policy On Scholastic Dishonesty:** Students who violate university rules on scholastic dishonesty are subject to disciplinary penalties, including the possibility of failure in the course and/or dismissal from The University. Since such dishonesty harms the individual, all students, and the integrity of The University, policies on scholastic dishonesty will be strictly enforced. See:

<http://deanofstudents.utexas.edu/conduct/academicintegrity.php>

**Quantitative reasoning:** This course carries the Quantitative Reasoning flag. Quantitative Reasoning courses are designed to prepare you with skills that are necessary for understanding the types of quantitative arguments you will regularly encounter in your professional life. So, this course may be used to fulfill the mathematics component of the university core curriculum and addresses the following three core objectives established by the Texas Higher Education Coordinating Board: communication skills, critical thinking skills, and empirical and quantitative skills.

**Sections to be covered:**

1. First-order differential equations [4 hours]
  - 1.1 Introduction
  - 1.2 First-order linear differential equations
  - 1.4 Separable equations
  - 1.9 Exact equations, and why we cannot solve very many differential equations
  - 1.10 The existence-uniqueness theorem; Picard iteration
2. Second-order linear differential equations [11- 12 hours]
  - 2.1 Algebraic properties of solutions
  - 2.2 Linear equations with constant coefficients
    - 2.2.1 Complex roots
    - 2.2.2 Equal roots; reduction of order
  - 2.3 The nonhomogeneous equation
  - 2.4 The method of variation of parameters
  - 2.5 The method of judicious guessing
  - 2.6 Mechanical vibrations (optional)
  - 2.8 Series solutions
    - 2.8.1 Singular points, Euler equations
    - 2.8.2 Regular singular points, the method of Frobenius (optional)
3. Systems of differential equations [15 hours]
  - 3.1 Algebraic properties of solutions of linear systems
  - 3.2 Vector spaces
  - 3.3 Dimension of a vector space
  - 3.4 Applications of linear algebra to differential equations
  - 3.5 The theory of determinants
  - 3.6 Solutions of simultaneous linear equations
  - 3.7 Linear transformations
  - 3.8 The eigenvalue-eigenvector method of finding solutions
  - 3.9 Complex roots
  - 3.10 Equal roots
  - 3.11 Fundamental matrix solutions;  $e^{At}$ 
    - Supplement*
    - 3.A Matrix multiplication as linear combination of columns
    - 3.B Vectors as arrows in  $\mathbb{R}^n$  and geometric meaning of operations (optional)
    - 3.C Null and Column spaces
    - 3.D Complete solution set of systems (RREF)
4. Qualitative theory of differential equations [optional 3 hours]
  - 4.1 Introduction
  - 4.2 Stability of linear systems
  - 4.4 The phase-plane

- 4.7 Phase portraits of linear systems
- 5. Separation of variables and Fourier series [6-7 hours]
  - 5.1 Two point boundary-value problems
  - 5.2 Introduction to partial differential equations
  - 5.3 The heat equation; separation of variables
  - 5.4 Fourier series
  - 5.5 Even and odd functions
  - 5.6 Return to the heat equation