Math 320, Lecture 5: Syllabus
Linear Algebra and Differential Equations
TR 9:30-10:45 in Van Vleck B239

Textbook: *Differential Equations and Linear Algebra*, 3rd Edition, Edwards and Penney, Prentice Hall.

Pre-requisite: Math 222.

Credit toward the math major may not be received for both Math 320 and Math 340.

Professor: Leslie Smith, Departments of Mathematics and Engineering Physics, Office Hours in Van Vleck 825 TR 12:30-2:00, lsmith@math.wisc.edu.

Teaching Assistant:

Jingrui Cheng, Office Hours MWF 7:00-8:00 PM in Van Vleck 516

Exams: There will be two evening exams: **Tuesday February 21** and **Tuesday, March 28**, during the time 7:15-8:30 PM. Please let me know IMMEDIATELY if you have a conflict with these dates. Each exam is 25% of the final grade.

Final Exam: Sunday May 7, 7:25-9:25 PM, 35% of grade.

Piazza: There will be a Piazza course page where all course materials will be posted, and to facilitate peer-group discussions.

Piazza Sign-Up Page: piazza.com/wisc/spring2017/math320005
Piazza Course Page: piazza.com/wisc/spring2017/math320005/home

Weekly Problem Sets: Homework is **due at the beginning of class**, typically on Thursday. Homework will be available on piazza approximately one week prior to the due date. Roughly 15 problems will be assigned each week (most of the time from the book, but not always).

Please write your name and section number clearly on each homework set, stapled please! Unstapled homework will not be accepted.

Grading of Homework: The TA and/or a grader will grade a subset of the homework problems given out each week, with some points also given for completeness. Typically (but not necessarily always), there will be 2 problems graded on a scale of 0-10, with 6 points for completeness. The homework scores will count for 15% of the grade.

Late Policy: Homework turned in after the beginning of class will be considered late and will be graded at 80% credit. Late homework will be accepted until 5 PM on the due date (no credit thereafter, no exceptions). The policy is intended to keep everyone as current as possible.

Please email Jingrui Cheng directly to make arrangements regarding late homework submission: jcheng37@wisc.edu

Calculators: Calculators and/or computer software may be used to help with homework problems but are not permitted during exams.

Grading Scale for Final Grade: 92-100 A, 89-91 AB, 82-88 B, 79-81 BC, 70-78 C, 60-69 D, 59 and below F

Course description: Differential equations are the fundamental tools that scientists and engineers use to model physical reality. The importance of differential equations to science and engineering cannot be over-emphasized. A distinct subject in its own right, linear algebra is a part of mathematics concerned with the structure inherent in mathematical systems. We shall study these subjects together for three reasons: (1) The viewpoint of linear algebra is immensely helpful in uncovering the order underlying the topic of differential equations; it helps us understand the "why" and not just the "how" of our calculations; (2) Linear algebra is essential to the theory of differential equations; (3) Linear algebra is crucial to the computer approximations which are often the only way to solve the most challenging differential equations.

Throughout this course, we will seek to answer the following basic questions:

- When does a differential equation have a solution? When is that solution unique?
- Can one construct the (unique) solution of a differential equation in terms of elementary functions? If not, can one approximate its solution numerically and/or understand it qualitatively?
- How does one choose the differential equation(s) used to model a physical system? What are the strengths and limitations of such models? Specifically, what is the significance of *linearity* in our models and applications?

Course outline: The course covers material in Chapters 1-8 of the text. The topics are listed below with corresponding chapter.

Chapter 1: First-Order ODEs (continuing from 221/222 with some review).

Chapter 2: Mathematical Models and Numerical Methods.

Chapter 3: Linear Systems and Matrices.

Chapter 4: Vectors Spaces.

Chapter 5: Higher-Order Linear ODEs.

Chapter 6: Eigenvalues and Eigenvectors (sections 6.1-6.2).

Chapter 7: Homogeneous Linear Systems of ODEs.

Chapter 8: Nonhomogeneous Linear Systems of ODEs (sections 8.1-8.2).

Learning Outcomes:

- Students will state and apply the Theorem of Existence and Uniqueness for first-order ODEs, and the Theorem of Existence and Uniqueness for second-order linear ODEs.
- Students will find analytical solutions to first-order ODEs, including (but not limited to) separable ODEs and linear ODEs.
- Students will construct approximate solutions to first-order ODEs using numerical methods.

- Students will state and apply rules for the algebra of matrices.
- Students will demonstrate knowledge of coupled linear algebraic equations, determine when the system has solution(s), and be able to find solution(s) when applicable.
- Students will find analytical solutions to second-order linear ODEs in simple cases.
- Students will demonstrate the relation between higher-order linear ODEs and coupled first-order linear ODEs.
- Students will apply knowledge of linear algebra and differential equations to solve coupled first-order linear ODEs with constant coefficients.