Beijing Jiaotong University

2020 Summer Session

MATH 200 Linear Algebra and Differential Equations

Course Outline

Term: June 29-July 24, 2020

Class Hours: 16:00-17:50 (Monday through Friday)

Course Code: MATH 200

Instructor: Kun Zhao

Home Institution: Tulane University

Office Hours: TBA and by appointment

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Credit: 4

Class Hours: This course will have 52 class hours, including 32 lecture hours, 8 professor office hours, 8 TA discussion session hours, and 4 review session hours.

Course Description: Differential equations arise naturally in the modeling of evolutionary systems in science, engineering and economics. These systems all involve changes and differential equations describing how the quantities of interest evolve. The challenge is to extract from the differential equations a prediction of the behavior of the variables of interest as time varies, which relies on solving the differential equations exactly/approximately. This course is designed to help you master mathematical techniques for solving differential equations. In this course, you will first learn techniques for solving scalar linear differential equations, such as integrating factor, undetermined coefficients, variation of parameter, and Laplace transform. Then much attention will be paid to systems of differential equations, whose study relies heavily on linear algebra. In this course, we will cover the basic theories and techniques in linear algebra sufficient for solving and analyzing systems of differential equations. We will then examine the subject and use the linear algebra tools to solve systems of differential equations, and to analyze their qualitative behavior without solving them.

Textbook: *Differential Equations with Boundary Value Problems*, Polking, Boggess and Arnold, 2nd Edition, Pearson.

Prerequisite: It is required that students have already completed two quarters or semesters of single

variable Calculus. Specifically, you should be familiar with derivatives and integrals of single variable functions. Familiarity with partial derivatives and complex numbers is suggested for some applications but not required.

Course Outline: The course covers material in Chapters 2, 4, 5, 7, 9, 10 of the text. The following is a tentative schedule, which may be subject to change, which will be announced in class.

- **Week 1**. Chapter 2: First-order linear differential equations: separable differential equations, first order linear differential equations, integrating factor, homogeneous differential equations, exact differential equations, Bernoulli equation, existence, uniqueness and continuous dependence on initial conditions of solutions, autonomous equations and stability.
- **Week 2**. Chapters 4 & 5: Second order differential equations: characteristic equation, method of undetermined coefficients, variation of parameters, harmonic motion, Laplace transform, inverse Laplace transform, Heaviside function, Delta function. **Midterm Exam**
- **Week 3.** Chapters 7: Matrix algebra, row-echelon reduction, Gauss-Jordan elimination, invertible matrices, determinants, cofactors, Cramer's rule, eigenvalues and eigenvectors.
- **Week 4**. Chapter 9 & 10: First-order linear systems of differential equations, homogeneous differential equations: non-defective matrices, homogeneous differential equations: defective matrices; Systems of nonlinear differential equations: phase plane portrait, linearization, stability of equilibrium points, long-time behavior of solutions. **Final Exam**

Exams: *There will be two quizzes, one midterm exam and one comprehensive final exam. The schedule is the following:*

1. *Quiz 1 – **July 3, 2020** (Friday, Closed book)*
2. *Midterm – **July 10, 2020** (Friday, Closed book)*
3. *Quiz 2 – **July 17, 2020** (Friday, Closed book)*
4. *Final exam – **July 24, 2020** (Friday, Closed book)*

The quizzes will have duration of 60 minutes, the midterm and final exams will have duration of 120 minutes and they will take place during the discussion period and in the regular classroom. If a student must miss an exam because of a university-approved conflict, please contact me as soon as possible, and no later than one week before the exam. Apart from these conflicts missing an exam or arriving late for an exam may result in the immediate failure (zero) of that exam.

Homework: Homework problems are assigned at the end of this syllabus. Homework will not be collected, due to the intensive labor required for grading homework. However, you are strongly encouraged to solve all the homework problems to better prepare for the tests.

Grading Policy: *For a solution to a problem in a test or in the homework to be considered perfect it is not only required the answer to be correct, but also that a correct outline of the reasoning or a correct calculation leading to it be given as well. In many cases a correct answer alone will not account for partial credit.*

Grading Procedures: *The course grade will be based on two quizzes (20% each), one midterm exam (25%), and a final exam (35%).   The following table*

F	D	C	B	A
<60%	*60%*	*70%*	*80%*	*90%*

will be used for grades. It provides the minimum percentages for the grades. Eventually, if necessary, an average grading (curving) will be used for the grades.

Office Hours: I am here to help. Please see me before or after class. If I can't help you then, we can set up another time to meet.

Academic Integrity: When completing an assignment for this course, students are expected to do original work for the assignment and to not reuse work they may have done in previous courses or other settings unless specific prior approval. Cheating is defined as the giving or receiving of aid (written, oral, or otherwise) in order for a student to receive undeserved credit on class work, homework, tests or any other assignment that is his or her own responsibility. Plagiarism violates the central core of education philosophy. It involves stealing another person's work and claiming it as one's own. It occurs whenever one directly copies another person's intellectual effort and integrates it into his/her class work without giving proper credit to the author. Paraphrasing is defined as "a restatement of a text or passage giving the meaning in another form" (Webster's New Universal Unabridged Dictionary, 1996). When one paraphrases but intentionally omits authorship of the work, this, too is a serious violation of academic honesty. All students have an individual responsibility to understand what cheating, plagiarism, and paraphrasing are. The student must also be aware that the consequences for doing the above listed offences are severe. Whenever you have doubt about what constitutes cheating, plagiarism, or paraphrasing, contact me.

Homework Problems:

Section	Problems
2.2	2, 3, 9, 14, 17, 35
2.4	2, 3, 10, 13, 18, 19, 29
2.5	1, 3, 5, 8
2.7	1, 2, 3, 7, 9, 21
2.9	7, 8, 9, 10, 11, 16, 17, 18, 19, 21, 23, 27
4.1	1, 2, 5, 6, 9, 15, 16, 17, 22
4.2	1, 3, 5
4.3	1, 3, 9, 11, 12, 17, 18, 20, 25, 28, 30, 38
4.4	1, 4, 7, 8, 11, 13, 14
4.5	1, 2, 5, 7, 10, 11, 14, 18, 24, 25, 31, 32, 40, 41, 45
4.6	1, 2, 7, 9, 11
5.1	1, 3, 5, 15, 17, 19, 21, 23, 29
5.2	1, 2, 3, 5, 19, 23, 27, 29, 31, 35, 37, 41
5.3	1, 3, 4, 5, 7, 9, 15, 17, 19, 21, 23
5.4	1, 3, 11, 13, 15, 19

5.5	1, 3, 5, 7, 11, 12, 13, 17, 19, 21, 23, 25, 29
5.6	2, 3, 4, 8.
Chapt 7, Lesson 1	Page 282: 11, 14, 16, 17, 31, 33, 37, 41, 49, 53, 54; Page 299: 1, 23, 25, 29
Chapt 7, Lesson 2	Page 306: 3, 11, 19, 23, 27.
Chapt 7, Lesson 3	Page 321: 14, 16, 21, 22, 28, 30; Page 328: 23, 25, 27, 31, 37 (skip any questions asking about basis)
9.1	1—12, 16—27
9.2	1, 3, 5, 7, 9, 11, 17, 19, 21, 29, 31, 33, 41, 43, 45, 47
9.5	1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31
9.6	35, 36, 37, 38
9.7	1, 3, 5, 7, 9, 11, 13, 15
10.1	1, 3, 5, 9, 11, 13
10.2	1, 7, 9, 11, 14