Math 3318–001: Differential Equations
Spring 2015, GS 104 (Geosciences), TTh 9:30–10:50

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Office Hours: before class (with advance notice), after class, and by appointment

Pre/corequisite: MATH 2326
Text materials: Edwards & Penney, *Differential Equations and Boundary Value Problems*, 4th ed., Pearson/Prentice Hall, 2008.
Course home page: http://mathed.uta.edu/kribs/3318.html
Last day for withdrawal: April 3
Final exam: Thursday, May 14, 8:00–10:30 AM, GS 104 (note time)
Other exam dates (tentative): Tue Feb 17, Tue Apr 7, both in-class
Course content (from the Undergraduate Catalog): Ordinary differential equations with emphasis on the solutions and analysis of first and higher order differential equations drawn from fields of physics, chemistry, geometry, and engineering.

LEARNING OUTCOMES: The successful student will be able to:

- *solve linear systems of ordinary differential equations* including higher-order equations, and including initial or boundary value problems
- *apply standard methods to solve nonlinear ordinary differential equations*, including separation of variables, exact equations, integrating factors, undetermined coefficients, variation of parameters, Laplace transforms, and infinite series
- *analyze the qualitative behavior of systems of nonlinear ordinary differential equations*, using stability analysis for equilibria as well as phase portrait analysis for global behavior
- *write characteristic equations for linear [systems of] ordinary differential equations*, using techniques such as matrix representations (eigenvalues) and Laplace transforms
- *prove the linear independence of functions using the Wronskian*
- *use and explain standard numerical methods for solving systems of differential equations*, including Euler's method and Runge-Kutta 4th-order approximation
- *develop, use, and interpret systems of ordinary differential equations used as mathematical models of real-world systems*, including temperature, radioactivity, fluid flow, and populations
- *communicate effectively and clearly* the analysis and explanations of such models

GRADES: Course grades will be determined by five components: graded homework assignments (15%), a project (10%), and three exams (25% each). Details on each component are provided later in this syllabus. Students are expected to keep track of their performance throughout the semester and seek guidance from available sources (including the instructor) if their performance drops below satisfactory levels.

POLICIES:

Expectations for class time: This class meets every Tuesday and Thursday (except spring break)from January 20 to May 7. Students are expected to be on time, prepared and ready to work at 9:30. Students are expected not only to attend, but to actively participate in, class discussions, in order to maximize learning and help the instructor gauge the pace. Students are also expected to seek help (from the instructor, the Math Clinic, or others) on homework problems *before* the class session at which they are due. Class time will be available to address misconceptions and confusions common to many students in the class, but it is often not possible to devote time to going over every problem on which anyone had difficulty. As a sign of respect for your peers and our common work, please keep all cellular phones, computers, and other electronic devices turned off during class. In emergencies cell phones may be set to vibrate only, and brief calls taken in the hallway outside.

Expectations for out-of-class study: The general rule of thumb for college courses is that for every hour spent in class, a student should spend 3 hours per week outside of class working on the course (this is why a 12-hour load is considered full-time: $12 \times 4 = 48$). This includes time spent reading, studying, working on homework, consulting the instructor or tutors, etc.

Attendance: Class attendance has been shown to be directly correlated with students' grades in general. Although there is no explicit penalty for absences, students who miss class remain responsible for understanding the topics, vocabulary, techniques, and notation used in class (as much as possible this will be consistent with the text). Students are also expected to make every effort to arrive on time (important announcements are often made at the beginning of class and not repeated), and to minimize disruption if they arrive late.

Late papers: Each student is allowed one late submission during the semester. The paper must be submitted before the beginning of the class period following that in which it was due. Papers not submitted by the end of class time on the due date are considered late. Submission of a late paper constitutes the student's agreement that this is the one allowed late assignment.

Electronic submissions: Each student is allowed one electronic submission during the semester. Electronic submissions must be complete and not missing any details necessary for grading. (If the electronic submission is made late, then it is both the only late paper allowed and the only electronic submission allowed.)

Make-up exams: No make-up exams will be given regardless of reason, unless the student presents, *before* the exam, sufficient justification to the instructor to convince him to make such arrangements. Due to grade reporting time constraints, no make-up final exams will be given.

Everything else: Class policy on drops, withdrawals, academic honesty, grade grievances, and accommodating disabilities follows the University policy on these matters. Copies can be obtained upon request.

Assignments

1. Homework

A set of homework problems will be assigned following discussion of each topic. A preliminary assignment sheet (subject to updating throughout the semester) is included in the tentative calendar at the end of this syllabus. Homework will be collected every Tuesday at the end of class (for sections discussed through the end of the previous class) and returned the following Thursday. Grading will consist of two components: (a) a simple check to see that the problems were completed, and (b) detailed grading of a subset (one or a few) of the assigned problems in each set. Homework may be handwritten but is expected to be legible, *with the work and reasoning clearly communicated.*

2. Project

Throughout the course we will study applications of differential equations as models of real-world systems from many fields. Toward the end of the course each student will complete a project on a topic of interest to the student. Students are allowed to work in groups of up to three, but a paper from multiple students working together should reflect correspondingly greater depth. The point of the project is twofold: first, to allow students to explore a little the areas in which they will later apply differential equations; and second, to demonstrate the ability to use technology and thoughtful exposition to communicate larger ideas than fit within the scope of a single homework or exam problem. This is the context in which differential equations are used in the world outside our classroom. The following outline may help you structure your work.

Choose a topic. The textbook and internet may help provide some ideas here. Some examples include: *Physics and engineering:* spring-weight-dashpot systems, forcing and resonance, friction and resistance, electrical circuits. *Population biology:* predator-prey systems, competition, symbiosis, the spread of an infectious disease. *Other areas:* chemistry, microbiology, even other areas of mathematics. Consult your instructor *outside of class* if you need help.

Develop a model. Although your textbook and the internet are excellent sources of ideas, you should be careful not to copy or plagiarize anyone else's work. If you want to use a model that someone else has developed, you should cite it and then extend either the model or the analysis.

Your model should represent a specific system, using either a system of two or more equations or a single equation of order two or more. The system should exhibit a *bifurcation*, i.e., should exhibit different qualitative behaviors when the value of one or more coefficients changes. You should use generalized parameters (i.e., symbols in place of specific numbers) in formulating your model in order for the behavior of solutions to be dependent on the value of at least one parameter.

Important: Your model *must* be approved by me in writing before you develop your project fully. The approval page (which in most cases will be my handwritten "OK" and initials on your written description) should be appended to your final submission.

The analysis. You do not have to solve the model system outright (indeed, your system should be complex enough to preclude this). Instead, you should identify and illustrate the different possible "behaviors" that solutions exhibit. Explain which parameter(s) you are varying to produce the different results. Perform an equilibrium stability analysis, and use appropriate software to produce a phase portrait and graphs of the solutions vs. time (your independent variable).

Although in some cases you may show computational work, in general the burden of communication lies in the text that provides context and motivation. You are strongly encouraged to use diagrams (properly explained) as one element of your report. Diagrams and equations may be either hand-drawn or typewritten, but the main text should be typewritten.

The report. The final report must contain the following sections, in order: (1) an introduction explaining the topic or real system being modeled, and articulating a question which a mathematical model can help answer; (2) development of the model, giving the system of differential equations and explaining what each term, variable, or parameter represents, and the underlying assumptions; (3) the actual mathematical analysis (see above); (4) a conclusion which interprets the results of the mathematical analysis in the context of the real system being modeled; and (5) a list of all resources (books, articles, web sites, people, software, etc.) consulted in working on this project (the main text should also make clear when and how such resources were used, especially in developing your model, performing computations, generating graphs, etc.). You do not need to cite your instructor.

Single-person reports are likely to be 3–5 pages long.

Afterward: Each student is allowed to submit a revised project write-up for a regrade, under the following terms: Both the revised paper and the graded original (to facilitate regarding) must be turned in together in class on Thursday, April 30. The new grade replaces the original. Students are strongly encouraged to consult with the instructor prior to submitting a revision. *Note: Revisions must be individual, even if the original project involved multiple students.*

3. Exams

There will be two exams during the semester and one final exam during the assigned final exam period. All exams will be closed-book and closed-notes, but students will be allowed to prepare and use a single 5"×7" card with notes written on both sides, as insurance against "mental blanks". No computers or calculators of any kind will be permitted (rather, their use will be assessed through the project). Exams will not be explicitly cumulative in nature, although the nature of the material means that later problems will inevitably draw on mathematical issues covered earlier in the course. All students are expected to have all electronic devices turned off and stored during exams, in order to avoid distracting others.

Calendar

A *tentative* schedule with topics is given below (subject to updating).

Date	Section(s)	Homework assignments
1/20	1.1,2	p.9 #11,19,28,36; p.17 #5,10,17,18,21,26,30
1/22	1.3	3,13,14,15,29,30
1/27	1.4	5,9,12,14,16,23,31,35,37,43,51,52,62
1/29	1.5	3,12,17,18,19,27,31,34,36
2/03	1.6	5,11,14,19,35,36,58,63,65
2/05	2.1	1,11,21,23,24,29,30
2/10	2.2	10,12,20,22,23,29
2/12	2.3,4,6	p.108 #10,19,24; p.121 #6,23,29; p.142 #6,23
2/17	**Exam 1**	
2/19	3.1	2,4,12,16,17,19,23,24,35,40,45
2/24	3.2	5,11,15,24,27,28,29,30,36,37
2/26	3.3	3,7,9,11,17,18,21,24,31,37,39,40,45
3/03	3.4	2,3,15,17,20
3/05	3.5	3,13,14,23,31,35,37,50,52,56
(3/10,	3/12)	*spring break*
3/17	3.6	3,4,10,15,17
3/19	3.7;4.1,2	p.231 #1,2,15; p.255 #1,13,18; p.266 #6,8,9
3/24	5.1	3,4,5,6,7,9,17,23,28,38,42
3/26	5.2	9,14,16,17,18,26,42,49
3/31	5.4	1,5,7,11,15,19,25,27,33
4/02	5.6	1,4,8,10,17,18,30
4/07	**Exam 2**	
4/09	6.1	3,5,7,8,14,16,17,20,24,28,30; *project models due*
4/14	6.2	1,4,7,10,11,19,25,28,31
4/16	6.3	1,3,7,10,11,12,13
4/21	7.1	2,3,8,10,11,13,20,25,28,32
4/23	7.2	1,3,10,16,17,20,21; *projects due!*
4/28	7.3	4,6,15,21,30,34
4/30	8.1	2,6,8,14; *project rewrites due (optional)*
5/05	9.1	1,8,9,11,12,16,22
5/07		catch-up/review
5/14	**Exam 3**	

University Policies

Drop Policy: Students may drop or swap (adding and dropping a class concurrently) classes through self-service in MyMav from the beginning of the registration period through the late registration period. After the late registration period, students must see their academic advisor to drop a class or withdraw. Undeclared students must see an advisor in the University Advising Center. Drops can continue through a point two-thirds of the way through the term or session. It is the student's responsibility to officially withdraw if they do not plan to attend after registering. **Students will not be automatically dropped for non-attendance**. Repayment of certain types of financial aid administered through the University may be required as the result of dropping classes or withdrawing. For more information, contact the Office of Financial Aid and Scholarships (http://wweb.uta.edu/ses/fao).

Americans with Disabilities Act: The University of Texas at Arlington is on record as being committed to both the spirit and letter of all federal equal opportunity legislation, including the *Americans with Disabilities Act (ADA)*. All instructors at UT Arlington are required by law to provide "reasonable accommodations" to students with disabilities, so as not to dis-criminate on the basis of that disability. Any student requiring an accommodation for this course must provide the instructor with official documentation in the form of a letter certified by the staff in the Office for Students with Disabilities, University Hall 102. Only those students who have officially documented a need for an accommodation will have their request honored. Information regarding diagnostic criteria and policies for obtaining disability-based academic accommodations can be found at www.uta.edu/disability or by calling the Office for Students with Disabilities at (817) 272-3364.

Title IX: The University of Texas at Arlington is committed to upholding U.S. Federal Law "Title IX" such that no member of the UT Arlington community shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity. For more information, visit www.uta.edu/titleIX.

Academic Integrity: Students enrolled in this course are expected to adhere to the UT Arlington Honor Code:

> *I pledge, on my honor, to uphold UT Arlington's tradition of academic integrity, a tradition that values hard work and honest effort in the pursuit of academic excellence. I promise that I will submit only work that I personally create or contribute to group collaborations, and I will appropriately reference any work from other sources. I will follow the highest standards of integrity and uphold the spirit of the Honor Code.*

UT Arlington faculty members may employ the Honor Code as they see fit in their courses, including (but not limited to) having students acknowledge the honor code as part of an examination or requiring students to incorporate the honor code into any work submitted. Per UT System *Regents' Rule* 50101, §2.2, suspected violations of university's standards for academic integrity (including the Honor Code) will be referred to the Office of Student Conduct. Violators will be disciplined in accordance with University policy, which may result in the student's suspension or expulsion from the University. *Papers involving plagiarism will receive an indelible grade of zero.*

Electronic Communication: UT Arlington has adopted MavMail as its official means to communicate with students about important deadlines and events, as well as to transact university-related business regarding financial aid, tuition, grades, graduation, etc. All students are assigned a MavMail account and are responsible for checking the inbox regularly. There is no additional charge to students for using this account, which remains active even after graduation. Information about activating and using MavMail is available at http://www.uta.edu/oit/cs/email/mavmail.php.

To obtain your NetID or for logon assistance, visit https://webapps.uta.edu/oit/selfservice/. If you are unable to resolve your issue from the Self-Service website, contact the Helpdesk at helpdesk@uta.edu or (817)272-2208.

Student Feedback Survey: At the end of each term, students enrolled in classes categorized as lecture, seminar, or laboratory will be asked to complete an online Student Feedback Survey (SFS) about the course and how it was taught. Instructions on how to access the SFS system will be sent directly to students through MavMail approximately 10 days before the end of the term. UT Arlington's effort to solicit, gather, tabulate, and publish student feedback data is required by state law; student participation in the SFS program is voluntary.

Final Review Week: A period of five class days prior to the first day of final examinations in the long sessions shall be designated as Final Review Week. The purpose of this week is to allow students sufficient time to prepare for final examinations. During this week, there shall be no scheduled activities such as required field trips or performances; and no instructor shall assign any themes, research problems or exercises of similar scope that have a completion date during or following this week *unless specified in the class syllabus*. During Final Review Week, an instructor shall not give any examinations constituting 10% or more of the final grade, except makeup tests and laboratory examinations. In addition, no instructor shall give any portion of the final examination during Final Review Week. During this week, classes are held as scheduled. In addition, instructors are not required to limit content to topics that have been previously covered; they may introduce new concepts as appropriate.

Grade Grievances: Any appeal of a grade in this course must follow the procedures and deadlines for grade-related grievances as published in the current graduate catalog.

Emergency Exit Procedures: Should we experience an emergency event that requires us to vacate the building, students should exit the room and move toward the nearest exit. When exiting the building during an emergency, one should never take an elevator but should use the stairwells. Faculty members and instructional staff will assist students in selecting the safest route for evacuation and make arrangements to assist handicapped individuals.

Student Support Services: UTA provides a variety of resources and programs designed to help students develop academic skills, deal with personal situations, and better understand concepts and information related to their courses. Resources include tutoring, major-based learning centers, developmental education, advising and mentoring, personal counseling, and federally funded programs. For individualized referrals, students may contact the Maverick Resource Hotline by calling 817-272-6107, sending a message to resources@uta.edu, or visiting www.uta.edu/resources.