MATH 221H: Honors Differential Equations
UNL, Fall 2015, Section: 001, CRN: 3578
Lecture: T, R, 9:30 am-10:45 am, Avery Hall 118

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Prerequisites: A grade of "P" or "C" or better in MATH 106, MATH 107, and MATH 208 (or 208H), and good standing in the University Honors Program (or invitation). You are expected to know differentiation and integration techniques and to be familiar with vector fields and parameterized curves.

Textbook: Fundamentals of Differential Equations, 6$^{\text{th}}$ Edition, by Nagle, Saff, and Snider.

ACE Outcome 3: "Use mathematical, computational, statistical, or formal reasoning (including reasoning based on principles of logic) to solve problems, draw inferences, and determine reasonableness." Your instructor will provide examples, you will discuss them in class, and you will practice with numerous homework problems. The exams will test how well you've mastered the material. The final exam will be the primary means of assessing your achievement of ACE Outcome 3.

Contacting me: The best way to contact with me is by email, alarios@unl.edu. Please put [MATH 221H] somewhere in the title and make sure to include your whole name in your email. Polite, courteous emails are appreciated; see my website for tips on email etiquette. My office is in Avery Hall, room 305, and my office hours are M,W,F, 12:30 pm - 1:20 pm. Drop-ins are welcome during these times. If you want to meet me at a different time, please email me in advance, and we will try to schedule a time to meet.

NOTE: Because of privacy rights, **I cannot discuss grades over email or telephone. Please do not email me asking about your grade. I will not be able to give you any information.** Of course, I am happy to discuss grades in my office.

Description: First and second-order methods for ordinary differential equations including: linear, separable, Laplace transforms, linear systems, and some applications.

Motivation: Differential equations lie at the heart of an extremely large number of natural phenomena. Our understanding of these equations and their solutions has yielded a massive amount of progress for the human race. Furthermore, the unsolved problems are enormously varied, rich, and challenging. Research in differential equations is found at the cutting edge of nearly every discipline in science and mathematics, and progress often requires cutting-edge mathematical tools and extreme computational power.

In this course, we will start at the beginning, and focus on the most basic differential equations, known as "ordinary differential equations" (ODEs). Even at this level, the equations involved are incredibly useful in modeling nature, and will require us to develop sophisticated and beautiful mathematics to handle them.

Homework: Homework is designed to help students understand the material and to prepare them for exams. The suggested exercises represent a minimal assignment. Some students may have to work additional exercises from the text to attain sufficient mastery of the material.

Reading & Exercises: You are expected to read the appropriate sections of the text **before** coming tothe class meeting in which the topic is scheduled. You are also expected to work through the indicated exercises after the corresponding material is presented in class, and **before** the next class meeting.

Scheduling: A tentative schedule of assignments and exams is included in this syllabus. These details are presented as a guide. Your instructor may change the dates for each assignment and/or exam, modify the exercise list, and/or add assignments. It is your responsibility to keep track of the course details and schedule for your section.

Collaboration: Collaboration is encouraged in this course. However, copying someone else's work and submitting it as your own is unacceptable. This act of academic dishonesty will be prosecuted in accordance with university policy.

Electronics: You are not allowed to have on your person during exams or quizzes any device that can access the internet or communicate in any way. Cell phones, Apple watches, etc. should be put away in backpacks/purses. Calculators, laptops, tablets, cell phones, and other non-medical electronic devices are not permitted during exams unless otherwise stated. During class, cell phones should be set on vibrate or off. If you need to take a call, send a text message, etc., please quietly leave the classroom to do so, so that you do not distract other students. You are welcome to return to class quietly when you are finished. If you wish to take notes using an electronic device, you must first demonstrate to me that you can type or write fast enough to do so properly, and that you can do it without distracting others, before the privilege to use such devices may be granted. If you are found to be abusing this privilege, you risk forfeiting it.

Grading: Your minimal course grade will be computed as follows.

Homework:	15%	A	90%	–	100%
Midterms:	$2 \times 25\% = 50\%$	B	80%	–	89.99%
Final Exam:	30%	C	70%	–	79.99%
Project:	5%	D	60%	–	69.99%
Total:	100%	F	0%	–	59.99%

Attendance: Daily attendance for class lectures is expected and is extremely important. While attendance is not recorded, missing even one class will put you behind. Note that there is a strong correlation between class absences and poor grades. You are responsible for all material and announcements in class regardless of whether or not you attended. **You are also responsible for making arrangements with another classmate to find out what you missed. You should not ask me to go over material you missed (due to tardiness or absences) during office hours or over email.**

Make-up exams: Make-up exams will only be given with written evidence of an official university excused absence.

Incompletes: A grade of "incomplete" may be considered if all but a small portion of the class has been successfully completed , but the student in question is prevented from completing the course by a severe, unexpected, and documented event. Students who are simply behind in their work should consider dropping the course.

Programming: This course contains a gentle introduction to scientific computing with Matlab. Matlab is one of the most widely-used programming languages in science, mathematics, and engineering, and can be a very strong asset to future scientific work. **No previous programming experience is assumed.** Student are assumed to be able to have

basic computer skills, such as using a mouse, keyboard, etc., and be able to download and install programs and navigate websites. Basic programming in Matlab will be taught in class on designated days. Programming assignments and/or projects will be announced in class.

ADA Statement: Students with disabilities are encouraged to contact the instructor for a confidential discussion of their individual needs for academic accommodation. It is the policy of the University of Nebraska-Lincoln to provide flexible and individualized accommodation to students with documented disabilities that may affect their ability to fully participate in course activities or to meet course requirements. To receive accommodation services, students must be registered with the **Services for Students with Disabilities (SSD) office**, 132 Canfield Administration, 472-3787 voice or TTY.

Grade Questions: Any questions regarding grading/scoring of homework, exams, or projects must be made within two class days from when they were handed back, or no change in grade will be made.
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Special Dates:

Sept. 4, 2015 (Friday):	Last day to withdraw from this course and not have it appear on your transcript.
Oct 16, 2015 (Friday):	Last day to change your grade option to or from Pass/No Pass.
Nov. 13, 2015 (Friday):	Last day to drop this course and receive a grade of W. (No permission required.) After this date, you cannot drop.

Departmental Grading Appeals Policy: Students who believe their academic evaluation has been prejudiced or capricious have recourse for appeals to (in order) the instructor, the departmental chair, the departmental appeals committee, and the college appeals committee.

Final Exam Policy: Students are expected to arrange their personal and work schedule to allow them to take the final exam at the scheduled time. No student will be permitted to take the final exam early. The final exam for this course is:
Wednesday, December 16, 2015, 10:00 am-12:00 pm (same classroom).

Disclaimer: While this syllabus was prepared carefully and according to information available at the beginning of the semester, changes may be necessary in the interest of good teaching. Changes to any of the information above will be announced in class and posted on the class web site. This includes in particular possible updates or corrections to the syllabus, and changes of exam dates.

Rough schedule: The following tentative schedule is a rough guide to the material covered in the course, but is subject to change. **Updates and changes to the content will be announced in class or on the course website.**

	DATES	SECTIONS	SUGGESTED EXERCISES
1	Aug 24 - 28	1.1 – Background	p5: 1-10, 13, 15, 16
		1.2 – Solutions and Initial Value Problems	p13: 1, 3, 5, 9, 11, 20
		1.3 – Direction Fields	p21: 1, 3, 5
		Tuesday September 1 – Programming Day: Bring Laptop With Matlab Installed	
2	Aug 31 - Sep 4	1.4 – The Approximation Method of Euler	p28: 1, 3, 5, 7
		2.1 – Introduction: Motion of a Falling Body	Read the section
		2.2 – Separable Equations	p43: 2, 3, 4, 7, 9, 13, 16, 18, 23, 37, 38
		Friday, September 4: last day drop and remove course from transcript	
		Labor Day is on Monday, September 7 (Does not affect this course)	
3	Sep 8 - 11	2.3 – Linear Equations (integrating factors)	p51: 2, 4, 5, 10, 13, 17, 18, 22, 23, 35
		2.6 – Substitutions and Transformations	p68: 1–8, 9, 11
		3.1 – Mathematical Modeling	Read the section
		3.2 – Compartmental Analysis	p99: 1, 3, 5, 7, 9, 14
4	Sep 14 - 18	3.3 – Heating and Cooling of Buildings	p107: 1, 3, 5, 7, 8
		3.4 – Newtionian Mechanics	p114: 1, 2, 7, 8
		3.5 – Electrical Circuits	p121: 1, 2, 5
		Thursday September 17 – Programming Day: Bring Laptop With Matlab Installed	
		3.6 – Improved Euler's Method	p129: 3, 7, 9, 15, 17 (Use Matlab)
		3.7 – Runge-Kutta Methods	p139: 7, 9, 13 (Use Matlab)
5	Sep 21 - 25	**Review**	Bring Questions
		EXAM 1	Thursday September 24
6	Sep 28 - Oct 2	9.1 – Introduction to linear systems	p502: 1, 3, 4, 11, 12
		9.2 – Linear Algebraic Equations	p506: 5, 7, 9
		9.3 – Matrices and Vectors	p515: 1, 3, 4, 21, 24, 25, 27, 29
		Tuesday October 6 – Programming Day: Bring Laptop With Matlab Installed	
7	Oct 5 - 9	5.4 – Introduction to the Phase Plane	p272: 1, 3, 5, 27 (use pplane8.m)
		9.5 – Hom. Lin. Syst. with Constant Coefficients	p534: 1, 2, 3, 6, 7, 9, 11-14, 31, 33, 49
		9.6 – Complex Eigenvalues	p541: 1-4, 13(a)
		12.2 – Linear Systems in the Plane	p733: 1, 3, 4, 5, 7, 8, 9, 10, 11, 13, 15
		12.3 – Almost Linear Systems	p743: 1, 3, 4, 7, 13, 14, 15
8	Oct 12 - 16	4.1 – Introduction to Second Order Equations	p157: 1, 3, 5
		4.2 – Homogeneous Linear Equations: The General Solution	p165: 1-6, 13-16, 28-32
		4.3 – Auxiliary Equations with Complex Roots	p173: 2, 3, 4, 5, 9, 13, 14, 23, 26
		4.4 – Nonhomogeneous Equations: Undetermined Coefficients	p182: 1-5, 9-15(odd), 27, 29
		4.5 – Superposition	p187: 3, 5, 7, 13-19(odd), 33, 34, 36
		Fall Semester Break, No Class on Monday and Tuesday, October 19 & 20	
9	Oct 21 - 23	6.3 – The Annihilator Method	p337: 1, 3, 7, 9, 32
		4.6 – Variation of Parameters	p193: 1-4, 7, 9, 12, 16
10	Oct 26 - 30	**Review**	Bring Questions
		EXAM 2	Tuesday October 27
11	Nov 2 - 6	4.9 – A Closer Look At Free Mechanical Vibrations	p202: 45, 47, 48; p222: 3, 5, 7
		Thursday November 5 – Programming Day: Bring Laptop With Matlab Installed	
		4.10 – A Closer Look At Forced Mechanical Vibrations	p230: 1, 3, 8, 9, 11
		7.1 – Introduction to Laplace Transforms	Read the section
12	Nov 9 - 13	7.2 – Definition of the Laplace Transform	p360: 3, 7, 8, 9, 12, 13, 15, 17, 19
		7.3 – Properties of the Laplace Transform	p365: 3, 5, 7, 9, 13, 25
		7.4 – Inverse Laplace Transforms	p374: 1-10, 21, 23, 25, 27, 30
		Friday, November 13, last day to withdraw from one or more courses for the term.	
13	Nov 16 - 22	7.5 – Solving Initial Value Problems	p382: 1-9(odd), 10, 11, 13, 17, 19
		7.6 – Transforms of Discontinuous Functions	p393: 1-7(odd), 8, 9, 13-19(odd), 20
14	Nov 23 - 29	7.7 – Convolution	p403: 1, 3, 5, 7, 13, 15, 17
		Thanksgiving Holiday, No Class Wednesday - Friday, November 25 - 27	
15	Nov 30 - Dec 4	7.8 – Impulses and the Dirac Delta Function	p410: 1-9(odd), 13, 15, 21, 23, 29
		Review	Bring Questions
16	Dec 7 - Dec 11	**Catch-up & Overview/Review**	
		Review	Bring Questions
		Review	Bring Questions