MATH 528 - Summer Session I 2021
Methods for the Physical Sciences I

Instructor: Dylan Bruney
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Office Hours: Tuesday 8:40-9:40, Thursday 11:30-12:30

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Office Hours: Tues & Thurs 2:00-2:30pm

Website: https://tarheels.live/bruney/math528/

Course Meets: M-F 9:45-11:15 am — Zoom: https://unc.zoom.us/j/4215882243

Text: E. Kreyszig, *Advanced Engineering Mathematics*, Tenth Edition.

Prerequisites: MATH 383 (Differential Equations)

Grades:
Homework = 50%
Two Midterm Exams = 20% (10% each)
Cumulative Final Exam = 30%
Optional Course Project = Up to 5% extra credit

Homework Policy: Each lesson will have 1 short corresponding homework assignment that will be due 2.5 business days after the lesson finishes (ie. homework from Wednesday's lecture will be due Friday night by 11:59pm, homework from Thursday's lecture will be due Monday night by 11:59pm, homework from Friday's lecture will be due by Tuesday night by 11:59pm) All homeworks will be posted 3 class periods in advance. Assignments will be posted on Gradescope. Late homework will NOT be accepted. The two homeworks with the lowest grade will be dropped. Exceptions are made for extraordinary circumstances, just email me but be reasonable. Collaboration on homework is allowed and encouraged; however, each student must submit an individual assignment.

Gradescope Entry Code:**3Y6PYX**

Exam Policy: There will be 2 in-class midterm exams, and 1 final exam. *No make-up examinations will be given.* If you have an excused absence from one midterm exam then you will be given the score that you earn on the final exam. The tests will be open book, and may involve calculators or computer applications (will be specified on the problem).

Optional Course Project: For up to 5% added to your overall course grade, you may submit a short report (no more than 5 pages) discussing any application of differential equations in a physical system that you find interesting. The topic or model does not need to be excessively complex. This can be an original topic, or a review of an existing application. To receive credit, the topic must first be approved by the course instructor via email. A digital copy of the report should be submitted to the course instructor by June 21 at 11:59 pm. Points will be awarded based

on the technical discussion as well as overall creativity. Be sure to appropriately cite any references. Topics can include (but are not exclusive to) specific applications to: aerodynamics and fluid flow, astrophysics, biological system models, chemical reactions, classical mechanics, ecosystem models, epidemiology, sports, and transportation.

Attendance: Students are expected to attend ALL lectures and take both midterm exams and the final exam. **Students should come prepared to lectures. This means that you should have read over the textbook material to be covered prior to class.**

Computational lab: There is a numerical lab section, MATH 528L (MWF 11:30 – 1:00 pm), attached to this course. You are strongly encouraged to take it. Some of the homeworks could turn out to be numerical assignments and can be worked on in 528L.

Important Dates:

Midterm 1: Friday, June 4 (in class hours)
Midterm 2: Thursday, June 17 (in class hours)
Optional course project due: Last day of class June 22 at 11:59pm
Final exam: TBA

Course Topics:

- Overview of Ordinary Differential Equations (Ch. 1, 2)
- Introduction to Numerical Methods for ODEs (Ch. 21.1)
- Linear and Nonlinear Systems of ODEs (Ch. 4)
- Laplace Transform Methods (Ch. 6)
- Series Solutions and Special Functions (Ch. 5)
- Fourier Analysis (Ch. 11)
- Partial Differential Equations (Ch. 12)

Honor System: It is expected that each student in this class will conduct themself within the guidelines of the Honor System. All academic work should be done with the complete honesty and integrity that this University demands. In this regard, you may work with others on the homework, but the written work you turn in must be your own.

Schedule

This semester's schedule includes 21 lectures, 2 in-class midterms, and 1 holiday.

Lesson	Day	Date		Topic	Textbook
1.	W	May	19	Introduction, First-order ODEs	1.1, 1.2, 1.3
2.	Th	May	20	Numerical methods for first-order ODEs	21.1
3.	F	May	21	Second-order ODEs	2.1, 2.2, 2.6
4.	M	May	24	Applications of 2nd-order ODEs w/ constant coeffs	2.4, 2.9
5.	T	May	25	Non-homogeneous linear 2nd-order ODEs, resonance	2.10, 2.7, 2.8
6.	W	May	26	Systems of differential equations	4..0-4.2
7.	Th	May	27	Constant coefficient systems	4.3
8.	F	May	28	Phase plane	4.3, 4.4
	M	May	31	HOLIDAY	
9.	T	Jun	1	Nonlinear autonomous systems & equilibrium solns	4.5
10.	W	Jun	2	Laplace transform for initial value problems	6.1, 6.2
11.	Th	Jun	3	Laplace transform of special functions and operators	6.3, 6.4, 6.5
	F	Jun	4	**Test 1 - Covers L1-L9 (included)**	
12.	M	Jun	7	Laplace transform for systems of ODEs	6.6, 6.7
13.	T	Jun	8	Power series methods, regular and singular points	5.1, 5.2
14.	W	Jun	9	Method of Frobenius	5.3
15.	Th	Jun	10	Bessel's equation	5.4
16.	F	Jun	11	Fourier series introduction	11.1, 11.2, 11.3
17.	M	Jun	14	Sturm-Liouville problems (Generalized Fourier series)	11.5, 11.6
18.	T	Jun	15	Fourier Integral and Transform	11.7, 11.8
19.	W	Jun	16	Solving PDEs with Fourier Transform	11.9
	Th	Jun	17	**Test 2 - Covers L10-L16 (included)**	
20.	F	Jun	18	Discrete Fourier Transform and FFT	11.9
21.	M	Jun	21	TBD	TBD
22.	T	Jun	22	**Reading Day**	

Note: This schedule may be subject to change.