MA 501-601 - Advanced Mathematics for Engineers and Scientists I   **Summer 2025**
Instructor: Luke Castle (he/him/his)
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Office Hours: Thursdays 12:00 - 1:00 PM, Tuesdays 6:00 - 7:00 PM, or by appointment. Office hours will be conducted via Zoom.

Prerequisites: MA 341 or equivalent. This class does not satisfy a GEP requirement.

Learning Outcomes: After completing this course the student should be able to use mathematical methods that arise in engineering problems. In particular, the student will be able to:

- Solve a variety of ordinary differential equations using different techniques, including power series solutions, method of Frobenius, Fourier series solutions, Fourier integral solutions, and Sturm-Liouville theory).

- Solve a variety of partial differential equations, including boundary value problems, initial value problems, and initial boundary value problems - primarily in the context of the heat, wave, Laplace, Poisson, and transport equations.

- Identify specific types of equations and decide on appropriate mathematical methods needed to solve said equations.

- Use various mathematical ideas and results to analyze certain physical problems.

Text (Optional): *Advanced Engineering Mathematics*, 7th or 8th Edition - O'Neil, Peter V., Thompson Books/Cole. ISBN-13: 978-1-111-42741-2 (recommended for additional practice problems; however, I intend for the course to be self-contained and the notes to be sufficient for understanding of the materials).

There is a table on our course Moodle page that maps sections of the textbook to the most closely related lecture video (for each edition).

Other Materials: There are no other outside materials needed for this course. Familiarity with Maple, Mathematica, and/or MATLAB is recommended. Students can access this software for free through the Virtual Computing Lab if you have a high speed Internet connection. Simply make a reservation, and when a machine becomes available, you can remote access the machine and use the mathematical software (or whatever programs you requested). Using Maple or MATLAB is not required for this course; some students use Excel, Wolfram Alpha, Desmos, or even photos of graphing calculators to visualize solutions.

Course Objectives: Survey of mathematical methods for engineers and scientists. Ordinary differential equations and Green's functions; partial differential equations and separation of variables; special functions, Fourier series. Applications to engineering and science. Credit for this course and MA 401 is not allowed.

Course Structure: This course consists of

- Lecture Videos: course videos should be viewed according to the schedule posted on the Moodle page. For your convenience, links to videos will be posted roughly one week ahead of the current date will be posted on the course Moodle page.

All questions regarding lecture video content should be directed to me. Since the videos for this distance course were recorded in a studio (and not in front of a live student audience), there may be occasional errors in the notes. Please alert me to any errors missed in the editing process so that I can correct them ASAP. Furthermore, I am in the process of rewriting the materials for this course, and typos/errors/etc. that have not already been noted in the given eratta will help to further improve the future iterations of this course!

- Homework: The main purpose of homework is practicing individual methods through problem solving. Unless otherwise stated, homework assignments will generally be due at 11:59 PM EST on Tuesdays.

- Piazza Forum: I encourage you to use Piazza to discuss the mathematics of the course, including homework and review problems. Take advantage of this feature, as you may get help quickly from fellow students even if I am not immediately available for help. Some guidelines to note:

  - You may post to the class anonymously or under your name. Regardless of how you post, I will have access to your name.
  - Ask for help, not answers. Talk about what you tried, where you are stuck, and what you think needs to happen. Paint a clear picture so that others can address issues specific to your problem-solving process.
  - Answer other students' questions. Push your peers to discover the answer for themselves by offering helpful hints and asking pointed questions.
  - While I encourage to help each other on homework problems, all homework is to be written up and submitted individually. When you turn in an assignment, you are telling me that the solutions provided are your own work, written in your words based on your understanding of the materials. Any marked similarity between submitted assignments will be treated as evidence of academic dishonesty.

  There will be a link to Piazza on our course Moodle page.

Course Schedule: The weekly course schedule is available via Moodle. All changes to the course schedule will be announced on Moodle and sent out via email.

Course Topics: A firm understanding of pre-requisite topics (trigonometry, sums, calculus, integration, ordinary differential equations, etc.) is expected and necessary for success in this MA 501 course. The following is a tentative outline of the lecture videos for our course:

- **Unit 1** - Review of Differential Equations   2 lectures

- **Unit 2** - Power Series Solutions of Differential Equations   4 lectures

- **Unit 3** - Fourier Analysis   9 lectures

- **Unit 4** - Sturm-Liouville Theory   3 lectures

- **Unit 5** - Partial Differential Equations in Rectangular Coordinates   9 lectures

- **Unit 6** - Partial Differential Equations in Other Coordinate Systems   3 lectures

- **Unit 7** - Additiontional PDE Topics   5 lectures

Course Grade: Final grades will be based on two in-class exams, 9 homework assignments, and a final exam.

Grade Item	Weight
Homework	35%
Exams	$2 \times 20\%$
Final	25%

Final letter grades will be determined as follows: 97-100 = A+; 93-96 = A; 90-92 = A-; 87-89 = B+; 83-86 = B; 80-82 = B-; 77-79 = C+ ; 73-76 = C; 70-72 = C-; 67-69 = D+; 63-66 = D; 60-62 = D-; 0-59 = F.

Homework: Below is a tentative schedule for homework deadlines. Due dates are subject to change, and you will be notified well in advance of shifts in deadlines. Unless stated otherwise, homework is always due by 11:59 PM on the Tuesday following its assignment. I will drop your lowest homework, computing your average out of the top 8 scores.

Homework Set	Due Date	Material	Homework Set	Due Date	Material
HW 1	5/20	1.1-1.2	HW 6	7/1	4.3, 5.1-5.4
HW 2	5/28	2.1-2.4	HW 7	7/8	5.5-5.7
HW 3	6/3	3.1-3.3	HW 8	7/15	5.8-5.9, 6.1-6.2
HW 4	6/11	3.4-3.7	HW 9	7/25	6.3, 7.1-7.5
HW 5	6/24	3.8-3.9, 4.1-4.2			

Please stay up-to-date on emails and Moodle - these are the avenues I will use to remind you of deadlines and to inform you of changes to the schedule.

Late Work: Given that many of us are in different time zones/working professionals/etc., I am willing to be flexible when it comes to homework deadlines provided you speak to me in advance (and you do not abuse this privilege). As long as the request is reasonable, I will gladly grant an extension. This is completely at my discretion, and I reserve the right to refuse an extension if I feel it unnecessary given the circumstances.

Exams: There are two exams, both of which will be posted to Moodle through the Gradescope platform. Exams will effectively be open-book, open-notes; however, they will will be timed experiences. As with the homework, when you submit an exam, you confirm that it is your own work based on your understanding. Submissions will be scrutinized, and marked similarities between exam submissions will be treated as evidence of academic dishonesty. You may not use answer sites (Chegg, Bartleby, etc.), other humans, nor AI chatbots on exams.

- **Exam 1 (Units 1-3)**: Available via Moodle Friday, June 13 - Saturday, June 14 as a 90 minute timed test.

- **Exam 2 (Units 4-6)**: Available via Moodle Friday, July 18 - Saturday, July 19 as a 90 minute timed test.

- **Final Exam (Units 1-7)**: Available via Moodle Monday, July 29 - Tuesday, July 30 as a 150 minute timed test.

Each exam will become available at 8:00 AM (EST) on the first designated day and close at 11:59 PM (EST) on the following evening.

Prior notice is **preferred** if an exam cannot be taken on the required date. Make-up policy for missing a test: (1) Reasonable notice for anticipated absences (preferably 1 week in advance) is preferred. (2) Emergency absences must be reported as soon as possible. That said - in cases of emergency, our class should be the lowest priority. Take care of yourself, family, etc. first and foremost. I will not require you to complete a missing exam until you feel able (within reason). (3) If the absence is excused, coordination will be necessary between you and the instructor to arrange an appropriate alternative testing window. (4) Make-ups due to oversleeping, car trouble, or any other excuse not approved by the University will be subject to instructor discretion and availability.

Attendance: As this course is a distance course, no attendance is taken. Since this is an asynchronous course, you are responsible for watching lecture videos, submitting homework on time, completing exams during on the designated exam days, and communicating with me via email/office hours/etc. Plan accordingly!

Academic Integrity: All students are expected to adhere to the university's regulations on academic integrity (i.e. no cheating or plagiarizing). See http://policies.ncsu.edu/policy/pol-11-35-01 for a detailed explanation of academic honesty.

- **Exams & Final**: Students will neither give nor receive any assistance on any exam or the final. Students may homework questions on Piazza.

- **Homework**: You are allowed to work together on homework assignments; however, each student must turn in their own work.

- **Utilization of the Honor Pledge**: All exams and tests must be completed independent of assistance from other people/chatbots/etc. Implicit in any submission is the pledge that "I have neither given nor received unauthorized aid on this test or assignment."

- **Penalty for violations**: Any violation of this policy will be reported to the Office of Student Conduct with a recommendation of a failing grade for the assignment and/or course.

Accommodations for Disabilities: Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, student must register with the Disability Services Office (DSO) (http://www.ncsu.edu/dso), 919-515-7653. Students must have the DSO send the instructor a letter verifying their disability and listing the reasonable accommodations. This must be done before the first test day that the student wishes accommodations to be observed. For more information on NC State's policy on working with students with disabilities, please see the Academic Accommodations for Students with Disabilities Regulation at http://policies.ncsu.edu/regulation/reg-02-20-01.

Privacy or Accessibility: Instructor is not responsible for ensuring privacy or accessibility of electronic materials that are not required components of the course (e.g., links to supplemental information that is not part of the required reading list).

Required Statement: "Students may be required to disclose personally identifiable information to other students in the course, via electronic tools like email or web-postings, where relevant to the course. Examples include online discussions of class topics, and posting of student coursework. All students are expected to respect the privacy of each other by not sharing or using such information outside the course."

Your Rights and Responsibilities: Students are responsible for reviewing the NC State University PRR's which pertains to their course rights and responsibilities:

- Code of Student Conduct   https://policies.ncsu.edu/policy/pol-11-35-01/

- Grades and Grade Point Average   https://policies.ncsu.edu/regulation/reg-02-50-03/

- Credit-Only Courses   https://policies.ncsu.edu/regulation/reg-02-20-15/

- Audits   https://policies.ncsu.edu/regulation/reg-02-20-04/

Electronically Hosted Course Components: The course site for the class is hosted on Moodle, which includes the weekly quizzes. The course forum is hosted by Piazza. You must address the accessibility of this website for you during the course drop/add period.

Copyrighted Materials: The course website contains copyrighted materials and was developed for instructional purposes to be used by students at North Carolina State University. Students currently registered in this course are permitted to print or make copies of parts of this site for their own personal use in conjunction with completing the course. Text, audio files, images or design of this website may not otherwise be distributed or modified in any manner without the prior written permission of the instructor.