

## MA-240-B: Ordinary and Partial Differential Equations - Spring 2024 Syllabus

Department of Mathematics, Albert Nerken School of Engineering

The Cooper Union for the Advancement of Science and Art

<b>Instructor</b>	Robert Smyth, Professor, Mathematics. See <a href="http://faculty.cooper.edu/smyth">faculty.cooper.edu/smyth</a> for office hours and contact information.
<b>Class Hours</b>	Tuesdays 6-8:50 PM (Room 503)
<b>Catalog Description</b>	Ordinary differential equations of the first order. Linear equations of higher order with constant coefficients. Power series solutions. Laplace transformation. Fourier series. Partial differential equations: method of separation of variables, applications to vibration and heat flow. <i>3 credits. Prerequisite: Ma113</i>
<b>Textbook</b>	Dennis G. Zill, Warren S. Wright, and Michael R. Cullen, <i>Differential Equations (with Boundary Value Problems)</i> , 8 <sup>th</sup> edition, Brooks/Cole Publishing Co., 2013, ISBN13: 978-1-111-82706-9.
<b>Learning Objectives</b>	<ol style="list-style-type: none"><li>1. Learn to apply the basic existence and uniqueness theorems to initial value problems.</li><li>2. Implement analytical methods to determine exact solutions to broad classes of ordinary differential equations including separable first order equations, linear equations, and exact equations.</li><li>3. Use appropriate computing technology to produce and plot approximate solutions by numerical methods to differential equations which are not amenable to exact analytical methods.</li><li>4. Apply Laplace transforms to solve differential equations with discontinuous terms.</li><li>5. Solve classical PDE boundary value problems with Fourier series and the method of separation of variables.</li></ol>
<b>Course Topics</b>	<ol style="list-style-type: none"><li>1. Basic definitions and terminology (1.1). Initial-value problems (1.2).</li><li>2. Solution curves without a solution (2.1). Separable first-order equations (2.2). Linear first-order equations (2.3).</li><li>3. More on linear first-order equations (2.3). Exact first-order equations (2.4). Solution by substitution (2.5). Euler's method (2.6).</li><li>4. Linear and nonlinear models (3.1 &amp; 3.2). Introduction to higher-order equations; boundary value vs. initial value problems (4.1).</li><li>5. Basic theory of linear differential equations: homogeneous/non-homogeneous (4.1). The special case of constant coefficients (4.3).</li><li>6. Reduction of order (4.2) and examples of application (one such, to constant coefficient equations (4.3)). Method of undetermined coefficients by superposition (4.4).</li><li>7. Variation of parameters (4.6). Linear oscillation models (5.1). Special second order boundary value problems (5.2).</li><li>8. Power series method (6.1). Series solutions about ordinary points (6.2). Introduction to Laplace transform formalism (7.1).</li><li>9. Inverse transform of derivatives and solution to initial value problems (7.2). Operational properties I (7.3).</li><li>10. Operational properties II (7.4). Impulsive forcing and Dirac Delta formalism (7.5).</li></ol>

- Introduction to inner product structure and orthogonal functions (11.1).  
11. More on orthogonal functions (11.1). Fourier series (11.2). Fourier sine and cosine series (11.3).  
12. Separable partial differential equations; technique of separation of variables (12.1).  
13. Classical PDEs and boundary-value problems (12.2). Heat equation (12.3).  
14. Wave equation (12.4). Laplace's equation (12.5).

**Tutoring** Tutoring is available for this course both through the Math Help Room (Rm 409: M 12-1pm, W 7-8pm, Th 7-8pm), and via individual tutoring. Click [here](#) for current scheduling information for one-on-one tutoring.

**Assessment** Your term grade will be determined by homework (6%), two midterms (30% each), and one cumulative final exam (34%). Homework problems and due dates are listed online at [faculty.cooper.edu/smyth/ma240/hw.htm](http://faculty.cooper.edu/smyth/ma240/hw.htm). The exams will test your familiarity with the principles of the subject with routine problems and your ability to extrapolate creatively from these principles on challenging problems. See the section on **Grades of Record** at [cooper.edu/engineering/curriculum/academic-standards-regulations](http://faculty.cooper.edu/engineering/curriculum/academic-standards-regulations) for the letter grades used for this course and their proper interpretation. The exam schedule is available at <http://faculty.cooper.edu/smyth/ma240/ma240.htm>.

**Homework Policies** You may work individually or in groups of at most three students. A group must make a single joint submission with all team members listed at the top of the front page. In the case of a group submission all members will receive the same grade for the assignment. You should make sure you understand all the solutions your team is submitting, even if other team members came up with them. Any assistance you (or your group) receives and all sources you use in preparing your homework assignments must be properly credited in writing on your submission. Groups may be re-formed on an assignment-by-assignment basis. Homework assignments must be submitted at the beginning of the class period on the assignment due date. Each assignment includes all problems from the list at [faculty.cooper.edu/smyth/ma240/hw.htm](http://faculty.cooper.edu/smyth/ma240/hw.htm) not previously submitted up to and including those pertaining to the last section completed during the last class meeting prior to the assignment due date. Credit will not be awarded for late submissions. However your lowest homework grade will be dropped.

**Exam Policies** Exams are closed book / closed notebook exams. You may use a basic scientific calculator, but no graphing or programmable calculators, computers, cellphones, books, notebooks, or other resources may be used. Bring a pencil or pen on the day of the exam. Adequate paper will be provided. You may not use your own paper. No pages, including extra pages for scratchwork, should be removed from a stapled exam packet. Exams are timed. Your score may be reduced if you do not stop working on your exam after time has been called. If you choose to leave the exam room during the exam period you will not be permitted to resume working on the exam after returning. Registered students must sit for the course examinations on the scheduled day and time. Failure to do so will generally result in forfeiture of the percentage credit allotted to the missed exam. Students who have medical excuses for missing an exam should contact the Dean of Students promptly. Failure to register a request for a medically excused absence in a timely manner with the Dean of Students may complicate and

potentially invalidate the request. Any student requesting a medically excused absence must provide the Dean of Students with documentation from a medical provider justifying the absence. The Dean of Students will inform me when an absence is due to a valid medical issue/condition so that the absence can be considered excused. In the event of an excused absence, the student must schedule an oral makeup exam with me as soon as is possible.

## **ADA**

### **Accommodations**

If you believe you are entitled to an accommodation through the Americans with Disabilities Act you must self-identify to the Office of the Dean of Students, and meet with me during the first or second week of the term to discuss arrangements for meeting your accommodation. Cooper Union has limited resources and extra time may be required for accommodation arrangement to be feasible. If you are entitled to an accommodation on exams, you must confirm exam accommodation arrangements with me (in writing via email) two weeks prior to *each* exam. Please detail any scheduling constraints in your accommodation arrangement confirmation emails. Students will not be afforded any special accommodations retroactively, i.e., for academic work completed prior to disclosure of the disability to me. Support services for students are described [here](#).