Math 305, Spring 2018
AN INTRODUCTION TO PARTIAL DIFFERENTIAL EQUATIONS WITH APPLICATIONS TO PHYSICS

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Office Hours:

Tuesdays 1:50-5:00 (Except for the first Tuesday of each month when there is a faculty meeting. On those Tuesdays office hours will be 1:50-3:30.)

Wednesdays 2:40-5:00

Thursdays 1:50-3:20

Mondays & Fridays by appointment

Reference: *An introduction to partial differential equations with applications to physics* course notes by Paul Allen, with some edits by myself. These will be posted online in chapters as we move along in the course.

Course Description: A standing wave on a vibrating string has a specific frequency of oscillation. The pitch of the string corresponds to the standing wave (b) in Figure 1 with no fixed nodes on the interior of the string. Overtones (c) and (d) have increasingly high frequencies and an increasing number of nodes. The infinite list of functions that describe the standing waves of the string form an infinite *orthogonal basis* of functions which, when scaled by a function of time and added together, can give every possible vibration pattern of the string.

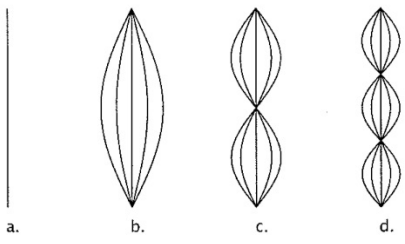

Figure 1

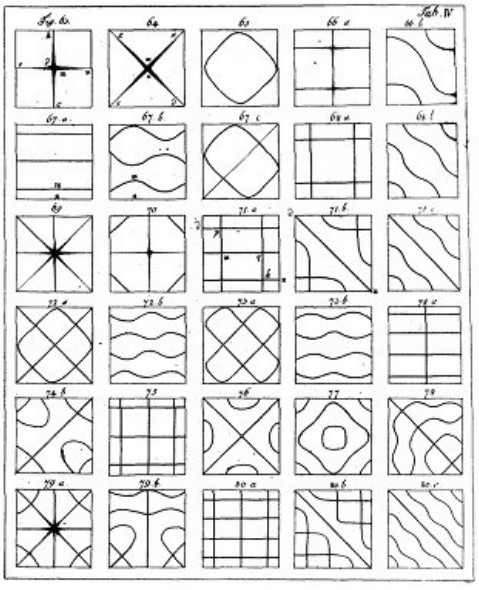

Figure 2

The same is true for a vibrating plate. The standing waves of the square vibrating plate in Figure 2 [1] are revealed by the nodal lines where the plate is motionless. The infinite list of standing waves on the plate forms an *orthogonal basis* of functions that again can be scaled and added to yield any vibration pattern of the plate.

This course focuses on using orthogonal bases of special functions to solve initial value problems involving oscillating objects. These methods extend in a pleasant way to the study of heat flow and to understanding solutions to the Schrodinger equation in quantum mechanics.

Inclusive Classroom Statement: The College mission statement states that Lewis and Clark, "seeks to be a community of scholars who are alive to inquiry, open to diversity, and disciplined to work in an interdependent world." In this spirit I expect that all of our statements and actions be based on mutual respect for one another. If you have ideas about how our classroom could be made more inclusive, please don't hesitate to discuss them with me.

Homework: Problem sets are the heart of this course. By doing problems one develops the ability to do mathematics precisely. If you must turn an assignment in late please let me know immediately, and turn the assignment as soon as possible. Late assignments will not be accepted more than a few days after their due date.

Project: This course will require a semester-long independent project, to be completed in small groups. The goal of the project is to write a typeset paper and give a presentation that dig deeply into a mathematical topic related to the course material. Details about the project will be provided in the first weeks of the course. Please brainstorm about topics that may interest you. There are two options: (1) complete one of the substantial sections or excursions in the course packet that we will not cover in class, or (2) find a journal article in *College Math Journal*, *Math Magazine*, *The American Math Monthly*, *The Rose-Hulman Journal*, or the *Math Intelligencer* that relates to course topics and explain its results in your own words.

Exams: There will be two take-home midterm examinations and one take-home final in this course. The dates of these exams are as follows, though the midterm times may change slightly to suitably fit the timing of the course.

Midterm Exam 1: February 21 - February 28.
Midterm Exam 2: April 4 - April 11.
Final Exam: April 25 - May 3.

Festival of Scholars: The Festival of Scholars is a campus-wide celebration of student work. It is an opportunity to discuss research, to exhibit, perform, or appreciate art, and to cross disciplinary boundaries. The Festival will be held on Friday, April 20, 2018. Classes will be cancelled on that day, but you are still required to participate in the Festival, either by presenting your work or attending presentations by your fellow students. I as I understand further how the Festival will be organized, I will explain how attendance will contribute to your course grade.

[1] Chladni plate image from the Whipple Museum

Grading: Your final letter grade for Math 305 will be based on the weighted total of the scores below. (Note that final grades are NOT based on fixed, pre-determined percentages, however 90% guarantees a minimum grade of A-, 80% a minimum grade of B-, etc.) See the College Catalog for an explanation of what each letter grade signifies.

Homework: 15%
Midterms: 20% each
Project Paper: 15%
Project Presentation: 5%
Final Exam: 25%

Academic Honesty: Academic honesty is expected of all Lewis & Clark students. In this course, homework can and should be worked on and discussed with others, but the work you hand in must be your own. Use of notes is permitted during take-home exams, however no collaboration with other people is permitted.

Special Needs: If you have a disability that may impact your academic performance, you may request accommodations by submitting documentation to the Student Support Services Office in Albany Quadrangle (x7191), and that office will notify me of the accommodations for which you are eligible.

Welcome! I expect that this will be a lot of very mathy fun.