University of Florida

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College *of* Liberal Arts *and* Sciences

MAP 4341/5345 Introduction to Partial Differential Equations

Reading Material

Course Texts: R. Haberman, Applied Partial Differential Equations, 4th edition (optional)
Additional Reading: P.J. Oliver, Introduction to Partial Differential Equations, Springer, 2014 (optional)
S.V. Shabanov, Lecture Notes on Partial Differential Equations (PDEs)

The lecture notes will be posted in the course page. They are close to the classroom lectures and contain practice (homework) problems.

Prerequisites

Students are expected to be familiar with ordinary differential equations and methods to solve them. Basic knowledge of differentiation and integration of functions of several variables is necessary (Calculus 3). The knowledge of basic ideas of linear algebra is not mandatory but will be helpful to comprehend the content of the course.

Course Content

Part 1: Partial differential Equations (PDEs). A solution to a PDE. Examples: 2D Wave equation. 2D Heat equation. 2D Laplace equation. 2D Helmhotz equation. Separation of variables in a PDE. Principle of superposition for a linear PDE. Boundary conditions.

Part 2: First-order PDEs. Basic methods of solving. The method of characteristics for first-order PDEs. The Cauchy problem for first-order PDEs.

Part 3: Classification of second-order PDEs. Hyperbolic, elliptic, and parabolic equations. Initial and boundary value problems for basic second-order PDEs. The existence and uniqueness of the solution. Differential operators in the space of square integrable functions on a bounded region. The eigen-value problem for a differential operator. The Sturm-Liouville problem. Complete sets of functions. The Fourier method for hyperbolic, parabolic, and elliptic problems in two variables for rectangular regions. Separation of variables in polar and spherical coordinates. Harmonic

functions and harmonic polynomials in two and three variables. Spherical harmonics. The Fourier method for hyperbolic, parabolic, and elliptic problems in circular, cylindrical, and spherical regions.

Goals: Learning basics techniques to solve first and second-order PDEs with emphasis on the Fourier method for solving initial and boundary value problems for hyperbolic, parabolic, and elliptic second-order linear PDEs.

Online and F2F classes

The course has face-to-face (F2F) and online sections. You must be cleared to attend F2F classes. Anyone who does not have clearance will not be admitted to the class meetings. You can switch from the F2F section to the online section and vice versa only during the first week of classes (the official add and drop period). Please contact the mathematics undergraduate coordinator if you have any problem to do so. If at the end of the first week the F2F section is empty, the course will go online and become an asynchronous course. The first class meeting will be via Zoom for all sections. The link to the meeting will be posted in Canvas.

Synchronous option: The F2F section will meet 2 times per week (WF4). The attendance for the F2F section is mandatory. The students in the online and F2F sections are required to have their cameras on from the start to finish during our classes on Zoom (MWF4). According to the UF policy, anyone may opt out of audio and video participation in classroom Zoom in case of technical problems or other unforeseen circumstances that make participation difficult or undesirable. In this case your participation must be acknowledged via Zoom Chat. All students are responsible for taking notes because sessions with video and audio participation cannot generally be recorded. Sessions can be recorded if no one objects. Anyone can send me a chat message privately (please learn how to do that in Zoom). Participation in the class and taking notes are essential to avoid any backlog of material to study because the course is developing fast and contains plenty of difficult concepts as well as most problems are technically involved. In case of any shortening of the lecture duration caused by technical issues with the classroom equipment, the students are expected cover the material using lecture notes posted in the course page. Your progress in the course will be tested almost every week (see Exams below). In addition to the regular class meetings, there will be a non-mandatory discussion session every Thursday, 4 period (10:40-11:30 am). The schedule and links for all Zoom meetings will be set via Canvas.

Asynchronous option: All lectures will be prerecorded and posted in the course page, and they can be viewed anytime and multiple times (even when doing graded assignments). There will be 3 prerecorded lectures per week to view and two non-mandatory Zoom sessions (MF4) to discuss the lectures and clarify any questions as well as to do some of the homework (practice) problems. If necessary, a third discussion can be added on Wednesday (W4). It is very important that you keep studying the lectures on the schedule posted in the course page, and prepare your questions for the discussion sessions. The schedule and links for all Zoom meetings will be set via Canvas. I will record 1-2 lectures for this week and post them in the course page so that you would be able to view them and decide what option is best

for you. Your progress in the course will be tested in the same way as indicated above (see also Exams below).

Exams

There will be 10-12 graded assignments and the final exam. The graded assignments will be conducted via Canvas every week or every other week, typically on Mondays evening hours (after 6 pm). Each assignment covers the material given in 3-6 lectures prior the assignment (excluding the lecture on the day of the exam). Each assignment is open for a specified period of time (2-3 hours) during which it must be completed and submitted via Canvas. The submission is free-response. Indicate the problem number, write your solution (do not omit technical details), box the answer, do the same for all problems, enumerate all pages as 1/n, 2/n, …, n/n, where n is the total number of pages, write and sign the academic honesty pledge at the bottom of the last page, write your name and your UFID number, scan all the pages in the above order into a single PDF file, and submit the file via Canvas. Make sure that you have a software or app to make such a PDF file. Other formats are not acceptable. Late submissions will not be accepted. The final exam is cumulative and will be conducted in the same fashion as regular graded assignments. You may use anything to prepare your submissions except discussing them with any person.

Special accommodation: Students requesting special accommodation for exams must first register with the Dean of Student Office. The Dean of Student Office will provide documentation to the student who must then provide this documentation to me when requesting accommodation.

Student honor code: Each submitted assignment must contain the signed academic honesty pledge: “Herewith I acknowledge that I did all the above problems myself and did not receive any help from any person”. Submissions without the signed honesty pledge will not be accepted. You are NOT allowed to discuss any assignment during the time period the assignment is open on Canvas. A breach of this policy is considered as cheating. If caught cheating, the course grade is an F, no exception.

Homework

Homework assignments will be posted in the course webpage. Homework is not turned in. Some of the homework problems can be discussed during the zoom meetings. Solving these problems is essential for understanding the course and attaining a good grade.

Grading

Each assignment contains some number of problems. Each problem is worth one point if solved correctly. If M is the total number of earned points and N is the total number of regular problems given, then your current grade is the average:

G = (M/N) 100%

The grade thresholds are:

A: G>90; A-: G>85; B+: G>80; B: G>75; B-: G>70; C+: G>65; C: G>60; C-: G>55;

D+: G>50; D: G>45; D-: G>40; F: G<40

Extra credit: There will be extra credit problems given in some of the assignments. They are not counted in the number N, but can increase your number M if solved correctly. The perfect score can therefore exceed 100% when the extra credit questions are correctly answered. Do not count much on these problems to increase your score later in the semester. These problems are more difficult than the regular ones.