Spring Term 2021

Instructor Prof. Francesco Di Plinio - francesco.diplinio@wustl.edu

I am a professor in the Mathematics department since 2019. I was a professor at University of Virginia and a postdoc at Brown before coming to WUSTL. I got my PhD in 2012 from Indiana University. My fields of expertise are Real, Fourier and Harmonic Analysis, and Partial Differential Equations, especially those related to fluids.

Class time/place MWF 10:00A-10:50A STL TIME - Last Class May 3, 2021 - No class Mar 3, Apr 12.
The course will be fully online with links from the Canvas webpage. Lectures organized as follows

- Mon-Wed 10:00A-10:50A - Online synchronous lecture on ZOOM, recorded and made available to course participants on ZOOM course portal after the class. During these lectures I will introduce the main topic of the week and cover most of the theoretical aspects of that topic.
- Fri 10:00A-10:50A - Online synchronous lecture and discussion on ZOOM, recorded and made available to course participants on ZOOM course portal after the class. During the Friday, I will answer questions on course material and previously assigned problems. Then we will discuss examples and applications of the theory. On occasion, a problem related to current topics will be presented/assigned and the students will be encouraged to work in groups and present their solution strategies to the other groups.
- lecture notes and slides will be provided beforehand so that you can follow along the presentation.
- a course diary is maintained on the Canvas webpage, with topics and examples covered each day.

Office and Office Hours STL TIME - On ZOOM portal

- MoTuWeTh: 9:00-10:00am (open hours)
- Fri: 11am-12noon (help session - I discuss homework problems upon request)
- otherwise by appointment (email 15 minutes in advance)

Prerequisites FA2020.L24.Math.5051.01 - Measure Theory and Functional Analysis I or equivalent

Course textbook and topics covered The principal textbook we will follow


The following is a non-exhaustive list of topics we will cover, with a reference to the corresponding chapter. Some of the topics that have been covered in FA2020.L24.Math.5051.01 will be expanded upon with no repetition. The italicized topics are applications.

- Linear spaces, the Hahn-Banach theorem and applications [1-4]
- Normed linear spaces, Hilbert spaces and their duals [5-8]
- Bounded Linear Maps [15-16]. Integral operators. Theory of Distributions [Appendix C, notes provided, other references], singular integral operators and Fourier integral operators
- Compact operators and the spectral theorem [21,23]. Applications to elliptic and parabolic PDE [22], Fredholm theory [24]
- Spectral theory of self adjoint unbounded operators [28,29,32-33]. Semigroups of operators [34,36], the Hille-Yosida and Lumer-Phillip's theorem Other additional topics can be proposed by the students or may be added if time allows.

Other textbooks of interest which will be occasionally referenced to in the preparation to this class are

- Functional Analysis, by W. Rudin
Classical Fourier Analysis by L. Grafakos, available on WUSTL-SpringerLink

Infinite-Dimensional Dynamical Systems in Mechanics and Physics, by R. Temam, Springer 1997

Partial Differential Equations II, by M. E. Taylor, 2011 available on WUSTL-SpringerLink

Course web page https://wustl.instructure.com/courses/61460 on Canvas. Used to gain access to syllabus, detailed course outline, assignments, homework and exam grades, lecture notes, and course announcements.

Homework There will be weekly/biweekly homework assignments, collected weekly (usually on Mondays) for grading purposes. The homework is designed to complement and enrich the theory presented in class. A large part of the homework problems will be discussed during the Thursday interactive. You will also be able to see a summary of your homework grades on the course page. Since solutions will be provided shortly afterwards the deadline, no extensions will be granted as a general policy. Homework is submitted online through Canvas.

Presentation In this class the second midterm exam will be administered in the form of student presentation. Each student will prepare a 20-30 minute ZOOM presentation of a topic listed above among the applications or other mutually agreed topic proposed by the student. The instructor may suggest other references in addition to the textbook. The presentation will be given synchronously at an agreed upon time and possibly recorded to be made available to other students. A list of available times will be distributed after the first midterm.

Exams Pending dispositions of the Director of Graduate Studies concerning qualifying exams for the graduate program there will be one midterm exam, one presentation as described above and a final exam. Exams are off-line and will be composed of two portions, roughly of equal weight. The first part will consist of questions related to the theory we have seen in class, usually with short answers. The second component will consist of 2-3 problems of length comparable to the homework assignments. The midterm exam will be posted on the tentative dates below and students will have a week of time to complete the assignment. Submission will be through Canvas. The final exam will be posted at the end of the course, with due date that of the final exam, May 11, 2021.

Grading

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Other factors such as in-class participation and improvement over time may impact positively your final grade.

Grading table


Submission guidelines Homework submission is electronic on Canvas portal or email to the instructor.

1. Write your name clearly at the top of every page. Put the problems in order, indicating clearly what you have skipped.
2. Turn in assignments in time ON OR BEFORE DUE DATE. Write neatly. If your homework is too messy, the grader might decide, with the instructor's consent, not to grade it.
3. Sourcing solution material from the Internet without mentioning the sources or collaborating without specifying the names of the collaborators is considered blatant academic plagiarism. Any instance of academic plagiarism will result in a 0% in the corresponding assignment/exam and discussed with the appropriate University Academic Officers. You can talk to each other about any of homework problems, but when you write up the problems to be handed in, you must work alone.
Questions and office hours Mathematical questions are appreciated and encouraged any time during the class. Please use the office hours as much as possible for additional clarifications, occasional homework help. I will also be answering email questions. Expect a 1 hour reply time on weekdays-work hours and a 12 hour reply time on nights/weekends.