Course Announcement: Math 147. Winter 2021

Introduction to Fourier Analysis and Its Applications

(Tuesdays and Thursdays, from 11:00am to 12:20pm)

Instructor: Dr. Lapidus,
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Burton Jones Endowed Chair in Pure Mathematics
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Prerequisites: Math 9C & 10B, Math 46 or 146A;
Co-requisite: Math 113 or 131
(or permission of instructor)

Book: "Fourier Analysis: An Introduction", by Elias Stein & Rami Shakarchi (Princeton Univ. Press).

Fourier analysis is one of these magical subjects in pure and applied mathematics which have a wide range of applications, both to the rest of mathematics and throughout the sciences (including physics, chemistry, biology, computer science and engineering), from the purest topics in number theory (like the Poisson summation formula and the theory of the celebrated Riemann zeta function), the dynamics of billiard balls on certain polygonal tables, the acoustics of musical instruments (Iike a violin or a guitar), to the understanding of how heat flows and how waves propagate from one region to another, to new (and actually currently widely used) fingerprinting techniques, computational science, as well as computer cryptography and decoding.

In this course, we will learn some of the basic results and techniques in Fourier analysis, from the mathematical theory of Fourier series (to which over half of the course will be dedicated) and its continuous analogue, Fourier integrals, to their myriad of applications. In the lecture, a mostly rigorous treatment of these mathematical topics will be provided, along with a discussion of the fascinating history of the subject and of its roots in physics and engineering. The weekly discussion section led by the teaching assistant will be an integral part of the course, and will survey, in particular, some of the most classical applications to music, wave motion and heat transfer, for example. In the weekly discussion, students will also be taught how to solve problems of varying difficulty.

Expectations: Regular attendance is expected and simple as well as some more challenging problems will be proposed throughout the lecture (as homework). Also, the students will be expected to prepare (either individually or in small groups) a project for the course, which they will present both orally (to the rest of the class) and in writing, toward the end of the quarter. The projects can discuss any of the many applications of Fourier analysis to pure or applied mathematics or to the other sciences. They can also focus on a particular mathematical topic which we will not have had the time to cover in depth in the lecture or in the discussion section.

Grade policy: The grade for the course will be based on the homework (about 40%), participation and attendance (about 20%), as well as on the written project (about 40%). Ordinarily, an oral presentation of the project would also be required; it is still strongly welcomed and encouraged. However, because of the current sanitary situation (Covid19), it will not be compulsory but extra credit will be awarded if such a presentation is given (on Zoom).

Participants: Both undergraduate and graduate students are welcome to register for the course, although, of course, the primary audience will consist of upper division students. Non-math, science students are also welcome, provided they have a sufficiently strong mathematical background or obtain the permission of the instructor to waive some of the pre or co requisites.

One of the last times I taught the course, about half of the students were undergraduate students and the other half was composed of graduate students, both in mathematics, physics and engineering. Furthermore, the graduate students helped mentor the undergraduates students, which was a mutually beneficial arrangement.

Please do not hesitate to contact me via email (lapidus@math.ucr.edu) if you have any questions about the course or its prerequisites. *Caution*: Let me emphasize that students should have good mathematical maturity in order to fully understand and enjoy the course.