AMATH 391  From Fourier to Wavelets  Fall 2019

Version 2.0: August 30, 2019  (please note change in classroom)

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Lectures: MWF 11:30-12:20 p.m. in RCH 209. Exception: On October 23, the lecture will be held in DWE 1515.

Office hours: MWF 2:00-3:00 p.m. or by appointment.

Calendar description: An introduction to contemporary mathematical concepts in signal analysis. Fourier series and Fourier transforms (FFT), the classical sampling theorem and the time-frequency uncertainty principle. Wavelets and multiresolution analysis. Applications include oversampling, denoising, data compression, singularity detection and, where possible, image analysis and processing.

Prerequisites: AMATH 231 or ECE 342 or PHYS 364 or SYDE 252 and (MATH 114 or 115 or 136/146 or SYDE 114). Not open to General Mathematics students.


This was the textbook for the course during its first offering, Winter 2007. After this time, the book was out of print and employed as an “unofficial” textbook for the course. A more recent version of this book has been published (and placed on Library Reserve) but the first edition will suffice. An electronic copy of the first edition will be available for download from the course website on Waterloo LEARN. It will once again serve as an “unofficial” textbook. As discussed below, the lecture notes along with the assignments will define the course.

Course Notes: Lecture notes will be posted electronically on the course’s website on Waterloo LEARN (see below), normally at the end of each week.

In the event that you would like to see what may lie ahead in the course, you are most welcome to view and/or download my lecture notes for this course for the Fall 2017 term. They can be found at http://links.uwaterloo.ca/amath391.

From year to year I am always making modifications to the course, so the lecture notes will change. You are responsible for keeping up with the course via the lecture notes for this term.)

Course webpage: Waterloo LEARN, AMATH 391 - Fall 2019. Students who are registered in the course will have access to this page.

Assignments: You will be asked to submit a number of assignments (roughly seven or eight). These assignments may have a computational component as well, but a rather mild one (as compared to CS courses). Late submissions without valid justification will not be accepted. Your assignment solutions should be legible, detailed and well-organized, indicating the logic and methods obtaining the answer and not merely a scribble of formulas and equations. In other words, your assignments should reflect the literal and mathematical maturity of a third-year student.

Your solutions are to be submitted in Math Drop Box No. 3, Slot No. 1 (Surnames A-M) or Slot No. 2 (N-Z). The Math Drop Boxes are located outside the Tutorial Centre in MC 4066. (Note that Slot No. 3 is reserved for another course that I am teaching this term.)

Please note that we cannot assume responsibility for assignments that have been submitted in incorrect slots/boxes.

Graded assignments will be returned to students as soon as possible. After the assignments have been graded, solutions will be posted electronically on the course website. Unless otherwise arranged, unclaimed assignments will be left in a large envelope posted beside my office door, MC 6326.
Midterm Exam: Tentatively scheduled for

Thursday, October 31, 2019, 4:30-6:00 p.m. in MC 4058.

Final Grade: The final grade will normally be calculated using the following weighting:

Term Work (Assignments) 10%, Midterm 25%, Final Exam 65%.

Your term work will be included in any computation of your final grade. If no assignments are submitted, then your maximum final grade (corresponding to a perfect midterm and final examination) is 90.

Books placed on reserve: A number of books have been placed on one-day reserve in the Davis Library. They are listed below, in very rough (decreasing) order of importance for the course:

  These two books are excellent for upper-year mathematics undergraduate courses.
  A more advanced and comprehensive mathematical treatment.
  A “tour de force” which is well recognized and appreciated by researchers in signal and image processing. In addition to wavelets, it provides a quite comprehensive treatment of Fourier-based methods.
  Introductory treatment, applications-oriented, written from an engineering perspective.

The role of problem sets

Although they formally constitute only 10% of your final grade, the problem sets should be considered as an essential component of this course. Each problem set will contain some routine questions along with some more challenging problems that are designed to reinforce the material covered in class.

In fact, the problem sets, as well as the lecture material, should be viewed as a primary guide to what you are expected to know in this course. The midterm and final examinations of this course will reflect the spirit of the problem sets. Based on many years of teaching courses such as this one, I can state with confidence that students’ performance in a course (i.e., their final grades) is strongly linked to the effort that they put into their assignments.