# Assignments Week 7 SF2705 Fourieranalysis.

First, there is a mid term break for two weeks and the next lecture is on the 25th of March. Last weeks note stated that there would be a lecture on March 11th. That was my mistake and the next lecture is on March 25th.

These are the things that you are expected to do before the Lecture on the **25th of March**.

**1 Reading:** Look through chapter 4 again and try to repeat previous chapters. We will spend the first hour to talk about one of the applications in 4.3 or 4.4 and then spend an hour to summarize Fourier series.

**2 Discussion questions.** Your assignment this week will be to hand in a three page summary of the first four chapters in Stein-Shakarchi. The following questions are intended to help you analyze what me have done. Try to frame the course so far along the following lines.

1. **Statements, Theorems etc.** Analyze what Theorems we have proved. Try to structure the theory. Some questions we have returned to several times, such as the convergence of Fourier-series. Why are the results formulated the way they are? How are they connected? What can we prove and what can we not prove that we would want to prove.

   Why do we make the definitions we make?

2. **Techniques.** What are the techniques that we use? Some techniques recur in several proofs, such as *i)* the use of Kernels, *ii)* uniform convergence of series, *iii)* approximations (proving a theorem for a continuous function and then approximate a general integrable function by means of continuous functions) etc.

   Try to think through, structure the techniques we use. It is easy to focus on the statements of Theorems or the calculations in the assignments - but when you do mathematics EVERYTHING THAT IS IMPORTANT IS TECHNIQUE. If you have the technique you can prove things and solve assignments, if you don't then you can't.

3. **Ideas.** Fourier Analysis is full of ideas. One way to try to frame this course is to analyze the ideas. The most obvious idea it to try to write a function as a sum of trigonometric functions. But there are other grand ideas such as interpreting the $e^{inx}$ as a basis of a vector space, or interpreting a curve as a $C^1$ function from the interval to the plane, or the terrible idea that symmetry breaking should imply point wise non-convergence for Fourier series.

4. **The stew.** In reality, mathematics is a stew of doctrine (Theorems, Lemmas etc.), techniques, ideas, applications everything mixed up so thoroughly that it is difficult to distinguish the different elements from one another. We may have a an idea (that the Dirichlet Kernel's oscillations and singularity should explain point wise convergence) that leads to definition (of good kernels) which leads to certain techniques (point wise convergence for good kernels and approximation of continuous functions by trigonometric polynomials) that leads to... These threads of mathematical ideas and technique interconnect with other threads of ideas and weaves themselves together to strong webs of ideas.

**3 Problems to consider:** Solve **1, 3** and **4** in chapter 4.

**4. Assignment for the 25th of March:**

**Assignment 1:** Hand in a three page carefully made summary of chapter 1-4 in Stein-Shakarchi. There is no right or wrong way to analyze mathematics and it is impossible to to summarize everything in three pages. I want you to seriously engage the book with a birds eye view. If you want to follow a single idea through the text, that is fine, if you want to focus on the different proofs of the convergence of Fourier series (point wise for $C^2$, point wise at a differentiable point and mean square convergence), that is also fine, if you want to summarize to what extent we has managed to solve the "wave equation" (on page 7) that was the starting point of the course, well, that is fine too. If you want to pick another aspect or that interests you that is also fine, as long as you engage the theory on a grander scale.

This assignment has three aspects, the first is to analyze a larger body of mathematics, the second is to force you to repeat the material and the third aspect is to give you a chance to practice writing - so write it well.

Hand in your assignment on the lecture on the 25th of March.

**5 Office hours:** It does not seem to be any need for office hours. In case you have any pressing question please write me an email (johnan@kth.se) and we can book a time on Friday.