

Istituzioni di Analisi Matematica – A.A. 2020/21

General informations

Course content This course in an English version of the same course held in Italian in 2019/2020 and in 2018/2019, hopefully better organized and improved by the experience gained in the previous years. The course held in 2020/21 (in Italian) contains the discussion of a lot of exercises, which could be useful in order to better understand the subject. *Students are strongly advised to work independently on the exercises before checking official solutions.*

Delivering of lectures As long as rules and protocols allow it, the course will be held in person. *Lectures will be recorded and made available to everyone*, usually on the same day. Streaming of lectures will not be done, because my equipment does not allow for local quality recording and streaming at the same time, and there are no cameras in the classroom for filming. If anyone wants to film and broadcast live, I am not opposed.

Tutoring The course has the support of a young collaborator, which students can contact (in addition to the lecturer) for clarifications on the topics of the course or on the exercises. Interested students are invited to contact him. More details about this activity will be posted on the Team of the course (all students at the University of Pisa can join it).

Exams Final exams will be carried out according to the rules explained separately in detail. *It is recommended not to trust any information concerning exam dates (even from official sources) unless confirmed by the teacher, directly or through the web page.* It is recommended to register for exams through the dedicated website <http://esami.unipi.it>, which also sends notifications in case of any changes.

Preparatory courses Apparently no written rule prevents one from taking the exam of this course before having successfully passed even the exam of Mathematical Analysis 1. In these cases it is therefore essential to rely on common sense: it is impossible, and actually counter-productive, to follow a course with profit if there are gaps or uncertainties in the preliminaries.

Highly motivated students can successfully follow this course in parallel with the analysis course of the third year.

Forum studenti From the teacher's "Archivio Didattico" (easily found with any search engine) one can access the "Forum Studenti", intended for those who attend this (and many other) course. The Forum is the right place to ask all questions, both about bureaucracy and mathematics, the answer to which may be of interest to more than one person.

All students are invited to register and follow the Forum regularly and actively (registered users can also request notifications). Being active also means trying to answer questions that other users ask, overcoming the fear of "saying nonsense". Everyone, especially those who are learning something new, happens to say nonsense: it is just a matter of deciding whether to do it before or to wait for the exam day ... It may seem strange, but many students prefer the latter ...

E-mail For all the general questions mentioned in the previous paragraph it is better to avoid sending e-mail to the teacher. These e-mails probably will never be answered, both because every day hundreds of e-mails arrive, and because it is really useless to explain the same thing 10 times to 10 different people, when it could be explained once and for all on the Forum. In addition, before writing any e-mail, it is always advisable to take a look here: <http://phdcomics.com/comics/archive.php?comid=1795>.

Didactic material designed for the course The *videos of the lectures* and pdf files with the *complete printout* are available in the Teacher's Archivio Didattico, which also gives access to a booklet with a summary of the theory and a collection of exercises, perennial "work in progress".

Suggested reading The videos and printouts of the lectures that are available on the Internet, together with the booklet of exercises, which are updated from time to time, should be more than enough to achieve a reasonable preparation in this subject.

That said, and recalling that any textbook one is comfortable with is adequate, the following books are also worth mentioning.

- [1] R. A. Adams; *Sobolev Spaces*; Academic Press.
- [2] H. Brezis; *Functional Analysis, Sobolev Spaces and Partial Differential Equations*; Springer.
- [3] L. C. Evans; *Partial Differential Equations*; Graduate Studies in Mathematics.
- [4] L. C. Evans, R. F. Gariepy; *Measure theory and fine properties of functions*; CRC Press.
- [5] E. Giusti; *Direct Methods in the Calculus of Variations*; World Scientific.
- [6] W. Rudin; *Real and Complex Analysis*; McGraw-Hill.

Further reading (as a joke, but not too much) It often happens that some students find my courses too "practical", or at least too little abstract. Well, with the following books they can amuse themselves, finding something to sink their teeth into.

- [7] H. Federer; *Geometric Measure Theory*; Springer.
- [8] A. Grothendieck; *Topological Vector Spaces*; Gordon And Breach Science Publisher.
- [9] W. Rudin; *Functional Analysis*; McGraw-Hill.

Achtung! The concepts and results presented in this course will appear to be rather simple and natural, when revised some years later. However, mankind took centuries to get there, and at a first sight these ideas turn out to be difficult. Experience has shown that it takes a long time to become familiar with these topics and methods. If one thinks about it, the same is true for the basic courses of Analysis 1 or Linear Algebra (let us think for example to the ε/δ definition of limit, or to the notion of basis for a vector space).

A 11-credit course requires the average student to work 275 hours in order to achieve a sufficient preparation, if starting with the correct prerequisites. However, it is completely unrealistic to think of getting decent results by working 10 hours a day for 27.5 consecutive days. Much more effective is to work 2.5 hours a day for 4 months, with some breaks in between (the brain also works while one is doing something else).