Universitat Autònoma de Barcelona

2023/2024

Harmonic analysis

Code: 100111
ECTS Credits: 6

Degree	Type	Year	Semester
2500149 Mathematics	OT	4	2

Contact

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Teaching groups languages

You can check it through this link. To consult the language you will need to enter the CODE of the subject.
Please note that this information is provisional until 30 November 2023.

Prerequisites

The first and second year Analysis courses of the mathematics degree. It is also useful, but not essential, to have

Objectives and Contextualisation

The main objective is to describe the way in which Harmonic Analysis allows to decompose a function as a sum o

Competences

- Actively demonstrate high concern for quality when defending or presenting the conclusions of one's work.
- Assimilate the definition of new mathematical objects, relate them with other contents and deduce their properties.
- Develop critical thinking and reasoning and know how to communicate it effectively, both in one's own languages and in a third language.
- Effectively use bibliographies and electronic resources to obtain information.
- Formulate hypotheses and devise strategies to confirm or reject them.
- Generate innovative and competitive proposals for research and professional activities.
- Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.

- Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
- Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
- Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.

Learning Outcomes

1. Actively demonstrate high concern for quality when defending or presenting the conclusions of one's work.
2. Develop critical thinking and reasoning and know how to communicate it effectively, both in one's own languages and in a third language.
3. Effectively use bibliographies and electronic resources to obtain information.
4. Formulate conjectures and devise strategies to confirm or reject said conjectures
5. Generate innovative and competitive proposals for research and professional activities.
6. Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
7. Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
8. Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
9. Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
10. Understand and know how to reproduce basic results in relation to the Hilbert transform.

Content

1. Fourier series and applications

2. Fourier integrals and applications.
3. The Poisson summation formula. The Heisenberg Uncertainty Principl
4. Fourier analysis in finite abelian groups. Dirichlet's theorem on prime r

5. Theory of distributions. Fourier transform of tempered distributions. Applications.

Methodology

The standard one in Mathematics. Discussion of definitions, examples and Theorems. We will also have problem sessions.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Directed	30	1.2	5, 8, 6
Type: Supervised			
Supervised	20	0.8	10, 5, 8, 6
Type: Autonomous			
Autonomous	85	3.4	10, 5, 8, 6

Assessment

The subject will be evaluated according to the three activities and their weights shown in the table.
Students who do not pass the course can repeat the final exam with the s

THERE IS ALSO THE POSSIBILITY OF DOING ONLY ONE FINAL EXAM WITH THAT WEIGHTS THE 100% O

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Exercises	40%	1	0.04	1, 2, 10, 4, 5, 9, 8, 6, 7, 3
Final Exam	50%	4	0.16	1, 2, 10, 4, 5, 9, 8, 6, 7, 3
Oral Exam	10%	10	0.4	1, 2, 10, 4, 5, 9, 8, 6, 7, 3

Bibliography

1. E. Stein and R. Shakarchi, "Fourier Analysis, an introduction", Princeton Lectures in Analysis, Priceton Univresity Press 2007

2. L. Grafakos, "Classical Fourier Analysis", Springer-Verlag,

3. C. Pereyra and L. Ward, "Harmonic Analysis; from Fourier to Wavelets", 2012.

4. R. Strichartz, "A Guide to Distribution Theory and Fourier Transforms". CRC Press, Boca Ratón, FL, 1994.

5. A. H. Zemanian, "Distribution Theory and Transform Analysis: An Introduction to Generalized Functions, with Applications, reprint edition". Dover Publications, New York, 1987.

Bibliografia complementaria:

-Geometric Harmonic Analysis I, A Sharp Divergence Theorem with Nontangential Pointwise Traces. D. Mitrea, I. Mitrea and M. Mitrea. Springer-Verlag, 2022.

-Geometric Harmonic Analysis II, Function Spaces Measuring Size and Smoothness on Rough Sets. D. Mitrea, I. Mitrea and M. Mitrea. Springer-Verlag, 2022.

-Geometric Harmonic Analysis III, Integral Representations, Calderón-Zygmund Theory, Fatou Theorems, and Applications to Scattering. D. Mitrea, I. Mitrea and M. Mitrea. Springer-Verlag, 2022.

-Geometric Harmonic Analysis IV, Boundary Layer Potentials in Uniformly Rectifiable Domains, and Applications to Complex Analysis. D. Mitrea, I. Mitrea and M. Mitrea. Springer-Verlag, 2022.

Software

There isn't any