


Due to the COVID-19 crisis, the information below is subject to change, in particular that concerning the teaching mode (presential, distance or in a comodal or hybrid format).

7 credits	45.0 h + 45.0 h	Q1
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Teacher(s)	Van Schaftingen Jean ;
Language :	French
Place of the course	Louvain-la-Neuve
Prerequisites	<i>The prerequisite(s) for this Teaching Unit (Unité d'enseignement – UE) for the programmes/courses that offer this Teaching Unit are specified at the end of this sheet.</i>
Main themes	Banach, Hilbert, Lebesgue, and Sobolev spaces, dual spaces, elliptic problems.
Aims	<p>Contribution of the course to learning outcomes in the Bachelor in Mathematics programme. By the end of this activity, students will have made progress in:</p> <p>By the end of the programme, the graduate is able to:</p> <p>1) recognise and understand a basic foundation of mathematics. Choose and use the basic tools of calculation to solve mathematical problems. Recognise the fundamental concepts of important current mathematical theories. Establish the main connections between these theories, analyse them and explain them through the use of examples.</p> <p>2) identify, by use of the abstract and experimental approach specific to the exact sciences, the unifying features of different situations and experiments in mathematics or in closely related fields (probability and statistics, physics, computing). 3) show evidence of abstract thinking and of a critical spirit. Argue within the context of the axiomatic method Recognise the key arguments and the structure of a proof. Construct and draw up a proof independently. Evaluate the rigour of a mathematical or logical argument and identify any possible flaws in it. Distinguish between the intuition and the validity of a result and the different levels of rigorous understanding of this same result.</p> <p>4) be clear, precise and rigorous in communicating. Write a mathematical text in French according to the conventions of the discipline. Structure an oral presentation in French, highlight key elements, identify techniques and concepts and adapt the presentation to the listeners' level of understanding. Communicate in English (level C1 for reading comprehension, level B2 for listening comprehension and for oral and written expression, CEFR).</p> <p>5) learn in an independent manner. Find relevant sources in the mathematical literature. Read and understand an advanced mathematical text and locate it correctly in relation to knowledge acquired.</p> <p>Learning outcomes specific to the course. By the end of this activity, students will be able to:</p> <ul style="list-style-type: none"> <li>-Use functional spaces to solve analytical problems,</li> <li>- Use the basic principles of functional analysis.</li> <li>- Identify the natural norm or inner product to solve analytical problems.</li> <li>- Define the natural notion of weak solutions.</li> <li>- Identify dual spaces.</li> </ul> <p>-----</p> <p><i>The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled "Programmes/courses offering this Teaching Unit".</i></p>

Evaluation methods	<p><b>Due to the COVID-19 crisis, the information in this section is particularly likely to change.</b></p> <p>The assessment will be decomposed in several parts:</p> <ul style="list-style-type: none"> <li>• 10% for preparation and participation in tutorials,</li> <li>• 15% for exercises handed over during the term,</li> <li>• 30% for the written open-book exercise exam,</li> <li>• 45% for the open book oral exam, assessing knowledge and understanding of fundamental concepts and results, the ability to build and write coherent reasoning.</li> </ul> <p>The marks for tutorials and exercises will be carried over to each session of the entire academic year, without the possibility of presenting them again.</p>
Teaching methods	<p><b>Due to the COVID-19 crisis, the information in this section is particularly likely to change.</b></p> <ul style="list-style-type: none"> <li>• Lectures and tutorials aiming to introduce fundamental concepts, to explain them by showing examples and by determining their results, to show their reciprocal connections and their connections with other courses in the programme for the Bachelor in Mathematics.</li> <li>• Exercise sessions aiming to teach how to select and use calculation methods and how to construct proofs.</li> </ul>
Content	<p>The lectures on Functional Analysis are devoted to the basic properties of the main functional spaces and their use to solve elliptic problems. They are devoted to the main abstract tools and their applications. The main parts of the lectures are:</p> <ul style="list-style-type: none"> <li>-Norms and inner products.</li> <li>-Banach and Hilbert spaces.</li> <li>-Convex sets and functions.</li> <li>-Lebesgue spaces.</li> <li>-Dual spaces</li> </ul>
Inline resources	<p>Online ressources on Moodle (<a href="https://moodleucl.uclouvain.be/course/view.php?id=7313">https://moodleucl.uclouvain.be/course/view.php?id=7313</a>), including problem sheets and solutions for the exercise sessions.</p>
Faculty or entity in charge	<p>MATH</p>

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Aims
Bachelor in Mathematics	MATH1BA	7	LMAT1122 AND LMAT1131 AND LMAT1221	
Minor in Mathematics	MINMATH	7		