UCLouvain

# lmat1223

*2019*

# Differential equations

In view of the health context linked to the spread of the coronavirus, the methods of organisation and evaluation of the learning units could be adapted in different situations; these possible new methods have been - or will be - communicated by the teachers to the students.

| 5 credits | 30.0 h + 15.0 h | Q2 |
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| Teacher(s) | Olbermann Heiner ; |
| Language : | French |
| Place of the course | Louvain-la-Neuve |
| Main themes | Mathematical study, performed using algebraic and analytical methods, of some problems about ordinary differential equations and of the qualitative properties of their solutions. |
| Aims | **General learning outcomes. By the end of the course, the student should be able to:**<br>1) recognise and understand a basic foundation of mathematics.<br>Choose and use the basic tools of calculation to solve mathematical problems.<br>Recognise the fundamental concepts of important current mathematical theories.<br>Establish the main connections between these theories, analyse them and explain them through the use of examples.<br>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).<br>3) show evidence of abstract thinking and of a critical spirit.<br>Argue within the context of the axiomatic method Recognise the key arguments and the structure of a proof.<br>Construct and draw up a proof independently.<br>Evaluate the rigour of a mathematical or logical argument and identify any possible flaws in it.<br>Distinguish between the intuition and the validity of a result and the different levels of rigorous understanding of this same result.<br>1 4) be clear, precise and rigorous in communicating.<br>Write a mathematical text in French according to the conventions of the discipline.<br>**Specific learning outcomes. By the end of the course, the student should be able to :**<br>- Construct mathematically solutions to differential equation problems.<br>- Link properties of a linear map to the properties of solutions of a differential equation in which it appears.<br>- Apply methods for systems of first-order differential equations to higher order differential equations.<br>- Exploit relationships between solutions of a linear differential equation..<br>- Study the uniqueness of solutions for a differential equations with the help of counterexamples and proofs.<br>- Caracterise topologically maximal solutions.<br>- Determine whether a differential equaton problem admits a global solution.<br>- Study the stability of an equilibrium.<br>- Define stability.<br>- Compare and link together definitions and criteria of stability with the help of proofs and counterexamples.<br>- State, prove and apply existence and uniqueness criteri for boundary value problems.<br>- Illustrate definitions and statements by examples and counterexamples.<br>- - - -<br>*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".* |

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| Evaluation methods | **Due to the COVID-19 crisis, the information in this section is particularly likely to change.**<br>Learning will be assessed by a final examination. The questions will ask students to:<br>- reproduce the subject matter, especially definitions, theorems, proofs, and examples<br>- select and apply methods from the course to solve problems and exercises<br>- adapt methods of demonstration from the course to new situations<br>-summarise and compare topics and concepts.<br>Assessment will focus on<br>- knowledge, understanding and application of the different mathematical methods and topics from the course<br>- precision of calculations<br>- rigour of arguments, proofs and reasons<br>- quality of construction of answers. |
| Teaching methods | **Due to the COVID-19 crisis, the information in this section is particularly likely to change.**<br>Teaching is divided into lectures and exercise sessions. The lectures aim to introduce and explain fundamental concepts, provide examples and elucidate connections with other courses.<br>The exercise sessions aim to teach how to select and use calculation methods and how to write down proofs. |
| Content | - initial value problems for ordinary differential equations: existence, uniqueness and dependence on the initial data,<br>- structure of solutions for linear equations,<br>- introduction to stability theory |
| Inline resources | Lecture notes will be made available online via Moodle. |
| Bibliography | |
| Faculty or entity in charge | MATH |

| Programmes containing this learning unit (UE) | | | | |
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| Program title | Acronym | Credits | Prerequisite | Aims |
| Bachelor in Mathematics | MATH1BA | 5 | | |
| Additionnal module in Physics | LPHYS100P | 5 | | |
| Minor in Engineering Sciences: Mechanics (only available for reenrolment) | LMECA100I | 5 | | |
| Minor in Mathematics | LMATH100I | 5 | | |