UCL Université catholique de Louvain

# LMAT1151

*2015-2016*

# Numerical analysis : tools and software of calculus

| 6.0 credits | 30.0 h + 45.0 h | 2q |
|---|---|---|

| | |
|---|---|
| Teacher(s) : | Claeys Tom ; |
| Language : | Français |
| Place of the course | Louvain-la-Neuve |
| Inline resources: | Site iCampus ( > http://icampus.uclouvain.be/). The site contains lecture notes, an introduction to Matlab, exercises to be solved during the exercise classes, solutions of a selection of exercises, corrections of recent exams. |
| Prerequisites : | Prerequirements to follow the course LMAT1151 are the courses LMAT1131 and LMAT1121. In particular: knowledge of basic notions of linear algebra (vector spaces, matrices, eigenvalues and eigenvectors, determinant, rank) and analysis (convergence, continuity and differentiability, integrals). |
| Main themes : | Sources of numerical errors, direct and iterative methods to solve linear systems of equations, iterative methods to solve non-linear equations, least square approximation, numerical integration. |
| Aims : | 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:<br>- 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>- 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>- 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>Learning outcomes specific to the course. By the end of this activity, students will be able to:<br>- Understand which are the possible sources of errors in a numerical method.<br>- Solve numerical problems using Matlab.<br>- Apply direct and iterative methods to solve linear systems.<br>- Solve a linear system in the least square sense.<br>- Understand the main idea of some methods of numerical integration.<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".* |
| Evaluation methods : | Assessment is by means of a written examination relating to both theory and exercises (15 points) and by means of a test consisting of exercises in Matlab (5 points). The examination tests knowledge and understanding of the main concepts and the ability to put them into practice. The Matlab test checks whether students are able to construct an algorithm to solve numerical problems and to implement the algorithm in Matlab. |
| Teaching methods : | Learning activities consist of lectures, written exercise sessions and exercise sessions on the computer. Lectures aim to introduce the fundamental concepts of numerical analysis and to explain them by showing examples and applications. Exercise sessions aim to teach how to construct numerical methods and how to use Matlab. |
| Content : | The following topics will be studied in this activity:<br>- machine representation of numbers,<br>- sources of numerical errors,<br>- stability and conditioning of numerical methods,<br>- direct methods to solve linear systems,<br>- iterative methods to solve linear systems,<br>- iterative methods to solve non-linear equations,<br>- QR factorization and solving linear systems in least square sense,<br>- introduction to numerical integration methods |

| | |
|---|---|
| Bibliography : | &t;!--{cke_protected}{C}%3C!%2D%2D%0A%20%2F*%20Font%20Definitions%20*%2F%0A%40font-face%0A%09%7Bfont-family%3A%22Cambria%20Math%22%3B%0A%09panose-1%3A2%204%205%203%205%204%206%203%202%204%3B%0A%09mso-font-charset%3A0%3B%0A%09mso-generic-font-family%3Aauto%3B%0A%09mso-font-pitch%3Avariable%3B%0A%09mso-font-signature%3A3%200%200%200%201%200%3B%7D%0A%40font-face%0A%09%7Bfont-family%3A%22%E3%83%92%E3%83%A9%E3%82%AE%E3%83%8E%E8%A7%92%E3%82%B4%20Pro%20W3%22%3B%0A%09mso-font-charset%3A0%3B%0A%09mso-generic-font-family%3Aroman%3B%0A%09mso-font-pitch%3Aauto%3B%0A%09mso-font-signature%3A0%200%200%200%200%200%3B%7D%0A%20%2F*%20Style%20Definitions%20*%2F%0Ap.MsoNormal%2C%20li.MsoNormal%2C%20div.MsoNormal%0A%09%7Bmso-style-update%3Aauto%3B%0A%09mso-style-unhide%3Ano%3B%0A%09mso-style-qformat%3Ayes%3B%0A%09mso-style-parent%3A%22%22%3B%0A%09margin%3A0cm%3B%0A%09margin-bottom%3A.0001pt%3B%0A%09mso-pagination%3Awidow-orphan%3B%0A%09font-size%3A12.0pt%3B%0A%09font-family%3A%22Times%20New%20Roman%22%3B%0A%09mso-fareast-font-family%3A%22Times%20New%20Roman%22%3B%0A%09mso-bidi-font-family%3A%22Times%20New%20Roman%22%3B%0A%09mso-ansi-language%3AEN-US%3B%0A%09mso-fareast-language%3AEN-US%3B%7D%0Ap.CorpsA%2C%20li.CorpsA%2C%20div.CorpsA%0A%09%7Bmso-style-name%3A%22Corps%20A%22%3B%0A%09mso-style-unhide%3Ano%3B%0A%09mso-style-parent%3A%22%22%3B%0A%09margin%3A0cm%3B%0A%09margin-bottom%3A.0001pt%3B%0A%09mso-pagination%3Awidow-orphan%3B%0A%09font-size%3A12.0pt%3B%0A%09mso-bidi-font-size%3A10.0pt%3B%0A%09font-family%3AHelvetica%3B%0A%09mso-fareast-font-family%3A%22%E3%83%92%E3%83%A9%E3%82%AE%E3%83%8E%E8%A7%92%E3%82%B4%20Pro%20W3%22%3B%0A%09mso-bidi-font-family%3A%22Times%20New%20Roman%22%3B%0A%09color%3Ablack%3B%0A%09mso-ansi-language%3AFR%3B%7D%0A.MsoChpDefault%0A%09%7Bmso-style-type%3Aexport-only%3B%0A%09mso-default-props%3Ayes%3B%0A%09font-size%3A10.0pt%3B%0A%09mso-ansi-font-size%3A10.0pt%3B%0A%09mso-bidi-font-size%3A10.0pt%3B%7D%0A%40page%20WordSection1%0A%09%7Bsize%3A612.0pt%20792.0pt%3B%0A%09margin%3A70.85pt%2070.85pt%2070.85pt%2070.85pt%3B%0A%09mso-header-margin%3A36.0pt%3B%0A%09mso-footer-margin%3A36.0pt%3B%0A%09mso-paper-source%3A0%3B%7D%0Adiv.WordSection1%0A%09%7Bpage%3AWordSection1%3B%7D%0A%2D%2D%3E--&t;<br>Lecture notes available on iCampus. |
| Faculty or entity in charge: | MATH |

| Programmes / formations proposant cette unité d'enseignement (UE) | | | | |
|---|---|---|---|---|
| Intitulé du programme | Sigle | Credits | Prerequis | Acquis d'apprentissage |
| Bachelor in Physics | PHYS1BA | 6 | - | |
| Bachelor in Mathematics | MATH1BA | 6 | - | |