




5.00 credits

30.0 h + 22.5 h

Q2

Teacher(s)	Remacle Jean-François ;
Language :	French
Place of the course	Louvain-la-Neuve
Prerequisites	First cycle level in numerical calculus and programming (LEPL1104) and in linear algebra (LEPL1101).
Main themes	<ul style="list-style-type: none"> <li>• Numerical methods for solving non-linear equations</li> <li>• Numerical methods for solving linear systems : iterative methods</li> <li>• Numerical methods for solving eigenvalue and eigenvector problems</li> <li>• Numerical solution of ordinary differential equations : initial value problems</li> </ul>
Learning outcomes	<p><b>At the end of this learning unit, the student is able to :</b></p> <p>With respect to the AA reference, this course contributes to the development, acquisition and evaluation of the following learning outcomes :</p> <p>AA1.1, AA1.2, AA1.3 AA2.1, AA2.4 AA5.2, AA5.3, AA5.5</p> <p>More precisely, after completing this course, the student will have the ability to :</p> <p>1</p> <ul style="list-style-type: none"> <li>• Analyze in depth the various key methods and algorithms for the numerical solution of important classes of problems from science and industry, related to applied mathematics</li> <li>• Better understand the numerical behavior of the various numerical algorithms for the solution of linear as well as nonlinear problems</li> <li>• Implement these methods in a high level computer language and verify their numerical behavior on a practical problem</li> </ul> <p>Transversal learning outcomes :</p> <ul style="list-style-type: none"> <li>• Collaborate in a small team to solve a mathematical problem using numerical methods</li> </ul>
Evaluation methods	Exam (50% of the grade) and homeworks (50% as well)
Teaching methods	<ul style="list-style-type: none"> <li>• Classes organized following the EPL guidelines.</li> <li>• Homeworks done individually</li> <li>• A more detailed organization is specified each year in the course plan provided on Moodle.</li> </ul>
Content	<ul style="list-style-type: none"> <li>• Reminder of the basic notions of linear algebra (linear spaces, vector and matrix norms, ...)</li> <li>• Floating point calculations.</li> <li>• Stability, precision and conditioning of algorithms.</li> <li>• QR and SVD factorizations.</li> <li>• Linear systems of equations : direct methods. LU, Choleski, Pivoting, Renumbering (RCMK), direct resolution of sparse systems, Fill-in.</li> <li>• Iterative methods (Krylov subspaces) : iteration of Arnoldi, conjugate gradients, GMRES, Lanczos.</li> <li>• Preconditioning of iterative methods, preconditioned conjugated gradients.</li> <li>• Computing eigenvalues, QR algorithm</li> </ul>
Inline resources	<a href="https://moodleucl.uclouvain.be/course/view.php?id=10034">https://moodleucl.uclouvain.be/course/view.php?id=10034</a>
Bibliography	<ul style="list-style-type: none"> <li>• <a href="http://bookstore.siam.org/ot50/">http://bookstore.siam.org/ot50/</a></li> </ul> <p>Nous suivons relativement scrupuleusement l'excellent ouvrage : Trefethen, L. N., &amp; Bau III, D. Numerical linear algebra (Vol. 50). Siam.</p>
Faculty or entity in charge	MAP

**Programmes containing this learning unit (UE)**

Program title	Acronym	Credits	Prerequisite	Learning outcomes
Additionnal module in Mathematics	<a href="#">APPMATH</a>	5		
Minor in Applied Mathematics	<a href="#">LMINOMAP</a>	5		
Specialization track in Applied Mathematics	<a href="#">FILMAP</a>	5		
Mineure Polytechnique	<a href="#">MINPOLY</a>	5		