





4.00 credits

20.0 h + 15.0 h

Q2

Teacher(s)	Rattez Hadrien ; Saraiva Esteves Pacheco De Almeida João ;
Language :	English > French-friendly
Place of the course	Louvain-la-Neuve
Prerequisites	Good knowledge of structural mechanics, structures stability and basis of finite elements method, as taught in LGCIV1022 et LGCIV1023
Main themes	<p>Variational principles in structural mechanics, classical theory of finite elements for structures:</p> <ul style="list-style-type: none"> <li>· Trusses (2D and 3D)</li> <li>· Frames (2D and 3D)</li> <li>· Plates and shells</li> <li>· Plane stress and plane strains.</li> </ul> <p>More advanced material will eventually be covered: elasto-plastic modelling of frames, structural instabilities, modelling of brittle materials, large displacements in structures.</p> <p>A computer project will be assigned to students that will consist in the development of a finite element code for a specific type of structure. The code will have to deal with inputs and outputs, including a graphical user interface.</p>
Learning outcomes	<p><b>At the end of this learning unit, the student is able to :</b></p> <p><b>Contribution of the course to the program objectives (N°)</b> AA1.1, AA1.2, AA1.3, AA2.1, AA2.2, AA2.3, AA2.4, AA3.1, AA3.2, AA4.2, AA4.4, AA5.6.</p> <p><b>Specific learning outcomes of the course</b></p> <p>1</p> <ul style="list-style-type: none"> <li>• Students will understand the principles of the finite element method applied to usual civil engineering structures (beams, frames, plates and shells).</li> <li>• Students will be trained in programming the finite element method. This includes the treatment of input data and the post-treatment of the results.</li> </ul>
Evaluation methods	<p>Continuous assessment and final oral exam.</p> <p>The assignments, which constitute the continuous assessment, are done in groups of 2/3 students and cannot be repeated in a second session; the continuous assessment mark acquired in the first session is retained in the event of a second session.</p> <p>Failure to comply with the methodological guidelines, particularly with regard to the use of online resources or collaboration between students for the assignment/project, will result in an overall mark of 0 for the continuous evaluation.</p> <p>The use of generative artificial intelligence (such as ChatGPT, Consensus, Perplexity, Bard, etc.) is prohibited for this course.</p>
Teaching methods	Lectures based on course slides; exercise sessions; practical applications.
Content	<p>Updated: September 2023</p> <ul style="list-style-type: none"> <li>- Theoretical development of the finite element method for beams, 2D, and 3D elastic elements, followed by practical considerations and applications.</li> <li>- Classical issues in structural mechanics and remedies (e.g., shear locking, reduced integration, flexibility formulations volumetric locking, instabilities).</li> <li>- Solution methods in nonlinear problems (incremental-iterative procedures, convergence criteria, etc)</li> <li>- Geometrical nonlinearities (total Lagrangian, updated Lagrangian, co-rotational formulations)</li> <li>- Material nonlinearities (elasticity vs plasticity, elastoplasticity, plasticity, yield surface, flow rule, hardening, etc)</li> <li>- (if time allows) Localisation and regularisation</li> </ul>
Inline resources	Available in Moodle.
Bibliography	Notes et supports de cours.

Other infos	The course involves: - The use / development of Python scripts; - The use of a commercial/research finite element software (Abaqus).
Faculty or entity in charge	GC

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Master [120] in Civil Engineering	<a href="#">GCE2M</a>	4		
Master [120] in Mechanical Engineering	<a href="#">MECA2M</a>	4		
Master [120] in Electro-mechanical Engineering	<a href="#">ELME2M</a>	4		
Master [120] in Mathematical Engineering	<a href="#">MAP2M</a>	4		
Master [120] in Energy Engineering	<a href="#">NRGY2M</a>	4		