UCLouvain

lgciv2041

2023

Numerical analysis of civil engineering structures

4.00 credits	20.0 h + 15.0 h	Q2

Teacher(s)	Rattez Hadrien ;Saraiva Esteves Pacheco De Alm João ;
Language :	English > French-friendly
Place of the course	Louvain-la-Neuve
Prerequisites	Good knowledge of structural mechanics, structures stabilty and basis of finite elements method, as taught in LGCIV1022 et LGCIV1023
Main themes	Variational principles in structural mechanics, classical theory of finite elements for structures: · Trusses (2D and 3D) · Frames (2D and 3D) · Plates and shells · Plane stress and plane strains. More advanced material will eventually be covered: elasto-plastic modelling of frames, structural instabilities, modelling of brittle materials, lage displacements in structures. 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.
Learning outcomes	**At the end of this learning unit, the student is able to :** **Contribution of the course to the program objectives (N°)** AA1.1, AA1.2, AA1.3, AA2.1, AA2.2, AA2.3, AA2.4, AA3.1, AA3.2, AA4.2, AA4.4, AA5.6. **Specific learning outcomes of the course** 1 • Students will understand the principles of the finite element method applied to usual civil engineering structures (beams, frames, plates and shells). • Students will be trained in programming the finite element method. This includes the treatment of input data and the post-treatment of the results.
Evaluation methods	Continuous assessment and final oral exam. 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. 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. The use of generative artificial intelligence (such as ChatGPT, Consensus, Perplexity, Bard, etc.) is prohibited for this course.
Teaching methods	Lectures based on course slides; exercise sessions; practical applications.
Content	Updated: September 2023 - Theoretical development of the finite element method for beams, 2D, and 3D elastic elements, followed by practical considerations and applications. - Classical issues in structural mechanics and remedies (e.g., shear locking, reduced integration, flexibility formulations volumetric locking, instabilities). - Solution methods in nonlinear problems (incremental-iterative procedures, convergence criteria, etc) - Geometrical nonlinearities (total Lagrangian, updated Lagragian, co-rotational formulations) - Material nonlinearities (elasticity *vs* plasticity, elastoplasticity, plasticity, yield surface, flow rule, hardening, etc) - (if time allows) Localisation and regularisation
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	GCE2M	4		
Master [120] in Mechanical Engineering	MECA2M	4		
Master [120] in Electro-mechanical Engineering	ELME2M	4		
Master [120] in Mathematical Engineering	MAP2M	4		
Master [120] in Energy Engineering	NRGY2M	4		