UCL Université catholique de Louvain

LMECA2120

2010-2011

Introduction to finite element methods.

5.0 credits	30.0 h + 30.0 h	1q

Teacher(s) :	Legat Vincent ;
Language :	Français
Place of the course	Louvain-la-Neuve
Main themes :	The objective of this course is to teach the student the theory and practical use of modern finite element methods for the solution of static problems. On completion of the course the student should - have a basic understanding of FE analysis and what can be achieved through its use, - be able to select an element type, materials, loading and boundary conditions, - be aware of the limitations and potential errors of FE modelling, - have a basic knowledge of how to interpret results provided by FE analysis, - be able to operate a standard FE analysis packages, - be aware of the range of applications of FE analysis.
Aims :	The aim of this lecture is to introduce students to the principles and practice of Finite Element analysis. The analysis of complex static and dynamic problems involves, in essence, three steps: - Selection of a mathematical model. - Computation of a numercila solution of the model. - Interpretation of the predicted response. *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”.*
Content :	Nowadays, finite element methods are used successfully for the analysis of very complex problems in various areas of engineering. A finite element analysis is now frequently imperative to reach a safe and cost-effective design. However, the appropriate and efficient use of finite element procedures is only possible if the basic assumptions employed in the mathematical model, the numerical FE discretisation and the computer implementation are known. The content of the course is as follows : - Boundary values problem in Continuum Mechanics, - Variational and discrete formulation for elliptic problems : element types and their derivation, assembly of stiffness matrices, loading and boundary condition considerations. - Linear elasticity, basic modelling of trusses and frames. - Mathematical theory of the best approximation : error estimations, modelling accuracy, efficient adaptive meshing techniques, convergence. - Mixed problems : Stokes equation and incompressible elasticity - Advection diffusion problems : Petrov-Galerkin and Discontinuous Galerkin formulations. - Resolution of large sparse systems : direct and iterative solvers, parallel issues.
Other infos :	- V. Legat, Introduction aux elements finis (lecture notes, 2004) - C. Johnson, Numerical Solution of Partial Differential Equations by the Finite Element Method, Cambridge University Press, (1987) - T. J. R. Hughes, The Finite Element Method, Prentice Hall, (1987). - O. C. Zienkiewicz, R. L. Taylor, The Finite Element Method (volumes 1 & 2), Prentice Hall, (1989). - G. Strang, G. j. Fix, An Analysis of the Finite Element Method, Prentice Hall, (1977). - P. G. Ciarlet, The Finite Element Method for Elliptic Problems, North Holland / American, (1978). - A. George, J. W. Liu, Computer Solution of Large Sparse Positive Definite Systems, Prentice Hall, (1981). More information and grading policy is available on the web-site http://www.uclouvain.be/81077.html Students will use MATLAB to explore the basic principles of the finite element method. Commercial codes are also presented and could be used.
Cycle and year of study :	> Master [120] in Chemical and Materials Engineering > Master [120] in Mathematical Engineering > Master [120] in Mechanical Engineering > Master [120] in Architecture and Engineering > Master [120] in Electro-mechanical Engineering > Master [120] in Physical Engineering > Master [120] in Biomedical Engineering > Master [120] in Civil Engineering

Faculty or entity in charge:	MECA