Finite Element Method

1. **Course number and name:** 020EFIGS4 Finite Element Method

2. **Credits and contact hours:** 4 ECTS credits, 2x1.25 hours

3. **Name(s) of instructor(s) or course coordinator(s):** Fouad KADDAH

4. **Instructional Materials:**
   - **a.** Traite de Genie Civil de l'Ecole polytechnique federale de Lausanne Volume 6 : Analyse des structures et milieux continus ; Methode des elements finis ; Auteurs Francois Frey et Jaroslav Jirousek, second edition 2014
   - **b.** Collection de l'universite de Compiegne : Une presentation de la methode des elements finis ; Auteurs : Gouri Dhatt et Gilbert Touzot (1984)
   - **c.** A first Course in the finite element method, Second edition Auteur : Daryl L. Logan Rose-Hulman Institute of Technology, second edition (1992)
   - **d.** Analyse des solides deformables par la methode des elements finis; Auteurs: Marc Bonnet et Attilio Frangi; les editions de l'Ecole Polytechnique de France (2006)
   - **e.** Finite Element Procedures, Klaus-Jurgen Bathe, Massachusetts institute of Technology (1996)
   - **f.** Modelisation Par elements finis 3eme edition; Auteur: Jean Charles Craveur, Dunod (2008)
   - **g.** Instructor's Class Notes

5. **Specific course information**
   - **a. Catalog description:** Practice finite element techniques through concrete examples of heat transfer, material strength, and elasticity theory. It provides the necessary elements for students to develop their own program and interact appropriately with commercial software.

   - **b. Prerequisites or co-requisites:** 020ANNGS1 Numerical Analysis

   - **c. Required:** Required for all Civil Engineering students.

6. **Educational objectives for the course**
   - **a. Specific outcomes of instruction:**
     - Learn how to model and solve a problem by finite elements;
     - Assimilate the numerical and computer implementation of the finite element method for the creation of its own program or software
     - Use commercial software reliably and efficiently
     - Interpreting and analyzing the results of a calculation by the finite elements

   - **b. PI addressed by the course:**

PI	1.1	1.2	1.3	1.4	2.3	6.4
Covered	yes	yes	yes	yes	yes	yes
Assessed						

7. **Brief list of topics to be covered:**
   - **a.** General introduction to the finite element method (2 hours)
   - **b.** Strong formulation in structural analysis and heat transfer (3 hours)
   - **c.** Weak formulation and Galerkin residual weighted method (2 hours)
   - **d.** Ritz technique and Finite element technique to solve weak formulation problem (2 hours)
   - **e.** Mesh generation methods (2 hours)
   - **f.** Formulation of bar element and beam element in structural analysis (6 hours)
   - **g.** Formulation of one-dimensional heat transfer elements (2 hours)
   - **h.** Formulation of two-dimensional heat transfer and plane stress/strain analysis (4)
   - **i.** Isoparametric Formulation and numerical integration (3 hours)
   - **j.** Numerical implementation of the finite element method (2 hours)
   - **k.** Use of Robot Software for structural analysis problems (2 hours)