Course Syllabus

1. Course number and name: 020ELFES2 Finite Elements Analysis
2. Credits and contact hours: 4 credits ; 35 h

3. Instructor's or course coordinator's name: Toufic WEHBE

4. Text book :
    a. other supplemental materials: Written course / Exercises Handout.

    [1] Techniques de l'Ingénieur

    [2] Introduction à la méthode des éléments finis, K.C. ROCKEY; H.R. EVANS; D.W. GRIFFITHS; D.A. NETHERCOTS

5. Specific course information
    a. brief description of the content of the course (catalog description)

The Finite Elements Method (FEM) is widely used by engineers to formulate and solve complex problems in all technical and scientific fields: mechanics, civil engineering, biomechanics, physics… Many existing softwares based on the FEM (Abaqus, Nastran, Femlab, Ideas, Catia…) propose simulations for design and manufacturing of parts. This course describes the theoritical basis of the FEM method and its application on problems of Strenght of Material. The students will better understand the use of FEM softwares and analyse the calculus results to validate them.

    b. prerequisites or co-requisites:

Statics, Strength of Materials (SEM), Mathematics

    c. Required/Elective/Selected Elective: Elective

6. Specific goals for the course
    a. specific outcomes of instruction

- Recognize the basics of solving problems with the FEM
- Write the FEM for 2D cases with different complexities;
- Integrate the numerical and computational implementation of the method in order to validate its utilization in softwares in a reliable way.

    b. KPIs addressed by the course.

KPI	a1	e2	e3	k1	k2
Covered	x	x	x	x	x
Assessed	x	x	x	x	x
Give Feedback		x	x	x	x

7. Brief list of topics to be covered and approximate lecture hours :

1-4
Reminder on strength of materials. Elasticity, strain, stress, boundary conditions, statically indeterminate system, virtual works, potential energy

5 – 10 Stiffness analysis. Meshing types and labelling. Stiffness matrix, boundary conditions, stiffness matrix of a linear spring, stiffness matrix of spring association, system with articulated beams. Examples and calculus.

11 – 14 Finite elements applied on 2D beam. Identification of the problem, displacement function, strain stress relation, relation between efforts and nodal displacement. Examples and calculus.

15 – 22 Triangular elements for plane elasticity. Stiffness matrix of a triangular element, coordinates system, punctual displacement function, relation between punctual displacement and deformation. Model convergence. Examples and calculus.

23 – 28 Rectangular finite elements
Rectangular finite elements for plane elasticity. Bending of beams. Model convergence. Examples and numerical application.