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## MECÂNICA ESTRUTURAL – 10371/10391/10411

2017/2018

### Assignment 1

#### 1. OBJECTIVES

To learn how to implement a computer code to solve a structural problem, using the finite element method (FEM).

To develop a one-dimensional (1D) finite element (FE) which couples two beam elements, one bar element and one torsion element to create a single linear element with 12 degrees-of-freedom (DOF).

To use the developed 12-DOF element to create a general orientation 12-DOF element that can represent a given segment of long structural elements such as propeller blades or wings.

To implement a computer code to perform static and mode analyses of a given wing structure with prescribed cross-section geometries, materials, loads and constraints along the span.

#### 2. PROBLEM

The development of the computer code to calculate the static deflection and the natural mode shapes of vibration with the corresponding natural frequencies of a wing-type structure shall be divided into the following tasks:

1. Investigation of the typical structure of a FEM program.
  2. Development of a flowchart indicating the problem structure and the relationship between its various modules.
  3. Development of the mathematical models:
    - a. One-dimensional 12-DOF linear beam model for static analysis.
    - b. One-dimensional 12-DOF linear beam model for modal analysis.
    - c. Rotated beam model.
    - d. Loads and boundary conditions.
    - e. Geometry and structural properties.
    - f. Meshing.
    - g. System equations and problem solving.
    - h. Data post-processing and visualization.
  4. Development of the algorithms for the mathematical models previously developed.
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5. Implementation in FORTRAN and testing of the code modules of the previously developed algorithms.
6. Integration of the various program modules to create the beam FEM program.
7. Preparation of a final report describing the previous tasks. The report should not have more than 70 pages.

### 3. TASK RESPONSIBILITY

This is a group project where each student should select a different task to contribute to the final program.

Table 1: Tasks and students' names.

Taks	Name
1	all
2	all
3a,4a,5a	
3b,4b,5b	
3c,4c,5c	
3d,4d,5d	
3e,4e,5e	
3f,4f,5f	
3g,4g,5g	
3h,4h,5h	
6	all
7	all